

Household Clean Water Technology

Validation, Use and Impact



In brief

- Lack of clean water is a major health issue in the developing world. It is important to be able to measure demand for clean water technology, in order for effective policy making.
- This study attempts to examine the willingness to pay (WTP) amongst consumers in rural northern Ghana. This information will allow a policymaker to simulate purchase behaviour at any given price.
- The authors examine whether the *Becker-DeGroot-Marschak* (BDM) mechanism is an effective tool to estimate demand for clean water technology. This study also examines the demand and the impact of the *Kosim* filter, a purification technology that removes particulates and neutralizes bacteria without the use of chemicals or electricity.
- Key findings:
 - At 10% cost recovery, 92% of households purchased the Kosim filter. At 20% and 30% of cost recovery, demand was 47% and 20%, respectively.
 - The BDM mechanisms can be a useful tool for measuring WTP in the field, but implementation require careful consideration of some challenges.
 - The Kosim filter resulted in a significant drop in diarrhea among children 0-5.
 - Policy makers must be aware of a potential disconnect between policy intentions and implementation in the field, particularly as it relates to children's health interventions that are mediated through the family.
- In terms of implementation, organizations should assess carefully the trade-offs between different methods of estimating demand. In addition, it may be possible to undertake modest amounts of cost recovery (10-20%) while maintaining take-up for the majority of households, for relatively expensive durable technologies.

Policy Motivation

*“In rural Africa...
over half the
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What is the demand for clean water technology in rural northern Ghana?

Lack of access to clean water is one of the most significant threats to health and welfare in the developing world. This problem is especially acute in rural Africa, where over half the population lacks access to improved water. A related issue is whether consumers are *willing to pay* for these technologies. Higher willingness to pay can indicate a higher value of the technologies for health improvements and can support sustainable market-based approaches to the provision of clean water technology.

Can we precisely and with minimal assumptions estimate demand/willingness-to-pay in the field? Can the Becker-DeGroot-Marschak (BDM) mechanism be implemented in the field to estimate demand for clean water technology?

Estimating demand accurately and precisely is critically important for effective policy making, whether the product of interest is privately or publically provided. Yet the standard techniques available to practitioners tend either to rely on strong assumptions or to provide very coarse information. The Becker-DeGroot-Marschak (BDM) mechanism is a tool from experimental economics with a number of attractive properties, including the potential to precisely elicit a consumer's willingness to pay for a product; however, it has not previously been rigorously tested in the field. Knowing a consumer's WTP can provide much more information for pricing policy, as it allows a policymaker to simulate purchase behavior at any price. This in turn could allow them to answer *what-if* questions that are necessary for effective policy making.

What are the short-term health impacts of point-of-use water treatment and how are those effects related to household characteristics, including willingness-to-pay?

Our study examines demand for and impacts of the Kosim filter, a particular purification technology that is appropriate for the region, as it both removes particulates and neutralizes bacteria without the use of chemicals or electricity. Linking potentially heterogeneous impacts to willingness-to-pay provides a necessary input for accurate cost-benefit analysis.

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Policy Impact

There are three key policies that this research informs:

- Pricing policy for organizations distributing durable clean water technologies in Ghana and elsewhere in the developing world.
- Use of the BDM mechanism to inform pricing policy for health goods.
- Whether the *Kosim* filter is effective in reducing short-term diarrhea outcomes

Audience

There are two types of organizations that this research is meant to inform. First, it will be useful to organizations involved with clean water technologies in Ghana and elsewhere in the developing world. Because our study examines demand for water filters, organizations interested in forming pricing policy for clean water technologies are a particular target group. Second, because our study examines methodologies for precisely measuring demand, it will be useful to organizations interested in forming pricing policy in developing countries.

Policy Implications

Our study yields four main findings:

At 10% cost recovery, 92% of households purchased the Kosim filter. At 20% and 30% of cost recovery, demand was 47% and 20%, respectively

We estimate this demand using our benchmark take-it-or-leave it mechanism.

The BDM mechanisms can be a useful tool for measuring WTP in the field, but implementation require careful consideration of some challenges

The BDM mechanism has several desirable properties for policy-focused research, including the ability to directly estimate the demand curve, calculate the relationship between willingness to pay for a product and that product's impact, and a built-in method for estimating the effect of prices on usage. We are particularly encouraged by the ability to estimate heterogeneous treatment effects, which are often posited but typically hard to identify. For example, we find that health impacts increase with willingness-to-pay up to a price of approximately 3 cedis (about 15% cost recovery), a pattern that parallels the usage data. While this particular finding need not generalize, there is hope that the methodology might. Against these considerable benefits, BDM faces some challenges. Most importantly, it produces lower valuations of the product compared to those obtained from the take-it-or-leave-it method. At any price, the share of individuals who expressed a willingness to purchase under BDM was 9-19% less than the share who accepted under a fixed-price offer. For example, 31% of households in the BDM group indicated a WTP at or above 4 cedis, while 47% in the take-it-or-leave-it group were willing to purchase at that price. This highlights the sensitivity of demand estimation to research methodology and suggest that policymakers should exercise caution with any methodology.

The Kosim filter resulted in a significant drop in diarrhea among children 0-5

Among households with children aged 0-5, those with the filter were 10% less likely to report that their children had diarrhea in the two weeks after purchase, compared

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with those who did not purchase.¹ This is a substantial drop, as 30% of such households reported that their children had diarrhea in the two weeks preceding our baseline survey. However, we stress that these results should be viewed with caution, because 1) they are very short term, and 2) diarrhea status is measured by self-reports of the respondents, rather than objective information. In follow-up work, we are measuring the long-term effects of the filter using both self-reports and more objective anthropomorphic measures.

Policy makers must be aware of a potential disconnect between policy intentions and implementation in the field, particularly as it relates to children’s health interventions that are mediated through the family

The central aim of providing access to clean drinking water is to improve children’s health. While all individuals can suffer from drinking unclean water, children are particularly at risk: diarrheal diseases are responsible for 17% of all deaths for children under five. However, in our follow-up work we found that many households did not consider clean water important for children’s health. Filtered water was often consumed by the adults in the household, typically the men, and considered a luxury good. While these intra-household dynamics were not central to our study, this finding underscores the need for health policy to carefully consider household and community behaviors that may affect actual outcomes.

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Implementation

Organizations should assess carefully the trade-offs between different methods of estimating demand

In the context of this study, the BDM mechanism produces lower estimates of demand than measured through take-it-or-leave-it offers. The researchers are working on refinements and alternative mechanisms that retain the useful properties of BDM but are less likely to under-estimate demand relative to take-it-or-leave-it offers. In addition, the researchers are working to understand the behavioural or other mechanisms at work that lead to these discrepancies. At the same time, there is little evidence evaluating the relationship of responses to take-it-or-leave-it offers to demand in non-experimental settings, so it is not clear that BDM “understates” demand. The researchers recommend that organizations interested in informing pricing policy undertake pricing studies wherever feasible.

For relatively expensive durable technologies, it may be possible to undertake modest amounts of cost recovery (10-20%) while maintaining take-up for the majority of households

We observed this result for the distributions of the *Kosim* filter in rural Northern Ghana. We emphasize, however, that under different contexts and with different technologies, the demand may differ substantially, and organizations should undertake pricing experiments as suggested in the paragraph above in order to

1. This estimate is computed using instrumental variables, where the random assignment of the filter prices is used to causally identify the effect of having the filter.

inform the pricing policy in a particular context.

Further Readings

Jameel Poverty Action Lab. “The Price is Wrong.” Policy Brief. <http://www.povertyactionlab.org/the-price-is-wrong>.

About the authors

James Berry is an Assistant Professor in the Department of Economics at Cornell University. His research addresses questions in development and labor economics, primarily through the use of field experiments. He is currently conducting several randomized evaluations to shed light on education production within the household and on decisions to take up and use health products.

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Raymond Guiteras is an Assistant Professor of Economics at the University of Maryland. He received his PhD from MIT in 2008. His research interests include environmental economics, development economics and applied microeconometrics. His research papers have studied the impact of climate change on Indian agriculture and the benefits of a sanitation program in India. Current research projects include a study of the effects of climate change-induced uncertainty on insurance markets and a series of randomized trials designed to measure the willingness to pay for clean water in northern Ghana.

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