Monetary Valuation of Environmental Goods: Alternatives to Contingent Valuation

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Chapter 2
Monetary Valuation and Economic Theory

“All theory depends on assumptions which are not quite true. That is what makes it theory.” (Solow, 1986, p. 195)

Since all valuation methods considered in this thesis are based on part of the neoclassical welfare theory, it is important to critically review the relevant part of this theory and its assumptions. The purpose of the critique is not simply to attack mainstream economic theory with its “high-and-mighty attitude” (Solow, 1986, p. 196), but rather to broaden the terms of the theoretical basis of the valuation methods considered. Section 2.1 looks at the neoclassical welfare theory in more detail. Next, in section 2.2, two other economic approaches will be discussed: a look at monetary valuation from the perspective of institutional economics (2.2.1), and from the perspective of ecological economics (2.2.2).

2.1 Neoclassical Welfare Economics

Neoclassical welfare economics can be placed in two different contexts:

- the economy as a whole, in which case we speak of the general equilibrium theory;
- individual behaviour, in which case we speak of the theory of consumer (and firm) behaviour.

General equilibrium theory
The central issue in the general equilibrium model is the performance of the market and the scarcity on this market as measured by relative prices. The ultimate objective is to achieve a Pareto efficient allocation among individuals, that is, an allocation where it is no longer possible to improve the well-being of one individual without harming at
least one other individual. According to the First Theorem of Welfare Economics, a competitive market will –under certain conditions– yield a Pareto efficient allocation (Ng, 1983, pp. 56-59). The Second Theorem of Welfare Economics states that each Pareto efficient allocation can be achieved in a competitive market setting, provided that we depart from appropriate initial distributions of resources (ibidem). Within this framework, a study is made of the conditions under which a competitive equilibrium exists that is Pareto efficient.

The competitive market operates under the following conditions (e.g., Canterbery, 1995, pp. 92-93):

1. The goods are undifferentiated in the sense that it does not matter whom you buy from or whom you sell to;
2. Consumers have perfect information about the prices charged by the various producers;
3. Producers have perfect information about the prices charged by their competitors;
4. Sale and resale of the goods are costless;
5. Each individual consumer takes the price as given;
6. Each producer takes the market price for the good as given, at that price they can sell as much as they wish.

The first four conditions imply that only one price exists for a good. The last two conditions are often referred to as price-taking behaviour. In reality, however, these conditions are seldom met. One speaks of market failures if (competitive) markets fail to accomplish Pareto efficient allocations. The following forms of market failure are usually distinguished (Verhoef, 1996, p. 8):

A. increasing returns to scale over the relevant range (falling marginal and average variable costs curves)
B. non-price taking behaviour (market power)
C. external effects
D. public goods
E. imperfect information

This thesis deals with one of these market failures in particular, namely external effects. Environmental problems are seen as the consequences of unpriced scarcity related to environmental goods (Goudzwaard, 1970; Lambooy, 1972). These goods are unpriced either because no markets exist or because existing markets do not work properly. By putting a price tag on environmental goods, i.e., by internalising them in
the market, the environmental problems may disappear (at least from a neoclassical economic point of view). The basic thought behind this disappearance is that, if a certain natural resource becomes scarcer, the price will rise. The consequences of this price increase are twofold.

On the one hand, producers will be stimulated to look for possibilities of substitution for the older, more expensive resource. Neoclassical economists believe that substitution will always be technically feasible, so that a supply of the substitute is created (Odink and Schoorl, 1990, p. 84). On the other hand, the demand for the old resource will decrease as its price rises, so that a demand for a substitute is created. This mechanism is presented in figure 2.1 below.

Figure 2.1: The neoclassical substitution mechanism

Pigou (1877-1959) was one of the first (neoclassical) economists who focused on the subject of externalities. He distinguished the marginal social net product (MSNP) and the marginal private net product (MPNP). The MPNP is

"the contribution that is capable of being sold and the proceeds added to the earnings of the person responsible for the unit investment." (Pigou, 1924, p. 151)

The MSNP is equal to the MPNP minus the uncharged damage caused elsewhere and plus the uncharged benefits caused elsewhere. External effects are the result of a divergence between these social and private products, e.g., negative externalities exist when MPNP>MSNP. In the words of Pigou (1924, p. 161):

"Here the essence of the matter is that one person A, in the course of rendering a service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons C, D and E, of such a sort that technical considerations prevent payment
being exacted from the benefited parties or compensation being enforced in behalf of the injured parties.\textsuperscript{2}

In short, externalities are uncompensated positive or negative influences that are not expressed in the market, and that directly and unintentionally affect the production possibilities or welfare level of third parties.

**Individual behaviour**

Apart from the general equilibrium approach, we could take one step back in the study of neoclassical economics. Rather than looking at the economy as a whole (whether or not in equilibrium), it is possible to study neoclassical economics in terms of individual behaviour. In section 2.1.1, some basic concepts relevant to the study of individual behaviour are reviewed (like for instance utility maximization, individual demand curves and welfare measures). Next, in section 2.1.2, various assumptions that underlie the neoclassical model of individual behaviour are critically reviewed in order to understand which assumptions drive the conclusions generated by the theory.

In the rest of this thesis the individual behaviour approach prevails. The thesis does not deal with neoclassical theory in the Arrow-Debreu-Walras sense, but with particular neoclassical assumptions about individual behaviour.

**2.1.1 Neoclassical Basis of Monetary Valuation Methods**

To solve the problem of externalities, price corrections are needed. These price corrections can be determined with monetary valuation methods. Monetary valuation methods are based on two ideas from neoclassical economics, viz. the concept of utility and the maximization of utility by individuals.

The first idea is that the value of some good can be derived from an individual’s preference for that good, the so-called subjectivistic concept of value (Lamboooy and Opschoor, 1974a and b). It is assumed that people have well-structured preferences for all kinds of goods. These preferences are represented by a set of indifference curves. Indifference curves originate from the assumption that the utility derived from consuming goods and services can be captured in a utility function. Indifference curves are now defined as the locus of points representing combinations of commodities that yield the same level of utility. Such a utility function exists if preferences satisfy the neoclassical assumptions of choice and some additional assumptions. These will be discussed in section 2.1.2.
The second neoclassical idea concerns rational behaviour. Rationality implies that individuals will maximize their utility. In other words, they will try to reach the highest indifference curve given their budget constraint (which states that, at certain prices, one cannot consume more than one earns).

Let $U(X,Z)$ represent a utility function, where $X$ is a vector of $k$ market commodities $(x_1,x_2,\ldots,x_k)$, and $Z$ is a vector of environmental commodities. The amount of money available to the individual is represented by $y$, and $P$ is the vector of prices of market commodities $(p_1,p_2,\ldots,p_k)$. So, for the moment, we assume that environmental commodities are unpriced in a market context. The maximization problem for an individual can now be represented as:

$$\begin{align*}
\text{maximize } & U(X,Z) \\
\text{subject to } & PX \leq y
\end{align*}$$

This renders the Marshallian or uncompensated demand function for the market commodities: $x(P,y,Z)$. These demand curves track the price effects which occur when the provision of a commodity changes.

For market goods the Marshallian demand functions are observable. Since (unpriced) environmental goods are not traded in a market, the demand functions for these goods are not observable. One solution to this problem is to estimate the Marshallian demand curves via a surrogate market (for example, the travel costs method; cf. section 3.1 in chapter 3). However, there is a more fundamental theoretical problem that remains to be solved. This concerns the fact that nominal income is held constant as one moves along the Marshallian demand curves. Furthermore, it will become clear that, to measure welfare changes correctly, we need demand functions that compensate for income effects. These functions are called Hicksian or compensated demand functions because they are constructed by varying prices and income so as to keep the individual at the fixed level of utility (i.e., the individual is compensated for price or quantity changes). Let $U^*$ be the constant level of utility that results for the maximization problem described above. We can now give the dual maximization problem to obtain Hicksian demand curves:

$$\begin{align*}
\text{minimize } & PX \\
\text{subject to } & U'(X,Z) \leq U^*
\end{align*}$$
The solution to this problem is the expenditure function $e(P, U^*, Z)$ which gives the minimum costs of achieving a fixed level of utility ($U^*$), given prices ($P$) and the provision of the environmental commodities ($Z$). The derivative of this function with respect to price $p$, gives the Hicksian demand function for a market good $x$.

$$H_i(P, U^*, Z) = \frac{\partial e(P, U^*, Z)}{\partial p_i}$$

Similarly, the derivative of the expenditure function with respect to an unpriced environmental good $z$, gives the Hicksian inverse demand function, or put differently, the marginal willingness to pay for changes in $z$, (Freeman, 1993, pp. 74-81, pp. 99-100).

$$W_i(P, U^*, Z) = \frac{\partial e(P, U^*, Z)}{\partial z_i}$$

Where $W_i$ stands for the marginal willingness to pay or marginal demand price for environmental good $z$. If the value of the right-hand side of the expression can be inferred from survey data, then we have a point estimate of the marginal willingness to pay for $z_i$. This is also equal (in absolute value) to the slope of the indifference curve through the point at which the welfare change is being valued. If the derivative can be estimated as a function of $z_i$, then we have the marginal willingness to pay function for $z_i$.

**Monetary welfare measures**

According to the literature, the theoretical basis of some monetary valuation methods using stated preferences (like contingent valuation and conjoint measurement) is as follows (Bateman and Turner, 1993; Freeman, 1993, Hanley and Spash, 1993). The benefits (or costs) of some environmental improvement (or deterioration) correspond to the monetary equivalents of the utility changes of all people affected by the improvement (or deterioration). These monetary equivalents are certain constructed areas under the Hicksian (inverse) demand curves, called compensating or equivalent variation. Monetary valuation methods like contingent valuation and conjoint measurement use questionnaires to estimate part of the Hicksian (inverse) demand curves. Subsequently, the methods try to unfold the corresponding monetary equivalents by determining the compensating or equivalent variation.
The compensating variation (COM) is defined as the area under the Hicksian demand function at the initial utility level (that is, before the change) and it measures the money income adjustment necessary to maintain an individual at this initial utility level (Ng, 1983, pp.87-89). The equivalent variation (EV) is defined as the area under the Hicksian demand curve at the final utility level (that is, after the change) and it measures the nominal income adjustment to keep an individual at this final utility level (ibidem).

Traditionally, these two welfare measures apply to price changes, that is, to what extent does a price increase affect utility. In the case of a price change, it is implicitly assumed that one can freely vary the quantity of the goods consumed. So, described that way, COM and EV concern price-constrained goods and are constructed areas under the Hicksian demand curves $H(U_1)$ and $H(U_2)$.

However, in the case of environmental effects it is often not possible for the consumer to adjust the quantity of the good. For instance, if noise from an airport affects the neighbourhood, residents of that neighbourhood cannot adjust the noise level. This was first observed by Hicks (1943). He stated that, in case of a welfare loss, i.e., a price fall:

"What the compensating variation measures is the change in income required to offset the fall in price, not the change in income required to offset the change in quantity acquired. It becomes apparent that these are not the same thing. We must, therefore, distinguish between what I may now call the 'price-compensating variation' [...] and the 'quantity-compensating variation' [...]" (p. 35)

Furthermore, Hicks introduced the price-equivalent variation ($EV^p$) and the quantity-equivalent variation ($EV^q$). The price-compensating variation ($COM^p$) and $EV^p$ refer to price-constrained or market goods, while the quantity-compensating variation ($COM^q$) and $EV^q$ refer to quantity-constrained or unpriced environmental goods. These quantity-constrained welfare measures are constructed areas under the Hicksian inverse demand curves $W(U_1)$ and $W(U_2)$.

Table 2.1 summarises these various welfare measures.
Table 2.1: Welfare measures – a summary

<table>
<thead>
<tr>
<th>Welfare change</th>
<th>Price-constrained</th>
<th>Quantity-constrained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare gain</td>
<td>COM$^g$ EV$^g$</td>
<td>COM$^g$ EV$^g$</td>
</tr>
<tr>
<td>Welfare loss</td>
<td>EV$^g$ COM$^g$</td>
<td>EV$^g$ COM$^g$</td>
</tr>
</tbody>
</table>

In figure 2.2, the quantity-constrained welfare measures are explained graphically. In the upper panel of figure 2.2, the initial, pre-change utility level and the final, after-change utility level of a welfare gain are represented by the indifference curves $U_1$ and $U_2$. The environmental good under consideration $z$ is shown on the horizontal axis and all other goods $X$ and $Z$ are represented on the vertical axis. Furthermore, since $z$ is unpriced the budget line (BL) is shown as a horizontal line. Income is denoted by $y$.

The lower panel of figure 2.2 presents the Hicksian inverse demand curves $W(U_1)$ and $W(U_2)$, related to the pre-change utility level and the after-change utility level, respectively. Also, the Marshallian demand curve $MD$ related to income level $y$ is shown. The environmental good $z$ is shown on the horizontal axis and the ‘price’ or marginal willingness to pay for $z$ is represented on the vertical axis.

**Quantity-constrained goods**

Imagine a recreational site and suppose the authorities plan to increase the provision of recreation activities from $z_1$ to $z_2$.

This entails a welfare gain from $U_1$ to $U_2$ in the upper panel of figure 2.2. There is no price change, hence the budget line does not move. The individual moves from point $A$ to point $D$. In the lower panel, the welfare gain implies a shift of the Hicksian inverse demand curve to the right, from $W(U_1)$ to $W(U_2)$.

In this case of a welfare gain, COM$^g$ is the willingness to pay (WTP) to ensure the gain (the increased provision of $z$) and keep the individual at the initial level of utility. Despite the fact that $z$ is unpriced, its increased provision will have an income effect by releasing some of that income previously spent on priced goods. So, the higher provision of recreation releases funds for spending on other priced recreation goods.
*Because z is considered to be a normal good, the Hicksian inverse demand curves are steeper than the Marshallian demand curve, and since only small changes in $p$ and $z$ are considered, the demand curves can be treated as straight lines.*
This income effect is compensated by taking the area under the initial Hicksian inverse demand curve \( W(U_1) \) and above the horizontal \( z \)-axis, which gives us \( \text{COM}^q; z_1MNz_2 \), or, formally:

\[
\text{COM}^q = \int_{z_1}^{z_2} W(z, p, U_1, Z) \, dz - c(z_1, P, U_1, Z)
\]

Alternatively, \( \text{EV}^q \) represents the willingness to accept (WTA) if the quantity increase does not occur, and it measures the increase in income necessary to leave the individual just as well off, with or without the quantity increase. \( \text{EV}^q \) is the area under the final Hicksian inverse demand curve \( W(U_2) \) and the \( z \)-axis; \( z_1KLz_2 \), or, formally:

\[
\text{EV}^q = \int_{z_1}^{z_2} W(z, p, U_2, Z) \, dz - c(z_1, P, U_2, Z)
\]

In the upper panel, \( \text{COM}^q \) is equal to \( y_1 - y_2 \) (which is negative since it reflects the willingness to pay to ensure the gain) and \( \text{EV}^q \) is equal to \( y_3 - y_4 \) (which is positive since it reflects the willingness to accept compensation).

In the case of a welfare loss, i.e., a decrease in the provision of the environmental good from \( z_2 \) to \( z_1 \), the individual will start from point D (in the upper panel) and move to point A. \( \text{EV}^q \) now becomes \( \text{COM}^q \) and vice versa. The individual's WTP to avoid the loss is represented by \( \text{EV}^q \) (\( z_1MNz_2 \) in the lower panel), and his or her WTA to compensate for the loss is measured by \( \text{COM}^q \) (\( z_1KLz_2 \)).

**Conclusion**

To sum up the literature, preference-based valuation methods (like contingent valuation and conjoint measurement) are based on the neoclassical welfare theory, as they depart from the neoclassical concept of utility and the maximization of utility by individuals. These methods try to determine the compensating or equivalent variations corresponding to a utility change.

### 2.1.2 Problems with Neoclassical Assumptions about Behaviour

This section critically reviews the assumptions that underlie this neoclassical model of individual behaviour. The assumptions underlying this model are listed in table 2.2. Each one of these assumptions will be addressed separately.
2.1.2.a Assumptions of Choice

The neoclassical assumptions of choice involve completeness, reflexivity and transitivity (Kreps, 1990, pp. 21-24).

Completeness

The assumption of completeness says that any two bundles of commodities can be compared. So, people have preferences for all kinds of commodities, and they can rank these preferences by stating that commodity 1 is at least as good as commodity 2, or vice versa. However, it may very well be that respondents to monetary valuation surveys do not have pre-defined preference orderings for certain environmental goods, so that the assumption of completeness might be violated. For instance, most people have never thought about their preferences for the spotted owl or some other rare bird (Rubin et al., 1991). They have to construct their preferences in the process of answering the valuation questions in a survey. Therefore, the context and procedures in making choices or judgements influence the preferences that are implied by the elicited responses. This is contrary to the assumption that is often made –but that is seldom made explicit– called procedure invariance (Tversky and Kahneman, 1981 and 1988), which, in practical terms, implies that behaviour should not vary across situations that economists consider equal.

The assumption of completeness is violated if the procedures and contexts in the survey lead to an ambiguous ordering of preferences. For instance, according to procedure invariance respondents should not be sensitive to irrelevant aspects of the survey design, like the initial starting point x in a valuation survey ("Are you willing to pay $x?"). Evidence shows that in some studies statistically different starting price effects prevail (Farmer and Randall, 1995). Furthermore, this evidence suggests that,
as the number of starting-prices grows large and their range grows wide, the probability of observing significant starting-price effects becomes large, and with that the possibility of violation of completeness increases.

**Reflexivity**
The second assumption of choice is reflexivity. It is a trivial assumption stating that a commodity will always be at least as good as itself. The results in valuation studies do not necessarily satisfy reflexivity. That is, sometimes the same commodity—the same according to economists—is not at least as good as itself. The underlying reason is, again, procedure variance (Boyle et al., 1993).

When you ask people to rank some social issues (like protecting the environment, fighting crime, making highways safer, giving foreign aid to poor countries or improving public education), the rank given may depend on the order in which the issues are presented (e.g., Carson et al., 1992, p. 39). For instance, when protecting the environment is put first, it will be given the second highest rank, whereas when it is put last, it will be given the fifth rank. Provided that these issues are not close substitutes, protecting the environment is the same commodity when it is put first as when it is put last—at least from an economic point of view. Consequently, their rank should be the same, and if it is not, reflexivity is violated. To solve these question-order effects, it is often suggested to rotate the question order randomly (ibidem, p. 81).

**Transitivity**
The assumption of transitivity is the third assumption of choice. It states that if A is preferred to B and B is preferred to C, then A will be preferred to C. This assumption is necessary for any discussion on utility maximization, because, if preferences are not transitive, there may be sets of bundles of commodities which have no optimal element (Varian, 1992, p. 95). Empirical results, however, prove that people can have intransitive preferences (Tversky, 1969).

One form of such intransitivities are preference reversals (Grether and Plott, 1979). The preference reversal phenomenon involves a pair of gambles. One gamble (the H bet) offers a high probability of winning a modest sum of money; the other gamble (the L bet) offers a low probability of winning a relative large amount of money. When offered a choice between the two bets, most subjects choose the H bet over the L bet. However, when asked to state their lowest selling price (WTA), the majority states a higher price for the L bet than for the H bet (Tversky and Thaler, 1990). This results in the following intransitive pattern, where X is some cash amount: L>X and X>H, yielding L>X>H>L (Tversky et al., 1990).
In a valuation study, intransitivities could occur when respondents are asked to choose between three situations, A, B, and C, representing three different environmental qualities for a certain lake and the three accompanying prices, as shown in table 2.3.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Entrance fee</th>
<th>Water quality of the lake</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>£3.00</td>
<td>High: suitable for swimming</td>
</tr>
<tr>
<td>B</td>
<td>£2.50</td>
<td>Medium: suitable for boating</td>
</tr>
<tr>
<td>C</td>
<td>£2.00</td>
<td>Low: suitable for boating</td>
</tr>
</tbody>
</table>

Assume that a respondent uses the following rule to choose from the three situations: if the price difference is fifty cents or less, choose the situation with the higher water quality; if the price difference is more than fifty cents, choose according to price. Such a simple rule leads to: A>B, B>C but C>A and thus to intransitive choices. This is a form of a lexicographic preference ordering, in which alternatives are compared only on the most important dimension (e.g., environmental quality or price), unless equal scores are obtained, in which case scores on the second most important dimension are considered, and so on until the decision is reached.

2.1.2.b Rationality Assumption

The rationality assumption states that people are self-interested (not necessarily selfish) utility maximizers. The ‘homo economicus’ maximizes his or her own utility level, given their budget constraint. Within (neoclassical) economic theory, rationality simply implies that humans are motivated by increasing their personal utility or welfare. Very few actions take place that ultimately are not self-interested. However, it is important to note that economic rationality does not imply individual income maximization, since personal well-being or even personal welfare is not solely monetary.\(^8\)

Since rationality is defined in terms of utility, which is an unobservable concept, it can be a rather trivial assumption. It can even provoke a circular argument as behaviour is explained in terms of preferences, which in their turn can only be defined through behaviour (Sen, 1995, p. 46). That is, one can explain away almost every form of irrational behaviour by stating that, apparently, the action involved maximized the individual’s utility. For example, it might seem irrational for a person who is on a diet to stuff himself with chocolates and cookies. Nevertheless, his behaviour is apparently
utility maximizing, otherwise he would not do it, since by assumption all humans behave rationally.

Aaron (1994) gives a list of all kinds of irrational forms of behaviour, or so-called paradoxes or anomalies (p. 9). Here are a few examples:

"Why do people give to charity, when they derive little or no direct benefit from such actions?

Why do people act according to their preferences and then feel guilt or shame, resolve to act differently and, on occasion, even keep their resolutions?

Why do people buy lottery tickets with expected values far below the purchasing price?"

Likewise, results from valuation studies are not always consistent with rationality. For instance, rationality entails that respondents take into account their budget constraint and preferences; their stated WTP should be clearly related to their budget and preferences. In a valuation survey, the WTP bids should be expected to increase with the level of the respondent's income and assets.

Work by Loomis et al. (1994) shows that, in valuation surveys, respondents do not consider their budget constraints as explicitly as they would in real transactions. People do not seem to live up to the theory when considering their budget constraint. The reason could be that the hypothetical survey responses do not require the same level of consideration and financial commitment that real purchases do.

A study by Kemp and Maxwell (1993) indicates that, by simulating a more realistic budget context, the mean WTP diminishes dramatically. This implies that, in normal valuation studies, respondents dramatically overstate their true values, because of the hypothetical budget context. The approach chosen by Kemp and Maxwell is a top-down disaggregation by which respondents consider a much wider range of possibilities for the individual valuation of public goods. First, the respondents were asked to divide the amount of their current tax bill over eight social concerns. The interview next focused on the one for environmental protection. Subsequently, the environmental concern was further divided into nine pre-specified categories, and a tenth line item for any other environmental issues the respondent could think of. Finally, they in four steps disaggregated the total elicited WTP for environmental protection, down to the share for oil spills off the coast of Alaska. Using unedited data,
the single-focus survey results in a mean WTP of $84.80 and the disaggregated survey in a mean WTP of $0.29 (ibidem, p. 230).

The inconsistencies with rationality can be explained in various ways. In addition to the hypothetical character of the surveys, the once-only character is also important. Since people are not very experienced in valuing environmental goods and services, it is extremely difficult for them to come up with their monetary value in a one-of-a-kind offer. In a normal market situation rationality may be better approximated, as people practice daily in the purchase and thus in the valuation of goods (Blomqvist, 1989; Tietz, 1992).

Yet another very important explanation for the problems relating to rationality in a valuation study for environmental goods, is the distinction between private and public preferences. This distinction is suggested by i.e. Margolis (1982) and Etzioni (1988). People have (at least) a two-dimensional preference structure for public environmental goods and services. For instance, a person may love his car and hate the train, but still vote for politicians who promise to tax gasoline in order to subsidise public transport. On the one hand they have private or individual preferences, but on the other hand they have public or collective preferences for environmental goods, and the latter are often incompatible with the former. Whereas the former are related to private costs and benefits and private utility or satisfaction, the latter are related to social costs and benefits and to more benevolent and moral considerations.

Rational behaviour, in the sense of the private preference structure, does not have to be rational in the sense of public preferences. One example is freeriding: respondents understate their public preferences. According to their public preference structure people are willing to pay £20 to save a forest from deforestation, but since they expect other people to pay a similar price for the forest to be saved, they understate their public preferences and only state an individual WTP of £10. Another, opposite, example is an overestimation of the public preferences, in order to boost the benefits of saving the forest and thereby securing the provision. In this case, the stated individual WTP related to the private preference structure could be £30.

In the valuation surveys discussed in this thesis, a hypothetical market is created in which respondents are asked for their individual or private WTP for a public, environmental good. This can be very confusing to them, since they might mix up the two different preference structures in their minds. Consequently, the resulting bids look irrational in relation to both preference structures. Sagoff (1988) asserts that asking a person's economic, private value for the environment, is a category mistake.
"The kind of mistake you make when you predicate one concept on another that makes no sense in relation to it. [...] Private and public preferences [...] belong to different logical categories. Public 'preferences' involve not desires or wants but opinions or views. They state what a person believes is right for the community or group as a whole. [...] An analyst who asks how much citizens would pay to satisfy opinions that they advocate through political association commits a category mistake." (pp. 93-94)

Earlier (on page 55), Sagoff states that it is meaningless to try and find combined or inclusive preference orderings, since people have multiple preference schedules which are appropriate in different situations (family, work, politics and so on). When you ask people to state their combined preference, you ask them not to behave as a parent, worker, consumer or citizen, but instead as the homo economicus or rational man. However, such a person does not exist in reality, only in economic theory. Sagoff argues that it is more correct to ask the respondents to state their public preferences in a political referendum, which better suits the social dimension of environmental goods than does the (hypothetical) market.

2.1.2.c Strict Convexity of Indifference Curves

Strict convexity of the indifference curves implies a diminishing marginal rate of substitution.\textsuperscript{5} This indicates that people will pay less additional money as the environment further improves, or, put differently, the (Hicksian) demand curve slopes downward to the right. The following example shows that convexity is not always a reasonable assumption. Let us take an individual who, on the one hand, likes living in the centre of a big city, and, on the other hand, likes peace and quiet. In this case, convexity would imply that the individual moves to a quieter suburb of the city or to a smaller city. Strict convexity rules out the possibility that this person stays in the centre or moves to a rural and quiet village, rather than move to a suburb (which is a mixed set of the two goods).

The valuation literature is not unanimous on the question whether preferences are indeed convex. Some suggest that strict convexity tallies with the facts, as long as the increments in environmental quality are sequentially presented to each respondent and as long as large discrete changes are involved (Desvouges et al., 1987; Hoevenagel, 1994). Others do not agree (Navrud, 1989), or state that large changes do not satisfy other assumptions like the ceteris paribus assumption.
Desvouges et al. (1987) conducted a survey to value three different water quality levels in the Monongahela River (Pennsylvania, US). Each respondent was asked to sequentially provide bids for changes in certain levels of water quality. The results are summarised in Table 2.4.

The table presents the results for two different question formats (open-ended questions and payment-card questions). In both cases respondents value the change in water quality levels higher when the quality is worse; the better the quality gets, the less people are willing to pay for it. This is shown in the second column (AWTP), which exhibits the marginal rate of substitution between money and water quality. These results do conform to the assumption of strict convexity of preferences.

**Table 2.4: Estimated value for levels of water quality**


<table>
<thead>
<tr>
<th>Change in water quality</th>
<th>Open-ended questions</th>
<th>Payment-card questions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\text{WTP}_{\text{mean}}$</td>
<td>$\text{\textdollar WTP}$</td>
</tr>
<tr>
<td>Avoid a decrease from level D to E (stay at D)</td>
<td>$24.5$</td>
<td>$-$</td>
</tr>
<tr>
<td>Increase from level D to C (go to C)</td>
<td>$17.6$</td>
<td>$6.9$</td>
</tr>
<tr>
<td>Increase from level C to B (go to B)</td>
<td>$12.4$</td>
<td>$5.2$</td>
</tr>
</tbody>
</table>

E: unsuitable for any water-based activities (including boating)
D: the current level of water quality, boatable water quality
C: fishable water quality (level where gamefish would survive)
B: level where individuals could use the river for swimming

In another study, in which the questions were not posed sequentially to each respondent, the assumption of strict convexity does not hold. Navrud (1989) asked different groups of respondents to value a 30%, 50 and 70% reduction in European sulphur emission so that the freshwater fish population could grow. According to decreasing marginal rates of substitution, respondents should be willing to pay less for the extra 20% reduction from 50 to 70% than for the 20% reduction from 30 to 50%. However, Navrud did not find significantly different mean WTP values for the 30%, 50 and 70% reduction. Using a payment-card elicitation method, he found a mean WTP of 335 Norwegian Krones for the first group (30%, n=1,035), 291 NOK for the second group (50%, n=808), and 387 NOK for the last group (70%, n=189).
2.1.2.d Assumption of Local Non-Satiation

Another assumption underlying neoclassical theory is the assumption of local non-satiation. Preferences are locally insatiable if arbitrarily close to every bundle \( x \) another bundle \( z \) exists that is strictly preferred to \( x \). One can always do a little better, even if one is restricted to only small changes in the consumption bundle. In short, more will always be better.

Sometimes, stronger forms of this assumption are made, namely weak or even strong monotonicity of preferences. Preferences are weakly monotone if for any two bundles \( x \) and \( z \), such that each component of \( x \) is at least as large as the corresponding component of \( z \) (\( x \geq z \)), \( x \) is preferred to or as good as \( z \) (\( x \geq z \)), which simply means that at least as much of everything is at least as good. Strongly monotone preferences exist if for any two bundles \( x \) and \( z \), such that \( x \geq z \) and \( x \neq z \), \( x \) is strictly preferred to \( z \) (\( x > z \)), which implies that all goods are good and that more is always better. Which of these three (strong or weak monotonicity, local insatiability) forms of assumptions are made, differs from one author to another. Varian (1992, p. 97) states that strong monotonicity is a prerequisite for the existence of a utility function, whereas Kreps (1990, p. 33) merely assumes local non-satiation.

In the valuation context, respondents will value a large environmental improvement more than a small one (a descending demand curve). So, the implication of the local non-satiation assumption for valuation studies is quite similar to the implication of strict convexity as mentioned above.

However, the question is whether more is indeed always better. Surely, it seems reasonable to assume that the optimal combination of chocolates and ice-cream is not infinite. After some point, people start to value chocolates and ice-cream as negative goods, which no longer positively contribute to their utility. This point is called the blisspoint. After the blisspoint, the indifference curves are no longer nicely descending curves but they may even become circle-like curves. This is shown in figure 2.3, which will be discussed below.

Since many goods are like chocolates and ice-creams, in the sense that you can have too much of them, neoclassical theory does not seem to be very useful in practice. However, neoclassical economists respond to this assertion by stating that most (rational) people will not voluntarily choose more than they want. After all, why should you choose more than you want? In short, 'too much' or 'overconsumption' does not
exist in their jargon. According to them the most interesting part of the consumers’ problem is the part where people have too little, where scarcity exists and people are forced to make choices. In terms of figure 2.3, neoclassical theory is restricted to the quadrant $z^*Bx^*0$.

**Figure 2.3: Circle-like indifference curves**

Figure 2.3 features circle-like indifference curves ($l_1$, $l_2$ and $l_3$). The budget lines are presented as $BL$, $BL'$ and $BL''$. As long as people do not consume more than $(x^*,z^*)$, which is the blisspoint $B$, the assumption of local non-satiation or strong monotonicity is not violated. So, when the budget line lies below the blisspoint, all standard neoclassical demand functions can be deduced. However, if the tangency point of the budget line and the indifference curve lies above or coincides with the blisspoint, it is impossible to deduce nice, continuously descending demand curves. Above the blisspoint (e.g., $BL''$), rational individuals will always choose point $B$. Consequently, demand will be constant (i.e., demand = $(x^*,z^*)$) and individuals will not spend their entire budget $y (p_x x^* + p_z z^* < y)$.

Whether environmental goods behave like chocolates and ice-cream, or whether the need for them is really insatiable, is not an easy question to answer. In the literature on this subject (Leiss, 1978; Maslow, 1954; Scitovsky, 1986), often a dichotomy in needs is presented. On the one hand, needs are considered to be absolute in the sense that we feel them whatever the situation of other people (the first necessities of life: housing, clothing and food). On the other hand, relative needs exist which we feel only if their satisfaction lifts us above other people (status, friendship, creativity). Absolute
needs are satiable, whereas relative needs may indeed be insatiable (Keynes, in Daly and Townsend, 1993). Although environmental goods like clean air and water seem to satisfy absolute needs, other environmental goods may satisfy relative needs. An example is the access to scenic beauty. If only a few people have the means of access to the site, the advantages to them are very large, as is the social distance between them and those who cannot afford the costs. But as the general level of affluence rises, more people will visit the site, thereby diminishing the value of the experience.

The assumption of local non-satiation can be tested by asking the WTP for a large improvement and the WTP for smaller improvements. The valuation survey should elicit higher WTP values for the large improvement than for the smaller improvements. Desvouges et al. (1993) tested the hypothesis that “WTP estimates increase for higher levels of natural resource services” (p. 93). The questionnaire describes a regulation that would require wire-net covers on waste holding ponds to protect the migratory waterfowl. Three groups of respondents were asked through open-ended questions for their WTP for the regulation. The first group (n=398) was told that the regulation would prevent 2,000 deaths annually. For the second group (n=408) this number was 20,000, and it was set at 200,000 for the third group (n=399). The sample means for the three levels of protection were $80, $78 and $88 per year for the first, second and third group, respectively. The sample medians were $25 in all three groups. Formal statistical tests reject the hypothesis stated above and thereby the assumption of local non-satiation (and implicitly also the assumption of strict convexity).

2.1.2.1 Consumer Sovereignty

The neoclassical theory is based on the principle of consumer sovereignty, which states that the consumer himself is the best judge of what gives him utility. This implies that the preferences of individuals should count in the allocation of resources. However, when dealing with choices concerning environmental goods, consumer sovereignty is debatable.

A first point is that rational people are primarily concerned with maximizing their own utility level. Even if people behave in an altruistic manner, they take into account only part of the utility of other people. A second point is that most people are layman where it comes to understanding complex environmental issues, no matter how much information they are presented with in the survey. Thus, the responses may reflect inadequate understanding of the issues or of the nature of the commodity. The last, but perhaps most important point is that people do not have ready-made, well-structured
preferences for most environmental goods, viz. they may lack self-knowledge in the sense that they cannot properly relate the consequences of alternative choices to their preferences. Below, this issue in greater detail will be examined.

### 2.1.2.1 Well-Structured Preferences

Kahneman (1986, p. 192) observed that the basic presumption underlying monetary valuation methods is that people have a set of coherent preferences for goods, including non-market goods, and that these preferences can be uncovered using monetary valuation methods. Fischhoff (1991) refers to this assumption as the "philosophy of articulated values". It conveys the prevailing tendency of economists to construct models on the assumption that people maximize satisfaction based on given tastes, instead of by exploring the formation of preferences. Several other authors have also suggested that the construction of preferences may be common in valuation studies (Fischhoff and Furby, 1988; Fischhoff et al., 1988; Sagoff, 1994; Schkade and Payne, 1994).

In the following sections, evidence is presented which shows that respondents to valuation surveys do not, in general, have well-formed preferences about any relevant topic, and that they cannot directly retrieve an appropriate response to an elicitation question. This evidence refers to:

1. procedure variance (framing and information effects)
2. heuristics (compatibility and availability heuristics)
3. dual preferences (warm glow and intentions)

#### Re 1] Procedure Variance

Earlier, when discussing the assumption of completeness (section 2.1.2.a), we saw that procedure invariance requires different representations of the same choice problem to yield the same preferences. In other words, preferences for certain options should be independent of their descriptions. The evidence of such context dependence in valuation problems is significant (Rowe and Chestnut, 1983; Loke, 1989) and pertains to framing effects and information bias.

Framing effects occur when \( V(D_1) \neq V(D_2) \), where \( D_1 \) and \( D_2 \) are different but theoretically similar frameworks for the same good, and \( V \) is the WTP value for the good (Boyle, 1989). A first example is the framing of questions in certain or in chance events. Tversky and Kahneman (1981) call this the certainty effect:
“a reduction of the probability of an outcome by a constant factor has more impact when the outcome was initially certain than when it was merely probable.” (p. 455)

In the first experiment they asked people (n=85) to choose between the option of a sure (100% chance) win of $30 and a 80% chance to win $45. In this case, 74% chose the first option and 26% chose the second one. In a second experiment they asked this group of people the same question but reduced the probability by a factor 4, so that they had to choose between a 25% chance to win $30 or a 20% chance to win $45. Now, the first option was chosen by only 42% and the second option by 58%. A second example of framing effects is elicitation bias. Desvouges et al. (1993) and McFadden and Leonard (1993) found that the dichotomous choice response mode (“Would you like to pay fX? Yes or No?”) produced significantly higher expressed valuations than did the open-ended WTP response mode (“How much are you willing to pay?”).

Another illustration of the violation of procedure invariance is information bias (cf. chapter 3, section 3.2). Information effects are defined as changes in observable bidding behaviour induced by changes in the information about the commodity. One speaks of information bias if these information effects are undesirable (Bergstrom et al., 1989). In general, information effects are desirable if increasing the information about a positive characteristic of the good will increase the stated WTP and if information on substitutes or complements will increase cq. decrease the WTP according to the sign of the cross-price elasticity of the demand. In relation to the quantity of information, Boyle (1989) and Hanley et al. (1995) found that increasing the relevant information results in an increase in the mean WTP and its variance.

Re 2] Heuristics
A second example of the fact that preferences are not pre-established, is the frequent use of heuristics by respondents. In CVM surveys respondents have to absorb a lot of information since they are unfamiliar with environmental goods and the monetary valuation of these goods. Because their information-processing and judgement-making abilities are limited, respondents have to use heuristics (Harris et al., 1989). So, although it seems logical that people take cognitive short-cuts that reflect simplistic decision-making processes, it is important to note that the valuation results are probably different from the results that would be obtained if more complex sets of trade-offs were considered (Grether, 1994).
In the literature distinct kinds of heuristics are described (Tversky and Kahneman, 1974).

One example is the compatibility heuristic: the weight of a stimulus attribute is enhanced by its compatibility with the response scale (Tversky and Thaler, 1990; Tversky et al., 1988). For instance, if people have to choose between two bets, the cash equivalent of which is expressed in dollars, compatibility implies that the payoffs, which are expressed in the same units, are weighted more heavily in pricing bets than in choosing between bets.

A second example is the availability heuristic, which applies to situations in which people assess the frequency of a class or the probability of an event by the ease with which instances or occurrences can be brought to mind. For example, the fact that respondents already knew about the Exxon-Valdez oil spill before being informed and questioned about it, had a significantly positive effect on their WTP for a prevention program for similar oil spills (Carson et al., 1992).

**Re 3] Dual Preference Structure**

When asked to give their private value for a certain environmental good, respondents may think that they are asked either “what is this good worth in general, from a social point of view”, or “what do I want the government to pay for this good”. So, respondents are not sure whether they are asked for their private or their public preference for that particular, mostly public, commodity. This was also discussed in section 2.1.2.b when the rationality assumption was considered.

Because of this lack of clarity about which preferences (private or public) are meant, respondents may merely state an overall preference for the preservation of the environment. This is referred to as “warm glow” (Diamond and Hausman, 1993), “moral satisfaction” (Kahneman and Knetsch, 1992 a and b), “the good cause dump” (Smith, 1992), or “symbolic bias” (Mitchell and Carson, 1989).

The warm glow theory argues that, if people give charitable contributions largely for the pleasure of giving, it is also plausible that they will give high values in valuation surveys. The Kahneman and Knetsch argument indicates that the responses to valuation questions express a willingness to acquire a sense of moral satisfaction, instead of a preference for a public good. This argument is somewhat trivial from an economic-theoretical point of view. After all, economic theory suggests that people indeed only pay to maximize their utility or well-being. Whether you call that the purchase of moral satisfaction or the maximization of utility, does not make any
difference in that respect (Harrison, 1992). The good cause dump hypothesis is probably a more meaningful idea for interpreting WTP bids. Respondents have a basket of good causes. When one of these causes is valued in a valuation survey, they will dump their valuation for the whole basket into the stated WTP, since they do not have or cannot come up with a well-structured preference for the good in question. Finally, symbolic bias occurs when respondents react to an amenity's general symbolic meaning instead of to the specific levels of the provision described. It is a propensity to respond to the symbol rather than to the substance.

2.1.2.g Ceteris Paribus, Time Dimensions and Complete Certainty

Most of the standard welfare analysis is carried out 'ceteris paribus'. The ceteris paribus condition claims that, apart from the environmental changes under consideration, all other factors are fixed. That is, preferences, quantities, all other prices, income, technical coefficients and household size are presumed to remain constant. One speaks of a marginal analysis or the so-called partial equilibrium analysis (Kreps, 1990).

In general, this is not a very realistic frame of mind, since often relatively large environmental changes are considered in valuation studies. The scale and the scope of these changes are massive and involve all other prices and other factors. Furthermore, a series of small incremental actions can add up to something significant. So, evaluating them in isolation with fixed price models, even if the prices used are the 'right' ones, can in aggregate be deceiving.

The ceteris paribus condition is more likely to hold for short periods of time, since it is more likely that factors like income, prices and preferences remain constant in the short run. This is one of the reasons why almost every valuation study is constructed in a timeless world.

Another reason is that a timeless world is much easier to analyse, because then the question of how to aggregate values that are realised at different moments in time and that might vary from one moment to another, does not have to be answered. On the other hand, according to Freeman (1993, chapter 7), this intertemporal aggregation issue cannot even be dealt with, due to the indefiniteness of a correct social discount rate. In most cases, the 'objective' rate of time preference, or the market interest rate, is used as an approximation. However, a single market interest rate does not exist, since a choice has to be made from the many different interest rates that exist in the market.14
Apart from the fact that the correct social discount rate is indeterminate, an ethical problem prevails. By choosing the discount rate, economists take an ethical position about the claims of future generations (Spash, 1993). At any positive discount rate the future is treated as being less important than the present.

Yet another rationale to regard merely the short term in valuation studies, is the fact that uncertainty decreases in the short run. Most neoclassical welfare analyses assume complete certainty, or at least uncertainty that is predictable in terms of chances. In reality, however, much uncertainty prevails. Uncertainty can take two forms (Freeman, 1986). The first one is supply uncertainty, which concerns the effects of suggested policies and programs on the existence or supply of the environmental good, the resulting costs, and the costs-bearers. The second form of uncertainty is demand uncertainty. Persons could be uncertain about their demand for an environmental good due to uncertainty concerning their income, uncertainty concerning the prices of complement or substitute goods, or uncertainty concerning preferences.

In some studies supply-uncertainty is part of the study (Johansson, 1988; Meier and Randall, 1991). A concept which has received considerable attention in the literature, is the concept of supply-side option value. This value concept is important in situations where an individual demands a good in the future, such as a visit to a natural park, but is uncertain about the fact whether the park will be available then. The supply-side option value is an extra payment, or risk premium, to ensure the future availability of the park (Johansson, 1988). According to Bishop (1988), the option value will be positive, provided that people are risk averse: people who do not like risk and uncertainty are willing to pay more to ensure the provision of the park than people who like to take a chance. Assuming that most people are risk averse when it comes to environmental goods, the true value of the park will be underestimated if we simply estimate the future use of the park, since that only gives the expected consumer surplus and ignores uncertainty and hence also the option value.

2.1.2. Conclusions

In this section, part of the neoclassical theory of individual behaviour was reviewed. Although some of the neoclassical assumptions about behaviour are criticised here, it is not the intention to completely discard the theory or its assumptions. In many situations (like when buying goods in the supermarket) the model is indeed successful. Moreover, sometimes we simply do not have an alternative.
If our purpose is to establish monetary values or prices for environmental goods, we simply will not be able to get around certain elements of the neoclassical theory because monetary valuation methods are based on this theory, i.e., the Hicksian analysis of demand and/or various assumptions about individual behaviour.

However, it is important to consider the assumptions under which these monetary valuation methods give valid and reliable results. By considering these assumptions, other factors come to the front that can clarify the analysis and put it in a certain perspective, namely the institutional background. The next section deals with these institutional factors, both from the viewpoint of institutional economics and from that of ecological economics.

### 2.2 Other Economic Approaches to Monetary Valuation

The most essential institutional criticism of neoclassical economics, is the fact that neoclassical analysis works with narrowly closed models, thereby limiting the analysis to too few conditions (Myrdal, 1978). The economy is an open, evolutionary and dynamic system. Preference structures, technological innovation and legal systems are not exogenous but endogenous to the economy. Institutionalists attempt to explain the dynamics of economic transformation by including these factors in their analyses. In order to do so, institutionalists need to borrow insights from other social disciplines like psychology, sociology and law.

Ecological economics also entails an institutional approach, extending the domain of institutional economics to include environmental or biospheric constraints. Ecological economics does not just borrow some insights from other disciplines, it is for a large part based on another discipline, namely ecology. This fundamental emphasis on the interdisciplinary character of economic analysis ('economics is not enough'), makes it hard to be acceptable to neoclassical economists. Moreover, ecological economics is more radical and ethical in its convictions than is the general institutional approach, which makes it even more unacceptable to neoclassicals.

Figure 2.4 demonstrates the different domains of neoclassical, institutional and ecological economics.
2.2.1 Institutional Economics

Institutional economics started in the United States in the last two decades of the nineteenth century. The founders of the institutional approach were Veblen, Mitchell and Common. Later, the theory has been further developed by, among others, Myrdal, Galbraith and Ayres (Canterbery, 1995, p. 244). The institutional criticism of neoclassical theory can be categorised in three themes. Below, these three themes will be discussed briefly.

1. Rejection of rationality in terms of individual utility maximization
2. Rejection of the general equilibrium approach
3. Inclusion of institutions in economic analyses

Re 1] Rejection of rationality in terms of individual utility maximization

Instead of by the neoclassical assumption of independent, subjective and individual consumer preferences, consumption in the institutional framework is determined by social and cultural considerations. This means that what is rational is not just a question of the consistency of preferences or the individual calculation of an optimum, but rather of developing common perspectives and generating norms and rules for what is preferable and appropriate. In the words of Buchanan (1994, p.123): "persons impose
internal constraints that restrict choice to those alternatives considered to be attainable within the 'rules'."

Re 2] Rejection of the general equilibrium approach
Institutional economics is about change, about the dynamic evolution of economies. These changes are interpreted in terms of changes in the social and technological structures. Within the social system there is a causal interdependence; there is no one basic factor, everything causes everything (Myrdal, 1978, pp. 773-774). There is neither equilibrium, nor is there a natural tendency towards equilibrium.

Re 3] Inclusion of institutions in economic analyses
Economic change cannot be explained by focusing solely on typical economic factors such as markets, prices and exchange relations, since markets and market processes do not operate in a vacuum but within an institutional structure that defines rights and duties, obligations and opportunities (Bromley, 1991). Consequently, economic change should be viewed from a framework of social, political, legal, historical as well as economic perspectives. In other words, economic change should be analysed in terms of changes in all kinds of institutions. Although little agreement exists among institutionalists on what the term institution actually means, it is generally referred to as a set of rules (Ostrom, 1986) or, alternatively, as a social organization which, through the operation of tradition, custom or legal constraint, tends to create durable and routinised patterns of behaviour (Hodgson, 1988).

Neo-institutional and new institutional economics
Nowadays, two institutional movements can be distinguished. The first is called neo-institutional economics. It has its roots in the institutional economics as reviewed above, and deals with much of the same subjects as the 'old' institutionalists, like values, norms, and social, legal and political structures. Hodgson is the leading figure in this tradition of neo-institutionalist thought. The second institutional movement is called new institutional economics. Generally, Coase, Williamson and North are considered to be the three leading new institutionalists. Their theory is based on ideas about transaction costs, as stated by the 'old' institutionalist Commons, as well as on neoclassical economic theory. Therefore, new institutionalists are sometimes called neoclassical institutionalists (Vira, 1997).

The two institutionalist movements differ on several vital features. For new institutionalists the standard neoclassical approach, based on the rational choice model, is to be extended, perhaps modified, but not abandoned. Institutions are defined as organizational and not as social structures. Individual choice of economic actors is the
basis for explaining the institutional system. For neo-institutionalists the rational choice model is to be abandoned in favour of a model that places economic behaviour in its social and cultural context (Rutherford, 1995). In this line of thought, institutions are social structures, the same as with the 'old' institutionalists. Neo-institutional economics attempts to explain economic behaviour by looking at institutional elements, instead of the other way around.

The solutions to environmental problems also differ between new institutional and neo-institutional economics.

**New institutionalists and environmental problems**

Most new institutionalists put transaction costs, property rights and negotiation schemes at the centre of their analysis. A famous example is the analysis by Coase (1960), who challenged Pigou’s long-standing conclusion that externalities require government intervention via some corrective tax. Coase argued that, in the absence of transaction costs, but with the existence of well-defined property rights, the victims and suppliers of externalities can benefit from direct negotiations, without government intervention, provided that the law ensures the structure of property rights.

For instance, the residents near an airport could negotiate with the airport authorities and airline companies about monetary compensation for the noise nuisance (cf. chapter 6 of this thesis). If the residents hold the property rights, the airport authorities could offer to compensate them by some amount larger than the costs entailed by the noise nuisance. Alternatively, if the property rights are vested in the airport authorities, the residents could offer to compensate the authorities for giving up a certain amount of air traffic. However, if the transaction costs are high (i.e., the costs of information, the costs of identifying, organizing and representing the parties, the costs of bringing the parties together, and the costs relating to the actual negotiation itself), they might outweigh the potential benefits of negotiations, thereby preventing a bargaining process. In this case, solving the environmental problems would require institutions to reduce transaction costs, such as a government agency responsible for informing both parties and identifying, organizing and representing the parties involved.

Note that the Coasian way of modelling negotiations is rather neoclassical (strict convexity, rationality, and other assumptions apply). But by including property rights and transaction costs in the analysis, Coase adds an institutional element when compared to the standard neoclassical modelling of externalities.
Neo-institutionalists and environmental problems

The solutions suggested by neo-institutionalists is aimed at changing people's behaviour via all kinds of institutions, not just via prices or property rights. Neoclassical economists recommend the creation of monetary incentives that force users of environmental goods and services to take account of the opportunity costs of their behaviour. Monetary incentives and disincentives are targeted at specific activities. They are not aimed at changing the underlying value system of individuals, but rather focus on the relative prices of alternative actions. The value of neo-institutional analysis is that it allows for the possibility that behaviour is influenced not only by monetary incentives but also by education, social norms, customs and culture patterns (Lambooy, 1981; Santopietro, 1995).

Since the market system alone produces neither the norm nor the institutions necessary to implement environmental norms and rules that are present in society, neo-institutionalists recommend norms which are formed exogenously to the economic system. An example is the safe minimum standard approach, which entails that, under reasonable allowances for uncertainty, threats to the survival of valuable resource systems are eliminated, provided that this does not entail excessive costs (Perman et al., 1999, p. 186). It sounds imprecise, but it is deliberately fuzzy because such an approach does not rely on a single criterion. Neo-institutionalists ascribe an important role to politicians and the government when it comes to the interpretation and implementation of these norms. Contrary to neoclassicals and even new institutionalists, they advocate an active and stimulating government (Lambooy, 1973).

Neo-institutional economics and monetary valuation

Neo-institutionalists contend that not all values are reducible to monetary measures, and that prices are not accurate measures of a resource's value to society, "so cost-benefit analysis is immediately suspect " (Swaney, 1987, p. 1767). Moreover, Swaney argues that "cost-benefit analysis is also plagued by implicit assumptions " (p. 1768). This refers to the fact that monetary valuation techniques are analytical devices for considering values from within an existing institutional (resource endowment) environment (Lambooy and Baarsma, forthcoming). The outcomes of monetary valuation studies vary, for example, with income and wealth distribution, with power structure and law. Then, what needs to be recognised, is that it is the institutional structure that defines these monetary values, and that it is meaningless to use these values as a decision or policy criterion in an institutional analysis. Besides, valuation is not just about monetary valuation. Reasoning in terms of institutional economics points instead to a broader interpretation of valuation. Valuation is then connected with the ideological orientation of individuals as actors in the economy. Valuation means
discriminating between "good" and "bad", between goodness and badness (Söderbaum, 1994).

The outcomes of a monetary valuation study should be placed in its institutional background. For example, income distribution, technology, market structure, property rights, consumer preferences and cultural values are all assumed to be structurally stable in neoclassical analyses. Nonetheless, in practice these institutions are dynamic entities. Here, the income distribution and cultural background are considered in further detail.

**Income distribution**

In monetary valuation studies individuals are asked for their WTP for changes in the provision or quality of a particular environmental good. When aggregating these individual valuations for an environmental good, the idea of 'one dollar, one vote' is used. This implies that people with the largest budget (the rich) care most about the environment. After all, in the neoclassical framework valuations are not just about the preferences of people but also about the ability to pay for the good in question. The outcome of a valuation study depends on the distribution of income, and if this outcome were treated as an acceptable price, the existing income distribution is assumed to be an acceptable basis for decision making (Mäler and Wyzga, 1976). Neo-institutionalists argue that we should be careful using the outcome of a monetary valuation study in an efficiency analysis. Since income distribution is one of the institutional elements that determine what is efficient, the income distribution determines the outcome of the valuation process (Lambooy and Baarsma, forthcoming).

In fact, negotiations à la Coase suffer from the same drawback. The Coase theorem states that the initial distribution of property rights is irrelevant with respect to the efficiency of the outcome. Within the neoclassical context this seems a completely valid statement, since efficiency is all that matters and equity is not an issue. However, the initial distribution of rights has severe consequences for the income distribution, viz. the income position of the victims deteriorates if they do not have the rights and thus have to compensate polluters. So, the initial distribution of rights is indeed relevant, since it determines the institutional setting and thereby the results or outcome of the negotiations. If one changes the distribution of rights, or any other institutional element for that matter, there will be a new efficient outcome.
Cultural background

Monetary valuation methodology has been developed chiefly in the United States. Sometimes monetary valuation methods, like contingent valuation, are referred to as exemplifying a typically American tendency to quantify that which is best left unquantified (Bockstael and Strand, 1994, p. 83). Nowadays, these methods are being applied internationally, but there might still be some truth in the above stated view, as putting a monetary value on environmental goods is not accepted everywhere. Particularly in developing or low-income countries, people might not be willing to pay for the environment simply because they have no money left, or because they are not used to thinking in terms of monetary values. Trade often does not take place in terms of monetary prices, but in terms of goods. People trade one good for another (for instance, meat is traded for fuel).

Another example refers to countries with high tax rates, where people might not be willing to pay as individuals for the provision of a public good. For instance, the Anglo-American (taxation) culture is much more individualistic than the European (taxation) culture. Consequently, individual payments for environmental goods fit the Anglo-American culture better than the Western European culture.

Let us elaborate on this latter point. In the US and the UK, the provision of (quasi-)public goods is often left to the market, whereas in Western Europe the provision is secured by tax payments and government intervention. Americans are used to pay access fees to go to beaches or to go hunting in the wilderness. Another factor that makes Americans more comfortable with monetising the environment, is the overwhelming number of court cases in which a monetary compensation is demanded (and awarded) for many kinds of suffered damage, whereas in the rest of the world such compensations would not be awarded. On the other hand, Europeans are not used to these individual payments for public goods and liability claim practices. Therefore, people in Europe are less willing to pay for a public good for which they already pay taxes.

Bohm (1979, in Harison et al., 1995) reports a fascinating instance of one such 'failed' experiment where subjects were being recruited to provide valuations for a public good, namely an extension of a bus route. Prior to the experimental sessions, the participants met and decided to boycott the experiment since it might result in them having to pay for a good that had traditionally been provided through general government revenues, or result in a proliferation of user-fees in other fields.
A final illustration relates to cultural values and property rights. In Western Europe, free entrance to public and often even to private nature reserves (forests, dunes, footpaths and so on) is quite common. This custom has implications for the design of a valuation study about nature reserves. In Denmark, Dubgaard (1994) conducted a contingent valuation survey to estimate the WTP for access to a semi-cultural landscape managed for recreational and amenity purposes. However, since Danish legislation guarantees free access to non-consumptive recreational activities on public forest land, beaches et cetera as well as on private territory, most Danish respondents would undoubtedly consider actual user payment for access illegitimate. Therefore, the hypothetical nature of the WTP question was emphasised (ibidem, p. 152):

"How much are you willing to pay for an annual pass that gives you unrestricted access to the area for one year? [...] NB! No plans exist to charge the public for admission to recreation areas in Denmark. The answers will be used for scientific purposes only."

This is the complete opposite to what American CVM practitioners consider as a basic requirement for a CVM survey to give valid results, namely to make the CVM setting as real or market-like as possible (Arrow et al., 1993). Nonetheless, in this case the CVM had to be adapted to fit the Danish culture.

In short, a WTP question might mean different things to different people or communities. WTP values depend on cultural aspects of the people in the country or community involved, viz. the extent to which the population is aware of associated and monetary values (UNEP, 1994).

**Alternatives to monetary valuation in project appraisals**

Considering the above mentioned ideas, neo-institutionalists would not typically recommend a monetary valuation study and an accompanying cost-benefit analysis when contemplating projects to reduce environmental problems. Instead, they would advise methods like multi-criteria analysis, positional analysis, or values juries.

In a multi-criteria analysis the effects of possible projects (A.) on various criteria (C,) are weighted with some (subjective) factor (W,) and then added for each project (see figure 2.5). Using these particular criteria and weights, the project with the highest score, is conceived of as best. Of course, one of the criteria could be a monetary criterion concerning costs and benefits. Yet, other criteria, like the toxicity of the effects, the
vicinity of potential victims or the number of hectares of natural habitat lost, are included as well.

**Figure 2.5: Schematic representation of multi-criteria analysis**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Alternatives</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁</td>
<td>K₁, K₂, K₃</td>
<td>W₁</td>
</tr>
<tr>
<td>C₂</td>
<td>L₁, L₂, L₃</td>
<td>W₂</td>
</tr>
<tr>
<td>C₃</td>
<td>M₁, M₂, M₃</td>
<td>W₃</td>
</tr>
<tr>
<td>C₄</td>
<td>N₁, N₂, N₃</td>
<td>W₄</td>
</tr>
</tbody>
</table>

Positional analysis identifies how interest groups are affected by alternative policy options, given the position the groups are in (Söderbaum, 1994, pp. 14-20). It differs from (neoclassical) cost-benefit analysis in the sense that people in a particular situation S₁ are allowed to react differently, instead of assuming that all people react in the same way (viz., according to the neoclassical assumptions about individual behaviour, such as rationality). The main purpose of positional analysis is to illuminate the decision situation. It uses questionnaires and dialogue techniques of a more qualitative kind, in order to find out what ideologies are held by various parties, how particular decisions might affect them and how they would react. The idea is that, when no consensus can be assumed regarding valuation rules, one has to refer to more than one valuational standpoint that may be relevant to decision makers and those affected (viz., transportation, energy management or health care ideologies). Positional analysis is more modest than cost-benefit analysis, in the sense that no unanimous conclusions are drawn but, instead, the analyst acts as a facilitator in a public dialogue, seeking conclusions conditional to possible futures and valuational standpoints. The outcome of a positional analysis is not a one-dimensional monetary value, but something like: assuming valutional or ideological orientation V₁, then alternative A₁ may be preferred, whereas if some other valutional orientations are articulated, V₂ and V₃, may point to other alternatives as preferable.

A final example of a method that neo-institutionalists could advise when contemplating environmental projects, is the implementation of a values jury, as proposed by Brown et al. (1995a). The idea of such a values jury stems from the use of juries to decide guilt, innocence, responsibility, compensation and penalty, which is a well-established legal
institution in the United States. Therefore, in principle, the application of this institution to matters of value in natural resource allocation is a natural and logical extension that fits in the American cultural background. Brown et al. (1995a, p. 251) assign the following two roles to a values jury: (1) to assist in the selection of a course of action, such as land management alternatives, and (2) to recommend a value magnitude, such as the magnitude of a damage payment. Like the juries already institutionalised, the values jury should consist of reasonable people, free of significant personal conflicts of interest, who are willing and able to understand the issues and consider them objectively. Because of this election mechanism, the jury approach avoids the problem of undue influence exerted by interest groups. Moreover, it avoids the problem of poor information by taking the time (i.e., several days if necessary) to inform the jurors adequately.

2.2.2 Ecological Economics

Ecological economics has been developed in the seventies by economists like Boulding, Daly and Georgescu-Roegen. It is a reaction to the dominant neoclassical theory, because:

"Neoclassical economics lacks any representation of the materials, energy sources, physical structures, and time-dependent processes that are basic to an ecological approach. Worse, it is inconsistent with the physical connectivity and positive feedback dynamics of energy and information systems." (Christensen, 1991, p. 76)

However, ecological economics is more than just a reaction to neoclassical theory. It is an attempt to combine several disciplines, viz. (neo-)institutional economics on the one hand and ecology on the other hand. It is interdisciplinary, with the intent to make economists more cognisant of ecological impacts and dependencies, and to make ecologists more sensitive to economic forces, incentives, and constraints. Ecological economics concentrates on, among other things, the following three problems (Costanza and Folke, 1997):

1. Assessing and insuring that the scale of human activities is ecologically sustainable ('sustainable scale');
2. Distributing resources in an ecologically efficient way, and not just economically efficient, within the current generation of man, as well as between this generation and future generations and between man and nature ('efficiency');
3. Seeking social fairness, in the sense that income and wealth are more equally distributed among people ('social fairness').

Basically, ecological economics broadens the limits of the economy by viewing the economy as a subset of the ecosystem.

**Relative versus absolute scarcity**

Ecological economics uses two distinct concepts of scarcity: relative scarcity and absolute scarcity. This distinction seems irrelevant since all scarcity is relative, in the sense that it is relative to wants or needs. But the concept of scarcity as used by the ecological economists, refers to resources instead of needs. Yet, the terms relative and absolute scarcity are still a bit vague, even though they refer to resources instead of needs. After all, scarcity has a subjective context, in the sense that it is related to the satisfaction of needs: scarcity increases when it becomes more difficult to find means to satisfy needs. Consequently, scarcity is always relative, it cannot be absolute. Perhaps it is better to speak of stocks, or reserves, rather than of absolute scarcity. In order to avoid any confusion when discussing ecological economics, we will adhere to the ecological economists' jargon and use the term absolute scarcity where one should actually use the term stocks or reserves.

Relative scarcity relates to "the scarcity of a particular resource relative to another resource, or relative to a different (lower) quality of the same resource" (Daly, 1992a, p. 39). Sometimes this is referred to as Ricardian scarcity, after David Ricardo (1772-1823) (Pearce, 1993). Absolute limits are not breached, but the costs of harvesting, extracting and using a resource rise when more resources are put into development, since the resources of the highest quality which are cheapest to process will be put into use first, and each subsequent resource used will be of a lower quality. This is called the law of diminishing returns. The solution to relative scarcity is substitution: as a resource becomes scarcer, its price will rise and it will be substituted by other, less scarce and less expensive resources (cf. figure 2.1 in section 2.1 of this chapter).

Ecological economists are convinced that the concept of relative scarcity is not broad enough since it does not contain absolute limits. Therefore, they define the concept of absolute scarcity as "the scarcity of resources in general, the scarcity of ultimate means" (Daly, 1992a, p. 39). Absolute scarcity increases because of the rising population and per-capita consumption, and occasionally it is alluded to as Malthusian scarcity, after Thomas Robert Malthus (1766-1834). According to Malthus, infinite economic growth is impossible, since the population has a natural growth rate described by a geometric progression, whereas the natural resources necessary to
support the population grow at a rate similar to an arithmetic progression. This absolute scarcity cannot be 'resolved', even if the invention and employment of resources which are less scarce might provisionally alleviate it.

The fact that the distinction between relative and absolute scarcity can be very confusing, even to ecological economists themselves, is illustrated by the story in figure 2.6.

**Figure 2.6: One bet on two different kinds of scarcity**

Source: ISEE 1997

This story is about a bet between an ecological economist, Paul Ehrlich, and a neoclassical economist, Julian Simon. Ehrlich bet that the prices of a series of metals would *go up* over ten years because they were getting scarcer, while Simon said that prices would *fall* because these metals were getting abundant. Environmentalists knew that these metals were not spontaneously generating beneath the earth’s surface, and that their high quality reserves were being consumed at quite a rapid pace. Consequently, the environmentalists expected Ehrlich to win the bet. However, he did not.

Why not? Because Ehrlich never considered the question of the kind of scarcity that was at issue. When looking at price movements, the concept at stake is scarcity in the market place (that is, relative scarcity) and not the physical scarcity in the ground of highly concentrated resources, which is connected to absolute scarcity. As it turned out, the physical scarcity of the high-quality ore bodies increased over the ten years, as Ehrlich knew it would, but scarcity in the market place declined over the same time, and it was this relative scarcity that drove the prices down.

According to ecological economists, neoclassicals think in terms of relative scarcity and not in terms of absolute scarcity. Absolute scarcity is not important, because, with the appropriate price rates, new resources, materials and processes can and will be found and developed, as a result of which the limits will constantly widen. Because of this continuous process of technological development, absolute limits do not exist; only relative scarcity exists, which can merely lead to temporary problems (Baarsma, 1996a). Neoclassicals have an unbridled belief in the feasibility of substitutions through technological development, and in the technical possibilities.

Ecological economists state that natural capital and man-made capital are complementary and are only marginally substitutable, whereas some neoclassicals claim that natural capital can be substituted by man-made capital (National Research
Chapter 2

Council, 1994, p. 8). According to ecological economists, the complementarity of man-made and natural capital could restrict economic activity even more stringently, since there would be no point in transforming natural capital into man-made capital beyond the capacity of the remaining natural capital to complement and sustain it, i.e., what is the use of more fishing boats when the fish population has disappeared.

However, ecological economists go even further in their critique of neoclassical economics. They argue that, even if substitution is technically feasible, it will only lead to a temporary moderation of the relative scarcity. But, since substitution always implies the replacement of one resource by another resource, in the end the possibilities for substitution will become limited because of the absolute scarcity of resources.  

The neoclassical answer to this runs as follows (Simon, 1981). Economic growth produced by productivity growth has no limits, because productivity growth itself has no fundamental limits. Productivity is not physical and is not subject to physical limits: it depends entirely on technology. Unlike physical resources, technology is not finite. Technology is simply knowledge, and knowledge is an inexhaustible resource. New knowledge makes it possible to substitute new materials for old ones, and to create resources from what was not previously considered useful. Knowledge does not wear out or get used up, but instead increases with use.

The ecological economist's reply would be something like this. To put knowledge into practice one needs physical resources. So, in sum, the possibilities of substitutions are not endless.

Price mechanism

Within the ecological economics framework, the function of prices is twofold. For one thing, prices are an instrument to give incentives to economic subjects, and for another, prices are an instrument to provide information about scarcity. According to Daly (1980), the incentive function of prices works well enough, whereas the information function does not. The price mechanism does not account for ecological limits. Prices solely reflect relative scarcity, and therefore prices cannot resolve absolute scarcity. After all, it is impossible to raise the relative prices of all commodities in general. If we would nevertheless try it, we would find that only the absolute price level rises and the result would be inflation instead of the desired substitution.
"Perhaps we respond to increasing absolute scarcity as if it were relative scarcity, that is, by trying to raise the relative price of everything." (Daly, 1992a, p. 42)

Since the market does not impose absolute limits upon the behaviour of subjects, limits, in the form of quantity restrictions, have to be imposed exogenously by politicians and ecologists. Consequently, ecological economists advocate the implementation of quota, instead of taxes, as an instrument to keep economic activity within ecological limits. If prices are fixed (taxes), then errors work themselves out in quantity changes, whereas if quantities are fixed (quota), then errors result in price changes. Ecologically, they assert, it is safer to let prices do the adjusting, since the ecosystem only cares about quantity.

What is needed according to ecological economists, is direct regulation by the authorities, to lay down standards and possibly also, if subjects do not come up with them, sanctions. By means of permits and prohibitions, physical limits have to be imposed upon economic activities. Within these limits the price mechanism can, in the most efficient way, lead to an optimal allocation of resources. But other institutions are necessary as well, for instance, an institution for stabilising the population and an institution for limiting the income and wealth inequality. The instruments suggested are probably very controversial: transferable birth licenses (every woman receives 2.1 licenses which she can trade freely) and minimum and maximum limits on income and wealth. For further elaboration on these institutions and instruments, the reader is referred to Boulding (1964) and Daly (1992a, pp. 50-76).

Ecological economics and monetary valuation
Valuation ultimately refers to one item's the contribution to meeting a specific goal. "A baseball player is valuable to the extent in which he contributes to the goal of the team's winning" (Costanza and Folke, 1997, p. 68). In neoclassical economics, a commodity is valuable to the extent in which it contributes to the goal of individual welfare as assessed by the willingness to pay. In this neoclassical context, value is based on the goal of utility maximization. Ecological economics is built on the (above-mentioned) three goals of sustainable scale, social fairness and efficiency. "Ultimately, valuation has to address all three kinds of goals" (ibidem, p. 68).

Some ecological economists reject monetary valuation, since economists are not yet capable of producing an integrated value concept that addresses all three goals. The concept developed so far only values individual welfare via human preferences expressed on a market. And for that reason:
“social costs and benefits have to be considered as extra-market phenomena; they are borne and accrue to society as a whole; they are not heterogeneous and cannot be compared quantitatively among themselves and with each other, not even in principle.” (Kapp, cited in Martinez-Alier, 1990, p. xxi)

Other ecological economists contend that, within exogenously imposed limits, the monetary valuation of environmental goods is highly important in relation to the solution to environmental problems. All natural capital also has economic value (measured in monetary terms), which must be recognised in order to manage the remaining world supply of natural systems. However, ecological economists are convinced that they use the monetary figures more prudently than do the neoclassical economists. These monetary values and the accompanying cost-benefit analyses are not allowed to determine targets, but only least-costs paths to targets that are established by non-market criteria, where these criteria reflect the three goals of sustainable scale, social fairness and efficiency.

The thirteen ecological economists (Costanza et al., 1997) that have attempted to value the world’s ecosystem services and natural capital are an example of ecological economists who belong to this latter group. They estimated this value to be within the range of US$16 to 54 trillion ($10^{12}$). Many of the values used in this article were based on the individuals’ willingness to pay for ecosystem services. Although the writers of the article are modest about the scientific validity of the estimate, they feel that its purpose is merely to show the enormous contribution of ecosystems to human welfare: even larger than the contribution of the gross national product.
Endnotes

1 Actually it was Marshall, and not Pigou, who first introduced the concept of external effects. But Marshall merely dealt with positive externalities (such as the positive effects from an expanding firm for other firms), whereas Pigou extended this analysis to negative externalities, which are more relevant in relation to environmental problems.

2 Baumol and Oates (1988) propose a different definition of externalities, in which the second part of Pigou’s description—about the lack of compensation possibilities—is not included. Some reasons for this alternative definition are presented in Baarsma (1995).

3 When the price or the quantity of some good changes, there will be a substitution effect and an income effect. In the case of a price fall for a normal good, the consumer will consume more of the cheaper good (substitution effect) and because he or she has relatively more money to spend, the consumption of the good will increase even more (income effect). But since the nominal income is held constant along the Marshallian demand curve, the benefits of the price fall are overestimated when the area below this demand curve is used (Ng, 1983, pp. 89-92).

4 Stated preference methods are based on data that are not observable in the market and that have to be deduced from people’s stated responses to hypothetical questions in surveys (cf. chapter 3, section 3.1).

5 Price-constrained welfare measures are not explicitly reviewed, as most environmental goods are quantity-constrained rather than price-constrained. For a discussion on price-constrained welfare measures, see Bateman and Turner (1993, pp. 136-140); Hanley and Spash (1993, pp. 32-40); Ng (1983, pp. 87-89).

6 Starting-point bias will be described in chapter 3, section 3.2. In chapter 5, where the results of the Uburgg study are presented, a test for starting-point bias is conducted.

7 As Tversky et al. (1990) point out, the causes for preference reversals are multifold; intransitivitiy is only one of the causes, the others are procedure invariance and the compatibility hypothesis (cf. section 2.1.2.1 of this chapter) which results in overpricing L or in underpricing H.

8 In chapter 4, section 4.4, the concepts of well-being and welfare will be discussed in greater detail.

9 The terminology convex versus concave is somewhat confusing. If preferences are represented by a concave function $U$, then preferences are convex, that is, indifference curves are convex to the origin (Kreps, 1990, pp. 34-37). For elaboration on this subject, see e.g., Varian (1992, chapter 1) or Goodstein (1995, pp. 529-538).

10 An open-ended question asks individuals to state any number they can come up with: “How much are you willing to pay...?” When using a payment card, a range of values is presented visually on a card. The respondent can pick any number from the card when answering the valuation question. This helps respondents to calibrate their replies.

11 For further elaboration on this point, see Baarsma (1996b).

12 When the results do not satisfy this test, an embedding effect could be present. This is a hot issue in the valuation literature and will be discussed in chapter 3, section 3.4.1.

13 Bergstrom et al. (1989) refer to this phenomenon as information overload, whereas the concept of bounded rationality or satisficing behaviour, introduced by Simon (1955), is also used.

14 Some investment analyses in The Netherlands use discount rates of 5 to 6% (Boneschansker and Van Noort, 1995). In a report, the Dutch Ministry of Finance recommends the use of the standard discount rate of 4% in the evaluation of public investments (Stuurgroep Heroverweging Disconteringsvoet, 1993).
1995). The World Bank applies an economic internal rate of return with a cut-off rate of 10 to 12% to determine the economic attractiveness of a project (Dixon et al., 1994, p. 41). Since 1992, the US Office of Management and Budget requires that all government agencies employ a discount rate of 7% in their cost-benefit analyses (this was 10% during the early 1970s) (Tietenberg, 1996, p. 81). In Sweden a discount rate of 6% is recommended by the National Swedish Audit Bureau (Gren et al., 1994, p. 69).

15 In (neoclassical) theory, the valuation of different people, rich or poor, could not be compared per individual (if interpersonal incomparability is assumed) or for different groups of individuals (due to the ordinal character of utility). However, in practice the valuations of different persons are aggregated, thereby assuming interpersonal comparability and cardinality of utility.

16 Still, a relatively high percentage of protest bids resulted from the survey: 40% of the respondents stated a zero bid.

17 Ecological economists defend this argument by pointing at the laws of thermodynamics (Daly, 1992b; Georgescu-Roegen, 1971 and 1976). In short, energy is not lost by using it (the first law), but it is transformed into an energy of lower quality, by which less or no work is possible (the second law). Economic activities are entropy increasing, because, among other things, all economic activities imply energy consumption.

18 For a critique, see Hueting et al. (1998).