Do Nonmonetary Prices Target the Poor?

Evidence from a Field Experiment in India

Bridget Hoffmann

Department of Research and
Chief Economist

DISCUSSION
PAPER Nº
IDB-DP-456

May 2016

Do Nonmonetary Prices Target the Poor?

Evidence from a Field Experiment in India

Bridget Hoffmann

Inter-American Development Bank

May 2016

Inter-American Development Bank

Abstract[*]

Monetary price subsidies are often used to increase take-up of health products, but monetary prices may screen out those with the highest returns, the poor. Using willingness to pay (WTP) data from a field experiment in India, this paper determines whether nonmonetary prices better target health products to the poor than monetary prices. It is found that monetary WTP is increasing in income and nonmonetary WTP is weakly decreasing in income. Comparing across price types, nonmonetary WTP falls relative to monetary WTP as income rises. Nonmonetary prices better target the poor than monetary prices (a larger fraction of total demand is poor).

JEL classifications: C93, D12, I18
Keywords: Nonmonetary prices, Willingness to pay, Field experiment

[*] Inter-American Development Bank, Research Department, 1300 New York Avenue NW, Washington, DC 20577, United States. Email: Bridgeth@IADB.org.

I would like to thank Treb Allen, Lori Beaman, Samuel Berlinski, Matthias Doepke, Seema Jayachandran, Cynthia Kinnan, Lee Lockwood, Ofer Cohen, Joel Gamoran, Chris Lau, Juan D. Prada, and seminar participants at Northwestern University for their helpful comments and their contributions to the paper. I would like to thank the Russell Sage Foundation, the Buffett Center at Northwestern University, The Graduate School at Northwestern University and the Center for the Study of Development Economics at Northwestern University for generous funding. Any errors are my own.

In developing countries, many health products provide large private and social benefits, especially for the poor.[1] Governments and non-governmental organizations use monetary price subsidies to increase take up of health products, but the poor are often screened out because they lack the cash, savings or credit to purchase, even at subsidized prices.[2] An alternative method of allocating health products is nonmonetary prices (time costs), which is a type of "self-selection" mechanism.[3] Nonmonetary prices may target the poor better than monetary prices because selection occurs on willingness to pay in time rather than money.

This paper studies two methods of self-targeting, monetary prices and nonmonetary prices, using data from a field experiment in India. I develop a model of household demand for a health product at monetary prices and at nonmonetary prices that illustrates three key features of demand. First, I show that for any monetary price the poor are underrepresented among demanders. Second, the model demonstrates that nonmonetary prices may not result in overrepresentation of the poor among demanders due to opposing income and substitution effects. When the utility function is concave, a higher wage implies a greater loss of consumption for each hour of work forgone to pay the nonmonetary price, but also implies a lower marginal utility of consumption. These opposing effects imply that whether demand at a nonmonetary price is increasing in the wage is theoretically ambiguous. Third, the model illustrates that the difference in the utility cost of a monetary price and a nonmonetary price is greater for the poor than the rich. This implies that regardless of whether the utility cost of the nonmonetary price is increasing in the wage, nonmonetary prices better target the poor than monetary prices.

To empirically test whether nonmonetary prices better target health products to the poor than monetary prices, I conducted a field experiment in Hyderabad, India using the TATA Swach Smart water purifier.[4] The experiment included nearly 800 households in seventeen slum neighborhoods of Hyderabad. I elicited each household's willingness to pay (WTP) for the water purifier both at monetary prices (rupees) and at nonmonetary prices (hours) using

[1]For large private and social benefits of health products, see Miguel and Kremer (2004), Thomas et al. (2006), Arnold and Colford (2007), and Baird et al. (2015).

[2]For high price sensitivity for health products, see Miguel and Kremer (2004), Adbul Latif Jameel Poverty Action Lab (J-PAL) (2011), Dupas (2014a, b), and Berry, Fischer, and Guiteras (2015). Information campaigns are an alternative to subsidies but have little effect on price sensitivity (Kremer and Miguel, 2007; Dupas, 2009; Meredith et al., 2013). For the effects of cash, savings and credit on take up see Devoto et al., 2012; Dupas and Robinson, 2013; Tarozzi et al., 2014; and Guiteras, Levine, Polley, and Quistorff, 2015.

[3]There is a large literature studying the use of self-selection mechanisms in targeting transfers (Nichols, Smolensky, and Tideman, 1971; Barzel, 1974; Diamond and Mirrlees, 1978; Nichols and Zeckhauser, 1982; Parsons, 1991; and Besley and Coate, 1992).

[4]The TATA Swach Smart water purifier follows US EPA guidelines and is economical in terms of both the initial cost (retail price of 999 Rs) and the cost per liter relative to similar water purifiers.

the Becker-DeGroot-Marshak (BDM) mechanism (Becker, DeGroot, Marshak, 1964).

I analyze the distribution of WTP for each price type across income levels. I find that monetary WTP is increasing in household income. For all monetary prices above 50 Rs ($0.85), rich demand exceeds poor demand. Further, the fraction of demanders that are poor falls as the monetary price rises. In contrast, nonmonetary WTP is weakly decreasing in household income. In a pooled sample of households' monetary WTP and nonmonetary WTP, I use household fixed effects to control for households' fixed valuation of the water purifier. Focusing on the differential effect of income on WTP by price type, I find that nonmonetary WTP falls relative to monetary WTP as income rises. I show that nonmonetary prices better target the poor than monetary prices (a larger fraction of total demand is poor) even though nonmonetary demand is similar across income levels.

This paper builds on the previous results that nonmonetary prices can improve targeting and lower program costs (Alatas et al. (2015); Dupas et al. (2015); Ma et al. (2014)). I experimentally vary the nonmonetary price and measure both monetary WTP and nonmonetary WTP for each household. This allows me to estimate the correlation between household income and nonmonetary WTP and to compare this correlation to the correlation between monetary WTP and household income. Further, because I have data on each household's monetary WTP and nonmonetary WTP, I am able to control for households' fixed valuation of the water purifier in order to identify the effect of income on WTP in time relative to WTP in money.

The remainder of the paper is organized as follows. In Section **??**, I model household demand at monetary prices and nonmonetary prices. The experimental design is described in Section **??**. In Section **??**, I investigate the distribution of willingness to pay. In Section **??**, I perform robustness checks, specifically concerning the distribution of willingness to pay. Section **??** concludes.

1 Model

This simple model describes the targeting achieved by a subsidy program when using a monetary price, P_M, and a nonmonetary price (in hours), P_{NM}, by modeling households' decisions of whether to purchase a water purifier at each price type.

Households have quasi-linear utility $U = u(c^i) + \alpha^i \mathbb{1}[d^i = 1]$ with a common, increasing, and strictly concave utility function over consumption goods. Purchase of the water purifier is denoted by an indicator variable d. Households receive additional utility α^i from ownership of a water purifier. The household specific utility received from a water purifier captures benefits in the form of better health and increased earnings due to reduced incidence of illness.

Household i maximizes its utility subject to its budget constraint, $c^i + \mathbb{1}[d^i = 1] \cdot P_M \leq w^i \bar{h}$ for a monetary price and $c^i \leq w^i * (\bar{h} - \mathbb{1}[d^i = 1] \cdot P_{NM})$ for a nonmonetary price. The price of consumption is normalized to one. I assume that there are an equal number of rich and poor households, where income is determined by an exogenous wage, $w^i \in \{w^p, w^r\}$ with $w^p < w^r$. There is no disutility of labor so all households choose to work the maximum number of hours, $\bar{h}$. Therefore, the opportunity cost in terms of consumption goods of each hour of the nonmonetary price is equal to the wage.

Household i purchases a water purifier if the additional utility received from a water purifier exceeds the loss in utility from reduced consumption. This creates a cut-off level of α for each wage level, j, and price type, k, denoted α_k^j such that a household will purchase a water purifier if its value of α exceeds the cut-off value and will not purchase otherwise. Suppose that α_i is distributed uniformly among households with each wage level. Without loss of generality, assume that the support of α is [0,1].

First, consider the case in which the water purifier is offered for a monetary price P_M. For a monetary price, all households with values of α_i greater than the cut-off $\alpha_M^j = u(w^j \bar{h}) - u\big(w^j \bar{h} - P_M\big)$ for $w^j \in \{w^p, w^r\}$ will purchase the water purifier. Demand among poor households, $D^p(P_M)$, is equal to $1 - \alpha_M^p$ and demand among rich households, $D^r(P_M)$, is equal to $1 - \alpha_M^r$. Because the utility function for consumption is concave, households with the higher wage have a lower marginal utility of consumption and suffer a smaller disutility of forgone consumption when they purchase a water purifier at a monetary price. This concavity implies that $\alpha_M^p \geq \alpha_M^r$ and, therefore, that the proportion of rich households that purchase a water purifier is greater than the proportion of poor households that purchase a water purifier.[5]

Because a smaller proportion of poor households than rich households purchase the water purifier at a monetary price, the targeting ratio, or proportion of demanders that are poor, is always less than one-half. For a monetary price, the poor are underrepresented among demaders. With the exception of the boundary cases, this is true for all monetary price levels,

[5] Since $D^r(P_M) = 1 - \alpha_M^r$ and $D^p(P_M) = 1 - \alpha_M^p$, the result holds since $\alpha_M^p = u(w^p \bar{h}) - u(w^p \bar{h} - P_M) > u(w^r \bar{h}) - u(w^r \bar{h} - P_M) = \alpha_M^r$ by concavity of the utility function for consumption. Strict concavity of u implies that for every $\lambda \in (0,1)$ and for every pair $0 \leq x < x\prime$, $u(x\prime) + u(x) < u(\lambda x + (1-\lambda)x\prime) + u(\lambda x\prime + (1-\lambda)x)$. The result follows by choosing $\lambda = P_M/(w^r \bar{h} - w^p \bar{h} + P_M), x = w^p \bar{h} - P_M$, and $x\prime = w^r \bar{h}$. The result holds for any monetary price P_M such that $D^r(P_M) > 0$ and $D^p(P_M) < 1$.

demonstrating the potential for nonmonetary prices to target the poor more effectively than monetary prices.

When considering demand at a nonmonetary price, it is not necessarily true that for a given value of α, households with a higher wage, and higher opportunity cost of time, have lower demand. The classical literature on ordeal mechanisms has assumed that time costs are more costly in utility terms for the rich (Nichols, Smolensky, and Tideman,1971; Barzel, 1974; Nichols and Zeckhauser, 1982; and Besley and Coate, 1992). For example, when the utility function for consumption is linear, the utility cost of the nonmonetary price is proportional to the wage and demand at a nonmonetary price is decreasing in the wage. However, when the utility function is concave, the utility cost of a nonmonetary price is not proportional to the wage. In this case, there are two opposing effects of a higher wage: (1) the substitution effect: a higher wage results in greater loss of consumption utility from forgoing an hour of work to pay the nonmonetary price since each hour of work can buy relatively more consumption; (2) the income effect: a higher wage implies higher consumption, and therefore, lower marginal utility of consumption, leading to a smaller utility loss from forgoing an hour of work to pay the nonmonetary price. Nonmonetary prices are most effective in targeting the poor when the substitution effect outweighs the income effect, and the marginal utility of consumption does not decrease too rapidly as consumption rises in the relevant range.[6]

For utility functions such as CRRA with relative risk parameter $\gamma \in (0, 1)$, the utility cost of the nonmonetary price is increasing in the wage, while demand at the nonmonetary price is decreasing in the wage. In this case the proportion of poor households that purchase the water purifier is greater than the proportion of rich households that purchase the water purifier. The targeting ratio is always greater than one-half and poor households are overrepresented among demanders.

For utility functions such as CRRA with relative risk parameter $\gamma \in (0, 1)$, the targeting ratio for any nonmonetary price will exceed the targeting ratio for any monetary price. Further, even in the case that nonmonetary prices do not result in a targeting ratio greater than one-half, there is still scope for nonmonetary prices to better target the poor than monetary prices. Normalize $w_p = 1$ so the poor are indifferent between paying a monetary price or a nonmonetary price of equal magnitude. Then, the targeting ratio is always greater for a nonmonetary price P_{NM} than for a monetary price P_M of the same magnitude.[7] This

[6]Define $v(w, P_{NM}) = u(w(\bar{h} - P_{NM}))$. If v satisfies increasing differences in w and $-P_{NM}$, then $u(w^r\bar{h}) - u(w^r(\bar{h} - P_{NM})) > u(w^p\bar{h}) - u(w^p(\bar{h} - P_{NM}))$ which implies that demand among the poor, $D^p(P_{NM})$, is greater than demand among the rich, $D^r(P_{NM})$. This holds for the set of nonmonetary prices, P_{NM}, such that $D^r(P_{NM}) < 1$ and $D^p(P_{NM}) > 0$.

[7]A greater targeting ratio for nonmonetary prices than for monetary prices implies that $[1 - \alpha^p_{NM}] *$

illustrates that nonmonetary prices will result in better targeting of the poor than similarly sized monetary prices.

This simple model illustrates that nonmonetary prices have the potential to be a powerful tool to target resources to the poor. In the model, monetary prices screen out the poor and the targeting ratio for monetary prices is always less than the fraction of the population that is poor. While the targeting ratio for nonmonetary prices may be greater or less than the fraction of the population that is poor, it always exceeds the targeting ratio for comparably sized monetary prices.

2 Experimental Design

The experiment was conducted in Hyderabad, Telangana from June 26, 2013 to July 18, 2013. Seventeen slums were randomly selected from a list of nearly 1,400 slums provided by the Greater Hyderabad Municipality. The list was restricted to slums with a population of at least 100 households.[8] Door-to-door surveying was conducted from Monday to Friday, with the survey team visiting a new slum neighborhood each day. Households were surveyed if an adult (age 20 years or above) household member was available and the household contained more than one person.[9] On average, 47 households completed the main survey in each slum with the number depending on the weather and surveyor absences.

Since the primary objective of the experiment was to study targeting of health investment goods to the very poor, households in the top and bottom quartiles of the income distribution are overrepresented in the sample. Eligibility for the main survey was determined by a pre-survey that consisted of 6 questions about household asset ownership and one categorical income question.[10] The pre-survey was completed by 1,233 potential respondents. Of these, 804 respondents were determined to be eligible for the main survey, and 798 completed the full survey.

The first part of the main survey consisted of background sections. Next, surveyors

---

$\left([1-\alpha_M^p]+[1-\alpha_M^r]\right) > [1-\alpha_M^p] * \left([1-\alpha_{NM}^p]+[[1-\alpha_{NM}^r]\right)$, which holds since $w^p = 1$, $w_r > 1$ and $u\prime(\cdot) > 0$. This holds for all monetary prices, P_M, and nonmonetary prices, P_{NM}, such that $D^p(P_M) > 0$ and $D^r(P_{NM}) > 0$.

[8] This excluded 5 slums with missing population data and 323 slums with fewer than 100 households. Thirteen slums selected from the list were skipped because they could not be located (6 slums) or because the neighborhood was located but did not contain a low-income, residential area (7 slums).

[9] Single occupant households were excluded because they were primarily bachelors who traveled to Hyderabad for school and would frequently return to their family outside of Hyderabad.

[10] The asset section of the pre-survey asked questions regarding tablets/laptops/computers, washing machines, four-wheeled vehicles, motorbikes/motorcycles/scooters, coolers, and cots/beds.

introduced the TATA Swach Smart water purifier and households completed two willingness to pay sections, one in money and one in time. Finally, households were assigned to a treatment group (either time or money) and a voucher for the water purifier was given to the household if the household decided to purchase the water purifier based on reported WTP.

The background sections collected data on income and assets, savings and credit, household expenditure, and education. In addition, data on water source, water treatment, and water borne illnesses was collected. A detailed section collected information about all household members' labor market activities.[11] Table **??** presents household and respondent summary statistics for the full sample, the poor (below median income), and the rich (above median income).

After the background sections, surveyors introduced the water purifier by reading a passage with information on the TATA Swach Smart. The TATA Swach Smart follows US EPA guidelines and is economical in terms of both the initial cost of the water purifier (market price of 999 Rs) and the cost per liter compared to similar water purifiers (for example, the PureIt brand).[12] Surveyors showed respondents an assembled TATA Swach Smart and gave respondents time to examine the water purifier and its box which displays the Maximum Retail Price.

Next, two WTP sections elicited respondent's monetary willingness to pay and nonmonetary willingness to pay for the TATA Swach Smart using the Becker-DeGroot-Marshak (BDM) mechanism. The two willingness to pay sections were designed to be identical except for the references to time prices and money prices. The order of these two sections was randomized by household.

For expected utility maximizers, the BDM mechanism should elicit respondents' true maximum willingness to pay.[13] The BDM mechanism is similar to a second-price auction in which the second-price is an unknown, randomly drawn price. The respondent states her maximum willingness to pay for a good and then a price is randomly drawn from a distribution of possible prices. If the price is less than or equal to the respondent's WTP, she purchases the good at the randomly drawn price. If the price is above the respondent's

[11] In addition, the survey included two sections regarding mental accounting statements developed in Soman (2011), with one section for time and one section for money. The order of these two sections was randomized by household.

[12] The market price of 999 Rs is approximately 16.50 USD.

[13] "True" willingness to pay is the highest price at which the individual would purchase the good at a known price. The BDM mechanism will not necessarily elicit true willingness to pay for individuals who are not expected utility maximizers (Horowtiz, 2006).

WTP, she cannot purchase the good.[14]

Each willingness to pay section walked respondents through the BDM mechanism using a procedure similar to the titration-based BDM procedure in Mazar, Koszegi, and Ariely (2014).[15] First, the respondent was asked to state her maximum willingness to pay (WTP) for the water purifier. In the monetary WTP section, WTP is reported in rupess and in the non-monetary WTP section, WTP is reported in hours. Next, the respondent was asked if she would purchase the water purifier at each price on a price list, beginning at 50 Rs or 1 hour lower than her initial bid. The prices on the price list increased by an increment of 50 rupees for monetary WTP and 1 hour for non-monetary WTP. Once the respondent stated that she would not purchase at a given price, no questions were asked regarding higher prices. The highest price at which the respondent stated that she would purchase was confirmed as her maximum willingness to pay. If a respondent indicated that she would not purchase the water purifier at a price 50 Rs or 1 hour lower than her initial bid or she refused to answer a question in the price list, the process was started again by asking the respondent to revise her initial willingness to pay.[16]

After eliciting each respondent's maximum willingness to pay in money and in time, respondents were randomly assigned to treatment groups with 418 assigned to the monetary price group and 380 assigned to the nonmonetary price group.[17] Respondents in the monetary group randomly drew a price in the range 50 Rs to 999 Rs and respondents in the nonmonetary group randomly drew a price in the range 1 hour to 18 hours. The nonmonetary price range was chosen to be approximately equal to the monetary price range at the prevailing male casual labor wage (about 450-500 Rs per 8-9 hour day).[18]

If the randomly drawn price was below the respondent's maximum willingness to pay

[14]Two recent experiments have addressed the practical question of whether BDM bids are closely related to market demand. Berry, Fischer, and Guiteras (2015) find that a smaller share of households purchase a water purifier in Ghana using BDM bids than take-it-or-leave-it offers, but the authors note that bargaining over purchase prices is the norm in this context. Miller et al. (2011) find that demand determined by BDM bids closely matches demand determined by real purchase decisions in an online shop.

[15]Mazar, Koszegi, and Ariely (2014) find that titration-based BDM in which respondents make single buy/not buy decisions for a sequence of prices nearly eliminated the sensitivity of BDM bids to the price distribution.

[16]In pre-trials, this method resulted in the fewest respondents refusing to purchase or reporting regret when the price chosen was less than or equal to their stated maximum willingness to pay and the most respondents stating that they preferred not to purchase when the price chosen was above their stated maximum willingness to pay.

[17]To assign treatments, respondents chose, without looking, a tile from a box that contained two tiles with the word money and two tiles with the word time. The tile that the respondent chose determined the respondent's treatment group.

[18]450 Rs is approximately 7.50 USD.

of the same price type, she was given a voucher for the water purifier. Respondents who received a voucher for the water purifier (those whose willingness to pay was above the price) were asked if they wished that they had not bid so high and respondents who did not receive a voucher for the water purifier (those whose willingness to pay was below the price) were asked if they wished that they had bid more. At the conclusion of the survey, all respondents were compensated for participation with a steel dining plate.[19]

For logistical reasons, both monetary and nonmonetary price vouchers were redeemed the following Saturday in a temple, school, or community center in the neighborhood.[20] This also kept the time and conditions of transaction consistent across money and time treatment groups. Respondents in the monetary price group who redeemed a voucher simply paid a surveyor the price on her voucher and received a TATA Swach Smart. Respondents in the nonmonetary price group who redeemed a voucher sorted seeds for the number of hours on their voucher. Sorting seeds by type was chosen as the task for the non-monetary price because it is not a common task in India so it is not associated with a particular caste. Although vouchers could be redeemed by either the respondent or his/her spouse, 86 percent of redeemed vouchers were redeemed by the respondent.[21]

3 Results

3.1 Willingness To Pay

I begin by looking at the distributions of monetary WTP and nonmonetary WTP. Figures **??** and **??** show the percentage of respondents who stated a willingness to pay at least as high as the price for each price level. Willingness to pay was elicited for one water purifier through the BDM mechanism. Separate distributions are shown for target, poor households and non-target, richer households. The poor subsample consists of households with per capita total income less than or equal to the median in the sample.[22] The objective of the pre-survey was to oversample households in the top and bottom quartiles of the population income distribution. Splitting the sample into rich and poor subsamples at the median ensures that

[19]The plates were purchased at a bulk price of approximately 30 Rs. per plate (approximately 0.50 USD).

[20]Redemption centers were open Saturdays from 10am to 6pm but stayed open past the closing time or opened on Sunday if a respondent needed additional time to complete her nonmonetary payment.

[21]Since the monetary price could be paid by either spouse regardless of who actually redeems the voucher, I also allow the non-monetary price to be paid by either spouse by allowing all vouchers to be redeemed by either spouse.

[22]The poor comprise 51 percent of the sample because many households report the median per capita household income.

all households in the bottom quartile of the population income distribution are included in the poor subsample. For simplicity, non-target households with per capita household income above the median are referred to as "rich".

Figure **??** shows the percentage of households in each income group with BDM bid greater than or equal to the price for each monetary price. As predicted by the model, for every monetary price except 50 Rs, demand is greater among the rich than among the poor. The Kolmogorov-Smirnov test rejects equality of the rich and poor distributions of monetary WTP (p-value < 0.001). Appendix Figure **??** shows the proportion of households with monetary willingness to pay above the price by quartile of the income distribution. The poorest quartile generally has the lowest demand and the richest quartile generally has the highest demand. However, the richest quartile does not have the highest demand at very low prices and the poorest quartile does not have the lowest demand at very high prices.

Figure **??** shows the percentage of households in each income group with BDM bid greater than or equal to the price for each nonmonetary price. The model describes the conditions under which nonmonetary prices will be most effective at targeting the poor. The curves show that although the poor have greater demand than the rich for all nonmonetary price levels, the difference between the curves is small at all price levels. The Kolmogorov Smirnov test does not reject equality of the rich and poor distributions of nonmonetary WTP (p-value of 0.326). Appendix Figure **??** shows the proportion of respondents with nonmonetary willingness to pay above the price by quartile of the income distribution. The richest quartile generally has the lowest demand while the demand of the first and third quartiles are very similar.

Figure **??** suggests that monetary prices will select richer households while Figure **??** suggests that nonmonetary prices will not provide strong selection on income. To quantify these relationships, I directly analyze income and willingness to pay in a regression setting. I estimate the OLS regression

$$wtp_i = \alpha + \beta y_i + \epsilon_i \tag{1}$$

where wtp_i is the natural logarithm of willingness to pay and y_i is the natural logarithm of income using robust standard errors. Table **??** presents the results using monetary WTP (Rs), and Table **??** presents the results using nonmonetary WTP (minutes).[23] In each table, Panel A uses variables measuring daily labor income, Panel B uses daily total income

[23] In order to facilitate comparison of coefficients across price types, nonmonetary willingness to pay is denominated in minutes. The market wage for male casual labor is approximately 450-500 Rs per 8-9 hour day or a wage rate of approximately 1 Rs per minute.

variables, and Panel C uses hourly wage variables.[24] Columns (1)-(2) look at the effect of household income on WTP and columns (3)-(4) look at the effect of respondent income on WTP. Columns (1) and (3) present baseline regressions. Columns (2) and (4) include neighborhood fixed effects.

Columns (1)-(2) of Table ?? show that household income is positively correlated with monetary WTP for the water purifier; when including neighborhood fixed effects, a 10 percent increase in household daily labor income implies a 2.0 percent increase in monetary WTP. At the mean, this implies that an additional 52 Rs of household daily labor income raises WTP by 5.8 Rs. As shown in columns (3)-(4) of Table ??, respondent income is also positively correlated with monetary WTP. When neighborhood fixed effects are included, a 10 percent increase in respondent daily labor income implies a 1.7 percent increase in monetary WTP. At the mean, this implies that an additional 22 Rs of respondent daily labor income raises WTP by 5.2 Rs.[25]

Columns (1)-(2) of Table ?? show that household income is negatively correlated with nonmonetary WTP for the water purifier, although the effect is small relative to the effect for monetary willingness to pay. When neighborhood fixed effects are included, a 10 percent increase in household daily labor income implies a 0.5 percent decrease in nonmonetary WTP. At the mean, this implies that an additional 52 Rs of daily household labor income lowers nonmonetary WTP by 8.6 minutes. Columns (3)-(4) show that respondent income does not appear to be correlated with nonmonetary WTP.

Tables ?? and ?? show there is stronger selection on household income than on respondent income, particularly for nonmonetary prices. The presence of a respondent who does not work or who works for a low wage does not necessarily identify a poor household. Therefore, the results in Tables ?? and ?? support the use of nonmonetary prices to select poor households. Corroborating this, Appendix Table ?? shows that the asset index is positively correlated with monetary WTP and negatively correlated with nonmonetary WTP.[26]

Further, selection occurs on household income rather than on household characteristics that may affect a household's valuation of the water filter. I augment equation ?? with household characteristics to show that the correlation of WTP and household income is

[24]The hourly wage is calculated for salaried workers by assuming 26 working days per month. The number of hours worked per day is taken from survey data.

[25]I cannot reject that the coefficients for household income (column (2)) and respondent income (column (4)) are equal in any of the three panels.

[26]The asset index is the first principal component of variables representing household ownership of five durable goods: automobiles, motorbikes/scooters, tablets/computers, washing machines, and evaporative coolers. The asset index is normalized to have mean 0 and standard deviation 1.

robust to the addition of household characteristics. Table **??** shows the results of estimating the following OLS regression

$$wtp_i = \alpha + \beta y_i + X_i + \epsilon_i \tag{2}$$

where X_i controls for household characteristics. With the exception of owning a water purifier at baseline, household characteristics (the number of children in the household under age 14, episodes of illness perceived to be caused by the drinking water, treating drinking water at baseline, and credit constrained) are not correlated with WTP.[27] Including household characteristics and neighborhood fixed effects, a 10 percent increase in household income implies a 1.9 percent increase in monetary WTP and a 0.3 percent decrease in nonmonetary WTP.

3.2 Relative Willingness to Pay

Using each households' monetary WTP and nonmonetary WTP, I can focus on the differential effect of income on monetary WTP and nonmonetary WTP. I use a pooled sample in which the dependent variable is either the natural logarithm of monetary WTP or the natural logarithm of nonmonetary WTP scaled by the median respondent hourly wage (23 Rs per hour). The regression equation contains household fixed effects, an indicator variable for nonmonetary WTP, and the interaction between the nonmonetary WTP indicator and the natural logarithm of an income variable with robust standard errors clustered by household. The household fixed effect controls for household's fixed valuation of the water purifier. Because the household fixed effect also controls for the general effect of income on WTP for the water purifier, the general effect of income on WTP is not identified in this specification. The coefficient of interest, the interaction term, identifies the differential effect of income on nonmonetary WTP relative to monetary WTP.

Table **??** presents the results of estimating the pooled OLS regression

$$wtp_{ij} = \alpha + \eta \mathbb{1}[NM_j = 1] + \beta \mathbb{1}[NM_j = 1] * y_i + \gamma_i + \epsilon_{ij} \tag{3}$$

where $\mathbb{1}[NM_j = 1]$ is an indicator for nonmonetary observations, wtp_{ij} is the natural logarithm of monetary WTP if $\mathbb{1}[NM_j = 0]$ and is the natural logarithm of nonmonetary WTP scaled by the median respondent hourly wage if $\mathbb{1}[NM_j = 1]$, γ_i is a household fixed effect using robust standard errors are clustered by household. Columns (1)-(2) use daily labor

[27] Households that own a water purifier at baseline have lower monetary WTP and nonmonetary WTP than households that do not own a water purifier at baseline.

income variables, columns (3)-(4) use daily total income variables, and columns (5)-(6) use hourly wage variables. As household income and respondent income rise, nonmonetary WTP falls relative to monetary WTP. Column (1) shows that increasing household daily labor income by 10 percent decreases nonmonetary WTP by 2.3 percent relative to monetary WTP. Similarly, column (2) shows that increasing respondent daily labor income by 10 percent decreases nonmonetary WTP by 2.0 percent relative to monetary WTP. The difference between monetary WTP and nonmonetary WTP increases with income, implying that nonmonetary prices target the poor better than monetary prices.

A household's WTP in time relative to money is a proxy for the respondent's value of time. Because I observe each respondents' monetary WTP and nonmonetary WTP, I can compare respondents' value of time (monetary WTP divided by nonmonetary WTP) to their wage. Respondents who make the decision of whether to pay a nonmonetary price or work for a wage at the margin have a value of time close to their hourly wage. On average, respondents who work for a wage and have the flexibility to work part of a day value their time at 1.07 times their wage.[28] Respondents who work for a wage but do not make the decision of whether to pay a nonmonetary price or work for a wage at the margin have a value of time that is much greater than their hourly wage. On average, respondents who work for a wage but cannot work part of a day value their time at 3.5 times their hourly wage.[29] These respondents have a value of time greater than the hourly wage because they must forgo more than an hour of labor income to pay an hour of the nonmonetary price.

The flexibility of hours worked is an important determinant of respondent's value of time, and therefore, differences in the flexibility of hours worked across income levels is an important determinant of the targeting achieved by nonmonetary prices relative to monetary prices. The percentage of respondents who work for a wage is very similar across income levels, but the percentage of respondents who report the ability to adjust hours worked downwards differs across income levels. 45 percent of rich respondents who work for a wage report downward flexibility in hours worked and 30 percent of poor respondents who work for a wage report downward flexibility in hours worked.[30] This implies that nonmonetary prices may better target the poor in contexts in which the rich do not have greater flexibility in hours worked than the poor.

[28] Among respondents for whom their value of time can be calculated, there are 88 respondents who report working for a wage and report the flexibility to work part of a day.

[29] Among respondents for whom their value of time can be calculated, there are 151 respondents who work for a wage and report that they cannot work part of a day.

[30] 36 percent of rich respondents work for a wage and 33 percent of poor households work for a wage.

3.3 Targeting

Next, I directly compare the targeting achieved by each of the price types. Figure **??** graphs the targeting ratio versus poor demand for each price type.[31] The level of poor demand is increasing along the x-axis. Therefore, moving right along the x-axis represents decreasing prices. Consistent with the model, Figure **??** shows that for any level of take-up among the poor, the targeting ratio for nonmonetary prices is greater than the targeting ratio for comparably sized monetary prices. This implies that nonmonetary prices result in fewer windfall beneficiaries (rich households) than monetary prices. Further, the figure illustrates that as prices rise, the difference in targeting achieved by the two price types increases because the targeting ratio for monetary prices falls and the targeting ratio for nonmonetary prices rises. I can reject that the slope of the targeting ratio line is zero for both monetary prices and nonmonetary prices.

Table **??** shows that for any level of take-up among the poor, nonmonetary prices result in fewer windfall beneficiaries (rich households) than monetary prices.[32] For example, poor demand at the monetary price 200 Rs is 277 households. This is nearly identical to poor demand at the nonmonetary price 2 hours, 273 households. However, the monetary price results in demand of 297 rich households, while the nonmonetary price results in demand of 257 rich households. Similarly, poor demand at the monetary price 350 Rs is 103 households which is nearly identical to poor demand of 99 households at the nonmonetary price 4 hours. The monetary price results in rich demand of 158 households and the nonmonetary price results in rich demand of 89 households. In both cases, the nonmonetary price results in fewer windfall beneficiaries.

Table **??** also compares prices on the basis of the targeting ratio (proportion of purchasers who are poor). Table **??** shows that nonmonetary prices have a greater targeting ratio than monetary prices. Further, as prices rise, nonmonetary prices better target the poor, while the opposite occurs for monetary prices.

The results above illustrate that nonmonetary prices target the poor better than monetary prices. Next, I provide evidence that targeting the poor may lead to the greatest health benefits.

[31] Targeting ratios are included in figure **??** if total demand is at least 20 households.

[32] Table **??** includes prices for which total take-up is at least 20 households.

3.4 Targeting and Health Benefits

I use the baseline survey data to show that allocating more water purifiers to the poor may lead to a greater decrease in water borne illnesses. The greater health benefits of allocating water purifiers to the poor are a result of three facts. First, the poor are significantly more likely to report that a household member suffered from an illness perceived to be caused by the drinking water. For example, column 3 of Table **??** shows that households with per capita income less than or equal to the median are 9 percentage points more likely to report that a household member had diarrhea. Second, poor households are significantly less likely to own a water purifier. As shown in column (5) of Table **??**, poor households are 14 percentage points less likely to own a water purifier. Third, households that own a water purifier are less likely experience illnesses. For example, as shown in column (4) of Table **??**, households that own a water purifier are 10 percentage points less likely to report that a household member suffered from diarrhea caused by the drinking water. Together these statistics imply that targeting water purifiers to the poor could led to the greatest health benefits.

Importantly, there is no evidence of differential water purifier use (conditional on ownership) across income levels. Among the subsample of households that own a water filter at baseline, there is no evidence to reject that rich and poor households report the same water purifier use to treat either children's or adults' drinking water. These results are shown in columns (6) and (7) of Table **??**.[33]

4 Robustness Checks

A concern with using the BDM method in practice is that it is difficult to enforce purchase decisions, eroding the incentive compatibility underlying the method. If purchase decisions are not enforced, respondents could purposely overstate their willingness to pay and then decide whether or not to purchase the good after the randomly chosen price is revealed. Surveyors emphasized that purchase decisions would be enforced, but due to logistical constraints during surveying, households had the built-in option of choosing whether or not to redeem their voucher.[34] 99 of 121 (82 percent) respondents who received a voucher in the monetary price treatment group redeemed their vouchers and 39 of 50 (78 percent) re-

[33]Using per capita daily household income instead of the indicator for above the median household income as the independent variable also results in a small and insignificant coefficient.

[34]The script for both sections clearly states that the respondent cannot change her bid after seeing the price and emphasizes that respondents must be willing and able to pay the amount that they bid on the following Saturday when all transactions take place.

spondents who received a voucher in the nonmonetary price treatment group redeemed their vouchers.[35] I present evidence using the distribution of WTP, non-incentivized survey data, and voucher redemption data to argue that respondents are not systematically overstating their WTP.

First, as shown in Figures **??** and **??**, no respondent in the sample states a monetary WTP above 850 Rs or a nonmonetary WTP above 16 hours. This is evidence that respondents are not systematically reporting their WTP as the price that they guess to be the maximum possible price since the script that surveyors read to respondents states the market price (999 Rs) and explicitly addresses nonmonetary bids above 16 hours.

Second, using non-incentivized survey data, a small fraction of respondents reported overestimating their WTP. At the conclusion of the main survey, respondents who received a voucher for the water purifier (WTP$\geq$ price) were asked if they wished they had not stated a WTP as high as the revealed price and respondents who did not receive a voucher for the water purifier (WTP$<$price) were asked if they wished they had stated a WTP at least as high as the revealed price. 12 percent of respondents who received a voucher for the water purifier stated that they overestimated their WTP.[36] Further, whether or not a respondent redeems her voucher is not correlated with reported overestimation of WTP. Panel A of Table **??** presents the results in the sample of monetary vouchers, the sample of nonmonetary vouchers, and subsamples by price level.

Third, I test whether respondents systematically overstate their WTP using voucher redemption data. If respondents were systematically overstating their WTP then, all else equal, the probability that a voucher is redeemed should be increasing in the difference between the respondent's WTP and the price. I regress an indicator for voucher redemption on the difference between the respondent's WTP and the price in the sample of monetary price vouchers and the sample of nonmonetary price vouchers. For a given WTP, a lower price indicates a higher difference between WTP and the price. In general, low price vouchers are more likely to be redeemed than high price vouchers which positively biases the coefficient on the difference between WTP and the price, increasing the chance that I find evidence of overstatement of WTP. Despite this bias, as shown in Panel B of Table **??**, the coefficient on the difference is small and insignificant for both price types.[37] Across all three types of data,

[35]Figures **??** and **??** show the number of vouchers issued and redeemed by income level for monetary prices and for nonmonetary prices.

[36]The percentage is similar across price types: 12 percent in the monetary price treatment group and 10 percent in the nonmonetary price treatment group.

[37]I also regress an indicator for voucher redemption on an indicator which equals 1 if price equals the respondent's WTP and 0 if the price is strictly less than the respondent's WTP, controlling for price, in the

there is no evidence that respondents systematically overstated their willingness to pay.

Even if the overall level of WTP is not overstated, the targeting achieved by the nonmonetary price could be overestimated relative to the targeting achieved by the monetary price. This could occur if the rich overstate their monetary WTP relative to the poor or if the poor overstate their nonmonetary WTP relative to the rich. I test for relative overstatement of WTP between the rich and poor using three different methods.

First, I use voucher redemption data to test whether income or wealth has predictive power for a household's decision of whether to redeem its voucher. Figures **??** and **??** show the number of vouchers issued and redeemed by price level. In particular, if the rich were overstating their monetary WTP relative to the poor, then the rich should be less likely to redeem monetary price vouchers than the poor. Similarly, if the poor were overstating their nonmonetary WTP relative to the rich, then the poor should be less likely to redeem a nonmonetary price voucher than the rich. Panel C of Table **??** shows the results of individual regressions of an indicator for voucher redemption on an indicator for poor controlling for price. Poor households are not less likely to redeem their voucher for either price type.

Additionally, I use demographic variables proxying income to test for differential voucher redemption by income level. Controlling for price, the respondent's education level, the asset index, indicator for credit constrained, and an indicator for whether the respondent works are not significant predictors of whether a household redeems its voucher in either the monetary price treatment group or the nonmonetary price treatment group. There is no evidence of differential voucher redemption by income level. However, because there are other reasons, potentially correlated with income, that a household may not redeem its voucher besides overstatement of WTP, such as forgetfulness or budget shocks, I directly test for overstatement of WTP using the voucher data.

Second, I follow the same strategy used above to test for universal overstatement of WTP using voucher redemption data. I regress an indicator for voucher redemption on the difference between the respondent's WTP and the price in the four subsamples created by splitting the sample by income level and price type. Table **??** shows that in all four subsamples the coefficient on the difference is small. The coefficient is positive and significant (at the 10 percent level) in the sample of rich households with nonmonetary price vouchers. This indicates that the rich may be more likely to overstate their nonmonetary WTP, which

sample of monetary price vouchers and the sample of nonmonetary price vouchers. I find no evidence of systematic overstatement of WTP. The indicator for price equal to WTP has less power than the variable representing the difference between WTP and price, but this strategy is able to separate the effect of the difference between WTP and the price from the effect of price.

would imply that the targeting results are underestimated. However, overall, there is strong evidence that neither the poor nor the rich are more likely to overstate their WTP.[38]

Third, I use non-incentivized survey data to determine whether income is correlated with reported overstatement or understatement of WTP.[39] I regress an indicator for reported overstatement of WTP on an indicator for below-median per capita household income in the sample of households who received a voucher. The indicator for income level is not significant in either the monetary or the nonmonetary price groups. Similarly, in the sample of households that did not receive a voucher, the poor were no more likely to report that they underestimated their WTP for either price type.

Across all three methods, there is no evidence that the rich are overstating their monetary WTP relative to the poor or that the poor are overstating their nonmonetary WTP relative to the rich. Thus, the targeting results are not driven by systematic differences in reporting of WTP across income levels.

5 Conclusion

Many health products have high private and social returns, especially for the poor. I study two methods to targeting health products to the poor, monetary prices and non-monetary prices (time costs), using a field experiment in India.

I develop a model of household demand for a health product at monetary prices and at nonmonetary prices. The model illustrates three features of demand. First, I show that for monetary prices, the poor are underrepresented among demanders. Second, the model shows that nonmonetary prices may not result in overrepresentation of the poor among demanders due to opposing income and substitution effects. For a concave utility function, the utility cost of the nonmonetary price may not be increasing in the wage. Third, the model illustrates that the difference in the utility cost of a monetary price and a nonmonetary price is greater for the poor than for the rich. This implies that regardless of whether the utility cost of the nonmonetary price is increasing in the wage, nonmonetary prices better target the poor

[38] In order to control for the price, I also use a regression specification in which the dependent variable is an indicator which equals 1 if price equals the respondent's WTP and 0 if the price is strictly less than the respondent's WTP. This indicator has less power than the variable representing the difference between the respondent's WTP and the price. The indicator is positive and significant in the sample of poor households with nonmonetary price vouchers, indicating that the poor may be more likely to overstate their nonmonetary WTP. The coefficient on the indicator is small and insignificant in each of the other three samples.

[39] A respondent is coded as overstating her WTP if she states that she wished that she had not stated a WTP as high as the revealed price and is coded as understating her WTP if she states that she wished that she had stated a willingness to pay at least as high as the revealed price.

than monetary prices.

I conducted a field experiment in Hyderabad, India to elicit willingness to pay at monetary prices and at nonmonetary prices using the Becker-DeGroot-Marshak (BDM) mechanism (Becker, DeGroot, Marshak, 1964). Overall, I find that nonmonetary prices better target the poor than monetary prices. Specifically, I find that monetary WTP is increasing in income, and in contrast, nonmonetary WTP is weakly decreasing in income. Using a pooled sample of monetary WTP and nonmonetary WTP, nonmonetary WTP falls relative to monetary WTP as income rises.

In this context, nonmonetary prices better target water purifiers to the poor than monetary prices and baseline survey data indicate that the poor have the greatest health benefits from water purifiers. Together, these results demonstrate that nonmonetary prices can be a powerful tool for allocating health products to those with the greatest benefits.

References

[1] Abdul Latif Jameel Poverty Action Lab (J-PAL). "The Price is Wrong: Charging Small Fees Dramatically Reduces Access to Important Products for the Poor." *J-PAL Bulletin* April 2011.

[2] Alatas, Vivi, Abhijit Banerjee, Rema Hanna, Benjamin A. Olken, Ririn Purnamasari, and Matthew-Wai-Poi. 2015. "Self-Targeting: Evidence from a Field Experiment in Indonesia." *Journal of Political Economy,* forthcoming.

[3] Arnold, Benjamin F., and John Colford, Jr. 2007. "Treating Water with Chlorine at Point-of-Use to Improve Water Quality and Reduce Child Diarrhea in Developing Countries: A Systematic Review and Meta-Analysis." *American Journal of Tropical Medicine and Hygiene,* 76(2), 354-364.

[4] Ashraf, Nava, James Berry, and Jesse Shapiro. 2010. "Can Higher Prices Stimulate Product Use? Evidence from a Field Experiment in Zambia." *American Economic Review,* 100 (5): 2383-2413.

[5] Baird, Sarah, Joan Hamory Hicks, Michael Kremer, and Edward Miguel. 2015. "Worms at Work: Long-Run Impacts of a Child Health Investment." `http://scholar.harvard.edu/files/kremer/files/worms-at-work_2015-07-23.pdf?m=1437674134`.

[6] Barzel, Yoram. 1974. "A Theory of Rationing by Waiting." *Journal of Law and Economics,* XVII (April 1974): 73-96.

[7] Becker, Gordon, Morris DeGroot, and Jacob Marschak. 1964. "Measuring Utility by a Single-Response Sequential Method." *Behavioral Science,* 9, 226-236.

[8] Berry, James, Greg Fischer, and Raymond Guiteras. 2015. "Eliciting and Utilizing Willingness to Pay: Evidence from Field Trials in Northern Ghana." BREAD Working Paper 459.

[9] Besley, Timothy and Stephen Coate. 1992. "Workfare versus Welfare: Incentive Arguments for Work Requirements in Poverty-Alleviation Programs." *American Economic Review,* 82 (1): 249-261.

[10] Cohen, Jessica, and Pascaline Dupas. 2010. "Free Distribution or Cost-Sharing? Evidence from a Randomized Malaria Prevention Experiment." *Quarterly Journal of Economics,* 25 (1): 1-45.

[11] Devoto, Florencio, Esther Duflo, Pascaline Dupas, William Parienté, and Vincent Pons. 2012. "Happiness on Tap: Piped Water Adoption in Urban Morocco." *American Economic Journal: Economic Policy,* 4(4): 68-99.

[12] Diamond, Peter A., and James A. Mirrlees. 1978. "A Model of Social Insurance with Variable Retirement." *Journal of Public Economics,* 10 (December 1978): 295-336.

[13] Dupas, Pascaline. 2009. "What Matters (and What Does Not) in Households' Decision to Invest in Malaria Prevention?" *American Economic Review,* 99 (2): 224-30.

[14] Dupas, Pascaline. 2014a. "Short-Run Subsidies and Long-Run Adoption of New Health Products: Evidence from a Field Experiment." *Econometrica* 82 (1): 197-228.

[15] Dupas, Pascaline. 2014b. "Getting Essential Health Products to Their End Users: Subsidize but How Much?" *Science,* 345(6202): 1279-1281, 12 September 2014.

[16] Dupas, Pascaline, Vivian Hoffmann, Michael Kremer, and Alix Peterson Zwane. 2015. "Targeting Health Subsidies through a Non-price Screening Mechanism: Evidence from a Randomized Controlled Trial in Rural Kenya." Unpublished.

[17] Dupas, Pascaline and Jonathan Robinson. 2013. "Why Don't the Poor Save More? Evidence from Health Savings Experiments." *American Economic Review,* 103(4): 1138-1171.

[18] Guiteras, Raymond, David I. Levine, Thomas Polley, and Brian Quistorff. 2015. "Credit Constraints, Discounting, and Investment in Health: Evidence from Micropayments for Clean Water in Dhaka." `https://www.econ.umd.edu/research/papers/648`.

[19] Hoffmann, Vivian. 2009. "Intrahousehold Allocation of Free and Purchased Mosquito Nets." *American Economic Review: Papers and Proceedings,* 99(2): 236-241.

[20] Horowitz, John. 2006. "The Becker-DeGroot-Marschak Mechanism is Not Necessarily Incentive Compatible, Even for Non-random Goods." *Economic Letters,* 93(1): 6-11.

[21] Kremer, Michael, and Edward Miguel. 2007. "The Illusion of Sustainability." *Quarterly Journal of Economics,* 122 (3): 1007-1065.

[22] Ma, Xiaochen, Sean Sylvia, Matthew Boswell, Scott Rozelle, and C.Y. Cynthia Lin. 2014. "Ordeal Mechanisms and Training in the Provision of Subsidized Products in Developing Countries." `https://reap.fsi.stanford.edu/sites/default/filesall6.ordeal_mechanisms_and_training_in_the_promotion_of_subsidized_products_in_developing_countries.pdf`.

[23] Mazar, Nina, Botond Koszegi, and Dan Ariely. 2014. "True-Context Dependent Preferences? The Causes of Market-Dependent Valuations." *Journal of Behavioral Decision Making,* 27(3): 200-208.

[24] Meredith, Jennifer, Jonathan Robinson, Sarah Walker, and Bruce Wydick. 2013. "Keeping the Doctor Away: Experimental Evidence on Investment in Preventative Health Products." *Journal of Development Economics,* 105: 196-210.

[25] Miguel, Edward, and Michael Kremer. 2004. "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities." *Econometrica,* 72(1), 152-217.

[26] Miller, Klaus M., Reto Hoffstetter, Harley Krohmer, and Z. John Zhang. 2011. "How should Consumer's Willingness to Pay be Measured? An Empirical Comparison of State-of-the-art approaches." *Journal of Marketing Resarch,* 48(1): 172-184.

[27] Nichols, D., E. Smolensky, and T.N. Tideman. 1971. "Discrimination by Waiting Time in Merit Goods." *American Economics Review,* LXI (June 1971): 312-323.

[28] Nichols, Albert, and Richard Zeckhauser. 1982. "Targeting Transfers through Restrictions on Recipients." *American Economic Review,* 72 (2): 372-377.

[29] Parsons, Donald O. 1991. "Self-screening in Targeted Public Transfer Programs." *Journal of Political Economy,* 99(4): 859-876.

[30] Soman, Dilip. 2001. "The Mental Accounting of Sunk Time Costs: Why Time is not Like Money." *Journal of Behavioral Decision Making,* 14, 169-185.

[31] Tarozzi, Alessandro, Aprajit Mahajan, Brian Blackburn, Dan Kopf, Lakshmi Krishnan, and Joanne Yoong. 2014. "Micro-loans, Bednets and Malaria: Evidence from a Randomized Controlled Trial in Orissa (India)." *American Economic Review,* 104(7): 1909-1941.

[32] Thomas, Duncan, Elizabeth Frankenberg, Jed Friedman, Jean-Pierre Habicht, Mohammed Hakimi, Nicholas Ingwersen, Jaswadi, Nathan Jones, Christopher McKelvey, Gretel Pelto, et al. 2006. "Causal Effect of Health on Labor Market Outcomes: Experimental Evidence." California Center for Population Research Online Working Paper CCPR-070-06.

Tables

Table 1: Household and Respondent Summary Statistics

	Full	Rich	Poor
	(1)	(2)	(3)
Panel A: Household Statistics			
Household contains children under 14 (percent)	72	60	84
Household owns water filter at baseline (percent)	30	37	24
Household reports treating children's water at baseline (percent)	74	79	72
Household reports treating adults' water at baseline (percent)	72	75	69
Household treats children's water with cloth or net (percent)	46	37	53
Household treats adults' water with cloth or net (percent)	56	49	64
Household episode of diarrhea (percent)	15	10	19
Average household size	4.7	4.6	4.8
Average daily household labor earnings (in Rs)	515	780	261
Average daily household non-labor earnings (in Rs)	39	64	15
Panel B: Respondent Statistics			
Female respondent (percent)	87	84	89
Respondent has no formal schooling (percent)	26	23	28
Respondent earns labor income (percent)	34	36	33
Average daily respondent labor earnings for workers (in Rs)	217	313	118
Average hourly respondent wage for workers (in Rs)	32	43	19

Note: Methods of water treatment include boiling, chemical treatment, water purifiers or filters, and straining water through a plastic net or cotton cloth. The percentage of households that treat children's drinking water is the percentage of households with children under the age of 14 who report treating their drinking water. Households are coded as treating their drinking water if they report that they treat their drinking water all year or in the rainy season. Households that treat their water with cloth or net is reported as a percentage of households that treat their drinking water. Households are coded as treating their drinking water with a cloth or net if these are the only methods used.

Table 2: Income and Willingness to Pay Monetary Prices

	(1)	(2)	(3)	(4)
Panel A: Daily Labor Income				
Log household income	0.193***	0.196***		
	(0.031)	(0.031)		
Log respondent income			0.164***	0.168***
			(0.040)	(0.040)
Area fixed effects	No	Yes	No	Yes
R^2	0.051	0.079	0.073	0.110
N	730	730	260	260
Panel B: Daily Total Income				
Log household income	0.190***	0.192***		
	(0.031)	(0.031)		
Log respondent income			0.158***	0.160***
			(0.037)	(0.037)
Area fixed effects	No	Yes	No	Yes
R^2	0.051	0.079	0.072	0.100
N	739	739	291	291
Panel C: Hourly Wage				
Log household income	0.176***	0.174***		
	(0.038)	(0.039)		
Log respondent income			0.179***	0.178***
			(0.059)	(0.061)
Area fixed effects	No	Yes	No	Yes
R^2	0.032	0.055	0.052	0.086
N	725	725	260	260

Note: The dependent variable is log of monetary WTP measured in rupees. The mean of the dependent variable in Panel A, column (2) is 290 Rs. The mean of household daily labor income in Panel A, column (2) is 517 Rs. This implies that an additional 52 Rs of daily household labor income increases monetary WTP by 5.8 Rs at the mean. The mean of the dependent variable in Panel A, column (4) is 307 Rs. The mean of respondent daily labor income is 216 Rs in Panel A, column (2). This implies that an additional 22 Rs of respondent daily labor income increases monetary WTP by 5.2 Rs at the mean. Robust standard errors in parentheses. In Panel C, the independent variable is the mean household hourly wage of all household members who work for a wage. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Table 3: Income and Willingness to Pay Nonmonetary Prices

	(1)	(2)	(3)	(4)
Panel A: Daily Labor Income				
Log household income	-0.048	-0.044		
	(0.034)	(0.034)		
Log respondent income			-0.006	-0.009
			(0.043)	(0.046)
Area fixed effects	No	Yes	No	Yes
R^2	0.003	0.053	0.000	0.073
N	683	683	243	243
Panel B: Daily Total Income				
Log household income	-0.049	-0.045		
	(0.033)	(0.033)		
Log respondent income			-0.031	-0.026
			(0.039)	(0.040)
Area fixed effects	No	Yes	No	Yes
R^2	0.003	0.052	0.002	0.068
N	693	693	272	272
Panel C: Hourly Wage				
Log household income	-0.094***	-0.084**		
	(0.036)	(0.036)		
Log respondent income			0.001	-0.018
			(0.061)	(0.062)
Area fixed effects	No	Yes	No	Yes
R^2	0.009	0.057	0.000	0.073
N	678	678	243	243

Note: The dependent variable is the log of nonmonetary WTP measured in minutes. The mean of the dependent variable is 171 minutes in Panel A, column (2). The mean of household daily labor income is 517 Rs in Panel A, column (2). This implies that an additional 52 Rs of daily household labor income decreases nonmonetary WTP by 8.6 minutes at the mean. In Panel C, the independent variable is the mean household hourly wage of all household members who work for a wage. In each panel, I cannot reject that the coefficient on household income is equal to the coefficient on respondent income. Robust standard errors in parentheses. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Table 4: Willingness to Pay and Household Characteristics

	Household Income		Respondent Income	
	(1)	(2)	(3)	(4)
Panel A: Monetary Prices				
Daily income	0.190***	0.193***	0.172***	0.178***
	(0.032)	(0.032)	(0.037)	(0.037)
Children under 14	0.003	0.007	-0.012	-0.008
	(0.018)	(0.018)	(0.035)	(0.035)
Water illness (indicator)	-0.020	-0.031	0.006	0.002
	(0.047)	(0.047)	(0.076)	(0.080)
Treats drinking water (indicator)	0.072	0.060	0.053	0.063
	(0.052)	(0.053)	(0.074)	(0.076)
Owns purifier (indicator)	-0.034	-0.039	-0.164**	-0.185**
	(0.052)	(0.054)	(0.081)	(0.086)
Credit constrained (indicator)	0.022	0.034	-0.073	-0.100
	(0.057)	(0.058)	(0.091)	(0.088)
Area fixed effects	No	Yes	No	Yes
R^2	0.053	0.080	0.091	0.121
N	736	736	290	290
Panel B: Nonmonetary Prices				
Daily income	-0.032	-0.025	-0.019	-0.011
	(0.034)	(0.034)	(0.038)	(0.041)
Children under 14	-0.020	-0.023	0.006	0.003
	(0.020)	(0.020)	(0.0408)	(0.041)
Water illness (indicator)	-0.017	-0.015	0.010	-0.004
	(0.048)	(0.048)	(0.083)	(0.083)
Treats drinking water (indicator)	-0.058	-0.028	-0.068	-0.024
	(0.058)	(0.058)	(0.084)	(0.088)
Owns purifier (indicator)	-0.141**	-0.173***	-0.104	-0.123
	(0.055)	(0.056)	(0.090)	(0.092)
Credit constrained (indicator)	0.019	0.035	0.079	0.076
	(0.067)	(0.070)	(0.095)	(0.099)
Area fixed effects	No	Yes	No	Yes
R^2	0.020	0.073	0.016	0.080
N	690	690	271	271

Note: In Panel A, the dependent variable is the log of monetary WTP measured in rupees. In Panel B, the dependent variable is the log of nonmonetary WTP measured in minutes. Robust standard errors in parentheses. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Table 5: Pooled: Income and Willingness to Pay

	Daily Labor Income		Daily Total Income		Hourly Wage	
	(1)	(2)	(3)	(4)	(5)	(6)
Nonmonetary	-0.170	-0.591*	-0.189	-0.479	-0.627**	-0.888**
	(0.382)	(0.355)	(0.365)	(0.302)	(0.267)	(0.357)
Nonmonetary*Household income	-0.229***		-0.223***		-0.263***	
	(0.064)		(0.061)		(0.077)	
Nonmonetary*Respondent income		-0.201***		-0.221***		-0.221*
		(0.070)		(0.060)		(0.112)
Household fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.847	0.851	0.847	0.855	0.849	0.848
N	1332	478	1348	536	1322	478

Note: The dependent variable is log monetary WTP (Rs) or log nonmonetary WTP measured in hours scaled by the median respondent hourly wage, 23 Rs per hour. Column headings are the specific income variable used in the regression. Robust standard errors are clustered by household. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Table 6: Targeting Poor Households

Price	Poor Take-Up	Total Take-Up	Targeting Ratio
(1)	(2)	(3)	(4)
Panel A: Monetary Price (Rs)			
50	380	742	0.51
100	360	712	0.51
150	317	637	0.50
200	277	574	0.48
250	197	443	0.44
300	145	356	0.41
350	103	261	0.39
400	71	201	0.35
450	44	144	0.31
500	36	122	0.30
550	12	54	0.22
600	6	28	0.21
Panel B: Nonmonetary Price (Hrs)			
1	358	687	0.52
2	273	530	0.52
3	181	329	0.55
4	99	188	0.53
5	60	106	0.57
6	31	57	0.54
7	18	28	0.64

Note: Prices are included in the table if total demand is at least 20 households. Households with per capita income less than or equal to the median in the sample are considered poor. The poor comprise 51 percent of the sample because many households report the median per capita household income.

Table 7: Income Level and Water Treatment

	Illness				Purifier Ownership	Indicator for Purifier Use	
	Any Illness		Diarrhea		Indicator	Children's Water	Adults' Water
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Poor indicator	0.069**		0.089***		-0.135***	-0.014	-0.031
	(0.035)		(0.025)		(0.032)	(0.049)	(0.044)
Own purifier indicator		-0.088**		-0.101***			
		(0.037)		(0.023)			
Baseline mean (poor)	0.439		0.189		0.236	0.880	0.867
N	798	798	798	798	798	169	227

Note: Households are classified as poor if their per capita daily income is less than or equal to the median. The dependent variables for columns (1)-(4) is an indicator for whether the respondent reports that a member of the household suffered from any illness or diarrhea perceived to be caused by the drinking water. Households are included in column (6) if they contain children under the age of 14. Robust standard errors are shown in parentheses. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Table 8: Voucher Redemption

	Monetary			Nonmonetary		
	Full	Price $\geq$ 150	Price < 150	Full	Price $\geq$3	Price <3
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Reported Overstatement of WTP and Voucher Redemption						
WTP overstatement	-0.097	-0.117	0.062	-0.178	-0.111	-0.278
	(0.121)	(0.146)	(0.044)	(0.232)	(0.304)	(0.376)
N	121	86	35	50	21	29
Panel B: WTP-Price and Voucher Redemption						
WTP-price	0.008	0.004	-0.035	0.013	-0.065	0.031
	(0.023)	(0.037)	(0.025)	(0.019)	(0.063)	(0.022)
N	121	86	35	50	21	29
Panel C: Income and Voucher Redemption						
Poor indicator	0.048	0.068	0.034	0.031	-0.073	0.053
	(0.067)	(0.089)	(0.083)	(0.121)	(0.120)	(0.168)
N	121	86	35	50	21	29

In Panel B, the difference between WTP and the monetary price is in units of 100 Rs. In Panel C, the regressions control for price. The poor indicator variable equals 1 for households with per capita daily total household income less than or equal to the median. Robust standard errors in parentheses. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Table 9: Relative Overstatement by Income Level

	Monetary Price		Nonmonetary Price	
	Rich	Poor	Rich	Poor
	(1)	(2)	(3)	(4)
WTP-price	0.0003	0.020	0.027*	-0.015
	(0.035)	(0.030)	(0.015)	(0.046)
N	69	52	22	28

Poor households are households with per capita household income less than or equal to the median. The difference between WTP and the monetary price is in units of 100 Rs. Robust standard errors in parentheses. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Figures

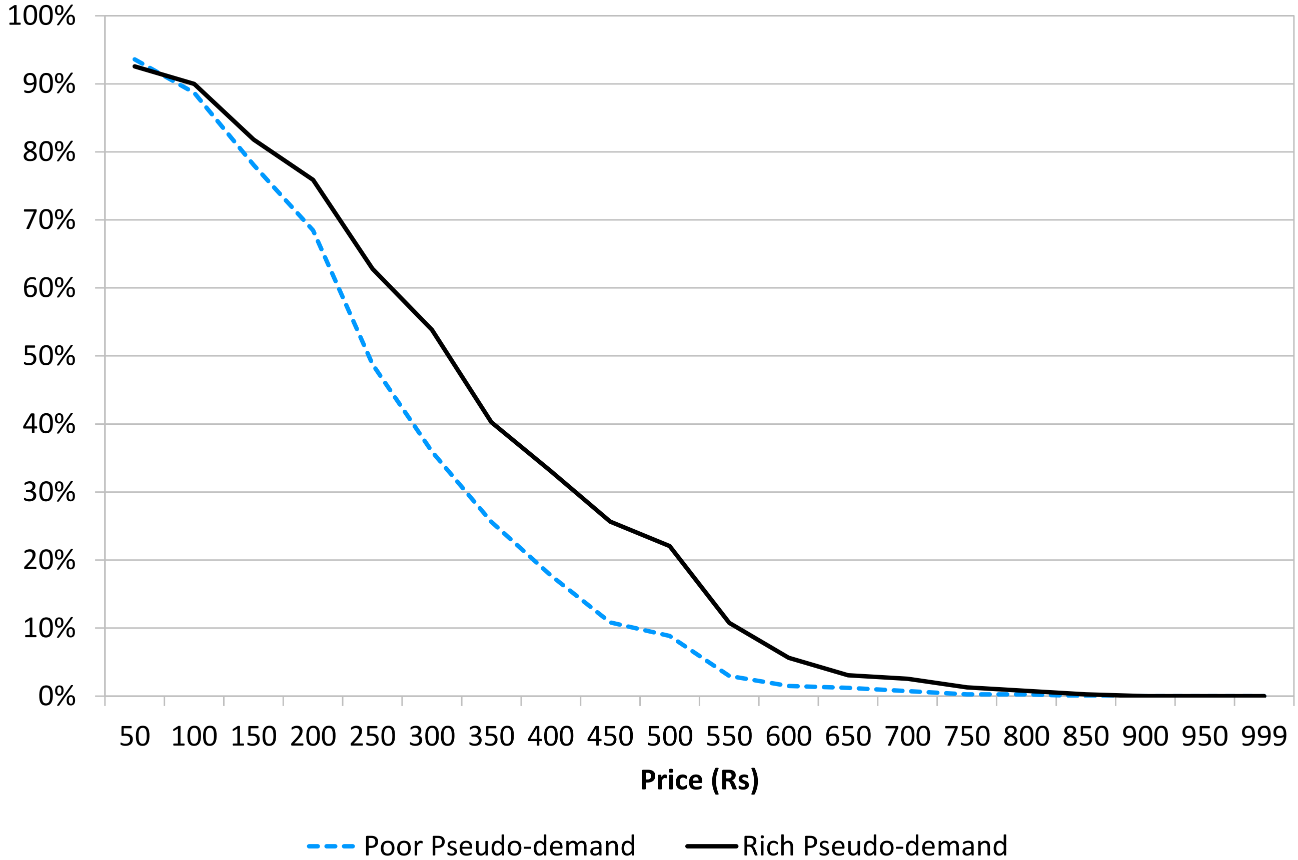

Figure 1: Pseudo-demand at Monetary Prices (by Income Level)

This figure shows the percentage of respondents who stated a monetary willingness to pay at least as high as the price for each price level. Willingness to pay was elicited for one water purifier through the Becker-DeGroot-Marshak (1964) mechanism. The Kolmogorov Smirnov test rejects equality of the rich and poor distributions of monetary willingness to pay (p-value < 0.001).

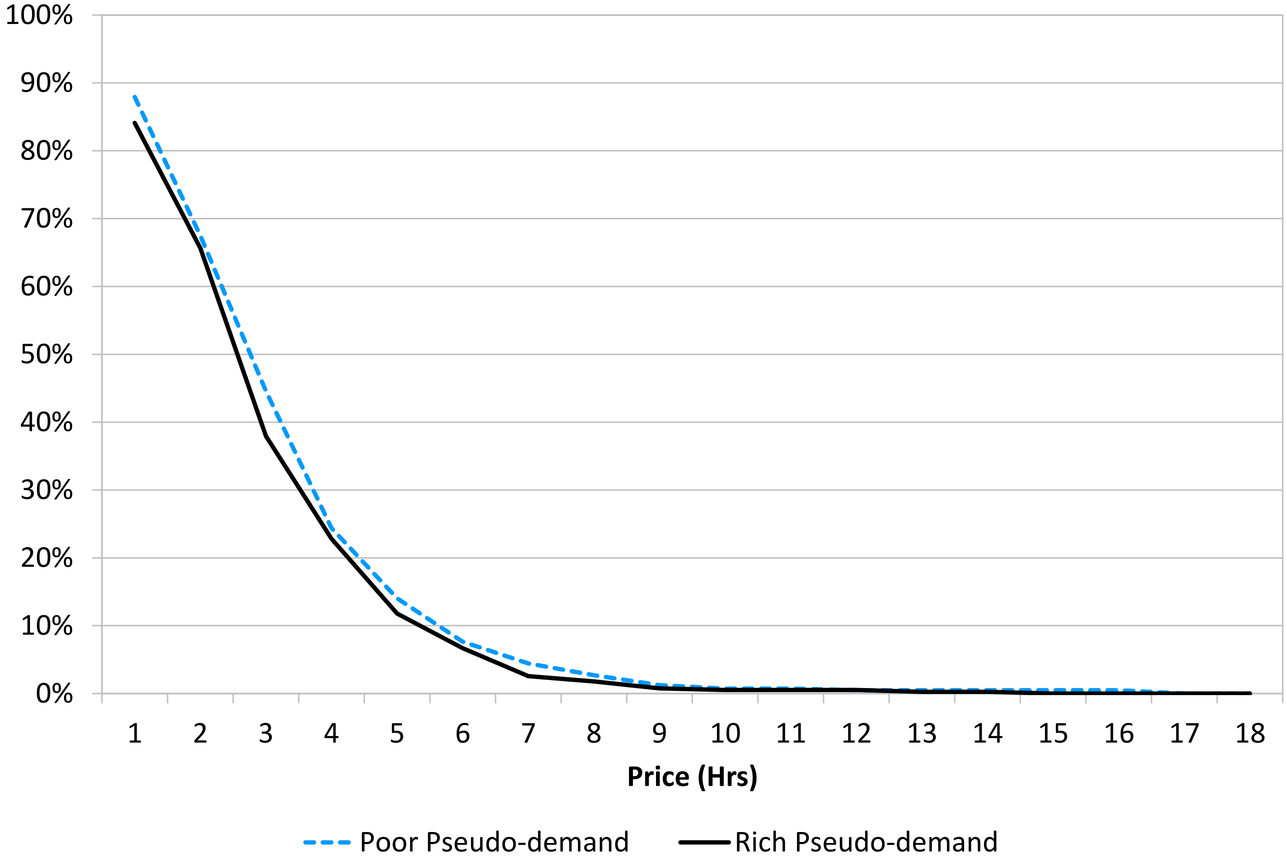

Figure 2: Pseudo-demand at Nonmonetary Prices (by Income Level)

This figure shows the percentage of respondents who stated a nonmonetary willingness to pay at least as high as the price for each price level. Willingness to pay was elicited for one water purifier through the Becker-DeGroot-Marshak (1964) mechanism. The Kolmogorov Smirnov test does not reject equality of the rich and poor distributions of nonmonetary willingness to pay (p-value of 0.326).

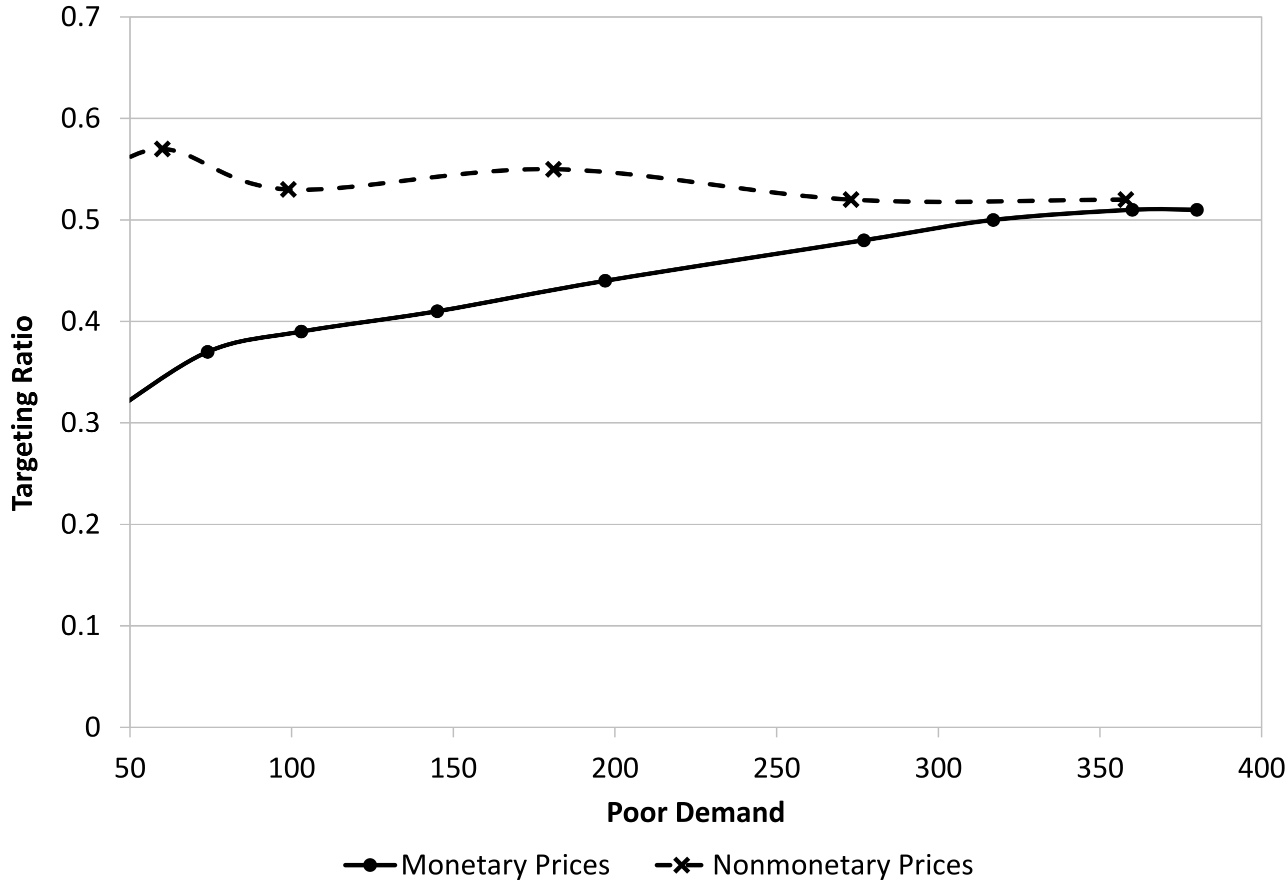

Figure 3: Targeting Ratios for Monetary and Nonmonetary Prices

This figure graphs the targeting ratios for monetary prices and nonmonetary prices by the level of poor demand. Targeting ratios are included if the total demand is at least 20 households. The level of poor demand is increasing along the x-axis. Therefore, moving right on the x-axis represents decreasing prices. The targeting ratio for monetary prices is always below the targeting ratio for nonmonetary prices and the difference in targeting ratios decreases as prices fall.

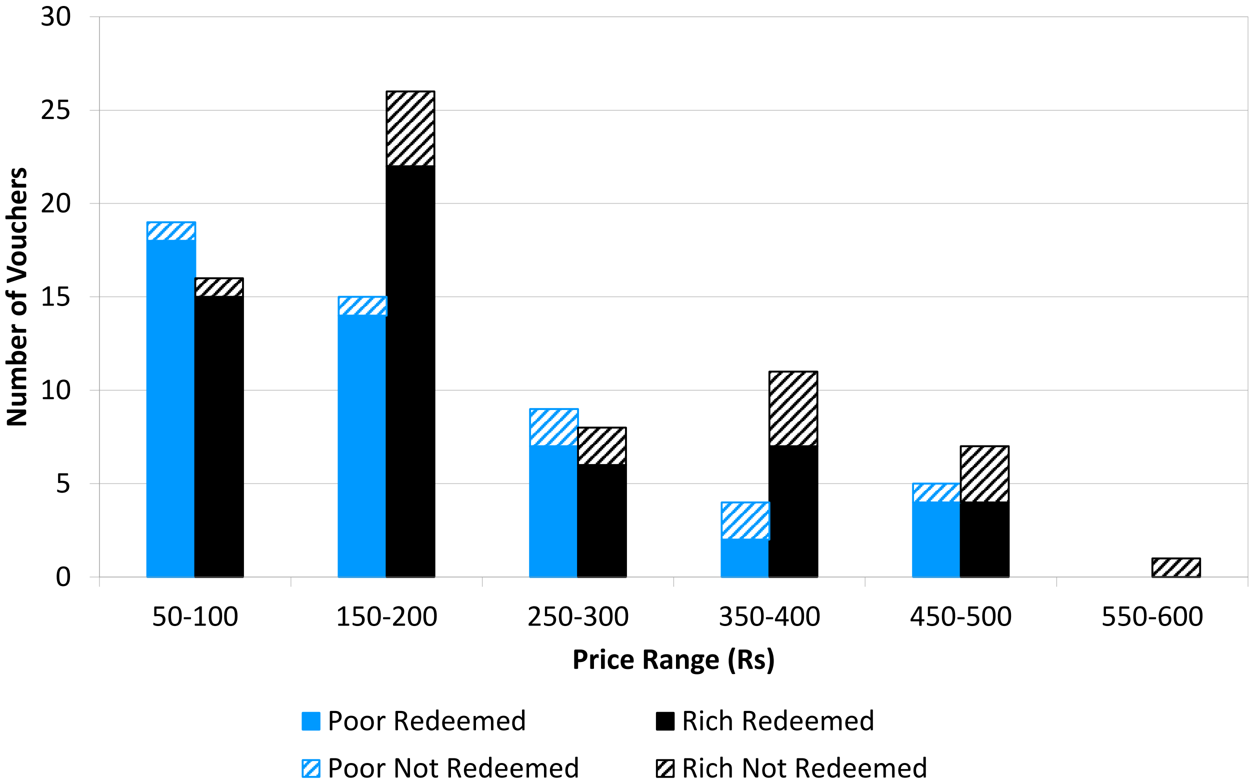

Figure 4: Monetary Price Vouchers Issued and Redeemed (by Income Level)

This figure shows the number of monetary price vouchers for the water purifier that were issued (willingness to pay$\geq$ price) and redeemed in the monetary price group. The size of the solid plus shaded bars represent the number of vouchers issued in each price bin. The solid bars represent the number of vouchers redeemed in each price bin. Vouchers are redeemed on the Saturday following the household survey at a neighborhood community center, temple, or school.

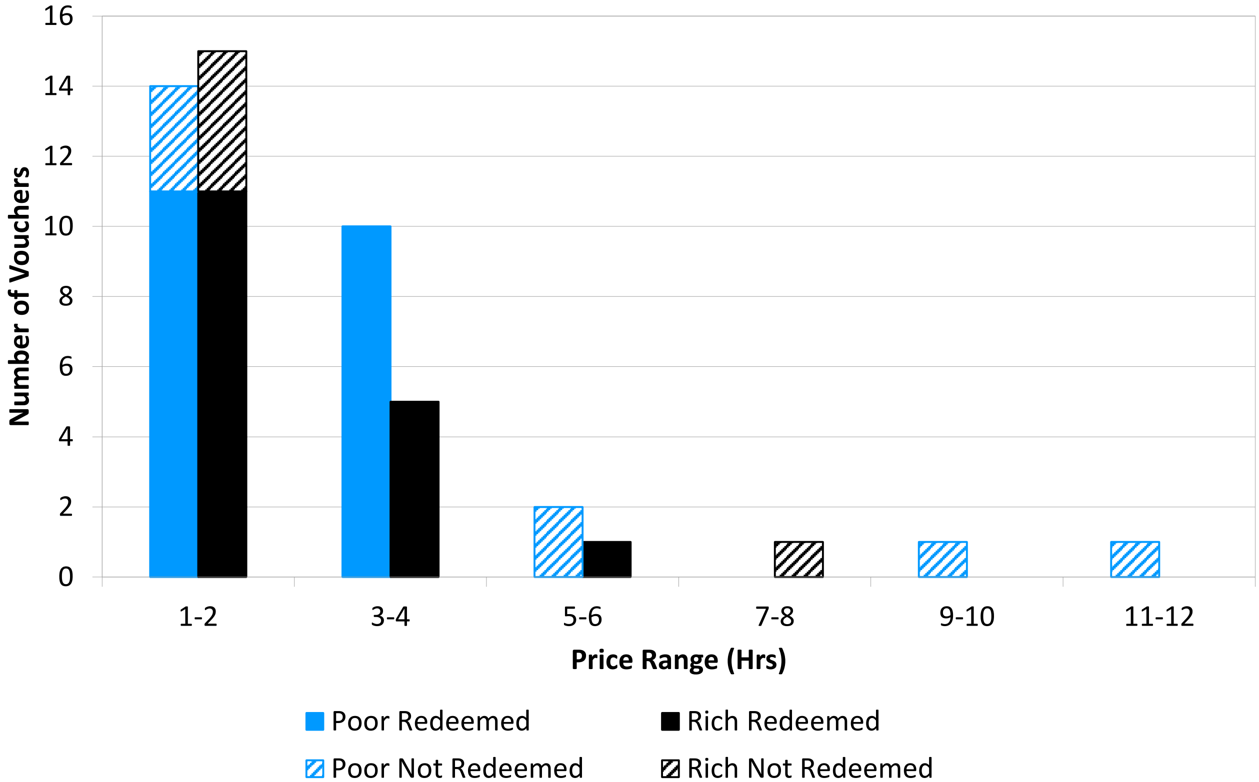

Figure 5: Nonmonetary Price Vouchers Issued and Redeemed (by Income Level)

This figure shows the number of nonmonetary price vouchers for the water purifier that were issued (willingness to pay$\geq$ price) and redeemed in the nonmonetary price group. The size of the solid plus shaded bars represent the number of vouchers issued in each price bin. The solid bars represent the number of vouchers redeemed in each price bin. Vouchers are redeemed on the Saturday following the household survey at a neighborhood community center, temple, or school.

Appendix Tables

Table A1: Asset Index and Willingness to Pay

	(1)	(2)
Panel A: Monetary Willingness to Pay		
Normalized asset index	0.080***	0.084***
	(0.1021)	(0.022)
Area fixed effects	No	Yes
R^2	0.017	0.045
N	742	742
Panel B: Nonmonetary Willingness to Pay		
Normalized asset index	-0.070***	-0.068***
	(0.025)	(0.024)
Area fixed effects	No	Yes
R^2	0.012	0.063
N	694	694

Note: In Panel A, the dependent variable is the log of monetary WTP measured in rupees. In Panel B, the dependent variable is the log of nonmonetary WTP measured in minutes. The asset index is the first principal component of variables representing ownership of five durable goods: automobiles, motorbikes/scooters, tablets/computers, washing machines, and evaporative coolers. The asset index is normalized to have mean 0 and standard deviation 1. Households may use more than one method of water treatment. Robust standard errors in parentheses. * Significance at the 10 percent level. ** Significance at the 5 percent level. *** Significance at the 1 percent level.

Appendix Figures

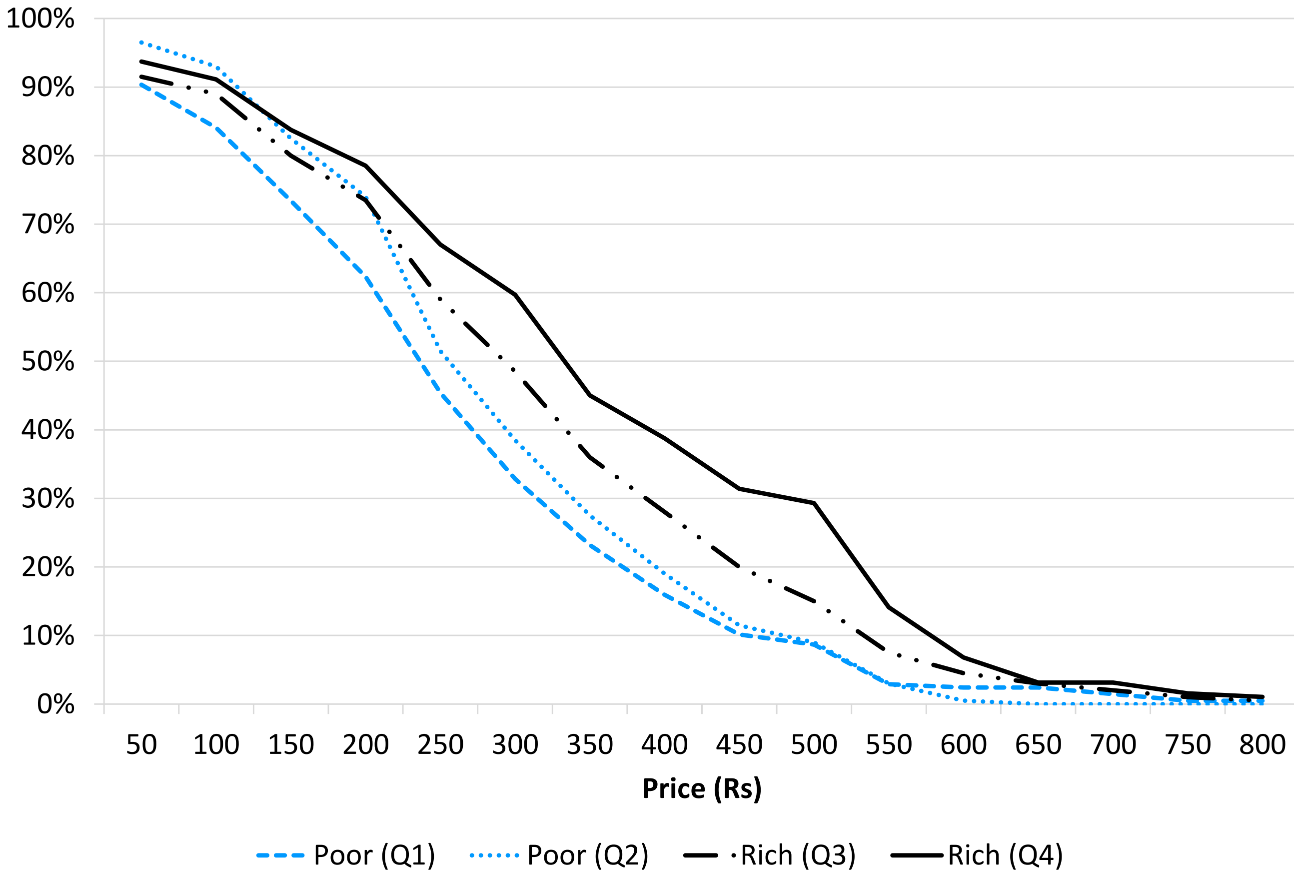

Figure A1: Pseudo-demand at Monetary Prices (by Income Quartile)

This figure shows the percentage of respondents who stated a monetary willingness to pay at least as high as the price for each price level. Willingness to pay was elicited for one water purifier through the Becker-DeGroot-Marshak (1964) mechanism. Households are divided into quartiles of the per capita daily household income distribution.

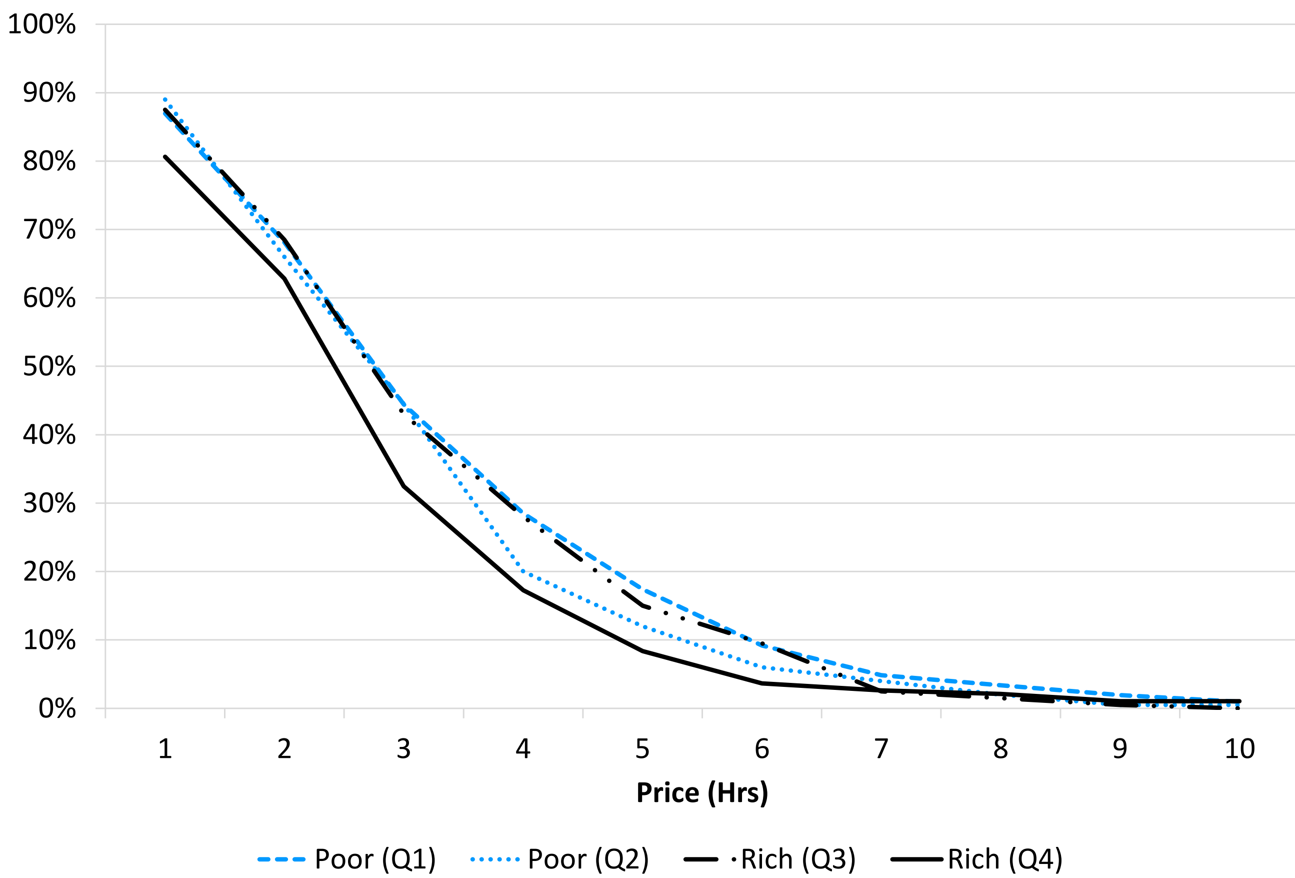

Figure A2: Pseudo-demand at Nonmonetary Prices (by Income Quartile)

This figure shows the percentage of respondents who stated a nonmonetary willingness to pay at least as high as the price for each price level. Willingness to pay was elicited for one water purifier through the Becker-DeGroot-Marshak (1964) mechanism. Households are divided into quartiles of the per capita daily household income distribution.