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An empirical analysis of household choices among water storage devices

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ABSTRACT

This paper investigates factors underlying the household decision to utilize a variety of water storage devices in the small, poor municipality of San Lorenzo, Guatemala. Seemingly unrelated probit models were estimated to account for potential interdependence among different types of storage devices. Almost all sampled households store water at home in a variety of devices such as buckets, barrels, cisterns, and roof tanks. Estimation results indicate that the decision to use water storage devices is related to household income, and that the direction of income effects varies according to the type of storage device. On the other hand, water service interruptions were found statistically significant only for the household choice of using barrels. Findings also indicate that small devices (e.g. buckets) and barrels are used in a complementary fashion. In contrast, large devices (i.e. roof tanks and cisterns) are deemed substitutes for small devices and barrels.

1. Introduction

Although developing countries are still far from universal access to piped water, many of them have substantially extended their water infrastructure in the last decades. Numerous benefits from providing piped water have been achieved, varying from health and educational improvements to the reduction of time, particularly women's time, allocated for water collection (Koolwal and van de Walle, 2013; Ortiz-Correa et al., 2015; Vásquez and Aksan, 2015). Recent studies, however, have found that

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many water systems are unreliable and water services are frequently interrupted (e.g. UNDP, 2006; Vásquez, 2013). As a result, households have increasingly adopted a variety of averting behaviors that can be considered as a demonstration of a latent demand for improvements of water services (McConnell and Rosado, 2000; Vásquez, 2012). For instance, when water services are constantly interrupted, households tend to invest in a variety of devices, from buckets and barrels to roof tanks and cisterns, in order to store water at home (Potter and Darmame, 2010; Vásquez, 2012; Virjee and Gaskin, 2010). Due to the cost of those devices, interruptions of water services impose a significant burden particularly on poor households that have fewer resources to implement averting measures (Baisa et al., 2010).

From a policy perspective, it is relevant to understand how households choose among a variety of averting measures as those decisions have welfare implications. Devices such as roof tanks may be preferred over barrels and buckets due to their substantial storage capacity, and because they can be connected to home's pipes so water is directly delivered to the point of use. Since poor households may not afford large storage devices, they may have a lower capacity to store water at home relative to more affluent households (Potter and Darmame, 2010; Zérah, 2000). Additionally, storing water in open-mouth devices may represent a latent health risk for households because those devices allow water recontamination (Fewtrell et al., 2005; Schmidt and Cairncross, 2009; Shaheed et al., 2014), and may facilitate the proliferation of pathogens (Cordeiro et al., 2011). Sealed storage devices that are built with anti-bacterial materials (e.g. roof tanks) may be preferred to mitigate health risks (Al-Omari et al., 2008); however, those devices tend to be relatively expensive. Consequently, poor households may be constrained to use inferior devices that may put their health at risk (e.g. buckets and barrels).

Prior studies have documented that in-home water storage is commonly observed in developing-country contexts where water services are already available (e.g. Vásquez et al. 2009; Virjee and Gaskin, 2010). However, few of those studies have investigated the factors associated with that household practice, perhaps because it is implicitly assumed that households store water at home to cope with unreliable systems. Vásquez (2012) argues that identifying the determinants of water storage practices requires moving beyond that assumption. Utility-theoretic frameworks such as the household production model (described in more detail below) predict that households choose a mix of water storage devices according to their preferences and financial capacity. Related studies have empirically shown that water storage practices are associated with both service and household characteristics. In Amman (Jordan), Potter and Darmame (2010) found that a sample of high-income households have more water storage capacity than a sample of low-income households. Through a regression analysis of household data from Delhi (India), Zérah (2000) found that households' storage capacity is related to system unreliability, household income, home ownership, and home location in a private colony. Similarly, Vásquez (2012) showed that household income, home ownership and the perceived quality of water services are associated with household expenditures on water storage devices in León (Nicaragua).

Despite the welfare implications of household choices regarding the type of devices utilized to store water at home, there hardly are any studies that have empirically investigated the determinants of those choices. Most existing studies have rather used household expenditures and storage capacity to represent in-home water storage practices. Among the exceptions is a study by Vásquez (2012) who estimated (separate) probit models for household use of small (i.e. plastic bottles, buckets and sinks) and large devices (i.e. barrels and tanks) to store water at home. His findings indicate that the perceived quality of water services affects the likelihood of using small and large devices, and that household size is related to the likelihood of using small devices only. In contrast, the likelihood of using large devices increases with household income, but income is insignificant for using small devices. The empirical approach followed by Vásquez (2012) does not account for potential interdependence between small and large devices; interdependence that can be expected given that household choices are derived from the same utility maximization process. For instance, households that utilize barrels may also need small devices to transport water to different points of use within their home. On the other hand, households with roof tanks or cisterns would not need to have small devices for water transportation because those large devices can be connected to the home's pipes. Hence, analyses of household choices among storage devices should take into account that there could be a degree of complementarity or substitutability among those devices.

This study contributes to the still thin literature on in-home water storage practices by investigating the determinants of household choices among a variety of water storage devices in the small,