Monetary Valuation Techniques of the Environmental Impact, in Sustainable Development Projects

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Abstract: Sustainable development projects, aiming to improve the quality of the environment, are projects with mainly non-monetary results, but with a great need of monetary resources. They are usually implemented by public authorities, that decide if and to what extent such a project is to be financed. The decision relies mainly on the balance of the non-monetary costs and benefits of the project. In order for such costs and benefits to join the financial results of the project in the analysis, several alternative valuation techniques have been developed. The present paper tries to shortly describe the monetary valuation techniques of non-market, environmental goods and services and discusses their relevance in the later implementation of the project.

Keywords: environmental impact, valuation, sustainable development, costs, benefits, consumer preferences

1 Introduction
The present paper approaches the valuation techniques of the pollution decrease, induced by a sustainable development project - an issue which is generally discussed in technical terms. The attempts of translating it into money come from the need to compare and generate a balance of the financial and non-financial benefits and costs of an environment protection project, in order to appraise its opportunity and finance gap. The social and environmental results of a sustainable development project must be carefully considered in the cost benefit analysis, as they finally support the price of the environmental goods and services delivered by the implementing entity, with a direct influence upon the financial health of the project.

By their nature, the issues approached by the present paper apply only to projects implemented by public entities. The valuation techniques described start from researching the way in which consumers appraise the environmental goods and services they are offered, as the financial results of the project depend on the individuals’ willingness to pay a price for environmental comfort.

In this context, the first paragraph of the paper defines the key concepts of the valuation techniques of environmental non-market goods and services, i.e.: the total economic value, the shadow price and the willingness to pay, as a measure unit of the latter. The second paragraph describes and illustrates the three main valuation methodologies, resuming techniques based on observed preferences of the consumers, declared preferences of the consumers and benefits transfer.

2 Definition of the key concepts
As mentioned before, the present paragraph attempts to define three concepts, essential for the understanding of the environmental impact valuation techniques. The first of these is the total economic value, whose components detail and classify the consumers’ perception upon a good or service. The second one is the shadow price, used as a measure unit for the economic value when the market price fails to play this role. Finally, the paragraph will be concluded by the description of the willingness to pay, as the main computation instrument of the shadow price assigned to the environment quality.

The total economic value is generally defined as the money value of a change in the individuals’ wellbeing, generated by a change in the quality of the environment. More precisely, the total economic value of a change in the social wellbeing is given by the net balance of the total willingness to pay for a
benefit and to accept a cost generated by the implementation of a project or policy.

The main two components of the total economic value are the use value and the non-use value. The use value involves the current use or consumption of the considered good (the water consumption, the fossil fuels consumption, the consumption of agricultural products as food or fuel, the visitation of a national park), as well as the future use or consumption of the considered good (the planned visitation of a national park).

Unlike the use value, the non-use value comes in a certain measure against the economic judgments, according to which the usefulness of a good is derived from its consumption, as the non-use value is given by the willingness to pay for preserving a good, without ever using it, in the present or the future.

It slowly becomes evident that the value assigned by the individuals to the benefits and the costs of a sustainable development project is so complex, that their valuation in conventional units is not an option.

This is why analysts felt the need to develop specific valuation techniques, based upon the key concept shadow price. In his turn, the shadow price is actually a generic concept, developed around two components:

- on the one hand, the shadow price stands for all adjustments of the market prices, when these fail to express (quantify) the social failure of a good, or when they cannot be observed directly. Such cases are recorded in the situation of market (social) failures, like externalities, monopoly etc. For instance the paper price, prescribed by the producers, doesn’t reflect the social cost of the paper if its technological production process generates pollution. In such circumstances, the paper price will be given by the market price plus the value of the negative externality generated by the pollution.

- on the other side, the shadow price may consist in the value assigned to the non-market good or service, by means of specific techniques. An extreme example in this context is the attempt to assign a proper monetary value to the human life.

Actually the shadow price, perceived as the socially correct value of the goods and services, is given by the opportunity cost of the consumed resources, that is by the individuals’ willingness to pay for the considered good or service. In other words, the concept measures the increase in the social welfare (SW), generated by any change in the availability of the goods and services. In this context, if the output of a public investment is noted \( Y_g \), then the shadow price becomes:

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SP_g = \frac{\Delta SW}{\Delta OutputY_g} \tag{1}
\]

The shadow price is valued in money, though in this context, money is only a convention for reducing the tangible and intangible results of a project to the same denominator.

As for the third key concept of our topic, the willingness to pay is given by the amount which someone who doesn’t have a certain good is willing to pay in order to buy it; in other words, we are talking about the maximum amount which an individual would be willing to pay, in order to receive a good/service or to avoid a damage. As a complementary concept, the willingness to accept is given by the amount which someone who has the good would be willing to accept, in order to sell it, respectively the minimum amount which an individual would accept in order to give the good up or to suffer a damage. As a remark, the amount corresponding to the individuals’ willingness to pay for a good is usually smaller than the amount which individuals are willing to accept as a compensation a loss.

The actual methods to quantify the individuals’ willingness to pay (or accept a compensation) for environmental goods and services is discussed in the next paragraph. Nevertheless, we’d like to conclude this section by shortly mentioning several obstacles in concretely applying the two concepts:

- the distribution of the money in the society: though not quite fair, the truth is that an individual’s willingness to pay for environmental comfort increases with his/her wealth. Nevertheless, the quality of the environment in a certain geographical area should not depend on the material welfare of its inhabitants.

- the geographical limits of the society: the fact that financial resources are administered within the borders of a region or state can raise problems when valuing environmental projects with transnational effects. Such problems are presently illustrated in state unions like the European Union: certain environmental standards must be respected all over the Union, though the financial resources
of its member citizens are by far not the same. In the same time, the financial transfers between the members states are not transparent enough, so that convincing the individuals to increase their willingness to pay is quite an effort.

- the consideration of the preferences of the next generations: interferes in policies aiming for instance at the elimination of the dangerous waste or the restoration of certain natural protected areas. The benefits will possibly never be enjoyed by the current generation, which make us come back to the non-use value and the willingness to pay a price for it.

3 Valuation techniques of the environmental impact

As above mentioned, the environmental effects targeted by a sustainable development project (like air pollution decrease or noise decrease) are mainly intangible. The direct consequence is the lack of corresponding market prices, which creates the need to apply indirect valuation techniques, based on shadow prices. The lack of markets for such goods comes on the one side from their public goods status, and on the other side, from the fact that the environmental impact to be valued is offered to the consumers as an accessory of another product: the noise accompanies the new highway, the air pollution comes together with the urban heating system.

As intangible and non-market goods, the environmental goods and services could be considered not financially valuable. This perspective is not completely absurd, if we think at extreme valuation exercises, like the assignment of a money value to the human life. Nevertheless, refusing to attach a financial value to intangible effects creates the danger that they join the monetary costs and benefits of a project with the value zero. As a consequence, the following techniques have been developed in order to reduce financial and non-financial effects to a common denominator.

The premise of the valuation is the following: if the analyst can identify an associated market for the environmental goods and services to be valued, then the economic values will be determined based on the associated market prices. For instance, if the ocean pollution leads to the decrease of the fish population, then the market value of the lost harvest can be observed on the fish market. If no associated market can be identified, then the price will be determined by means of non-market valuation techniques. The typical example in this context is the air pollution, as no market value can be reliably associated to clean air.

The non-market valuation techniques are based on the beneficiaries’ individual preferences, as observed by the valuator or described by the individuals. The benefits are valued by considering the willingness to pay for them, whereas the costs are valued by considering the willingness to accept a compensation for the loss induced.

The valuation is focused on the total economic value, given by the use and the non-use value. The three main valuation methodologies are based on the observed preferences of the consumers, the declared preferences of the consumers and the benefits transfer.

3.1 Techniques based on the observed preferences of the consumers

In this approach, the valuation of non-market impacts relies on observing the consumers’ current behavior, respectively observing the reasons that support their decision to buy on certain markets (usually markets of lasting goods, like the real estate market).

The main advantage of such techniques is given by the fact that the valuation is based on real decisions of the individuals, whereas the main disadvantage consists in the difficult testing of the behavioral assumptions. Moreover, the techniques included here are not able to cover the non-use value.

The main techniques discussed in this section are: the market analogy technique, the intermediate goods technique, the assets valuation technique, the hedonic price technique, the travel cost technique and the avoided costs technique.

The market analogy

The technique starts from the premise that the market price of a private good gives a correct estimate of the shadow price of a similar public good, if it equals the average amount that the consumers of the public good would be willing to pay for its consumption.

In a functional private market, the buyers of a certain good actually show their willingness to pay an amount, which is at least equal to the price set by the market. The willingness to pay for a marginal unit of a certain good is actually equal to the price set by the
market. Nevertheless, even if the public good is offered by the public authority at a price beneath the market price, there is still no guarantee that its beneficiaries appraise it at the same value like the ones who buy it from a private market.

As an example, let’s think about the drinking water sources of an individual: on the one hand we have the water distributed through the public network, on the other side the consumer has the possibility of buying bottled water or a water purification device, or of digging a well. The individuals who choose to buy bottled water show their willingness to pay an amount at least equal to the market price of the bottled water. Nevertheless, when setting a price for the public network water, the public authority must also take into account the low income individuals, who cannot afford to pay the price of alternative water sources. As a consequence, the price of the public water will represent the lowest limit of the willingness to pay of the low income consumers, whereas the price of the bottled water will represent its upper limit.

The intermediate goods technique
Some governmental projects produce intermediate goods, i.e. goods that are used as raw materials in economic activities. For instance, an irrigation project can deliver water to farmers, in order to be used in vegetable growing. If the intermediate product – i.e. the water – is sold on an efficient market, the water demand curve can be estimated directly, by applying econometric methods. If there is no efficient market for the water produced, its value must be estimated. The intermediate goods technique estimates the (gross) benefit of a project producing an intermediate good, based on the good’s added value to the downstream activity. In our example, the value of the irrigation project can be given by the income increase of the vegetable farmers.

Generally, the annual benefit of a project equals the variation of the annual income of the downstream businesses. The total benefit of the project results from computing the present value of the annual benefits along the project’s life.

The assets valuation technique
Certain projects may affect certain goods’ prices, like land, buildings, stocks, i.e. the impact of the project is capitalized in the market value of the respective goods. The increase (decrease) recorded in the goods’ value can be sometimes used in estimating the project’s benefits (costs). For instance, coming back to the irrigation project, if the farms are the only beneficiaries and if the land market of the farmers’ land is not distorted, then the market price of the vegetable crops can be added to the total value of the irrigation project.

The hedonic price
The hedonic price technique starts from the premise that the prices of marketable goods are built based on the different characteristics of the good in question. In this context, the technique tries to isolate the price corresponding to each one of these characteristics, by means of statistical methods. The technique is applied in two steps: in the first step, the analyst estimates the relationship between the price of a good and all the characteristics that determine its total value. The second step consists in the estimation of the consumers’ willingness to pay for a single characteristic, approximated based on the income and other socio-economic factors.

The hedonic price is generally used in relationship with two markets: the real estate market and the labor market. Speaking about the valuation of environmental goods and services, the relevant applications are the ones on the real estate market, where the price of a building is given by characteristics like number of rooms, location, structure, age and, last but not least, the quality of the environment and of the associated environmental services. The hedonic studies of the real estate market are used to identify the value of certain non-market gods, like the noise associated to road or air traffic, air pollution, water quality etc. For instance, a house located in the proximity of an airport will have a lower price then a house located in a quiet area. The price difference between the both can be considered the value assigned to the noise.

The travel cost technique
The technique starts from the premise that certain market and non-market goods may be complementary, i.e. the access to an intangible good can be conditioned by the acquisition of tangible goods. Under these circumstances, the travel cost technique values the individuals’ willingness to pay for an environmental good or service, like a national park or an archeological site, by means of the costs
associated to its „consumption”. The value of such sightseeing destinations is thus estimated through association with the values observed on the tourism market.

**The avoided costs technique**

The technique starts from the premise that *individuals can protect themselves by the undesired effects of a non-market good, by taking costly defensive measures*. The associated costs can be non-monetary (time consumption) or monetary. The latter involve the acquisition of a market good, able to diminish or eliminate the effects of the non-market good (protection expenses). The value of such acquisitions can be considered as the implicit price of the non-market good which individuals try to avoid.

An example in this context can be given by the double-layer windows, which reduce the exposure to traffic noise. The windows are here the market good which comes to substitute the non-market good (the absence of the noise), so that the acquisition price of the windows can be assimilated to the price of the non-market good.

Nevertheless, the usefulness of the method is limited by aspects like:

- the protection expenses often give just a partial estimate of the value of the non-market good to be avoided;
- the protection expenses can have a multiple purpose (double-layer windows reduce both the noise, and the heat losses);
- individuals can respond to a change in the environment quality by means of more than just one action/acquisition.

**3.2 Techniques based on the declared preferences of the consumers**

They rely on questioning the consumers with regard to their future behavior. The starting point is the description of certain hypothetical markets, on which the good in question could be sold/acquired. The analyst questions the individuals’ willingness to pay for (or accept) a change in the offer of the considered good (service), by mean of a survey. Under these circumstances, the technique supports the identification of the consumers’ real needs and willingness to pay for their satisfaction.

The main advantage of such techniques consists in their flexibility, as they allow both the ex-ante, and the ex-post valuation of most non-market goods. Moreover, the techniques can be applied to all kinds of benefits associated to a non-market good or service, including to the non-use values.

**3.3 The benefits transfer**

The technique is frequently applied in the valuation of environmental goods and services and consists in transferring the value of a certain non-market good from a former to a current study. The transferred value is adjusted if needed and then used in valuing the costs and benefits of another policy or project. The benefits transfer allows the decrease of the research costs, if relevant data can be identified in previous studies.

**4. Conclusions**

The main condition for a sustainable development project to be financed is that its social (environmental) benefits exceed its social (environmental) costs, that is why the valuation of the considered benefits and costs must be as precise as possible.

The above described valuation techniques rely entirely on consumer preferences, as observed by the analyst or declared by the individuals. Theoretically, the techniques based on observed preferences are less subjective, as the value of the intangible goods is derived from real prices and behaviors, recorded on existing markets. Practically, though the starting data are certain, the results can be corrupted by the number of considered variables, as well as by the possible interdependences between them. Moreover, such techniques are not able to work with the non-use value, which is an essential concept especially with regard to environmental goods and services.

These are the reasons why analysts often prefer to start from the declared preferences of the consumers, even if they could identify associated markets. The weak point here consists in the high level of subjectivity connected to the results, depending on the subjects selected for the survey, their social and informational background and their interest. Nevertheless, the techniques based on the declared preferences of the consumers do have a high potential. That is the reason why recent research in the field focuses on the increase of the accuracy and objectivity level of such techniques.
In our opinion, the results of the valuation techniques shortly described in the paper are still highly relative, if we consider the importance of their effects upon the financial health of the project’s implementing entity. Though we mentioned above that the money used in the valuation is rather a conventional unit, used to translate in a common language the financial and non-financial results of the project, finally the successful implementation of a project with environmental impact depends upon the accuracy of the individuals’ estimated willingness to pay for the project’s results. After the implementation, the beneficiaries of the delivered environmental goods and services will pay for them with real money.

References