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Using averting expenditures to estimate the demand for public goods: Combining objective and perceived quality☆

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ABSTRACT

In response to the perceived quality of a public good, households may choose to incur averting expenditures as a substitute to its aggregate provision, thereby revealing an (inverse) demand function. When unobserved heterogeneity affects both perceived quality and averting behavior, identification of the demand function is plagued by a problem of endogeneity. In this paper, we propose the use of an auxiliary (first stage) model of perceived quality as a function of objective quality to recover unbiased and microconsistent estimates of marginal willingness to pay for the provision of the public good. The approach can be applied when people have well-formed perceptions of the quality of the good, a prerequisite for the averting expenditures method, and when objective quality of provision is plausibly exogenous. We illustrate the approach with data on averting expenditures for two qualitative aspects of household tap water networks: water hardness and aesthetic quality in terms of taste and odor.

1. Introduction

There is an established practice of using household's averting behavior and associated expenditures to estimate the private benefits of public good provision, and more generally price non-market goods and externalities (Courant and Porter, 1981; Harford, 1984; Harrington and Portney, 1987). In this framework households face an exogenous supply of a public good, but they can select their preferred level of provision by incurring costly actions. By observing how averting expenditures vary with the objective level of provision, it is possible to identify an inverse demand schedule for the public good, also known as the marginal willingness to pay (WTP) schedule or valuation function (Cameron and James, 1987; Cameron, 1988). This

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has led to a number of empirical applications mainly focusing on the value of morbidity and mortality risks reductions using variations in air pollution (e.g. Gerking and Stanley, 1986; Deschenes et al., 2012) and water pollution (e.g. Smith and Desvousges, 1986; Harrington et al., 1989; Abdalla et al., 1992; Larson and Gnedenko, 1999; McConnell and Rosado, 2000; Abrahams et al., 2000; Yoo and Yang, 2000; Zivin et al., 2011).

A fundamental requirement for applying the averting expenditure approach is that households observe the objective quality of provision. However, it is the *perceived* failure to reach the privately desired provision level that will determine averting behavior and expenditures (Dickie and Gerking, 1996; Abrahams et al., 2000). In instances where individuals have heterogeneous perception of the public good provision, it is *a priori* important to control for the relationship between objective provision and perceptions (Whitehead, 2006). Heterogeneity affecting differences between perceived and objective quality is particularly pervasive when evaluating changes in risks (Slovic, 2000), as the same objective risk level may induce very different behavioral response depending on preferences and households' situation; see in particular Poe et al. (1998) and Poe and Bishop (1999) for empirical evidence on the impact of information on subjective risk perception and valuation. To account for such differences, a number of averting behavior studies have employed a measures of perceived provision to identify marginal WTP estimates (e.g. Um et al., 2002; Rosado et al., 2006; Jakus et al., 2009; Schram et al., 2010; Dupont and Jahan, 2012).

While using perceived quality in the valuation function potentially generates better estimates of marginal WTP, it also raises two potential issues. First, perceived quality combines information about objective provision and preferences, so that marginal WTP estimates no longer represent an inverse demand function. In fact, from a welfare theoretic perspective, interpretation of these figures is unclear and raises questions in their use to inform the socially optimal level of provision. Second, the perception of quality (as measured through survey questions) is itself an outcome, being a function of household characteristics and experiences (Danielson et al., 1995; Dupont, 2005; Nauges and van den Berg, 2009). Therefore perceived quality is potentially endogenous in an econometric sense. In particular, when unobserved factors affect both averting behavior and quality perception, identification of marginal WTP with variations in perceived quality is likely to generate biased estimates (Whitehead, 2006; Nauges and van den Berg, 2009; Orgill et al., 2013; Adamowicz et al., 2014; Bontemps and Nauges, 2016).

In an attempt to address these two issues, this paper proposes to combine information on perceived (subjective) and objective provision level. We control for the potential endogeneity of perceived quality in the valuation function with a simultaneous equation estimation procedure, modeling the relationship between objective quality and subjective perception in an auxiliary (first stage) regression. Thus on the one hand the valuation function accounts for the fact that the driver of choices (perceived quality) is only indirectly determined by objective quality, addressing the potential endogeneity of perceived quality. On the other hand, the auxiliary regression quantifies the relationship between subjective and objective provision, and can be used to obtain theoretically valid marginal WTP estimates in relation to the policy-relevant objective level of provision.[1] Importantly, the exclusion restriction relies on an assumption that objective quality is exogenous and affects the demand for marketed products only through perceived quality, and in the paper we emphasize conditions under which this is likely to be plausible.

To illustrate our approach, we employ data from a survey administered in England and Wales eliciting averting expenditures for two characteristics of public tap water supply,[2] namely water hardness and the aesthetic quality in terms of taste and odor.[3] As we discuss further in the paper, for these qualitative aspects of tap water supply the validity of the proposed exclusion restriction is plausible. First, preference-based sorting (e.g. Chay and Greenstone, 2005; Bayer et al., 2009) is unlikely, as these aspects of water quality can safely be assumed not to enter individual's location decisions. Second, the water industry in England and Wales is composed of state-regulated regional monopolies, with strict compliance with European drinking water standards (The Drinking Water Directive, 98/83/EC), which makes the provision of these services unrelated to socio-economic outcomes. Therefore, in the particular setting we consider, variation in the objective level of hardness and aesthetic quality can plausibly be seen as exogenous, and can be used to identity marginal WTP estimates for improvements to these aspects of tap water supply.

Aside from recording averting expenditures by households in relation to hardness and aesthetic quality of tap water, the survey provides information about perceptions of tap water quality. In this context, one potential source of unobserved heterogeneity that could give rise to the endogeneity of perceived quality is preference learning. There is ample evidence that experience with the consumption of a public good affects its valuation (e.g. Whitehead et al., 1995; Cameron and Englin, 1997; Czajkowski et al., 2014), and in the case of averting behavior products purchased on the market will provide consumers with an alternative experience of the good. This experience will then likely affect both perceived quality and

[1] In some settings, measures of objective and subjective quality may only be weakly related (see Orgill et al., 2013, for example). The empirical validity of the relationship between objective and subjective quality measures should therefore be documented as part of the estimation. However, note that the averting behavior approach relies on agents knowing the objective provision level so that a failure of the objective-subjective relationship may either indicate that the empirical measure of objective quality is not relevant to the decision-maker, or that applying the averting behavior method is not appropriate altogether.

[2] In a companion paper, Lanz and Provins (2016), we provide a comprehensive description of wider survey results, including detailed evidence about the sort of market product purchased. In the present paper, we rather focus on the potential endogeneity of perceived quality and implications for welfare estimates.

[3] Hard water can reduce the lifetime of water-using appliances and thus impose financial costs on households.