

Chapter 3

The Concept of Weak Complementarity

3.1 Introduction

The previous chapter presents the model for welfare measurement of price changes. This model relies on the result that a change in the price of a good is related to quantity demanded of that good by way of the envelope theorem. The same link naturally holds for factors (such as labor) sold at parametric prices. But many problems in the allocation of resources and the protection of the environment involve services that enter directly into a consumer's utility function or a firm's production function. For example, a household living in an industrial city will enjoy air quality determined not by their own consumption decisions but by the city's level and composition of transportation and manufacturing. A household may purchase the quantity of its drinking water, but the quality of the water will be determined by public water supply policies. In these cases, environmental quality is a direct determinant of utility, and government actions or exogenous events affect the level of the environmental good or service entering the individual's preference function. In such cases one cannot rely on the conceptual basis developed for price and income changes for measuring the welfare effects of changes in public goods. In this chapter we begin to develop the basic theory and extensions that support a more general set of welfare measures dealing with changes in the level of goods and services that enter preference functions exogenously.

The principle of welfare theory that supports welfare measurement developed for price and income changes applies to any argument of the indirect utility function or the expenditure function. Arguments of these functions are, by

definition, exogenous elements of the individual's decision problem. In concept, one can define the change in income necessary to compensate for an exogenous change in air quality just as one can define the change necessary to compensate for an exogenous change in the price of gasoline. In contrast, it makes no sense to attempt to measure the compensating variation of a change in the quantity of a good consumed, unless that quantity is imposed on the individual. Asking how much exogenous income would be necessary to compensate for a change in the consumption of a freely chosen good is an ill-formed question to which no good answer can be given without some idea of the cause of the change.

The exogenous elements we address in the next several chapters can most usefully be thought of as the level of public goods or publicly determined quality levels of privately consumed goods. These public goods are exogenous to the individual in the sense that the level of fecal coliform at Santa Monica beaches or the amount of airborne particulate matter in downtown Baltimore or the existence of a hazardous waste site at Love Canal cannot be altered by the individual. However, and this is a key point, the individual may make decisions that alter his exposure to these exogenously determined public goods. The level of air quality or the distance and pathways to hazardous waste contamination at a particular residential location are both exogenous, but the individual can choose his residential location and thus choose his exposure. Public drinking water quality is determined by public actions and exogenous events, but a household can affect its exposure by altering the quantity consumed, by installing filtering devices, or by switching to bottled water. Exposure to fecal coliform can be avoided or lessened by choosing a cleaner recreation site.

Some kinds of public goods are so 'pure' as to make avoidance or mitigation almost impossible. One partakes of national defense regardless of what consumption decisions one makes. Altering one's level of national defense requires nothing less than changing one's country of residence. But these extreme cases will not be of interest to us. It is through their behavioral adaptations and adjustments that people reveal their preferences for improvements in public goods. By recognizing these behavioral adjustments, we will get the model for welfare measures right.

In this chapter we explore the most frequently relied upon restriction on preferences used in environmental valuation—that of weak complementarity. In theory, weak complementarity allows the value of a change in a public good to be measured in terms of a related private good, although complications arise when Marshallian rather than Hicksian measures must be used. Because weak complementarity forms the implicit or explicit basis of so much of non-market valuation, both mathematical and philosophical debates about its applicability can be found in recent literature. This chapter contains more than most readers wish to know about this restriction that holds such a central place in the welfare economics of environmental change.