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Do non-monetary prices target the poor? Evidence from a field experiment in India☆

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ABSTRACT

This paper uses willingness to pay data from a field experiment in India to study targeting health products to the poor, using monetary prices and non-monetary prices (time costs). I model demand for the product at monetary and non-monetary prices. The model illustrates that monetary prices screen out the poor and that whether non-monetary prices screen out the non-poor is theoretically ambiguous because of opposing income and substitution effects. I find monetary prices select richer households and non-monetary prices do not provide strong selection on income. Both the poor and non-poor appear very elastic in the non-monetary price because of the high value of time in home production. I evaluate the problem of a principal with a fixed budget whose objective places some weight on coverage and some weight on targeting. Despite better targeting with non-monetary prices, the principal optimally chooses a monetary price for a large range of parameters.

In developing countries, many health products have large private and social benefits but very low take-up at the market price, particularly among the poor.[1] Governments and Non Governmental Organizations (NGOs) use price subsidies to increase take-up,[2] but monetary price subsidies do not necessarily select those with the highest returns (Ashraf et al., 2010; Cohen and Dupas, 2010; Kremer and Miguel, 2007). The poor often have the greatest benefit from health products, but are screened out even at subsidized prices, because they lack the cash, savings, or credit to purchase (Devoto et al., 2012; Dupas and Robinson, 2013; Tarozzi et al., 2014). Therefore, organizations face a trade-off between higher monetary price subsidies (at higher cost per unit cost) and excluding the poor.

An alternative method of allocating health products is non-monetary prices (time costs), often called "self-selection" mechanisms. Non-monetary prices may target the poor better than monetary prices because selection occurs on willingness to pay in time rather than money. If the time spent to purchase the product is productive, non-monetary prices may allow organizations to recover partial product costs without screening out the poor.

This paper studies two methods of targeting health products to the poor, monetary prices (rupees) and non-monetary prices (hours spent on a task), using data from a field experiment in India. I develop a model of household demand for a health product at monetary prices and at non-monetary prices that illustrates three features of demand. First, I show that for any monetary price non-poor demand exceeds poor demand, implying that the poor are underrepresented among demanders. Second, the model demonstrates that non-monetary prices may not result in greater demand among the poor than the non-poor 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 non-monetary price, but also implies a lower marginal utility of consumption. These opposing effects imply that whether the utility cost of the non-monetary price is increasing in the wage is theoretically ambiguous. Third, regardless of whether the utility cost of the non-monetary price is increasing in the wage, the model illustrates that, relative to the non-poor, the utility cost of a mon-

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[1] For high price sensitivity for health products, see (Abdul Latif Jameel Poverty Action Lab JPAL, 2011; Berry et al., 2015; Dupas, 2014, 2015; Miguel and Kremer, 2004). For large private and social benefits of health products, see (Arnold and Colford, 2007; Baird et al., 2016; Miguel and Kremer, 2004; Thomas et al., 2006).

[2] Information campaigns are an alternative to subsidies but have little effect on price sensitivity Dupas (2009); Kremer and Miguel (2007); Meredith et al. (2013).

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etary price is greater than the utility cost of a non-monetary price for the poor. This implies that non-monetary prices target the poor better than monetary prices.

To empirically test whether non-monetary prices target health products to the poor better than monetary prices, I conducted a field experiment in Hyderabad, India. Using the Becker-DeGroot-Marshak (BDM) mechanism (Becker et al., 1964),[3] I elicited willingness to pay (WTP) for a TATA Swach Smart water purifier at monetary prices (rupees) and at non-monetary prices (hours worked sorting seeds by type).[4] For logistical reasons, both monetary and non-monetary prices were paid the Saturday following the survey in a temple, school, or community center in the neighborhood. The experiment included nearly 800 households in seventeen slum neighborhoods of Hyderabad.

Water is a persistent public health concern in Hyderabad and the poor are disproportionately impacted.[5] At baseline, 70% of households did not own a water purifier and 41% of households reported that at least one household member suffered from an illness perceived to be caused by the drinking water during the last rainy season.

I analyze the distribution of WTP for each price type across income levels. I find that monetary prices select richer households as monetary WTP is increasing in income. The average WTP of the poor is 64 Rs less than the average WTP of the non-poor, and a 10% increase in household income per capita implies a 2.4% increase in monetary WTP. The evidence suggests that non-monetary prices do not provide strong selection on income. The average non-monetary WTP of the poor is 15 min greater than the average non-monetary WTP of the non-poor but household per capita income is not significantly correlated with non-monetary WTP. Further, using the prevailing wage rate to compare demand at different price types, demand at non-monetary prices is low relative to demand at monetary prices. However, compared to monetary prices, non-monetary prices provide better targeting of the poor.

Next, I evaluate non-monetary prices as a policy to target health products to the poor.[6] I model the problem of a principal with a fixed budget who can choose either a monetary price or a non-monetary price to allocate the health product. The principal's objective places some weight on coverage (total number of health goods distributed) and some weight on targeting (health goods distributed to the target, poor population). For a given budget, the optimal price depends on the weight placed on coverage relative to targeting, and on the output value of the task performed under the non-monetary scheme (i.e. whether it generates value that can be used to expand the budget constraint - henceforth the "productivity of the non-monetary price").

For reasonable values of the productivity of the non-monetary price, a non-monetary price is optimal only when the principal places much greater weight on targeting than on coverage. As the productivity of the non-monetary price increases, the non-monetary price is effectively less costly and the non-monetary price is preferred to the monetary price for a larger range of parameters. If the non-monetary price is not productive, the principal prefers a monetary price for any weighting of targeting and coverage in the objective function. If the productivity of the non-monetary price is equal to the median of the mean household hourly wage, a non-monetary price is optimal when the objective places much greater weight on targeting than on coverage.

Three recent experiments study the effectiveness of self-selection mechanisms in targeting resources in developing counties. Alatas et al. (2015) provides evidence that an ordeal can improve the targeting of Indonesia's Conditional Cash Transfer Program to poor beneficiaries. In western Kenya, Dupas et al. (2016) study the effectiveness of an ordeal mechanism in selecting those most likely to use a water treatment solution for health purposes. Inspired by Dupas et al. (2016), Ma et al. (2014) study the use of an ordeal mechanism in the distribution of eyeglasses in rural China. Both experiments find that the ordeal reduces program costs without screening out a substantial number of people who would have used the health product if given for free.

This paper makes several unique contributions to the literature on self-selection mechanisms. The WTP data used in this paper provide a much finer measure of non-monetary WTP, which allows me to consider the full range of non-monetary prices and trace out the full demand curve at non-monetary prices. Using the full demand curves at monetary and non-monetary prices, I can determine the optimal price as a function of the principal's budget, the weight placed on targeting relative to coverage, and the productivity of the non-monetary price.

The remainder of the paper is organized as follows. In section 1, I model household demand at monetary prices and non-monetary prices. The experimental design and data are described in section 2. In section 3, I investigate the distribution of willingness to pay and the correlation between income and willingness to pay of each price type. Section 4 describes the targeting achieved by monetary and non-monetary prices. In section 5, I model the problem of a principal with a fixed budget dedicated to distributing the preventative health product. I evaluate the principal's problem using estimated demand functions for monetary and non-monetary prices and discuss the optimal pricing policy. In section 6, I perform robustness checks, specifically concerning the distribution of willingness to pay. Section 7 concludes.

1. Model

This section uses a simple model of households' decisions whether or not to purchase a water purifier through the subsidy program for a monetary price, P_M, and for a non-monetary price, P_{NM} denominated in hours, to develop predictions for demand of the poor relative to demand of the non-poor and for the targeting ratio. The targeting ratio is defined as poor demand divided by total demand and represents the fraction of all water purifiers distributed at a given price that are distributed to the poor.

Households have quasi-linear utility $U = u(c^i) + \alpha^i d^i$ 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.

Each household maximizes its utility subject to its budget constraint. The price of consumption is normalized to one, and there is no disutility of labor so all households choose to work the maximum number of hours, $\overline{h}$. Household i's budget constraint is $c^i + d^i P_M \leq w^i \overline{h}$ for

[3] 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 WTP, she cannot purchase the good.

[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.

[5] The water supply for most tap water in Hyderabad is rated a 'C' on the water classification chart by the Central Pollution Control Board ("Hyderabad's dirty secret". Times of India, May 18, 2012. http://timesofindia.indiatimes.com/city/hyderabad/Hyderabads-dirty-secret/articleshow/13255341.cms; Central Pollution Control Board (2011a)), meaning that it must be treated and disinfected before it is considered safe for consumption (Central Pollution Control Board, 2011b). According to the National Health Profile of India by the Ministry of Health and Family Welfare, 141 people died from water-borne diseases in Andhra Pradesh (the state in which Hyderabad was located at the time of the experiment) in 2013 (DGHS, 2013). However, a WHO study estimates the number of deaths related to inadequate Wash, Sanitation, and Hygiene (WASH) in all of India to be 334,778 in 2012 W.H.O (2014). Scaling this by the fraction of the Indian population in Andhra Pradesh, gives a rough estimate of 23,385 deaths related to inadequate WASH India (2011).

[6] Self-selection mechanisms are widely used as a method of targeting the poor. For example, the National Rural Employment Guarantee Scheme (NREGS/NREGA) is a targeted poverty alleviation program in India that covers 11% of the world's population (Niehaus and Sukhtankar, 2013). Although the purpose of NREGA is to transfer resources to the rural poor, all households are eligible for NREGA benefits. The program relies on poorer households self-selecting into the program while richer households self-select out of the program because of the manual labor requirements.