The incidence of complex tariff schemes and information on water consumption: Experimental evidence

By Marie Estelle Binet[♣], Laurent Denant-Boemont[♦] and Sabrina Hammiche[▣]

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Abstract

1. Motivation

According the World Meteorological Organization, two thirds of the world population will face a water stress situation from 2025, in particular in Africa. But, water scarcity also concerns developed countries, as according to the European Water Association, it affects 11% of the European population. Therefore, European laws and policies intend to favor a « dehydrate » economy. In particular, since the Brottes law in 2013, French municipalities, as water providers, can experiment innovative water pricing schemes aiming to reach both ecological and social objectives.

For this purpose, water providers may adopt an increasing block rate pricing scheme. In its conventional form, this pricing scheme breaks down the metered volume of water during the billing period by ordered blocks with increasing prices. Such a tariff scheme is currently used in the United States, in many European and developing countries as it can achieve goals of environmental protection and social equity. However, in France, this pricing scheme is quite uncommon and thus innovative as 95% of the French municipalities price drinking water with a single flat volumetric charge.

But, for a proper use of a price increasing water schedule it is essential that the consumer be perfectly informed about the tariff he faces in order to assess the impact on his invoice of any change in his water consumption. If the consumer is not perfectly informed, he will not react to the incentives to meet the goals set by the tariff scheme. However, two recent articles by Binet et al. (2014), considering drinking water, and Ito (2014) dealing with electricity,

♣ PACTE and Sciences Po Grenoble, France. Corresponding author: marie-estelle.binet@iepg.fr

♦ CREM and University of Rennes 1, France.

showed that it is not the case as households face complex pricing scheme and consumption choices (as water is complementary to many indoor and outdoor equipments). Indeed, using data from a household survey carried out in the French overseas territory of Reunion Island in 2005, Binet et al. (2014) showed that the price perceived by consumers is lower than the price of a perfectly informed consumer (marginal price). Therefore, water consumption tends to be far greater than the optimal level.

We conjecture that such deviation could come from cognitive biases arising from the relative complexity of the increasing pricing scheme. As a consequence, to tackle with such biases in order to reduce households' water consumption, we also conjecture that relevant information could help consumers to make better choices.

Therefore, in this paper, we focus on biases induced by the effects of imperfect consumer's information about the parameters that determine their consumption behaviours. Following Thaler and Sunstein (2008), we *experiment innovative information policies to "nudge" water consumers facing an increasing block rate pricing scheme. It will help them to adopt a rational behaviour from an economic point of view*.

To disentangle the effect of pricing scheme from the one arising from information, we design an individual decision-making laboratory experiment. Our experimental approach is original as to the best of our knowledge, there are no other experiments on this topic except Ferraro and Price (2013) and Bernado et al. (2014). Using a field experiment, these authors found a significant and persistent impact of nudging based on the comparison to a social norm on water consumption. But their field experiment does not address the effect of pricing schemes and the possibility of combined effects between learning and pricing, which will be the case in this research.

2. Experimental design

To analyze the role played by the tariff scheme and by the level of information available for each participant, the experimental design will consist in combining 2 extreme pricing schemes (Linear and Non Linear) and 2 levels of information (No Information – NI – and Information – I -) in choice situations where heterogeneous participants regarding income and consumption needs should make consumption choices.

In the linear price treatment, water unit price is constant whereas for the non-linear scheme treatment, price increases when consumption level exceed a specified threshold. Concerning information, relevant information for pricing schemes is explicit in the experimental instructions for both treatments (No Information and Information), but, in the Information

treatment, we emphasize how unit price could change when participant is to make his consumption choice on the computer by a specific display on his computer screen.

In order to tackle with possible heterogeneity in individual consumption choices, we use the popular Stone-Geary approach in order to model the residential water demand (see Gaudin et al, 2001; Martinez-Espineria and Nauges, 2004; Madhoo, 2009 and Binet et al., 2016). Such a specification for individual demand enables to differentiate a captive component for consumption that is independent from prices and income from a variable one that is price and income dependent.

We therefore calibrate optimal consumption choices by assuming two possible levels of income and two classes of utility functions for water consumption, where the irreducible consumption part could differ from an individual to another.

In the situation choice, each participant should choose his consumption level within a given set of discrete values, for a specific tariff scheme. Individual payoff is the difference between indirect utility for consumption and water consumption charges as well as composition good consumption charges. This choice is repeated 20 periods under a NI condition and 20 periods under an I condition (within-subject design regarding information condition). We have 24 participants in each experimental session, each of them having the same endowment (income) for consuming water but two different utility levels.

Given our calibration, we compute optimal consumptions levels that differ depending on participant's characteristics (utility function and income level) and on pricing scheme. Information should not play a role in optimal consumption, but, following the empirical literature, we expect information to decrease water consumption level compared to the No Information case.

3. Experimental results

We had 120 participants in our 5 experimental sessions computerized with Z-Tree (Fischbacher, 2007) in the Labex-EM (University of Rennes 1, France).

Roughly speaking, our results indicate first overconsumption compared to theoretical predictions, which is consistent with the empirical literature about water consumption when using field data. However, this overconsumption does not differ from participants with "High" utility levels compared to "Low" Utility levels, but differs between Rich and Poor, the latter exhibiting more deviations from optimal consumption choice than the former. The second interesting result is that, in conformity with our conjectures, information significantly helps participants to reduce overconsumption, average consumption level being significantly

lower in the Information condition compared to the No Information condition, whatever the pricing scheme (Linear or Non-Linear). Last but not least, we found that information is more helpful for consumers to cope with optimal consumption choice in the Non-Linear Pricing Scheme.

4. References

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