

DOCTORAL PROGRAMME

BEHAVIOURAL RESPONSE TO POLICY INSTRUMENTS TOWARDS DOMESTIC
WATER CONSERVATION

By

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DOMESTIC WATER CONSERVATION**

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Abstract

Many cities around the world face acute water scarcity (Bates, Kundzewicz, and Wu 2008; World Bank 2016). Rapid urbanization and growth in population in many large cities has increased water scarcity while social inequities in access to water and pricing continue to prevail (McDonald et al. 2011; United Nations 2019, 97). Wealthy communities tend to be not only high-users of water but also recipients of low-priced water while the poorer communities often struggle to get enough water and pay a higher-price for it (Dale Whittington 1992; United Nations 2019). The challenges of water scarcity are particularly pronounced in the developing countries such as in India where per-capita water availability has declined rapidly over the last seven decades as population has grown, especially in cities (Narain and Pandey 2012; Shah 2016).

The use of water conservation policy instruments can reduce demand to help match supply (Hoque 2014). The use of non-price and price tools have become popular policy choices towards conservation, especially in some of the industrialized West (Ferraro and Price 2013; Fielding et al. 2013; Brent, Cook, and Olsen 2015). The adoption of such tools is limited in developing countries as witnessed in the limited prevalence of metering and billing at household level (ADB 2007); without measurement for feedback, neither of these tools can be deployed effectively even though there is a large and growing part of population that receives 24x7 water supply.

Even in the context of industrialized West where these tools are more popular, there are challenges of limited understanding of behaviour of household response (E. Frey and Rogers 2014). The response to an intervention is hard to predict with accuracy due to a variety of behavioural factors that affect response including diverse settings and priming from prior interventions. In particular, response to non-price signal often does not persist; discovery of specific pathways towards persistence of such change is an area of active enquiry (Brent, Cook, and Olsen 2015; Kidd et al. 2019). On the price-front, assumptions of standard econ behaviour guides policy-making but there is perhaps no empirical evidence supporting conservation behaviour in response to introduction of price at household level; only aggregate level studies are available on introduction of price of water or even energy (Dalhuisen et al. 2003). The heterogenous nature of expected response to introduction of price, as expected from diversity of individual habits, attitudes and beliefs, has not been examined and thus it remains to be understood.

Using long-term field experiments, I uncover the behavioural response to certain non-price and price interventions designed to test persistence and to understand the nature of heterogenous response at household level. I attempt to achieve persistence of behaviour change through a framework designed to change our automatic Type 1 response (Evans and Stanovich 2013; Kahneman 2011), presented in Chapter 1 - Behavioural Intervention. If Type 1 behaviour changes, e.g., through new habits to conserve (Jager 2003), it would reflect in persistence of changed behaviour (e.g., lowered water consumption). To examine heterogeneity in response, the research asks questions such as these: do people above the median level of usage respond

more to our intervention than those below the median, as seen in experiments that use social norms for comparison (Ferraro, Miranda, and Price 2011; Bernedo, Ferraro, and Price 2014; Ferraro and Price 2013)? Or, do people closer to meeting a difficult suggested goal (that we used as an implementation mechanism) respond more than those far away from the goal, hinting at the importance of goal-orientation in their behaviour (Latham and Locke 1991; Locke and Latham 2006)?

In the price part of the study (presented in Chapter 2 – Price Intervention), I examine standard price-theory response as well as several deviations from it using a quasi-experiment involving introduction of price followed by an increase in price, situated at a wealthy resident community. While standard price-theory predicts reduction in usage on introduction of volumetric price, does everyone respond in the same direction (Gneezy, Meier, and Rey-Biel 2011; B. S. Frey and Oberholzer-Gee 1997; Sachdeva, Iliev, and Medin 2009)? Or do some people respond in the reverse direction as they might feel that paying a new volumetric-price gives them a right to consume without an obligation to conserve?

I compare findings from non-price and price interventions and attempt to uncover the underlying factors in Chapter 3 – Explication of Response. I examine the role of self-reported water conservation habits and attitude towards water and environment.

My field experiment uses a control-treatments design with one control group of households and three treated groups of households with increasing levels of intervention. A weekly water report is the intervention containing simplified usage information (part A), use of suggested goal with injunctive feedback (B) and easy water conservation tips (C). A year-long gap after non-price intervention enables study of persistence in absence of contaminants, such as in-built price incentive which has contaminated conservation estimates in perhaps all prior studies.

After the non-price-experiment, two price interventions take place in sequence on the same set of households; first price is introduced and then it is increased after five quarters of billing. For a large part of the study (2 years out of almost 4 years of data collection), data is available at daily level. This makes it possible to study response to interventions at a low level of granularity, such as response to intervention events (e.g., water usage reports or a bill for payment). Throughout this study, water usage data is collected from three meters per household, creating daily and monthly panel data, both before and after each non-price and price intervention.

I find that people behave in ways that are systematically different from standard econ behaviour in several interesting ways. In the non-price experiment, a diverse set of tests including difference-in-differences (DiD) provide compelling evidence for an immediate effect and a persistent effect of a simple water usage report that was delivered for 5 weeks, once a week. The immediate response and analysis of self-reported water habits (collected in Priced stage) point to a strong possibility of change in habits as a channel of conservation effect in 3rd treated group T3 that got all three parts of the report. The effect persisted for the entire daily observation period of 2 years, even after price was introduced in the 2nd year. The untreated group from non-price experiment (i.e. the non-price control group) also reduced in presence of

price, supporting that even wealthy high users can respond to price towards conservation. Some households increased usage on introduction of price confirming an important divergence in response to same treatment.

The findings from this study support some of the well-known but oft-ignored policy recommendations, such as the role of metering and billing at household level, while providing several novel insights into conservation behaviour. Non-price tools can be designed to achieve persistent effects through our Type 1 behaviour change framework, even without expensive or frequent marketing campaigns. Price tools can target even rich households, including above median users, and non-price tools can work even below the median. This study holds promise for increase in conservation through demand management interventions towards more equitable distribution and pricing of supplied water in cities.