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Economic Value of Pro-Environmental Farming

- A Critical and Decision-Making Oriented Application of the Contingent Valuation Method

Jyrki J. Aakkula

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Economic Value of Pro-Environmental Farming

- A Critical and Decision-Making Oriented Application of the Contingent Valuation Method

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Abstract. This study investigates the applicability of the contingent valuation method (CVM), in particular, and monetary valuation in general in a situation where the CVM is used to elicit a monetary value of the conversion from conventional agriculture to pro-environmental farming for the social decision-making purposes. In order to frame the social decision-making context, a theoretical model is developed to derive the basic social design of pro-environmental farming.

The study has two empirical objectives. First, the reliability of the willingness to pay results is analyzed. The task is carried out by using different elicitation formats, theoretical models, and statistical estimation techniques in the estimation of the average WTP figures. Second, the validity of the CVM results is examined. The focus is on the commensurability of preferences, influence of attitudes, and the effect of additional information.

The analysis of the reliability of the average WTP results is carried out by using both the combined bidding game and payment card approach and the dichotomous choice elicitation technique. Mean WTP for the whole sample ranges from FIM 290 to 615, and median WTP for the whole sample from FIM 150 to 379. The results suggest that all the elicitation techniques and model specifications applied are reliable enough when the mean or median WTPs for the whole sample are concerned.

The examination of the validity of the CVM results is carried out by analyzing response behavior in relation to preferences and the effects of the interplay between information and attitudes. A conceptual model including response behavior and response motives is developed. The identification of the interactions between various types of response behavior, additional information, and the respondent's attitudes is carried out by means of the factor and cluster analyses. The results suggest that the provision of the additional information can raise the stated WTPs if the respondents have a positive initial attitude towards the good being valued, and the additional information provided reinforces their initial attitude.

Taking certain reservations into account, the conclusion is that the estimated total WTP (ranging from FIM 0.541 to 2.216 billion) can be interpreted as the maximum amount of money which the society can spend on the socially acceptable conversion from conventional agriculture to pro-environmental farming.

Index words: agricultural policy-making, contingent valuation method, information effect, monetary valuation, preference structure, welfare analysis

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1. Introduction

The role of agriculture has changed considerably in most European countries after the World War II. There was a food shortage right after the war, but it did not take long to recover from it. In a couple of decades, famine was replaced by surplus of most agricultural products. Overproduction started to be a major agricultural policy problem. This is still the case even today, but during the past twenty years some other agricultural policy aspects have gained more weight. One of the most important ones is the relationship between agriculture and the environment. Now it is widely recognized that agricultural production practices may harm as well as benefit the environment if they are not implemented in a proper way in relation to the needs of the ecosystem. For instance, excessive and inappropriate use of artificial fertilizers and pesticides can in the long run degrade the carrying capacity of the ecosystem and endanger the sustainable development. On the other hand, agricultural production maintains the rural landscape, which is usually appreciated highly among city-dwellers.

Adverse and beneficial environmental impacts of agriculture emphasize the fact that in a modern society farming has other tasks in addition to food production. For its own part, agriculture is responsible for the maintenance of pleasant living circumstances and stable food supply conditions. These objectives have many dimensions, ranging from food safety promotion to upholding of a viable countryside. Most of these dimensions are somehow related to the connection between agricultural production and its interaction with the surrounding and supporting ecosystem. In this respect, it is obvious that the choice of agricultural production technology matters when social well-being is concerned. Farming practices that are environmentally-friendly are more likely to help the agricultural sector to accomplish goals related to creating welfare from other sources than food production only.

Environmentally-friendly production practices create environmental and other benefits. They also mitigate certain harmful environmental effects due to agriculture. In this study, an environmentally-friendly agricultural production practice called pro-environmental farming is introduced. The idea behind pro-environmental farming is that, in addition to the production of foodstuffs, valuable environment-related services can be produced. In practice this is primarily done by reducing the use of chemical inputs and applying alternative cultivating methods. Thus, pro-environmental farming enhances the environmental and ecological quality of the rural environment which, in turn, is a resource entity consisting of both natural and man-made elements of the physical environment, and individual perceptions related to those elements. We can say that the rural environment is a stock of agriculture and environment producing market and nonmarket values, and pro-environmental farming is an agricultural practice capable of providing a considerable increase in their worth.

For a number of reasons, changes in the environmental or ecological quality cannot be priced through the market system. Thus, there is a need for valuation methods that help to attach a value to environmental and other effects resulting from a change in farming practices. This information is required for the purposes of social decision-making. If the market mechanism is not able to provide enough information, it is quite natural that additional approaches must be applied in order to facilitate the decision-making process. However, it should be clear that when we deal with a broader policy-making context, matters often become complicated. There is no established single scientific theory or theoretical framework that could cover the large number of social phenomena related to decision-making and the various forms that it takes in different circumstances. In the study, however, an attempt is made to give an idea of the difficulties involved when environmental and other nonmarket values are included in the social decision-making process.

The empirical analysis concentrates on the application of the contingent valuation method (CVM), which is used to elicit people's willingness to pay for a conversion from conventional agriculture to pro-environmental farming. The CVM is employed to create a hypothetical market for different kinds of non-priced effects that take place because of the conversion. The construction of the hypothetical market is required before monetary valuation can be applied. However, the emphasis of the study is not on the derivation of monetary measures of welfare change but on the assessment of the applicability of the WTP results in relation to the needs of policy-making. The idea is to broaden the framework through which the relationship between welfare change measures, human behavior, and social decision-making is interpreted in approaches based on the postulates of welfare economics.

The following parts of this chapter first introduce the agricultural policy background. This is relevant in order to perceive the development that has led to the recognition and inclusion of the increasing importance of environmental issues in the Finnish agricultural policy. This depiction is even more important as, during the preparation of this study, the Finnish agricultural policy has radically changed because of Finland's membership in the European Union from the beginning of 1995. Second, the main objectives of the study and the reasoning behind their selection are presented, followed by a review of the theoretical framework that the analysis relies on. Finally, the overall structure of the study is described.

1.1. Agricultural Policy Background

Right after the World War II Finland was faced with serious difficulties. It had lost the war and, although Finland was not occupied, the war had ruined the Finnish economy. An additional burden was created when Finland was com-

manded to pay a considerable amount of war indemnities to the Soviet Union. Agricultural production had declined, there was a lack of food, and rationing of foodstuffs was part of everyday life. Some eastern and northern territories that had earlier belonged to Finland were now merged into the Soviet Union. As a consequence, hundreds of thousands of evacuees had to be settled. In addition, there was a considerable number of soldiers who were returning from the front without a job or a place to go.

At the same time, the Finnish government was worried about the increase of the political influence of Finnish communists, who were more or less visibly backed by the Soviet Union. There was a danger of social unrest and political instability, which the government wanted to avoid. The solution was a land reform, which guaranteed for the evacuees and veterans a right to receive a small holding of a couple of hectares. This was not actually the first time in Finland when an attempt was made to calm down social unrest and discontent by a land reform. In 1918, right after Finland's independence and the Finnish Civil War, a land reform was introduced in order to give tenant farmers a possibility to buy the farm holdings that they had been cultivating under lease contracts. This reform was only a partial solution: still a large number of farm workers were without a possibility to have land of their own. Consequently, in 1922 a subsequent land reform was carried out. Everybody who had not possessed land before and was considered to be skilled enough to practice farming was guaranteed a right to have a small holding at a very reasonable cost (Kananen 1986, pp. 32-39). The success of these reforms obviously encouraged the settlement of the evacuees and veterans a few decades later.

It is generally acknowledged that structural problems of Finnish agriculture date back to the land reform after the World War II. This is not to say that the land reforms did not work. From the point of view of political stability, the land reforms did what was hoped for. In less than five years political institutions and the society were operating in a rather democratic way. Food shortage was also eliminated, although it is hard to say if the reforms played a major part in this development. However, the land reforms were probably the best thing to do in a very serious and difficult situation. The actual mistake was made in the agricultural policy that followed. Already in the late 1950s, but especially in 1960s, many owners of small holdings moved into cities or Sweden because of grim future prospects. Their farms were too tiny to give a decent living and except for logging there were few possibilities for working outside farms. In order to encourage people to stay in the countryside the government developed agricultural policy into a direction that made it possible to survive on a rather small farm, too. Consequently, the structural development in Finnish agriculture almost ceased. This led to agricultural policy that guaranteed sufficient farm income through high producer prices and other forms of agricultural support. As

a result, Finnish agriculture was soon tackling with problems of overproduction and excessive agricultural subsidies.

The need for an agricultural policy reform became more and more evident during the late 1980s and the early 1990s. However, the reform had to wait until the beginning of 1995, when Finland joined the European Union (EU). Agriculture was the most important single sector that had to face considerable adjustments. The Common Agricultural Policy (CAP) of the EU had to be adopted, but not immediately in a complete manner. The greatest alteration was that Finland's border control and import levy system for agricultural products were abolished overnight in the beginning of 1995, which meant that producer prices sank to the general EU level. However, Finland negotiated a five-year transition period involving certain exemptions. Finland received a right to establish specifically targeted support measures, which were not available for old EU member countries. Exemptions were granted by the EU based on Finland's harsh climatic conditions and undeveloped farm structure. There was a consensus between Finland and the EU that Finnish farmers cannot survive without special arrangements that give them time to rationalize their production. Thus, during the transition period Finland has a possibility to accelerate the structural change independent of some standard guidelines set in the CAP stipulations.

Currently, Finland has experienced four years of EU membership. Before this most people believed that the EU membership would rapidly alter the state of Finnish agriculture and would especially increase the welfare perceived by consumers. However, the first years in the EU have not really fulfilled these expectations. Both producer prices and input prices have fallen, but the decrease of the producer prices (on the average 40%) has been so extreme that the reduction in the input prices has not been able to compensate for the farm income losses. As a result, farmers would have gone into bankruptcy without the massive direct income support from both EU and national sources. Compared to the situation before the membership, the major change has occurred in the structure of agricultural support, not in its total amount. The support element that was earlier included in producer prices has now transformed into direct income support. There have not been major changes in the production, either. The cultivation of cereals has increased and livestock production has stayed at about the same level (MTTL 1999).

From the environmental point of view, the EU membership has had some positive ramifications. The implementation of the CAP-based agricultural support structure made it possible to introduce a new type of subsidy that was aimed to enhance the environmental quality resulting from agricultural production practices. This measure, titled as "Finnish Agri-Environmental Program" or FAEP, was based on Council Regulation 2078/92.

The overall goal of the FAEP is to reduce the load directed to the environment, especially surface and ground water and the air, and the hazards caused by

the use of pesticides, to preserve biodiversity, and manage the rural landscape. The program also aims at preserving or improving the productive capacity of the land. The program is mainly directed to the arable farming, as well as preservation of the landscape related to agriculture. There are connections to the forestry sector mainly for the part of traditional biotopes, forest pastures, and concerning the staging zones of arable land and forest and the advising on these issues (Ministry of Agriculture and Forestry 1994; Ministry of Agriculture and Forestry 1995). The financing of the agri-environmental program is carried out as a joint action between Finland and the EU. Both parties contribute annually an equal share of ECU 135 mill. Thus, the total amount of environmental support is ECU 270 mill., which corresponds annually to about FIM 1,700 mill. during the years 1995-1999.

The agri-environmental program consists of the General Agricultural Environmental Protection Scheme (the GAEPS) and the Supplementary Protection Scheme (the SPS). The GAEPS is paid in the whole country based on the arable land area, and it is differentiated by region. SPS is paid to regionally restricted measures and other special actions, which are directed to a limited number of farms. In addition, support is granted for advisory services of farmers, training, and financing of experimental projects related to the management of the environment. Joining the program is voluntary for farmers. To join the GAEPS program, a farmer has to fulfill several criteria. These criteria are: 1) making a farm environmental management plan, 2) meeting certain fertilizing base levels, 3) inspection of the pesticide sprayer, 4) having buffer strips on fields, 5) maintaining adequate plant cover, 6) and preserving landscape.

The implementation of the FAEP is the responsibility of the Ministry of Agriculture and Forestry, and, as it comes to the Supplementary Protection Scheme, the Ministry of the Environment is also involved. Authorities use monitoring to assess the activity of farmers to join a voluntary support scheme with environmental goals. The main idea in organizing the monitoring system for the use of agri-environmental support has been to utilize the existing administration and monitoring system of the Ministry of Agriculture and Forestry. The monitoring duty of the Agri-Environmental Protection Scheme is assigned to regional authorities, i.e. rural districts, which have also prepared regional programs in cooperation with environmental authorities. Environmental authorities can also take part in the monitoring or, if agreed, Environmental Centers can perform monitoring for rural districts (Pirttijärvi et al. 1995).

Although the FAEP has been the most influential single agri-environmental policy measure in the Finnish agriculture, there has been some preceding work. A good example of this is the first action program for sustainable rural development, introduced in 1992, when the Ministry of the Environment completed the Environmental Program for Rural Areas (EPRA) (Ministry of the Environment 1992).

According to the EPRA program, a prerequisite for agriculture is the adjustment of the economic system to the natural cycle to ensure that the harmful effects of agricultural production are as low as possible. Economic and social benefits must be optimized in a responsible manner, without endangering the potential for such benefits in the future. The living environment must be kept clean, diversified, and renewable for future generations. Informational, economic, and other instruments based on voluntary action of farmers are used to promote the protection of the rural environment. Environmental impacts will already be taken into consideration at the preparatory stage of agricultural decision-making and in shaping the structural, production. and income policies related to agriculture.

Thus, earlier developments in agricultural policy had already led to the adoption of more environmentally-friendly farming practices. Jokinen (1995, p. 132), for instance, notes that the Finnish agricultural policy has moved towards a new phase in environmental issues: it is recognized and even emphasized that agriculture is a potential source of valuable environmental services. It also seems that consumers favor agricultural products that can be claimed to be produced in an ecologically sustainable manner. In this respect, however, only the first steps have been taken. Measures implemented so far are insufficient because the inclusion of environmental and other nonmarket benefits into the social decision-making process has not really started yet. Both research and public discourse are required before the society will learn how to handle the information about people's wants and desires coming simultaneously from market and nonmarket sources. This study is intended to contribute to this discussion.

1.2. Main Objectives and Central Themes of the Study

The general purpose of this study is to illuminate the difficulties that are bound to be encountered when an attempt is made to include environmental and other nonmarket values in the social decision-making process. The empirical case utilized in order to make this attempt is based on a contingent valuation method (CVM) application. People's willingness to pay (WTP) is estimated for a conversion from conventional agriculture to pro-environmental farming. The empirical data is first used in an analysis that deals with an issue that can be labeled as the reliability of WTP results. This part of the study is concerned with methodical topics related to the CVM. It concentrates on the assessment of different elicitation and estimation techniques of mean and median WTPs. The CVM application also acts as an example of a monetary valuation method, which makes it possible to reflect the methodological problems that are related to the revelation of individual preferences, expression of attitudes, and the role of information. The idea is to examine the applicability and feasibility of money

metric measures of welfare change in a complex valuation situation which produces information for policy-making purposes. In this sense, it is also important to find out people's general attitudes towards agriculture and the environment, because they may explain people's responses better than the expressed monetary values. In other words, what we are concerned with here is the validity of WTP results.

Thus, at the primary level this study aims to appraise how feasible the CVM is for the valuation of benefits due to a change in agricultural production practices. At the conceptual level, the analysis is broadened to cover more complex theoretical issues, which cope with the assessment of the informational needs of the social decision-making process. Based on all this, the main objectives of this study can be presented in more detail:

Objective 1: To assess, based on the average WTP estimates and taking into account both the limitations set by the policy-making context and the implications of the survey findings and design, what can be said about the social desirability of the conversion from conventional agriculture to pro-environmental farming.

Objective 2: To examine how robust the mean and median WTP estimates are with regard to elicitation formats, model selection, and statistical estimation techniques. The point is to illustrate that different approaches to the estimation of mean and median WTPs produce somewhat diverse results, and that each estimate can be interpreted to be biased in one way or another. The goal is not to promote a certain CVM survey design but to give an idea about the factors that influence average WTP estimates at various stages of the design, implementation, and data analysis of a CVM survey.

Objective 3: To identify the connection between individual preferences and attitudes and the stated willingness to pay. The focus is on stability and commensurability of preferences, influence of attitudes, and effect of additional information. The idea is to test the possibility that in a valuation situation a respondent may not be able to act as rationally as the economic theory assumes. Preferences may be incommensurate or sensitive to additional information and initial attitudes related to the amenity to be valued and the valuation framework.

The main hypothesis concerning the interplay of information and attitudes is that additional information raises the respondents' willingness to pay only if additional information is consistent

with the respondents' prior information and if it strengthens the positive initial attitude of the respondents towards the valuation object. In certain cases, additional information can even reduce willingness to pay. This can happen if additional information makes the negative initial attitude towards the object of valuation more intensive.

The central hypothesis related to people's preference structure is that in complex valuation situations, which involve significant environmental and other nonmarket values, and where the trade-off between money and environmental benefits becomes actual, some people express preferences that can be identified as non-exchangeable.

Even though the main interest of the study is directed towards the complex relationship between the CVM and the social decision-making, it should not be forgotten that the suggested conversion from conventional farming to pro-environmental farming has remarkable policy relevance in any case. The design of the Finnish agricultural policy will still be encountering great challenges because of the ending of Finland's five-year transition period in the European Union in the beginning of 2000. In addition, the restructuring of the common agricultural policy of the EU (CAP) is expected to gain momentum in the near future because of the implementation of Agenda 2000. Thus, great changes are waiting. It is very likely or at least desirable that agricultural support schemes will also be based on other qualities of agricultural production than the production of foodstuffs only. It is an advantage if this issue is thoroughly reviewed before actual decisions have to be made.

1.3. Framework of the Study

The theoretical basis of this study is in neoclassical economics, especially in welfare economics and environmental economics. However, part of the material owes to ideas developed in the fields of ecological economics, institutional economics, environmental ethics, and environmental philosophy.

The framework of the study is depicted in Figure 1.1. A valuation process cannot emerge without an interaction between individuals and social institutions. The society builds upon individuals who have different attitudes, tastes, ethical views, and values. In other words, individuals have different preferences, which they reveal in varying ways through their behavior in relation to economic and political institutions. Consequently, the preferences of different individuals become aggregated into social preferences, which through some mechanism define socially desirable resource allocation.

When the market mechanism is in question, socially desirable resource allocation occurs at the market place, if all the relevant factors of the transaction are properly priced. The problem is that the market mechanism may not be able to do the pricing in a correct manner. Because of the physical or institutional characteristics of the factors involved, property rights cannot be defined in nonattenuated manner. In practice this means that we are dealing with nonmarket or public goods. Consequently, we must find another way to reveal individual preferences in order to guarantee socially desirable resource allocation. Political institutions are suitable for this purpose, but in a political system like the representative democracy very few issues can be decided in a referendum-type voting process where citizens can directly express their opinion. This is why we

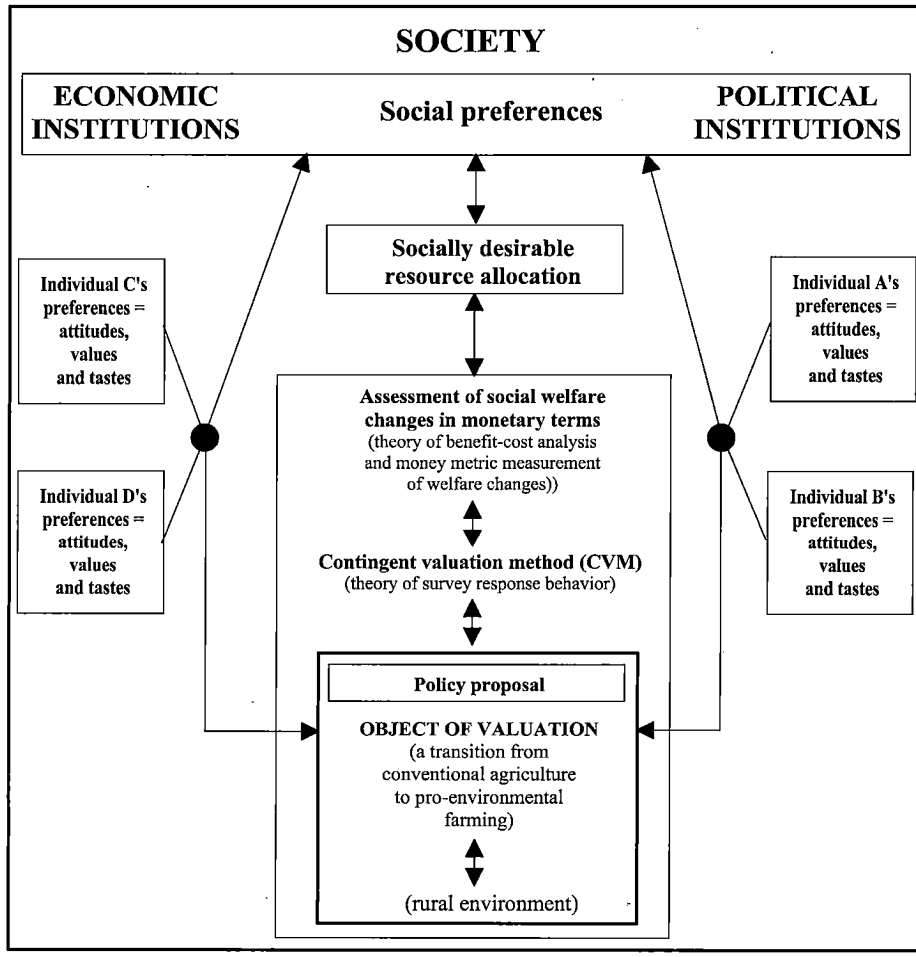

Figure 1.1. Framework of the Study.

need mediating methods like the CVM that reveal people's valuations in relation to nonmarket commodities.

A valuation process inevitably concentrates on some good, commodity, service, or amenity. The characteristics of the object of valuation influence considerably the method chosen and the applied methodology. In this case, the object of valuation is the conversion from conventional agriculture to pro-environmental farming. However, the conversion as such is only an array of cultivation practices aimed to produce ecological, environmental and other nonmarket benefits that enhance the quality of the rural environment. From the valuation point of view, this approach has many important features. The rural environment can be considered a public good, which means that policy issues related to its quality enhancement have to cope with incompletely defined property rights and internalization of positive and negative externalities. It is quite clear that the attachment of an economic value to these kinds of processes is a controversial and demanding task. In addition, the rural environment is likely to be interpreted in many different ways in people's minds. In this sense, it is essential to examine very carefully all the dimensions that are shaping people's standpoints in relation to pro-environmental farming and the rural environment.

When we apply monetary values that are based on people's responses concerning a hypothetical valuation situation, we have to make assumptions about people's response behavior in order to identify the possible sources of error. Motives behind response behavior can vary considerably, and this must be taken into account when WTP results are analyzed and conclusions are derived. We can also argue that the extensive bias literature that has originated in relation to the CVM is to a large extent a result of varying survey response behavior. Thus, the identification of the major features of response behavior makes it possible to interpret in a more holistic way how individual WTPs are constructed, and this helps to assess their applicability in the policy-making context.

Social preferences are derived from individual preferences in one way or another. In this sense, people's individual preferences concerning the conversion from conventional agriculture to pro-environmental farming reflect a certain social preference. The difficulty is that, in the world of scarce resources, this particular social preference must be assessed in relation to other social preferences. The objective is to find a social preference ordering that all the members of the society could approve. This is, of course, an unlikely outcome. People have different welfare rankings. The solution is to compare different welfare rankings and develop appropriate decision criteria. In this context, the commensurability of monetary values appears to be a very useful feature.

The benefit-cost analysis (BCA) provides an economic framework to assess monetary benefits and costs related to a certain policy proposal. Based on this, it is possible to evaluate the social desirability of the policy proposal. Because the contingent valuation method produces benefit (or as well as cost) estimates that

are expressed in monetary terms, it fulfills some basic methodological requirements of the BCA. In this sense, it is quite natural to use the CVM in the BCA framework. By doing this, it is possible to create public awareness for a particular problem by using money as a readily perceivable indicator of potential environmental and other nonmarket benefits or costs. However, many environmental and social changes due to a policy action may be so complex that their assessment through monetary valuation may be an inadequate way to facilitate social decision-making.

Clearly, the overall usefulness of the CVM seems to depend on its ability to convey reliable information about individual preferences related to the object of valuation. The question is about the validity of the underlying theory of measuring money metric utility changes in the form of consumer surpluses. The conceptual structure of the theory of welfare economics is highly elaborated, but the theory is not omnipotent. The application of money metric measures of utility changes may be an informative way to approach a decision-making situation, but methodological limitations should not be forgotten.

In addition to methodological validity, issues of methodical reliability must also be addressed. From the practical decision-making point of view, the reliability of a method can be even more important than its validity. If a method is reliable but not valid, it can be applied to measure changes in certain policy relevant variables, if the shortcomings in the validity are appropriately taken into account when the results are interpreted. In this respect, when the CVM is concerned, it is essential to test how the different value elicitation and estimation techniques as well as valuation scenarios differing in terms of information content influence the estimates of mean and median willingness to pay, which, in turn, may form the major source of economic information used in the social decision-making process. As long as the CVM shows some consistency in reliability terms, it may be a useful tool to incorporate nonmarket values related to pro-environmental farming into the social decision-making concerning agri-environmental issues.

1.4. Structure of the Study

The study has been organized in the following manner. Chapter 2 places the object of valuation, the conversion from conventional agriculture to pro-environmental farming, into a broader framework in both ecological and welfare economic terms. The idea is to explain how the concept of the rural environment, which defines the physical and operative context of pro-environmental farming, extends beyond the notion of agricultural landscape. Furthermore, a theoretical model is developed to derive the basic social design of pro-environmental farming when, in addition to conventional input choice, the aspects of

agriculture-supporting ecosystem, rural public goods and externalities are included in the social welfare maximization problem.

Chapter 3 gives a brief introduction about the benefit-cost analysis as the major economic framework of policy analysis. Social decision-making criteria, which can be seen to provide the justification for the money-based policy analysis of BCA type, are reviewed, together with the concept of the total economic value and its main components. The focus is on use and nonuse values as well as intrinsic, functional, and instrumental values. The purpose of this is to illuminate how the economic concept of value can be broadened to cover nonmarket value dimensions inherent in environmental and other public goods. Chapter 3 ends with an introduction of monetary valuation methods suitable for the assessment of nonmarket costs and benefits. In this connection it is shown how the CVM relates to other monetary valuation methods and the BCA framework.

Chapter 4 introduces the essential theoretical concepts of welfare economics required in the assessment of welfare changes. The theory that forms the basis for money metric measurement of welfare changes is reviewed. The focus is on equivalent and compensating surpluses. In addition, the questions why and when there are differences between willingness to pay (WTP) and willingness to accept compensation (WTA) and what the proper use of each measure is will be examined. This is followed by the presentation of the problems that arise when welfare change measures are aggregated across individuals. Chapter 4 is summarized by an institutionally-oriented discussion about the social feasibility of monetary valuation.

Chapter 5 presents the essentials of the contingent valuation method. The development of the method as well as the main elements of CVM survey design are described briefly. The emphasis of Chapter 5 lies on the evaluation of CVM biases. The idea is to show that the analysis of response motives is a useful tool when an attempt is made to explain inconsistencies and other anomalies of the results, which are frequently encountered in CVM applications. The nature of preferences that do not fulfill neoclassical standards is also examined. Next, a closer look at various WTP elicitation techniques, which are utilized in CVM research, is taken. The point is to argue that the choice of the elicitation method may be an interesting question in the academic sense but it may not be equally relevant when the social decision-making dimension is concerned. Chapter 5 ends with an overview of previous CVM studies that are related to the valuation of different rural amenities.

The empirical part of this study starts in Chapter 6. First, the sample and core elements of the questionnaire are described. Then, applied elicitation techniques, model constructions, and statistical estimation methods are reviewed. Based on this, different mean and median WTP estimates for the conversion from conventional agriculture to pro-environmental farming are calculated. A

demand function for pro-environmentally cultivated agricultural land is also derived. Finally, it will be examined to what extent starting point bias and additional information influence the estimated results of mean and median WTPs.

In Chapter 7 the analysis is extended to cover attitudinal dimensions. By employing factor analysis and cluster analysis, seven groups with different attitudinal profiles in relation to agriculture and sustainable development are identified. Across the attitudinal groups tests are made to find out whether the mean WTP is sensitive to the provision of additional information. In this context, the nature of preferences is also analyzed. Based on the attitudinal group profiles and stated individual WTPs it is assessed whether the respondents behave according to standard neoclassical preferences or not.

The main conclusions are presented in Chapter 8. The applicability of the mean WTP results from the viewpoint of welfare economics is evaluated. The purpose of this is to consider what can be said about the social desirability of the conversion from conventional agriculture to pro-environmental farming. In addition, some of the findings are discussed in order to assess how probative the empirical evidence found is in relation to the instability and incommensurability of preferences revealed in the form of attitudes and individual WTPs. Finally, some conclusions are derived in order to evaluate the applicability of the CVM in actual agricultural policy-making situations. Some ideas related to the need for future research are also proposed. Chapter 9 summarizes the whole study.

2. Pro-Environmental Farming and the Rural Environment

The purpose of this chapter is to place the object of valuation, the conversion from conventional agriculture to pro-environmental farming, into a broader framework in both ecological and welfare economic terms. First, the idea is to explain how the concept of the rural environment, which defines the physical and operative context of pro-environmental farming, extends beyond the notion of agricultural landscape. Not only aesthetic and scenic dimensions count when the value of the rural environment is established. In this connection, attention is paid to the observation and perception process taking place when an observer has to cope with changes occurring in a complex resource entity like the rural environment. Then, a theoretical model is developed to derive the basic social design of pro-environmental farming when, in addition to conventional input choice, the aspects of agriculture-supporting ecosystem, rural public goods and externalities are included in the social welfare maximization problem. In addition, economic concepts like public goods and externalities that are required to identify policy relevant characteristics of pro-environmental farming and the rural environment are clarified in more detail.

2.1. From Landscape to the Rural Environment

In most western cultures, the countryside is highly appreciated. There are several reasons for this. Peasant values and peasant way of living may have played a major part in the historical development of a nation. Usually, if we go two or three generations backwards in history, the roots of most people appear to be found in the countryside. However, even if the momentum of the recent history is neglected, there are pre-historical reasons for the recognition of the rural environment. Tiger (1992) argues that many of the basic sources of enjoyment can be traced to the ancestral past of the *Homo Sapiens* on the savannas of Africa. Human sense organs and the whole pattern of appreciation of air, light, texture, and sound evolved there. Therefore, the countryside yields primitive sensory pleasures, which are more tempting than sensory pleasures created by urban surroundings. Furthermore, it was probably an evolutionary advantage to live in areas where it was possible to see from distance when predators approached. It helped both to observe possible game and to receive an early warning if predators were coming closer. This may explain, at least partly, why a relatively open landscape is still appreciated. Tiger's (ibid.) anthropological approach is certainly thought-provoking. It indicates that some elements of the rural environment are unique and irreplaceable in the sense that they have emerged in co-evolution with the genotype of human beings. Thus, people would have a desire for open landscape for evolutionary reasons, at the level of basic instincts.

Usually referring to the rural environment first brings to people's mind things that are somehow related to landscape. This can be because of the anthropological explanation given above, but it can be also culturally induced. Take as an example the use of the word "landscape" in different languages. Words corresponding to the English word "landscape" ("maisema" in Finnish) have slightly differing connotations in other European languages. Cultural differences obviously exist and they have had some influence, although the basic functions and properties of landscape have always been rather similar everywhere. According to Keisteri (1990, pp. 33-36), the origin of the word "landscape" in Italian (*paesaggio*), Spanish (*paisaje*), and French (*paysage*) is traceable back to a Latin root "pagensis" recorded in the Latin of the Imperial time ca. 100-200. The English word "landscape" (as well as the word "scenery") has also its roots in Latin, in a word "sca(e)na", which means a natural view or pictorial landscape.

Keisteri (1990) also argues that the English word "landscape" actually incorporates the meanings of both a physical scene or view and its pictorial representation. The latter meaning probably entered the English language through English artists who used the word "landscape" to describe landscape paintings of Dutch artists. Thus, the word "landscape" also reflects, to some extent, the

manner in which an environment is observed. This interpretation is true especially in English, French, Italian, and Spanish. In German the word "Landschaft" (= landscape) is more rigorously associated with a land area with boundaries. It is possible to use the word "Landschaft" to refer to a reproduced image from landscape, but in most cases the word "Landschaft" is used even today to denote only a defined area of land or the area visible to the observer. In Swedish, the older connotation of the word "landskap" was approximately the same as in German, the emphasis was on the meaning connected with an area. Nowadays it can also be perceived to be related to pictures.

The meanings of the Finnish word for landscape, "maisema", have developed, no doubt, from its counterparts in other European languages. Like its Swedish equivalent, the Finnish word "maisema" was used at first only in the meaning of a restricted area. At that time it corresponded in different dialects to words for soil, land, terrain, district, or locality. In modern Finnish, the word "maisema" still carries the meaning of land or district, but the most common definition is the one based on visual observation. The word "maisema" can be defined in English as "an area of land surface, visible to an observer; sometimes: a view or a scene" (Nykysuomen sanakirja 1954, p. 368). As a conclusion, we can say that the words for "landscape" in most European languages have developed in two phases from the meaning of a defined area of land to a picture of such an area. Thus the European use of the word "landscape" occurs in a situation in which visible and experienced land areas can be referred to by a single word (Keisteri 1990).

Most evaluation studies of landscape values (contingent valuation studies and others) talk about either "agricultural landscape" (e.g. Russell 1988; Drake 1993), "cultural landscape" (e.g. Meeus et al. 1988), or "countryside landscape" (e.g. Bergstrom et al. 1985). Usually there are no explicit definitions, though Bergstrom et al. (1985, p. 140) list five elements of the countryside landscape: topography, vegetation, water, sky, and man-made structures. Their view is that combinations of these five elements produce landscapes that differ, especially, in terms of their visual quality. This seems to suggest that the interpretation of landscape in valuation studies follows the general connotation of the word "landscape" despite some variation in terminology. However, Pruckner (1995), for instance, takes a differing approach. Although he also refers to agricultural landscape, his idea is to evaluate "*the economic benefits associated with agricultural landscape-cultivating services*". The emphasis is not on the value of landscape as a visible entity but on its ability to produce services for the tourism sector. This is clearly an extension in the use of the word "landscape". Landscape is valued indirectly, based on its capacity to provide inputs for other industries.

Traditionally, the physical environment is divided into three categories (Linkola 1980, p. 119): natural environment, rural environment, and urban

environment. The natural environment is perceived to consist of those areas where no or very little influence of human action can be observed. A primeval forest is a good example. Well-developed man-made infrastructure, dense population, and lack of natural elements characterize the urban environment. Between these two extremes, there is the rural environment that, for the most part, is a product of the cultivation of natural elements. Boundaries towards natural environment and urban environment are somewhat vague, and a clear-cut classification of a certain area is not possible. For instance, at the age of global airborne pollutants, there is no area on earth not affected by human actions. Oftentimes, it is also hard to separate a rural settlement from a semi-urban settlement. Some measures have been developed for the statistical purposes, but in many cases the distinction is just a matter of taste.

It is obvious that visible landscape is a part of the rural environment. However, the concept of the rural environment should not be perceived to cover only the visible landscape. In the study we assume the view that the rural environment is a subjectively perceived resource and service entity that at the physical level consists of both natural elements and man-made structures of the physical environment (resource base). The main natural elements are topography, vegetation, animal species, water bodies, and space. The man-made structures are buildings, roads, ditches, electric wires, i.e. the infrastructure. It is apparent that most elements have features from both categories. They are a result of a long co-evolving process, during which the natural ecosystem has gradually turned into an agricultural production system. The resource base makes it possible to produce an array of services, amenities and commodities that are economic, socio-cultural, and ecological of their nature. Every observer evaluates both the resource base and the array of services subjectively, depending on their previous experiences, attitudes, and available information (see Figure 2.1).

If a closer look is taken on the resource base, it can be seen as a combination of visible and invisible objects that have more or less concrete and abstract characteristics. For instance, landscape can be perceived to consist of elements that can be observed visually and to which attributes depicting "objective" dimensions like color, shape, and location can be attached. If a group of people is asked to describe a landscape view in this simplified manner, their descriptions are probably not quite similar, but rather close to each other. Most essential natural elements and man-made structures will be mentioned in this narration, even though there will be some variation in exact wordings. The narrative can be considered a definition of visible landscape that is at least to some extent an "objective" entity in the sense that it is commonly observable. Thus, visible landscape represents phenomena that belong to the visible-concrete category of the rural elements.

People do not evaluate landscapes based on shared notions of features only, but most of the time they use adjectives that convey very subjective quality

judgments. Two people can approximately agree on the visual appearance of a certain landscape view, but they can end up with very diverse assessments in relation to its aesthetic or scenic quality. Visible landscape will be interpreted through existing individual values and knowledge. Earlier observations, experiences, and memories related to landscape viewing give a relative position for the landscape in question in a subjective ranking scale. It is not only aesthetic considerations that matter, but also attitudes towards rural life, rural inhabitants, and landscape-independent services affect the evaluation considerably. As a

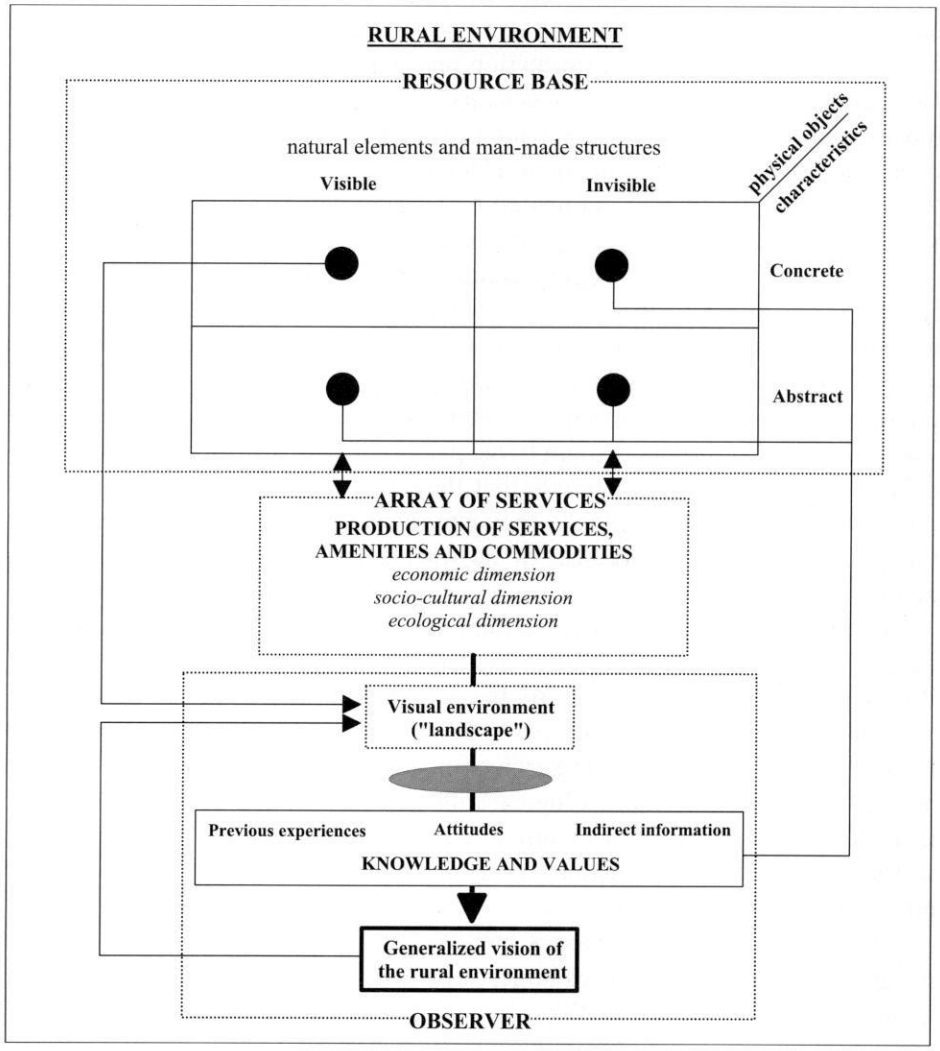

Figure 2.1. Rural Environment and Its Observation and Perception Process.

result, people have different opinions about the value of a certain visible landscape. They have, in other words, created an abstract landscape. This refers to the visible-abstract category. This view is also supported by Keisteri (1990), who emphasizes in her detailed discussion about the definition of landscape that there is, in addition to the physical landscape, an experiential, subjective landscape.

Nevertheless, as already mentioned earlier, the concept of the rural environment goes further, beyond landscape. Invisible elements can also be concrete, although they cannot usually be directly observed. This invisible-concrete category consists of elements of biogeochemical processes of the life-supporting ecosystem. Their existence is common knowledge, although it is usually possible to receive only indirect information on them. This is why very few people have deeper knowledge about mechanisms of the life-supporting system. In most cases, however, public perception of the countryside or the rural environment does not really cover invisible elements of the life-supporting ecosystem. People's views are clearly dominated by issues related to visible-concrete and visible-abstract landscape perceptions (see e.g. Spedding et al. 1988).

The invisible-abstract category copes with concepts that are probably very seldom taken consciously into account when the rural environment is referred to. Many highly philosophical dilemmas are related to the interaction between human beings and the ecosystem. The question is about ethical choices concerning the exploitation of environmental and natural resources. People's views can vary from strict anthropocentrism to deep ecocentrism. They may see the nature only as a source of raw materials that they are entitled to deploy in order to satisfy their needs. Alternatively, they can regard the nature as an entity that is immeasurably valuable because of its own cause, without any reference to human needs and ends.

However, when the actual valuation takes place, there are also other considerations, in addition to the resource base objects and characteristics, that matter. Without going into the details of the nature of the valuation process, it is plausible to argue that at least part of the value of the rural environment is indirectly derived through the services it provides. These services have economic, socio-cultural, and ecological dimensions. The economic dimension is related to the production of commodities that have a market price, like foodstuffs and certain recreational activities. They are already valued at the market place through the price mechanism.

The socio-cultural dimension is more abstract because it cannot be observed in easily detectable quantitative units. Some of its core elements are shown only in people's value judgments. What is, for instance, the importance of keeping a farm in the same family through generations? What is the significance of a living countryside? Certainly, it is hard to measure the value of these factors, but we should not deny that some abstract notions related to landscape quality,

peasant culture, and viability of the countryside are an essential part of the rural environment. Ecological services are products of the life-supporting ecosystem. Reference is usually made to biodiversity when these services are considered. Life-supporting functions can take place only if there is enough biological variability in the ecosystem. Agriculture-supporting biodiversity is responsible for the ecological sustainability of the agricultural production system.

It is quite clear that most services provided by the rural environment have features from all the three dimensions mentioned. Some services may even be difficult to classify according to these dimensions. For instance, food supply security and food safety are related to the production of foodstuffs, but they are not directly linked to the economic value of agricultural production. There is also the issue of national military security that is usually connected to inhabited countryside. The socio-cultural dimension does not exactly reflect this, although there is a close relation. However, the point is not to classify types of services provided by the rural environment but rather to remind that they are of wide diversity. Furthermore, in some cases it is very difficult to make a difference between a resource and a service provided by the resource. If biodiversity is defined as a service and the ecosystem as a resource, there is no meaningful way to detect when a natural element is part of the resource and when it is part of the service. Moreover, even in cases where a clear division between resources and services can be made, it is not necessarily important from the point of view of an observer who values the rural environment. It is likely that the observer has different motives to value different elements of the rural environment, but these motives are hardly separable in a quantitative sense.

Consider now a valuation situation related to the rural environment. Because the entity in question is certainly well-known, it is plausible to assume that most people already have a generalized vision concerning the rural environment before a specific valuation situation takes place. They have gone through the observation and perception process a number of times in their lives. They have a considerable amount of earlier direct experience regarding the visible landscape. Based on these observations and their values concerning the rural way of life, people have produced a certain cultural vision of landscape. In addition, they have received variable amounts of information about the agricultural ecosystem and the related ecosystems and their functions through education and the media. They have also developed certain notions about the desirable relationship between man and nature. This results in a wide range of variation in people's generalized visions of the rural environment. It is likely that their views are dominated by visual and cultural images of landscape. The ecological aspect is less important, although it is inherent to some extent.

Taking into account the complexity and subjectivity of the observation and perception process, it is quite apparent that an external observer like a researcher has enormous difficulties when he tries to cope with people's different

notions of the rural environment. This is even more true when a policy aspect is introduced. A resource entity and its provision of services are never in a static phase. There is always some institutional design going on in the form of different policy measures that are aimed to have some impact on the quality and quantity of the resource entity. Therefore, it is not possible to make a distinction between a resource entity, its provision of services, and policy measures intended to guarantee its maintenance and development. They all become entangled in a manner that leaves in most cases space for different interpretations and conclusions.

The complicated nature of the observation and perception process related to a multidimensional agri-environmental entity poses a challenge to the use of monetary valuation methods. On the one hand, from the viewpoint of economic theory and methodology, the object of monetary valuation should always be defined as unambiguously as possible. On the other hand, from the decision-making perspective, all the information about economic consequences of a certain policy proposal is relevant, although it may not represent theoretically correct welfare measures. Consequently, in most practical decision-making situations we face a trade-off between policy relevancy and theoretical validity, when monetary valuation is applied to the assessment of environment-related, complex policy proposals.

2.2. Socially Optimal Characterization of Pro-Environmental Farming

Agricultural output is dependent on inputs. When conventional agriculture is concerned, the major inputs are seen to be purchased inputs, like fertilizers and pesticides, and labor. Pro-environmental farming, in turn, acknowledges that also the rural environment has an important role as a production input because it provides the agriculture-supporting ecosystem. In this section the general economic characteristics of pro-environmental farming are developed and compared with those of conventional farming.

The agriculture-supporting characteristics of the rural environment cannot be defined in an unanimously manner. They are to some extent based on biodiversity, which is the major element of life-supporting functions at the ecosystem level, but it would be too simplified to consider these characteristics only as a function of biodiversity. We can only refer to the preceding chapter where we show how the rural environment provides a broad array of different services that play a critical role in supporting agricultural production in many ways.

Let us denote the agriculture-supporting function of the rural environment by g and recognize that it is affected by the use of conventional inputs. Now, denote the conventional input vector used in agriculture by x, and certain site-specific resource characteristics by r. Then, we can write $g = g(x, r)$. In order to

simplify the presentation, we can assume that the resource characteristics, r, depend only on the geographic location and remain constant over the analysis.

The relationship between x and g needs a closer look. There is some evidence that the use of conventional inputs harms the environment. However, it is not clear if this is always the case. Moreover, the actual impact of the use of conventional inputs on the agriculture-supporting functions of the rural environment cannot be reliably determined in all the cases. Thus, we cannot say that for $\forall x_i$, $\partial g/\partial x_i<0$. We have to conclude that the relationship between x and g varies so that for some x_i, $\partial g/\partial x_i<0$ and for other x_j, $\partial g/\partial x_j>0$. However, it is reasonable to assume that in most cases $\partial g/\partial x$ is negative, at least in the neighborhood of the current use levels of x, because otherwise it would be difficult to explain the adverse ecosystem impacts of conventional agriculture.

Now we can derive a production function for pro-environmental farming (Q) by adding $g(x)$ into the standard production function of conventional agriculture, $f(x)$:

$$Q = f(x, g(x)) \tag{2-1}$$

Consequently, the profit, Π, in pro-environmental farming (in the absence of taxes and subsidies) is

$$\Pi = pf(x, g(x)) - wx \tag{2-2}$$

where p is the vector of producer prices and w is the vector of prices of conventional production inputs. The optimal amount of conventional outputs x to be used in pro-environmental farming can be found by solving

$$\frac{\partial \Pi}{\partial x} = p\left(\frac{\partial Q}{\partial x} + \frac{\partial Q}{\partial g}\frac{\partial g}{\partial x}\right) - w = 0 \tag{2-3}$$

The solution of the optimal use of x offers a view on the potential benefits and costs due to the conversion from conventional agriculture to pro-environmental farming. It also allows an intuitive graphical interpretation. Consider first the case of conventional agriculture. In this case $\partial\Pi/\partial x$ simply gives $p(\partial Q/\partial x) = w$ meaning that the value of a marginal product is equal to the input price vector resulting in the use of $x = x_0$, as shown in Figure 2.2. In the case of pro-environmental farming, when $g(x)$ is incorporated, the situation changes. As already explained above, it is reasonable to assume that the increased use of conventional inputs in most cases reduces the ability of the rural environment to provide agriculture-supporting services. Thus $(\partial\Pi/\partial g)(\partial g/\partial x)$ is negative, creat-

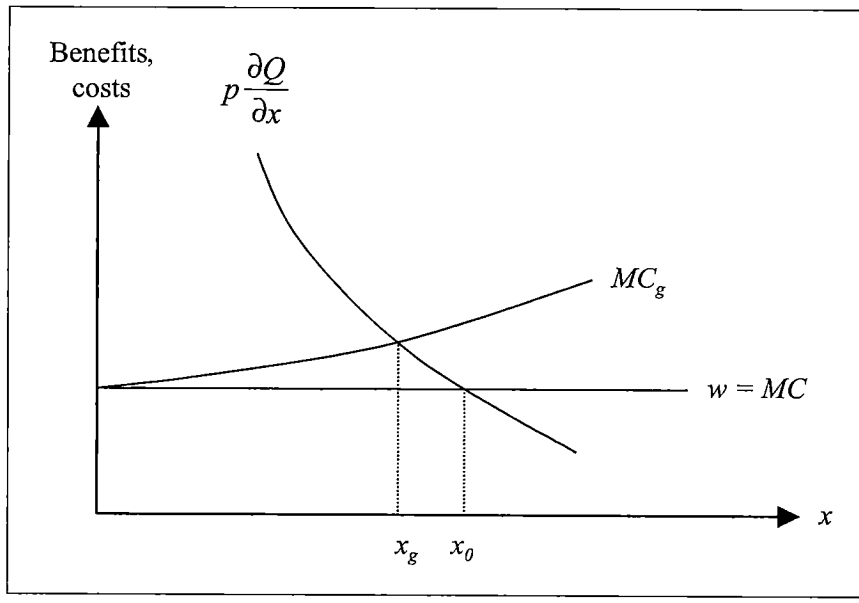

Figure 2.2. Effect of Pro-Environmental Farming on the Optimal Use of Conventional Inputs at the Farm Level.

ing an additional cost (described by the difference between MC and MC_g) and, consequently, the optimal amount of conventional inputs x_g is smaller ($x_g < x_0$) than in the case of conventional agriculture. The graphical presentation gives a partial analysis in which the prices of agricultural products are kept constant.

From the farmers' point of view the interesting question is whether pro-environmental farming is as profitable as conventional agriculture. Unfortunately Figure 2.2 or the theoretical introduction presented above does not answer this. However, considering what we know about yield changes when a farm converts from conventional agriculture to a pro-environmental farming practice like organic farming (approximately 30% decrease on the average), it seems that at least in the short run the conversion is not economically profitable if $\partial p/\partial Q = 0$, because in most cases it is not reasonable to assume that $w(x_0 - x_g) > p(f(x_0) - f((x_g), g(x_g)))$. Thus, to make the conversion from conventional agriculture to pro-environmental farming take place, we have to assume either a farmer's objective function different from the profit function, a producer price increase, or a policy intervention in order to improve the economic profitability of pro-environmental farming. Nevertheless, we should keep in mind that the key issue is to assess how the conversion from conventional agriculture to pro-environmental farming affects the social welfare.

Consider next the consumer side. Assume that consumers' indirect utility function (U) is quasilinear, i.e. linear in terms of income and concave in terms of agricultural products, Q:

$$U(p, I) = I + \omega(p(Q)) \tag{2-4}$$

where I is exogenous wage income and p is the price of agricultural products. The indirect utility function gives the maximum utility subject to exogenous parameters. For instance, for the change in the price of an agricultural product holds that, $\partial U/\partial p = \omega'(p(Q)) < 0$, i.e. the higher price decreases the maximum utility attainable for the consumer. In addition, consumers suffer from agricultural pollution according to $d(z(x))$, but also value the agro-ecosystem-supporting characteristics of pro-environmental farming according to $v(g(x))$. Thus, $d(z(x))$ and $v(g(x))$ express the value of positive and negative externalities and public goods that are extracted from the rural environment and its agriculture-supporting services.

Now features of pro-environmental farming can be derived as a solution to a social welfare maximization problem. Suppose that the social planner chooses the conventional input vector, x, in order to maximize the sum of producers' and consumers' surplus, their disvaluation of agricultural pollution and their valuation of agro-ecosystem-supporting characteristics of pro-environmental farming:

$$\begin{aligned} max\, SW = {} & \Pi(p, w, f(x, g(x))) + \omega(p(f(x, g(x)))) \\ & + d(z(x)) + v(g(x)) \end{aligned} \tag{2-5}$$

The social optimum is characterized by a vector of conventional inputs, x, for which holds that

$$\begin{aligned} \frac{\partial SW}{\partial x} = {} & \frac{\partial \Pi}{\partial Q}\frac{\partial Q}{\partial x} + \frac{\partial \Pi}{\partial Q}\frac{\partial Q}{\partial g}\frac{\partial g}{\partial x} + \frac{\partial \omega}{\partial p}\frac{\partial p}{\partial Q}\frac{df(x, g(x))}{dx} \\ & + \frac{\partial d}{\partial z}\frac{\partial z}{\partial x} + \frac{\partial v}{\partial g}\frac{\partial g}{\partial x} = 0 \end{aligned} \tag{2-6}$$

The effect of pro-environmental farming on consumers' welfare is explained in more detail in Table 2.1. It demonstrates that we have welfare effects of opposite signs indicating the potential trade-offs in choosing the optimal level of input use. Assuming the conventional *Inada* conditions for the marginal valuation of pro-environmental farming and for the marginal disutility from

agricultural pollution is sufficient to guarantee that the conversion from conventional agriculture to pro-environmental farming increases consumers' welfare despite the higher prices of agricultural products. Furthermore, this also means that the socially optimal input use is less than in the case of conventional agriculture. This is shown in Figure 2.3, which is an elaborated version from Figure 2.2. Note also that Figure 2.3 has been drawn in such a way that the socially optimal amount of x, x_{SW}, appears to be less than the farmers' profit-maximizing amount of x, x_g, in pro-environmental farming. This is a reasonable assumption, because we know (keeping in mind the chosen functional forms) that for all x_i, $| dSW/dx_i | > | (\partial SW/\partial \Pi)(\partial \Pi/\partial g)(\partial g/\partial x_i) |$, meaning that MSC is always greater than MC_g.

This analysis of social welfare change shows that environmentally-friendly agricultural policy can increase social welfare through the implementation of a production technique that is based on the reduced use of conventional agricultural inputs and the maintenance of the agriculture-supporting services of the

Table 2.1. Changes in Consumers' Social Welfare (SW_C) due to Pro-Environmental Farming.

Type of welfare change	Form of welfare change	Explanation of welfare change
Effect through the change in the prices of agricultural products	$\frac{\partial \omega}{\partial p}\frac{\partial p}{\partial Q}\frac{df(x,g(x))}{dx}$ $\Leftrightarrow$ $x\downarrow, SW_C\downarrow$	It is possible that the decrease in the use of x reduces Q, which in turn makes the prices p to rise. Obviously, this reduces the utility that consumers derive from consuming agricultural products.
Effect through the change in the amount of agricultural pollution	$\frac{\partial d}{\partial z}\frac{\partial z}{\partial x} \Leftrightarrow x\downarrow, SW_C\uparrow$	When x diminishes, also z falls, and disutility d decreases, i.e. social welfare increases.
Effect through the change in the valuation of the agriculture-supporting services of the rural environment	$\frac{\partial v}{\partial g}\frac{\partial g}{\partial x} \Leftrightarrow x\downarrow, SW_C\uparrow$	If the source of utility is the agriculture-supporting services of the rural environment, it is quite obvious that when x decreases, g increases, and the social welfare v derived from the agriculture-supporting services increases.

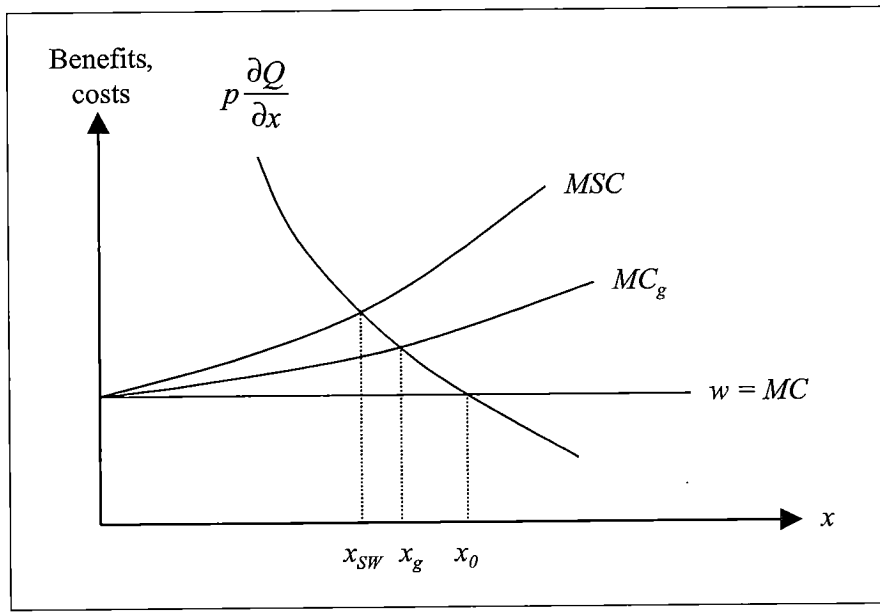

Figure 2.3. Effect of Pro-Environmental Farming on the Socially Optimal Use of Conventional Inputs.

rural environment. In this respect, pro-environmental farming can be seen as a promising agricultural policy alternative.

We can conclude that pro-environmental farming is an agricultural production practice that is meant to be used in order to maintain and enhance the ecological and environmental quality of the rural environment. It aims to reduce the use of chemical inputs like artificial fertilizers and pesticides as well the consumption of fossil energy. Pro-environmental farming attempts to promote production practices that contribute to the maintenance of special features of the rural environment and to the protection of life-supporting functions of the ecosystem. Reduced use of agro-chemicals, crop rotation, and preservation of rare biotopes and habitats are beneficial measures when biodiversity is concerned. Simultaneously, the natural biological potential of the agricultural production system is taken into a more efficient use.

This is the background for the definition for pro-environmental farming given in the questionnaire (see *Appendix B*): "*Pro-environmental farming has been offered as a solution to the problems of Finnish agriculture. Pro-environmental farming can be defined as an agricultural production practice in which the emphasis is on the maintenance of the distinctive characteristics of the rural environment and on the protection of the functions of natural ecosystems. Pro-environmental farming aims to reduce both agricultural surplus and adverse*

environmental impacts from agriculture. Primarily, this can be carried out by reducing the use of artificial fertilizers and pesticides."

The definition indicates that pro-environmental farming can indirectly also influence agricultural dilemmas other than adverse environmental and ecological impacts due to conventional agriculture. The reference to surplus reduction was relevant in 1991, when the interview survey was conducted. At that time there was considerable overproduction in most agricultural products. After Finland joined the EU in the beginning of 1995, changes in the agricultural policy made the connection between overproduction and people's tax burden much less apparent.

In order to set up the reference point for the welfare analysis of policy alternatives, welfare effects due to taxes and subsidies were left out. However, in the case at hand income transfers are likely to play a remarkable role, although they do not change social welfare, if all the people are assumed to have equal welfare weights. We must keep in mind how income transfers contribute to the origination of pre-existing distortions in the real-life policy-making and valuation situations. Information on agricultural support, for instance, may affect people's agriculture-related valuations, if people are explicitly made aware of the substantial role of subsidies in the formation of farm income. If people are not aware of the pre-existing distortions affecting their welfare, the valuations that they make in a certain choice situation may not truly reflect their best interest.

Now we can characterize the actual context of the agricultural decision-making situation that we are facing. The most essential producer-side ramification concerning the conversion from conventional agriculture to pro-environmental farming was that it is not likely to increase farmers' profits if producer prices do not simultaneously rise. Furthermore, if we consider that the profit function is the objective function[1] subject to which farmers attempt to maximize their welfare, they do not have an incentive to change their production practices without a policy intervention increasing the economic profitability of pro-environmental farming. On the consumer side, in turn, the conversion is bound to increase consumers' welfare, even if market prices of agricultural products rise. Thus, it could be possible to increase social welfare, if farmers were paid for the conversion from conventional agriculture to pro-environmental farming a subsidy greater than $\Pi(x_0) - \Pi(x_{SW})$ but smaller than the monetary equivalent of $SW_C(x_{SW}) - SW_C(x_0)$.

[1] Of course, we can also assume that farmers derive utility from knowing, for instance, that pro-environmental farming improves ecological sustainability. In this case, the objective function would not be the plain profit function, and we could hypothesize that farmers would be willing to convert from conventional agriculture to pro-environmental farming despite decreasing profits, because these would become compensated for in the form of utility derived from enhanced ecological sustainability.

We have now been able to characterize at the theoretical level the factors that contribute to the welfare change in the pro-environmental farming policy context. In practice, we will encounter a multitude of problems if we attempt to identify and quantify these welfare changes in monetary terms.

3. Decision-Making and Valuation

Pro-environmental farming was characterized on a general level as an input choice which equalizes the positive and negative effects in producers' surplus, consumers' surplus, and rural amenity valuation. The specification of the exact optimal level of input use, or the possible use of economic instruments to achieve this goal, requires monetary weighing of the positive and negative effects. This sort of analysis is typically carried out in a benefit-cost analysis (BCA) framework. The BCA provides a framework which acts as a conceptually sound basis for social decision-making, as long as we accept that all kinds of values can be expressed commensurably by using monetary units. However, we have to keep in mind that in this study the emphasis is on the assessment of consumers' willingness to pay for the conversion from conventional agriculture to pro-environmental farming, not on the assessment of all the benefits and costs borne in the conversion process.

First, a brief introduction is given about the benefit-cost analysis as the main economic framework of policy analysis. In this connection, we also review social decision-making criteria which can be seen to provide the justification for the money-based policy analysis of the BCA type. Then, the total economic value and its main components are reviewed. The focus is on use and nonuse values as well as intrinsic, functional, and instrumental values. The purpose of this is to illuminate how the economic concept of value can be broadened to cover nonmarket value dimensions inherent in environmental and other public goods. Finally, monetary valuation methods suitable for the assessment of nonmarket costs and benefits are reviewed. In this connection we also show how the CVM relates to these other methods and the BCA framework.

However, we have to note that in this study the contingent valuation method is applied in order to identify and value the benefits of the conversion from conventional agriculture to pro-environmental farming. The potential costs of such conversion are not estimated nor are their possible sources evaluated. Thus, this study does not represent a benefit-cost analysis, because it provides a monetary value only for the potential benefits of the conversion. Nevertheless, the valuation of the potential benefits of pro-environmental farming is carried out in a manner which is consistent with the principles of benefit valuation in the BCA framework. Accordingly, people's willingness to pay estimates derived in this study could be used as benefit estimates, and the benefit-cost

analysis could be completed if the costs of the conversion were available. This would be highly interesting, but unfortunately it is out of the scope of this study.

3.1. Social Decision-Making and the Benefit-Cost Analysis

According to Boadway and Bruce (1984), the two principal goals of the social decision-making process (SDMP) are to produce a social ranking over alternative possible states of the world and to carry out policies that satisfy individual preferences expressed through that ranking. In essence, the social decision-making process is a continuum of policy choices based on information acquired from different sources. Practitioners of welfare economics have developed economic tools that can be beneficial in obtaining the social ordering of the different states of the world and different policy alternatives. In this context, the term "state of the world" can be interpreted as a complete description of an economy including traditional economic factors, like supply and demand, political conditions, such as the degree of democracy, and physical characteristics, such as the natural resource base accessible to the society.

However, welfare economics is primarily interested in ranking states of the world that differ in economic characteristics, such as outputs of commodities, supplies of factors for different uses, and distributions of commodities over households. That is, the interest is in the ranking of alternative allocations of resources, and each of them is typical of a certain state of world or a social state. Furthermore, the ranking of social states is undoubtedly a normative procedure: it involves making subjective value judgments that are dependent on each individual's preferences. It is obvious that, for each set of value judgments adopted, a different social ordering results. Therefore there is no objective or unique way to order social states, and, as a consequence, there is no decision-making criterion that could be considered the most preferable. However, the lack of an unanimously accepted decision-making criterion does not imply that nothing should be done. In practical policy-making situations we are forced to choose and apply criteria, although we should simultaneously be aware of the problems related to their use.

We know that any attempt to derive a preferred social decision-making criterion is inevitably based on a set of judgments originating from considerations dealing with economic efficiency and social equity. The value judgment that is most frequently referred to in welfare economics is known as the *Pareto principle*. The principle postulates that a change in social states is desirable only if it makes some individual(s), better off in monetary terms without making any others worse off. This kind of change in income is sometimes called *the actual Pareto improvement* (API) (Randall 1987, p. 147). Nevertheless, even this rather weak value judgment can be opposed on the grounds of social justice. For instance, a change in income can make the rich much better off than the poor,

although both will be better off in absolute terms. In other words, the API does not take into account an initial or a resulting income distribution. This is a serious shortcoming in a policy-making context, because redistribution issues are usually of great importance in party politics. From the viewpoint of practical decision-making, it is relevant that when the actual Pareto improvement is concerned, a policy action producing a change in income should be approved by every individual who appears to be affected.

Apparently, policy-making would be extremely difficult and at least time-consuming if the Pareto principle were the prevailing decision-making criterion. Therefore, there have been a number of attempts to revise the Pareto principle in order to create more political applicability. The best known of these efforts is probably the *Kaldor-Hicks compensation criterion.* It can be stated in the following way: Assume that there is a policy A_0 as a starting point. Now, if another policy A_1 could be introduced so that those who gained could afford to compensate the losers and have some monetary gains remaining, the change from A_0 to A_1 would be a welfare improvement at the level of the society. This is sometimes also called the *potential Pareto improvement* (PPI) (Randall 1987, p. 147). Obviously, if the PPI is implemented as a social decision-making criterion, more information on people's preferences should be available. A quantitative comparison of preferences between losers and gainers is needed in order to calculate in monetary terms how much losers lose and gainers gain. If this quantitative comparison is carried out in monetary terms, we have to assume that the marginal utility of money is constant. Furthermore, if we want to compare preferences of different people in monetary terms, we have to assume that everybody has the same constant marginal utility of money. Thus, if the PPI is confirmed to be a valid value judgment for policy-making purposes, then it is accepted at the same time that interpersonal utility comparisons are feasible.

The benefit-cost analysis provides a systematic tool that can be applied for the assessment of the potential Pareto improvements related to different policy proposals. In the broadest sense, the BCA can refer to the measurement of economic costs and benefits from any change in resource allocation in the economy (Boadway and Bruce 1986). In practice, the BCA uses an array of methods which make it possible to give monetary estimates for the different value categories depicted in connection with the total economic value framework. The assessment of projects and policy proposals related to environmental issues is obviously a natural target for the BCA because there are usually benefits and costs involved that the market cannot deal with. Thus, the valuation of environmental commodities is often an essential part of the policy planning process (see e.g. Navrud and Pruckner 1997).

Nevertheless, the concept of the PPI must be operationalized before it can be used in empirical research. Several numeraires can come into question, but usually the *net present value* (NPV) is preferred. This is a discounted monetary

measure of a project's expected worth (Gittinger 1989, p. 487). In essence, the purpose of the BCA is to select a project that maximizes the NPV. This can be formulated more rigorously as follows:

$$\max \text{NPV} = \max \sum_{t=1}^{T} \frac{B_t - C_t}{(1+r)^t} \tag{3-1}$$

where B_t are benefits and C_t are costs in time period t, r is the discount rate, and T is the time horizon.

Because the BCA is typically a monocriterion analysis, i.e. it is based on a construction of a single decision criterion like the NVP, the optimal solution to the maximization can occur in the mathematical sense only if certain properties are satisfied. First, all the projects or their combinations compared by using the BCA must be mutually exclusive. Furthermore, a complete preorder structure of alternatives must exist, and the set of possible projects must be completely defined and fixed. These requirements may pose a problem because, given the complexity of decision-making situations, it is not always possible to define the set of possible projects beforehand in a fixed manner (Munda 1996).

The use of the monocriterion also implies that all benefits and costs have to be expressed in comparable and commensurable terms. In practice, this means the use of monetary units. However, combining different kinds of societal goals like economic efficiency, social equity, and ecological sustainability into a single numeraire is a problematic task. Consider the ramifications of the potential Pareto improvement principle. According to the standard neoclassical utility theory, the utility derived from consumption can be in the form of a utility function, say $U = U(Z, \boldsymbol{X})$, where Z is a nonmarket good, e.g. environmental quality, and $\boldsymbol{X}$ is a vector of ordinary market goods. Furthermore, if a budget constraint $\boldsymbol{PX} = Y$ holds (where $\boldsymbol{P}$ is the price vector of $\boldsymbol{X}$ and Y is money income), we can define an indifference curve map representing different combinations of money income and environmental quality that yield the same level of utility. In other words, it is always possible to find an amount of money in terms of willingness to pay for an environmental quality improvement or in terms of willingness to accept compensation for environmental quality deterioration that keeps utility constant (Munda 1996).

The dimension of time is highly relevant in the BCA because it implies that there is a need to discount benefits and costs that are supposed to take place in the future. Choices have to be made about whether to sacrifice consumption in one period in order to have more consumption in another. The problem is that there is no unambiguous rule to decide what an appropriate discount rate is. Using market interest rates may be an intuitively appealing alternative, but it lacks firm foundations. Market interest rates are often extremely volatile and

they can change considerably during the implementation period of the project. In many projects, even a minor change in the discounting rate may play a pivotal role when it is determined whether to make the implementation decision. This is especially crucial when resource management is in question, since many adverse environmental effects are very long-lived and many beneficial environmental effects occur far in the future. We should also remember that natural capital has often much lower growth rates than man-made capital and will therefore become obsolete if future returns to production are the sole criterion (Hanley and Spash 1993, p. 266)

Many environmentalists, and even some economists, regard discounting as ethically problematic because it appears to be inconsistent with the ideas of intergenerational equity. Their reasoning is that the higher the discount rate is, the lower the importance attached to the preferences of future generations will be. If high discount rates lead to the depletion of natural capital stock, then sustainability is jeopardized. Unfortunately, there is no unique relationship between high discount rates and environmental deterioration. High discount rates may shift cost burdens forward to later generations, but, if the high discount rate is allowed to determine the level of investment, they will also slow down the general intensity of development. This will make it easier to preserve natural capital stock to the future generations. However, the discounting practice of the BCA easily biases the analysis in favor of the current generation (Pearce and Turner 1990).

Another issue that must be taken seriously is the ability of the BCA to deal with different components of economic value. Especially so-called nonuse values may be difficult to take into account in the BCA. Their essential nature will be analyzed in more detail in the following chapter, where the concept of the total economic value is clarified, but at this point we should note that discounting can prevent valuation motives related to nonuse values from being fully realized. The use of a monocriterion as the decision rule makes it somewhat questionable to aggregate use and nonuse benefits and costs intragenerationally because complete commensurability must be assumed. Despite these dilemmas, Bishop and Welsh (1992) strongly suggest that the BCA should also include nonuse values of environmental resources. They argue that, although resource economists may be accused of "disciplinary imperialism" when they attempt to incorporate ever wider sets of values under the umbrella of monetary valuation, the negligence of nonuse values would also produce accusations of the use of masked value judgments in order to promote use values as the only true economic values.

3.2. Total Economic Value and Its Components

To fully comprehend the BCA framework and its limitations, we must look more closely on the concept of economic value. The most common approach used in valuation studies of environmental and resource assets focuses on the concept of the total economic value. It is customary to assume that under real-life conditions (i.e. under uncertainty) all values become *ex ante*, meaning that they represent an individual's expected benefits based on what is known at the time when the valuation takes place rather than in retrospect after the individual has experienced the consequences of his choice (Randall 1991). The main components of the total economic value are *use values* and *nonuse values*. Use value is the benefit accruing from the use (in some sense) of the resource, and nonuse value is the value a person attaches to a resource independent of his use of it (Kriström 1990a, p. 9). There are different forms of use values like direct use values and indirect use values (Bateman and Turner 1992, pp. 5-6). Direct use refers to either consumptive or non-consumptive use of an environmental resource. Consumptive direct use means that the resource will be physically utilized in the use process. For instance, when the rural environment is concerned, agricultural products are typical commodities from which direct consumptive use values can be derived. Non-consumptive direct use values are related to recreational services provided by the rural environment. The idea is to derive benefits from rural resources without reducing their physical quantity or quality. Indirect use of the rural environment is linked to appropriation that takes place through books, television programs, and other indirect devices.

In addition to current use, there is also the possibility of future use of the resource, which is probabilistic of its nature and thus subject to change as conditions alter. Principal value concepts coping with this kind of characteristics are *option values* and *quasi-option values*. They are usually included in the category of use values (see e.g. Randall 1987 or Bateman and Turner 1992). Option value refers to the value that arises from retaining an option to a good or service with uncertain future demand. Option value is an additional value to any utility that may arise when the good is actually consumed. If there is no uncertainty concerning the future availability of the resource, option value will be zero. However, if there is some uncertainty involved, people may be willing to pay a premium (option price) to keep the option of future use open. In other words, the option price of a resource is the sum of the money that people would be willing to pay today for the right to consume some quantity of a resource (at a fixed price) in the future. Weisbrod (1964) was first to formulate this. Quasi-option value (developed by Arrow and Fisher 1974) refers to utility gains expected to be realized from not undertaking irreversible decisions, and thus maintaining options for future use of some resource, given the expectations of future technological advance and/or the growth of knowledge. Suppose that the

passage of time leads to new information becoming available about the different uses of an environmental resource. If decisions about the development are taken later rather than sooner, a greater quantity of this new information can be taken into account. The value of the gains that are expected from deterring development in these circumstances is known as quasi-option value (Perman et al. 1996, p. 277).

The origin of nonuse values can be traced down to Krutilla (1967), who suggested, by introducing a concept called *existence value*, that people may still value a resource even though they do not actually use it. Existence value addresses the idea that some people value the existence of a certain natural resource although "*they would be appalled by the prospect of exposure to it.*" Consequently, the value of the resource is independent of any current or expected future use. In this sense, the resource's economic value broadens to cover a wider array of possible valuation motives than expressed in the definitions of option or quasi-option values. The magnitude of the nonuse values of environmental and natural resources is usually assumed to be in close connection to their degree of uniqueness, irreversibility, and non-reproducibility. Randall and Stoll (1983) and Randall (1986b) argue that existence value is motivated by altruism and suggest interpersonal, intergenerational, and Q-altruism. Interpersonal altruism arises from the well-being that can be experienced by an individual by knowing that other people may be able to enjoy the resource (*philanthropic value*). Intergenerational altruism reflects the desire to pass some of the present endowments onto future generations (*bequest value*). Q-altruism is the utility that one derives from simply knowing that the resource exists (*intrinsic value*).

Figure 3.1 summarizes the different components of the total economic value. However, because the applied terminology is somewhat vague and occasionally even conflicting, the categorization presented here is only indicative of its nature. Decomposition of values in practical valuation situations is a very difficult task. Different value categories can be considered to represent valuation motives, but they cannot be really identified and isolated as separate value units adding up to the total economic value. Thus, at this point we can only note that it is not possible to develop an unambiguous taxonomy of economic values which economists could unanimously agree on.

Cicchetti and Wilde (1992) argue that the total economic value can be uniquely decomposed into subcomponents if and only if it is possible to value the subcomponents separately and then aggregate them to construct the total value. They also note that multi-faceted changes in the quantity or quality of an environmental resource will generate total value measures which cannot be uniquely decomposed facet by facet. For instance, if a farmer takes an action that decreases the quality of the rural environment (say, he destroys a rare agriculture-related biotope in order to enlarge the potential cultivation area). In

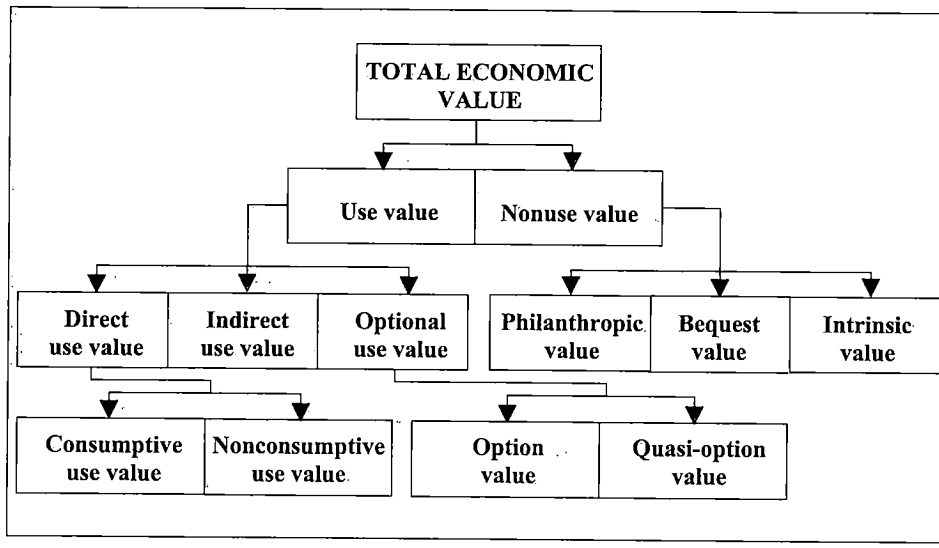

Figure 3.1. Total Economic Value and Its Components.

this case, there will be lost values associated with both the destroyed biotope and the fact that the destruction was caused by human actions. In general, there will not be any unique way to separate these two values from each other. Furthermore, there is always the danger of double-counting when nonuse values are aggregated across individuals.

It seems that environmental and resource economists agree on the features of use values but not on the nature of nonuse values. For instance, Cummings and Harrison (1995) point out that nonuse values may exist, but there is no proof that they are measurable or that they form a significant component of the total economic value. However, they are ready to admit that there should not be any argument concerning the concept of nonuse values as such. A number of motive-related reasons can lead an individual to sacrifice income for an environmental good or for any other public or private good. The dilemma is that there exists no operationally meaningful[2] way to decompose the total value into use values and nonuse values. The same is true if an attempt is made to decompose nonuse value further into motive-related components. Consequently, while nonuse values of a true nonuser might be obtained through a research instrument and considered to represent total values, the decomposition of a resource user's total

[2] Cummings and Harrison (1995) mean by "operationally meaningful" that we should distinguish between observable behavior and unobservable motivations. The operationally meaningful decomposition of the total economic value has to be based on observable and traceable behavior, not on unproved assertions about possible motives behind non-use values.

value for an environmental good into use and nonuse components is a highly questionable attempt.

The pragmatic and conceptual coherence of nonuse values can be also criticized. It can be argued that intrinsic value should not be included in the total economic value framework because the total economic value is related to the valuation of preferences held by people. Thus, it cannot encompass any value that may intrinsically reside in environmental assets themselves. Lazo et al. (1992) note that it may be problematic if nonuse values must be constructed in people's minds at the very moment when stated. This indicates that nonuse values may be highly sensitive to situation-related factors, especially if the valuation takes place in an environment of limited information and inadequate context. More et al. (1996) argue, in turn, that nonuse values like intrinsic value and existence value suffer from serious theoretical difficulties and anomalies that are bound to create confusion. First, there is the problem of what is really being valued. Existence value can be produced by the resource itself, by knowledge of the resource, and by the satisfaction that people derive from the resource. This potential source of conceptual chaos easily leads to a confusion of normative and positive economic arguments.

Second, existence and intrinsic values are essentially static value concepts. They value the world the way the world is now. We can think that if everything living has a value and moral worth of its own, we should not allow such organisms to become extinct. More et al. (1996) argue that the static value concept does not really allow room for competition, either in a biological or an economic sense. Their conclusion is that the static value concept conflicts with forces of social progress like transformation, growth, and creativity. Furthermore, they reason that the emergence of existence and intrinsic values in economic literature in recent years is a result of the rise of ecological threats. The world is changing rapidly in often unpredictable and even adverse ways. The question is about an attempt to preserve the status quo; to preserve the world as it used to be. Concepts like existence value and intrinsic value offer a possibility to carry this out by bringing into positive economic tradition normative notions camouflaged as "objective" and "quantifiable" scientific arguments.

O'Neill (1993, pp. 8-15) has discovered that the term "intrinsic value" is actually used in at least three different basic senses. First, intrinsic value can be considered as a synonym for non-instrumental value. This definition of intrinsic value corresponds to Randall's (1986b) view. The Q-altruism, which is based on people's care about nonhuman components of the ecosystem, is a source of intrinsic value of non-instrumental kind. The second type of intrinsic value can be called "non-relational intrinsic value". In this case, intrinsic value is used to refer to the value that an object has solely in virtue of its non-relational properties. To hold that nonhuman beings have intrinsic value in this sense is to hold that the value they have depends solely on their non-relational properties. In this

context, non-relational properties of an object are those that persist regardless of the existence or non-existence of other objects and that can be characterized without reference to other objects.

The clarification of differences between non-relational intrinsic value and non-instrumental intrinsic value requires a distinction between (1) values that objects can have in virtue of their relations to other objects and (2) values that objects can have in virtue of their relations to human beings. Clearly, the second set of values is a subset of the first. In addition, there are also (3) values that objects can have in virtue of being instrumental for human satisfaction. Obviously, the third set of values is again a subset of the second set of values because an object might have value in virtue of its relation with human beings without being of only instrumental value for humans. Consider now a wilderness area *X*. One might value *X* in virtue of not bearing the imprint of human activity. In essence, to say, "*X* has value because it is untouched by humans", is to say that *X* has value in virtue of a relation it has to humans and their activities. In other words, the wilderness area has value in virtue of absence of human actions. However, the value is not possessed by the wilderness area in virtue of its instrumental usefulness for the satisfaction of human desires. This indicates that non-instrumental intrinsic value need not be intrinsic in the non-relational sense (O'Neill 1993, pp. 13-15).

The third kind of intrinsic value is in question when every nonhuman organism is seen to have intrinsic value independent of its role or position in the nature. This value does not depend either on any function that a certain nonhuman organism may have or on any outside instance assigning values to that organism. It can be called "objective intrinsic value". The definition of objective intrinsic value is clearly more far-reaching than the definition of non-instrumental intrinsic value, which connects values to valuers or human beings. Furthermore, the relation between non-relational intrinsic value and objective intrinsic value is not that clear. Is it so that if there is a value that depends solely on intrinsic properties of an object, subjectivism about values must be rejected? If an object has value only in virtue of its intrinsic nature, does it follow that it has value independently of human valuations? According to O'Neill (1993, p. 15), the answer depends on the interpretation given to the phrases "depends solely on" and "only in virtue of". If these are interpreted to exclude the activity of human evaluation, non-relational intrinsic value behaves like objective intrinsic value; i.e. it is independent of the valuations of valuers. However, it is also possible to interpret that there is a valuing agent assigning value to objects solely in virtue of their intrinsic natures. Given this interpretation of the phrase, a subjectivist can be convinced about the applicability of non-relational intrinsic value.

The interpretation of intrinsic value in the objective sense is not consistent with the ideas of the total economic value framework. From the economist's

point of view, the essence of objective intrinsic value statement is in its denial of the subjectivist view of valuation, which states that the source of all value lies in valuers, in their attitudes, preferences, etc. Objective intrinsic value is clearly in contradiction with the principles of economic valuation. Of course, in this context it is not possible to analyze if the position expressed in objective intrinsic value statement is philosophically sound and theoretically defensible. However, O'Neill (1993, p. 9) raises an interesting question. He argues that the definition of objective intrinsic value is based on a meta-ethical, not an ethical claim on nonhuman beings having intrinsic value. Thus, the argumentation supporting objective intrinsic value would no longer be concerned with properties of intrinsic value as such but with properties of preferable ethics.

Spash (1993), in turn, argues that, if economists want to make progress in coping with intrinsic values in the economic analysis, they must incorporate new philosophical ideas. A partial challenge against utilitarism is not enough if it does not lead to the clear rejection of the whole utilitarian framework. He emphasizes that the core of the problem is the confrontation between a deontological perspective and a teleological one. Teleological ethical theories, which include utilitarian ones, place the ultimate criterion of morality in some nonmoral value (for example, utility or welfare) that results from acts. Such theories assign instrumental value only to the acts themselves and intrinsic value to the consequences of those acts. In contrast, deontological ethical theories attribute intrinsic value to features of the acts themselves. In this sense, behavior violating certain ethical rules is always considered inappropriate and unacceptable, even if it would produce the best possible outcome in terms of monetary welfare measures.

It seems that a unified theory of value is an impracticability in economics. Of course, it may be possible to bring different value concepts closer to each other, but this requires a very careful examination of the prevailing theoretical and methodological disagreements. In this respect, we completely share the views promoted by Green and Tunstall (1991) and Brown (1984). The former argue that the meaningful evaluation of environmental goods depends both upon economic theory being adequate and a congruence between economic and environmental theories of value. The latter asserts that decision-making procedures should use economic measures of value, but these measures should be applied with a full understanding and awareness of their context-depending nature. When the constraints of the total economic value framework are fully taken into account, the contingent valuation method can contribute to the process that aims to produce information on nonuse values for the purposes of social decision-making.

3.3. Monetary Valuation Techniques for Measuring Environmental Benefits and Costs

We should remember that the BCA is a framework for the monetary assessment of benefits and costs, not a valuation method as such. The BCA describes the principles that are applied when different benefits and costs are evaluated in connection with a set of projects or policy proposals. Thus, when the BCA is criticized, a distinction should be made between a critical review of the principles of the BCA and criticism towards the actual monetary valuation method used to achieve monetary estimates for benefits and costs. It may happen that a monetary valuation method is in contradiction with some principles of the BCA, although it supports the basic idea of making benefits and costs comparable in commensurable units. There are also other methods than the BCA that are used for choosing between different project alternatives. Some of them apply monetary values but are not compatible with the BCA. In this context, however, we only examine monetary valuation methods that are compatible with the BCA.

Figure 3.2 presents a typology of different BCA compatible monetary valuation methods. All of them can be used for the assessment of environmental benefits and costs on certain conditions, but their theoretical presumptions and practical applicability vary. These methods produce monetary estimates for environmental benefits and costs, and they can be divided into theoretically valid and theoretically defective methods. Theoretically valid methods are based on welfare economics and they express welfare changes in terms of willingness to pay or willingness to accept compensation. Theoretically defective methods lack theoretical purity, although they can produce monetary value estimates that are relevant for the BCA.

Theoretically valid BCA compatible methods can also be called "behavioral linkage methods", because they establish a linkage between a change in environmental quality and related economic performance (Mitchell and Carson 1989). This can be further illustrated by characterizing the methods along two dimensions. The first dimension, revelation of preferences, deals with people's expression of their preferred choices. They can be displayed either indirectly or directly. Preferences toward an environmental commodity are revealed indirectly if the indicator used is the demand of some related market good. Direct revelation of preferences simply means that the indicator used is the stated or real demand of the environmental commodity itself. The second dimension, the nature of market behavior also involves two options, it can be regarded as observed or hypothetical. Market behavior is called observed if the analysis is based on market transactions really occurred, and it is called hypothetical if the market in question has to be created for the purposes of research.

Mitchell and Carson (1989) provide a comprehensive description of different methods belonging to each of these four quadrants. In this context, however, we

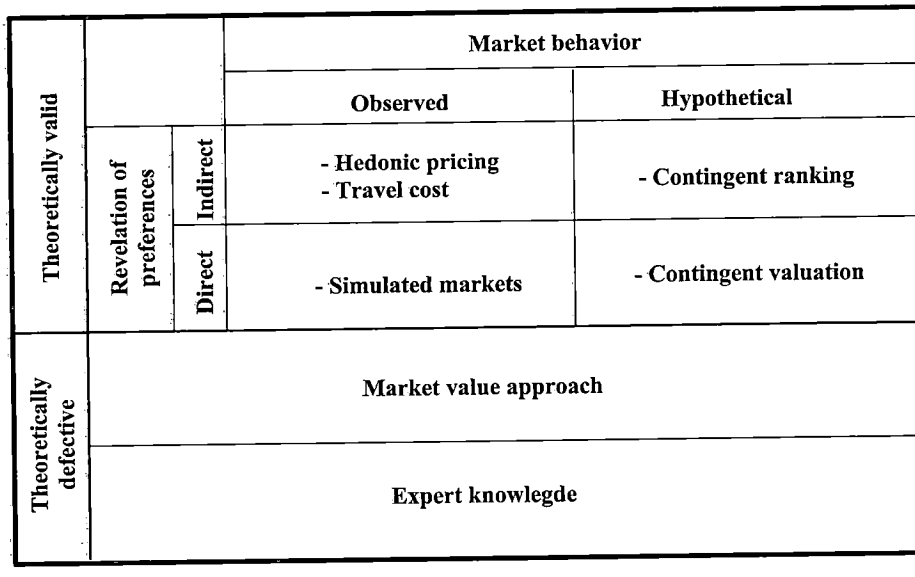

Figure 3.2. BCA Compatible Monetary Valuation Methods.

will concentrate on methods that are widely regarded as competitors of the contingent valuation method (CVM) in the valuation of environmental benefits. The idea is to show how the CVM (direct-hypothetical quadrant) relates to methods like the hedonic price method (HPM) and the travel cost method (TCM) (indirect-observed quadrant). A comprehensive review of the CVM is not given here but the main features of the method are examined in detail in Chapter 5.

When the CVM is applied, the main difficulties are related to the hypothetical nature of the provided market scenario. The HPM and TCM, in turn, experience limitations because of the indirect approach that they apply to preference revelation. The idea behind indirect preference revelation is that the demand for nonmarket goods is somehow related to the consumption of market goods. Thus, many environmental goods and services have substitutes and/or complements that are routinely purchased on the market. Furthermore, it is reasonable to assume that in many cases the exchange of market goods can generate a remarkable amount of implicit information about the demand and supply of environmental commodities. The problem is to extract and use this information. The core conceptual foundation of this approach is the notion of weak complementarity developed by Mäler (1974).

Consider the utility function $U = U(Z, \boldsymbol{X})$, where Z is a nonmarket good and $\boldsymbol{X}$ is a vector of ordinary market goods. Maximizing utility, U, subject to the budget constraint $\boldsymbol{PX} = Y$, where $\boldsymbol{P}$ is the price vector of $\boldsymbol{X}$ and Y is money income, creates a set of Marshallian demand functions for individual x_i:

(3-2) $$x_i = x_i(Z, \boldsymbol{P}, Y)$$

If the utility function $U = U(Z, \boldsymbol{X})$ is nonseparable in Z and $\boldsymbol{X}$, i.e. $U = U(Z, \boldsymbol{X}) \neq U(Z) + U(\boldsymbol{X})$, the amount of Z provided will influence the ordinary demand for x_i. By estimating the demand for x_i given various levels of Z, it should in principle be possible to describe a demand schedule for Z (Randall 1987, p. 267). This means that the Marshallian economic surplus associated with a change in Z can be calculated. Moreover, if this can be done, it will be possible to approximate or to calculate exactly the theoretically correct Hicksian measures of value. Now, weak complementarity can be defined in the following way: a nonmarket (environmental) good Z is weakly complementary to a private good x_i if $\partial U/\partial Z = 0$ when $x_i = 0$. This is to say that when the quantity demanded of private good x_i is zero, the marginal utility of nonmarket good Z will also be zero (Young and Allen 1986).

When the HPM is applied, the weak complementarity between a market good and environmental quality is expressed, for instance, through the relationship between observed house prices and environmental quality in different residential locations. Not surprisingly, the overwhelmingly largest part of HPM literature has concentrated on the relationship between property values and the benefits of improvements in amenities (public or/and environmental goods that vary spatially). Typically, the demand function for an environmental amenity of interest is estimated through a two-stage procedure. First, expenditures allotted to relevant market goods are regressed on measurable characteristics of the environmental amenity. The estimated coefficients and the actual values of characteristics for the sample are used to compute implicit marginal prices for the characteristics. Second, the implicit prices are regressed on the characteristics and other variables, such as income.

The weak-complementary-based demand for certain nonmarket values is also often measured by the travel cost method. It is the oldest and most frequently used method for valuing a recreation site. The travel cost technique exploits the fact that people from different origins bear a different travel costs in order to reach a common site and, therefore, they can be expected to participate in or to visit the site at different rates. Converting travel time and distance to a travel cost, assuming that individuals take trips until the marginal cost of the trip equals its marginal value, and regressing the number of trips on the marginal travel cost and demographic variables reveals the demand function for trips to a site. Thus, the TC approach estimates the demand for an input (the site), not the joint outputs (e.g. travelers' experiences) (Mendelsohn and Brown 1983). In other words, we assume that the only decision variable is the number of visits made to a given site, and that the quality characteristics of the site are exogenous. The demand equation for the site is given by relating the number of visits

to the (fixed) price of return transportation and other demand shifters, such as income. The transportation expenses are taken to be a proxy of the price of the visit. When possible, allowances should be made for the opportunity costs or travel time as well as the direct monetary cost of travel (Young and Allen 1986).

Both the HPM and the TCM share the theoretical validity[3] of the CVM and are compatible with the BCA because they reveal, at least indirectly, how much people are willing to pay for certain environmental goods and services. In this respect, there is no difference between the indirect methods and the CVM. However, we can argue that the indirect methods are more reliable because they are based on revealed, not stated, preferences. From the point of view of the planning of holistic social policy, the most evident problem related to the TCM and HPM is that they only capture benefits accruing to direct users of an environmental good. They can tell the use value, but not the nonuse value. This is usually considered the most significant difference between the indirect methods and the CVM. For instance, if there are significant benefits to members of a society who do not directly participate in the utilization of the rural amenities, both TCM and HPM will understate the value of the rural environment. On the other hand, for policy purposes concerning rural amenities for which an estimate of the value of recreational benefits is required, the HPM and TCM are valid techniques. However, it is important to remember that the indirect approaches are based on current or historical market data. They are incapable of valuing a change in the environmental quality which may take place at a future date (Young and Allen 1986).

There also exists an extensive literature that compares the results of the indirect methods to those achieved by using the CVM. Conclusions drawn in different studies vary somewhat. However, it seems that in most cases values produced by either the indirect methods or the CVM are relatively close to each other (Smith 1993), although Cummings et al. (1986, p. 72) argue that all comparative studies have failed to assess the accuracy of both the CVM and the indirect methods. According to them, there is a lack of uniform approach to evaluate accuracy across individual comparative studies. Of course, we should note that if there is a large group of nonusers likely to express considerable nonuse values, the indirect methods can yield significantly lower value estimates than the CVM.

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[3] It should be noted that even "theoretical validity" is a relative concept. If in the HPM case a demand function is derived that relates house prices (or rents) to environmental quality, then estimated welfare change measures represent Marshallian and not Hicksian measures of welfare change. For instance, when environmental quality is improved, the Marshallian estimate in general overestimates the WTP for that improvement. However, the measure provides an upper bound for the theoretically correct WTP. The same is true in the TCM case when welfare change measures are estimated based on a demand function that relates travel costs of a trip to visit frequency (Perman et al. 1996, p. 264-266).

Furthermore, many environmental services and goods are not necessarily situation-specific, which means that there is no market data available for indirect revelation of preferences. Even if the data exist, there is no guarantee that the indirect methods and the CVM are measuring the same concept of benefits. For instance, in one of the first comparisons of indirect and direct methods (Brookshire et al. 1982) the hedonic price model and the CVM were contrasted in the valuation of air quality. The CVM scenario described the alternative general air pollution levels by means of photos, while the hedonic price model of property values used changes in concentrations of certain pollutants that were explained to offer similar visibility changes. As a result, the CVM described the change as affecting the entire area, while the pollution measures in the hedonic price model were intended to characterize concentrations at each house location (Smith 1993). We can argue that there were two different environmental goods in question, although their valuation took place in the same physical framework.

It is also possible to produce monetary estimates of benefits and costs which do not have a sound theoretical background based on welfare economics. This can be carried out by applying *market value approaches* or *expert knowledge* (these methods are titled as "theoretically defective" in Figure 3.2). Market value approaches assume that a change in the environment may alter economic activities and thus change the monetary revenues and costs of the activities. Consequently, a change in these revenues and costs can sometimes be used to value a change in the environment. The market value techniques value a benefit as an increase in revenue or as a decrease in monetary outlay. Similarly, they value a cost as an increase in monetary outlay or as a reduction in revenue. It is also possible to examine changes in the productivity or income that take place because of a change in environmental conditions (Binning et al. 1997).

The advantage of the market value approaches is that they are based on either directly observable revenues and costs or rather simple causal relationships between environmental characteristics and production functions. Their disadvantage is that in most cases benefits or costs are not necessarily derived in a manner that can be considered to represent the economic concept of value in the sense of willingness to pay or willingness to accept compensation. This flaw indicates that the implementation of the market value approaches in the BCA framework should be carried out with caution. However, the market value approaches deal with observable revenues and costs and they all interpret observable behavior. In this sense, they have something to offer to the BCA.

Expert knowledge is still probably the most frequently applied method to assess benefits and costs related to the use of natural and environmental resources. Actually, it should not be called a method because it does not rely on any identifiable methodology, but the question is about expert judgment. Experienced professionals who are more or less familiar with the problem present their views on the magnitude of benefits and costs involved in a certain project.

Expert judgments may be influenced by results of more rigorous valuation approaches, but they are not directly derived from them. Sage (1981) uses the term "wholistic evaluation", by which he means that the evaluation and choice of alternatives is first and foremost based on previous experience from similar situations. Thus, the judgment is intuition-based. In practice, expert knowledge plays a remarkable role in most BCA applications because other methods are impossible or too costly to carry out. An example of an expert knowledge-based method is the unit day value approach. This relies on expert judgment to develop an approximation of the average willingness to pay for a recreation activity. Selected values are considered to be equivalent to consumer surplus (Walsh 1986, p. 230). It is clear that this kind of estimates of consumer surplus are not theoretically valid when they are compared to consumer surplus estimates that are derived from WTPs acquired through the CVM, TCM, or HPM.

There are also approaches to valuation that are not based on the presumption that preferences should count in monetary valuation (see e.g. Eberle and Hayden 1991). However, it is not possible to review them in this context. Their existence indicates that information required for social decision-making purposes can be constructed through a large variety of methods with very different theoretical and ideological premises. Consequently, the usefulness of the CVM depends heavily on the chosen presumptions. If the economic methodology behind the BCA framework is for some reason rejected, then the CVM automatically loses much of its validity and applicability. Nevertheless, monetary valuation in the form of the CVM is a preferred choice when theoretically correct monetary value estimates incorporating nonuse values are needed in the BCA framework.

4. Measurement and Welfare Economic Theory

This chapter introduces the essential theoretical concepts of welfare economics required in the assessment of welfare changes. First, the theory that forms the basis for money metric measurement of welfare changes is reviewed. The focus is on equivalent and compensating surpluses. Then, the questions why and when there are differences between willingness to pay (WTP) and willingness to accept compensation (WTA) and what the proper use of each measure is will be examined. This is followed by the presentation of the problems that arise when welfare change measures are aggregated across individuals. Finally, the chapter is summarized by an institutionally-oriented discussion about the social feasibility of monetary valuation.

4.1. Measuring Welfare Changes in Monetary Terms

Practitioners of applied welfare economics have developed an elaborated theoretical framework to measure welfare changes. Because direct measurement of utility is impossible, related measures have to be applied that reflect the changes in welfare as well as possible. These measures are usually derived from information that is acquired by observing consumers' actual behavior at the market place, and that is why they are usually expressed in monetary terms. From the viewpoint of policy-making, the question is about an estimation of the sum of potential Pareto improvements related to a price or quantity (quality) change of a commodity.

The starting point of welfare change measurement is the demand theory. The goal is to deduce as many properties of a demand function as possible and thus extract the maximum amount of information available. Consider an individual's utility function:

$$U = U(\boldsymbol{X}, \boldsymbol{Z}, z_f) \tag{4-1}$$

where $\boldsymbol{X}$ is a vector of all market goods, z_f represents the rural environment, and $\boldsymbol{Z}$ is a vector depicting all other nonmarket commodities. Now, a consumer wants to maximize his utility in respect of income, Y:

$$\begin{aligned} &max\, U = U(\boldsymbol{X}, \boldsymbol{Z}, z_f) \\ &s.t.\;\; Y = p\boldsymbol{X} \end{aligned} \tag{4-2}$$

The solution to the maximization problem (Equation 4-2) is a set of ordinary or Marshallian demand functions:

$$x_i^m = x_i^m(p, Y, \boldsymbol{Z}, z_f) \tag{4-3}$$

The demand of any x_i^m is derived from a set of prices, p, consisting of the price of the market good in question and prices of all other market goods, from income, Y, and from the existing quality and quantity of the rural environment, z_f, and all other nonmarket goods, $\boldsymbol{Z}$. Demand is uncompensated because, when prices change, income is not adjusted to compensate for the resulting change in utility.

Marshallian demand curves are downward sloping when the goods in question are normal goods. At a certain market price, a consumer demands a certain amount of the good. However, the consumer does not have to pay for every unit

as much as he would be willing to pay because at the market he faces only one equilibrium price. In other words, the consumer does not have to pay the reservation price for every unit. This difference between the reservation price and the actual market price is called consumer surplus. Thus, consumer surplus is defined as the area under the demand curve and above the market price line. It can be interpreted to mimic in observable monetary units an unobservable gain in utility.

Consumer surplus estimates derived from Marshallian demand functions have some shortcomings. In the case of multiple price changes or simultaneous price-income changes, they cannot produce consistent results. The change in consumer surplus depends on the order in which these changes in prices and income are considered or, more generally, on the path of adjustment (Johansson 1987). The associated problem is usually called the path dependency problem. The implication of this phenomenon is obvious. It does not make sense to use areas to the left of Marshallian demand curves to evaluate changes in consumer surplus created by multiple price or income changes unless the resulting change in consumer surplus is unique. It is possible to derive a set of rules that makes a money metric measure of consumer surplus based on Marshallian demand functions unique, but this kind of situation is far from reality. Individual indifference maps are required to be homothetic, because only then the consumer surplus change can be uniquely defined in the case when all prices change. This also means that all income elasticities of demand must be unity. When only a few prices change, it is sufficient that the income elasticities for this subset of goods are equal. In other words, the marginal utility of income must be constant with respect to prices and/or income, which change (Nicholson 1989).

Unfortunately, even if a money metric measure is unique, it does not necessarily measure the utility change correctly. This may happen despite the fact that utility changes themselves are always unique (although they cannot be directly observed) (Just et al. 1982, pp. 76-83). The sign of the consumer surplus change may be the opposite compared to the sign of the utility change expressed by the consumer's individual utility function. Of course, what should matter from the point of view of policy-making is the sign of the true welfare change, and not the sign of the money metric measure of consumer surplus change (Johansson 1991, pp. 40-47). Thus, Marshallian demand functions cannot necessarily be applied if the uniqueness of the change in consumer surplus is to be guaranteed. Fortunately, less demanding money metric measures of consumer welfare change can also be developed. They represent simple but rather plausible willingness to pay interpretations.

It is possible to substitute x_i back into $U(\cdot)$ (Equation 4-2), which yields a quasi-convex optimal value function $V(p, \mathbf{Z}, z_f, Y)$. This function is also called indirect utility function, and it defines the highest level of utility attainable, given prices p, income Y, and the existing quality and quantity of the rural

environment, z_f, and all other nonmarket goods, $\boldsymbol{Z}$. The connection between the indirect value function and the Marshallian demand function can be expressed by *Roy's identity*, which relates $x_i^m(\cdot)$ and $V(\cdot)$ in the following way:

$$x_i^m(p, Y, \boldsymbol{Z}, z_f) = \frac{\dfrac{-\partial V(p, Y, \boldsymbol{Z}, z_f)}{\partial p_i}}{\dfrac{\partial V(p, Y, \boldsymbol{Z}, z_f)}{\partial Y}} \tag{4-4}$$

that is, the derivative of indirect utility function with respect to the i^{th} price yields the i^{th} demand function, after normalizing by the marginal utility of income. Associated to the utility maximization problem presented in Equation 4-2, there is an expenditure minimization problem:

$$\begin{aligned} &min(p\boldsymbol{X}, \boldsymbol{Z}, z_f) \\ &s.t.\ U(\boldsymbol{X}, \boldsymbol{Z}, z_f) = \hat{U} \end{aligned} \tag{4-5}$$

The solution to this minimization problem is a set of Hicksian (or compensated) demand functions

$$x_i^h = x_i^h(p, \hat{U}, \boldsymbol{Z}, z_f) \tag{4-6}$$

which give the quantity demanded as a function of the prices of market goods, utility, and the quantity and quality of the rural environment and other nonmarket goods when the utility is constant. It should be kept in mind that income is of no consequence: as prices change, expenditures are adjusted to maintain the constant utility level. Now the expenditure function, $E(\cdot)$, can be derived. It shows the amount of income, Y, which an individual would have to attain a utility level $\hat{U}$ at a set of prices of market goods, p, and at the existing quality and quantity of the rural environment, z_f, and all other nonmarket goods, $\boldsymbol{Z}$. This can be done by substituting the Hicksian demand function back into the objective function (Equation 4-5) to yield:

$$E(p, \hat{U}, \boldsymbol{Z}, z_f) = \sum \left[p_i x_i^h(p, \hat{U}, \boldsymbol{Z}, z_f) \right] \tag{4-7}$$

Now the Hotelling's lemma can be applied:

(4-8) $$\frac{\partial E(p, \hat{U}, \mathbf{Z}, z_f)}{\partial p_i} = x_i^h(p, \hat{U}, \mathbf{Z}, z_f)$$

That is, the Hicksian demand functions are simply the derivatives of the expenditure function with respect to prices.

Consider a consumer with a specific income facing a set of commodity prices, p. One of the prices changes from p_0 to p_1 (see Figure 4.1). Now, the way should be found to compare in a feasible way the consumer's well-being before and after the change without dealing directly with utility, which is unobservable. Based on the earlier theory development, it is possible to define two of the most frequently applied money metric measures of welfare change, i.e. compensating variation (CV) and equivalent variation (EV). Compensating variation can be defined as the amount of income which must be taken away from a consumer after a price, quantity and/or income change to restore the consumer's original welfare level. Correspondingly, equivalent variation is the amount of income that must be given to a consumer instead of price, quantity, and/or income changes to leave the consumer as well off as with the change. Thus, compensating and equivalent variations are defined as income adjustments which maintain the consumer at particular levels of welfare (Just et al. 1982, p. 85).

Mathematical representation in the case of price change can be derived by means of the expenditure function, $E(\cdot)$. If income is Y, and if there is no change in the quantities of $\mathbf{Z}$ and z_f, and if the price of one market commodity changes from p_0 to p_1 (other prices, p, remaining equal) and, as a result, utility changes from U_0 to U_1, then compensating and equivalent variations can be written:

(4-9a) $$CV = E(p_1, p, \mathbf{Z}, z_f, U_0) - E(p_0, p, \mathbf{Z}, z_f, U_0)$$

(4-9b) $$EV = E(p_1, p, \mathbf{Z}, z_f, U_1) - E(p_0, p, \mathbf{Z}, z_f, U_1)$$

The relationship shown in the Hotelling's lemma (Equation 4-8) indicates that Equations 4-9a and 4-9b can be seen as integrals under Hicksian demand curves from p_0 to p_1. Graphically expressed, the area to the left of $x^{h1}(p, \mathbf{Z}, z_f, U_1)$, between the prices p_0 and p_1, is the equivalent variation (ABEF), and similarly for $x^{h0}(p, \mathbf{Z}, z_f, U_0)$, the area ACDF is the compensating variation. Figure 4.1 also shows the ordinary demand curve $x^m(p, \mathbf{Z}, z_f, Y)$. It intersects the Hicksian demand curve for U_0 at p_0 (x^{h0}) and the curve for U_1 at p_1 (x^{h1}). We can easily see that the area to the left of the ordinary demand curve (x^m) and between the price lines p_0 and p_1, i.e. ACEF, is the Marshallian consumer surplus that has already been referred to (Kohlstad and Braden 1991, pp. 28-30).

The close linkage between the expenditure function and the indirect utility function makes it possible to derive alternative definitions for the compensating and equivalent variations:

(4-10a) $$CV = V(p_1, p, \mathbf{Z}, z_f, Y_0) - V(p_0 p, \mathbf{Z}, z_f, Y_0)$$

(4-10b) $$EV = V(p_1, p, \mathbf{Z}, z_f, Y_1) - V(p_0, p, \mathbf{Z}, z_f, Y_1)$$

The theoretical content of this formulation is the same as the formulation based on the expenditure function (Equations 4-9a and 4-9b). We can conclude that the *CV* focuses on the initial level of income and reveals the amount of required compensation from thereof, while the *EV* considers the subsequent level of income as the reference point.

In certain cases, especially when we deal with environmental commodities, the quantity and/or quality of such a commodity must be taken as given. A consumer cannot vary the amount of the commodity that he is going to consume or use. The consumer can only decide whether to consume or not. In these cases, it is theoretically more appropriate to use other money metric measures than *CV* or *EV* to estimate related welfare changes. In this context, concepts like com-

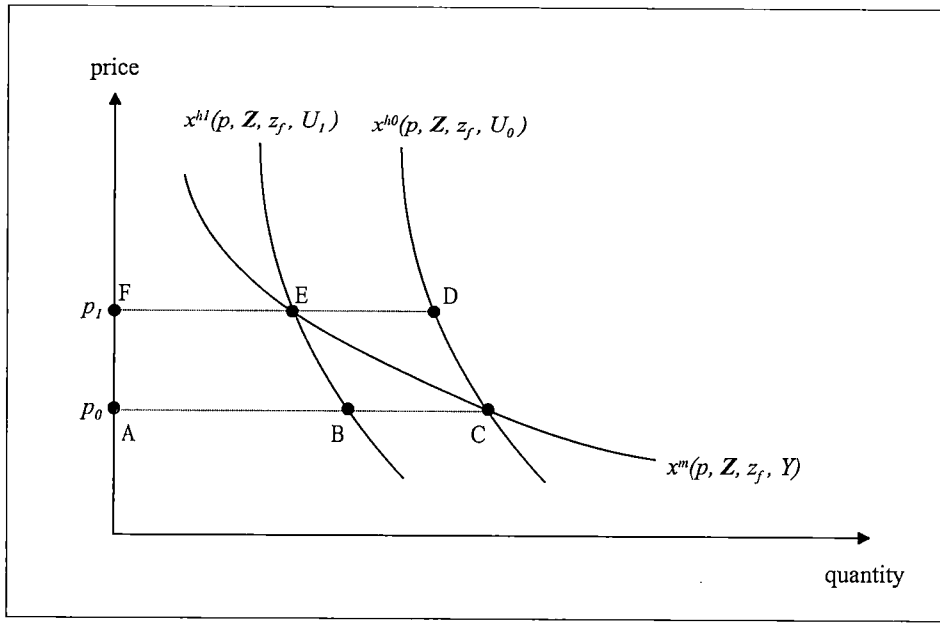

Figure 4.1. Marshallian Consumer Surplus, Compensating Variation and Equivalent Variation (Kohlstad and Braden 1991, p. 29).

pensating surplus (*CS*) and equivalent surplus (*ES*) are usually applied (Mitchell and Carson 1989, pp. 24-27).

The difference between variation and surplus measures is not very drastic but, nevertheless, of some importance when nonmarket commodities are concerned. The change in quantities and/or qualities replaces the change in prices. If we assume that there is a change in the quality of the rural environment from z_{f0} to z_{f1}, all the other variables remaining the same as before, then the *CS* and *ES* measures based on the expenditure function can be noted:

$$CS = E(p, \boldsymbol{Z}, z_{f1}, U_0) - E(p, \boldsymbol{Z}, z_{f0}, U_0) \tag{4-11a}$$

$$ES = E(p, \boldsymbol{Z}, z_{f0}, U_1) - E(p, \boldsymbol{Z}, z_{f0}, U_1) \tag{4-11b}$$

and correspondingly, the *CS* and *ES* measures derived from the indirect utility function can now be written:

$$CS = V(p, \boldsymbol{Z}, z_{f1}, Y_0) - V(p, \boldsymbol{Z}, z_{f0}, Y_0) \tag{4-12a}$$

$$ES = V(p, \boldsymbol{Z}, z_{f1}, Y_1) - V(p, \boldsymbol{Z}, z_{f0}, Y_1) \tag{4-12b}$$

To fully understand the difference between variation and surplus measures, consider Figure 4.2, where the price is initially p_0 and the quality of the rural environment is originally z_{f0}. Now, suppose that as a result of some policy action the quality of the rural environment decreases to z_{f1}. From the viewpoint of market-oriented consumption, this would be equivalent to raising price to p_1, so that the consumption would fall to z_{f1} along the Marshallian demand curve x^m. Assume for a moment that this price increase seemingly accompanies the reduction of quality. The Hicksian demand curves associated with the final and initial states are thus x^{h1} and x^{h0}, respectively. The change in Marshallian consumer surplus is a reduction of area (B+C+D). Applying the equivalent variation the change is only area (B+C), so the associated error in the Marshallian consumer surplus change is area (D). On the other hand, the compensating variation of changing price from p_0 to p_1, i.e., area (B+C+D+E), does not measure the willingness to pay for the quality reduction in the event of change. The consumer is not free to adjust z_f following the price change, and so he is worse off than otherwise. Of course, the consumer could decide not to visit the rural environment ever again, but this would probably cause even a bigger welfare loss.

Apparently, the necessary compensation for an imposed quality change is given by the change in the area under the Hicksian demand curve (x^{h0}), minus the change in what is actually paid. The consumer loses gross benefits of area

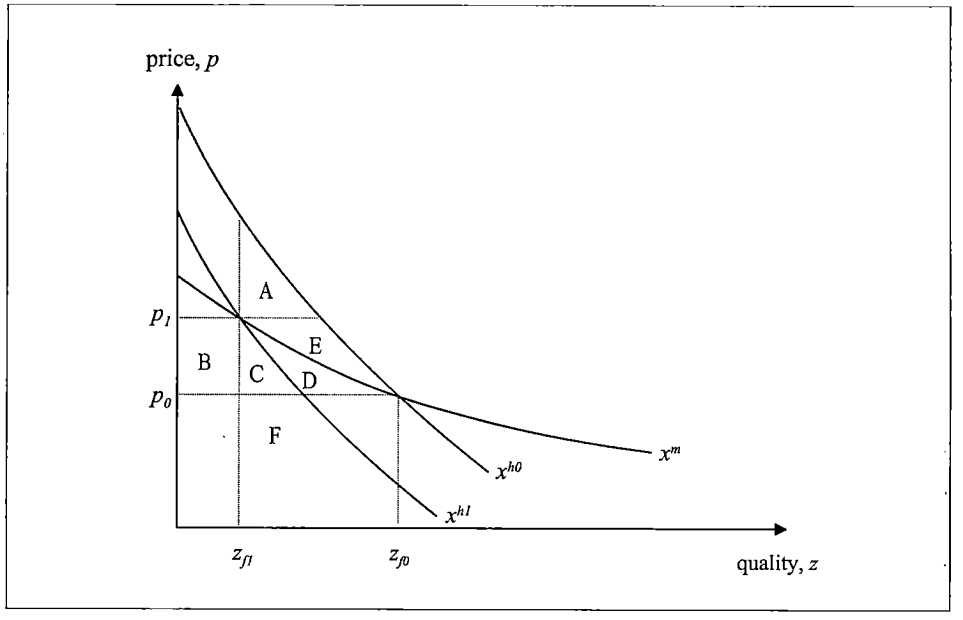

Figure 4.2. Difference between Variation and Surplus Measures (Just et al. 1982, p. 137).

(A+C+D+E+F), but reduces expenditure by area (F–B) for a net loss of area (A+B+C+D+E). The error in the Marshallian consumer surplus change as a measure of compensating variation is not simply area (E), as in the price change case, but area (A+E). This implies that special considerations are required for compensating variation when a quality/quantity change is imposed. Similarly, special considerations are required for the equivalent variation when a quality/ quantity change imposition is removed. Furthermore, if both initial and final qualities/quantities are restricted, both variations require special consideration.

The compensating surplus differs from the compensating variation because the *CV* allows the adjustment of consumption following the compensation. Thus, we can conclude that, if the subsequent quality/quantity is limited so that adjustment is not possible following the compensation, the compensating surplus should be used instead of the compensating variation. In such cases, the *CS* is no doubt the most correct money metric measure of welfare change. Correspondingly, if the initial quality/quantity is restricted so that adjustment is not possible in the event of compensation, the equivalent surplus should be used instead of the equivalent variation in welfare analysis (Just et al. 1982, pp. 136-139).

From the viewpoint of CVM practitioners the most important thing is, however, that it is possible to interpret compensating and equivalent variations

(surpluses) as willingness to pay (WTP) and willingness to accept compensation (WTA). For example, compensating variation for a price fall can be interpreted as the maximum amount of income that a consumer would be willing to pay rather than reject the price reduction. For a price increase, compensating variation is the minimum amount that the consumer must be paid or he is willing to accept to tolerate the higher price. Thus, compensating variation questions measure the gains or losses associated with taking a proposed action, in this case changing price. Consequently, WTP can be defined to be the amount of money that a consumer would be willing to give up to obtain a change and still be as well off as with his previous entitlement. Correspondingly, WTA can be defined to be the amount of money that would have to be given to a consumer in order to make him forgo a change, provided that he would still be as well off as if the change had occurred.

Equivalent variation, on the other hand, measures gains and losses to the consumer associated with not taking the proposed action. That is, equivalent variation for a price fall can be interpreted as the minimum amount of income the consumer is willing to accept to forgo a lower price. Correspondingly, for a price increase, equivalent variation is the maximum amount that a consumer is willing to pay to avoid the higher price. Thus, equivalent variation is the maximum bribe the consumer is willing to pay to avoid adverse change in economic conditions or the minimum bribe necessary to gain relinquishment of a claim on improvement in economic conditions (Just et al. 1982, p. 87). The connection between WTP/WTA measures and compensating/equivalent variations and surpluses is summarized in Table 4.1.

In Figure 4.3, in turn, the relationship between *CS/ES* and WTP/WTA is outlined in a graphical manner, based on Bateman and Turner (1992, pp. 25-28). The upper panel of Figure 4.3 describes, by means of indifference curves (u_0, u_1), welfare changes when the consumed amount of the unpriced, quantity-constrained environmental good, z, alters. The good Y represents all the other

Table 4.1. Hicksian Measures for Contingent Valuation Surveys (Mitchell and Carson 1989, p. 25).

Type of change	WTP	WTA
Quantity increase	*CS*	*ES*
Price decrease	*EV;ES*	*CV;CS*
Quantity decrease	*ES*	*CS*
Price increase	*CV;CS*	*EV;ES*

WTP = willingness to pay
CS = compensating surplus
CV = compensating variation
WTA = wilingness to accept compensation
ES = equivalent surplus
EV = equivalent variation

available goods (i.e. total income). The budget line, *bl*, is horizontal because the use of z does not cost anything to the consumer. Thus, the consumption of z is solely dependent on its supplied amount. Assume that the initial amount of the environmental good z is z_0. The corresponding consumer utility is then depicted by point A. If the supply of z increases from z_0 to z_1, the consumer moves along the budget line to achieve a higher level of utility, B. In the lower part of Figure 4.3, the corresponding change, described through the Marshallian demand curve x^m, appears to be an increase in consumer surplus (areas $b+c$). Both substitution and income effects due to the change in supply of z have been taken into account. Despite the zero price of z, the income effect still exists[4], and the Marshallian consumer surplus is not an accurate measure of welfare change. The income effect can be compensated by examining how much the consumer is willing to pay to make sure that the supply of z increases from z_0 to z_1 (type 1 measure: WTP_{CS}). The consumer's maximum willingness to pay for the change from z_0 to z_1 is the payment BC. As a result of the payment, the income of the consumer decreases and he returns to his initial utility level (u_0), which is depicted by point C. In the lower panel of Figure 4.3 the Hicksian demand curve x^{h0} and area c below it accurately describe the welfare increase (compensating surplus) due to the quantity change.

Alternatively, we can assume that the same quantity increase from z_0 to z_1 is not implemented. In this case, the lost possibility of utility increment can be compensated to the consumer by paying him the amount AD, which would make it possible for him to achieve the higher utility level u_1. The amount AD is the equivalent value of minimum extra income, which the consumer is willing to accept to forgo the welfare gain of increased provision of z. This moves the consumer to point D on u_1 and maps out the Hicksian demand curve x^{h1} in the lower panel. The correct welfare measure for this scenario is therefore the equivalent surplus (area $a+b+c$ in the lower panel) (type 2 measure: WTA_{ES}). This means that WTP_{CS} < Marshallian consumer surplus < WTP_{ES} or WTP < WTA. Thus, the consumer wants to have more compensation for annulled quantity increase than he is willing to pay to make the same thing happen.

Consider next a welfare loss, e.g. a decrease in the provision of z from z_1 to z_0. In this case the consumer will start at point B and the initial indifference curve will be u_1. Faced with a fall to point A on the new utility level u_0, the consumer will be willing to pay the amount BC to avoid the loss (type 3 measure: WTP_{ES}). Nevertheless, if the welfare loss due to the change in the provision of z does occur, then the consumer can still be compensated by giving

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[4] Even if z itself is unpriced, its increased provision will still have an income effect by releasing some of the income previously spent upon priced goods. For instance, if z is recreation, its increased provision relieves spending upon other priced recreation goods.

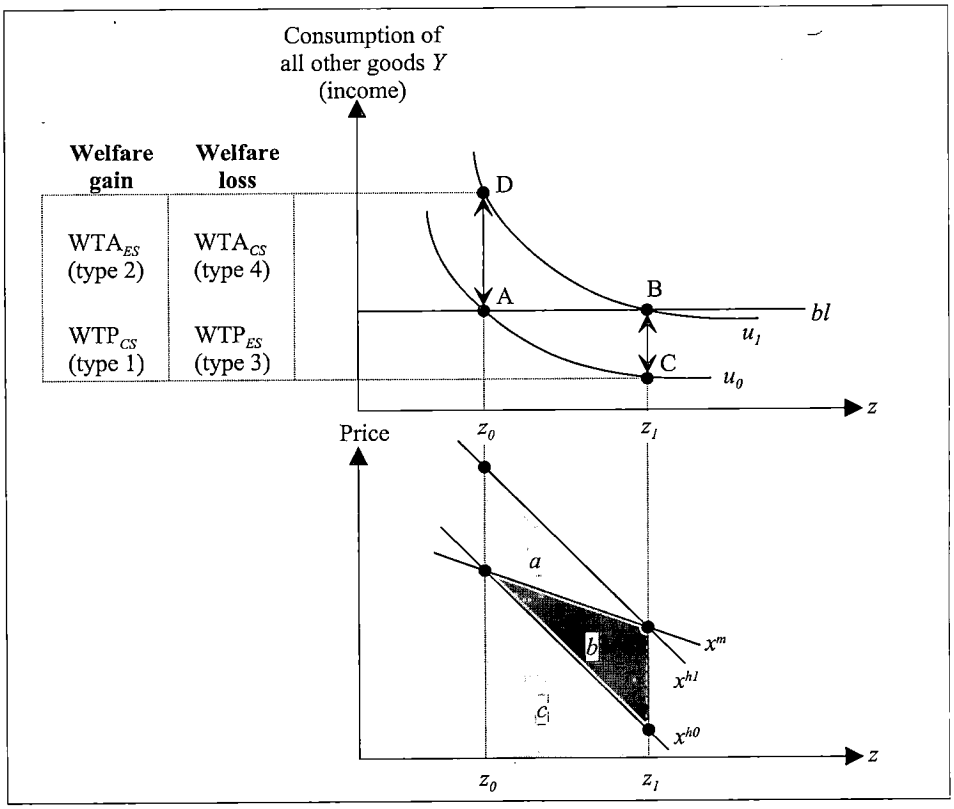

Figure 4.3. Compensated Welfare Change Measures for an Unpriced Quantity Constrained Good (Bateman and Turner 1992, p. 27).

him extra income AD to return him to his initial utility level u_1 (type 4 measure: WTA$_{CS}$). The interesting point is that now WTP$_{ES}$ < Marshallian consumer surplus < WTA$_{CS}$. Therefore, in the case of both gain and loss, WTA exceeds WTP.

As we can see, there are theoretical problems in the consumer surplus measure of welfare change. Nevertheless, because of the impossibility of mapping utility functions, Marshallian consumer surplus measures have often been calculated as the best practical estimates of welfare change. In theory, the CVM approach, in eliciting explicit statements of how much income consumers are willing to pay to ensure that a welfare gain occurs (or to prevent a welfare loss from occurring) or how much income they are willing to accept as compensation to endure a welfare loss (or forgo a welfare gain), directly estimates the true Hicksian welfare changes of these measures. This is clearly a theoretical advantage.

4.2. Choice Between WTP and WTA

We can easily see that in a market situation WTP and WTA are logically equivalent to the buyer's best offer and the seller's reservation price, which are Pareto-safe prices. Therefore, the use of the potential Pareto improvement (PPI) criterion actually requires that beneficial and adverse effects have to be valued in terms of compensating and equivalent measures of welfare change (Randall 1987, p. 245). The policy implication is that if a compensation test allowing interpersonal cardinal utility comparisons is regarded as a proper criterion for social decision-making, then WTP and WTA expressed in equivalent and/or compensating measures (variation or surplus, depending on the nature of the change) are theoretically the most correct measures of welfare change.

Apparently, the choice between WTP and WTA measures is in a decisive role when an elicitation question in a CVM survey is phrased. Unfortunately, their use in the case of environmental and other nonmarket goods is not as straightforward as it is when market goods are in question. The nonrival and nonexclusive nature of environmental goods makes it impossible to define property rights in a nonattenuated manner. This complicates the analysis to some extent and, as a consequence, one of the most enduring controversies in the field of CVM research is whether the WTP or WTA approach should be chosen.

Willig (1976) showed that, in the case of a price change, the difference between WTP and WTA was a function of income elasticity. Moreover, he showed that in the case of the income elasticity having a reasonable value, the difference between WTP and WTA had to be small. However, in many empirical studies CVM researchers continuously reported considerable differences between WTP and WTA measures for the same good being valued. It appeared that his theoretical results were mainly valid for policies that changed prices for consumers with well-behaved utility functions. Above all, this implied that his results might not be appropriate for some commonly estimated but not conventional demand functions. This is true especially in cases where the provision of public goods involves quantity changes and, in particular, for policy changes where the quantity of the good provided goes to zero (Mitchell and Carson 1989, p. 31).

Randall and Stoll (1980) expanded Willig's (1976) analysis from price changes to a situation where a quantity or quality change of a commodity alters welfare. They observed that the CV and EV are identical and equal to Marshallian consumer surplus if commodities are fully divisible and tradable without transaction costs in an infinite market. For fully indivisible commodities CV is larger than EV in a welfare loss case and smaller in a welfare gain case. In addition, the difference between CV and EV is somewhere in the middle of these two cases if the commodity is divisible and if its exchange claims transaction costs. As a

practical guideline they concluded that if the commodity is divisible, the commodity market is fairly competitive, the transaction costs are low, and the price elasticity is small, then the use of Marshallian consumer surplus causes only a small error when compared to possible inaccuracies in estimation techniques. At the same time, *CV* and *EV* are so close to each other that WTP and WTA measures should be almost equal.

Hanemann (1991) showed that in the case of imposed quantity changes, the theoretical difference between WTP and WTA is governed by the ratio of the income elasticity to the substitution elasticity rather than by the income elasticity alone. The substitution elasticity refers to the ease with which other market commodities can be substituted for the given public good while maintaining an individual at the constant level of utility. The elasticity of substitution takes the value of zero if no amount of increment in any market goods can substitute for the change in the public good, and the value of infinity if at least one market good is a perfect substitute for the public good. It is possible to show that the smaller the substitution effect and the larger the income effect is, the greater is the disparity between WTP and WTA. Furthermore, if either the income effect is zero or the substitution effect is infinite, WTP and WTA must coincide. If the public good in question is unique and the income elasticity is of ordinary magnitude, the difference between WTP and WTA can become considerable. There is no doubt that Hanemann's (1991) work is unsettling because it implies, in contrast to Willig's (1976) results, that there may exist large real differences between WTP and WTA measures for unique environmental goods. This suggests that the property rights chosen are of great importance.

Shogren et al. (1994) tested Hanemann's (1991) propositions. The authors analyzed experimentally in a non-hypothetical auction market situation differences between WTP and WTA by using easily substitutable market commodities (i.e. candy bars and coffee mugs) as well as a nonmarket commodity of low substitutability (i.e. reduced health risk). They found out that WTP and WTA amounts related to market commodities with close substitutes did not differ statistically significantly from each other. The opposite was true in the case of a nonmarket commodity without close substitutes. The WTP and WTA measures diverged and the difference persisted even with repeated market participation and full information on the nature of the good. Thus, the results of Shogren et al. (1994) give support to Hanemann's (1991) hypotheses.

The most serious problem in CVM studies using WTA type questions is that it is difficult to create plausible contingent market scenarios (Carson 1991). Consequently, the current consensus among CVM researchers seems to be that WTA cannot reliably be measured by using a CVM survey. Already Cummings et al. (1986, pp. 102-106) in their "*reference operating conditions*" for contingent valuation studies recommended that only WTP measures should be elicited in the attempt of valuing environmental commodities. In addition, the recom-

mendation of the NOAA Panel (Arrow et al. 1993) is that WTP format should be used instead of WTA format because WTP is a more conservative choice. Generally, when aspects of the survey design and the analysis of responses are ambiguous, the option that tends to underestimate the acquired welfare measure is preferred. However, the NOAA Panel did not review any theoretical issues concerning the superiority of WTP to WTA.

As noted above, the formulation of the elicitation question also depends on the prevailing set of property rights. It does not make sense to present a WTA question to a non-owner of a resource if the person cannot simultaneously be guaranteed property rights that ensure his entitlement to the compensation offered. Mitchell and Carson (1989, pp. 38-41) have developed an interesting approach that rethinks the role of property rights when selecting between WTP and WTA in the case of public goods which require annual payments or their equivalents in order to maintain the given level of quantity and/or quality. Many important public goods have this feature. Water quality, for instance, would rapidly decline if the government did not spend any money on control measures. For public goods of this type, neither ownership nor use as such is able to capture the relevant relationship between the good and the consumer.

Two dimensions of a public good receive special attention: it is held either individually or collectively, and its level of quantity/quality is either currently accessible or currently inaccessible. Individually held rights to a public good can occur when a public good is clearly excludable. Then individuals can be granted exclusive rights to its use by the collective if such a grant is considered to serve the public interest. Various allocation rules are used when the rights are granted, and the rights are usually not transferable. Collectively held rights occur when access to the public good is available to all members of the collective, and when individual members cannot trade their right to access. The rural environment is a good example of a public good of this kind. People have a collective property right to visit the countryside (public access), but the right cannot be transferred by any means. Now, there is a cost to provide the good at a given quality level, and this cost is borne by all consumers through some combination of taxes (agricultural support), prices (agricultural products), and the like. Moreover, if the level of payment is not maintained, the quality of the rural environment will soon deteriorate. Correspondingly, if a quality increase of the rural environment is desired, higher payments (higher taxes, higher producer prices) will be needed to cover the cost of providing the new quality level.

The second dimension for determining the appropriate surplus measure for a public good is whether a given level of quantity/quality is accessible. At the moment, there exists a certain number of exceptionally valuable traditional agricultural landscape areas that have been tracked down by governmental authorities. This can be regarded to represent the quality level of the rural environment. On the other hand, it is currently impossible to have twice as many

exceptionally valuable traditional agricultural landscape areas. This framework for conceptualizing the property right to public goods has important implications for the choice of the correct Hicksian surplus measure for CVM surveys. Now, the aim is to measure the benefits of this public good starting from the consumer's initial level of utility. If a given utility level of the public good is not currently available, the WTP_{CS} measure determines the would-be value of the increased provision. This is parallel to a private good case in which an individual has similar property rights (i.e. he is not able to use the good and does not own it). In both cases, the WTP_{CV} correctly measures the amount that the individual is willing to pay for the improvement that leaves him as well off before the change as after it.

In the public good case, however, the WTP_{CS} is also regarded to be the most correct measure for a proposed decrease when a given quality level is currently available. The corresponding set of property rights for a private good case concerns a situation where an individual has access to a private good (i.e. he owns the good and is able to use it). We can easily observe (see Table 4.1) that in this private good case (quantity decrease) the recommended welfare change measure is WTA_{CS} instead of the proposed WTP_{CS} if the measurement is to be carried out starting from the initial level of utility. Now, since the individual in the public good case is already paying for the public good on a regular basis, the Hicksian compensating surplus for this case is the amount that the consumer is willing to pay to forgo the reduction in the quality of the good and still be as well off as before. If the rural environment is thought of as an example in this context, people have two options: better quality of the rural environment and higher payments or poorer quality of the rural environment and lower payments. In the case of quality decrease of the rural environment, the WTA question would inquire how much people would have to be paid to voluntarily accept the poorer quality of the countryside. However, as explained above, people are already financing the maintenance of the rural environment through taxes. In such a situation, people have the right to enjoy the quality of the rural environment but, simultaneously, they have to pay for it. Thus, the effective property right is actually WTP, not WTA. The essential property which makes WTP rather than WTA appropriate is that the same people constitute both sides of the transaction.

4.3. Aggregating Welfare Measures

Aggregation of individual utilities in empirical applications is based on certain pre-assumptions, which have to be clarified first. These pre-assumptions are related to people's preferences and behavioral models. In addition, we have to deal with the question about the choice of correct summary statistics and appropriate statistical estimation techniques of WTP.

As we know, utility or welfare cannot be measured directly. There are no measurable units that could be identified as "utils". The tradition among economists is to assume that money is a close measure of utility and that an individual expresses his search for ever-greater satisfaction through the consumption of goods and services. However, it is not likely that all people have similar attitudes towards money. For many people money and utility can be surrogates, but this need not be the case in general. Thus, the marginal utility of income can vary considerably among people.

Monetary gains and losses can be summed up across individuals in a theoretically correct way only when the distribution of welfare in the society is at the optimal level. This, in turn, implies that all individual marginal utilities of income have to be equal (Johansson 1993). This kind of situation occurs only when the society is in the Pareto optimal state. Normally, not all the criteria of Pareto efficiency are fulfilled. Thus, certain preconditions have to be satisfied before measures of welfare change (for instance, equivalent version of willingness-to-pay) can be added up across individuals or households. First, it is necessary that the marginal social utility of income is identical for all individuals. This is possible only in two cases. The first alternative is to assume that the marginal utility of income is the same for all individuals. This is true if all individuals have identical ordinal preferences, i.e. the same indifference curve maps. If individual indifference curves do not coincide, there is no unambiguous way to make individual marginal utilities of income equal across individuals. The second alternative is to assume that some institution (e.g. government) continually redistributes income in order to maintain the equality of marginal social utilities (Boadway and Bruce 1986). However, every action of redistribution is likely to create transaction costs. In other words, an attempt to develop a society that makes it possible to aggregate individual utilities in a theoretically correct manner is in itself a costly project that has redistribution and reallocation effects.

Aggregation across people can also be difficult because it is hard to know what the target population should be. This is a relevant question especially when significant nonuse values are involved. Jakobsson and Dragun (1996) conducted a CVM survey examining the value of the preservation of endangered species in the State of Victoria, Australia. The population surveyed was adult Victorians, but the authors emphasize that it is quite likely that Australians in other states and even people overseas may have existence values for Victorian endangered species. Thus, restricting the survey to Victorians may underestimate the value of protecting species in the State of Victoria.

Rubin et al. (1991) carried out a CVM survey that was aimed to investigate the value of the preservation of the northern spotted owl in the Pacific Northwest in the USA. The target population consisted of residents of the Washington State. The authors reasoned, however, that due to the public good nature of

preservation, protecting spotted owls in the Washington and Oregon states would provide benefits to people throughout the nation. Therefore, they extrapolated the results to cover the whole country by assuming that WTP decreases about 10% for every 1000 miles in distance. Even though the authors remarked that their extrapolations are more illustrative than conclusive, their approach underlines the potentially important role of nonuse values.

If the theoretical reservations concerning the aggregation of money metric measures of utility are left aside, it seems that aggregation across individuals depends heavily on the magnitude of nonuse values involved and on the scope of locality of the good being valued. Some natural resources create nonuse values on a global scale, for example, rain forests of the Amazon area in Brazil. In this case, a random sampling from the target population would be extremely difficult and costly. Obviously, there is no definite rule where to draw the line in the aggregation issue. In practice, nevertheless, some lines must be drawn. Consider the valuation of the Finnish rural environment. It can be regarded as a national public good because the deterioration of the Finnish countryside does not have much impact on environmental quality and life-supporting systems on the world scale, unlike the Amazonian rain forests. Thus, the target population is those who are able to enjoy the rural environment and who in essence are responsible for the costs of producing the public good in question. This is obviously important from the social point of view because people usually consider it fair that potential beneficiaries of public goods participate in their production costs.

Another important aggregation issue is the use of summary statistics, which usually means the choice between the mean and the median. In the case of dichotomous contingent valuation data, effects of different statistical estimation techniques should also be considered. The choice of summary statistics depends on the formulation of the valuation scenario and the nature of desired policy recommendations. If the ultimate goal is to aggregate costs and benefits in a benefit-cost analysis framework, then the mean value is the appropriate measure because it makes it possible to apply Pareto concepts in the welfare change analysis (Harrison and Kriström 1995). This indicates that, if the objective is to find out whether the proposed change is a potential Pareto improvement, the mean value should be used. However, if the goal is to interpret the results in terms of the outcome of a referendum, the median is a more appropriate summary statistics, although the use of the median value does not in general produce a Pareto efficient outcome (Johansson et al. 1989).

From the point of view of statistical estimation techniques, the median has some advantages over the mean. First, it is a more robust measure of central tendency. The mean is more sensitive to perturbations caused by errors in the data or by unusual observations (Hanemann 1984). It is also true that the mean is sensitive to the specification of the cumulative distribution function used in

the dichotomous data estimation, while the median is robust in this case, too (Kriström 1990a). Furthermore, the mean is more sensitive to methodical alternatives in the structural model estimation, such as generalized least squares or maximum likelihood (Hanemann 1989). However, robustness of the median can also be a problem. Boyle et al. (1988) argue that, although the median may be less sensitive with respect to skewness in the distribution, one can expect the distribution of WTP values to be skewed, and thus the median may not be the ideal measure of central tendency. Consequently, the choice between the mean and the median should be made in a theoretically well-grounded manner, although issues related to statistical estimation should not dictate it.

4.4. Some Institutionally Oriented Viewpoints

Considering the complexity of the social decision-making process and the number of problems related to individual preferences and their revelation, it is not surprising that monetary valuation has been seen in many occasions as an inadequate approach to provide valid information for the purposes of policy-making. Some social scientists even challenge the rationality of the use of individual preferences as the basis for the assessment of social welfare change. They either strongly oppose the use of people's preferences as a legitimate starting point of social decision-making or favor institutional structures that eliminate the necessity of making interpersonal welfare comparisons by a third party.

If preferences are regarded as unreliable and/or invalid, a possible solution is to reject the idea that preferences (whatever they are like) should count in the social decision-making which deals with environmental amenities and services possessing public good characteristics. For instance, Sagoff (1994) promotes this rather non-economic view. He argues that choices should count instead of preferences, and that preference-satisfaction does not necessarily lead to improved well-being of the society as a whole. According to him, the core of the problem is that economists cannot make a difference between preferences as psychological phenomena and preferences as logical constructs derived from certain behavioral assumptions.

Empirical psychologists explaining behavior in terms of its causal conditions do not give preferences a prominent position. Some of them regard preferences as private mental states that are not observable and thus not testable in the scientific sense. If an attempt is made to explain a choice of an individual in terms of preferences, any explanation will inevitably have an *ad hoc* nature. There can be a dozen of potential explanations, some of them more likely than the others, but it is not possible to detect which of them, if any, is the correct one. Thus, preferences as psychological phenomena represent unidentified behavioral motives behind actual choices.

The social choice theory, in turn, presents preferences as formal constructs derived logically from stipulated descriptions of individual behavior. The behavioral model is prescribed, and the social choice theory does not speculate on the psychic, environmental, genetic, or other causes of behavior. Usually the applied behavioral concept is rationality. When this approach is broadened to the societal level, social choice theorists begin with "given" or "assumed" descriptions of alternative social states and then construct preference schedules as rankings among stipulated behavioral descriptions. Thus, the social choice theory is concerned with the logical, not the psychological, properties of preference orderings. Therefore, the relation between preference and choice in this context becomes logical, not psychological, or causal.

Now, Sagoff (1994) argues that welfare economists follow social choice theorists by constructing preferences logically from stipulated descriptions of behavior. Yet, welfare economists assert that these logical constructs function as the psychological causes of this behavior. In this connection, they make themselves guilty of the use of *ad hoc* explanations by supposing that theoretical terms logically constructed from ways of describing behavior simultaneously cause that behavior. In other words, welfare economists misleadingly combine an epistemological program of clarifying the logical structure of preferences and a psychological program of identifying the causal mechanisms behind them. Consequently, there will be a mix-up of epistemological and psychological elements, which leads welfare economists to move casually between the logical analysis of rationality and psychological claims about behavioral motives.

In practical applications welfare effects of preference satisfaction are expressed through money metric measures of welfare change, i.e. willingness to pay. If social welfare is defined as a function of willingness to pay for something rather than a function of "true welfare" originating from having something, the allocation of natural resources takes place in favor of those who can afford to pay the most for the use. The pivotal question is whether the WTP approach really measures changes in personal welfare associated with the consumption of different goods and services. The problem is that welfare economics does not offer any other method for measuring changes in personal well-being. The ramification of this is that the relation between willingness to pay and welfare is a stipulative or definitional rather than a contingent one. This is why the proposition that the more people will pay for things, the more welfare they will derive from having them, must be treated as a tautological definition and not as a fact. Therefore, the claim that preference satisfaction promotes well-being in essence merely assumes that the truth is what actually should be proved to be the truth (Sagoff 1994).

Concerning the utilization of CVM results in the social decision-making context, Sagoff's (1994) claims are extremely discouraging. If stated prefer-

ences are not proper indicators of actual future choices, the CVM is hardly applicable. In addition, if money metric welfare measures cannot be applied when changes in social well-being are assessed and evaluated, the Kaldor-Hicks compensation criterion is hardly an appropriate criterion to be used in the ranking of alternative policy proposals. However, Sagoff's (ibid.) purpose is not to rebut the concept of consumer sovereignty. He considers that, although markets and democratic processes may fail to produce an optimal resource allocation, they should be regarded as the most appropriate settings for individuals to make choices and to pursue their visions of the personal and social good. The moral properties related to choices, like accountability, responsibility, commitment, and consent, are not dependent upon preferences that can be assumed to be behind different choices. Thus, as long as social decision-making is based on information gathered from our actual choices and not from our preferences, we need not be worried about decisions related to the allocation of natural and environmental resources.

When the CVM is used, the idea of the market failure is implicitly accepted. If the market functioned properly, there would not be any necessity to search for people's preferences beyond actual market transactions. In essence, the application of the CVM is based on thinking that lies behind the prevailing centralized approach to environmental problems. Because of the externality nature of many environmental effects, the society is forced to take policy actions to internalize benefits and costs produced by these effects. Independent of the nature of the chosen policy instrument, a Pigouvian tax, a command-and-control regulation, or informative guidance, the point of the centralized approach is that the society identifies the amount of harm or benefit and employs some policy instrument in order to achieve an optimum where social welfare is maximized as well as possible. The CVM is an excellent tool for this kind of approach. It can be used for the estimation of nonmarket benefits created by public good or externality type environmental commodities and impacts.

However, all economists do not feel comfortable with the idea of inevitable market failure. In his famous article Coase (1960) sketched an approach that emphasized the importance of property rights and rejected intervention by the government in favor of market bargaining in order to achieve the socially optimal level of internalization of externalities. Given the existence of an appropriate property rights system (guaranteed ownership of resources via enforcement by the society) and certain other assumptions, he argued that a harm producer and a harm sufferer should be left in an unregulated situation. A bargaining process would then develop on an automatic basis. The so-called *Coase theorem*[5] states that if transaction costs are zero, the initial assignment of

[5] The Coase theorem is often abbreviated into the form that property rights do not matter, but this is not an appropriate interpretation as Schmid (1987, p. 219) rigorously points out.

property rights will not affect the efficiency with which resources are allocated (Posner 1993).

The Coase theorem has been questioned in many occasions in the economic literature but it has succeeded in maintaining most of its relevance. The major problem with the applicability of the Coase theorem is that in real-life situations the role of transaction costs becomes significant. It is quite conceivable that the trade between two parties always involves some kind of transaction costs. Positive transaction costs would reduce the effective value of any offer or payment. The amount paid would be equal to the amount received minus the transaction costs. Consequently, if the transaction costs were larger than the potential gains from the trade, no trade would take place.

It is difficult to say to what extent the Coasian approach could really replace methods like the CVM. Pearce and Turner (1990) have concluded that the Coase theorem has been important in forcing advocates of public intervention to define their terms and justify their case more carefully than they might have done otherwise. Randall (1987) emphasizes that the Coasian analysis has contributed to the understanding of externalities and market functions. In essence, the theorem has successfully suggested that market phenomena may be more pervasive than has been generally recognized, and that the market behavior is likely to occur whenever gains from trade exist, even in settings customarily considered to be outside the market. Moreover, as Posner (1993) notes, the Coasian approach has vividly promoted the point that intelligent public intervention requires more information than governments are usually likely to have.

In the CVM context the explicit or even implicit assignment of property rights matters. It may affect response behavior. When a respondent is asked, for instance, how much he is willing to pay for a conversion from conventional agriculture to pro-environmental farming, the scenario indirectly implicates that the farmers own environmental benefits related to the rural environment. It is not surprising that some respondents oppose this kind of definition, because property rights related to the rural environment are far from being defined in a nonattenuated way. The result can be a serious motive conflict. On the one hand, the respondent wants to have environmental benefits produced by pro-environmental farming. On the other hand, he is not willing to pay for them because, according to what he considers "fair" property rights, he should be entitled to them anyway. Of course, it is difficult to say if this kind of respondent would enter any bargaining process either.

Property rights and other social institutions seem to matter more than is usually recognized. However, it is not realistic to assume that institutional innovations and developments could remarkably broaden the applicability of the market mechanism when environmental commodities and services are concerned. Problems related to transaction costs will persist. This guarantees that

monetary valuation methods of nonmarket benefits like the CVM will also be needed to assist social-decision making in the future.

5. Creating Hypothetical Markets - The Contingent Valuation Method (CVM)

The purpose of this chapter is to introduce the essential features of the contingent valuation method. First, some light is cast on the historical development and the future prospects of the contingent valuation method (CVM). This helps to understand why the CVM has become such a popular tool in environmentally oriented monetary valuation. Then, the main steps of the CVM survey design are described. Third, a model of response behavior is introduced. It can be used when major sources of bias inherent in CVM studies are analyzed. Next, respondents' preference structures are investigated. The idea is to show that they may differ in certain occasions from the standard presumptions of the neoclassical preference theory. In addition, the role of information in contingent valuation applications is examined in more detail, and the most commonly applied value elicitation formats and their strong and weak points are reviewed. Finally, a brief summary is given concerning some earlier CVM studies related to the valuation of services provided by the rural environment.

Like any other method based on interviews or surveys, the CVM is not a monolithic exercise of a standard formula. This is reflected in the various forms of the survey design and sometimes complicated interpretation of survey outcomes. The aims of the researcher may be deliberately or accidentally misunderstood among respondents, which has resulted in intensive investigation of possible sources of error or biases, as they are usually called in the CVM literature. It is also apparent that many biases are more or less connected to different survey elements and their design alternatives. This can be easily recognized when the value elicitation question is considered.

The contingent valuation method involves the use of sample surveys or questionnaires to elicit the respondents' willingness to pay for commodities, projects, or programs that are generally hypothetical of their nature. The name of the method refers to the fact that the values revealed by respondents are contingent upon the constructed or simulated market presented in the survey scenario (Portney 1994). The great appeal of the contingent valuation method is obviously in its market resemblance and conceptual simplicity. When there is no market for a good, a hypothetical one can be created for it. People are simply asked how much they are willing to pay to receive an increase (or to prevent a decrease) in the quality or/and quantity of a good (willingness to pay, WTP). Alternatively, people can also be asked how much they demand compensation

in case an adverse change in the quality or/and quantity of a good would occur or the quality and/or quantity of the good would not improve or increase (willingness to accept compensation, WTA). Most applications of the CVM have coped with environmental and other nonmarket commodities that have characteristics of public goods. In this respect, the CVM has a history that indicates its appropriateness for the analysis of benefits provided by pro-environmental farming and the rural environment.

5.1. Some Milestones and Future Prospects of the CVM

The birth of the CVM dates back about fifty years. Ciriacy-Wantrup (1947) published a paper on the economics of soil conservation, in which he observed that some conservation benefits did not fall into the category of market commodities. In the paper he also sketched the first CVM question, although there was no empirical work included. The first real empirical application of the CVM was carried out in 1958 at the request of the US National Park Service. The survey was about people's willingness to pay entrance fees in the case of publicly owned outdoor recreation areas. The experiment was successful, and it was later described in Mack and Meyers (1965). The second application of the CVM occurred in 1961 when Robert Davis examined in his Ph. D. dissertation the economic value of recreation in the Maine woods (see Davis 1963a). Although it is not likely that Davis at that time was able to imagine the future success of his interview technique, he was clearly promoting the monetary assessment of recreational values by noting that *"Since nearly all forms of outdoor recreation are susceptible of market analysis, it is highly feasible for responsible agencies to initiate market studies to uncover the processes of demand and consumer valuation which guide user choices."* (Davis 1963b, pp. 248-249). Interestingly, both pioneering applications were produced independently and the authors were not aware of Ciriacy-Wantrup's (1947) suggestions (Hanemann 1992).

However, the interest towards the CVM did not really explode. It took some time and certain theoretical development was required before the CVM started to flourish. The first step was the introduction of new value concepts. Weisbrod (1964) focused on uncertainty and presented a concept of *option demand* that later became known as *option value*. Krutilla (1967) proposed the concept of *existence value*[6]. He argued that some people may obtain satisfaction from mere knowledge that certain environmental and natural resources continue to exist, although they would be appalled by the prospect of being exposed to them. It was obvious from the beginning, even if not indubitable, that the new value

[6] Different value categories were reviewed in Chapter 3.2.

concepts represented a motive for natural resource conservation that was not inherent in market prices. Thus, they should be included in a social benefit-cost analysis. Nowadays existence value is usually referred to as passive use or nonuse value to suggest that the utility derived does not depend on any direct or indirect interaction with the resource or good in question (Portney 1994).

It appeared that the CVM was the only method capable of estimating values like option value and existence value[7]. However, the formal theory of welfare economics was not developed enough to provide sound theoretical evidence for the estimation of utility changes in the case of public goods. Mäler (1974) was able to extend the standard welfare theory of price changes to changes in the supply of a public good. After this theoretical achievement, the use of the CVM became more popular. It was applied in many fields of environmental benefit estimation, for instance, in the assessment of water and air quality, in landscape issues, and for recreational purposes. The emphasis was both on applications and methodological development (Hanemann 1994a).

An important milestone in the history of CVM occurred in 1979, when Bishop and Heberlein (1979) published their paper, in which a discrete choice questioning format was for the first time applied in CVM surveys. The idea was to create a hypothetical market that corresponded to the real market as much as possible. The respondent was asked if he is willing to pay a certain amount (specified by a researcher) for a change in the provision of a public good. The only thing that the respondent had to do was answer "yes" or "no". This imitated a real market situation where a buyer decides to purchase or not to purchase, based on the price of a good. However, as innovative as the discrete choice format was, it lacked sufficient utility theoretical background. It was not clear whether the welfare measures derived from the discrete choice data automatically carried over to the conventional continuous case (Kriström 1990a, p. 62). The problem was solved by Hanemann (1984), who was able to show the connection between discrete valuation questions and economic theory via the random utility model (see Chapter 6.2 for details). This facilitated greatly the spreading of the CVM because the method was now theoretically sound, in addition to its better feasibility in the form of mail and telephone surveys. The discrete choice format also gave the CVM more credibility because it eliminated some of the criticism that was aimed to the elicitation techniques applied previously (open-ended and bidding game formats). Furthermore, it is likely that the discrete choice technique provided a more "scientific" status to the CVM because it required the application of statistical estimation techniques.

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[7] Of course, there are also some differing views. For instance, Larson (1992) argues that nonuse values can also be derived from people's observable market behavior. There is also a school of economists that denies the entire possibility of estimating nonuse values in an economically sound way (see e.g. Shavell 1992).

The first comprehensive evaluation of the CVM took place in 1984 when an "Assessment Conference" was held in USA. The initiative came from the US Environmental Protection Agency (EPA), which was interested in developing more enhanced methods for environmental assessment. This was basically because of two legislative actions, the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) in 1980 and the *Executive Order 12291* (46 Fed. Reg. 13, 193. Feb. 17, 1981), which forced the US authorities to pay more attention to the assessment of environmental damages. The CERCLA recognized for the first time the CVM as an appropriate technique to value environmental damages due to release of hazardous substances and oil (Portney 1994). The Executive Order 12291 required the US Federal Agencies to also consider environmental benefits and costs of federal regulations and actions before their implementation (Carson et al. 1993).

The results of the "Assessment Conference" were not unambiguous, but they clearly showed some support to the CVM. The overall conclusion was that the assessments made during the conference indicated that the CVM has potential to become a viable method for estimating values of public goods. However, the economists involved stated that the realization of that potential implies challenges for those who are responsible for the further theoretical and empirical development of the method (Cummings et al. 1986).

The CVM has been dominated by US economists. Even though the interest towards the CVM has also risen in Europe (see e.g. Navrud 1992), most applications are still carried out in the US. This is a ramification of what happened in Prince William Sound in March 1989. An oil transport ship, called *Exxon Valdez* and owned by *Exxon Company*, suffered a shipwreck. A large coastal area, mainly in the state of wilderness, was hit by an oil spill. Many instances sued Exxon, and very soon it became evident that the method used for damage assessment would have a great influence on the total sum of compensation that Exxon would be forced to pay to numerous plaintiffs. The Exxon Valdez incident also influenced the enactment of the US *Oil Pollution Act* (OPA) in 1990. The OPA was important in the sense that it included the recovery of lost passive-use values as one of the several types of damages that should be compensated for. Because of this development, industry groups facing potential liability suits concerning passive-use damages strongly questioned the reliability of the CVM (Carson et al. 1993).

One of the best-known attempts to deny the applicability of the CVM in damage assessment was a seminar in 1992 organized by a consulting company called Cambridge Economics, Inc. (see Cambridge Economics 1992). The seminar can be seen as a countermove of the oil industry towards the development that took place in the Exxon Valdez issue. The State of Alaska had sponsored a CVM researcher group led by Richard Carson in order to acquire estimates for lost passive-use values. Consequently, the oil industry wanted to question in

advance the validity of any CVM results concerning the estimation of lost passive-use values. However, the report requested by the State of Alaska (i.e. Carson et al. 1992) appeared to be a very influential CVM study. The intensity of debate around the issue helped to move the discussion from academic circles to a more political platform.

Concerns and arguments raised by critics and defenders of the CVM led the National Oceanic and Atmospheric Administration (NOAA) to convene a panel of eminent outside experts co-chaired by Nobel prize winners Kenneth Arrow and Robert Solow to examine the issue. In January 1993 the Panel, after lengthy public hearings and after reviewing a large number of comments and papers, issued a report that is considered the most important single guideline for conducting CVM surveys. In the *Report of the NOAA Panel on Contingent Valuation* it was concluded that "*CV [contingent valuation] studies can produce estimates reliable enough to be the starting point for a judicial or administrative determination of natural resource damages - including lost passive-use value.*" (Arrow et al. 1993, p. 4610). The NOAA Panel made it clear that its favorable opinion was conditional: surveys should follow the guidelines set by the NOAA Panel in order to be taken into consideration for litigation purposes. However, the NOAA Panel did not really attempt to state the final word because its authors admitted that there would always be controversy when intangible losses have to be evaluated in monetary terms.

The NOAA Panel report has had remarkable influence on the CVM research. As expected, it has increased the amount of CVM studies that are intended to be utilized in a legal or an administrative context. In addition, during the recent years, almost every published CVM paper has in one way or another tested the NOAA guidelines, responded to the questions, or commented on the topics raised by the NOAA Panel (Mäntymaa 1997). For instance, Harrison and Lesley (1996) criticized heavily the NOAA Panel's recommendation to use random sampling in the selection of respondents. According to them, this practice, combined with in-person interviews, makes CVM surveys so expensive that very few researchers can afford to carry them out. They presented some evidence showing that by means of a statistical model and by using averages of population characteristics it was possible to predict the WTP of the whole population without using truly random samples. Cummings and Harrison (1995), in turn, attacked indirectly the NOAA Panel by questioning the existence of nonuse values as a significant component of the total value of environmental resources.

At the moment it seems that the NOAA Panel's guidelines will survive despite the criticism: in Carson et al. (1996, p. 25) it is stated that "*Overall, then, based on a series of large scale, in-person surveys, we conclude that there is support for the Arrow-Solow Panel's proposed protocol for CV surveys. While it may be possible to relax these standards, we do not have a basis as yet*

for determining how adjustments to the recommended practices would influence the economic consistency of the CV estimates of monetary values." However, despite their general support for NOAA Panel's recommendations Carson et al. (1996) also make some reservations. They note that their supplementary research using the Alaska Exxon Valdez survey data suggests that the NOAA Panel's concerns about temporal reliability, question format, and social desirability biases appear unwarranted, at least to some extent.

Another major CVM debate of this decade started from a symposium organized by the Journal of Environmental Economics and Management in 1992 (Mäntymaa 1997). Kahneman and Knetsch (1992a) indicated that the CVM suffers from the embedding effect (as a part of a more inclusive good the good being valued receives a lower WTP than if it is valued on its own), and that respondents in CVM surveys do not behave according to economic theory but express moral satisfaction when they have a hypothetical chance to contribute to the provision of public goods. In the same issue of the journal, the discussion was continued by a comment from Smith (1992) and a reply from Kahneman and Knetsch (1992b). Other contributions to the discussion have been articles from Harrison (1992) and Carson and Mitchell (1995).

There have also been many other incidents that have significantly influenced the development of the CVM, but it is not possible to list them all in this context. However, the milestones mentioned above should already be adequate to show how the CVM has developed from a highly empirical *ad hoc* preference revelation approach to a theoretically and methodologically enhanced monetary valuation method, which also starts to gain weight in the social decision-making process. Of course, this development has not taken place without fierce criticism, which implies that the CVM still has questionable features, both in theoretical and methodological sense.

It seems that in the future there will be several lines of development of the CVM research. The fundamental division will be, of course, between CVM supporters and its opponents. The opponents will attempt to show further that the CVM is not able to reveal people's true economic preferences, and that is why it should not be used in valuation situations where nonuse values are at stake. The essence of this critique can be found e.g. in Diamond and Hausman (1994). Moreover, some CVM researchers themselves are also critical towards the method. According to Jakobsson and Dragun (1996), there is an evident tendency in the CVM literature to focus on methodological issues that offer more complex views on the interpretation of CVM results than the basic neoclassical welfare theory. There is an increasing number of CVM researchers who are more and more interested in what is the proper domain of application of the CVM (see e.g. Wiestra et al. 1995).

However, the mainstream of the CVM research will cope with development that is more traditional. The questioning and testing of certain NOAA Panel's

recommendations will continue. The embedding effect (also known as the part-whole bias and the issue of scope) is likely to have a prominent role in the research agenda (Mäntymaa 1997). Furthermore, some work will be done in order to develop more enhanced estimation techniques for the dichotomous approach. There is probably a need for conceptual accomplishments in the domain of welfare economic theory, especially in relation to the negative willingness to pay (see e.g. Kriström 1995). Outside academic circles the applications of the CVM for administrative and litigation purposes will gain more acceptance and will become standard tools especially in damage assessment. The increasing number of practical applications indicates that the role of the CVM in decision-making will gradually be taken into closer inspection.

5.2. Design of a CVM Survey

It is obvious that there is no standard approach to the design of a contingent valuation survey. Nevertheless, certain elements should be found virtually in every well-designed CVM application (see e.g. Cropper and Oates 1992; Cummings et al. 1986; Mitchell and Carson 1989; Portney 1994; Randall et al. 1983). First, the survey must contain a scenario or description of the hypothetical or real policy or program the respondents are being asked to value or vote upon (1). Second, the survey must contain a mechanism to elicit value from the respondent (2). Third, the survey has to elicit information on respondents' socio-economic characteristics, values, and attitudes (3).

(1) In some cases, scenarios can be quite detailed, providing information on the expected effects of the policy or the program as well as likely ramifications if the program is not adopted. The scenario consists of three elements: First, there must be a detailed description of the good(s) being valued. The researcher constructs a contingent market place, which is communicated to the respondent in a written or spoken form. Second, it is important to depict the institutional structure under which the good is to be provided as well as the rules under which the decision about the possible implementation would be made. Third, when the respondent is asked to reveal his WTP, it is also necessary to indicate how the payment would be collected.

(2) As indicated above, the survey must contain a mechanism for eliciting value or a choice from the respondent. These are questions that elicit respondents' willingness to pay (or willingness to accept compensation) for good(s) being valued. These questions should be designed to facilitate the valuation process without themselves biasing the respondents' WTP amounts. They can take many forms, including e.g. open-ended questions ("What is the maximum amount of money you would be willing to pay for the program X?"), bidding games ("Would you pay FIM Y for the program X? If yes, would you consider paying FIM $Y + n$ for the program X? If no, would you then consider paying

FIM $Y + n - k$ for the program X?"), or dichotomous formats ("The government is planning a program X. Your annual tax bill would go up by FIM Y if the program X will be implemented. Do you accept the FIM Y tax increase or not? Answer yes or no.").

(3) Mere WTP responses recorded in monetary terms are not necessarily enough for a thorough analysis. There is also a need to elicit information on the socio-economic characteristics of the respondents (age, sex, income, etc.), as well as on their attitudes towards the good being valued. The purpose of this is usually to gather information for the estimation of a valuation function for the good that includes these characteristics as possible explanatory variables. It is also common to include follow-up questions that attempt to make sure that the respondents have understood the scenario correctly and have reacted in their responses in an appropriate way, i.e. have taken the presented scenario seriously.

In addition, many other things have to be decided before a CVM survey can be carried out. A target population and a sampling structure must be chosen. There are also many alternatives how to conduct a survey in practice. The choice has to be made whether mail, telephone, or face-to-face interviews, or some combinations of these are used. Pre-testing is also a very important element in a successful survey design because it is difficult to simulate beforehand the respondents possible reactions to certain aspects of the survey construction.

Even though it is likely that there will never be a CVM survey design of universal acceptability, the guidelines set by the NOAA panel in 1993 are the most appreciated frame of reference at the moment (Arrow et al. 1993). The task of the NOAA panel was related to damage assessment in the context of the US Oil Pollution Act in 1990. Consequently, some of the recommendations are aimed to improve the court room credibility of the CVM, and they are not intended to be methodologically sound in the economic sense. Keeping in mind the NOAA Panel's concentration on damage assessment, it is conceivable that, according to Portney (1994), the NOAA Panel[8] gave its acceptance to the use of CVM with some reluctance. None of the NOAA Panel members would have been comfortable with the use of any of the previous CVM applications as the basis for actual monetary damage compensation.

The NOAA panel recommendations for a reliable design of CVM surveys are divided into three groups: general guidelines, guidelines for value elicitation surveys, and goals for value elicitation surveys. The general guidelines cope with details of survey administration and they can be applied to any survey. The report emphasizes that in gathering information it is essential to use personal contact, preferably face-to-face interviews. This also helps to minimize

[8] *Paul R. Portney* was one of the NOAA Panel members. The others were *Kenneth Arrow, Robert Solow, Edward Leamer, Roy Radner*, and *Howard Schuman*.

nonresponses, which is one of the goals. The use of face-to-face interviews requires pre-testing for interviewer effects, and the report also recommends careful pilot work and pre-testing of the whole CVM questionnaire in order to make sure that it is understandable and acceptable across respondents. Furthermore, the panelists suggest that the reporting of results should make clear the definition of the target population sampled, the sampling frame used, the sample size, and the non-response rate and its components. In addition, research reports should include the exact wording, the sequencing of the questionnaire, and the description of any other communications used.

The guidelines for value elicitation surveys are derived from the best CVM surveys and represent the state-of-the-art design. First, the recommendation is to apply a conservative design in order to avoid implausible WTP estimates. Willingness to pay should be used instead of willingness to accept compensation, and a preferable form of the valuation question is a referendum format (i.e. the valuation question should be posed as a vote in a referendum). An accurate description of the program or policy must be provided to the respondents. It is also necessary to remind the respondents of substitute commodities for the program being valued. There should also be a "no-answer" option included (in addition to the "yes" and "no" alternatives) in the main valuation (referendum) question, and respondents who choose the "no-answer" option should be asked indirectly to explain their choice. It would also be preferable to use follow-up questions to check the motives behind "yes" and "no" responses. Furthermore, it is emphasized that CVM surveys should offer a variety of other variables (e.g. socio-economic and attitudinal) that can help to interpret the responses to the primary valuation (referendum) question.

The goals for value elicitation surveys consist of items that, according to the NOAA panel, "*are not adequately addressed by even the best CV surveys*" (Arrow et al. 1993, p. 4609). There may be some hubris in the statement, but that aside, some of the issues raised by the NOAA panel in this context are of great importance when the reliability of results is considered. Survey respondents must be reminded that their willingness to pay for the program being valued will reduce the amount of money that they are able to spend on other private or public goods. Furthermore, special attention should be paid to the survey design in order to eliminate misleading response motives that are based on general positive feelings derived from a donation for a good cause (so called "warm-glow" effect) or on dislike of some of the parties playing an essential role in the valuation framework. The NOAA panel was worried that these sentiments can be confusing in the sense that they make the respondents focus on issues irrelevant to the program being valued. They were also concerned about the ability of the respondents to recognize the difference between interim and permanent losses in resource quantity and quality. There were other interesting

remarks, too, but they chiefly referred to issues that are relevant in cases where CVM results are utilized in a litigation process.

5.3. Model of Response Behavior and Biases in the CVM

In the CVM applications, the number of possible sources of error is considerable. This is because the CVM is a stated-preference valuation method, not a revealed-preference valuation method. There is usually no parallel real market data about people's behavior and preferences to contrast results achieved through the CVM with. The problem with the CVM is that, in most cases, it constructs a more or less hypothetical scenario, which in many respects differs from the every-day life decision-making, choice, or valuation situations. Furthermore, it is misleading to believe that the valuation scenario is restricted to cope only with the quality or quantity changes present in the good being valued. Randall (1986a) argues that, in addition to the value of the commodity offered, WTP estimates are based on the process by which the commodity is provided, as well as on the method of payment. Thus, the valuation of the good itself cannot really be separated from the issues associated with its implementation. Very often, the valuation scenario includes elements that alter existing property rights in one way or another. Moreover, even in cases where property rights are not altered, the valuation decision cannot be made independent of the prevailing institutional structure.

When possible sources of errors (or biases as they are known in the CVM literature) are considered, they are apparently related to the concepts of reliability and validity. Validity refers to the degree to which the CVM results correctly indicate the "true" value of the asset under investigation. Reliability, in turn, refers to the consistency or repeatability of the CVM results. It is important to recognize that reliability and validity are not synonyms: a particular CVM instrument can, in repeated trials, yield a consistent value estimate for a particular asset. However, if these trials are all subject to a bias, the results will not be valid. Reliability deals with biases related to the questionnaire and scenario design, implementation of a survey, and statistical analysis of data. Validity is connected to more methodological issues. It is concerned with the links between economic theory and the CVM, revelation of "true" preferences, and comparison of monetary estimates achieved by different valuation methods (Bateman and Turner 1992, p. 37).

It can sometimes be difficult to define what a bias is. If it is depicted as a systematic error that causes an inflated or deflated mean WTP, then there should be a benchmark to compare with before a systematic error can be claimed to be involved. In this sense it is conceivable that it is not possible to create a comprehensive classification of CVM biases. However, some further investigation of biases is required in order to understand the critique that is

directed towards the CVM. In their extensive typology of CVM biases Mitchell and Carson (1989, pp. 236-237) identify 22 different biases, divided into three broad categories: (1) response misrepresentation, (2) induced value derivation, and (3) scenario misspecification.

(1) Response misrepresentation. Biases in this class occur when a respondent misrepresents his true WTP. The reason for misrepresentation can be intentional. The respondent tries to benefit from it (e.g. strategic bias) or it can be less intentional, the respondent may just attempt to please the interviewer or the sponsor of the interview (e.g. interviewer bias).

(2) Induced value derivation. Biases of this category occur when respondents believe that elements of the contingent market provide information about the "correct" value of the good. For instance, some elicitation methods offer information that helps the respondent to define his WTP amount (e.g. starting point bias). The act of being interviewed or some features of the situation may function as a source of indicators that lead the respondent's answers to a certain direction.

(3) Scenario misspecification. Biases in this class occur when a respondent does not respond to the correct contingent scenario. Either the researcher specifies the scenario incorrectly in terms of the economic theory or major policy elements or the respondent perceives the good being valued in a way that differs from the intentions of the researcher (e.g. part-whole bias).

Another slightly different typology was created by Smith and Desvousges (1986) and further developed by Kriström (1990a) and by Bateman and Turner (1992). They also partition biases into three major categories: (1) general, (2) procedural, and (3) instrument-related biases.

(1) General biases include sources of errors that cover a very broad array of theoretical and methodological issues. They are derived from the concerns related to motives of economic behavior (strategic bias), ramifications of the artificial market structure (hypothetical bias), rationality of respondents' decision-making (part-whole bias), and sensitivity to changes in the survey information content (information bias).

(2) Procedural biases are concerned with aggregation problems of monetary value estimates (aggregation bias), inaccuracies in sampling (sampling bias), and errors due to the interviewer or the interview situation influencing the answers of the respondent (interviewer bias).

(3) Instrument-related biases are concerned with the effect of the form of payment used in the scenario (payment vehicle bias) and the effect of applied valuation question format (starting point and anchoring biases).

The two bias typologies follow a slightly different logic, although it is not quite clear what the reasoning behind the classification actually is. Therefore, in this study, an alternative way to approach the bias problem is outlined. Biases are divided into internal and external biases. Internal biases are related to

respondents' behavior in the valuation situation and effects of the valuation instrument design. External biases are biases that are created, for instance, by sampling errors, defective estimation techniques, or flawed aggregation procedures. The idea behind this classification is that internal biases are something unavoidable. The behavior of respondents and the design of the valuation instrument are so organically linked together that an attempt to reduce a certain bias element only creates other internal biases. In other words, internal biases are interacting. External biases, in turn, are independent of each other or internal biases. Their elimination is possible without any changes in the value instrument itself. For instance, sampling bias can be removed by taking a new, better sample and reproducing the survey.

Now a response behavior theory can be sketched (see Figure 5.1). There are five main categories of response behavior: strategic behavior, misinterpreting behavior, indifferent behavior, protest behavior, and expected behavior. They are based on goal-oriented, nonchalant and/or well-intentioned response motives. A goal-oriented response motive means that a respondent is willing to promote his own interests instead of acting according to the wishes of the researcher. A nonchalant response motive indicates that a respondent is not interested in engaging in the questioning situation at all. A well-intentioned response motive implies that a respondent is willing to act according to the wishes of the researcher, but there is no guarantee that the respondent perceives the researcher's goals correctly.

From the researcher's point of view the most desired type of behavior is expected behavior because it is just what the researcher wants. A respondent behaving expectedly perceives the valuation instrument correctly and is ready to express his actual willingness to pay and other relevant preferences without any hidden agenda. Misinterpreting behavior differs from expected behavior in certain respects. A respondent behaving misinterpretingly exhibits well-intentioned response motives, but he fails at least partly to understand essential characteristics of the valuation instrument. Therefore, the expressed individual WTP can be misleading. The reasons for misinterpreting behavior can vary. The presented valuation scenario may contain elements which the respondent cannot fully understand. In this case, it could be that improved survey design would remove the problem. However, it is also possible to claim that the cognitive capacity of the respondent is so restricted that it is not possible to construct a meaningful hypothetical valuation situation at all. Nevertheless, if the respondent fails to reveal his true preferences, it is not because of intentional misrepresentation but shortcomings of the survey design or his intellectual capacity.

Strategic behavior means that the respondent has a clear idea of how he should behave in a survey situation in order to benefit from the survey outcome as much as possible. His response motive is thus truly goal-oriented. The respondent thinks further than the researcher, and he does not want to reveal his

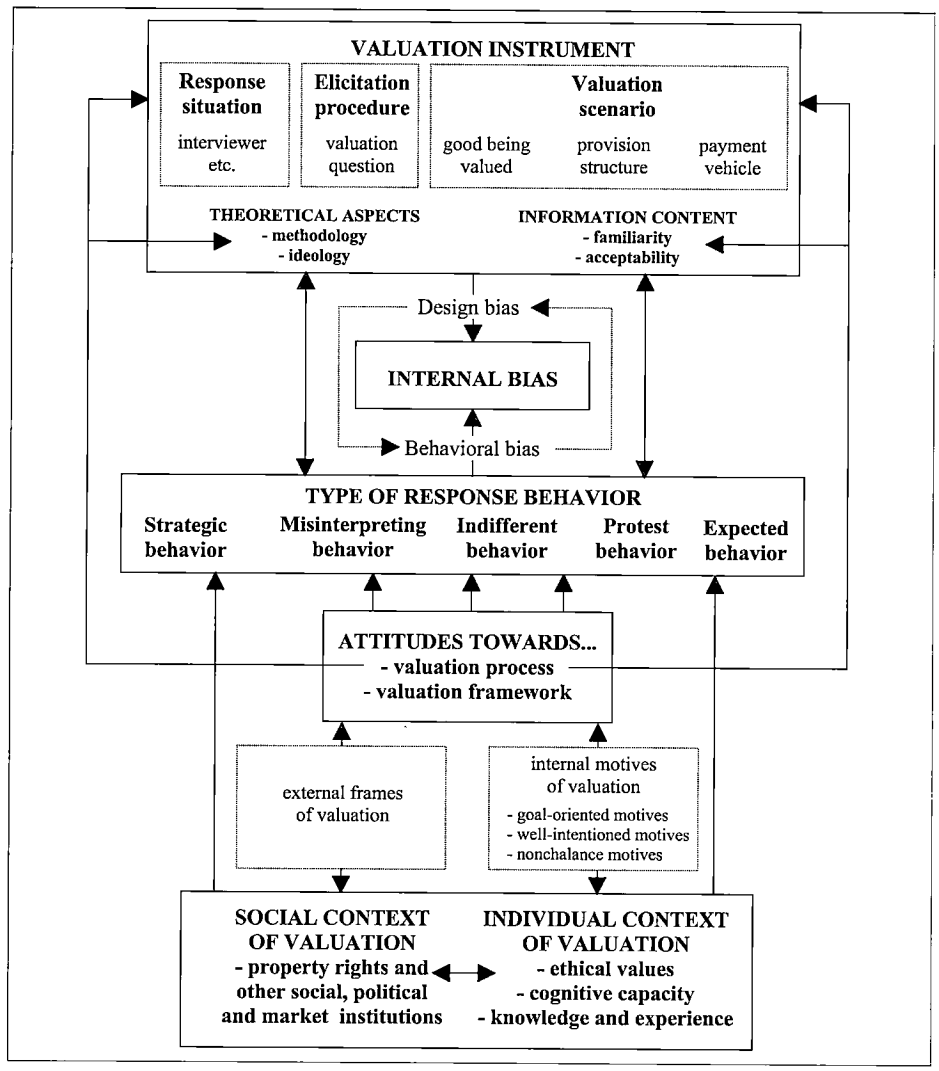

Figure 5.1. Framework to Analyze Response Behavior from the Internal Bias Perspective.

true preferences because that would not help him to achieve his goals related to the provision of the good being valued. In other words, the respondent intentionally misrepresents his preferences in order to mislead the researcher. Indifferent behavior is also problematic from the researcher's point of view, even though for opposite reasons than strategic behavior. If the respondent is behaving indifferently, his WTP response is random, meaning that it lacks both validity and reliability. In the case of strategic behavior the respondents' answers are

likely to be highly reliable in terms of repeatability, although not valid in the methodological sense. Indifferent behavior, in turn, can be seen to exhibit elements that from the researcher's viewpoint seem to be irrational.

Protest behavior is probably the most complex phenomenon of the different response behavior alternatives. This is because the respondent may simultaneously express both goal-oriented and well-intentioned response motives. In the extreme, protest behavior means that the respondent refuses to participate in the valuation situation in any manner. In this case the respondent's behavior is based on goal-oriented response motives although it is not strategic. The respondent does not attempt to mislead the researcher by misrepresenting his preferences, but he merely signals that his preferences are not compatible with the valuation scenario introduced by the researcher. This is usually due to two reasons. First, the respondent is not satisfied with the property rights that are related to the good being valued, the provision structure, or the payment vehicle in the valuation scenario. Second, the respondent may oppose the whole idea of making a trade-off between money and an environmental public good (Rekola 1997). If the proposed valuation scenario includes a major change of property rights, it is possible that these changes create conflicting motives of valuation. The respondent may favor the actual good and its quality/quantity change being valued but cannot really approve the changes of property rights related to the provision of the good or the collection of the WTP payment. Property rights pose a dilemma even in a case where the valuation scenario does not introduce major changes to the prevailing property rights. It is possible that the respondent does not approve of the existing state of property rights for some reason. Thus, he may be inclined to think that participating in the survey would be an implicit sign of acceptance of the prevailing property rights.

However, it is not likely that the majority of respondents have such well-formulated views about the valuation situation. Most respondents no doubt have well-intentioned response motives when they participate in the interview. This does not prevent them from recognizing that the valuation scenario includes elements that they cannot approve. The result is a conflict of motives. On the one hand, the respondent wants to please the researcher and, on the other hand, he somehow wants to express differing opinions related to the issue. In this kind of situation, protesting can take various forms. The respondent can state zero WTP independent of his true valuations in order to show that he fundamentally disagrees with the presented scenario or some of its elements. If the structure of the survey instrument allows, the respondent may consciously give conflicting and inconsistent answers to interrelated questions. Nevertheless, it is likely that the protest is mainly directed towards questions that most seriously violate the respondent's beliefs. For instance, if the respondent feels that the proposed trade-off between money and the environmental public good is inappropriate because of ethical reasons, he may state zero WTP but still make clear that he in

general favors policy actions that promote the line of policy development depicted in the valuation scenario.

In most cases, the connection between the design of the valuation instrument and response behavior is obvious. For instance, redesigning those elements of the valuation instrument that are potential sources of misunderstanding can mitigate the impact of misinterpreting behavior. However, we should recognize that there exists no optimal design for a CVM survey. Some of the external biases can be eliminated by careful design, but most internal biases are a product of the joint impact of design and response behavior. They cannot be removed, but their influence can be assessed if they are appropriately recognized. This becomes apparent when the CVM bias literature is reviewed.

Different types of response behavior outlined above are more or less familiar to CVM practitioners. In the CVM literature, for instance, the possibility of goal-oriented response motives is well recognized, and it is usually referred to as strategic bias (see e.g. Cummings et al. 1986, pp. 21-28). It is quite apparent that strategic bias has its roots in the free-rider problem. Because of nonrivalness and nonexcludability in the consumption of public goods, it is not necessarily possible to make potential users of a public good pay their fair share of the production or maintenance costs of the public good. Thus, a respondent may figure out that by stating an artificially low value he may be able to reduce his payment obligation considerably. Of course, this means that other respondents do not try to behave in the same way because then there would be a risk of a non-provision outcome. It is also possible to choose another strategy: if the respondent is sure that the authorities will not be able to collect the individually stated payment, it is strategically worthwhile to overstate the individual WTP in order to increase the possibility of the public good provision.

Strategic bias can be interpreted through the framework presented in Figure 5.1. First, we have to assume that the ethical values and moral norms of the respondent allow him to act in a misleading way. Second, the respondent must have either considerable cognitive capacity or previous experience and knowledge about similar valuation situations because he can recognize a good opportunity to free-ride. In other words, the information content of the valuation scenario is likely to be at least somewhat familiar to the respondent. All this means that he is able to identify those elements in the valuation scenario which make it possible for him to state misleading preferences without a risk of being made responsible for them. When an environmental public good is in question, the respondent has a clear picture about existing property rights and he knows that in this case property rights cannot be defined in a nonattenuated manner. Therefore, his actions do not depend only on the phrasing and design of the valuation scenario but also on his knowledge about the general institutional valuation framework. Third, the respondent needs to have a positive attitude

towards to the valuation process because he is willing to participate in the process, even if his intentions are not what the researcher expects them to be.

The general opinion among CVM researchers seems to be that strategic bias should not be a significant problem in carefully designed CVM instruments and, as a consequence, there is not much empirical evidence for free-riding based behavior. One reason for this is that most CVM instruments do not offer obvious opportunities or incentives for the outcome manipulation (Freeman 1986). It is also likely that a deliberate choice to act with guile in the valuation process is intellectually a very demanding task, which probably requires that the respondent is quite well aware of all aspects of the valuation process. This is not usually the case in most CVM studies. Bateman and Turner (1992, p. 42) suggest that environmental public goods are themselves a major explanatory factor regarding the apparent lack of free-riding problem. Nonuse and altruistic values attached to environmental public goods act as a counter-incentive to free-riding tendencies. However, the existence of altruistic motives can easily produce the same outcome as purely selfish motives. If the respondent is convinced that a certain environmental resource should be preserved, for instance, for the next generations, his stated WTP is probably even higher than it would be in the case where he would only attempt to secure the provision of the environmental resource for his own use. Apparently, it is possible that altruistic motives also lead to misrepresentation of preferences. Goal-oriented behavioral motives are not an exclusive right of a rational and selfish economic man.

In both cases described above the strategic behavior of respondents can produce individual WTPs exceeding remarkably the realistic budget constraint[9]. In most CVM applications it is routinely checked whether the stated WTP is in a reasonable magnitude range compared to the budget constraint of the respondent. Implausibly high WTPs are usually rejected as indicators of strategic behavior (see e.g. Mäntymaa 1993, p. 52). However, although this practice may be appropriate when the respondent's behavior is guided by self-interest, it may not be appropriate when the respondent is driven by altruistic motives. It is essential to recognize that monetary resources are not the only ones that count in the policy-making process. Although the altruism-motivated inflated individual WTP cannot be immediately realized in monetary terms, the altruistic respondent is probably more willing to use his other resources to promote the preservation of environmental resources. The selfish respondent is not inclined to act after he has noticed that his inflated strategic bid did not work as expected. In other words, the altruistic respondent's stated WTP is a stronger indicator of his

[9] Of course, in theory, altruistic motives can also lead to the understatement of willingness to pay. A respondent may consider the proposed valuation scenario beneficial to him, but harmful to the society as whole. In this case a truly altruistic respondent would understate his willingness to pay in order to secure the best of the society.

behavioral intentions and future actions than the stated WTP of the selfish respondent.

This imaginary example shows again the central role behavioral motives play in CVM survey responses. It also illuminates the connection between design and response behavior. It is possible to eliminate the incentive for strategic behavior by introducing a WTP elicitation question that does not give the respondent an obvious possibility to overstate his WTP. A dichotomous choice question format would do that. However, we can ask whether the use of the dichotomous choice format would introduce a bias of another kind. When a respondent with altruistic goal-oriented motives can state his WTP in an open manner, his response conveys information about his preferences and, especially, about the intensity of his preferences. By eliminating certain kind of information through alternative design of a valuation question, the researcher may destroy essential knowledge. It depends heavily on the policy-making context what pieces of information are the most valuable.

It was possible to explain strategic bias as a result of goal-oriented response motives. A similar connection can also be made between hypothetical bias and well-intentioned response motives. Hypothetical bias is usually defined as the difference between the stated payments in response to a hypothetical opportunity to pay and actual payments when individuals are presented with the opportunity in reality (Jakobsson and Dragun 1996, p. 84). The main problem is that hypothetical bias is very difficult to test because of the lack of benchmark material. In the CVM literature, a keen discussion has evolved about the issue, but no conclusive view has been presented so far. In some recent experimental studies, considerable differences between actual and hypothetical payments have been found. For instance, in Cummings et al. (1995) the researchers state that in their experimental setting values elicited by the real dichotomous choice question were significantly different from the values elicited by the hypothetical dichotomous choice question. Similar results are referred to in Neill et al. (1994) where it is shown (based on controlled experiments in laboratory conditions) that hypothetical WTP is consistently and significantly higher than WTP that reflects real economic commitment, and the difference between hypothetical and actual WTP is not attributable to different provision rules of the hypothetical and real valuation institutions. However, there are also opposite opinions. Mitchell and Carson (1989) reject the entire notion of hypothetical bias, referring instead to situations of low model reliability. Freeman (1986) declares that the hypothetical nature of the CVM instrument is more likely to lead to random measurement error than to actual bias.

Nevertheless, it is clear that there can be a difference between stated preferences and actual behavior. Cummings et al. (1986, pp. 67-68) emphasize the fact that when the whole valuation scenario is hypothetical, it takes time to search preferences for the scenario which is likely to be unfamiliar to the

respondent. Thus, there is also a need for information as well as additional time to process that information involved. In these circumstances, it is not surprising that there is a risk that individual perceptions related to the CVM scenario would not be consonant with the intentions of the researcher. Different individuals will perceive, and therefore value, different commodities (consider the observation and perception process depicted in Chapter 2.2). In addition, WTP measures will be influenced by the context within which the scenario is described and framed. Therefore, the CVM will elicit responses reflecting attitudes rather than intended behavior, and attitudes do not perform too well as indicators of intended behavior. Consequently, careful design of a CVM study can considerably reduce the gap between what the researcher means and what the respondent perceives. However, it is not wise to reject prematurely the proposition that choices involving actual payments are substantively and significantly different from choices involving hypothetical payments. This is in an illuminating manner explained by Ajzen and Fishbein (1977).

The Ajzen-Fishbein model postulates that individuals have both positive and normative beliefs in relation to behavior. These beliefs in turn create attitudes and subjective norms concerning behavior, which combine as an intention to perform specific behavior. This intention will then influence the specific behavior actually exhibited. The actual behavior will lead into the modification of positive and normative beliefs. Therefore, each stage of the process influences the next. However, this influence is not perfect, for example, intentions may not perfectly predetermine actions. Similarly, feedback loops provide a dynamic adjustment system so that, for example, a recent visit to the countryside may well affect the respondent's WTP to preserve the rural environment (Bateman and Turner 1992, p. 44). It is apparent that information has a pivotal role in this process, which is actually a learning process. The respondent is not likely to encounter the valuation situation with fixed preferences. The information conveyed by the valuation scenario and the whole valuation process can have a significant impact on the normative and positive beliefs of the respondent. As a consequence, the respondent's attitudes concerning the appropriate actions and behavior may be reassessed and intentions become modified. However, any additional piece of information or even additional considering time may make the cycle continue. Thus, even in the case where intentions would perfectly predetermine actions, beliefs, attitudes, and intentions can alter so rapidly that an outside observer (like the researcher) is forced to conclude that the stated WTP is not the same as the real WTP. Nevertheless, this kind of observation obstacle occurs in every valuation situation and does not necessarily pose a special problem for the CVM technique.

A mental process like this indicates that respondents' preferences are at least partly created during the valuation situation. Schkade and Payne (1992), for example, are in favor of the view that people have well-defined values only for

very familiar topics. Under this presumption, respondents in a CVM survey must derive specific valuations for less familiar topics through some inferential process. This view leads to the conclusion that, in many cases, people must construct their responses at the time they are asked an elicitation question, rather than retrieve a previously formed value or preference. Thus, this idea of *constructive preferences* goes beyond a mere denial that observed preferences result from retrieving the appropriate value from a mental master list in memory. This is to say that people are not as rational in their choices as they are assumed to be. Their ability to process information is limited, and so is their cognitive capacity. This can be perceived to be the fundamental argument for the existence of constructed preferences and beliefs (Simon 1955).

Hanemann (1994b) defends the CVM by asking what "true economic preferences" are. He asserts that if an individual responds with thought to a question about voting to raise taxes for a public good, how can somebody judge that the individual's stated preference is not to a valid one. In the light of evidence from neuroscience and psychology, it is obvious that all cognition is a constructive process. People construct their memories, attitudes, and beliefs, and there is considerable variation among people in this respect. In addition to the person, the construction process depends on the item and the context. A general perception in survey research and in other sciences dealing with cognitive issues is that people are cognitively somewhat incompetent: they tend to resolve problems of reasoning and choice in the simplest way possible. Hanemann (ibid.) concludes that the real issue is not whether preferences are a construct of limited human cognitive capacity but whether they are a stable construct. According to him, even though this surely varies with circumstances, the evidence for contingent valuation is quite strong (see e.g. Carson et al. 1994).

The interesting point is that both opponents and supporters of the CVM seem to share the notion of constructed preferences, but they do not agree on their implications. The opponents consider the existence of constructed preferences as a fatal flaw that makes a sound economic analysis impossible because the basic postulate of rational economic behavior is seriously violated. On the other hand, the supporters insist that it is not relevant when and how the preferences are formed, if they are stable, consistent, and detectable. Both views are probably correct in some respect. Despite the nature of the construction process of preferences, they no doubt convey useful information. Another question is, how this information should be interpreted. The mean willingness to pay may be too restrictive a standard to be used as the only measure to express the variety of motivations that are inherent in a valuation survey. However, it is quite clear that hypothetical bias is strongly related to cognitive issues and it is present in every survey.

Again, if hypothetical bias is examined through the framework depicted in Figure 5.1, we can see that well-intended response motives and misinterpreting

behavior can be used to explain hypothetical bias. The starting point is that response behavior leading to hypothetical bias is not intentional. The respondent attempts to act according to what he thinks is the researcher's intention. He considers the valuation scenario and responses to the valuation question within his capacity. There is no guarantee that the researcher's intentions will be interpreted correctly among respondents. The problem is that there is no reliable way to trace the respondents' cognitive process. However, the respondent must have both, a favorable attitude towards the valuation scenario and ability to process the information offered. Because the valuation scenario cannot be too detailed, the respondent is required to have previous knowledge about relevant social institutions that frame the valuation process. It is not surprising that many critics of the CVM find these demands too overwhelming for ordinary people (see e.g. Shavell 1992). Of course, cross-checks on understanding and acceptance can and should be made as recommended by Arrow et al. (1993). However, there is a risk involved that the survey instrument becomes too complex, being far beyond the ability or interest of many participants.

In most cases, however, we can probably trust that in carefully planned and designed CVM surveys well-intentioned response motives produce WTP answers that at some accuracy reflect meaningful preferences. Still, there is, in addition to hypothetical bias, another distorting impact that can result from well-intentioned response motives. It is called "*warm-glow of giving*"[10] or the *purchase of moral satisfaction*. Kahneman and Knetsch (1992a) argue (based on a CVM study that they have conducted) that responses to the CVM question express a willingness to acquire a sense of moral satisfaction by a voluntary contribution to the provision of a public good. In attaining this satisfaction, the public good is a means to an end; the consumption is the sense of moral satisfaction associated with the contribution. Thus, the respondent does not really consider the valuation scenario that is presented to him; he is more interested in being in a situation where he can show his positive attitude towards a good cause. In this sense, the WTP stated by the respondent is not dependent on the valuation scenario as such, even though the good being valued has an impact on the magnitude of the moral satisfaction felt. However, the existence of purchase of moral satisfaction is a controversial issue. For instance, Smith (1992) has strongly attacked the conclusions drawn by Kahneman and Knetsch (1992a). He considers the design of their CVM study flawed and inadequate in many respects. Harrison (1992) finds the "moral satisfaction" hypothesis meaningless. According to him, it is totally unimportant whether one calls utility "moral satisfaction", "economic benefits", "jolly", or something else.

Harrison (1992) may be right in a very narrow methodological sense when he judges the "moral satisfaction" hypothesis meaningless. People's behavior is

[10] Andreoni (1990) has introduced the concept of "warm-glow of giving".

based on a large variety of motives (i.e. they have many variables in their utility functions), and in this respect labeling them with different names is only a source of greater methodological confusion. However, from the point of view of policy-making, the issue is more complicated. Again, we can hypothesize that different motives lead to different actual behavior despite relatively similar WTPs. Respondents expressing preferences derived from the feeling of moral satisfaction may be very passive citizens when the valuation issue is taken into the political agenda. If the interest towards the issue is not as keen as the valuation exercise has suggested, it may happen that no further actions will be carried out after the preparatory stage. Common resources will be wasted.

It is easy to see that some forms of *interviewer bias* also fall into the category of well-intentioned response motives and misinterpreting behavior. In such a case the respondent tries to please the interviewer by giving answers that he assumes the interviewer to expect. The response situation itself and the interaction between the respondent and the interviewer become more important than the information included in the valuation scenario. It is also possible that the respondent will feel pressure to give a "correct" answer because he believes that he is obliged to act according to the wishes of the interviewer. Of course, it can happen, too, that the interviewer irritates the respondent. Consequently, the respondent hides his preferences, stating zero WTP instead of the "true" WTP. This can be regarded as a form of protest behavior. It is essential to notice that the response situation can function as a source of bias-creating behavior, like the valuation scenario. Nevertheless, the use of professionally trained interviewers is usually considered to guarantee that the response situation related biases stay in control.

The respondent can also be misled by the elicitation procedure. He may think that the valuation question asked by the interviewer (or found in the questionnaire in mail surveys) includes essential information on the "right" value of the good being offered. This is a problem especially when the bidding game or the payment card elicitation formats are applied (*starting point bias*). The same is true, but to a lesser extent, when the dichotomous choice question is used (*anchoring bias*). In both cases, the respondent is inclined to say "yes" as a result of misinterpretation of information conveyed by the valuation question. However, the behavior of the respondent is based on well-intentioned motives because he acts without any ulterior motives to satisfy the interviewer.

The ramifications of well-intentioned response motives cannot be completely eliminated in CVM surveys. According to Jakobsson and Dragun (1996, p. 84), the elimination of hypothetical bias can be attempted by making both the good being valued, the provision structure, and the payment vehicle as credible and realistic as possible. This helps to reduce the gap between expressed preferences (WTP) and actual behavior (real payment). It is also important to present the valuation scenario in a way that makes it clear to the respondent that the interest

lies in his intentions, not in his attitudes only. All this naturally helps the respondent in his demanding cognitive task to become aware of what the researcher is after. Nevertheless, we should keep in mind that even though a careful survey and scenario design can improve the communication between the respondent and the researcher, it does not remove the fact that people possess different abilities regarding perceiving and processing information. It is not likely that a heterogeneous sample of respondents can be made to act cognitively homogeneously.

There is always a fundamental problem to be encountered when an attempt is made to reduce hypothetical bias by a more realistic scenario specification. The CVM has been developed to cope with valuation situations where there is neither market solution nor information about revealed preferences available. The hypothetical nature of the CVM is the price that has to be paid for its ability to also produce estimates for nonuse values involved. The complete exclusion of the hypothetical element in the CVM scenario would lead to value estimates that would be more or less limited to use values. There is also a possibility that the attempt to reduce misinterpreting behavior by making the contingent valuation scenario as realistic as possible may induce strategic behavior. Becoming better informed may direct the respondents' thoughts to strategic choices in preference expression. As mentioned earlier, this is the main characteristic of internal biases. Behavioral and design biases cannot be eliminated jointly and simultaneously. There is in most cases a bias trade-off involved. Well-intentioned response motives can transform into goal-oriented response motives if circumstances are favorable.

The comprehension of the various forms of response behavior is also highly useful when we attempt to understand the discussion that has taken place concerning the *embedding effect* (or part-whole bias, problem of scope, symbolic bias, mental account bias, disaggregation effect). This effect or bias results, in general terms, when respondents value some larger entity than the entity actually in question. However, there a number of different issues related to the embedding effect, which has resulted in some confusion over the nature of the problem. Kahneman and Knetsch (1992a, p. 58) introduced the concept of the embedding effect. According to them, embedding takes place when "*the same good is assigned a lower value if WTP for it is inferred from WTP for a more inclusive good rather than if a particular good is evaluated on its own*". Later, Kahneman and Knetsch (1992b) developed their definition further. Embedding is perfect if the same WTP is observed for nested commodities. Regular embedding occurs if the WTP for a particular commodity varies depending on whether the commodity is assessed on its own or as a part of a more inclusive commodity.

Hanemann (1994b) is rather critical towards the concept of embedding applied by Kahneman and Knetsch (1992a; 1992b). He argues that there are three

distinct notions combined when it is claimed that by using the CVM the same WTP is received despite the number of environmental assets being valued. First assertion, which arises if the object of valuation is thought to be the number of assets, is that WTP varies inadequately along with changes in the scale or scope of the asset being valued. This can be called a scope effect. Secondly, if each asset is regarded as a separate argument in the utility function, then the implication is that a given asset has a quite different value depending on its placement in the argument order. This can be called a sequencing effect. Thirdly, with either preference structure, the WTP for a composite change in a group of public goods may be less than the sum of the WTP for the individual changes separately. It can be called a sub-additivity effect. Both the sub-additivity effect and the sequencing effect are certainly present in contingent valuation responses. They can be explained in terms of substitution effects and diminishing marginal rates of substitution, i.e. by concepts derived from the standard economic theory.

The main source of concern is the scope effect. Theoretically, there is some evidence that people may be inclined to be insensitive to the scale of the good being valued. Tversky and Kahneman (1981) suggest that people tend to think in terms of "mental accounts" when making budgetary decisions. This means that people see groups of goods, rather than specific goods, as the basis for their utility maximization. This is related to the idea depicted by Deaton and Muellbauer (1980). They suggest that consumers have a two-stage budgeting scheme where total income is first allocated to various broad categories of expenditure and then subdivided within categories among specific items. Another explanation can be found in research evidence indicating that respondents tend to ignore information not mentioned in the questionnaire that has to be logically inferred or created by mental transformation. Therefore, respondents use only information directly available to them when making judgments about uncertain events. Thus, individuals, when making decisions under conditions of uncertainty, seem to use inferential rules, called "heuristics", to reduce difficult mental tasks to simpler ones (Hoevenagel 1991). This simplification process may cause people to become insensitive to the scope of the commodity being valued. Kahneman and Knetsch (1992a) argue that moral satisfaction due to a contribution for a good cause can create embedding (see the "warm glow" discussion earlier in this Chapter).

Convincing empirical evidence about the existence of embedding in the form of the scope effect is missing. Carson (1994) reviewed 27 studies that had included an external test (split-sample) of the scope effect, and he found that only two studies exhibited statistically significant documentation about the presence of embedding. These were the studies conducted by Kahneman and Knetsch (1992a) and Desvousges et al. (1992). However, for instance, Smith (1992), Harrison (1992), and Hanemann (1994b) have criticized both of them heavily. Moreover, Boyle et al. (1994) have concluded, based on their empirical

findings, that part-whole bias is a possible explanation for contingent valuation estimates that are insensitive to marginal changes in environmental commodities. They emphasize that it is an extremely difficult task to value marginal changes of natural resources when such changes represent small proportions of the total environmental asset in question. Part of this difficulty is due to the respondents' inability to process small changes and their general lack of familiarity with the commodity being valued.

Bateman and Turner (1992) assert that although the part-whole issue is a potential problem which can be exacerbated by poor CVM instruments, with the appropriate design of CVM surveys it can be reduced to acceptable levels. Jakobsson and Dragun (1996) share this view and state that, if a survey is properly designed and appropriately implemented, the scope effect does not seem be an inherent problem of the CVM. Two design issues should especially be taken into account. First, both the relevant larger entity and the commodity being valued should be described, with a clear warning not to confuse the commodity with the larger entity. Second, respondents should be asked to value the larger entity and then to allocate a portion of its value to the particular commodity of interest (Willis and Garrod 1993). Recently, CVM researchers have also developed tests, like the test of component sensitivity, to detect the possible existence of embedding (Carson and Mitchell 1995).

The embedding question is still open. Although there is a number of potential solutions or explanations, they are only partly complementary and occasionally competing. Randall and Hoehn (1996), in turn, argue that embedding effects are standard economic phenomena induced by substitution relationships and constrained endowments, and they are also present in market demand systems. These effects can be of substantial magnitude and are usually more pronounced in the case of quantity-rationed goods, which implies that embedding effects may be greater for public goods than for market goods. However, it is essential to note that Randall and Hoehn (ibid.) do not prove the existence of perfect embedding in the sense meant by Kahneman and Knetsch (1992a), even though the presence of small discretionary budgets relative to total wealth, combined with scarcity impacts and sequential effects, can create a situation where the value measures seem to be insensitive to the scope of the commodity being valued. In principle, the results achieved and the argumentation presented by Randall and Hoehn (1996) merely show that regular embedding is and should be a common and detectable economic phenomenon in both market and nonmarket environments. This is not to say that the CVM does not play any role: there may be a tendency that the CVM amplifies embedding effects, especially in cases of poor survey design.

The embedding effect clearly falls into the category of misinterpreting behavior and well-intentioned response motives. Respondents are willing to express their true preferences, but they are unable to do it because of communication prob-

lems, bounded rationality, and limited ability of information processing. The origin of embedding is very much the same as that of hypothetical bias, indicating that embedding can be reduced through appropriate survey design. However, there may be a simultaneous inherent risk of promoting goal-oriented response motives. Respondents who fully comprehend the valuation scenario are also likely to perceive their possibilities to influence the survey outcome. Like in the case of hypothetical bias, the elimination of one source of error can create another. In certain contexts, the embedding effect may also be related to protest behavior. The respondent may have strong ethically motivated feelings towards the object of valuation. That is why he can react to the object's symbolic meaning instead of the specified provision level (*symbolic bias*, see e.g. Mitchell and Carson 1989). By refusing to express values different from the value of the entity of the goods, the respondent manifests his disagreement with the valuation scenario as a whole.

5.4. Protest Behavior in Relation to Weakly Comparable and Noncompensatory Preferences

Protest behavior can be seen as a phenomenon that borrows features from both misinterpreting and strategic behavior. In misinterpreting response behavior the source of bias is that the respondent does not perceive correctly the valuation situation presented by the researcher. This is also true to some extent when protest behavior is concerned. The difference is, however, that a protesting respondent may perceive the presented scenario correctly but he is not willing to buy it. In this respect, a protesting respondent conducts himself like a strategically behaving respondent. Nevertheless, the difference is that when acting strategically the respondent attempts to make the researcher believe that he is expressing his true preferences. In the case of protest behavior, the respondent does not have that kind of incentive. The respondent has a value-based reason to protest. As explained previously, he may oppose the property rights structure inherent in the valuation scenario or the idea of trade-off between money and environmental quality.

Protest behavior can appear in many ways in practical CVM surveying situations. Especially in mail surveys questionnaires are not returned as a result of protest behavior. *Nonresponse bias* is usually considered to exist if the respondents and nonrespondents differ in observable characteristics that influence WTP (Whitehead et al. 1993). In this case, the treatment of the nonrespondents can be straightforward if we assume that their WTP follows the same pattern as that of the respondents. The trick is to employ bias functions (Blackburn et al. 1994). If the respondents' age, income, gender, or any other observable socio-economic variables correlate with their WTP, the estimates can be calibrated to apply to the whole target population. Another possible bias

related to nonresponse is *sample selection bias*. It can take place if individuals who have strong positive or negative attitudes towards the commodity being valued are more likely to respond (or alternatively not to respond) than those who have different or opposite attitudes. This bias should not be confused with external biases like sampling bias, which is technical of its nature and has nothing to do with possible biases due to response behavior. The dilemma is that it is difficult to analyze nonrespondents beyond the match of socio-economic variables between those who return the questionnaire and the target population as a whole. Even if the patterns of socio-economic characteristics may be similar among the respondents and across the target population, this does not necessarily indicate that there is no bias inherent. There is no reason to believe that nonresponses should be correlated with socio-economic characteristics. They can also correlate with attitudes that are independent of most common background variables.

According to Jakobsson and Dragun (1996, p. 91), several researchers have recently tested for nonresponse and sample selection biases. However, the results of this research have been mixed so far. Whitehead et al. (1993) found in their combined telephone-mail survey no significant sample selection bias but there was some evidence of nonresponse bias. Dalecki et al. (1993) also detected a nonresponse effect. Fredman (1995) and Mattson and Li (1994) tested for nonresponse bias by using mail surveys with follow-ups. The conclusion was that there was no nonresponse bias inherent, and that people who responded were representative for the whole population. Bostedt and Bohman (1995), who concluded that nonresponses were mainly due to general reasons, made approximately the same assessment. Of course, the manifestation of protest behavior through selective response needs not to be present in every CVM study. The hypothesis indicates that the risk of protest behavior increases when the valuation scenario includes a major change of prevailing property rights or issues with considerable ethical and moral dimensions, like nonuse values.

In-person interviews constitute a slightly different problem in relation to protest behavior. If the respondent is interviewed face-to-face, it is more difficult to refuse to answer. In most cases the respondent is pressed to give an answer and, as a consequence, the respondent may choose a zero WTP response to the valuation question as a means to signal his disagreement towards the valuation scenario or some of its components. However, it is also possible that a respondent gives a zero WTP response although he is not really protesting and has in principle a positive WTP towards the issue being valued. In this latter case, the question is about misinterpreting behavior, not actual protest behavior. Examining alternative preference structures that may be represented among respondents in more detail can illuminate this.

Lockwood (1997) argues that meaningful response behavior can be based on three types of preference expressions: *weakly comparable*, *noncompensatory*,

and *exchange*. If weakly comparable preferences are involved, it means that an individual can choose between different alternatives, although he is not able to produce a general ranking across them. According to O'Neill (1993, pp. 102-122), weak comparability is a sign of incommensurability between two objects. However, this does not have to mean the same as incomparability. There is a possibility of rational choices between two objects, even though plurality of values and context specificity of the choice may make the choice situation too complicated for a straightforward assessment by utilizing simplified monetary valuation framework. The rational decision can be made, but only after thorough consideration of the situation.

In case preferences are noncompensatory or exchangeable, they are always strongly comparable, indicating that different alternatives can be completely ranked on the basis of their value. Exchangeable preferences represent the common economic preference concept relying on characteristics like continuity, reflexivity, nonsatiation, and completeness. The continuity condition in essence means that any change in one good can be compensated for by a change in another good (Lockwood 1997).

An individual with noncompensatory preferences can produce a value ranking of the alternatives such that one alternative can be said to be better than another, even though the individual is still unwilling to make trade-offs between the alternatives. As a consequence, noncompensatory preferences indicate that a reduction in the quantity or quality of the valued entity cannot be compensated for by a change in another entity. *Lexicographic preferences* are probably the best known form of noncompensatory ordering. Lexicographically ordered preferences provide the basis for a rational mode of noncompensatory choice derived from the possession by the valued entity of certain properties that constitutes value referents. Furthermore, these properties are hierarchically ordered such that the possession of a higher-level property results in a preference for that entity compared with another entity which only possesses lower level properties. Such an ordering requires strong comparability between entities, i.e. all relevant entities can be ranked based on their value (strongly lexicographic), even if different types of value possessed by the entities are incommensurable. Correspondingly, a ranking may be partial if there are insufficient properties to generate a ranking which discriminates between all relevant entities (weakly lexicographic) (Lockwood 1997).

What are the ramifications of preference structures inconsistent with the standard neoclassical model? Lockwood (1996, p. 277) writes that "*If some persons' values are better represented by noncompensatory preferences, or are only weakly comparable or noncomparable, then economic methods do not provide a comprehensive evaluation of alternatives. At best, economics provides an assessment of those values which persons express according to compensatory preferences. At worst, economic data may contain value expressions*

that are structurally incompatible with the underlying economic theory." This kind of situation can arise in a CVM survey when respondents have to cope with a valuation scenario with a design that is based on the assumption of exchangeable preferences, even though respondents possess noncompensatory or weakly comparable preferences. This is particularly likely when a CVM survey is concerned with the valuation of environmental commodities of irreplaceable nature or large policy packages.

There is also some empirical evidence of the existence of noncompensatory as well as weakly comparable preferences. Stevens et al. (1991) conducted a CVM study to estimate the existence value for four wildlife species of New England. Based on the respondents' WTPs and on answers to certain attitudinal claims they concluded that only 30 percent of all respondents gave answers that appeared consistent with the neoclassical model of behavior. They also reasoned that approximately 25% of the respondents had lexicographic preferences. However, the definition of lexicographic preferences that Stevens et al. (ibid., p. 397) used was not quite standard. According to them, lexicographic preferences mean that above a certain level of minimum income (Y_m) the environmental good is always preferred to income, and below that level more income is always preferred to the environmental good. The difference between the normally used definition and Stevens et al.'s (ibid.) definition is, as Spash and Hanley (1995) point out, that Stevens et al. (ibid.) allow individuals to either care solely about income (until Y_m) or solely about wildlife. Lexicographic preferences, however, allow increases in income to augment welfare as long as wildlife is unaffected.

Spash and Hanley (1995) note another interesting feature of lexicographic preferences, which can be called preference irreversibility. People with lexicographic preferences who regard themselves as having the minimum standard of living, with the corresponding minimum income (Y_m), will not be willing to pay anything for an increase of the environmental commodity (Z), because they cannot afford to do so, but will give an infinite valuation of a decrease in Z. Consider a situation where an individual is assumed to start at point A(Z_1, Y_1) (Figure 5.2). Now, because Y_1 is higher than Y_m, the individual is willing to give up some income (Y) in order to receive more Z. Thus, the individual accepts the move from point A(Z_1, Y_1) to point E(Z_2, Y_2) because Y_2 is still higher than the minimum level Y_m (remember that Z by definition has priority over Y as long as $Y > Y_m$). Consequently, this means that U[E(Z_2, Y_2)] > U[A(Z_1, Y_1)]. However, once the move to E has been made, there would be no way to go back to A without reducing utility, and the reduction in Z that this implies would be given an infinite valuation. In this way, Z_2 becomes now the new reference point above which Z must be maintained. More generally, if Z is increased from Z_1, the individual is willing to pay the entire amount $Y_1 - Y_m$ to receive the increase,

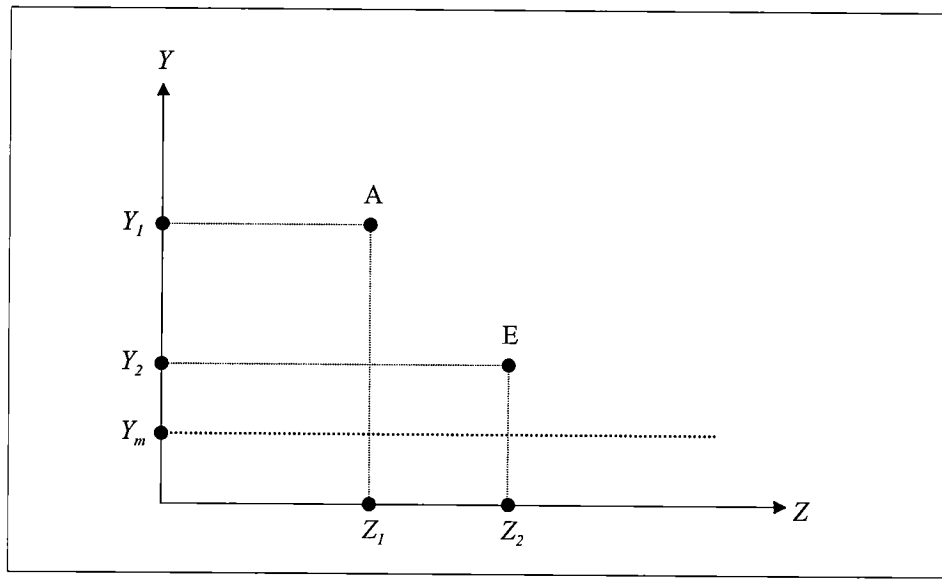

Figure 5.2. Irreversibility of Lexicographic Preferences (Spash and Hanley 1995, p. 195).

but if this is reversed, the compensation required becomes infinite. This is what is meant by irreversibility of lexicographic preferences.

Spash and Hanley (1995) also found empirical evidence of the existence of lexicographic preferences when the preservation of biodiversity is concerned. The survey included two different samples, a sample of 125 students, and a sample of 200 randomly chosen people. Face-to-face interviews were used. The two different samples were included because the authors wanted to compare if there are significant differences related to knowledge about biodiversity. It appeared that 23% of the respondents in the public sample stated that animals / plants / ecosystems should be protected irrespective of the costs and refused to give a WTP amount (category 1). Furthermore, 75% of the respondents also stated that animals / plants / ecosystems should be protected irrespective of the costs but they, however, expressed positive but rather low WTP (category 2). Spash and Hanley (ibid.) argue that the respondents in category 1 can be identified as having lexicographic preferences. It is also possible that at least some of the respondents in category 2 have lexicographic preferences, but this cannot be known for sure without further investigation. Another possibility is that the respondents in category 2 expressed weakly comparable preferences.

The nature of noncompensatory preferences is further illustrated in Figure 5.3. There are two income levels (Y_m, Y_s) and two commodity levels (Z_m, Z_s). Y_m is reference income which an individual needs in order to have a minimum

standard of living. Y_m is, of course, a relative quantity and culturally as well as subjectively determined. Y_s is an amount of income that is needed to have a "satisfactory" standard of living. At this income level and above the individual is able to satisfy most of his reasonable needs. Again, the actual level is culturally and subjectively determined. Z_m refers to the quantity of Z that is required to fulfill the individual's most urgent needs in relation to Z. Z_s, in turn, is the "satisfactory" level of Z. After Z_s the amount of Z loses its significance as a source of increasing welfare. Now, we can assume that Y_m, Y_s, Z_m, and Z_s represent thresholds on which preferences change their nature.

Consider first the situation where $Y < Y_m$. Following the reasoning of Stevens et al. (1991) we can argue that as long as the individual's income is lower than what is required for the minimum standard of living, he categorically prefers Y to Z, i.e. manifests noncompensatory preferences. After income has risen over the threshold Y_m, the individual again expresses noncompensatory preferences until the amount of Z exceeds the critical minimum level Z_m. Then, on condition that Y still stands between Y_m and Y_s, a switch in preferences occurs (see e.g. Edwards 1986). Having a fair amount of Z and Y for a reasonable quality of life the individual is willing to make trade-offs between them (exchangeable preferences). A move from point A to point B is possible if the individual thinks that an increase in Z compensates for a decrease in Y or vice versa. The question is about the rate of marginal substitutability between Z and Y. In contrast, a move

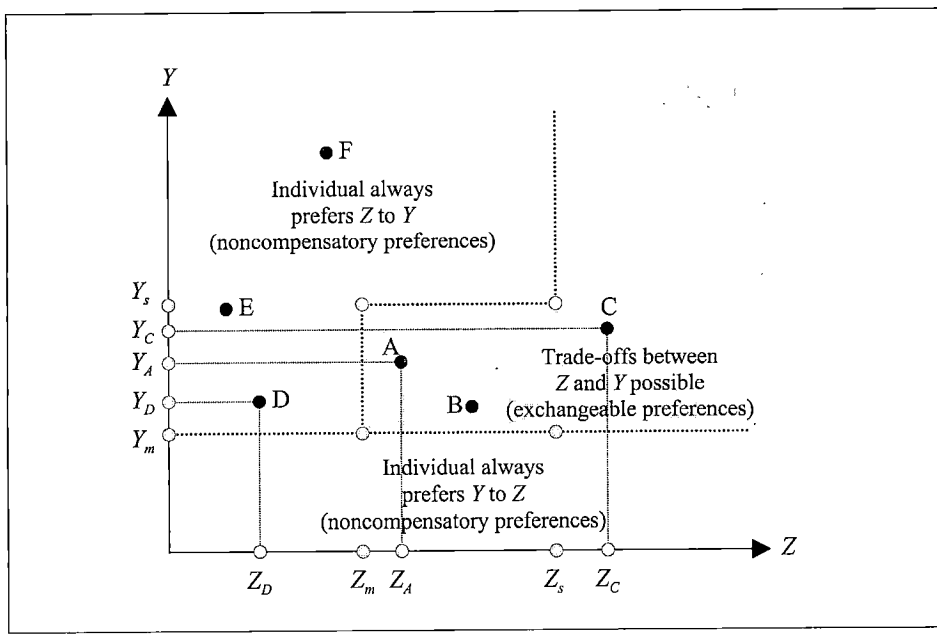

Figure 5.3. Preference Changing Thresholds in Relation to Income (Y) and Environmental Commodity (Z).

from C to A is not possible, because it would result in a decrease in both Y and Z. The next horizontal threshold is achieved when income exceeds the level of satisfactory income (Y_s). The interest in trade-offs between Y and Z diminishes because the individual is affluent enough to neglect the utility of additional income and to express more concern in relation to Z. Thus, he switches back to noncompensatory preferences until the amount of Z becomes so much bigger that the satisfactory level Z_s will be exceeded. Therefore, beyond the satisfactory levels of both Y and Z, preferences again switch from noncompensatory to exchangeable.

However, as Bromley (1996) points out, reference levels or thresholds are highly arbitrary by their nature. Thus, the existence of preference switching thresholds is problematic from the researcher's point of view because thresholds are highly subjective and depend on cultural, social, and economic characteristics of prevailing institutions. It is not possible to identify them in the aggregated sense and, consequently, each individual reference level becomes a norm against which a change provided by a policy will be evaluated.

The idea of preference switching thresholds or reference levels may appear to be somewhat unfeasible, but it can be explained by analyzing people's behavior in complex choice situations. The concept of bounded or limited rationality is essential (Simon 1955). In a multi-dimensional valuation situation, the respondent is forced to process unfamiliar information in rather a short time. It is quite natural that this leads to the use of mental practices which reduce the difficulty of decision-making. The respondent is tempted to favor a simplified decision rule instead of thorough consideration of all possible alternatives and their outcomes. This may lead to, for instance, satisfying behavior, which means that the respondent chooses an alternative that just meets a minimal set of requirements (Harris et al. 1989).

Because the identification of individual preference switching thresholds is very demanding in empirical applications, the researcher may regard responses demonstrating noncompensatory or weakly comparable preferences as indicators of irrational or at least indifferent response behavior. Consider, for instance, a valuation situation where the individual is asked how much he is willing to pay for preventing a decrease in Z from Z_C to Z_A. Assume that point C(Y_C, Z_C) represents the current, subjectively interpreted position of the individual. It can be easily seen that the maximum willingness to pay to prevent the decrease is $Y_C - Y_m$ and the minimum WTP is $Y_C - Y_A$. Then, consider a valuation situation where the individual is asked how much he is willing to pay for preventing a decrease in Z from Z_C to Z_D, the interpretation of C being as above. Because this valuation situation involves crossing of the preferences switching quantity threshold Z_m, the individual starts to exhibit noncompensatory preferences. As a result, he refuses the suggested trade-off because he feels that this time it is an inappropriate way to cope with the values involved. If the refusal is interpreted

as zero WTP, a very peculiar situation emerges. From the researcher's viewpoint, the behavior of the individual looks very strange because it appears that he is willing to pay something to prevent the smaller decrease $Z_C - Z_A$ but nothing to prevent the larger decrease $Z_C - Z_D$.

If any conclusions for policy-making purposes are derived, they will probably be misleading, because despite the refusal to state WTP the individual places a great value on preventing the decrease $Z_C - Z_D$. The approval of zero WTP as a valid answer considerably undermines the true valuations involved. The individual will most likely demonstrate his preferences in another manner, for instance, by attempting to directly influence politicians and other decision-makers. In this case, the individual's willingness to pay will be expressed through his actions, which obviously has a welfare effect because some resources will be used to facilitate them.

At this point it may useful to consider again what the difference between noncompensatory (lexicographic) and weakly comparable preferences actually is. In the case of noncompensatory preferences, the trade-off between Y and Z is unacceptable because one of them is considered immeasurably valuable compared to the other. When weakly comparable preferences are concerned, the negative attitude towards the trade-off can be explained by the complexity of the choice situation. The respondent is not ready to reduce the multiple attributes of the choice situation into a simplifying comparison between only two aspects. Therefore, the ranking across different alternatives becomes ambiguous, although the individual is able to make choices between two or more different alternatives. Consider again Figure 5.3. When noncompensatory preferences rule, it is easy to rank alternatives D, E, and F. F is always preferred to D and E, and D is always preferred to E because, by definition, the only element affecting the ranking is the amount of Z. Now, assume that noncompensatory preferences are replaced by weakly comparable preferences. The result is that the individual still declines to make trade-offs between Y and Z but, in addition, he is unable to rank D, E, and F unambiguously. He may prefer E to D, D to F, and F to E, causing a cycle to emerge. The fundamental reason for this is that the individual does not do the ordering based only on Z and Y, but other variables are included, too. The more complex the valuation situation is, the more likely weakly comparable preferences are demonstrated among respondents.

It is difficult to say what the origin of weakly comparable preferences actually is. MacLean and Mills (1988) suggest that some moral rights cannot be reduced to exchangeable property rights. However, it is not a rule that the presence of moral aspects always leads to lack of ability to make monetary trade-offs. Many people may be inclined to believe that some environmental assets are either priceless or beyond market-like transactions because of intergenerational, spiritual, or ethical reasons (Rekola 1997). Jakobsson and Dragun

(1996, p. 95) note that most contingent valuation literature has regarded respondents as consumers. It is possible that respondents will support a policy that will reduce their personal income if they believe that it is beneficial to the community as a whole. Following the terminology of Blamey and Common (1992), people will then act as "citizens" for the public interest, rather than as selfish "consumers". If this is the case, it is inappropriate to make "citizen" and "consumer" valuations commensurate because they are based on different behavioral motivations.

Obviously, both noncompensatory and weakly comparable preferences produce survey responses that can be interpreted as indicators of protest behavior. There is, however, an essential difference, as already explained earlier. Noncompensatory preferences create response behavior, which only resembles protest behavior but is actually misinterpreting behavior. Respondents with noncompensatory preferences do not oppose the property rights structure of the valuation scenario or they do not reject the idea that there can be a trade-off between environmental quality and money. They just do not want to rank on the cardinal scale the different combinations of environmental quality and income. The policy-making implication of all this is obvious. Even though both preference structures in practical valuation situations produce refusals to make trade-offs between income and Z, noncompensatory preferences make it possible to order different alternatives as the basis of the amount of Z. Moreover, respondents with noncompensatory preferences accept the idea that the ranking is closely related to the use of money as a yardstick. In this respect, it is critical how zero WTP responses are interpreted. Noncompensatory preferences as such do not challenge the use of money as a commensurable unit of value, they only question applications that rely on the idea that people express their willingness to pay in a continuous manner.

There is no doubt that the possible existence of weakly comparable preferences poses an even more serious threat to the CVM than noncompensatory preferences. The disapproval of the use of comparisons based on monetary valuation means that different kinds of techniques should be applied when information is acquired about people's preferences for the purposes of policy-making. In certain cases, we just have to accept that the complexity of the valuation situation cannot be compressed into easily comparable and commensurable dimensions. Therefore, preferences of the respondents demonstrating weakly comparable preferences can be expressed in a form that goes beyond the methodological reach of monetary valuation methods. However, this should not be a worrying conclusion because, as O'Neill (1993) points out, it should be perfectly natural that people have preferences that are comparable in a larger social decision-making context but become incommensurable in a narrow monetary valuation framework.

5.5. Role of Information in CVM Surveys

Although information issues reviewed in this section are related to the use of the CVM in the valuation of nonmarket goods, they are also relevant in market situations. It is apparent, however, that in nonmarket cases the role of information becomes even more critical because of the unfamiliarity of the valuation situation and the complexity of nonmarket commodities being valued.

Information bias has been an object of interest, especially in the early CVM literature. It has been defined in different ways. Freeman (1986) concludes that there are actually two kinds of information biases. One refers to the effect of providing information on values and costs related to factors that may have relevance in the evaluation process of the good being valued. The second type of information bias is considered to result from changes in the information provided to individuals about the good itself. In other words, information bias originates from respondents' varying reactions towards information presented in a CVM survey. For instance, the sequence in which different kinds of information are provided may influence respondents' stated WTPs. The general amount and quality of information is also significant, particularly if the total cost of the nonmarket good improvement is included in the information. Unfortunately, the tests for such bias are difficult to construct, and they usually involve either withholding information from one group and supplying it to another, or measuring the degree of information thought to be held by respondents (OECD 1989, p. 37).

Randall (1986a, p. 120) connects the information bias with policy evaluation. A contingent valuation survey offers the respondents a public policy proposal for approval or disapproval. From the respondents' perspective any such public policy proposal is a bunch of commodities delivered and payments exacted. Thus, the rational respondent bases his contingent market decision on the value of the commodity or amenity offered, the rule by which the agency decides whether or not to provide the commodity, and the rule that determines the payment exacted from the respondent. All three aspects are relevant to policy evaluation, and a change in any of them could alter WTP results. In this sense, the information given to the respondent plays a pivotal role. Consequently, responses that are acquired without specifying the essential features of the related policy instrument likely to be introduced are certainly misleading if the whole policy-making process is concerned.

There have been studies detecting significant information effects and studies that have not been able to confirm their existence. Boyle (1989) investigated how the different descriptions of the item being valued (brown trout fishery) affected the resulting WTP estimates. He found no significant difference between mean WTP statements for three levels of information, although the variance fell significantly as information increased. However, Boyle (ibid.) reminds

that his study was designed to estimate use values, not existence values. Bergstrom et al. (1985) found in their study concerning the preservation of prime farmland in South Carolina that additional information given to the respondents about the major benefits of prime land protection had a statistically significant increasing effect on the mean WTP. We can hypothesize that WTP estimates related to objects of valuation expressing considerable nonuse value potential might be more sensitive to changes in the information content.

By applying a theoretical model, Bergstrom et al. (1990) developed a hypothesis concerning the effect of additional information on the magnitude of willingness to pay for wetland protection. The additional information given consisted of the description of consumption services or attributes associated with recreational trips to the wetland study area. Their results indicate that additional information about services provided by the wetland area increased WTP for wetland protection. However, they argue that the identified information effect should not be considered an undesirable bias. On the contrary, Bergstrom et al. (ibid.) emphasize that additional information in fact increased the completeness and accuracy of wetland protection valuations and therefore induced a desirable information effect. They conclude that information may be an important determinant of perceived values that consumers place upon environmental commodities.

Bergstrom et al.'s (1990) argument about the usefulness and even necessity of additional information inevitably raises the question how much information should be provided to individuals if a public agency is interested in their revealed or stated preferences. In terms of the neoclassical theory, additional information should be provided to individuals as long as the expected value of the information is greater than its cost. Because of many practical problems, it is not possible to assess *ex ante* when the costs of providing additional information become greater than the expected utility related to it. There is also the problem how much information of complex environmental resources individuals can be expected to assimilate and perceive. However, Spash and Hanley (1995) also support the view that more information is better than less information. They conclude in relation to the valuation of biodiversity that uninformed preferences are likely to underestimate the social value of biodiversity protection. In addition, if preferences for biodiversity protection are to be sought as a guide to policy decisions, individuals need to be given as much information on biodiversity protection as they can reasonably be expected to comprehend.

Considering the ubiquitous role of information and the arguments made by Bergstrom et al. (1990) and Spash and Hanley (1995), it is not surprising that many researchers have abandoned the term "information bias". Jakobsson and Dragun (1996) point out that the valuation process will depend on all the elements of the contingent valuation scenario, including the payment mechanism, information, likelihood of actual provision, etc. The concept of informa-

tion bias was largely based on the notion that respondents were assumed to be concerned only with the value of the good in question, all other elements of the hypothetical market being neutral. Thus, the influence of different amounts of information and different payment vehicle arrangements was interpreted as bias. However, now most CVM researchers assume, probably more correctly, that variation in information will and should produce different value estimates. What is important is to ensure that information given is seen to be true, constant across the sample, and not designed to induce bias towards a particular result (Bateman and Turner 1992).

Vatn and Bromley (1994) are also interested in the role of information, although their approach is somewhat different. They are concerned with the compression of information that takes place during a CVM survey. They point out that it is not likely that the consumer can consider a particular object, with a particular price attached to it, and make a truly informed decision. This is mainly because of the complexity of the choice situation related to environmental goods and services. Consequently, reliance on the compact information produced by the CVM may produce natural resource use decisions that are in fact inferior to decisions made without hypothetical monetary valuation. Thus, their recommendation is that the most fundamental environmental choices should be made without artificially created monetary values. The vast amount of information inherent in natural resource use decisions is better taken into account by applying collective decision procedures instead of monetary valuation.

Apparently, the information content of a CVM survey is an essential and influential element. It can reduce biases, but it can also induce them. In many cases, well-intentioned behavior originates from insufficient information. The researcher does not describe the valuation process and its meaning clearly and accurately enough. By increasing the amount of information, respondents' views and the researcher's intentions would become closer to each other. Unfortunately, there is no way to determine what the correct amount of information is. The researcher's judgment is decisive in this respect. From the point of view of policy-making, the information effect is quite important. If value estimates for the proposed policy are extremely sensitive to the information content of the valuation scenario, it is likely that their applicability diminishes. It is a sign of the fact that the policy proposal is perceived in an ambiguous way and needs clarification at its various stages.

Generally, CVM researchers assume that the total WTP rises when the amount of conveyed information increases in the survey. If the WTP responses are very sensitive to the amount of information provided, it is a very difficult task to define what the "right" amount of information that should be given in a contingent valuation survey is. It is also possible that a respondent finds himself in a situation where he is overloaded by information. This means that, when the valuation issue is controversial and the additional information (I_a) provided is

not consistent with the prior information (I_p) held by the respondent, the additional information no longer increases the WTP. On the contrary, the WTP can even diminish. A related but a somewhat different problem arises when the additional information increases the variability of the WTP estimates. If some of the respondents find the additional information inconsistent with their prior information, then the variance of WTP is likely to increase as more information is introduced. Correspondingly, if the additional information is consistent with the prior information, the variance of WTP might decline (Romstad 1991). Both of these phenomena are illustrated in Figure 5.4.

Now it is possible to classify different impacts that information has on respondents' WTPs. However, it is essential to notice that if the respondent can judge whether or not the additional information is in conflict with the prior information, the respondent has already attached certain characteristics to the commodity being valued. In other words, the respondent is more or less aware of his preferences and expresses a positive or negative attitude towards the quality/quantity change of the nonmarket commodity being valued. Assume that the respondent has some prior information (I_p) about the valuation issue, and that some additional information (I_a) is provided. Furthermore, let A_p denote that the resulting action is based on the prior information, and let A_a denote that the resulting action is based on the additional information provided. The action can be, for instance, the respondent's actual participation in a conservation program that is carried out as a consequence of very high stated WTPs expressed in a contingent valuation survey. In addition, let WTP_p denote the

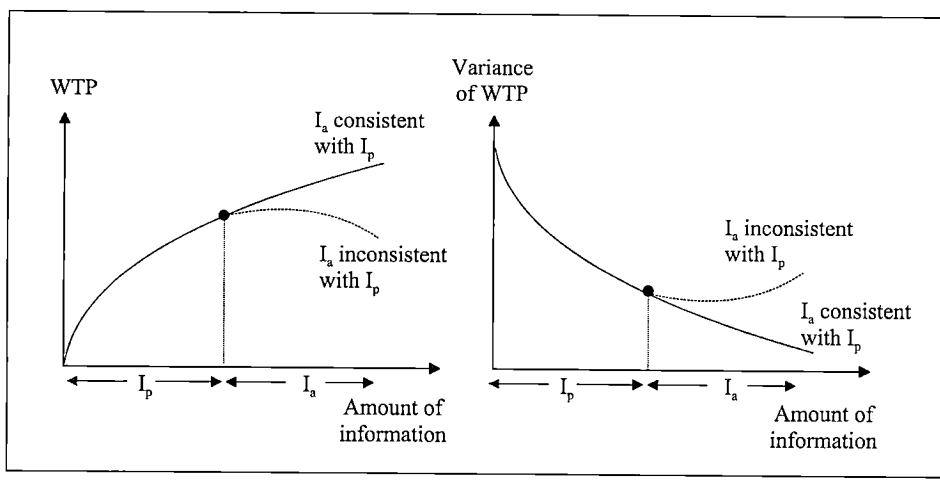

Figure 5.4. Effect of Consistent and Inconsistent Additional Information (in Respect of Prior Information) on WTP and on Variance of WTP (Romstad 1991, pp. 2-3).

willingness to pay at the prior information level I_p, and let WTP_a denote the willingness to pay after the respondent has received additional information I_a through the CVM survey instrument.

It is very likely that when the additional information is part of the prior information already held by the respondent, WTP_p equals WTP_a regardless of the nature of the initial attitude. It is also likely that when the respondent agrees on the additional information this strengthens his initial attitude based on the prior information. Thus, if the initial attitude towards the nonmarket commodity being valued is positive, WTP_a is greater than WTP_p, and if the initial attitude is negative, the reverse is true or WTP_a is less that WTP_p. As it can be seen, this is a potential explanation for the information effect since, if the CVM instrument conveys information that extensively lists both pros and cons of the nonmarket commodity being valued, the variance of WTP increases. This is mainly because those who have a positive initial attitude reject all negative information and, correspondingly, those who have a negative initial attitude refuse to take into account any positive information. The tendency to reject that part of additional information that is in conflict with the prior information dominates especially when there is an opportunity to receive information that strongly supports the initial attitude.

A more complicated situation emerges when the received additional information strikingly deviates from the prior information. The respondent has two choices. He can totally neglect the additional information indicating that WTP_a would again equal WTP_p. On the other hand, the respondent can reassess his initial position. The problem is that the conflicting additional information may lead the respondent to change his initial view as well as to make him stick to his initial view even more categorically. Thus, depending on the quantity and quality of the additional information, unconditionality of preferences and attitudes, and relative importance of the issue, WTP_p can be greater than, less than, or equal to WTP_a. Certainly, this feature increases the variance of WTP. Consequently, the information effect is most likely when the issue at hand is controversial or when the respondents' level of knowledge is rapidly changing over time (Romstad 1991, p. 6).

Ajzen et al. (1996) have also examined the relationship between information and willingness to pay. They support the conclusion that CVM measures are sensitive to the quality and quantity of information provided in the valuation scenario. They also present empirical evidence that information about a public or private good can function as a means of persuasive communication. The magnitude of this effect depends on the level of motivational priming, personal relevance of information, and quality of arguments. When a public good type commodity is being valued under conditions of priming of altruistic motives as well as arguments strongly emphasizing the positive sides of the commodity being valued, personal relevance (i.e. will the respondent be able to consume the

commodity) of the valuation situation does not significantly affect WTP. However, if the motivational priming promotes individualistic or egoistic motives and strongly positive arguments are presented, high personal relevance has a clear impact on WTP. In this case WTP for the commodity of a public good type is much higher if it is readily available for the respondents in the near future.

The situation becomes even more interesting when strongly positive arguments are replaced by rather neutral information about the beneficial features of the commodity. In the case of the altruistic motivational priming, high personal relevance of commodity consumption produces lower WTP than low personal relevance. Ajzen et al. (1996) explain this seemingly paradoxical result by arguing that, under low personal relevance, WTP and attitudinal judgments can be influenced by implicit motivational orientations that are unrelated to the contents of the commodity description. As a result, subtle contextual cues in the valuation scenario can seriously bias WTP under conditions of low personal relevance. In these circumstances priming of altruistic motives can lead part of the respondents to express WTP answers that reflect, for instance, a sense of moral satisfaction instead of actual monetary values (see e.g. Kahneman and Knetsch 1992a).

Siikamäki (1997) has investigated how additional positive information affects respondents' WTP for reduced use of pesticides. There were two different scenarios introduced, a complete ending of pesticide use, and a 50% reduction of pesticide use. Both scenarios were divided into two subsamples, the first of which contained rather neutral information about environmental and health effects of pesticide use and the second one strongly emphasized the advantages resulting from reduced use of pesticides. It appeared that additional positive information was a statistically significant explanatory variable in a logistic regression model where the other explanatory variable was the dichotomous bid. Siikamäki and Aakkula (1996), who furthered the analysis by examining the relationship between attitudes and WTP, have used the same data. By using the factor and cluster analysis, the respondents were divided into three attitudinal groups, and mean WTP was estimated for each group. It was possible to detect significant mean WTP differences between some of the groups. For instance, the group labeled as "environmentalists critical of conventional agriculture" (46% of the respondents) had a three times higher mean WTP for the 50% reduction of pesticides use than the group labeled as "admirers of technological progress" (28% of the respondents). The mean WTPs were FIM 2,006 and FIM 617, respectively. However, the study could not answer the question whether additional information influenced the mean WTP inside the attitudinal groups.

Clearly, the testing for the information effect is somewhat complex. If a CVM survey design is used where respondents face varying amounts of information the tests for differences in mean WTPs can be performed. However, as indicated above, respondents' reactions to additional information depend on

their initial attitudes. Thus, it would probably make sense to compare separately the change in WTP due to increased information among those who have a positive initial attitude and among those who have a negative initial attitude. Assuming that the additional information given includes clearly favorable aspects for the commodity being valued, and that at least some of the respondents with positive attitude are not familiar with the additional information, there should be a greater difference in the mean WTPs between the less informed and the more informed supporter groups than between the less informed and the more informed opponent groups. This kind of information is also more interesting from policy-makers' viewpoint because it gives a more detailed picture of the interest groups involved.

5.6. Choice of the Elicitation Method

The CVM survey must also contain a mechanism for eliciting value or a choice from the respondent. The bias review also showed that the choice of the elicitation method has an important role in bias elimination. Mitchell and Carson (1989) list in their typology of CVM elicitation methods nine different alternatives. The categorization is carried out along two dimensions: whether the actual maximum WTP for the good is conclusively obtained through a valuation question, and whether a single valuation question or an iterated series of questions is asked (for a single level of the public good being valued).

In the beginning, CVM researchers applied continuous or open-ended questions. The idea was to ask directly a how-much question, and the response was expected to reveal the actual maximum WTP of the respondent. However, CVM researchers soon realized that respondents had problems to relate themselves to open-ended WTP questions. They felt that the whole questioning situation was unfamiliar and out of the context of everyday life experiences. In essence, many respondents reacted by refusing to state their WTP. Therefore, the open-ended question was soon replaced by a procedure called a bidding game. Mäntymaa (1993, pp. 68-69) depicts the idea of the bidding game in the following way. First the interviewer asks if the respondent is willing to pay a certain amount of money, x, to receive a change in a quantity or quality of a resource. If the answer is "yes", the interviewer adds an incremental amount k on x. In case the answer is "no", the interviewer subtracts the same amount k from x. After this, the interviewer asks the same question again using a new amount of money, $x + k$ or $x - k$. The process will be repeated until the respondent accepts the amount offered and does not want to increase or decrease it any more.

The bidding game imitates the characteristics of a real-life auction and, therefore, it is likely to be familiar to respondents. The nature of the choice required (yes/no) is also very simple. There are some other virtues, too. The likelihood of capturing the maximum actual WTP is high, and it is likely that the

process of iteration will enable the respondent to consider the value of the amenity as fully as possible. The same is true in the case of a payment card approach, which is an alternative to the bidding game. In the payment card elicitation method, the respondents receive a visual aid, a payment card, which contains a large array of potential WTP amounts, ranging from zero to some large amount. Thus, the payment card method also provides the respondent more context to make up his mind than the plain open-ended questioning (Mitchell and Carson 1989). However, both the bidding game and the payment card are prone to starting point bias, meaning that the stated WTPs will correlate heavily either with the initial bid in the bidding game or with the range of bids mentioned in the payment card (Bateman and Turner 1992).

The next step was the development of the dichotomous choice approach (also referred to as discrete choice or take-it-or-leave-it approach). In dichotomous choice applications, respondents are asked to accept or to reject a suggested cost (or compensation) for a given environmental change. Each respondent is inquired if he is willing to pay (receive) one of these costs (compensations) for the change on all-or-nothing basis, with no further iteration. The prices are randomly assigned to respondents so that each price is administered to an equivalent subsample (Kriström 1990a). As a modification of the dichotomous approach, a version with a follow-up question or even two follow-up questions has been developed. In this scenario, the respondent is asked a question requiring a "yes" or "no" answer about whether he or she would pay a specified price. If the respondent says "yes", another WTP question is asked using a higher price randomly chosen from a prespecified list. If the answer is "no", a follow-up question with a lower price is asked (Hanemann et al. 1991).

The most significant advantage of the dichotomous choice is that it mimics respondents' day-to-day market decisions much more closely than any other elicitation scenario. However, because the data collected is binary-type, willingness to pay amounts are statistical estimates and, thus, they are dependent on the statistical techniques applied. Another advantage of the dichotomous approach is that it reduces the incentive for strategic behavior (i.e. stating WTPs that differ from the true WTPs in order to receive some extra benefits) and other kinds of goal-oriented behavior. It is more difficult for the respondent to influence the mean willingness to pay within the dichotomous approach than within other approaches, for obvious reasons.

However, there are also some shortcomings involved in the dichotomous choice approach. The binary-type data conveys, of course, a limited amount of information. Thus, more observations are needed for the same level of statistical precision in sample WTP estimates. Furthermore, because of the nature of the data acquired, advanced statistical procedures are required in order to derive any useful summary statistics on WTP. Unfortunately, no real consensus exists regarding how to obtain these summary statistics (Kriström 1990a). A good

example of the effects of different statistical estimations can be found in Bowker and Stoll (1988). They investigated people's willingness to pay concerning the preservation of living-sites of one endangered species or whooping cranes. They applied three different theoretical models and both logit and probit estimation with different truncation points. Depending on the specification, their mean and medium estimates for WTP ranged from USD – 61.56 to USD 148.54.

It may also happen that some respondents decide not to invest any effort at all in identifying their true WTP. Several researchers have been concerned about the fact that a proportion of respondents in dichotomous choice applications is prone to "yea-saying". A strict yea-sayer would answer "yes" to a dichotomous choice question regardless of whether the bid value asked is larger or smaller than his true WTP. The ramification is that yea-saying would bias dichotomous choice estimates of mean WTP upwards (Ready et al. 1996). However, it is hard to say what the magnitude of yea-saying is. Kanninen (1995) has developed a statistical approach for double- or multiple-bounded dichotomous data to estimate the proportion of respondents that are yea-sayers. In her study concerning the valuation of wildlife and wetland habitats she concluded that as much as 20 percent of respondents were yea-sayers.

The motives behind yea-saying are somewhat unclear, but Brown et al. (1996) provide a reasonable explanation. People may have two objectives in responding to a WTP question. First, they may want to truthfully answer the question asked about their actual willingness to pay. Second, they may want to indicate how favorably they view the good being valued, or at least whether they view the good favorably or not. The problem with a value elicitation question of the dichotomous choice type is that only a "yes" response indicates a positive attitude towards the good being valued. If the bid amount offered to the respondent is more than the respondent thinks he would be willing to pay, the respondent must choose between two objectives. If it is more important to indicate a favorable impression of the good being valued than to indicate a truthful WTP, the respondent will say "yes".

A general observation is that when respondents have to cope with preference uncertainty and they are ambivalent about their answers, they are more likely to provide a positive response. This is probably because if respondents have some small, positive value for the good being valued, but are not able to express it explicitly in monetary terms, they feel more comfortable with the "yes" answer. To respond "no" in such a case would more likely be incorrect for persons who have determined that they attach some value to the good in question (Cook 1998). Furthermore, preference uncertainty is a source of the anchoring phenomenon, which creates problems in the dichotomous choice format, too. Like in the bidding game or in the payment card, it is possible that the bid acts as a starting point or an anchoring point of value formation when respondents are

uncertain about their true willingness to pay and need cues in order to provide an answer that they assume to be appropriate and satisfactory.

A further development of the dichotomous choice format is the so-called (policy) referendum approach. This involves constructing an artificial or simulated public referendum over a proposed policy or program which would affect the provided quantity or quality of some environmental commodity (Bergstrom 1990). The respondent should believe that certain policy decision rules pertain. The policy is implemented if a majority of citizens approves it, and for each voting citizen, approval is conditional on a level of individual cost, which is specified at some point in the referendum scenario. The difference between the dichotomous choice format and the policy referendum approach is one of principle: instead of market behavior voting behavior is imitated. Hoehn and Randall (1987) point out that the policy referendum model with individually defined costs promotes truth-telling as the individually optimal response strategy.

The discussion about the superiority of different elicitation methods has not led to a unanimous conclusion so far. The NOAA Panel (Arrow et al. 1993) supported very strongly the use of the referendum format. The imitation of the real referendum means that a "no-answer" option should also be included because in a real referendum it is also possible to skip voting. However, the attempt of the NOAA Panel to advocate the referendum format is a part of their overall demand for conservative design. This includes the use of WTP instead of WTA and the choice of summary statistics that tend to underestimate WTP. The NOAA Panel argues that a conservative design increases the reliability of the estimates by eliminating extreme responses that could enlarge estimated values implausibly. Not all the CVM researchers have been satisfied with this assertion because it may lead to approaches that are in contradiction with theoretically correct guidelines of design, one example being the selection between WTP and WTA (Harrison 1993). Nevertheless, the use of the referendum format makes it theoretically correct to apply the median instead of the mean as the principal summary statistics. This is in most cases a more conservative choice.

It may be useful to examine the starting point bias in more detail because it illuminates the possibility that different elicitation formats may induce different kinds of response behavior. As already mentioned, the general cause of starting point bias is that the initial bid suggests a reasonable final bid to respondents. This occurs because people are being asked to value items they are not used to valuing and they are not familiar with the valuation situation. Thus, respondents may interpret the initial bid to convey some relevant information that they should take into account in their answers. Respondents may assume that the researcher, who probably is an expert in his specific field, has somehow in advance estimated the true value of the item and is now using the value as a starting bid. So respondents tend to adjust their answers to reflect the value

given in the starting bid. It is also possible that respondents just want to please the interviewer and suppose the starting bid to represent the kind of answer that the interviewer is looking for. In this respect respondents express well-intentioned response motives.

There are also a few possible sources of starting point bias. It may happen that the starting bid is significantly different from the respondent's actual willingness to pay, and the respondent becomes bored with the iteration process and truncates the process before his actual WTP is revealed. Thayer (1981) presents a model where the utility derived from participating in a CVM survey is an argument in the respondent's utility function. This argument expresses the potential trade-off a respondent must face between taking time to provide an honest final WTP answer and giving a dishonest WTP answer in order to terminate the boring bidding process. However, it is highly questionable if boredom can play a major role when respondents choose their answering strategies (although the possibility of indifferent response behavior should be remembered). First, there is no need for a respondent to provide a dishonest answer; he can directly jump to his best guess of his actual WTP. According to Boyle et al. (1985), the respondents take this strategy when they wish to end the bidding process. Nevertheless, the boredom explanation is apparently not valid when the starting bid is given without subsequent iteration process or additional valuation questions (anchoring in the dichotomous choice approach).

The advantage of the bidding game technique is, as already explained above, efficiency in obtaining WTP estimates. We can also hypothesize that the iteration process makes it possible for the respondent to consider thoroughly his preferences and true willingness to pay. All this indicates that, if it were somehow possible to remove or neutralize the confusing impact of the starting bid, the bidding game technique would again be a potential elicitation method. Randall and Farmer (1992) make a very interesting contribution in order to restore the validity of the bidding game approach. They consider the possibility that a continuous WTP data set influenced by a starting bid may contain information about the "true" value of the mean WTP.

Randall and Farmer (1992) have developed four different models to explain the effect of the starting bid (see Figure 5.5). In all these models, the relationship between the expected value of the stated WTP, or E(WTP), and the starting bid, or SB, is of interest. If E(WTP) were determined only by the "true" WTP and were not affected by SB, the relationship between E(WTP) would be a horizontal line, such as that labeled WTP_t (the "true" WTP) in Figure 5.5a. If, to illustrate the other extreme, E(WTP) were equal to SB, and were therefore not influenced by the "true" WTP, the relationship between E(WTP) and SB would be a straight line of slope 1 passing through the origin (Figure 5.5b). This line is labeled UNIT in all the subfigures.

Both models are in a way very informative, but it is likely that they very seldom exist in reality. In 5.5a there is no starting point bias present, and in 5.5b the data set is completely useless because the starting bid is the only explanatory variable indicating that it is impossible to extract any information about the "true" WTP. To make the situation more relevant and real world like, assume that the respondent, *i*, believes that SB_i, the starting bid randomly presented to him, contains some meaningful information about the value of the commodity being offered. This kind of assumption is usually motivated by the respondent's confidence in the researcher's competence. The respondent believes that the bid he is facing bears some relationship to something relevant, e.g. to answers other respondents have been giving, or to expert estimates of the value of the commodity being offered.

While the respondent is assumed to believe that SB_i conveys some information about the value of the commodity, he is also aware that his WTP_i deviates somewhat from SB_i. His first task is to determine whether his WTP_i is greater or less than SB_i. Knowing, for instance, that WTP_i is greater than SB_i and believing that SB_i contains some information about the value that some people attribute to the commodity being offered, he must formulate WTP_i. Assume that the respondent conducts a search for WTP_i. If the search were complete and the respondent made a complete adjustment, he would formulate $E(WTP)_i = WTP_i$. Thus, the complete adjustment would generate the horizontal plot of $E(WTP) = WTP_t$ illustrated in Figure 5.5a, where respondents with low SB_i would adjust all the way up to WTP_t, and those with high SB_i would adjust all the way down to WTP_t. Nevertheless, searching for one's true WTP_i is a difficult task. An adjustment process that started at SB_i and stopped before reaching WTP_t would most likely generate a curve such as WTP_{ica} in Figure 5.5c, a straight line of slope *s*, where $0 < s < 1$, intersecting the line UNIT. A data set exhibiting this kind of incomplete adjustment process would probably produce a statistically significant starting point bias. The data set would contain useful information about the respondents' WTP_t. Taking into account the incomplete nature of the adjustment process, the mean WTP_t would be located at the intersection of WTP_{ica} and UNIT, where obviously no adjustment on the average occurs.

Assume again that the respondent, *i*, provides a valid answer to the initial starting bid. Furthermore, assume that the respondent believes that SB_i contains information about the costs per household of the commodity proposed. In addition, assume that the respondent's motivation is rational and selfish, but he does not intend to make a strategic misstatement of the WTP_i. In this case, the respondent will seek to adjust toward WTP_i, but always subject to a simple rule: $E(WTP) \leq WTP_i$. This way, if $WTP_i > SB_i$, he will adjust upward at least part of the way toward WTP_i but never beyond it; if $WTP_i < SB_i$, he will adjust downward at least as far as WTP_i. This is an attractive adjustment rule for a respondent seeking to provide a response to encourage proposals beneficial to

himself but, at the same time, to take particular care to avoid endorsing policies that would yield his household smaller benefits than costs. A sample of respondents all following this adjustment path would generate a trace of E(WTP) similar to the curve WTP_{icra} (Figure 5.5d). The curve WTP_{icra} would have a positive slope, intersect UNIT, and become asymptotic to the horizontal line estimating the mean WTP (labeled WTP_m) somewhere to the right of the intersection. Statistical tests would again likely show a significant starting point bias but the data most likely contains useful information about the "true" WTP. The logic of the incomplete but rational adjustment model implies that the horizontal asymptote to WTP_{icra}, or WTP_m, is a valid estimate of the mean WTP_t.

There are also some other researchers defending other elicitation formats than the dichotomous choice. Ready et al. (1996) conducted a CVM study concerning willingness to pay for food safety improvements. In particular, they tested for differences between continuous and discrete contingent valuation estimates by using split-sample design. They found out that the dichotomous choice elicitation method consistently generated much larger estimates of WTP

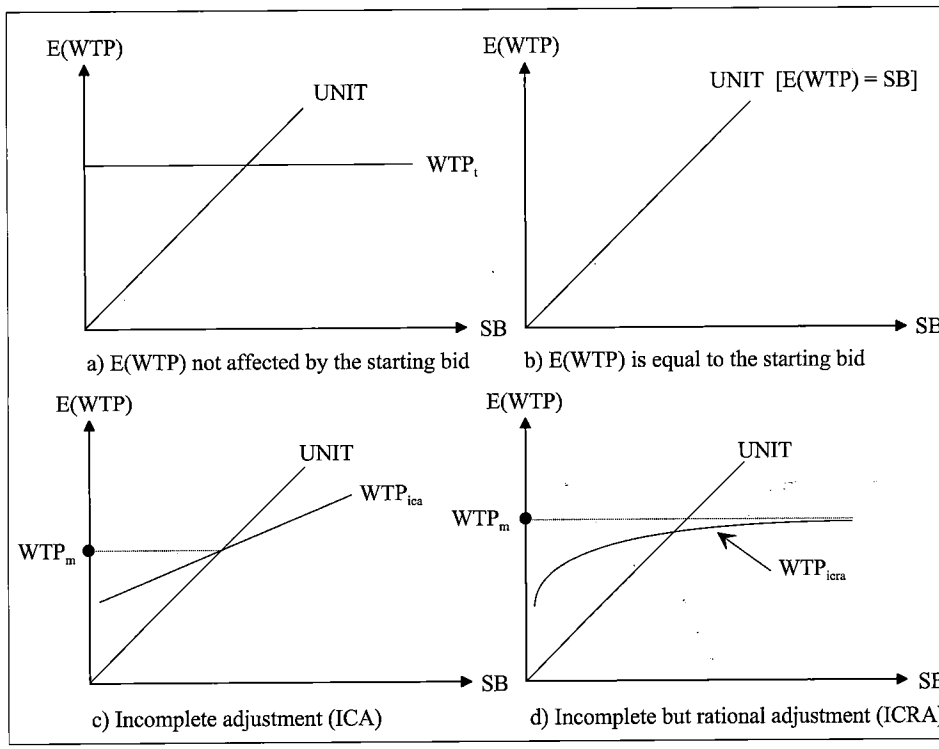

Figure 5.5. Relationship Between the Expected Value of the Stated WTP and the Starting Bid (Randall and Farmer 1992).

than a continuous method (payment card). They also concluded that few of these differences were due to bias introduced by the statistical estimation techniques related to the analysis of the dichotomous data. According to them, most or all the differences were created by the differences in response behavior. In addition, the continuous WTP responses showed a significant scope effect, while the dichotomous responses did not. Based on their results, Ready et al. (ibid.) wonder whether the CVM researchers have been too quick to abandon continuous methods in favor of dichotomous choice methods. In addition, Boyle et al. (1996) found some evidence that WTP estimates based on continuous data were lower than estimates derived from dichotomous data. Their conclusion was that either open-ended questions underestimate values or dichotomous choice bid structures may lead to systematic overestimates. However, Boyle et al. (ibid.) consider that the NOAA Panel's (Arrow et al. 1993) endorsement of dichotomous choice questions is perceivable and acceptable, but they point out that other questioning formats should not be completely neglected. For instance, open-ended data are likely to yield smaller standard errors if not highly skewed toward high values.

Bateman et al. (1995) conducted a CVM survey that tested for the effects of altering the method of eliciting willingness to pay responses. One of their ideas was to assess the applicability of the guidelines endorsed by the NOAA Panel (Arrow et al. 1993). They employed three WTP elicitation methods: open-ended questions, dichotomous choice questions, and iterative bidding questions. Their results indicated that respondents experienced significant uncertainty when they answered open-ended questions. They may also have exhibited free-riding or overbidding tendencies. When answering dichotomous choice questions, respondents seemed to experience much less uncertainty, although the suggestion that bid levels affected the responses was not ruled out. The iterative bidding questions appeared to provide a medium approach with respondents exhibiting certain of the characteristics of both other formats. Their overall conclusion was that the level of uncertainty induced by open-ended formats is a major concern, and that further research is required to detect behavioral motivations behind individuals' responses to iterative bidding and dichotomous choice questions.

It seems that any design detail of a CVM survey has produced an extensive literature of arguments and counter-arguments. Bearing this in mind, the discussion about the "correct" elicitation method is not surprising. However, it is obvious that no elicitation alternative can be better than the others in all respects. The choice of the elicitation format depends on the goals of the CVM survey. If legitimacy and credibility are required for litigation purposes, the recommendations of the NOAA Panel (Arrow et al. 1993) should be taken very seriously. The problem is, nevertheless, that no CVM design can be completely bias-free. There is always a trade-off included: a choice of a certain elicitation method reduces some biases but most likely induces a few others. This is not to

say that careful survey design is not of great importance. There is no question about this, although its purpose is not to attempt to remove all biases but make the researcher aware of their existence and their impacts on the survey outcome.

5.7. Previous CVM Studies on the Value of Rural Amenities

In recent years there have been a number of contingent valuation applications that have estimated people's willingness to pay in relation to economic values somehow connected to agricultural landscape. Cultural and institutional contexts, commodities being valued, valuation scenarios, and elicitation techniques have varied so much that no universally applicable conclusions can be derived. However, the mere existence of a considerable number of this kind of CVM surveys indicates that the issue has been regarded worth studying. This shows, at least indirectly, that benefits derived from agriculture-related resources have certain significance.

Bergstrom et al. (1985) estimated the willingness to pay for protecting 25%, 50%, 75%, or 100% of the agricultural land in Greenville County, South Carolina, USA. They used a payment card and a mail survey. Their observation was that local households were willing to pay annually ca. USD 9 for the maintenance of the whole 72,000 acres area of prime agricultural land. Converted into an annual payment per acre, this resulted in USD 13. Bergstrom et al. (ibid.) also noted that the relatively low WTP may have been an indication of zero or negative net benefits from public programs aiming to preserve agricultural land. Halstead (1984) estimated willingness to pay for avoiding residential development on agricultural land in three counties in Massachusetts, USA. The chosen elicitation method was the iterative bidding game. The mean annual WTP for avoiding high-density development ranged from USD 70 to USD 176. Of course, it is somewhat difficult to say if people's willingness to pay resulted from true appreciation of agricultural landscape or from dislike towards urban development and the interest groups behind it. It is interesting that despite the quite similar valuation scenarios of these two US studies the mean WTPs differed significantly.

Drake (1987; 1992; 1993) has reported WTPs related to the maintenance of Swedish agricultural landscape. Based on a personal interview survey of 1,089 respondents and using a payment card procedure he concluded that the mean annual WTP per person for preserving agricultural land in its current use was SEK 470. Because 12% of the respondents refused to answer the WTP question, a regression procedure was applied in order to estimate a WTP for those who declined. The corrected WTP appeared to be somewhat higher, SEK 541 per person and year. Drake (1992) also calculated an estimate for the total annual WTP for all Swedes and the average annual WTP per hectare of agricultural land. The figures are SEK 3.36 billion per year and SEK 975 per hectare and

year, respectively. A few questions measuring attitudes were also included. The most important motives for the maintenance of agricultural landscape among the respondents were the conservation of nature (47%), aesthetic values (22%), recreational use (13%), and cultural-historic values (12%).

Hanley (1989) has applied the CVM to the valuation of rural recreation benefits derived by visitors of the Queen Elizabeth Forest Park in Central Scotland. Even though the forest park cannot be considered to be an organic part of agricultural landscape, it provides similar recreational and scenic values whose existence is to some extent dependent on the surrounding countryside. The target population was the on-site users of the forest park, and 1,148 questionnaires were collected, partly by means of interviews and partly the respondents filling them in themselves. The study consisted of several WTP questions, but the payment vehicle used in all of them was an entry fee. WTP was inquired separately for wildlife, recreational services, and landscape. In addition, WTP was inquired for combining all the aspects of the site. The latter scenario was constructed by asking visitors how much they would be willing to pay for an entry to the park, per person per visit, if these entry fees prevented the government from selling the forest park to a private forestry company. In this case, the mean WTP appeared to be GBP 1.25 per person per visit. Assuming that the total number of visits per year is 145,000, the total WTP at the annual level would be GBP 181,000.

However, as Hanley (1989) points out, the total WTP represents only use and nonuse values of actual site visitors. Possible nonuse values of non-visitors are not included. In addition, the contingent valuation estimates may be biased downwards. Some respondents may have objected the scenario presented, engaged in free-riding, or valued the forest less under the hypothetical market situation (private ownership) than the current situation (public ownership). It is also possible that an alternative payment vehicle such as a payment to a trust fund would have resulted in higher WTP amounts. The study also included WTP estimates produced using the travel cost method, but the comparisons of the results of the two methods is difficult because the travel cost estimates varied from GBP 73,949 to GBP 1,497,858 depending on the functional form employed.

Willis and Garrod (1993) have carried out a CVM study valuing possible future landscapes in the Yorkshire Dales National Park. The assessed landscapes comprised images of the range of possible future landscapes: today's landscape, abandoned, semi-intensive agricultural, intensive agricultural, planned, conserved, and wild landscapes. The CVM survey encompassed both residents and visitors of the national park area. The sample size was 600 (300 + 300). The questionnaire design was somewhat dependent on whether the questionnaire was aimed to visitors or residents. However, both subsamples received identical questions on recreational activities undertaken, attitudes towards congestion,

preferences over a range of landscape features, expenditures towards countryside causes, and willingness to pay to maintain landscape. Two variants of the questionnaire were used in the resident subsample to test for part-whole bias.

It appeared, not surprisingly, that the most preferred landscape was today's landscape, followed by conserved landscape and wild landscape. The authors explain this by referring to known psychological preferences for the status quo and to the choice heuristics of individuals based on representativeness, availability, and anchoring. The mean willingness to pay for the most preferred landscape varied from GBP 7.67 to GBP 34.96 depending on the landscape type and the status of the respondents (visitor or resident). The willingness to pay to preserve today's landscape in the Yorkshire Dales across all visitors and residents amounted to some GBP 42 million per year. No part-whole bias was detected. According to them, their analysis indicated that the landscape benefits produced by today's landscape justify the use of further public expenditure for the maintenance of landscape.

Willis et al. (1995) have conducted a CVM study in order to estimate benefits related to the Environmentally Sensitive Area (ESA) scheme. This originated in England in the 1980s from concerns about the adverse impact of more intensive agricultural practices on the countryside. There was a need to support the continuation of traditional farming practices in areas where these practices had contributed to a distinctive landscape, wildlife habitat, or preservation of archeological and historical features. The target population consisted of the three groups who were likely to benefit from the ESA scheme: residents in the ESAs, visitors to the ESAs, and the rest of the public. Personal interviews were used and the questions for each group were designed to be as similar as possible. Taken all together, 3,077 interviews were conducted. Both an open-ended payment card and a dichotomous choice format were applied to elicit WTPs. In addition to their WTP for the ESA scheme, the respondents were asked how much they currently spend on countryside activities.

Because of the rather complex design of their study, Willis et al. (1995) produced a large number of estimates for the mean WTP. The payment card format created a range from GBP 11.84 to GBP 36.65, where the WTP varied according to the ESA area (Somerset Levels and Moors, South Downs) and status of the respondents (resident, visitor, general public). The dichotomous choice format was applied only in the case of the public. It gave a substantially higher mean WTP, GBP 138.37 per household per year (a logit model was used in estimation), which is roughly 3.8 times that elicited by the open-ended payment card format (GBP 36.65). The same observation has been made in several other CVM studies. The median WTP derived from the dichotomous choice data appeared to be GBP 48.51.

As a conclusion, Willis et al. (1995) note (based on their own study and other major UK CVM studies) that the CVM estimates of WTP by individuals or

households per year for nature conservation vary enormously. Many of the differences between estimates from various studies can be accounted for or explained by differences in the populations of reference, different values held by users compared to nonusers, and the different number of benefit issues estimated by the study. In addition, differences can be attributed to whether a marginal change in quantity is being valued, whether the total value of the good is being assessed, whether the change is irreversible, and whether substitutes are available and considered in the valuation of the specific good. They want to note that, when the object of valuation (like the ESA areas) consists of many distinct and different goods, the complexity of the entire valuation situation will be reflected in the variation of estimated WTPs.

Pruckner (1995) has taken a somewhat differing approach. Although he has also referred to the value of agricultural landscape, his purpose has been to evaluate "the economic benefits associated with agricultural landscape-cultivating services". The target population was tourists spending vacations in Austria, and a sample of 4,585 were personally interviewed. In addition to the WTP question, other questions dealing with links between the countryside, the agricultural sector, and tourism in Austria were included. The central elements of the valuation scenario were an informative introduction, in which it was pointed out what is meant by agricultural landscape-cultivating activities, the description of the payment vehicle (an earmarked fund in order to carry out the depicted landscape-cultivating activities), and the actual WTP question, in which it was inquired how much a tourist party would be willing to pay per day into the earmarked fund to guarantee the provision of landscape-cultivating activities. The mean and median WTPs recorded were ATS 9.20 and ATS 3.50 per person per day, respectively. The author stated as a conclusion that, although the results revealed a considerable total willingness to pay, the amount would not probably suffice to maintain farmers in mountainous regions. He also emphasized that the results facilitate the making of agricultural policy conclusions concerning direct compensation to farmers for the provision of nonmarket goods.

In this study, the good being valued is an agricultural production practice, pro-environmental farming, the value of which is assumed to be derived from its positive impacts on the quality of the rural environment. None of the previous studies on the subject has applied a similar valuation scenario. However, valuation objects, value dimensions, and inherent valuation motives are more or less the same in all the described CVM studies concerning rural amenities. The maintenance of agricultural land or agricultural landscape is a central dimension of the object of valuation in this study, as it is also in Halstead (1984), Bergstrom et al. (1985), Drake (1987) and Willis and Garrod (1993). On the other hand, the pro-environmental farming scenario resembles Pruckner's (1995) approach because of its instrumental nature. Pruckner's "landscape-cultivating activities" have a similar role in the maintenance of agricultural landscape as the pro-

environmental farming practices have in the maintenance of the rural environment.

It is also clear that all the described CVM studies concerning rural amenities promote the view that the countryside provides significant nonuse values in addition to use values. Studies having agricultural landscape as the object of valuation (Drake 1987, Willis and Garrod 1993) emphasize values related to agricultural tradition and aesthetic issues. Hanley (1989) and Willis et al. (1995), in turn, are more inclined to underline values that have environmental or ecological origin. The focus of this study is more environmentally-oriented, too. The rural environment has an ecological dimension which should be given to at least the same weight as to the landscape dimension.

However, the main difference between this study and the previous CVM studies valuing rural amenities is the viewpoint taken on the social decision-making. Although in this study, too, a monetary value estimate is derived in relation to the rural environment and rural amenities, the emphasis is on assessing the feasibility and applicability of the value estimates that are meant to be used in the social decision-making context. Thus, the idea is not only to indicate that certain nonmarket amenities and services can have a monetary value but also to show that the concept of monetary value is prone to serious misperceptions if people's responses are interpreted in a valuation framework which does not pay enough attention to the complexity of the valuation situation, different forms of response behavior, and the plurality of preferences.

The general observation based on all these CVM studies concerning the valuation of rural amenities is that people in both the USA and in Europe appreciate agricultural landscape, farming, and the rural environment. Because the sources of benefits and the groups of beneficiaries examined vary considerably across studies, it would be inappropriate to develop any further conclusions about the aggregate monetary value of the elements of the rural environment. Furthermore, the reliability and validity of monetary value estimates of single studies may be questionable, but not the joint evidence provided by these studies. The maintenance of the rural environment seems to be a socially desirable measure.

6. Willingness to Pay for Pro-Environmental Farming

The purpose of this chapter is to present the central issues related to the implementation of the empirical part of this study and principal willingness to pay results concerning the conversion from conventional agriculture to pro-environmental farming. First, the essential design and substance issues concerning the valuation instrument, the choice of sample and sampling method, and overall questionnaire design are elaborated in more detail. This is followed by an

introduction of different approaches to the estimation of mean and median willingness to pay. Then, the actual estimates for mean and median WTP are calculated, and a demand curve for pro-environmentally cultivated agricultural land is derived. Finally, it will be examined to what extent the data is plagued by the starting point bias and effects of varied information levels.

6.1. Survey Design

The design of the survey instrument was guided by three goals. The primary quantitative goal was to gather information about people's mean willingness to pay for the conversion from conventional agriculture to pro-environmental farming, the second goal was to test the various effects of information on people's WTP, and the last goal was to identify people's attitudes related to certain agricultural and environmental issues. The purpose of this was to produce a data set that would make it possible to analyze how the interplay of information and attitudes affects people's WTP for pro-environmental farming. Consequently, this dictated the choice between different possible options related to the overall survey design.

When the object of valuation is a policy measure that affects country-wide, it is natural that the target population of surveying is all those people who can be considered capable of making sovereign choices. Thus, the target population was 3,603,852 Finnish people between 16 and 69 years of age. The choice of sampling method is the next relevant step. Although random sampling is always preferred in theory, practical viewpoints like the costs created by the surveying process may lead to the choice of an alternative sampling approach. In this case, for reasons that will be explained later, a rather large sample based on face-to-face interviews would have been required, which means that the use of random sampling would have made the costs of the survey much too high. To avoid the excessive surveying costs, a sample of 671 persons was selected for face-to-face interviews[11] by using a sampling method that was a combination of stratified and clustered sampling techniques. The chosen sampling method set a lower limit to the sample size. The purpose of this was to achieve adequate statistical correspondence between the sample and the target population.

The stratification was carried out in order to obtain a sample in which the distribution of the population corresponded to the distribution across Finnish provinces. Then a certain number of districts in both towns and sparsely populated areas of a province were randomly selected (taking into account the proportion of city-dwellers and country people in the province in question). In these districts, the interviewers made the assigned number of interviews. The

[11] A group of 53 trained and experienced interviewers from Tutkimustieto Oy conducted the interviews between April 26 and May 19, 1991.

interviewers selected respondents following the prevailing distribution of sex and age in the district (see *Appendix A* for further details). The interviews were conducted either at a respondent's home or in the proximity of a shopping center. If a potential respondent refused to be interviewed, the interviewer randomly chose another respondent who fulfilled the sex and age criteria.

The motivation behind the choice of face-to-face interviews was their suitability for complex valuation situations where the respondents may need the assistance of the interviewer in order to perceive correctly all the requirements of the valuation process. Although this involves a risk of interviewer bias, the potential advantages of face-to-face interviews no doubt outweigh the possible disadvantages. Of course, the precondition is that the interviewers are well-trained. Another important factor that also favors the use of face-to-face interviews is that people are more likely to attend a survey when they are personally interviewed.

In the questionnaire the core element was the actual valuation instrument that was used to reveal people's willingness to pay for the conversion from conventional agriculture to pro-environmental farming. It consisted of the description of the good being valued, its provision structure, the payment vehicle, and the actual WTP elicitation procedure. In order to define to object of valuation more precisely, a brief summary depicting the essential features of pro-environmental farming was given. The idea of the description was to introduce pro-environmental farming as a suitable alternative cultivation method to mitigate the current environmental and economic problems caused by conventional agriculture[12]. The detailed provision structure of pro-environmental farming was not specified, but it was assumed that appropriate and adequate agricultural and environmental policy measures supporting and promoting pro-environmental farming practices would be implemented by the agri-environmental authorities. Furthermore, it was assumed that people's stated WTP amounts would be collected in the form of tax-like payments. In addition, no estimate for the amount of agricultural support at that time was given[13].

The actual WTP elicitation procedure was two-fold. After the presentation of the valuation scenario, the questioning proceeded by asking how large a proportion of the agricultural land should be converted from conventional agriculture to pro-environmental farming (the scope question). The idea was to allow each

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[12] The exact wordings of the description and other questionnaire elements can be found in *Appendix B* where the different sequences of the questionnaire are reproduced.

[13] The estimate for the amount of agricultural support was not included into the valuation scenario, because at that time there was a considerable disagreement of the true amount of agricultural support. If the amount had been included, then we should also have included the estimate for agricultural support needed after the conversion from conventional agriculture to pro-environmental farming would have taken place. This was considered to be beyond the scope of this study.

respondent to define by himself an appropriate share of the agricultural land to be converted from conventional agriculture to pro-environmental farming. This design made it possible to derive a demand function for the acreage to be converted from conventional agriculture to pro-environmental farming.

When each respondent is allowed to choose the acreage to be converted from conventional agriculture to pro-environmental farming, the characterization of the object of valuation becomes more ambiguous. The critical question is whether people would still be willing to pay the amount that they have stated when they recognized that pro-environmental farming practices would be carried out in a larger or smaller magnitude than they have considered to be appropriate and essential. However, because one of the objectives of this study was to assess the social desirability of the conversion from conventional agriculture to pro-environmental farming, it was considered policy-relevant to apply a valuation scenario where the acreage of pro-environmentally cultivated agricultural land was not fixed. This was assumed to reduce, at least to some extent, the rejection of the valuation scenario because of scope reasons. Thus, the aim was to produce a monetary estimate that provides information about the overall magnitude of benefits assigned to the conversion from conventional agriculture to pro-environmental farming, and, consequently, not an average WTP measure solely estimated for a certain pre-specified acreage to be converted from conventional agriculture to pro-environmental farming.

Next, the respondent was asked the actual WTP question: *"How much would you be willing to pay annually in order to secure that the pro-environmental farming would be carried on in the magnitude that you stated in your previous answer? Would you be willing to pay a tax-like annual payment of FIM ___ ?"* Three different starting point bids, FIM 100 (ca. USD 20), FIM 500 FIM (ca. USD 100), and FIM 1,300 (ca. USD 260), were used. The choice of the starting point bids was based on a small-sample pre-testing, which gave an idea about the likely lower and upper bounds of individual WTP responses.

The elicitation method applied was a combination of the bidding game and payment cards (BG-PC). For instance, if the starting bid was FIM 500 and the respondent refused to pay that much, the interviewer asked if the respondent would be willing to pay FIM 100. In case the respondent still refused to accept the offer, the interviewer inquired whether the respondent would be willing to pay at least FIM 50 or whether he would rather not pay at all. In case the respondent was willing to accept the FIM 100 offer, he was shown a payment card in which amounts ranging from FIM 150 to 450 were printed, the interval being FIM 50. A similar technique was used in the case of other starting bids. However, the FIM 50 precision in WTP elicitation was maintained only up to FIM 1,000. After that, the required precision changed to FIM 100. In case the respondent was willing to pay more than FIM 2,500, he was asked an open-

ended WTP question. The iterative questioning process is described in more detail in *Appendix C.*

The choice of the applied WTP elicitation method was based on the following reasoning. On the one hand, the use of the open-ended valuation question was rejected because the respondents might have felt it too difficult to state directly their willingness to pay because of the rather complex nature of the good being valued. On the other hand, the use of the dichotomous choice valuation question as the only means of WTP elicitation would have led to estimation problems in the analysis of the mean WTP of the attitudinal groups (see Chapter 7) where mean WTP estimates were calculated for several subsamples. In order to achieve the same statistical explanatory power and precision as in the BG-PC based estimation, the sample size should have been considerably larger, which, in turn, would have raised the surveying costs too high. In addition, the advantage of the BG-PC elicitation method was that it made it possible to apply the simultaneous dichotomous choice estimation in those cases where there were enough observations.

The questionnaire also contained elements that were designed in order to examine the possibility of some information related biases. As the use of different starting bids indicates, one of the goals was to test the existence of a starting point bias. In addition, the purpose was also to test the effects of additional information. To make the comparison of different starting bids and information levels possible, six slightly different questionnaires were used. The questionnaires were randomly assigned to the respondents. A brief information package describing the characteristics of the rural environment was included in half of the questionnaires, and the sequence of some other items of the questionnaire was dependent on whether the information package was included or not. Thus, there were two distinct questionnaires from the perspective of the information content. The questionnaires with differing information content had, as already mentioned above, three levels of starting bids. To check the suitability of the questionnaire, the market research institute responsible for the face-to-face interviews tested it in the field conditions. Some minor design improvements were made in order to clarify the interviewers' role in the WTP elicitation process.

In the questionnaire there were also questions concerning the attitudes and values of respondents. They were mainly claims about the state of the Finnish agriculture and environment and the relationship between them. The idea of the set of attitudinal questions was to identify how people relate themselves to the environmental and economic consequences of conventional agriculture. In addition, the attitudinal questions were aimed to reveal how people feel about certain environmental and ecological issues relevant to sustainable development. The respondent had to indicate, by applying a five-point scale, how strongly he agreed or disagreed with the presented claims[14]. Attitudinal ques-

[14] See *Appendix B*, Question 3-7, for the actual attitudinal questions.

tions were formulated in a manner that would have produced clearly identifiable, somewhat polarized attitudinal dimensions in respect of agricultural and environmental issues. The formulation was meant to facilitate the use of the attitudinal questions in the further statistical analysis, i.e. in the factor and cluster analyses.

The structure of the different questionnaires is depicted in Figure 6.1. In the beginning of every interview, questions were asked about basic socio-economic factors like age, gender, marital status, etc. Then, depending on the type of the questionnaire, the interviewer proceeded to the WTP question (type II questionnaire), or he briefly gave some more information to the respondent about the rural environment and its characteristics (information package) (type I questionnaire). The following section in type I questionnaire consisted of the attitudinal questions. The actual WTP question was asked after these two sections. The respondents who answered type II questionnaire never received any additional information about the rural environment and were asked to answer the claims measuring attitudes after they had already responded to the WTP question.

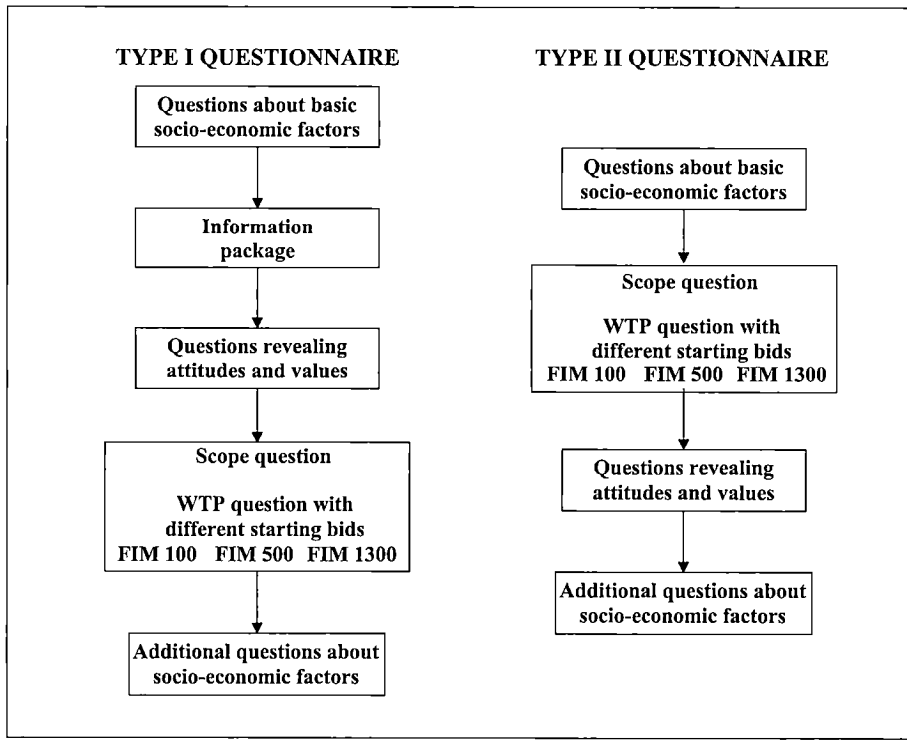

Figure 6.1. Sequence of Sections in the Questionnaires.

The overall quality of responses appeared to be of good standard. Only eight questionnaires had to be rejected because of insufficient answers to the willingness to pay question. Thus, the number of observations that is used as the basis for most of the analysis is 663. There were accidental missing values for certain socio-economic background variables like, for instance, income (16% of the respondents refused to reveal their approximate before-tax income) but in most cases the data was very close to complete. This is probably due to the use of face-to-face interviews. However, the shortcoming of the sampling method is that there is no data available from those who refused to participate in the survey.

6.2. Modeling and Estimation of Willingness to Pay When Using the Dichotomous Choice Questioning Format

In this section, we review in more detail the three approaches that are applied in the WTP estimation from the dichotomous basis. The standard case is based on Hanemann (1984). It is a random utility model with a logit specification acting as the cumulative distribution function. The simple spike model follows the guidelines set by Hanemann and Kriström (1995). In addition, a non-parametric estimation technique is elaborated (see e.g. Kriström 1990b).

The dichotomous choice approach in its different variations is nowadays the most commonly applied elicitation format in contingent valuation surveys. Its major advantage is to make the valuation situation resemble a market transaction. The respondent faces a simple decision: Does he want to or does he not want to pay a fixed amount of money for a specified change in environmental quantity and/or quality? Of course, there are also several problems involved. In theory, an anchoring effect may be present in the sense that the respondent assumes that the offered amount somehow indicates the "true" value of the environmental improvement and thus feels obliged to answer in the affirmative. However, if the possible biases related to the response situation and other details of the valuation scenario are neglected, there is still a serious problem to cope with: How to derive a meaningful mean or median willingness to pay estimate from a large amount of "yes" and "no" answers that are given to a number of different offers, $A^B = A_1, .., A_m$, (known as the bidding vector) and distributed across $n_1, .., n_k$ individuals? At each offer A_i $(i = 1..m)$ there will be h_i $(i = 1..k)$ people accepting the offer for the suggested project and $n_i - h_i$ rejecting to pay the specified amount (Kriström 1990a, p. 61).

There are a few alternative approaches to solve the problem. One that is often referred to is the model developed by Hanemann (1984). The principal merit of Hanemann's model is that it cleverly combines economic theory and statistical estimation procedures. It is based on the so-called random utility model (RUM). The basic postulate of the RUM is that a consumer makes

rational and utility maximizing discrete choices the exact grounds of which are not known by anyone but himself. If an observer, like a CVM researcher, wants to model the consumer's or the respondent's behavior, he has to accept that there will be inherent a certain amount of randomness because the consumer's utility functions are not known. From the researcher's point of view, imperfect information means that, although the respondents in their responses maximize their individual utility, the researcher does not know exactly how the offer relates to the respondents' utility.

Thus, individual respondents are assumed to know their utility function (V), which have as arguments income (Y), an environmental commodity (Z), and a socio-economic conditioning factor (S). Other arguments, like prices of market goods, which are not supposed to change, are suppressed for simplicity. A crucial assumption is that, even though the respondent knows his utility function (V) (see e.g. Johansson et al. 1989)

$$V = V(Y, Z; S) \tag{6-1}$$

with certainty, it contains some components that are unobservable to the researcher who, consequently, treats them as stochastic. Thus, the utility function observed (V_o) by the researcher can be written

$$V_o = V_o(Y, Z; S) + \varepsilon \tag{6-2}$$

where ε is a random variable or an error term with zero mean. The term ε expresses how much the utility observed by the researcher differs from the respondent's actual utility. Of course, it is not possible to define the true characteristics of the random variable. However, if we attempt to analyze the dichotomous choice situation confronted by the respondent, some assumptions must be made about the distribution of the random variable. In practice, these assumptions dictate what the dichotomous WTP estimation model will be like.

Assume that the supply of the environmental commodity increases from Z_0 to Z_1. The change in utility (ΔV) experienced by the respondent can be described in the following way:

$$\begin{aligned} \Delta V &= V(Y, Z_1; S) - V(Y, Z_0; S) \\ &= V_o(Y, Z_1; S) + \varepsilon_1 - [V_o(Y, Z_0; S) + \varepsilon_0] \end{aligned} \tag{6-3}$$

where $V(\cdot)$ and $V_o(\cdot)$ are consistent with Equations 6-1 and 6-2, respectively. If the respondent has to face a choice situation where he is supposed to decide whether to pay or whether not to pay for the proposed quantity and/or quality

change of the environmental commodity Z, the respondent weighs benefits and costs in the spirit of Equation 6-3. If the utility increase is large enough when Z rises from Z_0 to Z_1, the respondent is likely to be willing to pay a certain amount of money, A_i, for the increase:

$$V(Y - A_i, Z_1; S) - V(Y, Z_0; S) \geq 0 \quad \Leftrightarrow V(Y - A_i, Z_i; S) \geq V(Y, Z_0; S) \tag{6-4}$$

According to Equation 6-4, the respondent approves the offer A_i if the utility produced by the increase of Z is greater than the utility lost when paying the amount A_i. When the respondent is inquired his willingness to pay for, say, pro-environmental farming, his response is affirmative only if the inequality depicted in Equation 6-4 becomes satisfied and the amount A_i is his maximum willingness to pay for the change in the magnitude of pro-environmental farming (Z) from Z_0 (existing initial level) to Z_1 (proposed subsequent higher level). Furthermore, Equation 6-4 indicates that the respondent's maximum willingness to pay can now be expressed as has been done in Equation 6-5:

$$V(Y - ES, Z_1; S) = V(Y, Z_0; S) \tag{6-5}$$

where ES is as great as the highest possible offer A_i satisfying the inequality depicted in Equation 6-4. As a welfare measure, ES represents the equivalent surplus or the amount of income Y that should be given to the respondent instead of the quantity change from Z_0 to Z_1 to leave the respondent as well off as with the change in the environmental commodity Z.

Furthermore, we can assume that respondents' willingness to pay is distributed along some distribution function G_{wtp}. In this case the probability of the "yes" answer to the WTP question based on the offer A_i can be defined in the following way (Hanemann 1984):

$$P[WTP \geq A_i] = 1 - G_{wtp}(A) = P[\Delta V(\cdot) \geq \varepsilon] = F_\varepsilon(\Delta V) \tag{6-6}$$

where $\Delta V = V(Y - A_i, Z_1; S) - V(Y, Z_0; S)$, $\varepsilon = \varepsilon_0 - \varepsilon_1$, and F_ε is the cumulative distribution function for the random term or error (ε).

To compute the expected value, i.e. the mean value of willingness to pay, $E(WTP)$, we can use the fact that for any random variable χ belonging to the set of real numbers (R) with a cumulative distribution function F, it can be shown that (Kriström 1990a, pp. 65-66):

(6-7) $$E(\chi) = \int_0^{\infty} (1 - F(\chi))\, d\chi - \int_{-\infty}^{0} F(\chi)\, d\chi$$

and as a logical implication, we can write

(6-8) $$E(WTP) = \int_0^{\infty} \left(1 - G_{wtp}(A)\right) dA - \int_{-\infty}^{0} G_{wtp}(A)\, dA$$

or alternatively

(6-9) $$E(WTP) = \int_0^{\infty} F_{\varepsilon}(\Delta V(A)) dA - \int_{-\infty}^{0} (1 - F_{\varepsilon}(\Delta V(A))) dA$$

At this point, we have to make two choices before we can actually estimate *E(WTP)*. First, we must select the functional form for F_{ε}. Second, we have to decide how to specify utility functions contributing to ΔV. The choice of F_{ε} is usually made from a somewhat restricted set of alternatives. The applicable binary choice models include the linear probability model (LPM), the logit model (LM), and the probit model (PM). Because of problems related to heteroskedasticity (Maddala 1983, p. 16) and especially because of the possibility of probability predictions outside the [0..1] range (Kennedy 1992, p. 229), the LPM is not suitable for the estimation of *E(WTP)*. The selection between probit and logit models is a matter of taste because the standard normal cumulative distribution function does not differ much from the standard logistic cumulative distribution function (c.d.f.). However, because the standard logistic c.d.f. is numerically simpler, it is usually preferred among CVM researchers. In most CVM applications both logit and probit models produce similar *E(WTP)* estimates (Bowker and Stoll 1988).

The standard logistic cumulative distribution function, *F(x)*, is also used in this study for the estimation of *E(WTP)*. We can write

(6-10) $$F(x) = \frac{1}{1 + e^{-\Delta V(A)}} = F_{\varepsilon}$$

Hanemann's (1984) model offers an intuitively appealing and theoretically interpretable derivation for ΔV. Assume a simple linear-in-income utility function

(6-11) $$V_i = \alpha_i + \beta Y$$

where $i = 0$ or 1 (referring to either Z_0 or Z_1 supply situation), α_i is a constant, β is the marginal utility of income, and Y is income.

Consider Equation 6-4 and replace the utility functions by using the specification given in Equation 6-11. As a result,

(6-12) $$\begin{aligned}\Delta V &= V(Z_1) - V(Z_0) = \alpha_1 + \beta(Y - A) - (\alpha_0 + \beta Y) \\ &= \alpha_1 - \alpha_0 - \beta A\end{aligned}$$

where $\alpha_1 - \alpha_0$ can be denoted as a to simplify the notation. Now it is possible to give parameters α and β a theoretically sound interpretation. Parameter α shows the effect of the change in supply of Z from Z_0 to Z_1 on the respondent's utility. In other words, parameter α represents the marginal utility of environmental improvement. Correspondingly, parameter β indicates the respondent's marginal utility of income in relation to the environmental commodity Z.

Applying Equations 6-9, 6-10, and 6-12, we can now write

(6-13) $$E(WTP) = \int_0^{\infty} \left(\frac{1}{1 + e^{-\alpha + \beta A}} \right) dA - \int_{-\infty}^{0} \left(\frac{1}{1 + e^{\alpha - \beta A}} \right) dA$$

The simplifying computations show that $E(WTP) = \alpha/\beta$. The proof is given in Kriström (1990a, pp. 153-154) and is not reproduced here.

Also the median WTP, *M(WTP)*, can be derived. The median WTP is a cost such that the probability of acceptance of a certain offer, A^*, is 50%. In a case like this the median respondent will be indifferent between paying A^* to acquire a higher level of environmental quality (Z_1) or remaining at the level of prevailing environmental quality (Z_0). Thus, A^* can be considered to be *M(WTP)*. We can denote

(6-14) $$P[V(Y - A^*, Z_1; S) + \varepsilon_1 \geq V(Y, Z_0; S) + \varepsilon_0] = 0.5$$

and using Equations 6-10 and 6-14, it is possible to write

(6-15) $$\frac{1}{1 + e^{-\alpha + \beta M(WTP)}} = 0.5$$

where solving in respect of *M(WTP)* gives $M(WTP) = \alpha/\beta$. As a conclusion we can state that, if a symmetric cumulative distribution function is used and the applied range of integration is $[-\infty..\infty]$, then $E(WTP) = M(WTP) = \alpha/\beta$.

However, there are different views about the correct limits of integration. The use of the range $[-\infty..\infty]$, which is also followed in this presentation, is based on the reasoning given by Johansson et al. (1989). Their argument for extending integration to ∞ is that some respondents are willing to pay more than the bidding vector's (A^B) highest bid A_m. Correspondingly, their argument for extending integration backwards to $-\infty$ is that some respondents are not willing to pay the lowest bid level (A_1) and so it can be argued that some of these respondents would, rather than pay for an increase in the provision, prefer to receive an increase in their income in exchange for a reduction in the provision. Sellar et al. (1986), on the other hand, argue that there should be truncation following the limits of observable data, i.e. $[0..A_m]$. Their main argument is that beyond the highest bid level A_m the extrapolation is dependent upon the distributional assumptions being made (Bateman et al. 1995). Hanemann (1989) points out, however, that the approach of Johansson et al. (1989) produces the correct formula to employ when measuring the mean WTP for dichotomous choice CVM models that admit the possibility of negative WTP values. Nevertheless, as Hanemann (1989) shows, it is not possible to say if truncated *E(WTP)* is greater or smaller than non-truncated *E(WTP)*. It depends on the magnitudes of $1 - P[\text{"yes" to } A_i = 0]$ and $P[\text{"yes" to } A_m]$.

Parameters α and β can be estimated by using either generalized least squares or maximum likelihood techniques. For estimation problems having enough "yes" and "no" responses per each offer, either method of estimation is acceptable. In the case of few responses per each offer, maximum likelihood techniques are usually preferred (Bowker and Stoll 1988). In this study, the maximum likelihood technique is used. In practice, the idea of the maximum likelihood technique is to maximize the likelihood function or its natural logarithm *ln(L)*, which in this case can be noted as (see e.g. Judge et al. 1988, p. 791):

$$(6\text{-}16) \qquad ln(L) = \sum_{i=1}^{n} \left[T_i ln\left(1 - G_{wtp}(A)\right) + (1 - T_i)\left(lnG_{wtp}(A)\right) \right]$$

where T_i is a variable that indicates the response to the dichotomous valuation question. T_i is equal to 1 if the respondent has accepted offer A, and otherwise T_i is equal to 0.

It is also possible to calculate the variance of $E(WTP) = \alpha/\beta$. This can be done by applying a formula (see e.g. Kriström 1990a, p. 86):

(6-17) $$Var\left(\frac{\alpha}{\beta}\right) \approx \frac{\alpha^2}{\beta^2}\left(\frac{var(\alpha)}{\alpha^2} + \frac{var(\beta)}{\beta^2} - \frac{2cov(\alpha,\beta)}{\alpha\beta}\right)$$

The model developed by Hanemann (1984) is not the only alternative to analyze dichotomous data. There are also some other estimation approaches that are based on the use of parametric distribution functions. Bishop and Heberlein (1979) suggested that the mean willingness to pay can be approximated by an area under a logistic function by using the highest bid (A_m) of the bidding vector as a truncation point and applying the specification $\Delta V = \alpha + \beta lnA$ instead of $\Delta V = \alpha - \beta A$. However, this kind of approximation lacks theoretical support because, as Hanemann (1984) notes, no explicit specification of $V(Y - A_i, Z_1; S) - V(Y, Z_0; S)$ can create a utility difference $\Delta V = \alpha + \beta lnA$. Therefore, Bishop and Heberlein's (1979) approach is not strictly compatible with the utility maximization hypothesis.

Cameron (1988) has pointed out that Hanemann's (1984) approach becomes computationally complicated if one wishes to employ a general type utility function and a general type distribution function. She proposes an approach that focuses on the distribution of WTP instead of the random (error) term ε. Consequently, the main advantage is that it is possible to circumvent the computation of utility differences for more complex specifications of utility functions. Nevertheless, Cameron's (1988) approach is not as convincing as Hanemann's (1984) model in terms of theoretical merit. Sellar et al. (1986), in turn, have shown that certain specified logarithmic approximations for ΔV outperform Hanemann's (1984) suggestions if goodness-on-fit statistics is taken as a yardstick. However, because the specifications that Sellar et al. (1986) have applied are not directly derived from utility functions, they have more empirical than theoretical weight as evidence. Thus, Hanemann's (1984) model clearly has more advantages than the competing approaches.

When dichotomous data is used, the central problem of estimation is that the amount of information extracted from each response is rather meager. If the respondent does not accept the offer A_i, we only know that his WTP is lower than the offer A_i. A step forward would be taken if it were possible to detect whether the respondent's WTP is true zero, and not just lower than the offer A_i. This kind of innovation poses an estimation problem because standard logit and probit models do not allow the respondent to have zero willingness to pay for an environmental improvement. So there is room for development of estimation techniques. However, some theoretical aspects should also be taken into consideration. We can argue that the zero WTP is just a sign of free-riding and not a legitimate piece of evidence of true zero WTP. Nevertheless, it should be perceivable that there are people who are not ready to pay for environmental

improvements if they consider the improvements meaningless to themselves. The spike model developed by Hanemann and Kriström (1995) allows this kind of behavior.

Relying on the notation employed above, we can now write the distribution function F of WTP or the random (error) term ε (Kriström 1995, p. 4):

$$F_\varepsilon = \begin{cases} 0 & \text{if } A < 0 \\ p & \text{if } A = 0 \\ G_{wtp} & \text{if } A > 0 \end{cases} \tag{6-18}$$

where $p \in [0, 1]$ and $G_{wtp}(A)$ is a continuous and increasing function such that $G_{wtp}(0) = p$ and $lim\ G_{wtp}(A) = 1$ when $A \rightarrow \infty$. The probability that a person is willing to pay a positive sum of money not exceeding A is therefore $G_{wtp}(A) - p$, indicating that there is a jumpdiscontinuity in zero. As we can see, the spike model is a variation of the random utility model, the only difference being that the formulation of F_ε also allows the discontinuity caused by the approval of zero WTP responses. In practice there appears to be three major differences when a logit spike model is compared to a logit random utility model. First, because the cumulative distribution function employed in the spike model is not symmetric, the equality between $E(WTP)$ and the median WTP no longer holds. Second, the dichotomous valuation question becomes two-fold. Third, the asymmetry of the distribution function and the two-fold valuation question together produce a more complicated likelihood function to be maximized (which is true, of course, only if the parameter estimation is carried out by using the maximum likelihood technique).

Consider the calculation of $E(WTP)$. In the case where F_ε is chosen to be a normal logistic cumulative distribution function and the ΔV specification of Hanemann (1984) is applied, it can be shown that (Kriström 1995, p. 12)

$$E(WTP) = \int_0^\infty \frac{1}{1 + e^{-\alpha+\beta A}} dA = \frac{1}{\beta} ln\left(1 + e^{\alpha}\right) \tag{6-19}$$

The median WTP can still be expressed as $M(WTP) = \alpha/\beta$ if at least half of the respondents have WTP greater than zero. Otherwise M(WTP) will be zero. This is the main difference between an ordinary RU model and the spike model, because these results indicate that in the spike model both $E(WTP)$ and $M(WTP)$ are always ≥ 0. This not the case when Hanemann's standard approach is applied (see e.g. Bowker and Stoll 1988).

The two-fold valuation question goes as follows: first the interviewer asks whether the individual would want to contribute at all to the project. If the answer is "no", no further questions will be asked. If the answer is "yes", then the interviewer asks a conventional dichotomous choice valuation question with some offer A_i. Unfortunately, there is a potential correlation between the two questions asked. There might be an ordering effect, such that the ordering of the valuation questions has an impact on the reported answers. However, it is not likely that the problem is as severe as when the double-bounded dichotomous choice question is applied. In that case there is the risk that an incentive-compatibility problem may arise (see e.g. Cummings et al. 1995).

Based on the two answer categories of the valuation question and on Equation 6-18, the maximum likelihood function or its natural logarithm $ln(L_s)$ for the spike model can be formulated (Kriström 1995, p. 6):

$$ln(L_s) = \sum_{i=1}^{n} \left[S_i T_i \, ln\left(1 - G_{wtp}(A)\right) + S_i (1 - T_i) \, ln\left(G_{wtp}(A) - G_{wtp} + (1 - S_i)(1 - T_i) \, ln \, G_{wtp}(0)\right)\right] \tag{6-20}$$

where T_i is a variable that indicates the response to the conventional dichotomous valuation question. $T_i = 1$ if the respondent has accepted the offer A and otherwise $T_i = 0$. Variable S_i describes the answer to the first question. If the respondent is willing to contribute to the project, i.e. his WTP > 0, then $S_i = 1$ and otherwise $S_i = 0$. The data analyzed in this study is suitable for the spike model application because the bidding game helps to identify the respondents whose expressed WTP is zero. Of course, it is possible to argue that at least some of these zeroes are due to the bidding process because some of the respondents may have stated a zero response in order to end the bidding game prematurely. This would mean that the *E(WTP)* estimate given by the spike model is an understatement.

Hanemann's (1984) model as well as the approaches suggested by Bishop and Heberlein (1979) and Cameron (1988) are based on a parametric distribution assumption. Thus, there is always the risk of misspecification of the distribution function involved because an assumption is made about individual utility functions that cannot really be observed by the researcher. It is well known that, in general, the maximum likelihood estimates of the parameters in F_ε will be inconsistent if the distribution assumption is incorrect. Consequently, this motivates a search for methods where the distribution function is not critical (Kriström 1990b).

Responses of a standard dichotomous choice application can be expressed as a ratio between "yes" answers (h_i) and all the answers (n_i) related to each offer

A_i belonging to the bidding vector $A^B = A_1, .. , A_m$. This gives a sequence of proportions:

(6-21) $$\pi = \pi_1,..,\pi_i,..,\pi_m$$

where $\pi_i = h_i / n_i$. Ayer et al. (1955) show that if π forms a monotone non-increasing sequence of proportions, this sequence provides a distribution free maximum likelihood (DFML) estimator of the probability of acceptance.

In case the sequence is not monotonic, Ayer et al. (1955) propose the following algorithm (also known as the pool-adjacent-violator algorithm): If $\pi_i < \pi_{i+1}$ for some i ($i = 1..m-1$), then $\pi'_i = \pi'_{i+1}$, where the dot denotes the maximum likelihood estimates. The proportions π_i and π_{i+1} are replaced by $(h_i + h_{i+1})/(\pi_i + \pi_{i+1})$ and the procedure is repeated until the sequence is monotonic in i. It is possible to show that this estimator has the desirable consistency property, i.e. under the conditions provided by Ayer et al. (1955) the estimated probabilities converge in probability to the true probability for acceptance (Kriström 1990b).

Because there will be at most m estimates for the probability of acceptance, a rule must be developed in order to interpolate between the proportions. Usually linear interpolation is applied but there is no elaborate theoretical reasoning behind this. Furthermore, it is customary to assume that if $A_i = 0$, then all respondents accept the offer. This gives the starting point of the *empirical survival function*, as the sequence of proportions π is sometimes called. However, this kind of assumption is not theoretically completely valid because it rules out the possibility of negative WTP. In this respect, the non-parametric approach resembles the simple spike model. The more serious problem related to the non-parametric estimation is that there is no theoretically correct model to define the specific offer A_i that would produce a 100% rejection rate. Thus, it is somewhat vague what should be used as the end point of the empirical survival function. This has a crucial meaning because the area under the empirical survival function approximates the mean WTP. In most cases, linear extrapolation is employed. It is based on the proportions π_{m-1} and π_m.

Because the non-parametric estimation is rather sensitive to the choice of the offer A_i that produces the 100% rejection rate, it is reasonable to argue that the median WTP should be preferred to the mean WTP. This recommendation can be given despite the fact that in most cases the median WTP must also be estimated through interpolation. Nevertheless, if the bidding vector has been constructed correctly, the median should be a more robust estimate than the mean. The median WTP will be located between offers which satisfy the condition $\pi_1 .. > \pi_i \geq 0.5 \geq \pi_{i+1} > .. \pi_m$. After the offers π_i and π_{i+1} have been located, the linear interpolation (or other kind of interpolation) between them makes it possible to define the exact offer A^* that gives $\pi = 0.5$.

6.3. Mean and Median Willingness to Pay for Pro-Environmental Farming

In Tables 6.1 and 6.2, mean and median WTPs are reported in three categories, for the whole sample, for those who have not received additional information, and for those who have received additional information. Mean and median WTPs have been estimated by using two elicitation methods, the combined bidding game-payment card format and the dichotomous choice format. The mean and median WTP elicitation based on the combined bidding game-payment card technique is carried out in two slightly divergent versions. The first version covers all the 663 observations, and leaving out observations in which the expressed WTP was equal to or higher than FIM 2,500 produces the second one. The reasoning behind this practice is to eliminate responses that can be considered outliers. However, an elimination process of this kind has not its roots in any unambiguous postulate of economic theory. It merely illuminates the fact that mean WTP can be quite sensitive to a small number of deviating individual WTPs.

It is also possible to utilize the dichotomous choice format because the starting bids used in the combined bidding game-payment card (BG-PC) technique form a bidding vector consisting of offers FIM 100, 500 and 1,300. Concerning the dichotomous choice, two different, although closely related, model specifications of parametric nature are applied. The starting point is a random utility model with the logit specification acting as the cumulative distribution function. The standard model is based on the approach introduced by Hanemann (1984). In the application of the standard model, the effect of different truncations is tested. The simple spike model in turn follows the guidelines set by Hanemann and Kriström (1995). In addition, a non-parametric estimation technique that is based on dichotomous choice data is also used (Kriström 1990b). All these approaches were reviewed in detail in Chapter 6.2.

There is some variation in the average figures depending on the chosen elicitation method or model specification. Mean WTP for the whole sample ranges from FIM 290 to FIM 615 and median WTP for the whole data from FIM 150 to FIM 379. This supports the common notion that median is a more robust estimate than mean. It is a matter of taste if the observed variation in mean and median WTPs is considered significant from the policy-making perspective. The highest mean WTP estimate is approximately four times bigger than the lowest median WTP estimate. If the monetary estimate is the only criterion for decision-making, the differences in average figures can be regarded as worrying. However, if the monetary estimate is taken as auxiliary information the purpose of which is to facilitate the decision-making process and not to dictate its outcome, the situation becomes less restricting.

Table 6.1. Mean WTPs Estimated by Using Different Elicitation Methods and Statistical Models, FIM/Person/Year.

	BG-PC N=663 (BG-PC w/o outliers N=647)	Standard model $-\infty..\infty$ (Standard model $0..\infty$) [Standard model $0..A_m$]	Non-param. model $0..A$ (Non-param. model $0..A$+500) [Non-param. model $0..A$–500]	Simple spike model
Without additional info	357 (315)	207 (402) [319]	507 (554) [460]	542
With additional info	446 (354)	384 (325) [262]	633 (694) [573]	635
Whole sample	402 (334)	297 (362) [290]	562 (615) [509]	587

Table 6.2. Median WTPs Estimated by Using Different Elicitation Methods and Statistical Models.

	BG-PC N=663 (BG-PC w/o outliers N=647)	Standard model $-\infty..\infty$ (Standard model $0..\infty$) [Standard model $0..A_m$]	Non-param. model $0..A$ (Non-param. model $0..A$+500) [Non-param. model $0..A$–500]	Simple spike model
Without additional info	150 (150)	207 (207) [207]	218 (218) [218]	333
With additional info	150 (150)	384 (384) [384]	323 (323) [323]	429
Whole sample	150 (150)	297 (297) [297]	281 (281) [281]	379

Consider first the apparent sensitiveness of the combined bidding game-payment card format in relation to the highest bids. The removal of 16 highest individual WTPs (2.4% of the sample) reduces the mean WTP by 16.9% (from FIM 402 to FIM 334). If the same removal of observations is done concerning the standard model $[-\infty..\infty]$ and the non-parametric model $[0..A]$, the mean WTP changes somewhat less, 11.4% (from FIM 297 to FIM 263), and 8.2% (from FIM 562 to FIM 516), respectively. A corresponding comparison of changes in median WTP produces exactly the opposite order of magnitude changes. There is no alteration when the combined bidding game-payment card format is in question (FIM 150 - FIM 150), 11.4% (from FIM 297 to FIM 263) for the standard model $[-\infty..\infty]$ and 7.5% (from FIM 281 to FIM 260) for the non-parametric model $[0..A]$.

The estimation of the standard error of the mean WTP is another way to assess the sensitivity related to the exclusion or inclusion of the highest bids. In the BG-PC model, the standard error of the mean WTP diminishes from FIM 24.7 to FIM 17.8 (28%) when the 16 highest WTP responses are eliminated. In the standard model [$-\infty..\infty$] the approximate estimate for the standard error of the mean WTP decreases from FIM 66.5 to FIM 63.5 (4.4%). Thus, based purely on the statistical properties of different models, the dichotomous choice format seems to be more reliable in terms of the mean WTP estimation, although the BG-PC approach seems to be in this context more robust in terms of the median WTP estimation.

Although it is possible to suggest that the highest bids in the BG-PC format are outliers and should be left out because of this, the elimination should always be based on sound theoretical arguments. In other words, the question is about the validity of WTP responses. If the highest bids are eliminated, the argument must be that the highest bidders do not reveal their "true" WTP. This may be the case, for instance, because of some sort of goal-oriented response motives. A much-used strategy is to compare the expressed individual WTP to individual income. If the individual WTP is implausibly high in relation to income, we can conclude that the respondent behaves strategically. However, it is very difficult to define what is an "implausibly high" proportion of income, because income may be an inadequate indicator of all the resources that the respondent is ready to sacrifice to match his expressed willingness to pay. Especially when environmental values are at stake, many people are willing to make considerable efforts in order to promote their views. Thus, a comparison between expressed WTPs and income levels may appear to be a too simplifying choice as a screening criterion.

Table 6.3 presents an analysis of whether the 16 highest bids can be deemed the results of strategic behavior. Of course, it is not possible to derive an assessment criterion that would unambiguously show if a certain response was a misstatement of the "true" WTP. Consider first the ratio between WTP and pre-tax income. As already argued in the previous paragraph, there is no clear-cut way to define when this ratio becomes "implausibly high". If one-percent level is chosen, then 14 observations are dubious of their nature. If five-percent level is chosen instead, then only one observation looks suspicious. All the responses are also consistent in the sense that all but one respondent are willing to convert at least 25% percent of total agricultural land under pro-environmental cultivation. In addition, all but one respondents have a clearly positive attitude[15] towards sustainable development, which can be perceived to be a strong indica-

[15] The methods that were applied to identify attitudinal groups are explained in Chapters 7.1, 7.2, and in *Appendix F*.

Table 6.3. Some Characteristics of Possible "Outlier" Observations.

Number of observation	Individual WTP FIM/year	Pre-tax income FIM/year	Individual WTP / pre-tax income, %	Attitude towards sustainable development*)	Proportion of pro-environmentally cultivated land should be
69	2 500	350 000	0.7 %	+++	50 %
100	5 000	100 000	5.0 %	+++	100 %
121	3 000	65 000	4.6 %	+++	50 %
292	2 500	180 000	1.4 %	+++	60 %
317	2 500	35 000	7.1 %	+++	25 %
435	2 500	n.a.	n.a.	−−	10 %
442	2 500	65 000	3.8 %	++	50 %
454	5 000	n.a.	n.a.	++	85 %
497	3 000	350 000	0.9 %	++	25 %
560	2 500	225 000	1.1 %	++	50 %
584	3 500	225 000	1.6 %	+++	100 %
592	2 500	180 000	1.4 %	+	25 %
609	3 000	100 000	3.0 %	++	100 %
655	5 000	350 000	1.4 %	+++	100 %
685	2 500	225 000	1.1 %	++	25 %
689	2 500	225 000	1.1 %	++	25 %

*) The more '+' signs, the more positive attitude towards sustainable development. The more '–' signs, the more negative attitude towards sustainable development.

tor that the respondents truly prefer pro-environmental farming to conventional agriculture.

Observation number 592 and especially observation number 435 qualify as potential strategic responses because at the first glance there appears to be some inconsistency. Observation number 435 expresses high WTP but is not in favor of sustainable development, which is a central concept closely related to pro-environmental farming. However, a closer look reveals that respondent number 435 has a very positive attitude towards conventional farming. He is also a farmer and his father has been a farmer. Because he also wants to convert only 10% of the total agricultural land to pro-environmental farming, the conclusion is obvious. Respondent number 435 considers pro-environmental farming a means to guarantee that there will also be conventional agriculture left in the future. Thus, the answer is strategic in the sense that the respondent values something else than what is meant to be valued in the valuation scenario. However, it does not mean that the respondent misstates his WTP because he would probably be willing to pay the amount he has mentioned if it really secured the future of conventional agriculture. It is likely that respondent number 592 represents rather similar views. He does not have a farming background, but he has a very positive attitude towards conventional agriculture and a positive attitude towards pro-environmental farming, too. The result is that there is not

enough substantiated evidence to prove that the highest bidders conceal their "true" WTP and express exaggerated values.

This example clearly shows that, although the dichotomous choice format can be more desirable in terms of statistical properties, it lacks the wider analytic power of the BG-PC format. The motivations behind expressed WTPs and some other not so obvious relationships in the data are more easily detectable when an elicitation format which directly gives the individual WTP is applied. In this respect this study supports the view presented by Boyle et al. (1996), who argue that the prevailing endorsement of the dichotomous choice format should not lead to a complete rejection of other questioning formats.

Although the estimation results of mean and median WTPs achieved through different methods and specifications are consistent with certain theoretical and statistical properties that they are supposed to fulfill, one anomaly deserves a closer inspection. When mean and median WTPs are compared, all but two pairs of estimates follow the hypothesis that mean or median WTP for those who have received additional information is higher than for those who have not. The exceptions occur when the mean WTP is estimated by using the standard models $[0..\infty]$ and $[0..A_m]$. The reason for this phenomenon is that the logit model behind the standard models is statistically somewhat inappropriate when the subsample of those who have not received additional information is in question. The estimation results can be found in *Appendix D,* and they show that the *t*-value for the parameter α (INTERCEPT) is statistically questionable (0.1081). In addition, the result of the likelihood ratio test ($\chi^2 = 0.39$) indicates that it is not possible to reject the hypothesis that $\alpha = \beta = 0$, meaning that the applied logit model severely lacks explanatory power.

As an overall conclusion, we can state that any of the applied elicitation techniques and model specifications seems to be reliable enough when mean or median WTPs are estimated for the whole sample. The observed variation in the average figures is due to different presumptions behind alternative models, not inadequate reliability of the CV method as such. However, reliability cannot be separated from validity. It is clear that different valuation questions and other details of the valuation scenario considerably influence the outcome. This will be illuminated in more detail in Chapter 6.5, where possible starting point bias and information effects are examined.

6.4. Demand Function for the Pro-Environmentally Cultivated Agricultural Land

Individual WTP responses can also be used in another way to depict total WTP for pro-environmental farming. It is possible to derive a demand function for acreage under pro-environmental cultivation. As already explained above, the actual WTP question was preceded by an inquiry the purpose of which was to

define the proportion of agricultural land that the respondents considered appropriate to be converted from conventional agriculture to pro-environmental farming. There were six pre-specified alternatives ranging from 0% to 100%, and the respondents were allowed to state some other percentage figure if they desired to do so. However, some of the respondents were not able or willing to specify the appropriate proportion. All in all, 610 respondents out of 663 (92%) answered this question.

The idea is to derive a total demand function (D_T) for acreage under pro-environmental farming among Finnish citizens. First, $WTPA_i$ is calculated. It is willingness to pay (aggregated across the Finnish population) per hectare per year for the respondent-stated-proportion (r_i; $r_i \in [0..1]$) of the total agricultural land in 1991 (Q) to be converted to pro-environmental farming

$$WTPA_i = \frac{\frac{P}{N}\left(\sum_{j=1}^{m} WTP_j\right)_i}{Qr_i} \tag{6-22}$$

where

$i = 1..k$
$j = 1..m$
$N =$ total amount of the respondents
$P =$ Finnish population in 1991 (15-69 years old)
$WTP_j =$ individual willingness to pay for r_i

By applying the aggregation procedure developed above it is possible to acquire a set of k observations (OBS) that depict total willingness to pay per hectare for a certain amount of Q:

$$OBS = \left\{\left(\sum_{i=1}^{k} WTPA_i, Qr_1\right), \left(\sum_{i=2}^{k} WTPA_i, Qr_2\right), \ldots, \left(WTPA_k, Qr_k\right)\right\} \tag{6-23}$$

Because the set OBS expresses a price-quantity relationship, the total demand curve (D_T) can be obtained by fitting an appropriate function to the set of points. In this case, an exponential function of the form

$$D_T: \quad Y = ce^{-dx} \tag{6-24}$$

was used where

Y = total willingness to pay per hectare per year for acreage under pro-environmental farming (TWTP/ha)

X = acreage under pro-environmental farming, ha (ACREAGE)

c, d = parameters to be estimated

The estimation procedure was carried out by using SAS Statistical Package and its NLIN procedure, resulting in parameter values $c = 2811.34$ and $d = 1.71$ ($R^2 = 0.9733$).

The total demand function (D_T) is inverse because it is more logical to view the TWTP/ha as a function of the total quantity of acreage under pro-environmental farming. That is, for each level of the demand for pro-environmental farming the inverse demand function measures how much people are willing to pay for that amount. Consequently, the cumulative total willingness to pay (*TWTP*) for a conversion to pro-environmental farming can be calculated by integrating the total demand function over the area [0 .. 2.578960]. This gives

$$(6\text{-}25) \qquad TWTP = \int_0^{2.578960} 2811.34 \cdot e^{-1.71 \cdot ACREAGE} \, dACREAGE = 1.624 \cdot 10^3$$

and when the appropriate units are taken into account, the cumulative *TWTP* is FIM 1.624 billion per year. As we can easily see, the derivation of the total demand function for pro-environmental farming and its integration over the area [0..2.578960] should produce approximately similar total willingness to pay to the multiplication of mean willingness to pay times the target population (which is in this case FIM 1.449 billion per year). In essence, the estimation of the total demand function is an attempt to distribute the mean willingness to pay in a more informative way.

In Figure 6.2, where the total demand curve is depicted, we can see that the cumulative total WTP accumulates rather rapidly. For the first 50% of acreage under pro-environmental farming the cumulative total WTP is FIM 1.462 billion. Thus, for the latter 50%, the increase is only FIM 162 million. A fifty-percent increment in the total acreage raises the cumulative total WTP less than 10 percent. A brief calculation shows that 50% of the cumulative total WTP becomes accumulated when acreage under pro-environmental farming reaches 398,000 hectares. The corresponding average WTP/ha is FIM 1,423.

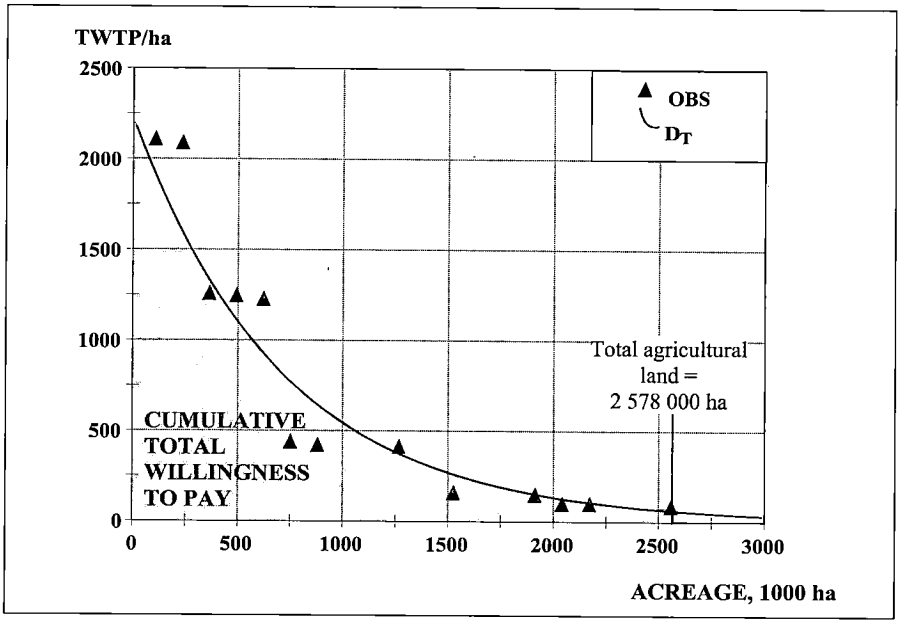

Figure 6.2. Total Demand Function for Acreage under Pro-Environmental Farming.

6.5. Existence of Starting Point Bias and Information Effects

When information is perceived in a broad sense, the starting point bias can also be regarded as a certain type of information effect. If the respondent believes for some reason that the starting bid contains information about the "correct" value level of the valuation object, then this information will influence his WTP response. The same applies to virtually all CVM design issues: any change in any element of the valuation instrument can be considered to alter the information content. This should be kept in mind when the effects of information are analyzed, because it may be difficult to identify how much different changes in questionnaire design have influenced the information content and further the individual WTP. However, although the exact sources of information effects could not be localized, the overall information sensitiveness of the mean WTP would indicate that people's valuations are highly dependent on the information provided. This should somehow be reflected in the interpretation of results.

As explained previously, six slightly different questionnaire formats were used in order to detect the possible starting point bias and information effects. There were three different starting bids and two different information levels, which were created by changing the sequence of questions and including a very

brief package of additional information. The mean WTPs of each questionnaire category are printed in Table 6.4. The reported mean WTPs were calculated by using the combined bidding game-payment card elicitation method.

The type of the questionnaire has a recognizable influence on the mean. The higher the starting bid, the higher the average WTP. In addition, there appears to be a connection between additional information and higher mean WTPs. Statistical significance of the differences among the mean WTPs is examined in Table 6.5 by using a *t*-test, which is an appropriate method to compare group means when variables with continuous values are in question.

The *t*-test results give support to the existence of the starting point bias. Especially, if a closer look is taken to the pairwise comparisons between Q1 and Q3 or between Q4 and Q6, this becomes obvious. In both cases, the difference between means is statistically significant, the risk of falsely rejecting the null hypothesis being much less than 5%. Thus, a large increase in the starting bid (from FIM 100 to FIM 1,300) raises WTP responses. There is also some indication of the existence of the information effect, but the evidence is not statistically significant enough. If the pairwise comparisons Q1-Q4, Q2-Q5, and Q3-Q6 are taken under inspection, we can see that the risk of falsely rejecting the null hypothesis is in each case higher than 5%. This is also true in the pairwise comparison between no-additional-info and additional-info. Of course, in the latter case not even a *t*-value less than 0.05 would be a convincing piece of evidence because of the joint-effect of information and starting bids. Correspondingly, comparisons between SB 100, SB 500, and SB 1,300 do not pro-

Table 6.4. The Mean WTPs of Different Questionnaires and Their Combinations in Respect of the Starting Bid and Additional Information.

Type of the questionnaire	N	%	Mean WTP, FIM
Q1 (SB=100 / no add. info)	116	17.5	272
Q2 (SB=500 / no add. info)	109	16.4	333
Q3 (SB=1300 / no add. info)	107	16.2	474
Q4 (SB=100 / add. info)	118	17.8	316
Q5 (SB=500 / add. info)	109	16.4	495
Q6 (SB=1300 / add. info)	104	15.7	544
No add. info (Q1+Q2+Q3)	332	50.0	357
Add. info (Q4+Q5+Q6)	331	50.0	446
SB100 (Q1+Q4)	234	35.3	294
SB500 (Q2+Q5)	218	32.9	414
SB1300 (Q3+Q6)	211	31.8	509
All	663	100.0	402

Table 6.5. T-test Values of Pairwise Comparisons of Different Questionnaires and Their Combinations.

Pairs under comparison	Prob>|T|	Pairs under comparison	Prob>|T|
Q1 - Q2	0.2968	Q3 - Q6	0.4845
Q1 - Q3	0.0145	Q4 - Q5	0.0545
Q1 - Q4	0.5383	Q4 - Q6	0.0098
Q1 - Q5	0.0110	Q5 - Q6	0.6372
Q1 - Q6	0.0009		
Q2 - Q3	0.0779	No add. info - Add. info	0.0719
Q2 - Q4	0.7924		
Q2 - Q5	0.0585	SB100 - SB500	0.0299
Q2 - Q6	0.0076	SB100 - SB1300	0.0004
Q3 - Q4	0.0742	SB500 - SB1300	0.1486
Q3 - Q5	0.8431		

duce unambiguous evidence for the support or rejection of the null hypothesis because it is not possible to separate the influence of additional information from the starting bid. Thus, this kind of examination does not necessarily confirm or falsify the hypothesis about information effects.

The same ambiguous conclusion about the possible existence of information effect can be made when the logit standard model [$-\infty..\infty$] is applied. The rather big difference in mean WTP between those who received additional information and those who did not (FIM 384 – FIM 207 = FIM 177) seems to suggest that information has an identifiable effect. However, if the standard deviations of the mean WTPs (87 and 103, respectively) are taken into account, the approximate "confidence intervals" (384±87 → [297..471]) and (207±103 → [104..310]) slightly overlap, indicating that the difference between mean WTPs is not statistically significant.

However, the combined effect of additional information and starting bids indicates that the changes in the information content do affect people's willingness to pay. For instance, the pairwise comparison between Q1 and Q6 shows this very clearly (t-value = 0.0009). Although we cannot really explain the influencing mechanism, we can assume that the information provided has had an impact through two channels. On the one hand, additional information has increased people's knowledge about positive ramifications of the conversion from conventional agriculture to pro-environmental farming. It is quite conceivable that when people learn more about the advantages of a policy proposal, they are also more willing to contribute to it. On the other hand, people may feel uneasy when confronted by the interviewer because they are not previously familiar with the context of the valuation method or situation. Consequently,

they do not really know how they are expected to act. Then, it is natural that any information given by the interviewer is considered valuable. In this kind of situation, the starting bid easily transforms into a benchmark that becomes an indication of the "correct" answer.

Because there exists preliminary although not properly confirmed evidence that information may have a considerable effect on WTP responses in certain occasions and conditions, it is meaningful to examine in more detail the relationship between respondents' WTP and the information content delivered through the survey instrument. This is done in the next chapter by introducing an attitudinal dimension.

7. Attitudes, Information, Preferences, and Willingness to Pay

The evidence presented in the previous chapter was inconclusive in relation to the existence of information effects. One reason for this may be that attitudes play a central role when people are confronted with new information. The purpose of this chapter is to examine whether attitudes appear to be a useful source of explanation when people's willingness to pay is analyzed in connection with possible information effects, as well as whether attitudes can help to identify that kind of response behavior that can be considered to have its origin in a preference structure different from the standard neoclassical one. Through this, both reliability and validity of willingness to pay responses can be assessed in a complex valuation situation where several elements make it difficult for the respondent to produce sound and consistent monetary value statements.

First, the empirical results acquired through the factor analysis are represented. By means of the cluster analysis, respondents are divided into groups based on the attitudinal dimensions revealed in the factor analysis. Then, a hypothesis on the effect of additional information is constructed and this hypothesis is tested in connection to individual WTP responses. Finally, the different attitudinal groups and individual WTP responses are used in order to assess the nature of preferences manifested through survey responses.

7.1. Attitudinal Factors Among Respondents

When an attempt is made to summarize a large body of data including many variables by means of relatively few parameters, a number of different statistical methods in the field of multivariate analysis can be applied. In the case at hand, where the aim is to find certain identifiable differences in attitudes towards agriculture and the environment, the question is about an analysis of interde-

pendence in the sense that the set of attitudinal variables taken under closer inspection are assumed to have an equal status. This means that the variables, although expected to be interdependent, cannot be classified as dependent variables and explanatory variables (Chatfield and Collins 1980, pp. 7-8). The factor analysis (FA)[16] applies for this kind of approach. Its idea is to derive new variables called common factors, which are expected to give a better understanding of the data.

The empirical analysis of respondents' attitudes was based on 22 attitudinal questions included in the questionnaire. They measured respondents' views regarding agriculture, the environment, and sustainable development (question 3-7 in *Appendix B*, claims from *a* to *v*). All the questions were presented in the form of claims and the respondents had to agree or disagree with them by expressing their opinion on a five-point scale. These questions were the same in all the questionnaires, although their placement varied to some extent depending on the type of the questionnaire (see Figure 6.1 in Chapter 6.1). In one half of the questionnaires attitudinal claims were asked after the actual WTP question and in the other half before the actual WTP question.

It appeared that there was significant correlation between most of the attitudinal variables. When testing pairwise Pearson correlations, 18 variables out of 22 variables had at least one correlation coefficient higher than 0.3. This strongly indicated that it was worthwhile to proceed with the application of the factor analysis.

The factor analysis was executed by using the FACTOR procedure that is included in the SAS/STAT™ software package. The main option chosen was the principal factor analysis that is based on an orthogonal common factor model. The prior communality estimates were calculated by using squared multiple correlation (SMC)[17] (Method I). In addition, two other factor analyses were carried out, a principal factor analysis in which the prior communality estimates were calculated by using maximum absolute correlation of a variable with any other variable (Method II), and a maximum likelihood factor analysis where the prior communality estimates were calculated by applying the SMC (Method III). These two additional analyses were used in order to confirm the results. The rotation method chosen in all three analyses was the varimax method.

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[16] The statistical theory behind the factor analysis is not reviewed in this connection, but it can be found in *Appendix F*.

[17] The SMCs may be obtained, for instance, as one minus the reciprosals of the corresponding elements of the inverse factor score matrix. Using the SMCs as communalities limits the analysis to the variance a given variable actually shares with other variables in the data set. Consequently, variance not shared with the specific set of variables is treated as unique (Bernstein et al. 1987, p. 189).

From the 22 original attitudinal claims 10 were included in the final analysis. The other variables were excluded because of too low values of pairwise Pearson correlation coefficients or too low estimates of final communality. The rule of thumb was that the exclusion of a variable took place if the highest pairwise correlation coefficient was less than 0.2 or the final communality estimate was less than 0.3. According to Child (1990, pp. 34-35), if the final communality is too low, in the region of 0.3 or less, the increasing existence of unique variance makes the analysis unreliable because it is not possible to reject the hypothesis that the major part of unique variance is created by error variance.

In the factor analysis, the most important decision to be made is probably the choice of the number of common factors. Most often, the final choice of the number of common factors is based on some combination of the proportion of sample variance explained, subject matter knowledge, and the general reasonableness of the results (Johnson and Wichern 1982, p. 437). In this case, the plausible number of common factors was found to be three, although the application of different selection criteria did not produce unambiguous results. Occasionally, a rule is recommended that only factors which have eigenvalues greater than one should be included. However, this criterion is more suitable for the principal component analysis than for the factor analysis (Child 1990 pp. 37-38). According to this criterion, the maximum number of factors to be extracted would have been from one (Method I) to two (Methods II and III).

Another way to decide the number of factors is to use the so-called *Cattell's scree test.* The idea is to derive the number of factors from the relations among successive eigenvalues. This inference is usually made graphically by presenting eigenvalues along the Y-axis and their serial positions along the X-axis. The goal is to separate the overall curve into two functions with the early eigenvalues representing factors that are more important and the later ones representing factors that are less important (Bernstein et al. 1988, p. 174). The Cattell's scree test plots produced by each of the three methods are shown in *Appendix E.* The conclusion was that the recommended number of factors to be extracted varied from two (Method III) to three (Methods I and II).

It is also possible to use the so-called *chi-square test* when the maximum-likelihood factor analysis (Method III) is applied. The aim is to determine if the correlation matrix with unity diagonals differs significantly from the identity matrix and if the residual matrix differs significantly from the null matrix because of the extraction of one or more common factors. The problem with the chi-square test is, however, that with large samples a matrix containing trivial residual variance can still differ from a null matrix, resulting in the extraction of trivial factors (Bernstein et al. 1988, pp. 174-175). In this case, the chi-square test indicated that the correct number of factors should be four. When the null hypothesis was that three factors construct a sufficient solution, then the null hypothesis could be rejected at the 0.01% level of significance. Nevertheless,

when the null hypothesis was that four factors construct a sufficient solution, then the risk of rejecting a true null hypothesis increased to almost 15%. Thus, based on the chi-square test, the recommendation was four factors to be extracted.

Although the criteria guiding the factor selection process proved not to be unambiguously interpretable, the rotated factor patterns were very similar in each case. Based on general knowledge about the subject matter and on certain aspects of the applied selection criteria, especially Cattell's scree test, a three-factor solution was considered to have the most desirable features. It offered an illuminating explanation that did not actually alter when a fourth factor was included. The rotated factor pattern produced by Method I is presented in Table 7.1.

When the results presented in Table 7.1 are interpreted, we can see that the percentage variance is quite low. This value tells how large a portion of the total variance is explained by the common factors. In this case, the portion is approximately 43%. Thus, about 57% of the total variance is due to specific or error variance. However, the inclusion of a fourth factor would have increased the common variance only by 0.3%. This fact also supports the selection of the three-factor model. However, the main purpose of Table 7.1 is to give information that makes it possible to develop meaningful descriptions for each factor.

Table 7.1. Variables, Factor Loadings[18], Communalities, Eigenvalues, and Percentage Variance in the Varimax-Rotated Principal Factor Solution of Three Factors (Method I).

Variable	Factor 1	Factor 2	Factor 3	h^2
X136	**0.683**	0.282	0.258	0.613
X137	**0.593**	0.182	0.224	0.435
X135	**0.526**	**0.384**	0.269	0.497
X138	**0.509**	0.209	**0.373**	0.441
X144	0.207	**0.672**	0.009	0.495
X141	**0.313**	**0.501**	0.166	0.377
X140	0.272	**0.478**	0.182	0.336
X145	–0.068	**–0.608**	0.114	0.387
X133	0.245	0.071	**0.577**	0.398
X134	0.183	–0.053	**0.573**	0.365
Eigenvalues	1.667	1.613	1.063	4.343
Percentage variance	16.672	16.128	10.629	43.429

[18] Factor loadings higher than 0.3 are in bold. The criteria for the detection of significant or salient factor loadings are somewhat vague. However, a rule of thumb, very widely used by factor analysts, is that factor loadings having values of ±0.3 or greater are usually regarded as significant, on condition that the sample size is greater than 100 (Child 1990, p. 39).

The following variables received significantly high positive loadings on Factor 1: X136, X137, X135, X138, and X141.

- X136: The use of fertilizers and pesticides is at too high a level in Finnish agriculture
- X137: The intensification of Finnish agriculture deteriorates the environmental quality and food safety
- X135: Environmental problems caused by agriculture are already significant
- X138: Conventional agriculture should quickly be developed into the direction of organic farming
- X141: Agriculture has to carry its fair share of the environmental taxes

The following variables received high positive loadings on Factor 2: X144, X141, and X140. In addition, variable X145 had a high negative loading and variable X135 received a significantly high positive loading on Factor 2.

- X144: Agricultural subsidies financed by taxpayers must be cut down if agriculture is not able to produce foodstuffs at competitive prices
- X141: Agriculture has to carry its fair share of the environmental taxes
- X140: Conventional agricultural subsidies can be cut down if the corresponding amount of money will be used to promote environmental investments and environmentally related subsidies in agriculture
- X135: Environmental problems caused by agriculture are already significant
- X145: It is a right thing to allocate tax money for the maintenance of agriculture because the viability of the countryside and the pleasantness of the environment depend on agricultural activities

The following variables received high positive loadings on Factor 3: X134, and X133. In addition, variable X138 received a significantly high positive loading on Factor 3:

- X134: The present generation must take better care of the environment that will be left to the coming generations
- X133: Environmental conservation should have greater emphasis, even at the expense of economic growth
- X138: Conventional agriculture should quickly be developed into the direction of organic farming

The interpretation of the three factors is the following:

Factor 1: This factor represents an attitude the leading argument of which is that adverse environmental impacts of conventional farming practices constitute the most severe problem in Finnish agriculture. The

most preferable solution is to develop current farming practices into the direction of organic farming, and in this process it is even acceptable to use economic instruments.

Factor 2: This factor can be seen to represent an attitude the core element of which is dislike towards conventional agriculture on the grounds of additional tax burden caused by agricultural subsidies. The emphasis is not on adverse environmental effects of agriculture, although environmentally beneficial farming practices are not opposed. However, a high positive loading of variable X140 and a high negative loading of variable X145 seem to contradict to some extent. The valid interpretation is probably that the promotion of environmentally beneficial farming practices is acceptable only if the government can simultaneously guarantee that the total amount of tax money allocated to agricultural subsidies decreases. Nevertheless, adverse environmental effects of farming are more like an excuse to criticize agriculture than a source of true concern.

Factor 3: This factor expresses an attitude, which emphasizes the importance of sustainable development in agriculture. Environmental issues have a high ranking. The major source of concern is the damage that might already have been caused to sustainable development and future generations because of the undiscriminating admiration of economic growth. As a part of this general framework, organic farming is seen to be a preferred alternative when the future of agricultural production is concerned.

The factors differ in respect of both economic and environmental issues. Factor 1 and Factor 2 represent views that are clearly critical towards conventional agriculture, although for different reasons. When it comes to Factor 2, it seems that the resistance culminates on the grounds that are most probably derived from standpoints related to income distribution and income transfers. The bottom line is that the society should subsidize farmers only if this leads to detectable efficiency gains. This view mainly concentrates on economic aspects and is quite insensitive in terms of environmental concerns. Factor 1 conveys a more pragmatic approach. The use of taxpayers' money to support agriculture is not undesirable as such, but it becomes undesirable when the outcome is negative in the form of adverse environmental effects. However, the expression of environmental concern is not as genuine and fundamental as it is in the case of Factor 3. It is more like a signal of discontent with an investment the profits of which have not been as large as expected. Thus, Factor 3 is the only factor that

represents a true environmental concern, while agricultural subsidies and their effect on social welfare is all but ignored.

7.2. Further Division of Respondents into Clusters Based on Attitudes

The factor analysis sheds some light on the general attitudinal dimensions that can be found in the data. However, the factors cannot be attached to single observations without further manipulation. This can be done by means of factor scores which express how the observation is ranked in respect of a certain factor[19]. If the factor scores are normalized into the form of a standard normal distribution, then we can easily see what the relative position of the observation on the factor in question is. By using the so-called cluster analysis, it is possible to use the information that is inherent in the factor scores. The idea of the cluster analysis is to divide observations in such a manner that observations with a similar factor score pattern will be grouped together. More generally, the cluster analysis aims to allocate a set of observations to a set of such clearly identifiable groups in which observations within a group are similar to one another while observations in different groups are dissimilar (Chatfield and Collins 1980, p. 212).

The clustering process can be conducted in various ways. It is possible to group variables instead of observations (in this respect, the cluster analysis has quite similar goals as the factor analysis). The groupings can be disjoint, hierarchical, overlapping, or fuzzy. Disjoint clusters place each object in one and only one cluster. Hierarchical clusters are organized so that one cluster may be entirely contained within another cluster, but no other kind of overlap between clusters is allowed. Overlapping clusters can be constrained to limit the number of objects that belong simultaneously to two clusters, or they can be unconstrained, allowing any degree of overlap in cluster membership. Fuzzy clusters are defined by a probability or grade of membership of each object in each cluster. They can belong to any of the cluster categories mentioned above, i.e. they can be disjoint, hierarchical, or overlapping (SAS 1987, p. 47). In this study, the cluster type chosen was the disjoint cluster because otherwise the analysis of the relationship between attitudes and willingness to pay would have become too complicated.

The clustering analysis was conducted by using the FASTCLUS procedure that is included in the SAS Statistical Software Package. The FASTCLUS procedure finds disjoint clusters of observations by means of a *k*-means method. This method was developed by MacQueen (1967), who suggested the term *k*-means for describing his algorithm that assigns each item to the cluster having

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[19] See *Appendix F* for a more detailed explanation of the nature of factor scores.

the nearest centroid (mean). In its simplest version, the process is composed of three steps. First, the observations are partitioned into k initial clusters (k is defined by the researcher). Then, the algorithm proceeds through the list of observations, assigning an observation to the cluster whose centroid (mean) is the nearest (distance needed in this process is usually computed using Euclidean distance with either standardized or unstandardized observations). Next, the centroids for the cluster receiving the new observation and for the cluster losing the observation are recalculated. This procedure is repeated until no more assignments take place (Johnson and Wichern 1982, pp. 555-556). The FASTCLUS procedure does not start by the partition of all observations into k preliminary groups, but a corresponding approach is applied. A set of points called cluster seeds is selected as a first guess for the centroids (means) of the clusters. Each observation is then assigned to the nearest seed to form temporary clusters (SAS 1987, p. 494).

The FASTCLUS procedure does not automatically recommend a certain number of clusters, but it prints two statistical criteria, the pseudo-F or the Calinski and Harabasz index and the cubic clustering criterion (CCC), which can be used in the identification process of clusters. The pseudo-F value is computed as $[trace\ B/(k-1)] / [trace\ W/(n-k)]$ where n and k are the total number of observations and the number of clusters in the solution, respectively. The B and W terms are the between and pooled within cluster sum of squares and cross product matrices. The CCC is a product of two terms. The first term is the natural logarithm of $[1-E(R^2)] / (1-R^2)$ where R^2 is the proportion of variance accounted for by the clusters, and its expected value is determined under the assumption that the data have been sampled from a uniform distribution based on a hyperbox. The second term is $(np/2)^{0.5} / [0.001+E(R^2)]^{1.2}$ where p is an estimate of the dimensionality of the between cluster variation. The constant terms are chosen based on extensive simulation results (Milligan and Cooper 1985). There is no unambiguous way to interpret the pseudo-F and CCC criteria, but usually the recommendation is to look for consensus between the two statistics. The idea is to find simultaneous local peaks for both test statistics. When calculating the pseudo-F and the CCC, we also assume that the variables which the clustering process is based on do not correlate with each other (SAS 1993, p. 98). In this case, the noncorrelation is guaranteed because the factor scores used in the cluster analysis were created through an orthogonal factor analysis.

In Figure 7.1 the results that the test criteria produce are represented graphically. There are three local peaks, two minimums (6 and 8 clusters) and one maximum (7 clusters). In this case, the seven-cluster solution was chosen because it appeared to offer a meaningful interpretation for existing attitudes. The essential information concerning the chosen solution can be found in Table 7.2. The mean factor scores (MFS) represent the mean value of factor scores that the

factor in question has received in the cluster. Because factor scores are normalized and standardized, a positive mean value of factor scores indicates that the cluster having the positive mean value has a stronger-than-average tendency to support the views expressed in that specific factor. Similar but inverse logic can be applied to negative values. The interpretation of the cluster-related mean factor scores is the main source of inference when essential features of the clusters are analyzed further.

The clustering procedure was carried out with a reduced sample size. Five observations were removed because of insufficient factor scores. Sixteen observations were excluded because of high individual WTPs (WTP ≥ FIM 2500). This was done in order to receive more reliable mean WTP estimates within clusters. The exclusion of observations did not influence the cluster structure in any significant way. The contents of the clusters were interpreted by using the means of normalized factor scores and the mean WTPs of each cluster. The aim was to find a plausible explanation that offers a consistent overall picture about the relationship between attitudes and WTP. In addition, a few socio-economic variables were tested in order to find out possible differences regarding the gender, age, income, place of living, and education between the clusters. The characterization of the clusters is presented below, but first some general remarks are made. The cluster related mean values of socio-economic variables are represented in Table 7.3.

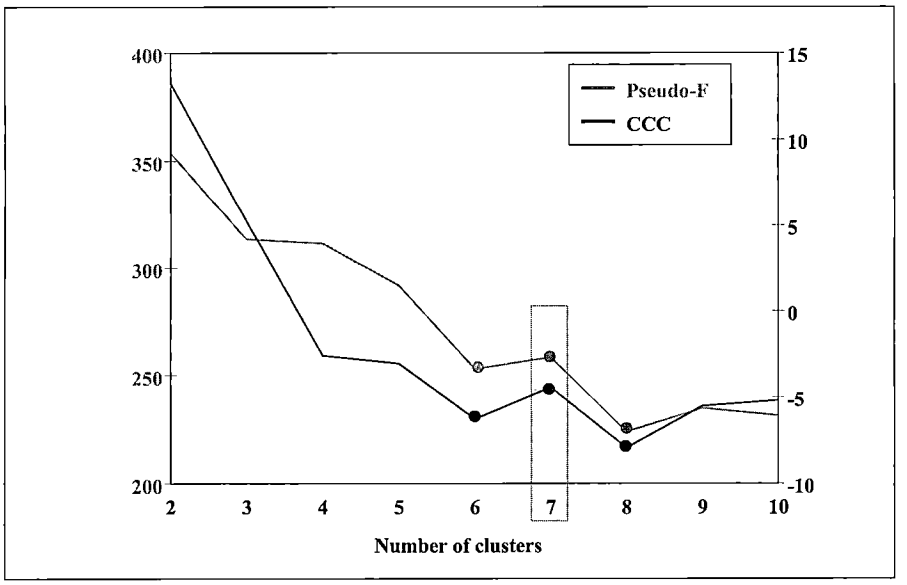

Figure 7.1. Relation Between the Number of Clusters and the Test Criteria.

Table 7.2. Solution with Seven Clusters.

Cluster	Frequency	%	Mean score, Factor 1	Mean score, Factor 2	Mean score, Factor 3	Mean WTP, FIM/year
1	53	8.2	–0.83	–1.09	–1.61	149
2	66	10.3	–1.38	–1.34	0.03	360
3	175	27.3	0.79	0.72	0.71	410
4	103	16.0	0.39	0.77	–0.57	223
5	11	1.7	–0.78	1.41	–3.57	64
6	78	12.2	–1.27	0.54	–0.47	276
7	156	24.3	0.36	–0.71	0.55	418
	642	100.0				333

Table 7.3. Cluster Related Means of Certain Socio-Economic Variables.

Cluster	Gender females-%/ males-%	Age, years	Gross income, FIM/year	Place of living*	Education*
1	40 / 60	43	160300	4.23	2.87
2	53 / 47	37	187600	4.68	2.82
3	55 / 45	43	164400	2.99	2.98
4	36 / 64	37	160500	2.81	3.42
5	27 / 73	28	160000	3.27	3.18
6	47 / 53	35	160800	3.03	3.13
7	63 / 37	38	154900	3.61	2.92
Average	51 / 49	39	163000	3.40	3.03

* Place of living and Education variables are presented in the form of an index. In the case of Education, the index can vary from 1 to 6, 1 representing elementary level education and 6 indicating a university degree. The index of Place of living can also vary from 1 to 6, 1 representing the center of a big city and 6 indicating a sparsely populated rural area. See *Appendix B*, questions 5-1 and 5-5 for a detailed description of the response alternatives.

The relationship between attitudes and WTP seems to be quite logical. For instance, the highest mean WTPs take place in Clusters that have the highest MFCs (Clusters 3 and 7) in relation to Factor 3. This is no doubt what could be expected because Factor 3 represented clearly articulated appreciation of sustainable development. Correspondingly, Cluster 5 has the lowest MFS in respect of Factor 3 and it has the lowest WTP of all Clusters, which is consistent. The obvious conclusion is that attitudes have some influence on the stated individual WTPs. When comparing the mean WTP differences across the clusters, some statistically significant[20] differences were found (Table 7.4). When

[20] When reference is made to statistical significance, the 5% risk level is meant if not stated otherwise.

socio-economic variables were tested against Clusters, it was quite surprising that there were no differences in means among Clusters regarding income and education. However, some statistically significant differences across Clusters were detected in respect of age, gender, and place of living (Table 7.4).

The problem with pre-tax income was that quite many respondents did not give the information (103 out of 642 or 16%). The missing answers were replaced by the average pre-tax income, which obviously led to a uniform cluster-related income distribution. This remarkably decreases the explanatory power of income and partly explains why no differences in income across clusters were detected. Another explanation is that attitudes do not depend on financial matters. Nevertheless, the economic theory presupposes that there is a positive correlation between income and WTP. However, in this data, the correlation coefficient between income and WTP is extremely low, only 0.017, even

Table 7.4. The Statistically Significant (t=0.05) Differences in the Cluster-Related Means of Age, Gender, and Place of Living.

Compared clusters	Age	Gender	Place of living	WTP
1-2				
1-3			*** 1	*** 3
1-4			*** 1	
1-5	*** 1			
1-6	*** 1		*** 1	
1-7		*** (60%--37%)	*** 1	*** 7
2-3			*** 2	
2-4		*** (47%--64%)	*** 2	
2-5			*** 2	
2-6			*** 2	
2-7			*** 2	
3-4	*** 3	*** (45%--64%)		*** 3
3-5	*** 3			
3-6	*** 3			
3-7	*** 3		*** 7	
4-5				
4-6				
4-7		*** (64%--37%)	*** 7	*** 7
5-6				
5-7		*** (73--37%)		
6-7		*** (53%--37%)	*** 7	

(The statistical significance is indicated by the symbol "***". When age, place of living and WTP are concerned, the number following the symbol "***" tells which of the clusters has a higher mean. In the case of gender, the percentage numbers refer to the percentage of males inherent in the clusters under comparison.)

when the respondents not revealing their income are removed. This means that it is not appropriate to derive elaborated conclusions that are based on income data.

If the respondents' mean WTP is cross-tabulated in relation to education, some observations can be made. If those who have the highest level of education (a university degree) are compared to those who have the lowest education, there is a statistically significant difference in means, FIM 550 (N=52) versus FIM 237 (N=162), showing that people who have a university degree are ready to pay the higher amount. Although a clear linear correlation between education and WTP cannot be found, the considerable difference between the least and most educated groups suggests that education might have some influence on WTP. However, because we cannot detect any statistically significant differences in respect of education when the attitude-based clusters are in question, it may be safe to conclude that education is not a decisive factor when an individual takes his position on issues related to the environment and agriculture or their interaction.

The verbal interpretation of Clusters:

Cluster 1: *People who prefer conventional agricultural practices.* At the first glance this cluster seems to be somewhat difficult to interpret because all the MFSs are negative, meaning that people in this group do not really think that current agricultural production practices are environmentally harmful or that farming is a burden to taxpayers. In addition, people in this group neglect sustainable development, which is indicated by a relatively low mean WTP. In further tests, it appeared that 26 out of 53 members of this group were farmers, when random selection would have produced only 2 or 3 farmers. Thus, the possible explanation is that people belonging to this group are professionally related to agriculture and have mainly for this reason a positive attitude towards agriculture. This is why the sustainability factor scores such low points: these people do not see any need for change. According to their opinion, the current way of farming is both socially and environmentally the most desirable production alternative. This is perceivable because they also defend their economic interests: they have invested in a certain production technology and want to receive a decent return for their investment. This group has male dominance, although the difference is statistically significant only when compared to Cluster 7, which has the largest relative amount of women. Moreover, because of the dominance of farmers, people belonging to this

group most likely live in the countryside. The difference in means[21] is statistically significant compared to Clusters 3, 4, 6, and 7 the members of which are more likely to be city-dwellers.

Cluster 2: *People who have a positive attitude towards agriculture in general.* This group resembles Cluster 1 in respect of the first two factors. According to the MFS of Factor 1, members of Cluster 2 are even less critical towards environmental problems caused by conventional farming than members of Cluster 1. However, members of Cluster 2 are more concerned about sustainable development and state higher mean WTPs (although the difference in means is not statistically significant), probably as a consequence of their concern. Despite their appreciation of farming, the members of this group do not oppose changes in production practices as strongly as the members of Cluster 1. The members of this Cluster have a positive attitude towards agriculture in general and are even to some extent environmentally conscious, even though this consciousness is at the average level (the MFS of Factor 3 is very close to zero, 0.03). This group has female dominance, although the difference is statistically significant only when compared to Cluster 4, which has the second largest relative amount of women. We can say that Cluster 2 is a female equivalent of Cluster 1. Consequently, again, people belonging to this group most likely live in the countryside. The difference in means is statistically significant compared to all other Clusters (except to Cluster 1, of course). We can conclude that the increase in the relative number of woman shifts the attitudinal emphasis to a less conservative direction when environmental issues are in question. It is also interesting that in this group the average gross income is the highest. However, income differences across Clusters are not statistically significant, as already indicated before.

Cluster 3: *People who demand a change in current farming practices and are ready to pay for it.* In this group, the members perceive the problems caused by conventional agriculture and express concern about sustainable development. The group has a female majority, it has urban dominance, and its members are rather old. This group repre-

[21] Although we talk about differencies in means, the term refers both to the results of nonparametric tests (Wilcoxon rank-sum test, Kruskal-Wallis test) and the results of pairwise *t*-tests or Tukey's studentized range tests. Nonparametric tests were applied in the case of gender, place of living, and education.

sents people who have a critical attitude towards conventional farming and who simultaneously comprehend (at least intuitively) the importance of pro-environmental farming as a source of environmental benefits. They are willing to pay for the maintenance of the rural environment if they can be convinced that new agricultural production methods are environmentally sound. Moreover, people in this group seem to require that farmers should also take responsibility for paying their share of environmental taxes. Furthermore, it appears that the members of this group have a tendency to value environmental and natural assets more than any other group. In addition, 27.3% of the respondents belong to the Cluster, which makes it the largest one.

Cluster 4: *People who have a critical attitude towards conventional farming because of economic reasons but who are not worried about sustainable development.* People in this group can be seen to represent slightly masculine values, which is no doubt a reflection of a high relative amount of men. For this group, it is typical to agree with the claim that agriculture should not be supported. Some concern is expressed about adverse environmental impacts of agriculture. However, this view does not seem to be connected to a more holistic environmental concern about issues related to sustainable development. Thus, the critique of current agricultural practices does not have its roots in environmental consciousness. The dislike of agriculture is apparently created by economic reasons, it is an opinion of a worried taxpayer. This Cluster is also urban like Cluster 3, but its members are younger than the members of Cluster 3. The mean WTP of Cluster 4 is also clearly lower than the mean WTP of Cluster 3, and the difference between the mean WTPs is statistically significant.

Cluster 5: *People whose attitudes towards agriculture are solely motivated by their opposition of agricultural subsidies.* If the previous Cluster could be described as somewhat masculine in its attitudes, this Cluster represents the same line of thinking taken to the extreme (the highest relative proportion of men, 73%). Environmental issues are not on the agenda at all, sustainable development is a swearword. Agriculture is strongly disliked because of its frequent visits to the common purse of the society. The overall socio-economic profile of Cluster 5 resembles the profile of Cluster 4 to some extent. We can hypothesize that this group represents young, urban men who are interested in technological issues. However,

because Cluster 5 has only eleven members (1.7% of the sample), we should not draw any far-reaching conclusions. It is also a tendency in the cluster analysis that one of the clusters usually becomes much smaller than the others. Because of the small size of Cluster 5, a statistically significant WTP difference cannot be found when this Cluster is compared to other Clusters, despite the clearly lowest mean WTP of all Clusters.

Cluster 6: *People whose attitudes towards agriculture are to a great extent motivated by their opposition of agricultural subsidies although the reasons for this are not unambiguous.* In addition, Cluster 6 has some masculine characteristics, although the male dominance in relative numbers is not as evident as it was in Clusters 4 and 5. However, Cluster 6 is to a great extent parallel to Cluster 4 despite the difference in respect of the MFS of Factor 1. In Cluster 6, conventional farming is not considered a significant risk to the environment, while the members of Cluster 4 expressed some concern about adverse environmental impacts of current agricultural practices. Compared to Cluster 5 we can see that the signs of all the MFSs are the same. The main difference between this Cluster and Cluster 5 is probably the extremely pronounced negative attitude towards agricultural support in the latter. It may be derived more or less consciously from the argument that considers all market interference initiated by the government a potential source of welfare loss. In Cluster 6 (as well as in Cluster 4), the opposition is most likely created by the view that farmers have received more income transfers in the form of agricultural subsidies than they would have earned. The overall socio-economic profile of Cluster 6 resembles the profile of Cluster 4; there are no statistically significant differences in mean WTPs or socio-economic variables. The same is also true when Clusters 5 and 6 are contrasted.

Cluster 7: *People who express concern about adverse environmental effects of conventional agriculture, emphasize the importance of sustainable development, and are ready to approve agricultural subsidies in order to guarantee domestic food supply and the maintenance of the countryside.* In this Cluster, the members have a detectable tendency to criticize current farming practices. However, simultaneously they think that no serious harm to the environment has occurred yet. Possible adverse impacts on environmental quality are not irreversible. Consequently, this Cluster supports organic farming and sustainable development in general. This Cluster also

agrees on the idea that agriculture should be responsible for its share of environmental payments. However, the overall environmental concern is not expressed as strongly as in Cluster 3, which scores highest in this respect. Furthermore, this group favors the idea of using subsidies for the maintenance of the countryside in order to maintain the viability of the countryside to some extent, but does not support the idea of cutting down the subsidies of conventional farming. This is probably the greatest distinction compared to Cluster 3, which shows very little sympathy regarding subsidies allotted to conventional agriculture. The pattern seems to be that a group emphasizing the importance of environmental issues has a female majority. Cluster 7 has the largest relative amount of women and the difference is statistically significant compared to Clusters 1, 4, 5, and 6, which all have a male majority. The members of Cluster 7 live most likely in small towns or in the centers of rural areas. A statistically significant difference in means can be found when Cluster 7 is compared to two most rural Clusters, 1 and 2, and when Cluster 7 is compared to two most urban Clusters, 3 and 4. There is also a statistically significant difference in mean WTP when Cluster 7 is contrasted to Clusters 1 and 4, which both have the lowest mean WTPs.

These results clearly support the conclusion that the correlation between attitudes and WTP cannot always be explained in a straightforward way. In Table 7.5 a summary is presented about the attitudes included in the seven Clusters and their relations to the mean WTP. The column labeled "Conventional farming" expresses the overall cluster-related attitude towards conventional farming. The intensity of the attitude can vary from three plus signs to three minus signs (a plus sign indicating a favorable attitude). Correspondingly, the column labeled "Sustainable development" refers to the general cluster-related attitude towards sustainable development, the intensity of the attitude being depicted as explained above. When the attitude towards conventional farming is concerned, it is obvious that the dislike of conventional farming is based on environmental or/and economic grounds. The number of black dots indicates how heavily the dislike has its roots in environmental and/or economic issues. The more black dots, the more decisive is the issue in the formation of the expressed attitude. In the "WTP" column black dots reveal if Cluster's mean WTP has been low (FIM 0-99, one dot), medium (FIM 100-349, two dots), or high (FIM 350- , three dots).

It is interesting to notice that the high WTP seems to depend on the respondents' attitude towards sustainable development. If Cluster scores high in this respect, the attitude towards conventional farming can be either negative or

Table 7.5. Summary of the Attitudinal Profiles of Clusters.

Cluster	Conventional farming	Attitude towards Source of critique Environmental	Economic	Sustainable development	WTP
1	++			−−	••
2	+++			+	•••
3	−−	••	••	+++	•••
4	−	•	••	−	••
5	−−−		•••	−−−	•
6	−		•	−	••
7	+	•		++	•••

positive. For instance, Cluster 2 is extremely positive concerning conventional farming and sustainable development while Cluster 3 also strongly supports sustainable development but is simultaneously very critical of conventional farming. Despite this obvious distinction in attitudes, both clusters express a high mean WTP. The conclusion is that the motive behind the stated WTP is probably somewhat different in each case.

When people were asked about their WTP concerning pro-environmental farming, the information included in the questionnaire let the respondents understand that the maintenance of the rural environment would be carried out by changing prevailing agricultural production practices to a more environmentally-friendly direction. This was also presented to be the way to cut down agricultural surplus. Furthermore, the text in the questionnaire indicated that agricultural subsidies will be required in the future, too. The valuation scenario did not actually contain any information about the possible change in the subsidies. It is also essential to point out that the scenario gave the impression that the financing of the agricultural subsidies would be based on tax-like fees, not on voluntary donations. The whole framework should be kept in mind as we investigate possible explanations for the response motives of the respondents.

Consider first the group having the lowest WTP, i.e. Cluster 5. In this group, the idea of spending tax-money on agricultural subsidies is probably the issue that triggers the fundamental resistance. When this is combined with a complete negligence about sustainable development, it is not surprising that pro-environmental farming receives neither sympathy nor money from this Cluster. It is likely that the members of Cluster 5 would not object to a complete shutdown of domestic agriculture if imported foodstuffs were any cheaper.

Clusters 1, 4, and 6 construct a category of people with a medium high WTP. The members of Cluster 1 believe that conventional farming is the best form of agricultural production. There is no need for a change. Sustainable development

or any other environmentally oriented concern is not a relevant issue for Cluster 1. Furthermore, sustainable development is considered an unrealistic approach. However, the members of Cluster 1 express a medium high WTP, mainly because they see the maintenance of the rural environment, at least to some extent, as a guarantee of the further existence of conventional agriculture. It is a smaller disadvantage to alter production practices than to quit farming completely. The members of Cluster 4 have actually the same kind of choice situation as the members of Cluster 1, namely that, although pro-environmental farming is not a great idea from their perspective, they are ready to support it to some extent, because the alternative is even worse. In this case, the alternative is conventional farming with its adverse environmental and, especially, economic effects. Cluster 6 is somewhat ambivalent in its position. If its members were able to choose freely, they would probably prefer more intensive, conventional type of farming in order to get rid of agricultural subsidies through efficiency gains. Thus, the mild support that Cluster 6 gives to pro-environmental farming and the maintenance of the rural environment is most likely motivated by the hope that pro-environmental farming would reduce agricultural subsidies. There is no trace of any environmentally oriented concern.

When Clusters that have the highest mean WTP are taken under consideration, i.e. Clusters 2, 3, and 7, it is obvious that rather different attitudinal profiles can produce almost equal mean WTPs, and rather similar attitudinal profiles can also result in widely differing mean WTPs. This is, of course, confusing, but we must remember that the formulation of the valuation scenario may offer varying lines of action for the respondent to proceed in order to promote his specific goals. In a complicated response situation, the attitudinal profile of a respondent simultaneously covers many aspects of individual values and social views. It is comprehensible that seemingly similar attitudinal profiles in one respect may differ in some other crucial respect, causing a striking difference in the stated WTP. Thus, it is not always easy to identify what components of the attitudinal profile of a respondent function as reliable indicators of actual WTP.

In Cluster 2, the belief in the excellence of conventional farming is the strongest of all Clusters, but sustainable development also receives cautious support. Although conventional agriculture from the point of view of Cluster 2 does not cause any problems, pro-environmental farming is an acceptable alternative if it can convince people about the overall necessity of domestic agricultural production. This is probably why the mean WTP is so high in this group in spite of its pronounced trust in conventional farming. When contrasted with Cluster 1, which has a similar attitudinal profile concerning the attitude towards conventional farming, it becomes apparent that the difference in the mean WTP can be explained by the positive attitude in Cluster 2 towards sustainable development. A very similar pair of Clusters is formed by Clusters 3 and 4, which

both have a negative attitude towards conventional farming, but Cluster 3 favors sustainable development and Cluster 4 does not. Again, the positive attitude towards sustainable development seems to explain the difference in the mean WTP. The reasoning in Cluster 3 probably goes in the following way: Conventional farming is a source of many environmentally and economically adverse effects. Environmental farming may have potential to mitigate these disadvantages. Therefore, it is not a bad idea to try to change agricultural practices that do not seem to benefit the society. The possible change is such a valuable thing that it is worth paying for.

The third Cluster in the high WTP category is Cluster 7, which can be seen to be a mixture of the attitudes of the groups 2 and 3. As in Cluster 2, the attitude towards conventional farming is slightly positive, although some concern about the adverse environmental effects of conventional farming is expressed as in the case of Cluster 3. In addition, the support for sustainable development is stronger than in Cluster 2 but not as strong as in Cluster 3. In Cluster 7, the high mean WTP is probably a result of the respect of peasant values and the peasant way of living. The members of this group see the importance of agricultural tradition, even though they do not completely approve of the current production practices because of their negative environmental impacts. However, the critique is not directed towards farmers as such. Farmers are considered to have been compelled to adopt conventional agricultural production practices because of the nature of the current agricultural policy. Consequently, Cluster 7 sees pro-environmental farming as a proper measure to halt this environmentally questionable development, which also contradicts with the old peasant idea about harmony between man and nature.

So far, it has been possible to create meaningful attitudinal profiles for all Clusters. However, it would be interesting to test to what extent the attitudinal profiles match the answers that have been given to questions that were not included in the factor and cluster analyses. A test was conducted in respect of a question in which it was inquired what the respondents think about changes that have taken place in the rural environment during the past twenty years. Possible answering alternatives were that the change of the rural environment has been positive, there has been no change at all, or the change has been negative. Figure 7.2 presents how the normalized means of the answers vary across Clusters. Table 7.6 shows which differences in means between Clusters are statistically significant.

A brief examination of Figure 7.2 and Table 7.6 shows clearly that Clusters 1 and 2 differ from Clusters 3, 4, 6, and 7 in a statistically significant way, i.e. members of Clusters 1 and 2 do not regard changes in the quality of the rural environment as negative as members of Clusters 3, 4, 6, and 7. This is consistent with the attitudinal profiles because Clusters 1 and 2 have the most positive and the least critical attitude towards conventional farming. It is quite natural that

they consider the changes that have occurred positive because it is apparently conventional farming that has been responsible for most of the changes. Correspondingly, the members of Clusters 3, 4, and 6 have a critical attitude towards conventional farming and are inclined to see the changes in tones that are more negative. The problem is, however, that this kind of reasoning does not seem to shed any light on the behavior of Clusters 5 and 7. Fortunately, the attitude of the members of Cluster 7 can be explained easily through their attitudinal profile, while the motives of Cluster 5 remain somewhat obscure.

As was already indicated above, the members of Cluster 7 have a slightly positive attitude towards conventional farming because they believe that the adverse environmental effects of conventional farming are created by agricultural policy and not by farmers. Thus, they are worried about the deterioration of the rural environment when they simultaneously support farmers as representatives of an endangered lifestyle. Of all Clusters, the attitude of Cluster 5 is the most difficult to perceive. The group expresses extremely pronounced opposition towards conventional farming but yet thinks that the changes in the rural environment have been more positive than negative during the past twenty years. There are two possible explanations, but probably neither of them can really capture the truth. We can hypothesize that in their fundamental resistance of agriculture the members of Cluster 5 consider any sign of deterioration of the rural environment a good thing. Their response should possibly be interpreted as "Yes, we have seen many bad things happen in the rural environment during the past twenty years and we are now really satisfied." Another possible explanation is that the members of Cluster 5 are eager supporters of technological

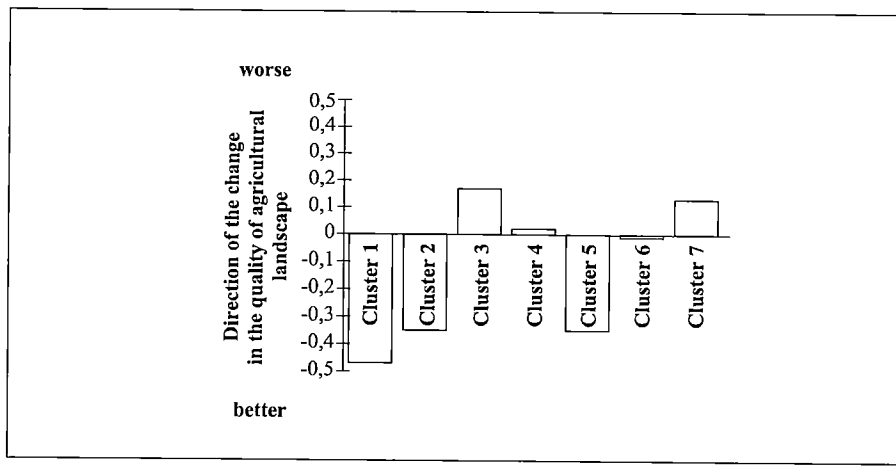

Figure 7.2. Normalized Cluster-Related Means of the Response Concerning the Quality Change of the Rural Environment During the Past Twenty Years.

Table 7.6. Statistically Significant Differences in Means between Clusters Regarding the Attitude towards the Change of the Rural Environment during the Past Twenty Years.

Compared clusters	Attitude towards the change of the rural environment	Compared clusters	Attitude towards the change of the rural environment
1-2		3-4	
1-3	*** 1+	3-5	
1-4	*** 1+	3-6	
1-5		3-7	
1-6	*** 1+	4-5	
1-7	*** 1+	4-6	
2-3	*** 2+	4-7	
2-4	*** 2+	5-6	
2-5		5-7	
2-6	*** 2+	6-7	
2-7	*** 2+		

(Explanation of symbols: for instance " *** 1+ " means that the difference between Clusters is statistically significant and that the members of Cluster 1 have a more positive view about the quality development of the rural environment).

progress and powerful use of machines. In this case, it would be understandable if they considered the changes more positive than negative because during the period of the past twenty years the mechanization of Finnish agriculture has reached its peak.

7.3. Influence of Additional Information

In connection with testing the starting point bias, the preliminary conclusion was that there is no statistical evidence about the existence of information effects in this data set. However, in Chapter 3.5 we argued in relation to the conceptualization of information effects or bias that the influence of changes in information may be dependent on the initial attitudes of respondents. In this connection, Romstad's (1991) ideas were referred to. He pointed out two major tendencies. First, it is reasonable to assume that additional information (I_a) increases a respondent's WTP if I_a is consistent with prior information (I_p). If this is not the case, a respondent's WTP decreases. Secondly, it is plausible to conjecture that additional information reduces the variance of WTP responses if I_a is consistent with I_p. Therefore, the case is the opposite, if I_a is inconsistent with I_p the variance of WTP responses increases again.

Unfortunately, the valuation situation can be even more complicated. WTP changes due to rejection or acceptance of I_a clearly depend on the initial atti-

tudes of respondents and on the proportion of I_a included in I_p. In some cases it is ambiguous to estimate the direction of change in WTPs. Consider Table 7.7, where eight options that vary in respect of the nature of initial attitudes at the prior information level and the nature of additional information are listed. Apparently, the general rules presented above can be applied as such only to some of the alternative situations.

Take option (1) first. Respondent have a positive initial attitude, agree with I_a, which is no news to them. Obviously, there will be no change in mean WTP or in variance of WTP. The same logic is also true in the case of option (2), if I_a is already included in I_p, there is no reason for changes. The interpretation of option (3) is also straightforward when it comes to mean WTP. Respondents have a positive initial attitude and they agree with I_a, which is previously unfamiliar information to them, and thus it is quite reasonable that mean WTP rises. However, the direction of change of the variance of WTP is somewhat ambiguous. We can argue that the variance of WTP decreases if initially higher WTP responses rise less in absolute terms than initially lower WTP responses. If higher WTP responses rise relatively as much as lower WTP responses, the variance increases. In other words, the direction of change is extremely situation-specific. That is why there is a question mark between variances in option (3).

The hypothesis supported here is, however, that an increase in mean WTP also causes the variance to rise. The reasoning is grounded on simple arithmetic derived from the mathematical properties of variance. Consider a data set which consists of two individuals, A and B, having I_p based WTP responses of FIM 100 and 500. They receive I_a that is consistent with their I_p. Their WTPs rise to FIM 150 and 560, respectively. The variance grows despite the fact that a

Table 7.7. Initial Attitudes, Additional and Prior Information, and the Expected Change in Mean WTP and in the Variance of WTP.

		PRIOR INFORMATION			
		Positive initial attitude		Negative initial attitude	
ADDITIONAL INFORMATION		$I_a \subset I_p$	$I_a \not\subset I_p$	$I_a \subset I_p$	$I_a \not\subset I_p$
	Agree	(1) $WTP_p = WTP_a$ $Var(WTP_p) = Var(WTP_a)$	(3) $WTP_p < WTP_a$ (<) $Var(WTP_p)$? $Var(WTP_a)$	(5) $WTP_p = WTP_a$ $Var(WTP_p) = Var(WTP_a)$	(7) $WTP_p > WTP_a$ (>) $Var(WTP_p)$? $Var(WTP_a)$
	Disagree	(2) $WTP_p = WTP_a$ $Var(WTP_p) = Var(WTP_a)$	(4) (=) WTP_p ? WTP_a $Var(WTP_p) < Var(WTP_a)$	(6) $WTP_p = WTP_a$ $Var(WTP_p) = Var(WTP_a)$	(8) (=) WTP_p ? WTP_a $Var(WTP_p) < Var(WTP_a)$

relative increase of A's WTP compared to B's WTP is 50% versus 12%. Although no final conclusions can be drawn, the probability of having increased variance after receiving I_a is likely to grow when the difference between minimum and maximum values in the I_p data set increases.

In option (4), the issue becomes even more complicated. It is also possible that a respondent finds himself in a situation where he receives I_a that is a new piece of information and is not consistent with I_p. The individual has to cope with an overload of information. He has two alternatives. He can totally reject I_a and stick to I_p. In this case WTP remains the same or increases somewhat when the respondent tries to convince himself about the superiority of his initial standpoint. It is also possible that I_p-inconsistent I_a will be able to influence the positive initial attitude and to change it less positive. This would lead to a meager decrease in the respondent's WTP. Because of these opposite impacts it is likely that mean WTP does not change significantly. On the other hand, the opposite impacts suggest that the variance of WTP increases in an observable manner. The change in variance is likely to be the smaller the more prior information respondents have and the stronger their initial positive attitudes are.

What was said above about the case of positive initial attitudes can be applied to the case of negative initial attitudes. The reasoning concerning options (1) and (2) can be related to options (5) and (6) as such. Additional information does not change I_p-based WTP or variance of WTP if it is not a new piece of information, no matter if it is in conflict with I_p or not. When it comes to option (7), we can use reasoning applied in the case of option (3) in a reversed form. If I_a strengthens initial negative attitudes it is quite natural that WTP_p becomes greater than WTP_a. Although it is not possible to be sure about the direction of the change of the variance, a parallel argumentation regarding option (3) can be easily developed. The mean WTP decreases and it is likely that high WTPs fall more than low WTPs (in absolute terms), meaning that $Var(WTP_a)$ becomes smaller than $Var(WTP_p)$. There is also a striking similarity between options (4) and (8). The reasoning goes in option (8) like in option (4). Most individuals probably totally disregard I_a when it is inconsistent with their I_p. However, some people's attitudes may alter to a less negative direction due to contradictory elements of the new piece of information. Similarly, some people are inclined to lower their WTP after receiving conflicting information in order to make themselves more convinced about the supremacy of their initial standpoint. Consequently, $Var(WTP_a)$ becomes greater than $Var(WTP_p)$.

Now it is quite easy to identify situations that are the most complicated from the viewpoint of a CVM survey designer. As has already been pointed out, it is likely that when the respondent agrees with the additional information it strengthens his initial attitude based on the prior information. Thus, if the initial attitude towards the nonmarket commodity being valued is positive, WTP_a is greater than WTP_p, and if the initial attitude is negative, the reverse is true or WTP_a is

less than WTP_p. This is no doubt a potential explanation for information bias since, if the CVM instrument conveys information that extensively lists both pros and cons of the nonmarket commodity being valued, the difference between the mean WTP of supporting and opposing groups widens. Those who have a positive initial attitude reject all negative information and, correspondingly, those who have a negative initial attitude refuse to take into account any positive information. The tendency to reject that part of additional information which is in conflict with the prior information dominates especially when the major part of the received additional information strongly supports the initial attitude.

Less serious but still significant bias may emerge, as indicated above, when the received additional information strikingly deviates from the prior information. The problem in this case is that the conflicting additional information may lead the respondent either to change his initial view, or to make him stick to his initial view even more categorically. Thus, depending on the nature of the additional information in relation to initial attitudes and the unconditionality of initial preferences and attitudes, WTP_p can be greater, less than, or equal to WTP_a. As a consequence, information effect is most probable when the issue at hand is controversial, when the respondents' level of knowledge is rapidly changing over time, or when the issue is of great relative importance on the respondent's personal agenda (Romstad 1991, p. 6). If the issue is controversial or if it has a high ranking on the personal agenda, it is likely that respondents' initial attitudes are explicitly defined and pooled. If respondents' level of knowledge is changing rapidly over time, it increases the probability that respondents receive additional information that is not included in their prior knowledge about the subject.

It seems that the valuation problem examined in this study has all the characteristics that increase the probability of the existence of information effects. The maintenance of the rural environment by means of pro-environmental farming is definitely a controversial issue. Agriculture-related problems, like surplus, subsidies, and leakage of nutrients to waterways guarantee that conflicting views have a sound ground where to flourish. Sustainable development and other environment-related topics are also controversial issues because there are still people who give the highest priority to economic growth at the expense of environmental and natural resources. The public discourse concerning all these issues is extensive and economic, social, and biological research ceaselessly produces new information about the advantages and disadvantages of different farming practices. Thus, the conditions of having information effects certainly become fulfilled when the valuation of the rural environment is concerned.

Apparently, the testing for information effects is more difficult than the testing for starting point bias. If a CVM survey design where respondents face varying amounts of information is used, the tests for differences in mean WTPs

can be taken. However, as indicated above, respondents' reactions to additional information depend on their initial attitudes. Thus, it would probably make sense to compare separately the change in WTP and in variance of WTP due to additional information among those who have positive initial attitudes and among those who have negative initial attitudes. Assuming that additional information includes favorable aspects and that at least some of the respondents with positive attitude are not familiar with the favorable additional information, there should be a greater difference in the mean WTP between less informed and more informed supporter groups than between less informed and more informed opponent groups. Furthermore, we can test if variances of WTP behave as we expect.

Table 7.8 presents the cluster-related *t*-tests. Each Cluster is divided into two subgroups, into those having only prior information (I_p) and those having additional information (I_p+I_a). The information package including additional information was added to half of the questionnaires and the sequence of some other sections of the questionnaire was altered, as already explained before. Additional information consisted of a brief description of the advantages of pro-environmental farming and the importance of the rural environment. In the information package, the public good nature of the rural environment was also referred to. Furthermore, in the information package it was predicted that many valuable characteristics of the rural environment are in danger of disappearing if nothing is done to change the course of current development. In Table 7.8, we can see that in most clusters (except Cluster 1) both subgroups have an almost equal number of observations. This supports the conclusion that additional information does not cause extreme changes in basic attitudes in most cases, even though it may influence the expressed WTP.

Cluster 1 deserves a closer look because of the difference between the sizes of the subgroups. A sampling error is possible, of course. There may be a disturbance due to a skewed sampling because there is no guarantee that the sample is representative if groups strongly supporting, opposing, and being somewhat indifferent towards the commodity being valued are not normally distributed across the socio-economic factors that are used as sampling criteria. However, this kind of sampling bias is not likely. Both types of questionnaires (I_p and I_p+I_a) were assigned randomly to the respondents and there is no reason to assume that any actions taken by the interviewers could have caused a bias like this. This means that additional information has changed the negative initial attitude into a positive one. If the attitudinal profiles of different Clusters are examined, the most likely transition takes place between Cluster 1 and Clusters 2 and 7. The amount of additional information has not been so overwhelming that it could have caused a change in the attitude towards conventional farming, but it might have been influential enough to create a more positive attitude towards sustainable development.

Based on the frequencies of the subgroups, a possible explanation is that among those people who basically supported the views of Cluster 1 were some who had already started to question the environmental appropriateness of conventional farming. When they were offered an alternative supporting sustainable farming practices that simultaneously guaranteed the further existence of farming, these people allowed themselves to consider a new option. Because they already had more or less clearly pronounced doubts regarding conventional farming, the idea of sustainable development evoked a positive response among them when they had a chance to think about it more carefully.

Except in Cluster 1, it seems reasonable to assume that the additional information package and the change of sequence of some sections in the questionnaire did not cause any large-scale conversions in people's initial attitudes. Some pieces of information have been new to the respondents and this has had an impact, but the impact has not been big enough to make positive initial attitudes negative and vice versa. Thus, it is interesting to examine if evidence from the phenomena depicted in Table 7.7 can be found in Table 7.8.

Take Cluster 1 under a closer inspection. In Table 7.8 we can see that $WTP_p > WTP_a$, even though the difference is not statistically significant. $Var(WTP_p)$ is also greater than $Var(WTP_a)$ and the difference is statistically significant. In addition, the initial attitude towards pro-environmental farming and issues related to it are negative (see Table 7.5). Based on this knowledge, it is quite easy to recognize that option (7) in Table 7.7 corresponds the best to the profile of

Table 7.8. Cluster-Related Mean WTPs and Standard Deviations of Respondents Receiving (I_p+I_a) or Not Receiving (I_p) Additional Information.

Cluster	I_p / I_p+I_a	Number of observations	Mean WTP, FIM	Prob>|T|	Standard deviation	Prob>F
1	I_p	34	194	0.0800	393	0.0000
	I_p+I_a	19	68		90	
2	I_p	35	186	0.0055	310	0.0000
	I_p+I_a	31	556		642	
3	I_p	88	393	0.6300	476	0.6373
	I_p+I_a	87	428		500	
4	I_p	52	276	0.0900	374	0.0090
	I_p+I_a	51	169		257	
5	I_p	5	30	0.5500	67	0.0363
	I_p+I_a	6	92		225	
6	I_p	37	264	0.7900	385	0.8627
	I_p+I_a	41	287		374	
7	I_p	73	421	0.9600	463	0.2913
	I_p+I_a	83	416		523	

Cluster 1. Thus, the member of Cluster 1 agrees with I_a although he is not previously familiar with I_a. This interpretation is consistent with the ideas presented in Table 7.7, but is it consistent with the reality? The brief additional information package consisted of information that pointed out only the advantages of pro-environmental farming and maintenance of the rural environment. What kind of agreement is in question? The first impression is that the members of Cluster 1 should have disagreed with I_a because I_a clearly supported pro-environmental farming. A deeper examination of the problem reveals another possible explanation, which is more likely to be correct. Additional information was consistent with initial negative attitudes in the sense that I_a confirmed the respondents' ideas about the negative consequences that could take place if pro-environmental farming replaced conventional farming.

Cluster 2 has characteristics that are easy to identify. The initial attitude is positive, $WTP_p < WTP_a$, and the difference in means is statistically significant. $Var(WTP_p)$ is smaller than $Var(WTP_a)$ and this difference is statistically significant. Cluster 2 clearly matches the conditions of option (3) in Table 7.7. People in Cluster 2 have had a slightly positive initial attitude towards sustainable development and when they receive new additional information pointing out the advantages of pro-environmental farming and the maintenance of the rural environment their WTPs rise considerably. The behavior of the members of Cluster 2 gives evidence that very strongly supports the existence of information effects in this data set.

Cluster 3 apparently belongs to option (1), the initial attitude as well as the attitude toward I_a are positive, but there is no change in WTP or in Var(WTP) because I_a has been included in prior knowledge. Cluster 4 shares the characteristics of Cluster 1 and can be placed in option (7). However, the reasons why people in Cluster 4 feel that additional information supports their negative initial attitudes are probably different from the case of Cluster 1. The members of Cluster 1 probably reasoned that the conversion to pro-environmental farming would not guarantee the existence of agriculture as a proper line of business. On the other hand, the members of Cluster 4 might have thought that the conversion to pro-environmental farming would not change anything in respect of agricultural subsidies. Cluster 5 has features typical of option (8). The members of Cluster 5 receive I_a with mixed feelings, they cannot integrate I_a into a functional part of I_p. The benefits of pro-environmental farming cannot be totally neglected, although environmental questions do not have a high ranking on the agenda. Conflicting views create some uncertainty about the value of I_a and this is reflected through increasing variance. Cluster 6 can be situated in either category, in (5) or in (6). This does not make any difference because in both cases I_a is already included in I_p. Cluster 7 can be regarded as similar to Cluster 3 in the sense that it represents a positive initial attitude with no changes in mean WTP or in Var(WTP). Moreover, when the positive initial attitude is

taken into account, the members of Cluster 7 probably agree with I_a. Thus, Cluster 7 can be placed into option (1) in Table 7.7.

7.4. Assessment of Preferences

Attitudes can also be utilized when we investigate the nature of preferences that are likely to lie behind the expressed WTP responses. As explained in Chapters 5.3 and 5.4, it is not always straightforward to interpret the response behavior. There may be deviations from the basic assumption that all respondents duly exhibit exchange preferences, which, as noted earlier, represent the standard neoclassical preference concept relying on characteristics like continuity, reflexivity, nonsatiation, and completeness. The continuity condition means that any change in one good can be compensated for by a change in another good. This kind of substitutability becomes frequently expressed in the neoclassical value theory (Lockwood 1997).

It should be plausible to assume that if an individual has a strong positive attitude towards pro-environmental farming, he is also willing to pay for its promotion at least a small amount of money if he exhibits standard neoclassical exchange preferences. Table 7.9 lists all attitudinal Clusters and the amount of zero and positive WTP responses in respect of the information content. We can see that also in Clusters that clearly favor pro-environmental farming (Clusters 2, 3, and 7) there is a considerable number of zero responses. Spash and Hanley (1995) argue that such response behavior is an indicator of the existence of lexicographic preferences. This can partly be the case in this study, too, but there is not enough evidence to verify the exact nature of the preference structure. However, we can argue that the respondents who simultaneously favor pro-environmental farming and state zero WTP for it express preferences that are not continuously exchangeable of their nature. Thus, approximately 17% of the respondents (113 out of 658) behave in a manner that does not support the theoretical underpinnings of welfare economics in this respect.[22]

Of course, we can argue that the expressed attitudes are not valid indicators of preferences or behavior. To some extent, this is true because intentions very seldom become fully acted out. Moreover, it may be that expressed attitudes are plagued with inconsistencies in certain respects. However, responses in this case seem to be quite reliable because cross-tabulations of different answers do not reveal any major anomalies. For instance, all those respondents who favor pro-environmental farming at the attitudinal level want to convert a considerable amount of agricultural land under pro-environmental farming. In this re-

[22] We cannot reject the possibility that some of the respondents who favor pro-environmental farming and state zero WTP do so because of lack of income. However, their share is likely to be quite small.

Table 7.9. Number of Zero and Non-Zero WTP Responses across Attitudinal Clusters and Information Content.

Cluster	Information content	Responses (WTP=0)	Responses (WTP>0)	Responses (All)	Ratio of zero responses
1	No add. info	19	15	34	0.56
	Add. info	11	9	20	0.55
	All	30	24	54	0.56
2	No add. info	17	18	35	0.49
	Add. info	9	23	32	0.28
	All	26	41	67	0.39
3	No add. info	27	68	95	0.28
	Add. info	25	66	91	0.27
	All	52	134	186	0.28
4	No add. info	15	37	52	0.29
	Add. info	19	32	51	0.37
	All	34	69	103	0.33
5	No add. info	4	1	5	0.80
	Add. info	5	1	6	0.83
	All	9	2	11	0.82
6	No add. info	9	28	37	0.24
	Add. info	12	29	41	0.29
	All	21	57	78	0.27
7	No add. info	16	55	71	0.23
	Add. info	19	69	88	0.22
	All	35	124	159	0.22
All	No add. info	107	222	329	0.33
	Add. info	100	229	329	0.30
	All	207	451	658	0.31

spect, there is no difference between people stating positive WTP or zero WTP. This observation again supports the interpretation that zero WTPs are a result of a non-exchange preference structure, not a product of conflicting and inconsistent behavioral motives.

In addition, we should not completely exclude the possibility that some of the zero WTP responses are protest answers. However, it is not likely that an

individual with well-defined exchange preferences would start to protest against the presented valuation scenario or the questioning situation. There are certainly some protesting elements included in zero WTP responses, but they are most likely derived from the fact that the respondents have felt uneasy about the offered trade-off between money and environmental benefits. Thus, the protesting is still based on views that are not completely consistent with exchange preferences.

If a positive attitude towards pro-environmental farming combined with zero WTP is considered to be a suspicious phenomenon, the same can be said concerning the situation where negative attitudes towards pro-environmental farming show up simultaneously with high positive WTPs. In Table 7.10, the number of WTP responses that are greater than or equal to FIM 1,000 is presented across Clusters. It appears that 16 respondents (2.4% of the whole sample) with a negative attitude towards pro-environmental farming (from Clusters 1, 4, 5, and 6) are willing to pay FIM 1,000 or more for the promotion of pro-environmental farming, despite their views. If the critical WTP level is lowered to FIM 500, then the number of seemingly inconsistently behaving respondents is 46 (7.0%).

The explanation for this kind of response behavior is hard to find. It is difficult to imagine what kind of preferences can lead to response behavior like this. The question is probably about well-intentioned response motives. The respondents have tried to please the interviewer by expressing high WTPs despite their actual attitudes (misinterpreting response behavior). There is also a possibility of strategic behavior. The respondents belonging to Cluster 1 and thus strongly favoring conventional agriculture may have reasoned that high WTPs for pro-environmental farming simultaneously act on behalf of the survival of conventional agriculture. Some of the high WTP responses may simply

Table 7.10. Number of WTP<1000 and WTP≥1000 Responses across Attitudinal Clusters.

Cluster	Responses N (WTP<1000)	Responses N (WTP≥1000)	Responses N (all)	Ratio of WTP≥1000 responses
1	50	4	54	0.07
2	57	10	67	0.15
3	151	35	186	0.19
4	98	5	103	0.05
5	11	0	11	0.00
6	71	7	78	0.09
7	130	29	159	0.18
All	568	90	658	0.14

be products of nonchalant response motives that have led to indifferent response behavior and random responses to the WTP question.

8. Discussion: Relating the Results to the Welfare Theory

This chapter presents a concluding assessment of the usefulness and applicability of the contingent valuation method as an assisting tool in relation to policy-making. First, we must examine what the welfare analysis based on mean and median WTP figures or the derived demand function can tell about economic welfare enhancing characteristics of pro-environmental farming. Then, we have to judge how the existence of non-exchange preferences combined with the findings about the interaction between attitudes and information affect the reliability and validity of the results. Next, we must consider if the observed sources of bias and inaccuracy offer alternative approaches to interpret the application of the CVM methodology and terminology. Only after this assessment we can conclude to what extent this CVM application can be relied on as an indicator of the economic and social value of a hypothetical policy alternative.

8.1. Total WTP for Pro-Environmental Farming and Its Interpretation in the Welfare Analysis Context

The welfare analysis related to the conversion from conventional agriculture to pro-environmental farming is a complicated task. This is mainly due to two factors. Concerning both taxpayer-consumers and farmers, the conversion involves welfare effects, the net value of which is difficult to determine. In addition, the current situation may be plagued by pre-existing distortions, the exact nature of which we do not necessarily know. It is very likely that the context of agri-environmental policy-making is prone to certain market and government failures that frequently create distortions.

The conversion from conventional agriculture to pro-environmental farming would diminish farmers' profits from agricultural production because the new, lower optimal amount of chemical inputs in pro-environmental farming is likely to reduce, in the form of lower yields, sales revenues more than production costs. If producer prices rise, and thus help to compensate for the negative farm income effect due to the conversion, consumer-taxpayers will experience an adverse change in consumer surplus when the prices of agricultural products increase. The obvious conclusion is that, as far as agricultural products are considered the only source of agriculture-related benefits, the conversion from conventional agriculture to pro-environmental farming will not be socially desirable.

It should be plausible to assume that environmental net benefits from agriculture have an inverse relationship with the intensity of agricultural production. Thus, the decrease in the use of chemical inputs increases environmental benefits. This has a positive welfare effect on consumer-taxpayers[23]. Consequently, consumer-taxpayers face a trade-off due to decreasing welfare derived from agricultural products and increasing welfare derived from agriculture-related environmental benefits. In this setting, the total WTP for the conversion from conventional agriculture to pro-environmental farming (ranging from FIM 0.541 billion to FIM 2.216 billion[24]) is considered the maximum amount of money that the society can spend to implement the conversion. Thus, the society could use a sum of money up to the total WTP amount to compensate farmers for their farm income losses.

In the preceding analysis we assumed the existence of a market failure that prevents the market from including the value of environmental net benefits in agricultural product prices. This is no doubt a relevant starting point, because many agriculture-related environmental benefits possess characteristics of public good type. In the sense, the market failure concerning the market's inadequate ability to price environmental public goods is a pre-existing distortion affecting the interpretation of welfare changes. Furthermore, in order to make the analysis of welfare effects related to the total WTP for the conversion more realistic, we have to consider the possibility of other pre-existing distortions.

At the time when the survey was conducted, Finnish agriculture was more heavily subsidized than currently, and the magnitude of agricultural support continuously criticized in the public. Thus, agricultural support represented another source of a pre-existing distortion, probably due to a government failure in agricultural policy design. Taking this into account, it is likely that part of the respondents considered that the major advantage of pro-environmental farming would be its ability to cut down agricultural support. From the viewpoint of welfare analysis this is not problematic as such, because the motives of valuation are irrelevant as long as they do not affect the validity of reliability of the welfare measure. However, the situation becomes somewhat different, if there is reason to doubt that people's WTP responses do not reflect valuations in the sense that is presupposed in the welfare change analysis.

The respondents (almost one third of all respondents) who expressed zero willingness to pay are the most critical group when the welfare effects are concerned. It is quite possible that certain respondents felt that the conversion

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[23] Of course, farmers also benefit from higher environmental quality but in order to simplify the analysis, it is reasonable to assume that farmers' welfare is determined by the profit function.

[24] The magnitude of the total WTP depends on the chosen estimate. The lowest average WTP was FIM 150 (median WTP in BG-PC) and the highest average WTP was FIM 615 (mean WTP in non-parametric model 0..*A*+500). The target population was 3,603,852.

from conventional agriculture to pro-environmental farming would have diminished their welfare. This applies especially to Cluster 1, which represents people who prefer conventional agriculture and consider it superior to pro-environmental farming[25]. We cannot rule out the possibility that the zero WTP respondents in Cluster 1 would even have expressed negative willingness to pay if this had been allowed.

The respondents in Clusters 4, 5, and 6, in turn, represent the view that agriculture and especially conventional agriculture is a source of social welfare loss. They consider any increase in the public financing of agriculture undesirable from the viewpoint of consumer-taxpayers. However, they are not critical towards pro-environmental farming as such, they only see its impact to be insignificant regarding the most central issue, which is the income transfer from consumer-taxpayers to farmers in the form of too excessive agricultural support. Nevertheless, whatever the arguments behind the opposition towards the conversion from conventional agriculture to pro-environmental farming are, they may act as a source of negative willingness to pay.

In addition, as noted before, the critical question is whether people would still be willing to pay the amount that they have stated if they recognized that pro-environmental farming practices would be carried out in a larger or smaller magnitude than they have considered to be appropriate and essential. Consider a situation where a respondent is willing to pay a certain amount for a complete conversion of agricultural land from conventional agriculture to pro-environmental farming. Then the respondent is told that the actual policy proposal, which has been chosen to be implemented, will only convert one quarter of agricultural land to pro-environmental farming. In this case, it is more than likely that when the conversion scale diminishes, the respondent also wants to reduce his willingness to pay for the conversion. This is consistent economic behavior, because people usually pay less if they receive less.

It may even be possible that the increase of the conversion scale diminishes the initial willingness to pay, although this argument seems to contradict with the standard presumption stating that people are willing to receive more of a commodity if their total expenses for doing so do not increase. In this respect, it would be consistent to assume that a respondent who is willing to pay a certain amount for the conversion of one quarter of agricultural land from conventional agriculture to pro-environmental farming would not mind a more extensive conversion if he was guaranteed that the complete conversion could take place without any additional costs. However, we also have to consider the possibility that the one-quarter conversion of agricultural land to pro-environmental farming is a different commodity from the complete conversion to pro-environmen-

[25] We have to keep in mind that a considerable number of respondents in Cluster 1 were farmers. They might have had a strategic motive to underestimate their WTP.

tal farming. Thus, the increase of the acreage under conversion is not necessarily more of the same commodity, but another commodity. Consequently, it is not possible to be sure that a respondent stating certain WTP for the one-quarter conversion to pro-environmental farming would express as high WTP for the complete conversion. This reasoning indicates that the total willingness to pay for the conversion from conventional agriculture to pro-environmental farming estimated in this study can, at its best, be the upper bound for the total WTP.

The estimate for the total WTP for the conversion from conventional agriculture to pro-environmental farming is, however, policy relevant, because it shows the magnitude of welfare increase that could be gained if an optimal conversion policy could be designed. Unfortunately, this is not possible because of the public good nature of the benefits that pro-environmental farming provides. It dictates that as long as the production of the benefits due to pro-environmental farming is financed by using income transfers based on public tax revenues, also those who would prefer a lower-than-current level of provision have to contribute their share of provision costs of the current level. And vice versa, those who feel that the current level of provision is inadequate cannot exclude themselves from cost-sharing.

It seems that because of the number of possible interpretations related to the results we should not derive any unambiguous conclusions concerning the welfare effects of the implementation of pro-environmental farming. Although a clear majority of respondents expressed a positive WTP in relation to the conversion scheme, we must still be careful when we interpret the total WTP as the indicator of social desirability of the conversion from conventional agriculture to pro-environmental farming. The possible existence of non-quantified negative willingness to pay creates a serious assessment problem. If we assume that the respondents are capable of fully informed decisions related to their stated WTP, then we also have to admit that the large number of zero responses is a sign of dislike or at least disinterest towards pro-environmental farming.

It may be that the possibility of negative WTP is correlated with the details of policy implementation. If the conversion from conventional agriculture to pro-environmental farming is carried out in such a way that farmers' rights to choose their production techniques will not be threatened, and the conversion will not be a source of ever-increasing agricultural subsidies, the possibility of negative willingness to pay will probably diminish considerably. It is not likely that anybody would oppose agriculture-related environmental benefits due to pro-environmental farming as such if the policy measures to be implemented are designed to take into account the reservations that some groups may have regarding the related agricultural policy aspects.

Nevertheless, keeping all the listed reservations in mind, it is probably justified to argue that the estimated total WTP (FIM 0.541 - 2.216 billion) for the conversion from conventional agriculture to pro-environmental farming can

be interpreted as the maximum amount of money which the society could spend for the socially acceptable compensations to farmers for their losses of farm income, if the conversion from conventional agriculture to pro-environmental farming occurred.

8.2. Preferences, Attitudes, Information, and Validity of the Results

The use of money metric measures of welfare change is based on certain assumptions of the nature of people's preferences. If we want to aggregate individual WTPs, we must assume that people express their preferences in a continuous manner. If this holds, it makes sense to claim that people reveal their preferences in a reliable way in a hypothetical transaction situation where they are asked to trade environmental quality for money. We can say that people exhibit exchange preferences. Another essential preference issue is stability, which is important especially from the policy-making point of view. If preferences were not stable, it would be problematic to use them for decision-making purposes. Furthermore, the validity of WTP measures depends on response motives and respondents' ability to perceive correctly the different elements of the valuation instrument. As noted above, a respondent may conceal his true preferences and express goal-oriented response motives in order to pursue aims not intended by the researcher. Moreover, even in a case where a respondent has well-intentioned response motives, he may fail to cooperate with the researcher as expected because of cognitive shortcomings.

The empirical findings of this study seem to suggest that it is an oversimplified view to assume that all respondents have preferences that follow the idea of continuous substitutability between monetary units and the good being valued. A significant number of the respondents (17%) had a positive attitude towards pro-environmental farming, although they simultaneously expressed zero willingness to pay for it. If we assume that the respondents had well-intentioned response motives and that they perceived the valuation scenario as intended, it seems peculiar that the positive attitude towards the good being valued does not produce a positive WTP. Although there are a number of possible explanations, we should not rule out the prospect that zero responses are produced by a preference structure that deviates from exchange preferences. The possible preference-related explanations cover noncompensatory and weakly comparable preferences.

The problem is that the empirical data is not detailed enough to make it possible to separate respondents with noncompensatory (lexicographic) preferences from respondents with weakly comparable preferences. This would be interesting from the theoretical point of view because the validity of valuation methods based on value commensurability becomes more seriously challenged if we accept that a considerable number of people exhibit weakly comparable

preferences. Noncompensatory preferences as such are not in a conflict with the idea of monetary valuation because people with noncompensatory preferences are able to produce a value ranking between different alternatives such that one alternative can be said to be better than another. Thus, the transitivity of choices is not threatened. The situation changes considerably when weakly comparable preferences become the prevailing ones. The complexity of the choice context makes it possible that even if A is preferred to B and B is preferred to C, C can still be preferred to A. As a consequence, transitivity no longer holds. An outside observer is not able to produce a consistent ranking across different alternatives, which makes it difficult to provide coherent policy recommendations.

Of course, zero responses can also be explained without assuming non-exchange preferences. First, a respondent expressing zero WTP and having a positive attitude towards pro-environmental farming may exhibit goal-oriented response motives. He anticipates that other respondents will state WTP amounts that are high enough to guarantee a sufficient magnitude of pro-environmental farming. However, the existence of strategic behavior of this kind is questionable. As noted earlier, strategic behavior is very seldom detected in CVM applications, and it is not very plausible that respondents would try to free-ride when the expected utility due to truthful preference revelation is considerably larger than the required contribution. Nevertheless, the introduction of a more reliable test for the detection of possible free-riding behavior would require an analysis of the psychological profiles of the respondents. We can reason that the more risk-averse person is in question, the less inclined he is to attempt to free-ride because there is always the risk that after a certain point excessive free-riding would prevent pro-environmental farming from taking place. This would completely obliterate the benefits due to pro-environmental farming.

The second possibility is that some of the zero respondents with a positive attitude towards pro-environmental farming consider that they already contribute enough in the form of existing agricultural subsidies. Although they strongly prefer pro-environmental farming, they still feel that the conversion should be carried out by reallocating agricultural support. If this is the motive behind zero WTP, we cannot prove that these respondents possess other than exchange type preferences. However, because the valuation scenario did not explicitly spell out the role of agricultural subsidies in respect of different agricultural policy actions and their financing, it is probably safe to assume that only some of the zero respondents would have been able to see the connection between agricultural support and taxes that they pay.

The third possibility is that the respondents have exchange preferences and express well-intentioned response motives but fail to perceive correctly the valuation instrument. The result would be, at least from the researcher's point of view, irrational behavior. Unfortunately, it is not possible to analyze the re-

spondents' answers in detail in this respect. However, the examination of the answers of the respondents who had a negative attitude towards pro-environmental farming but who expressed high WTP seems to suggest that the number of "irrational" answers is not that significant. The same probably applies to the group of zero respondents. Thus, the conclusion is that most respondents perceived the elements of the valuation instrument reasonably well and were able to answer the questions without major cognitive problems.

When the stability of preferences in relation to additional information is considered, two somewhat different issues must be addressed. First, additional information may change the intensity of preferences. In this case the basic nature of the relationship between the initial attitude and the good being valued does not alter. However, the change of preference intensity becomes reflected in terms of the expressed WTP. If the additional information reinforces the initial positive attitude, it is likely that individual WTP increases. This phenomenon was observed in Cluster 2, where the mean WTP rose considerably (from FIM 186 to FIM 556) when additional information was provided to the respondents. The difference between the mean WTPs was also statistically highly significant ($t = 0.0055$). A similar but opposite phenomenon took place in Clusters 1 and 4, where the provision of additional information reduced the mean WTP. In this case the difference between the mean WTPs was not statistically significant but clearly indicative ($t = 0.08$ and $t = 0.09$, respectively). Based on these examples, which are also supported by theoretical arguments, we can claim that the information content of a CVM survey correlates with stated WTPs if the attitudinal profiles of the respondents are of a certain type.

Second, additional information may cause a fundamental change in the initial attitude towards the good being valued. This is a more serious implication because in this case the stability of preferences becomes highly questionable. A change in preference intensity can be regarded as a minor source of bias, but a change from a negative initial attitude to a positive initial attitude or vice versa can be considered a major indicator of preference instability. The empirical evidence of the existence of this kind of phenomenon is not completely convincing in this survey, but some signs were detected. In other clusters except in Cluster 1 the number of respondents receiving and not-receiving additional information was almost equal. Because the same number of questionnaires of both types were assigned to the respondents, it is likely that in every attitudinal cluster there should be an equal number of them if additional information has not affected the initial attitudes of the respondents. Since this is not the case in Cluster 1, we can conclude that additional information has been influential enough to change the initial attitudes of some of the respondents who otherwise would have belonged to Cluster 1. It seems plausible that the introduction of additional information has made some respondents move from Cluster 1 espe-

cially to Cluster 7, where there is a slight surplus of the respondents who have received additional information.

Considering the empirical evidence presented in this study, we seem to have some reason to question the exchangeable nature of preferences that is implicitly assumed to hold when money metric measures of welfare change are applied. On the other hand, we have to take into account that the prevailing view among CVM researchers is that, by means of appropriate survey design, distorting information effects can be eliminated. However, sensitivity to the information provided does not explain all the observed peculiarities. There is evidence, although somewhat preliminary, that a considerable number of respondents has expressed preferences that are non-exchangeable in their nature. This observation is of great importance because it indicates that money metric measures of welfare change may have a more restricted domain of application than traditionally believed. From the policy-making point of view this is also a highly relevant conclusion because the Kaldor-Hicks compensation principle loses part of its qualification as a social decision-making criterion.

8.3. Possible Policy Recommendations

When the social decision-making process is in question, it is never possible to produce unanimously approved policy recommendations. Because the ranking of distinct social states is a normative procedure involving subjective value judgments, it is apparent that for each set of value judgments adopted a different social ordering results. Thus, there is no objectively unique way to order social states, indicating that there is no decision-making criterion, either, that could be considered the most preferable. Consequently, any method that aims to assist social decision-making should be assessed by analyzing its inherent value postulates.

In real-life social decision-making situations a valuation method can serve its purpose, despite some shortcomings found in its theoretical and methodological validity and reliability. Thus, as long as the context-dependence and observed inadequacies are properly taken into account, CVM results can be utilized to the extent that seems to be expedient. The fact is that market-based solutions or referendum-like direct democratic processes cannot always be applied when decisions are made about the allocation of environment-related resources. There will always be a social necessity for methods that somehow reveal and mediate people's preferences. In this respect the CVM can be employed if its limitations are not forgotten and its inherent value judgments are treated with appropriate thought.

As we have noted previously, the total WTP for the conversion from conventional agriculture to pro-environmental farming ranges from FIM 0.541 - 2.216 billion depending on the chosen estimate for the average WTP. Currently, in

1999, the annual expenses of the Finnish agri-environmental program (FAEP), which is aimed to enhance the environmental quality of agriculture, are around FIM 1.7 billion. The equivalence is significant. It would be tempting to argue that the result shows that the Finnish agri-environmental program represents a high level of social desirability. However, the equivalence between the total willingness to pay for pro-environmental farming and the expenses of the FAEP is more or less a coincidence. The pre-existing distortions combined with certain interpretation problems of the WTP results indicate that the social desirability of the conversion from conventional agriculture to pro-environmental farming cannot be proved in a conclusive manner.

In cases where economic and social implications of the prevailing institutional system are complicated, it is not possible to design valuation instruments that could take into account all the relevant aspects related to the proposed institutional changes. Especially when a valuation instrument includes a major change in property rights or in some other central social or economic institutions, the results should be interpreted with great care. Apparently, the choice of the WTP approach in this case implicitly indicates that farmers are perceived to own the rural environment and they have to be paid by non-farmers if the latter ones want to enjoy higher environmental quality produced by pro-environmental farming. It is quite natural if some of the respondents regard this kind of distribution of property rights as unacceptable.

The accuracy of the average WTP estimates can also be challenged on other grounds. We have to doubt the respondents' ability to make elaborate benefit and cost calculations when they are interviewed. Some people may have an idea of how much they spend on agricultural products, but only very few people can judge what their share of the tax money used to finance agricultural support is. The same reasoning applies to agriculture-related benefits. Most people perceive the advantages of domestic food production and appreciate agricultural landscape, but the evaluation of changes that take place at the ecosystem level is much more difficult. The respondents should be extremely knowledgeable and well-informed in order to be able to assess all the relevant benefits and costs that are related to a major change in agricultural or environmental policy.

However, despite these shortcomings, the CVM can provide useful information. Consider the valuation exercise at hand. The valuation situation related to the conversion from conventional agriculture to pro-environmental farming is very complicated because of its physical extent, conceptual complexity, and institutional peculiarity. There are not too many alternatives to communicate this kind of valuation situation to people whose preferences are being examined. Compared to most other methods based on the revelation of people's preferences, the CVM excels due to its wide applicability. Hypothetical markets can be created anywhere. In principle, there are no geographical or conceptual

limits. Thus, very complicated valuation situations can be described by using the CVM framework. This is clearly an advantage.

Nevertheless, considering the complexity of the whole valuation framework regarding pro-environmental farming and the rural environment, it is obvious that the respondents' WTP answers reflect more general perceptions related to environmental and agricultural issues than a careful analysis of the likely welfare effects of the proposed agricultural policy measure. This perception is also indirectly supported by the observed influence of additional information. If the respondent's initial attitude towards a policy measure being valued was positive, then the piece of additional information had a significant increasing impact on the respondent's WTP. Furthermore, the same information was neglected if the respondent's general attitude towards the object of valuation was negative. This indicates that the respondents' preferences are not so well-developed that they could be accurately reflected at the societal level in the form of money metric measures of welfare change.

Thus, we argue that the information related to the attitudinal profiles of the respondents, impact of additional information, and information on preference structures of the respondents may be more useful than the individual willingness to pay measures. If almost two-thirds of the respondents have a positive attitude towards the conversion from conventional agriculture to pro-environmental farming, it is a clear signal to agricultural policy-makers independent of the recorded magnitudes of individual WTPs. In this respect, the current development induced by the Finnish agri-environmental program and especially its supplementary protection scheme, which has led to a rapid increase of agricultural land under organic farming, certainly seems socially acceptable and desirable.

Furthermore, if we accept that preferences related to pro-environmental farming and maintenance of the rural environment can be in some cases non-exchangeable of their nature, agricultural and environmental policy measures should be designed in a manner that pays more attention to ethical viewpoints and property rights as an essential part of people's valuation process. The money-based thinking that has promoted monetary valuation approaches needs to be extended to cover aspects that cannot and should not be made commensurable in monetary units. The CVM also has a role in this framework, but it cannot be regarded as the only source of value determination.

In this respect, it seems that the major future research challenge for the CVM will somehow be related to the nature of people's preferences. The nature of preferences dictates the theoretical validity of money metric measures of welfare change. It would be useful to examine in different monetary valuation contexts to what extent, if any, people express preferences of non-exchangeable nature. Especially, an attempt should be made to empirically distinguish between respondents with noncompensatory and weakly comparable preferences. The nature of preferences will also be reflected in policy recommendations

derived from WTP responses. It would be a step forward if such valuation scenarios were developed which could cope with pre-existing distortions and conceptually incorporate negative willingness to pay into the valuation framework.

All in all, considering the methodological difficulties and the complexity of agricultural policy context in relation to the CVM results presented, we have to conclude that this study could not unambiguously prove the social desirability of the conversion from conventional agriculture to pro-environmental farming. However, this study hopefully succeeded in showing the true nature of preferences, attitudes, and valuations that the Finns have towards the rural environment and its maintenance through pro-environmental farming. This is no doubt useful background information when agri-environmental policy decisions are being made in the future.

9. Summary

The overall purpose of this study was to investigate the applicability of the contingent valuation method, in particular, and monetary valuation in general, in a situation where the CVM is used to elicit a monetary value of the conversion from conventional agriculture to pro-environmental farming for the social policy-making purposes. In more specific terms, this study aimed to assess, based on the average WTP estimates and taking into account both the limitations set by the policy-making context and the implications of the survey findings and design, what can be said about the social desirability of the conversion from conventional agriculture to pro-environmental farming.

At the empirical level, the study had two objectives. First, the reliability of the willingness to pay results, i.e. their consistency and repeatability, was analyzed. The task was carried out by using different elicitation formats, theoretical models, and statistical estimation techniques in the estimation of the average WTP figures. This helped to assess how robust and logically behaving the means and medians derived from people's WTP responses were. Second, the validity of the CVM results, i.e. their ability to reveal people's "true" preferences, was examined. The focus was on the commensurability of preferences, influence of attitudes, and the effect of additional information.

The motivation behind the study is related to the change in agricultural policies that has taken place in Finland, as well as in other EU countries, during the past two decades. Problems with the surplus of agricultural products combined with emerged adverse environmental impacts due to agriculture have made it clear that agricultural production influences the social welfare considerably, creating undesirable side-effects that should somehow be eliminated. The recognition of this fact has led governments to design agricultural policy meas-

ures which pay attention to the importance of the joint production of foodstuffs and agriculture-related environmental public goods. The dilemma is that the environmental benefits of the public good type are not necessarily reflected in the prices of agricultural products. This is why we need a method that can attach a monetary value to the non-priced environmental amenities, too. By doing this, i.e. by giving them certain commensurability in respect of market goods, we make them visible to the market place and other social institutions. The CVM can accomplish this, at least to some extent. It can convey information that is required in the social decision-making process when the decisions are made about desirable agricultural production practices and the overall development of the rural environment.

In order to frame the social decision-making context, a theoretical model was developed to derive the basic social design of pro-environmental farming when, in addition to conventional input choice, the aspects of agriculture-supporting ecosystem, rural public goods and externalities are included in the social welfare maximization problem consisting of the sum of consumers' and producers' surpluses in relation to the conversion from conventional agriculture to pro-environmental farming. Based on this, pro-environmental farming was argued to be an agricultural production alternative that maintains and enhances the ecological and environmental quality of the rural environment. Conceptually, this definition means that pro-environmental farming is considered an agricultural production practice that creates positive externalities in the form of enhanced environmental quality. The problem is, however, that the rural environment consists of so many elements, visible or invisible, concrete or abstract, human-originated or natural, that people may have difficulties to perceive all the dimensions which are relevant to the valuation. In essence, people may not correctly understand what they are asked to value. This possibility of miscomprehension is one source of bias that is always present in CVM studies.

The contingent valuation method also has some significant advantages. The CVM involves the use of sample surveys or questionnaires to elicit the respondents' willingness to pay for commodities, projects, or programs that are generally hypothetical of their nature. In other words, the CVM creates a contingent market that imitates the real market place. Clearly, the appeal of the contingent valuation method was in its hypothetical nature, which gives a wide applicability in relation to the valuation of somewhat unlikely policy proposals. In this case, the CVM made it possible to contrast conventional agriculture and pro-environmental farming and, consequently, value the hypothetical conversion from the former to the latter. Nevertheless, we have to remember that the hypothetical nature of the valuation situation can sometimes also be a problem. If the respondents consider the valuation scenario presented too hypothetical, they may give WTP answers that do not appropriately reflect their preferences.

Moreover, the CVM has another very useful quality. When we are making an attempt to value environmental goods, we very often have to cope with values that are not necessarily related to the use of these goods. In other words, people can have nonuse values that are motivated, for instance, by intergenerational fairness, intragenerational altruism, or the intrinsic value of the nature. Monetary valuation methods that are based on revealed preferences, like the travel cost and hedonic price methods, cannot necessarily take nonuse values into account. Because of the public good nature of environmental goods, the joint consumption of the market good and the environmental good can be an inferior indicator of the total economic value of the environmental good in question.

The third advantage of the CVM is that the monetary estimates that it produces represent theoretically correct money metric measures of welfare change. In this sense, the use of the CVM is more preferable than, for instance, the use of market value approaches or methods relying on expert knowledge. This quality combined with the two other qualities, the wide applicability due to hypothetical market construction and the ability to include nonuse values, have proved to be of great importance when decision-makers have been provided information on the possible costs and benefits of a project with major environmental consequences. Thus, the rapid increase of the popularity of the CVM is at least to some extent due to its applicability in the benefit-cost analysis framework.

The data needed in the empirical analysis of willingness to pay were acquired by using face-to-face interviews. A sample of 671 respondents was chosen from the target population of 3,603,000 Finnish people between 16 and 69 years of age. The sampling method applied was a combination of stratified and clustered sampling techniques. In the interview the respondents were asked how large a proportion of the agricultural land should be converted from conventional agriculture to pro-environmental farming. Then, the respondents were asked the actual WTP question, which inquired their willingness to pay for the conversion in the magnitude that they had stated in the previous question. Three different starting point bids, FIM 100 (ca. USD 20), FIM 500 (ca. USD 100), and FIM 1,300 (ca. USD 260), were used, and the primary elicitation method applied was a combination of a bidding game and payment cards (BG-PC). In addition to the BG-PC elicitation method, the dichotomous choice elicitation format based on a bidding vector consisting of the starting point bids was constructed. The questionnaires were also differentiated in respect of the information content, half of the questionnaires providing more information than the other half. In addition, questions revealing attitudes and socio-economic background variables were asked.

The first empirical objective, the analysis of the reliability of the average WTP results, was carried out by using both the BG-PC and the dichotomous choice elicitation approaches. Related to the BG-PC, it was tested whether the

starting bid and the information content affected the stated WTP. It was found out that the starting point bias was present, but the information content did not have a statistically significant effect. Concerning the dichotomous choice, three different model specifications were used. A random utility model with the logit specification acting as the cumulative distribution function was developed. In addition, a simple spike model was constructed, and a non-parametric estimation technique based on the dichotomous choice data was also applied.

There was some variation in the average figures depending on the chosen elicitation method or model specification. Mean WTP for the whole sample extended from FIM 290 to FIM 615, and median WTP for the whole sample ranged from FIM 150 to FIM 379. However, it is a matter of judgment if the observed variation in mean and median WTPs is considered to reduce the reliability of the results from the policy-making perspective. Despite some minor statistical peculiarities in certain estimation procedures, we were able to conclude that all the elicitation techniques and model specifications applied seemed to be reliable enough when the mean or median WTPs for the whole sample were concerned. The observed variation in the average figures was due to different presumptions behind the alternative models, not inadequate reliability of the contingent valuation method as such.

The second empirical objective, the examination of the validity of the CVM results, was carried out by analyzing response behavior in relation to preferences and the effects of the interplay between information and attitudes. A conceptual model including response behavior and response motives was developed. Five main categories of response behavior, i.e. strategic behavior, misinterpreting behavior, indifferent behavior, protest behavior, and expected behavior, were singled out. They were considered to be based on goal-oriented, nonchalant, and/or well-intentioned response motives. A goal-oriented response motive means that a respondent is willing to promote his own interests instead of acting according to the wishes of the researcher. A nonchalant response motive indicates that a respondent is not interested in engaging in the questioning situation at all. A well-intentioned response motive implies that a respondent is willing to act according to the wishes of the researcher, but there is no guarantee that the respondent perceives the researcher's goals correctly.

The most desired type of behavior is expected behavior. A respondent behaving expectedly perceives the valuation instrument correctly and is ready to express his actual willingness to pay and other relevant preferences without any hidden agenda. A respondent behaving misinterpretingly exhibits well-intentioned response motives, but he fails at least partly to understand certain essential characteristics of the valuation instrument. Therefore, the stated individual WTP can be misleading. Strategic behavior means that the respondent has a clear idea of how he should behave in a survey situation in order to benefit from the survey outcome as much as possible. His response motive is thus goal-oriented,

i.e. the respondent intentionally misrepresents his preferences. In the case of indifferent behavior, the respondent does not really want to consider the valuation scenario presented, and that is why he gives nearly random responses in order to get through the survey with minimum effort.

The fifth mode, protest behavior, is the most complex form of response behavior. In its extreme, protest behavior means that the respondent refuses to participate in the valuation situation in any manner. By doing this, the respondent does not attempt to mislead the researcher by misrepresenting his preferences, but he merely signals that his preferences are not compatible with the valuation scenario introduced by the researcher. This is usually due to two reasons. First, the respondent is not satisfied with the property rights that are related to the good being valued, the provision structure, or the payment vehicle in the valuation scenario. Second, the respondent may oppose the whole idea of making a trade-off between money and an environmental public good.

Thus, meaningful response behavior can be based on three types of preference expressions: weakly comparable, noncompensatory, and exchangeable. Weakly comparable preferences indicate that an individual can choose between different alternatives, although he is not able to produce a general ranking across them. If preferences are noncompensatory or exchangeable, they are always strongly comparable, assuming that different alternatives can be completely ranked based on their value. An individual with noncompensatory preferences can produce a value ranking of the alternatives such that one alternative can be said to be better than another, even though the individual is unwilling to make a trade-off between the alternatives. Exchangeable preferences represent the standard economic notion of preferences. Both weakly comparable and noncompensatory preferences clearly challenge the applicability of the CVM or any other monetary valuation method.

In order to assist the identification of non-exchangeable preference based response behavior and the possible interplay between additional information and attitudes, an analysis of the respondent's attitudes was carried out by means of the factor and cluster analyses. The factorization was based on the responses to attitudinal claims that were presented in the questionnaire. Three factors were extracted. They represented attitudes towards both agricultural and environmental issues. Factor 1 described an attitudinal dimension that considered the adverse environmental impacts due to conventional agriculture the most severe agriculture-related problem in Finland. Factor 2 presented an attitudinal dimension the core of which was dislike towards agriculture because of agricultural subsidies. Factor 3 expressed a more holistic attitudinal dimension, the major concern of which was the environmental damage that may already have been caused and which thus has reduced the welfare of future generations.

Utilizing the factor scores that each respondent received in the three factors, the respondents were divided into seven attitudinal groups through the cluster

analysis. Cluster 1 consists of the respondents who prefer conventional agricultural practices. Cluster 2 includes the respondents who have a positive attitude towards agriculture in general. Cluster 3 represents the respondents who demand a change in current farming practices and are ready to pay for it. The respondents in Cluster 4 have a critical attitude towards conventional farming because of economic reasons, but they are not worried about sustainable development. Cluster 5 portrays the respondents whose attitudes towards agriculture are solely motivated by their opposition of agricultural subsidies. Cluster 6 contains the respondents whose attitudes towards agriculture are to a great extent motivated by their opposition of agricultural subsidies, although their opposition is not on the grounds of firm principles. The respondents in Cluster 7 express slight concern about adverse environmental effects of agriculture, understand the importance of sustainable development, and are ready to approve of agricultural subsidies in order to guarantee domestic food supply and the maintenance of the countryside.

When the effect of additional information was tested by using a simple comparison of the mean WTPs of the two questionnaire types with differing information content, the difference between the mean WTPs did not appear to be statistically significant ($t = 0.0719$), even though the mean WTPs deviated considerably (FIM 357 without I_a versus FIM 446 with I_a). The situation changed when the effect of additional information was tested inside the attitudinal clusters. In Cluster 2, the mean WTP rose considerably (from FIM 186 to FIM 556) when additional information was provided to the respondents. The difference between the mean WTPs was also statistically highly significant ($t = 0.0055$). The conclusion was that the provision of the additional information can raise the stated WTPs if the attitudinal profile of the respondents is of a certain kind, i.e. they have a positive initial attitude towards the good being valued, and the additional information provided reinforces their initial attitude, being simultaneously relatively "new" to them. There was also some evidence that a negative initial attitude towards the good being valued combined with the additional information conflicting with the initial attitude could result in a decrease in the mean WTP. However, this evidence was not conclusive in terms of statistical significance.

The information on the respondent's attitudes was utilized further when the nature of their preferences was examined. A significant number of the respondents (17%) had a positive attitude towards pro-environmental farming, although they simultaneously expressed zero willingness to pay for it. If we assume that the respondents had well-intentioned response motives and that they perceived the valuation scenario as intended, it seems peculiar that the positive attitude towards the good being valued does not produce a positive WTP. Thus, it is reasonable to believe that non-exchangeable preferences (probably both noncompensatory and weakly comparable preferences) were represented among

the respondents. From the policy-making point of view, this is a highly relevant conclusion because the Kaldor-Hicks compensation principle loses part of its justification as a desirable social decision-making criterion.

The average WTP results were also used in the welfare change analysis that aimed to assess whether the conversion from conventional agriculture to pro-environmental farming can be considered a socially desirable policy action. The conclusion was that if certain reservations related to the possible existence of negative WTP and the design of the survey are properly taken into account, it is justified to argue that the estimated total WTP (FIM 0.541 - 2.216 billion depending on the chosen estimate for the average WTP) for the conversion from conventional agriculture to pro-environmental farming can be interpreted as the maximum amount of money which the society can spend for the socially acceptable income transfers in order to make the conversion happen.

Finally, some conclusions were derived concerning agricultural policy-making in relation to the possible conversion from conventional agriculture to pro-environmental farming. An interesting equality in magnitude was detected between the total WTP estimated in this study and the annual expenses of the Finnish agri-environmental program. Even though this match was considered more a coincidence than a sign of intuitively successful agricultural policy-making, it should not be forgotten that two-thirds of the respondents in this study expressed a positive willingness to pay for the conversion from conventional agriculture to pro-environmental farming. It is a clear indicator that the public supports the maintenance of the rural environment and environmentally-friendly agricultural production practices. In this respect, the current development induced by the Finnish agri-environmental program and especially its supplementary protection scheme, which has led to a rapid increase of agricultural land under organic farming, seems well-grounded.

Although it was not possible to make a final and conclusive assessment about the acceptability, applicability, and feasibility of the contingent valuation method as the indicator of the socially most desirable policy development, the monetary valuation of the conversion from conventional agriculture to pro-environmental farming appeared to provide essential information on people's willingness to pay, attitudes, and preferences in relation to the rural environment and environmentally-friendly production practices. Its usability for the purposes of agri-environmental policy-making remains to be seen.

References

Ajzen, I. & Fishbein, M. 1977. Attitude-Behaviour Relations: A Theoretical Analysis and Review of Empirical Research. Psychological Bulletin 84(59): 888-918.

Ajzen, I., Brown, T.C. & Rosenthal, L.H. 1996. Information Bias in Contingent Valuation: Effects of Personal Relevance, Quality of Information, and Motivational Orientation. Journal of Environmental Economics and Management 30(1): 43-57.

Andreoni, J. 1990. Impure Altruism and Donation to Public Goods: A Theory of Warm Glow Giving. Economic Journal 100: 464-477.

Arrow, K.J. & Fisher, A.C. 1974. Environmental Preservation, Uncertainty, and Irreversibility. Quarterly Journal of Economics 88: 312-319.

Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Radner, R. & Schuman, H. 1993. Report from the NOAA Panel on Contingent Valuation. Federal Register. Vol. 58(10): 4602-4614.

Ayer, M., Brunk, H.D., Ewing, G.M. & Silverman, E. 1955. An Empirical Distribution Function for Sampling with Incomplete Information. Annals of Mathematical Statistics 26: 641-647.

Bateman, I.J. & Turner, R.K. 1992. Evaluation of Environment: The Contingent Valuation Method. CSERGE GEC working paper 92-18. University of East Anglia, Norwich and University Collage, London.

Bateman, I.J., Langford, I.H., Turner, R.K., Willis, K.G. & Garrod, G.D. 1995. Elicitation and truncation effects in contingent valuation studies. Ecological Economics 12(2): 161-179.

Bergstrom, J.C. 1990. Concepts and Measures of the Economic Value of Environmental Quality: a Review. Journal of Environmental Management 31: 215-228.

Bergstrom, J.C., Stoll, J. & Randall, A. 1990. The Impact of Information on Environmental Commodity Valuation Decisions. American Journal of Agricultural Economics 72(3): 615-621.

Bergstrom, J.C., Dillman, B.L. & Stoll, J.R. 1985. Public Enviromental Amenity Benefits of Private Land: The Case of Prime Agricultural Land. Southern Journal of Agricultural Economics 17(1): 139-149.

Bernstein, I.H., Garbin, C.P. & Teng, G.K. 1987. Applied Multivariate Analysis. Springer-Verlag Inc., New York, U.S.A.

Binning, C., Carter, M., Mackie, K., Matthews, N., McGlynn, G., McVay, P., Palmer, D., Scoccimarro, M., Wilks, L., Sinden, J. & James, D. 1997. Techniques to Value Environmental Resources: an Introductory Handbook. Commonwealth Department of the Environment, Sport and Territories, the Commonwealth Department of Finance, and the Resource Assessment Commis-

sion. Available: http://www.erin.gov.au/portfolio/esd/handbook/valuatn.html#1.

Bishop, R.C. & Welsh, M.P. 1992. Existence Values in Benefit-Cost Analysis and Damage Assessment. Land Economics 68(4): 405-417.

Bishop, R.C. & Heberlein, T.A. 1979. Measuring Values of Extra Market Goods: Are Indirect Measures Biased? American Journal of Agricultural Economics 61(5): 926-930.

Blackburn, M., Harrison, G.W. & Rutström, E.E. 1994. Statistical Bias Functions and Informative Hypothetical Surveys. American Journal of Agricultural Economics 76(12): 1084-1088.

Blamey, R.K. & Common, M. 1992. Sustainability and the Limits to Pseudo Market Valuation. In: Lockwood, M. & DeLacy, T. (eds.). Valuing Natural Areas: Applications and Problems of the Contingent Valuation Method. Johnstone Centre, Charles Sturt University, Albury, Australia. p. 117-146.

Boadway, R.W. & Bruce, N. 1986. Welfare Economics. Basil Blackwell Ltd, Oxford, Great Britain.

Bostedt, G. & Boman, M. 1995. Respondents and nonrespondents in contingent valuation surveys - reducing uncertainty in value inference. In: Bostedt, G. Benefits of amenities in the forest environment: Four papers based on contingent valuation. Report No. 110. Department of Forest Economics, Swedish University of Agricultural Sciences, Umeå, Sweden.

Bowker, J.M. & Stoll, J.R. 1988. Use of Dichotomous Choice Nonmarket Methods to Value the Whooping Crane Resource. American Journal of Agricultural Economics 70(2): 372-381.

Boyle, K.J. 1989. Commodity Specification and the Framing of Contingent-Valuation Questions. Land Economics 65(1): 57-63.

Boyle, K.J., Johnson, F.R., McCollum, D.W., Desvousges, W.H., Dunford, R.W. & Hudson, S.P. 1996. Valuing Public Goods: Discrete versus Continuous Contingent-Valuation Responses. Land Economics 72(3): 381-396.

Boyle, K.J., Desvousges, W.H., Johnson, F.R., Dunford, R.W. & Hudson, S.P. 1994. An Investigation of Part-Whole Biases in Contingent Valuation Studies. Journal of Environmental Economics and Management 27(1): 64-83.

Boyle, K.J., Welsh, M.P. & Bishop, R.C. 1988. Validation of Empirical Measures of Welfare Change: Comment. Land Economics 64(1): 94-98.

Boyle, K.J., Bishop, R.C. & Welsh, M.P. 1985. Starting Point Bias in Contingent Valuation Bidding Games. Land Economics 61(2): 188-194.

Bromley, D.W. 1996. The Environmental Implications of Agriculture. A paper presented in the OECD Seminar on Environmental Benefits from a Sustainable Agriculture: Issues and Policies. September 10-13, 1996, Helsinki, Finland. COM/AGR/CA/ENV/EPOC(96)106.

Brookshire, D.S., Thayer, M.A., Schulze, W.D. & d'Arge, R.C. 1982. Valuing Public Goods: A Comparison of Survey and Hedonic Approaches. American Economic Review 72(3): 165-177.

Brown, T.C. 1984. The Concept of Value in Resource Allocation. Land Economics 60(3): 231-246.

Brown, T.C., Champ, P.A., Bishop, R.C. & McCollum, D.W. 1996. Which Response Format Reveals the Truth about Donations to a Public Good? Land Economics 72(2): 152-166.

Cambridge Economics 1992. Contingent Valuation: A Critical Assessment: A Symposium. Cambridge Economics, Inc. April 1992. Cambridge, MA, U.S.A.

Cameron, T.A. 1988. A New Paradigm for Valuing Nonmarket Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression. Journal of Environmental Economics and Management 15: 355-379.

Carson, R.T. 1994. Contingent Valuation Surveys and Tests of Insensitivity to Scope. Paper presented at the International Conference on Determining the Value of Nonmarketed goods: Economic, Psychological, and Policy Relevant Aspects of Contingent Valuation Method. July 1994, Bad Hamburg, Germany.

Carson, R.T. 1991. Constructed Markets. In: Braden, J.B. & Kolstad, C.D. (eds.). Measuring the Demand for Environmental Quality. Elsevier Science Publishers B.V., Amsterdam, The Netherlands.

Carson, R.T. & Mitchell, R.C. 1995. Sequencing and Nesting in Contingent Valuation Surveys. Journal of Environmental Economics and Management 28(2): 155-173.

Carson, R.T., Hanemann, W.M., Kopp, R.J., Krosnick, J.A., Mitchell, R.C., Presser, S., Ruud, P.A. & Smith V.K. 1996. Was the NOAA Panel Correct about Contingent Valuation? Discussion Paper 96-20. Resources for the Future, Washington D.C., U.S.A.

Carson, R.T., Martin, K. & Wright, J. 1994. A Note of Evidence of the Temporal Reliability of Contingent Valuation Estimates. Working paper, July 1994. Economics Department, University of California, San Diego, U.S.A.

Carson, R.T., Meade, N.F. & Smith, V.K. 1993. Introducing the Issues. Choices. 2nd Quarter (1993): 5-8.

Carson, R.T., Mitchell, R.C., Hanemann, W.M., Kopp, R.J., Presser, S. & Ruud, P.A. 1992. A Contingent Valuation Study of Lost Passive Use Values Resulting from the Exxon Valdez Oil Spill. A Report to the Attorney General of the State of Alaska, November 10, 1992, U.S.A.

Chatfield, C. & Collins, A.J. 1980. Introduction to Multivariate Analysis. Chapman and Hall, London, Great Britain.

Child, D. 1990. The Essentials of Factor Analysis. 2nd ed. Cassel Educational Limited, Great Britain.

Cicchetti, C.J. & Wilde, L.L. 1992. Uniqueness, Irreversibility, and the Theory of Nonuse Values. American Journal of Agricultural Economics 74(5): 1121-1125.

Ciriacy-Wantrup, S.V. 1947. Capital Returns from Soil-Conservation Practices. Journal of Farm Economics 29: 1181-1196.

Coase, R. 1960. The Problem of Social Cost. Journal of Law and Economics 3: 1-44.

Cook, D.M. 1998. A New Psychological Approach to Dichotomous Choice CVM. A paper presented in the 5th Biennial ISEE Conference (International Society for Ecological Economics), November 1998, Santiago, Chile.

Cropper, M.L. & Oates, W.E. 1992. Environmental Economics: A Survey. Journal of Economic Literature 30(6): 675-740.

Cummings, R.G. & Harrison, G.W. 1995. The Measurement and Decomposition of Nonuse Values: A Critical Review. Environmental and Resource Economics 5(8): 225-247.

Cummings, R.G., Harrison, G.W. & Rutström, E.E. 1995. Homegrown Values and Hypothetical Surveys: Is the Dichotomous Choice Approach Incentive-Compatible? The American Economic Review 85(1): 260-266.

Cummings, R.G., Brookshire, D.S. & Schulze, W.D. 1986. The Contingent Valuation Method. In: Cummings, R.G. et al. (eds.). Valuing Environmental Goods. An assessment of the Contingent Valuation Method. Rowman and Allanheld, Totowa, New Jersey, U.S.A.

Dalecki, M.G., Whitehead, J.C. & Blomquist, G.C. 1993. Sample Non-response Bias and Aggregate Benefits in Contingent Valuation: An Examination of Early, Late and Non-respondents. Journal of Environmental Management 38: 133-143.

Davis, R.K. 1963a. The Value of Outdoor Recreation: An Economic Study of the Maine Woods. Ph. D. Dissertation. Harvard University, Department of Economics, MA, U. S. A.

Davis, R.K. 1963b. Recreation Planning as an Economic Problem. Natural Resources Journal 3: 239-249.

Deaton, A. & Muellbauer, J. 1980. Economics and Consumer Behaviour. Cambridge University Press, Cambridge, Great Britain.

Desvousges, W.H., Johnson, F.R., Dunford, R.W., Boyle, K.J., Hudson, S.P. & Wilson, K.N. 1992. Measuring Natural Resource Damages with Contingent Valuation: Tests of Validity and Reliability. A paper presented in Contingent Valuation: A Critical Assessment. Cambridge Economics, Inc. Washington, D. C., April 2-3, 1992.

Diamond, P.A. & Hausman, J.A. 1994. Contingent Valuation: Is Some Number Better than No Number. Journal of Economic Perspectives 8(4): 45-64.

Drake, L. 1993. Relations Among Environmental Effects and Their Implications for Efficiency of Policy Instruments - An Economic Analysis Applied to Swedish Agriculture. Swedish University of Agricultural Sciences, Department of Economics, dissertations 1993:6. Uppsala, Sweden.

Drake, L. 1992. The Nonmarket Value of Agricultural Landscape. European Review of Agricultural Economics 19(3): 351-364.

Drake, L. 1986. Värdet av bevarat jordbrukslandskap, resultat av intervjuundersökningar. Sveriges lantbruksuniversitet, institutionen för ekonomi och statistik, rapport 289. Uppsala.

Eberle, W.D. & Hayden, F.G. 1991. Critique of Contingent Valuation and Travel Cost Methods for Valuing Natural Resources and Ecosystems. Journal of Economic Issues 25(3): 649-687.

Edwards, S.F. 1986. Ethical Preferences and the Assessment of Existence Values: Does the Neoclassical Model Fit? Northeastern Journal of Agricultural and Resource Economics 15(2): 145-150.

Fredman, P. 1995. Endangered species: Benefit estimation and policy implications. Report No. 109. Department of Forest Economics, Swedish University of Agricultural Sciences, Umeå, Sverige.

Freeman, A.M. 1986. On Assessing the State of the Arts of the Contingent Valuation Method of Valuing Environmental Changes. In: Cummings, R.G. et al. (eds.). Valuing Environmental Goods. An assessment of the Contingent Valuation Method. Rowman and Allanheld, Totowa, New Jersey, U.S.A.

Gittinger, J.P. 1989. Economic Analysis of Agricultural Projects. Second edition (first published 1982). The Johns Hopkins University Press, Baltimore, U.S.A.

Green, C.H. & Tunstall, S.M. 1991. The Evaluation of River Quality Improvements by the Contingent Valuation Method. Applied Economics 23: 1135-1146.

Halstead, J. 1984. Measuring the Nonmarket Value of Massachusetts Agricultural Land: A Case Study. Journal of Northeastern Agricultural Economic Council 13(1): 12-19.

Hanemann, W.M. 1994a. Contingent valuation and economics. Department of Agricultural and Resource Economics and Policy, Division of Agriculture and Natural Resources, University of Kalifornia at Berkeley, U.S.A. Working paper No. 697, April.

Hanemann, W.M. 1994b. Valuing the Environment Through Contingent Valuation. Journal of Economic Perspectives 8(4): 19-43.

Hanemann, W.M. 1992. Preface. In: Navrud, S. (ed.). Pricing the European Environment. Oxford University Press Inc., New York, U.S.A.

Hanemann, W.M. 1991. Willingness To Pay and Willingness To Accept: How Much Can They Differ? The American Economic Review 81(3): 635-647.
Hanemann, W.M. 1989. Welfare Evaluations in Contingent Valuation Experiments with Discrete Response Data: Reply. American Journal of Agricultural Economics 71(4): 1057-1061.
Hanemann, W.M. 1984. Welfare Evaluations in Contingent Valuation Experiments with Discrete Response. American Journal of Agricultural Economics 66(3): 332-341.
Hanemann, W.M. & Kriström, B. 1995. Preference Uncertainty, Optimal Design and Spikes. In: Johansson, P.-O. et al. (eds.). Current Issues in Environmental Economics. Manchester University Press, Manchester, Great Britain.
Hanemann, W.M., Loomis, J.B. & Kanninen, B.J. 1991. Statistical Efficiency of Double Bounded Dichotomous Choice Contingent Valuation. American Journal of Agricultural Economics 73(11): 1255-1263.
Hanley, N.D. 1989. Valuing Rural Recreation Benefits: An Empirical Comparison of Two Approaches. Journal of Agricultural Economics 40(3): 361-374.
Hanley, N.D. & Spash, C.L. 1993. Cost-Benefit Analysis and the Environment. Edgar Elgar Publishing Limited, Aldershot, England.
Harris, C.C., Driver, B.L. & McLaughlin, W.J. 1989. Improving the Contingent Valuation Method: A Psychological Perspective. Journal of Environmental Economics and Management 17(3): 213-229.
Harrison, G.W. 1993. General Reactions to the NOAA Report. Reports for the CVM Network. Stockholm School of Economics, March 12, 1993. p. 19-25.
Harrison, G.W. 1992. Value of Public Goods with the Contingent Valuation Method: A Critique of Kahneman and Knetsch. Journal of Environmental Economics and Management 23(3): 248-257.
Harrison, G.W. & Lesley, J.C. 1996. Must Contingent Valuation Surveys Cost So Much? Journal of Environmental Economics and Management 31(1): 79-95.
Harrison, G.W. & Kriström, B. 1995. On the Interpretation of Responses in Contingent Valuation Surveys. In: Johansson, P.-O. et al. (eds.). Current Issues in Environmental Economics. Manchester University Press, Manchester, Great Britain.
Hoehn, J.P. & Randall, A. 1987. A Satisfactory Benefit Cost Indicator from Contingent Valuation. Journal of Environmental Economics and Management 14: 226-247.
Jakobsson, K.M. & Dragun, A.K. 1996. Contingent Valuation and Endangered Species: Methodological Issues and Application. Edward Elgar Publishing Limited, Aldershot, United Kingdom.
Johansson, P.-O. 1993. Cost-Benefit Analysis of Environmental Change. Cambridge University Press, Cambridge, Great Britain.

Johansson, P.-O. 1991. An Introduction to Modern Welfare Economics. Cambridge University Press, Cambridge, Great Britain.

Johansson, P.-O. 1987. The Economic Theory and Measurement on Environmental Benefits. Cambridge University Press, Cambridge, Great Britain.

Johansson, P.-O., Kriström, B. & Mäler, K.-J. 1989. Welfare Evaluations in Contingent Valuation Experiments with Discrete Response Data: Comment. American Journal of Agricultural Economics 71(4): 1054-1056.

Johnson, R.A. & Wichern, D.W. 1982. Applied Multivariate Statistical Analysis. Prentice-Hall, New Jersey, U.S.A.

Jokinen, P. 1995. Tuotannon muutokset ja ympäristöpolitiikka: ympäristösosiologinen tutkimus suomalaisesta maatalouden ympäristöpolitiikasta vuosina 1970-1994. Annales Universitatis Turkuensis C 116, Turun yliopisto, Turku, Finland.

Judge, G.G., Hill, R.C., Griffiths, W.E., Lütkepohl, H. & Lee, T.-C. 1988. Introduction to the Theory and Practice of Econometrics. John Wiley and Sons, Inc., U.S.A.

Just, R.E., Hueth, D.L. & Schmitz, A. 1982. Applied Welfare Economics and Public Policy. Prentice-Hall Inc., Englewood Cliffs, N. J., U.S.A.

Kahneman, D. & Knetsch, J.L. 1992a. The Purchase of Moral Satisfaction. Journal of Environmental Economics and Management 22(1): 57-70.

Kahneman, D. & Knetsch, J.L. 1992b. Contingent Valuation and the Value of Public Goods: Reply. Journal of Environmental Economics and Management 22(1): 90-94.

Kananen, I. 1986. MTK ja Suomen maatalouspolitiikka: elintarvikepulasta omavaraisuuteen 1917-1949. Kirjayhtymä, Helsinki, Finland.

Kanninen, B.J. 1995. Bias in Discrete Response Contingent Valuation. Journal of Environmental Economics and Management 28(1): 114-125.

Keisteri, T. 1990. The Study of Changes in Cultural Landscapes. Fennia 168(1): 31-115.

Kennedy, P. 1992. A Guide to Econometrics. 3rd edition. The MIT Press. Cambrigde, U.S.A.

Kohlstad, C.D. & Braden, J.B. 1991. Environmental Demand Theory. In: Braden, J.B. & Kolstad, C.D. (eds.). Measuring the Demand for Environmental Quality. Elsevier Science Publishers B.V., Amsterdam, The Netherlands.

Korhonen, P. & Manninen, J. 1994. Monimuuttujamenetelmät 36C070. Helsingin kauppakorkeakoulun monisteita 672. Helsinki, Finland.

Kriström, B. 1995. Spike Models in Contingent Valuation: Theory and Illustrations. Invited paper, presented in the 1st Toulouse Conference on Environmental Economics. Toulouse, France, March 30-31, 1995.

Kriström, B. 1990a. Valuing Environmental Benefits Using the Contingent Valuation Method - An Econometric Analysis. Umeå Economic Studies No. 219, University of Umeå, Sweden.

Kriström, B. 1990b. A Non-Parametric Approach to the Estimation of Welfare Measures in Discrete Response Valuation Studies. Land Economics 66(2): 135-139.

Krutilla, J.V. 1967. Conservation reconsidered. The American Economic Review LVII(4): 777-786.

Larson, D.M. 1992. Further Results on Willingness to Pay for Nonmarket Goods. Journal of Environmental Economics and Management 23(2): 101-122.

Lazo, J.K., Schulze, W.D., McClelland, G.H. & Doyle, J.K. 1992. Can Contingent Valuation Measure Nonuse Values? American Journal of Agricultural Economics 74(5): 1126-1132.

Linkola, M. 1980. Suomalainen kulttuurimaisema. In: Kinnunen, A. & Sepänmaa, Y. (eds.). Ympäristöestetiikka. 2nd ed. Gaudeamus, Mäntän kirjapaino, Mänttä 1983, Finland.

Lockwood, M. 1997. Integrated Value Theory for Natural Areas. Ecological Economics 20(1): 83-93.

Lockwood, M. 1996. End Value, Evaluation, and Natural Systems. Environmental Ethics 18(3): 265-278.

Mack, R.P. & Myers, S. 1965. Outdoor Recreation. In: Dorfman, R. (ed.). Measuring Benefits of Government Investments. The Brookings Institution, Washington D. C., U. S. A.

MacLean, D. & Mills, C. 1988. Norms and Behavior in Philosophy and Social Science. In: Peterson, G.L. et al. (eds.). Amenity Resource Valuation: Integrating Economics with Other Disciplines.

MacQueen, J.B. 1967. Some Methods for Classification and Analysis of Multivariate Observations. Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. 1: 281-297.

Maddala, G.S. 1983. Limited-Dependent and Qualitative Variables in Econometrics. Econometric Society Monographs. Cambridge University Press, Cambrigde.

Mardia, K.V., Kent, J.T. & Bibby, J.M. 1989. Multivariate Analysis. 7th printing. Academic Press Inc., San Diego, California, U.S.A.

Mattson, L. & Li, C.-Z. 1994. Sample Non-responses in a Mail Contingent Valuation Survey: An Empirical Test on the Effect on Value Inference. Journal of Leisure Reserach 26(2): 182-188.

Meeus, J., van der Ploeg, J.D. & Wijermans, M. 1988. Changing Agricultural Landscapes in Europe - Continuity, Deterioration or Rupture? IFLA Conference, Rotterdam, The Netherlands.

Mendelsohn, R. & Brown, G.M. 1983. Revealed Preference Approaches to Valuing Outdoor Recreation. Natural Resources Journal 23(3): 607-618.

Milligan, G.W. & Cooper, M.C. 1985. An Examination of Procedures for Determining the Number of Clusters in a Data Set. Psychometrika 50(2): 159-179.

Ministry of Agriculture and Forestry 1995. Maaseutumaisematyöryhmän muistio. MMM työryhmämuistio 1995:4. Helsinki, Finland.

Ministry of Agriculture and Forestry 1994. Ehdotus maatalouden ympäristöohjelmaksi. Maatalouden ympäristötukityöryhmä. MMM työryhmämuistio 1994: 19. Helsinki, Finland.

Ministry of the Environment 1992. Ehdotus maaseudun ympäristöohjelmaksi. Maaseudun ympäristöohjelmatyöryhmän muistio. Työryhmän mietintö 1992: 68. Ympäristöministeriö. Helsinki, Finland.

Mitchell, R.C. & Carson, R.T. 1989. Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources For the Future, Washington D. C., U.S.A.

More, T.A., Averill, J.R. & Stevens, T.H. 1996. Values and Economics in Environmental Management: A Perspective and Critique. Journal of Environmental Management 48(4): 397-409.

Morrison, D. 1976. Multivariate Statistical Methods. McGraw-Hill, U.S.A.

MTTL 1999. Finnish Agriculture and Rural Industries 1998. Agricultural Economics Research Institute, Publications 91a. Helsinki, Finland.

Munda, G. 1996. Cost-benefit analysis in integrated environmental assessment: some methodological issues. Ecological Economics 19(2): 157-168.

Mäler, K. 1974. Environmental Economics: A Theoretical Inquiry. The Johns Hopkins University Press for Resources for the Future, Baltimore, U.S.A.

Mäntymaa, E. 1997. Essays on Environmental Benefits and Hypothetical Markets. Acta Universitatis Ouluensis, Oeconomica, G 2. University of Oulu, Finland.

Mäntymaa, E. 1993. Ympäristöhyötyjen arviointi contingent valuation -menetelmällä. (Abstract: Valuing environmental benefits using the contingent valuation method). Research Reports 109, Research Institute of Northern Finland, University of Oulu, Finland.

Navrud, S. (ed.). 1992. Pricing the European Environment. Scandinavian University Press, Oslo, Norway.

Navrud, S. & Pruckner, G.J. 1997. Environmental Valuation - To Use or Not to Use? Environmental and Resource Economics 10(1): 1-26.

Neill, H.R., Cummings, R.G., Ganderton, P.T., Harrison, G.W. & McGuckin, T. 1994. Hypothetical Surveys and Real Economic Commitments. Land Economics 70(2): 145-154.

Nicholson, W. 1989. Microeconomic Theory: Basic Principles and Extensions. The Dryden Press, Orlando, Florida, U.S.A.

OECD 1989. Environmental Policy Benefits: Monetary Valuation. OECD, Paris, France.

O'Neill, J. 1993. Ecology, Policy and Politics: Human Well-Being and the Natural World. Routledge, London, Great Britain.

Pearce, D.W. & Turner, R.K. 1990. Economics of Natural Resources and the Environment. Harvester Wheatsheaf, Great Britain.

Perman, R., Ma, Y. & McGilvray, J. 1996. Natural Resource and Environmental Economics. Addison Wesley Longman Limited, England.

Pirttijärvi, R., Aakkula, J., Miettinen, A. & Sumelius, J. 1995. Agro-Environmental prospects of Environmental Support. In: Agriculture at the crossroads. Lauri Kettunen's jubilee publication. Agric. Econ. Res. Inst. Research Publications 77: 136-159. Helsinki. Finland.

Portney, P.R. 1994. The Contingent Valuation Debate: Why Economists Should Care. Journal of Economic Perspectives 8(4): 3-17.

Posner, R.A. 1993. Nobel Laureate Ronald Coase and Methodology. Journal of Economic Perspectives 7(4): 195-210.

Pruckner, G.J. 1995. Agricultural landscape cultivation in Austria: An application of the CVM. European Review of Agricultural Economics 22: 173-190.

Randall, A. 1991. Total and Nonuse Values. In: Braden, J.B. & Kolstad, C.D. (eds.). Measuring the Demand for Environmental Quality. Elsevier Science Publishers B.V., Amsterdam, The Netherlands. p. 303-320.

Randall, A. 1987. Resource Economics - An Economic Approach to Natural Resource and Environmental Policy. 2nd ed. John Wiley and Sons, U.S.A.

Randall, A. 1986a. The Possibility of Satisfactory Benefit Estimation with Contingent Markets. In: Cummings, R.G. et al. (eds.). Valuing Environmental Goods. An assessment of the Contingent Valuation Method. Rowman and Allanheld, Totowa, New Jersey, U.S.A.

Randall, A. 1986b. Preservation of Species as a Resource Allocation Problem. In: Norton, B.G. (ed.). The Preservation of Species. The Value of Biological Diversity. Princeton University Press, Princeton, New Jersey, U.S.A. p. 79-109.

Randall, A. & Hoehn, J.P. 1996. Embedding in Market Demand Systems. Journal of Environmental Economics and Management 30(3): 369-380.

Randall, A. & Farmer, M.C. 1992. Starting Price Effects in Contingent Valuation Data Sets. A paper presented in The Annual Meetings of the AAEA, 9-12 August 1992, Baltimore, Maryland, U.S.A.

Randall, A. & Stoll, J.R. 1983. Existence Value in a Total Valuation Framework. In: Rowe, R.D. & Chestnut, L.G. (eds.). Managing Air Quality and Scenic Resources at National Parks and Wilderness. Westview Press, Boulder, Colorado, U.S.A.

Randall, A., Hoehn, J.P. & Brookshire, D.S. 1983. Contingent Valuation Surveys for Evaluating Environmental Assets. Natural Resources Journal 23(3): 635-648.

Ranta, E., Rita, H. & Kouki, J. 1989. Biometria - tilastotiedettä ekologeille. Yliopistopaino, Helsinki.

Ready, R.C., Buzby, J.C. & Hu, D. 1996. Differences between Continuous and Discrete Contingent Value estimates. Land Economics 72(3): 397-411.

Rekola, M. 1997. Monetary Valuation of Nonmarket Environmental Benefits: Ethics and Property Rights. Paper presented in the Course of Social Scientific Theories and Environmental Problems, January 15-17, 1997, University of Turku, Finland.

Romstad, E. 1991. Incorporation of Information in CVM-Studies. A paper presented at the Annual Meeting of the European Association of Environmental and Resource Economists (EAERE), June 11-14, 1991, Stockholm, Sweden.

Russell, J.A. 1988. Valuing Cultural Landscapes in the USA, Britain, and Australia. Enviromental Studies, University of Tasmania, Occasional Paper 22.

Sage, A.P. 1981. Behavioral and Organizational Considerations in the Design of Information Systems and Processing for Planning and Decision Support. IEEE Transactions on Systems, Man and Cybernetics. SMC-11: 640-678.

Sagoff, M. 1994. Should Preferences Count. Land Economics 70(2): 127-144.

SAS 1987. SAS/STATTM Guide for Personal Computers. Version 6, 1st edition. Cary, North Carolina, U.S.A.

SAS 1993. SAS/STATTM Guide for Personal Computers. Version 6, 4th edition, volume 1, 3rd printing. SAS Institute Inc. Cary, North Carolina, U.S.A.

Schkade, D.A. & Payne, J.W. 1992. Where Do the Numbers Come From?: How People Respond to Contingent Valuation Questions. A paper presented in Contingent Valuation: A Critical Assessment. Cambridge Economics, Inc. Washington, D. C., April 2-3, 1992.

Schmid, A.A. 1987. Property, Power, and Public Choice - An Inquiry into Law and Economics. Praeger Publishers, New York, U.S.A.

Sellar, C., Chavas, J.P. & Stoll, J.R. 1986. Specification of the Logit Model: The Case of the Valuation of Nonmarket Goods. Journal of Environmental Economics and Management 13: 382-390.

Shavell, S. 1992. Should Contingent Valuation Estimates of the Nonuse Value of Natural Resources Be Used in Public Decisionmaking and the Liability System? A paper presented in Contingent Valuation: A Critical Assessment. Cambridge Economics, Inc. Washington, D. C., April 2-3, 1992.

Shogren, J.F., Shin, S.Y., Hayes, D.J. & Kliebenstein, J.B. 1994. Resolving the Differences in Willingness to Pay and Willingness to Accept. The American Economic Review 84(1): 255-270.

Siikamäki, J. 1997. Torjunta-aineiden käytön vähentämisen arvo? Contingent valuation -tutkimus kuluttajien maksuhalukkuudesta. (Abstract: The economic value of decreased use of pesticides? A contingent valuation study on willingness to pay). Agricultural Economics Research Institute. Research Reports 217. Helsinki, Finland.

Siikamäki, J. & Aakkula, J. 1996. Measuring Consumer Preferences for Using Pesticides in Finnish Agriculture - A Contingent Valuation Approach. A paper presented in the IAAE Symposium Economics of Agro-Chemicals, Wageningen, Netherlands, 24-27 April, 1996.

Simon, H.A. 1955. A Behavioral Model of Rational Choice. Quarterly Journal of Economics 69: 99-118.

Smith, V.K. 1993. Nonmarket Valuation of Environmental Resources: An Interpretive Appraisal. Land Economics. 69(1): 1-26.

Smith, V.K. 1992. Arbitrary Values, Good Causes, and Premature Verdicts. Journal of Environmental Economics and Management 22(1): 71-89.

Smith, V.K. & Desvousges, W.H. 1986. Measuring Water Quality Benefits. Kluwer & Nijhoff, Boston, U.S.A.

Spash, C.L. 1993. Economics, Ethics and Long Term Environmental Damages. Environmental Ethics 15(2): 117-132.

Spash, C.L. & Hanley, N. 1995. Preferences, Information, and Biodiversity Preservation. Ecological Economics 12(3): 191-208.

Spedding, C.R.W., Hoxey, A.M., Miller, F.A. & Walsingham, J.M. 1988. The Countryside: some facts, concerns and perceptions. CAS Paper, 18: 10-41. Centre for Agricultural Strategy, Reading, Great Britain.

Stevens, T.H., Echeverria, J., Glass, R.J., Hager, T. & More, T.A. 1991. Measuring the existence value of wildlife: What do CVM estimates really show? Land Economics 67(4): 390-400.

Thayer, M.A. 1981. Contingent Valuation Techniques for Assessing Environmental Impacts: Further Evidence. Journal of Environmental Economics and Management 8(3): 27-43.

Tiger, L. 1992. The Pursuit of Pleasure. Little, Brown and Co, U.S.A.

Tversky, A. & Kahneman, D. 1981. The Framing of Decisions and the Psychology of Choice. Science 211: 453-458.

Vatn, A. & Bromley, D.W. 1994. Choices without Prices without Apologies. Journal of Environmental Economics and Management 26(2): 129-148.

Walsh, R.G. 1986. Recreation Economic Decisions: Comparing Benefits and Costs. Venture Publishing, Pennsylvania, U.S.A.

Weisbrod, B.A. 1964. Collective-consumption Services of Individual Consumption Goods. Quarterly Journal of Economics 78(3): 471-477.

Whitehead, J.C., Groothuis, P.A. & Blomquist, G.C. 1993. Testing for non-response and sample selection bias in contingent valuation: Analysis of combination phone/mail survey. Economic Letters 41: 215-220.

Wiestra, E., Hoevenagel, R., van der Veen, A. & Geurts, P. 1995. The domain of the CV method: which goods can be valued properly? A paper presented in the Joint European-American Conference on Nonmarket Valuation. June 14-16, 1995, Oslo, Norway.

Willig, R.D. 1978. Consumer's Surplus without Apology. American Economic Review 66(4): 589-597.

Willis, K.G. & Garrod, G.D. 1993. Valuing Landscape: A Contingent Valuation Approach. Journal of Environmental Management 37: 1-22.

Willis, K.G., Garrod, G.D. & Saunders, C.M. 1995. Benefits of Environmentally Sensitive Area Policy in England: A Contingent Valuation Assessment. Journal of Environmental Management 44(2): 105-125.

Young, T. & Allen, P.G. 1986. Methods for Valuing Countryside Amenity: An Overview. Journal of Agricultural Economics 37(3): 349-364.

Appendix A: Structure of the Sample

Table A-1. Sample in Respect of Gender, Province and Type of Place of Living.

	Females	Males	All
Province of Uusimaa			
- city	78	69	147
- rural commune	25	24	49
	103	93	196
Province of Turku and Pori			
- city	23	25	48
- rural commune	18	21	39
	41	46	87
Province of Häme			
- city	18	17	35
- rural commune	22	20	42
	40	37	77
Province of Kymi			
- city	9	11	20
- rural commune	12	9	21
	21	20	41
Province of Mikkeli			
- city	5	5	10
- rural commune	6	7	13
	11	12	23
Province of Kuopio			
- city	13	12	25
- rural commune	8	14	22
	21	26	47
Province of Keski-Suomi			
- city	10	10	20
- rural commune	9	10	19
	19	20	39
Province of Pohjois-Karjala			
- city	6	6	12
- rural commune	6	6	12
	12	12	24
Province of Vaasa			
- city	25	22	47
- rural commune	3	3	6
	28	25	53
Province of Oulu			
- city	13	15	28
- rural commune	15	13	28
	28	28	56
Province of Lappi			
- city	5	3	8
- rural commune	6	6	12
	11	9	20
	335	328	663

Table A-2. Sample in Respect of Gender and Age.*

	Females	Males	All
15-19 years	31	40	71
20-29 years	70	68	138
30-39 years	73	67	140
40-49 years	63	67	130
50-59 years	51	51	102
60-69 years	39	42	81
	327	327	654

* Nine respondents did not report their age (8 females and 1 male).

Appendix B: Questionnaire

Six different types of the questionnaire and the sequence of the elements in each of them.

Questionnaire type 1:

1. Questions inquiring basic socio-economic characteristics of the respondent
2. Additional information package
3. Attitudinal questions and claims
4. Willingness to pay iteration question (starting bid FIM 100)
5. Questions inquiring extra socio-economic characteristics of the respondent

Questionnaire type 2:

1. Questions inquiring basic socio-economic characteristics of the respondent
2. Additional information package
3. Attitudinal questions and claims
4. Willingness to pay iteration question (starting bid FIM 500)
5. Questions inquiring extra socio-economic characteristics of the respondent

Questionnaire type 3:

1. Questions inquiring basic socio-economic characteristics of the respondent
2. Additional information package
3. Attitudinal questions and claims
4. Willingness to pay iteration question (starting bid FIM 1,300)
5. Questions inquiring extra socio-economic characteristics of the respondent

Questionnaire type 4:

1. Questions inquiring basic socio-economic characteristics of the respondent
4. Willingness to pay iteration question (starting bid FIM 100)
3. Attitudinal questions and claims
5. Questions inquiring extra socio-economic characteristics of the respondent

Questionnaire type 5:

1. Questions inquiring basic socio-economic characteristics of the respondent
4. Willingness to pay iteration question (starting bid FIM 500)
3. Attitudinal questions and claims
5. Questions inquiring extra socio-economic characteristics of the respondent

Questionnaire type 6:

1. Questions inquiring basic socio-economic characteristics of the respondent
4. Willingness to pay iteration question (starting bid FIM 1,300)
3. Attitudinal questions and claims
5. Questions inquiring extra socio-economic characteristics of the respondent

1. Questions inquiring the basic socio-economic characteristics of the respondent

1-1. Sex

a) female
b) male

1-2. Age

a) 15-17
b) 18-19
c) 20-24
d) 25-29
e) 30-34
f) 35-39
g) 40-49
h) 50-59
i) 60-64
j) 65-69

1-3. Marital status

a) married or living together
b) widow
c) divorced
d) not married

1-4. Number of family members living at home _____, of which

a) under 5 _____
b) 5-12 _____
c) 13-18 _____

1-5. Do you live in a

a) block of flats
b) link house
c) detached house
d) farm
e) somewhere else, where? _____

1-6. Do you

a) own your flat/house/farm
b) live as a tenant

2. Additional information package

Farming is a way to maintain the rural environment in Finland. It consists of man-made and natural elements. Hundreds of years of cultivation carried out by farmers has left its mark on the flora, fauna, and scenery. This unique combination of two different systems is known as the rural environment.

In the rural environment you are free to enjoy its recreational values, beauty of scenery, and peaceful atmosphere. The rural environment is, in a way, a public good maintained for you by farmers.

The rural environment is, however, threatened by various forms of social development and agricultural production practices. Increased use of pesticides and artificial fertilizers changes the nature of ecosystem and agricultural land is developed for the needs of urban expansion.

Many valuable things are in a danger of disappearing if we do not understand the meaning of the rural environment as a source of pleasure and recreation.

3. Attitudinal questions and claims

3-1. Quality of the rural environment is nowadays better than it used to be. Do you agree?
   a) Yes, I do
   b) No, I do not
   c) There has not been any change

3-2. How important is it to you that the characteristics of the rural environment will also be maintained in the future?
   a) Very important
   b) Quite important
   c) Quite unimportant
   d) Completely unimportant

3-3. What is the most important task of Finnish agriculture?
   a) Self-sufficiency in agricultural production
   b) To keep the countryside viable and inhabited
   c) To maintain the rural environment
   d) To give farmers adequate income
   e) To secure the appreciation of entrepreneurship in the society
   f) To preserve the traditions of a peasant way of living

3-4. What is the next most important task of Finnish agriculture?
   a) Self-sufficiency in agricultural production
   b) To keep the countryside viable and inhabited
   c) To maintain the rural environment
   d) To give farmers adequate income
   e) To secure the appreciation of entrepreneurship in the society
   f) To preserve the traditions of a peasant way of living

3-5. Which of the following issues contributes the most to the well-being of Finnish society?
   a) High employment rate
   b) Taking care of the environment
   c) Guaranteeing the individual freedom of choice
   d) Stable economic growth
   e) Guaranteeing private property rights
   f) National cultural heritage
   g) High educational level
   h) Solving problems related to housing

3-6. Which of the following issues contributes the second most to the well-being of Finnish society?
   a) High employment rate
   b) Taking care of the environment
   c) Guaranteeing the individual freedom of choice
   d) Stable economic growth
   e) Guaranteeing private property rights

f) National cultural heritage
g) High educational level
h) Solving problems related to housing

3-7. A set of claims will be presented. There are five alternatives from which to select your answer. The alternatives are:

1) I agree completely with the claim
2) I agree to some extent with the claim
4) I disagree to some extent with the claim
5) I disagree completely with the claim
3) I do not know

Set of claims:

a) To secure his own existence man has to co-operate with the nature
b) Man has a right to force the nature to satisfy his needs
c) Man has been created to control the creation
d) It is possible to raise our standard of living in the long run without any restrictions
e) Man's interference in the processes of the nature very often has harmful consequences
f) Rapid economic growth is more often a disadvantage than an advantage
g) Man has already misused natural resources in an irreversible way
h) Most environmental problems can be solved by means of scientific and technological innovations without a change in the man's way of living
i) Deterioration in the state of environment cannot be stopped until man gives up seeking a rapid increase in his material welfare
j) Environmental conservation should have greater emphasis, even at the expense of economic growth
k) The present generation must take better care of the environment that will be left to the coming generations
l) Environmental problems caused by agriculture are already significant
m) The use of fertilizers and pesticides is at too high a level in Finnish agriculture
n) The intensification of Finnish agriculture deteriorates the environmental quality and food safety
o) Conventional agriculture should quickly be developed into the direction of organic farming
p) The publicity given to the environmental problems caused by agriculture is objective in its nature
q) Conventional agricultural subsidies can be cut down if the corresponding amount of money will be used to promote environmental investments and environmentally related subsidies in agriculture
r) Agriculture has to carry its fair share of the environmental taxes
s) Agriculture itself is the best way to protect environment
t) Polluter pays principle should be applied without any exceptions
u) Agricultural subsidies financed by taxpayers must be cut down if agriculture is not able to produce foodstuffs at competitive prices
v) It is a right thing to allocate tax money for the maintenance of agriculture because the viability of the countryside and the pleasantness of the environment depend on agricultural activities

4. Willingness to pay iteration question

4-1. Pro-environmental farming has been offered as a solution to the problems of Finnish agriculture. Pro-environmental farming can be defined as an agricultural production practice in which the emphasis is on the maintenance of the distinctive characteristics of the rural environment and on the protection of the functions of natural ecosystems. Pro-environmental farming aims to reduce both agricultural surplus and adverse environmental impacts from agriculture. Primarily, this can be carried out by reducing the use of artificial fertilizers and pesticides.

What do you think is the amount of agricultural land which could be converted into pro-environmental farming?

a) 0 %
b) 10 %
c) 25 %
d) 50 %
e) 75 %
f) 100 %
g) some other %, how much? _____

4-2. How much would you be willing to pay annually in order to secure that pro-environmental farming would be carried on in the magnitude that you stated in your previous answer? Would you be willing to pay a tax-like annual payment of FIM _X_ ? (*X is equal to 100 or 500 or 1,300*) [26]

4-3. Was it difficult to answer the willingness to pay question?

a) it was easy
b) it was difficult
c) I do not know

[In case that the respondent's answer was b) to question 4-3, he was asked

4-4. Why was it difficult to answer?

a) I do not have enough information about what the concepts "pro-environmental farming" and "rural environment" mean
b) I did not understand what was really meant by the question
c) These questions are too theoretical to be answered in a proper and sensible way
d) Some other reason, what? _____]

4-5. Which way would you prefer to pay the pro-environmental farming fee?

a) Through taxation
b) Through increased prices of agricultural products
c) Does not matter

4-6. Do you feel that you receive some satisfaction/pleasure/utility from the maintenance of the rural environment?

a) No, I do not
b) Yes, I feel refreshed every time I visit the rural environment or practice activities there
c) Yes, I receive some pleasure from the thought that other people and future generations can enjoy the rural environment
d) Yes, I receive satisfaction from the fact that the rural environment exists
e) Yes, the maintenance of the rural environment produces me some utility, but my utility does not correspond to any alternatives presented above

[26] A more detailed description of the revealing process of a respondent's willingness to pay can be found in *Appendix C.*

5. Questions inquiring extra socio-economic characteristics of the respondent

5-1. Educational background
- a) comprehensive school
- b) high school
- c) vocational education
- d) higher vocational education
- e) matriculation examination
- f) university

5-2. Family gross income per year, FIM
- a) 0 - 20,000
- b) 20,001 - 50,000
- c) 50,001 - 80,000
- d) 80,001 - 120,000
- e) 120,001 - 160,000
- f) 160,001 - 200,000
- g) 200,001 - 250,000
- h) 250,001 - 300,000
- i) 300,001 - 400,000
- j) over 400,000

5-3. Own occupation
- a) Farmer
- b) Worker
- c) Official
- d) Entrepreneur/manager/director
- e) Full-time mother/father
- f) Student
- g) Retired (former occupation _____)
- h) Other

5-4. Father's occupation
- a) Farmer
- b) Worker
- c) Official
- d) Entrepreneur/manager/director
- e) Full-time mother/father
- f) Student
- g) Retired (former occupation _____)
- h) Other

5-5. Where do you live?
- a) In the center of a city of more than 50,000 inhabitants
- b) In the suburb of a city of more than 50,000 inhabitants
- c) In a town of less than 50,000 inhabitants
- d) In the center of a commune
- e) In a village
- f) In a scattered settlement

5-6. Do you have a garden of your own?
- a) Yes
- b) No

5-7. Do you have a summer cottage?
- a) Yes, we own a summer cottage
- b) Yes, we have rented a summer cottage
- c) No, we do not have

5-8. The sign of the commune
The sign of the province
The sign of the interviewer
Date and time

Appendix C: Exemplary Iteration Process to Reveal the Respondent's Willingness to Pay

In this example FIM 500 is the initial starting bid. The iteration process presented below is a combination of a bidding game and payment cards. The interviewer's first question is:

> "How much would you be willing to pay annually in order to secure that pro-environmental farming would be carried on in the magnitude that you stated in your previous answer? Would you be willing to pay a tax-like annual payment of FIM 500?"

1. The respondent approves the initial starting bid

If the respondent says YES, the next question will be: "Would you be willing to pay FIM 1,300". If the answer is still YES, the respondent will be asked whether he is willing to pay FIM 2,500. If the answer is still YES, the interviewer presents an open question: "State the highest amount that you are willing to pay".

If the respondent is willing to pay FIM 500 but not FIM 1,300 he will be shown a payment card with some alternatives:

a) FIM 500
b) FIM 600
c) FIM 700
d) FIM 800
e) FIM 900
f) FIM 1000
g) FIM 1100
h) FIM 1200

and he is asked to select the alternative which is closest to his willingness to pay.

Also, if the respondent is willing to pay FIM 1300 but not FIM 2500 he will be shown a payment card with some alternatives

a) FIM 1300
b) FIM 1400
c) FIM 1500
d) FIM 1600
e) FIM 1700
f) FIM 1800
g) FIM 1900
h) FIM 2000
i) FIM 2100
j) FIM 2200
k) FIM 2300
l) FIM 2400

and he is asked to select the alternative which is closest to his willingness to pay.

2. The respondent does not approve the initial starting bid

If the respondent is not willing to pay the initial starting bid (FIM 500) he will be asked if he is willing to pay FIM 100. If the answer is NO, he will be asked if he is willing to pay FIM 50. If the answer is still NO, the interviewer interprets that the respondents willingness to pay is FIM 0.

If the respondent is not willing to pay FIM 100 but is willing to pay FIM 50, the respondent's WTP will be denoted to be FIM 50.

If the respondent is willing to pay FIM 100 but not FIM 500 he will be shown a payment card with some alternatives

a) FIM 100
b) FIM 150
c) FIM 200
d) FIM 250
e) FIM 300
f) FIM 350
g) FIM 400
h) FIM 450

and he is asked to select the alternative which is closest to his willingness to pay.

Appendix D: Parameter Estimates for Standard Logit Models

(This print is produced by using the SAS® statistical package and its CATMOD procedure)

STANDARD LOGIT MODEL THE WHOLE SAMPLE

MAXIMUM-LIKELIHOOD ANALYSIS-OF-VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT (α)	1	10.76	0.0010
BID (β)	1	59.80	0.0000
LIKELIHOOD RATIO	1	3.32	0.0683

ANALYSIS OF MAXIMUM-LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT (α)	1	-0.41510	0.126600	10.76	0.0010
BID(β)	2	0.00140	0.000181	59.80	0.0000

STANDARD LOGIT MODEL WITHOUT ADDITIONAL INFO

MAXIMUM-LIKELIHOOD ANALYSIS-OF-VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT (α)	1	2.58	0.1081
BID (β)	1	28.47	0.0000
LIKELIHOOD RATIO	1	0.39	0.5327

ANALYSIS OF MAXIMUM-LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT (α)	1	-0.28840	0.179500	2.58	0.1081
BID (β)	2	0.00139	0.000261	28.47	0.0000

STANDARD LOGIT MODEL WITH ADDITIONAL INFO

MAXIMUM-LIKELIHOOD ANALYSIS-OF-VARIANCE TABLE

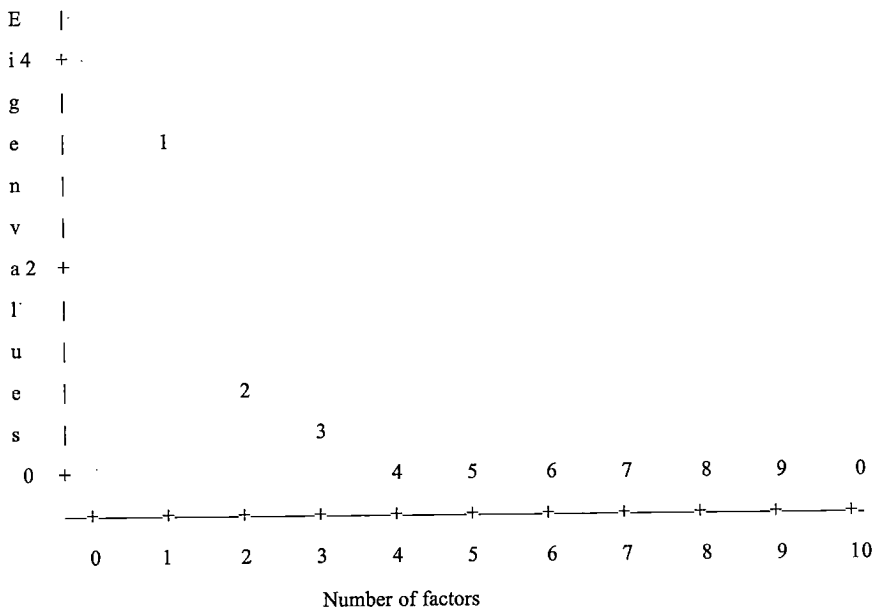
Source	DF	Chi-Square	Prob
INTERCEPT (α)	1	9.15	0.0025
BID (β)	1	31.33	0.0000
LIKELIHOOD RATIO	1	3.81	0.0509

ANALYSIS OF MAXIMUM-LIKELIHOOD ESTIMATES

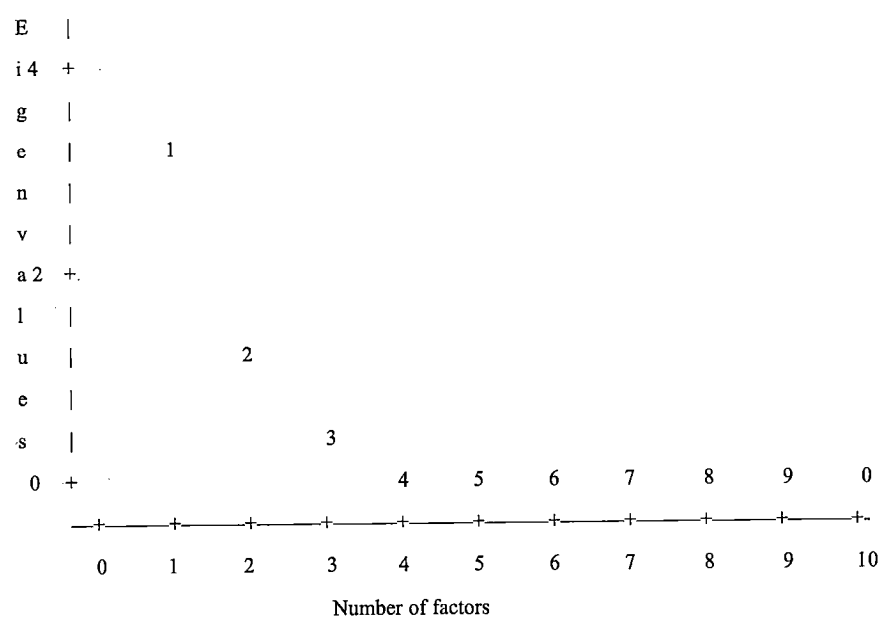
Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT (α)	1	-0.54200	0.179200	9.15	0.0025
BID (β)	2	0.00141	0.000253	31.33	0.0000

Appendix E: Cattell's Scree Test Plots of Eigenvalues

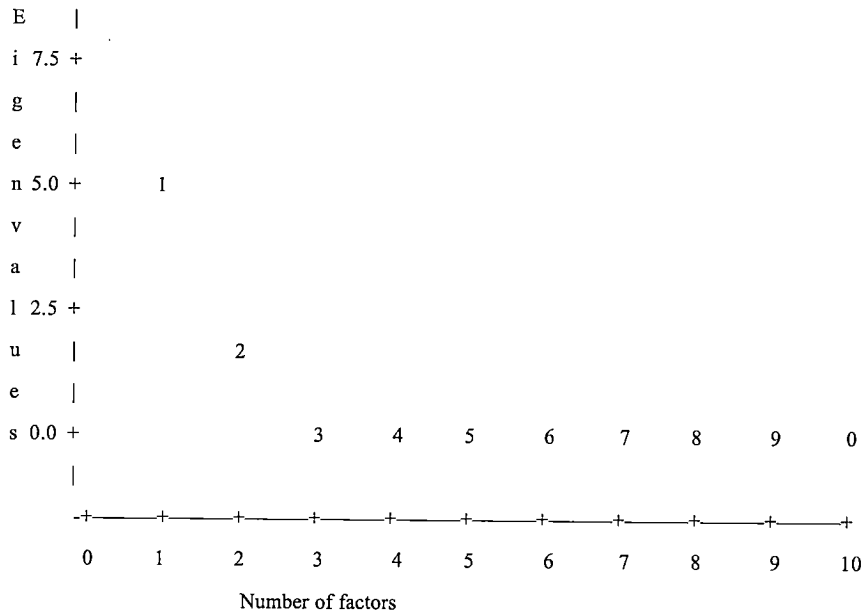
Method 1: Principal factor analysis based on an orthogonal common factor model with SMC prior communality estimates



Method II: Principal factor analysis based on an orthogonal common factor model with prior communality estimates calculated by using a variable's maximum absolute correlation with any other variable



Method III: Maximum likelihood factor analysis with SMC prior communality estimates



Appendix F: Essentials of the Factor Analysis

When an attempt is made to summarize a large body of data including many variables by means of relatively few parameters, a number of different statistical methods in the field of multivariate analysis can be applied. The interest of most multivariate techniques lies on the simplification of data in a manner that helps rather to create a hypothesis than to test it. In the case at hand, where the aim is to find certain identifiable differences in attitudes towards agriculture and the environment, the question is about an analysis of interdependence in the sense that the set of attitudinal variables taken under closer inspection are assumed to have an equal status. This means that the variables, although expected to be interdependent, cannot be classified as dependent variables and explanatory variables (Chatfield and Collins 1980, pp. 7-8). Thus, the regression analysis and related methods are not applicable.

Methods that are the most often used to reveal interdependencies between variables with equal status are called the *principal component analysis* (PCA) and the *factor analysis* (FA). The principal component analysis is concerned with explaining the variance-covariance structure through a few linear combinations of the original variables. Although initially p components are required to reproduce the total system variability, often a small number, k, of the principal components can account for much of this variability. If so, there is almost as much information in the k components as there is in the original p variables. Thus, the original data set, consisting of n measurements on p variables, is reduced to one consisting of n measurements of k principal components. An analysis of the principal components often reveals relationships that have not been previously detected and thereby allows interpretations that would not ordinarily result otherwise (Johnson and Wichern 1982, p. 361). Furthermore, although the PCA accomplishes to some extent the explanation of the covariance structure through the factorization of covariance matrix, it is still merely a transformation rather than the result of a fundamental model for covariance structure. In this respect, the PCA also possesses other shortcomings: the forms of the components are not invariant under changes in the scales of the responses, and no rational criterion exists for deciding when a sufficient proportion of the variance has been accounted for by the principal components (Morrison 1976, p. 302).

The factor analysis shares the core ideas of the principal component analysis. The idea is to derive new variables called common factors, which are expected to give a better understanding of the data. The PCA produces an orthogonal transformation of the variables, which depends on no underlying model, whereas the FA is based on a proper statistical model. The FA is more concerned with explaining the covariance structure on the variables than explaining the variances. The part of the variation that is explained by common factors is called common

variance. Any variance which is unexplained by the common factors can be described as unique variance and it is explained by unique factors[27]. Furthermore, unique variance can be divided into error variance and specific variance. Error variance results from the imperfections of the test measurement. Thus, specific variance is the part of the total variance that is left, and it is related to individual variables and their qualities. Each FA model possesses some particular qualities that are not shared with any other FA model, and some portion of the variation arising from these qualities produces specific variance. Unfortunately, it is not possible to separate error variance from specific variance. Consequently, the fundamental distinction between the FA and PCA analyses is their outlook on unique variance. The presence of unique variance is taken into account in the FA, whereas in the PCA the intrusion of unique variance is ignored (Child 1990, pp. 28-30).

The factor analysis is clearly the preferred method in this case. When possible differences in attitudes expressed through several responses are sought, the primary task is not to construct new variables (= principal components) that would explain the total variance of the original variables as well as possible, but to group original variables in the form of a statistical model that explains as much as possible of the covariance and correlation among variables. Consequently, such latent variables can be found that convey essential information in a form that is easier to interpret than the information found dispersed over the original variables. Thus, if the original variables do not have a high correlation among them (positive or negative), it is not worthwhile to carry out the factor analysis (Ranta et al. 1989, pp. 474-476).

The basic factor analytic model is given by Equations F-1a and F-1b, the latter of which is a matrix form version of the first one. Both equations define the factor equation:

(F-1a) $$y_{ij} = s_{iI}\lambda_{jI} + s_{iII}\lambda_{jII} + .. + s_{iN}\lambda_{jN} + s_{iu}\lambda_{ju}$$

(F-1b) $$\underset{(p\times m)}{\boldsymbol{Y}} = \underset{(p\times N)}{\boldsymbol{S}}\ \underset{(N\times m)}{\boldsymbol{L}^{\mathrm{T}}} + \underset{(p\times N)}{\boldsymbol{S}_u}\ \underset{(N\times m)}{\boldsymbol{L}_u^{T}}$$

where $i = 1, 2, .., p$ (the number of subjects), $j = 1, 2, .., m$ (the number of observable variables), and $k=I, II, .., N$ (the number of latent variables or factors). The individual elements identified in Equation F-1a as s_{iI}, s_{iII}, ... , are the factor scores for subject i across the various factors. The matrix of factor

[27] It may be useful to clarify the concepts applied: A *common factor* can be defined as an unobservable, hypothetical variable that contributes to the variance of at least two of the observed variables. A *unique factor* is an unobservable, hypothetical variable that contributes to the variance of only one of the observed variables (SAS 1987, p. 451).

scores is denoted $\boldsymbol{S}$ in Equation F-1b with subjects as rows and factors as columns. The individual elements identified in Equation F-1a as λ_{jI}, λ_{jII}, ... , are called pattern elements or factor loadings for factors *I, II, .., N*. Instead of relating one observed variable to another observed variable, factor loadings relate factors to observed variables. The collection of factor loadings forms the factor pattern matrix, $\boldsymbol{L}$. Matrix $\boldsymbol{L}$ has variables as rows and factors as columns. Thus, the symbol y_{ij} in Equation F-1a denotes an observed element of $\boldsymbol{Y}$, where the first subscript denotes subjects, and the second subscript denotes the number of variables that have been obtained. In essence, $\boldsymbol{Y}$ becomes simply a data matrix and it is known as a raw-score matrix. Although the factor analytic model does not require raw scores to be scaled in any particular form, we usually assume that each column of $\boldsymbol{Y}$ is normalized with a mean of 0 and a standard deviation of 1.

The final term in Equation F-1a, $s_{iu}\lambda_{ju}$, is the product of two quantities that represent the unique variance. There is one unique factor for each variable in the model. The loading of each variable on its corresponding unique factor is given by λ_{ju} and, by definition, all other variables are assumed to have loadings of 0 on that factor. Moreover, the factor score of the subject on each unique factor has the same properties as the factor scores for the other factors. Of course, the inclusion of the term $s_{iu}\lambda_{ju}$ or its matrix counterpart $\boldsymbol{S}_u\boldsymbol{L}^T_u$ is optional. If the terms are included, the model is a classical form of a common factor model, and if not, then the model is a principal component model. (Bernstein et al. 1987, pp. 161-162).

An alternative and a more common notation to describe a factor analysis model is presented in Johnson and Wichern (1982, pp. 402-403). Suppose that the observable random vector $\boldsymbol{X}$ with m components (X_1, X_2, .., X_m) has a mean μ. The factor model postulates that $\boldsymbol{X}$ is linearly dependent upon a few unobservable random variables F_I, F_{II}, .., F_N, called common factors (the matrix $\boldsymbol{F}$) ($N < m$), and m additional sources of residual variation, e_j, so that

(F-2a) $$X_j = \lambda_{jI}F_I + .. + \lambda_{jN}F_N + e_j + \mu_j$$

or, in matrix notation

(F-2b) $$\underset{(m\times 1)}{\boldsymbol{X}} = \underset{(m\times N)}{\boldsymbol{L}}\ \underset{(N\times 1)}{\boldsymbol{F}} + \underset{(m\times 1)}{\boldsymbol{\varepsilon}} + \underset{(m\times 1)}{\mu}$$

Parameter λ_{jk} and matrix $\boldsymbol{L}$ are similar to their counterparts in Equations F-1a and F-1b, so that λ_{jk} is the loading of the j^{th} variable on the k^{th} factor and $\boldsymbol{L}$ is the matrix of factor loadings. The variate e_j describes the residual variation specific to the j^{th} variable (includes both error variance and specific variance) (matrix $\boldsymbol{\varepsilon}$

is the corresponding matrix and conceptually represents the same role as $\boldsymbol{S}_u\boldsymbol{L}^T{}_u$ does in Equation F-1b).

At this point, it is necessary to introduce the covariance matrix $Cov(\boldsymbol{X})$ often denoted by $\boldsymbol{\Sigma}$:

(F-3) $$\boldsymbol{\Sigma} = \boldsymbol{L}\boldsymbol{\Phi}\,\boldsymbol{L}^T + \boldsymbol{\Psi}$$

where $\boldsymbol{L}$ is the matrix of factor loadings, $\boldsymbol{\Phi}$ is the factor correlation matrix, and $\boldsymbol{\Psi}$ is a matrix that consists of the variances of e_js (later denoted as ψ_j).

Based on Equation F-2a and assuming that the common factors F_I, F_{II},..,F_N are independent of each other (i.e. $\boldsymbol{\Phi} = \boldsymbol{I}$), we can write

(F-4) $$Var(X_j) = (\lambda_{jI})^2 + (\lambda_{jII})^2 + \ldots + (\lambda_{jN})^2 + \Psi_j$$

The portion of the variance of the j^{th} variable contributed by the N common factors is also called the j^{th} communality or h_j^2. Thus, the communality h_j^2 depicts how large a portion of the variation related to the j^{th} variable X_j can be explained by the N latent variables or common factors. That portion of $Var(X_j)$ due to the unique factor is called the unique variance, as already mentioned above. Moreover, we can see that the j^{th} communality, h_j^2, is the sum of factor loadings of the j^{th} variable on the N common factors. (Johnson and Wichern 1982, pp. 402-404; Korhonen and Manninen 1994, pp. 61-62).

The independence of factors assumed in Equation F-4 means that the factor model is an orthogonal factor model[28]. Intuitively, if the common factors are independent of each other, it seems to be easier to interpret them. Furthermore, the residual variates, e_j, are assumed to be independent of one another and of the common factors, F_k. In addition, it is customary to assume that the common factors and the residual variates each have a multivariate normal distribution. The conditions for the orthogonal factor model are formally denoted in Equations F-5a, F-5b, and F-5c:

(F-5a) $$E(\boldsymbol{F}) = \underset{(N\times 1)}{0}\,; \quad Cov(\boldsymbol{F}) = E\left[\boldsymbol{F}\boldsymbol{F}^T\right] = \boldsymbol{\Phi} = \underset{(N\times N)}{\boldsymbol{I}}$$

[28] Another alternative is an oblique factor model. If the common factors F_k are correlated so that $\boldsymbol{\Phi}$ is not diagonal, the resulting factor model is the oblique factor model (Johnson and Wichern 1982, p. 403)

(F-5b) $$E(\varepsilon) = \underset{(m\times 1)}{0} \; ; \quad Cov(\varepsilon) = E\left[\varepsilon\varepsilon^T\right] = \underset{(m\times m)}{\Psi} = \begin{bmatrix} \psi_1 & 0 & \dots & 0 \\ 0 & \psi_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \psi_m \end{bmatrix}$$

(F-5c) $$Cov(\varepsilon, F) = E\left[\varepsilon F^T\right] = \underset{(m\times N)}{0}$$

In practice, it is seldom possible to give factor loadings a direct interpretation even in the case of the orthogonal factor model. Usually, some transformation is required. This is called factor rotation. The idea of factor rotation is to make the factors move closer to relevant variables in order to receive more easily interpretable factor loadings for each original variable. Theoretically, factor rotation is based on a certain feature of factor loadings known as the first form of factor indeterminacy. When $k > 1$, there is always some inherent ambiguity associated with the factor model. This can be seen by taking any orthogonal matrix, say $\boldsymbol{G}$, so that $\boldsymbol{GG}^T = \boldsymbol{G}^T\boldsymbol{G} = \boldsymbol{I}$. Now, Equation F-2b can be rewritten as

(F-6) $$\boldsymbol{X} = \boldsymbol{LF} + \varepsilon + \mu = \boldsymbol{LGG}^T\boldsymbol{F} + \varepsilon + \mu$$

Since the random vector $\boldsymbol{G}^T\boldsymbol{F}$ also satisfies the conditions expressed in Equations F-5a and F-5c, it is impossible, on the basis of observations on $\boldsymbol{X}$, to distinguish the loadings $\boldsymbol{L}$ from the loadings $\boldsymbol{LG}$. That is, factors $\boldsymbol{F}$ and $\boldsymbol{G}^T\boldsymbol{F}$ have the same statistical properties, and although the loadings $\boldsymbol{LG}$ are, in general, different from the loadings $\boldsymbol{L}$, they both generate the same covariance matrix $\boldsymbol{\Sigma}$. That is:

(F-7) $$\Sigma = \boldsymbol{LL}^T + \Psi = \boldsymbol{LGG}^T\boldsymbol{L}^T + \Psi$$

This indeterminacy in the definition of factor loadings can be resolved by rotating the factor loadings to satisfy an arbitrary constraint, such as $\boldsymbol{L}^T\boldsymbol{\Psi}^{-1}\boldsymbol{L}$ is diagonal or $\boldsymbol{L}^T\boldsymbol{D}^{-1}\boldsymbol{L}$ is diagonal $(D = diag(\sigma_{11}, .., \sigma_{mm}))$, where in both cases the diagonal elements are written in a decreasing order. At the moment, the most widely used orthogonal rotation method is probably the varimax method. Its rationale is to provide axes with a few large factor loadings and as many near-zero factor loadings as possible. This is accomplished by an iterative maximization of a quadratic function of the loadings. The specific function that the varimax procedure maximizes is the sum of the variances of the squared factor loadings within each column of the factor loading matrix, $\boldsymbol{L}$, where each row of loadings is normalized by its communality (Mardia et al. 1989, pp. 257-258, 268-270).

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