Chapter 4

Implementing Weak Complementarity

4.1 Introduction

The message from Chapter 3 is clear. To use revealed preference methods and only revealed preference methods to value changes in public goods, specifically changes in environmental quality, requires imposing some added restrictions on the individual's decision problem. The most commonly employed restriction is weak complementarity. In this chapter we deal with an array of conceptual and empirical problems that arise in making the weak complementarity model of environmental valuation operational in a conventional demand setting. The first section considers how one might go about specifying demand functions or systems that incorporate prices, income and quality characteristics. Subsequent sections treat conceptual issues that arise when the weak complement is really a household-produced good. When this is true, time enters the problem in a number of ways, complicating both specification and welfare measurement. Finally we consider how to make conceptual and empirical sense of welfare evaluation when individuals do not have perfect information about quality changes.

4.2 Specifying Demand as a Function of Quality

Eventually the researcher bent on empirical work must write down a demand function to be estimated. Economists have fewer priors and less experience in estimating demand functions with quality characteristics, compared with prices and income. The issues raised in the last chapter suggest this should be done with care, especially with regard to how the public and private goods interact.

Whether one begins with the demand function or a preference function, the implied relationship between q and one or more z's should make sense by connecting motives with behavior. This caution is relevant even if income effects are expected to be insignificant, because the weak complementarity condition still must hold for behavioral measures to make sense. If income effects are expected to be substantial, using the area determined by shifting an arbitrarily specified Marshallian demand function as a welfare measure is particularly dangerous. If the demand function is not consistent with an underlying preference relationship between q and $\mathbf{z}$ for which weak complementarity and the Willig condition hold, the area between the two Marshallian demands can not be assumed even to be bounded by CV and EV. We saw that one can force any analytically integrable demand function to be consistent with weak complementarity by adjusting the constant of integration, at the risk of generating a preference function that lacks plausibility.

For some types of preference structures consistent with plausible stories about the relationship between q and $\mathbf{z}$, it is possible for the Marshallian demand function to shift backwards at current prices with an increase in quality, even when that quality characteristic is desirable and adds to utility and even when weak complementarity and the Willig condition hold. In these cases, the Marshallian demands conditioned on different levels of the public good must cross at some price above current price, so that the area between the two curves ends up being a properly bounded and signed consumer surplus measure. Suppose one ignores the underlying preference structure and begins with an arbitrarily specified Marshallian demand. Then the finding that $\partial z_i/\partial q < 0$ could imply either a specification/measurement error or a recognition of this special form of preferences. Beginning with a demand function without appreciating the implications of motives can lead to ambiguity in interpreting estimation results.

The concern over quality changes originated in the development of price indices. Researchers were investigating approaches to correct price indices for changes in the quality of goods or services. In fact, this is what motivated Willig's 1978 paper as well as the earlier work by Fisher and Shell (1971). In estimating behavioral models, our goal is to measure welfare effects of quality changes rather than to calculate price indices. This would seem to make the specification of demand as a function of quality even more important and arguably of greatest importance for *systems* of demand functions. These considerations, while timely, are not new. Hanemann (1982, 1984) explored various approaches to modelling demand systems with quality components. Hanemann (1982) suggested three ways of making preferences depend on quality. One approach is to write utility as a function of one or more subfunctions, each of which is a function of the quantity of a quality-differentiated good or service and the level of its quality characteristics. A second approach involves writing