QUANTIFYING BENEFITS FOR COST-BENEFIT ANALYSIS

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ABSTRACT
Cost Benefit Analysis is one of the most widely used financial tools to select future investment projects in public and private sector. This method is based on comparing costs and benefits in terms of constant prices. While costs are easier to predict and monetize, the benefits should be identified not only in direct relation with the investment, but also widening the sphere of analysis to indirect benefits experienced by the community from the neighbourhood or the whole society.
During financial analysis, respectively economic analysis, benefits are taken into account in a different basis. While financial analysis deals with direct revenues generated by the investment project, the economic analysis integrates supplementary social benefits monetized using different methods of estimation. The quality of economic analysis is vital in accepting investment projects because economic rationality should be respected, especially positive value for NPV.
The most challenging part of CBA is to monetize benefits because these are not easy to be identified, involve difficulties to be quantified and require numerous calculations and presumptions in order to associate a monetized value to each piece of benefit. Identification of benefits is a long process during which all positively affected parties should be nominated presuming that the investment project will hold added value to their life, environment or wealth. In the second stage, all benefits should be quantified exactly by comparing the "business as usual" scenario with the possible state of the art after implementing the investment project. La last stage of monetisation requires the ascertainment of the value of each unit of benefit in order to calculate the monetized value of all benefits.
This paper proposes to present a theoretical view regarding benefits in CBA followed by a practical part which will present possible methods of valuating the benefits in different categories of investment projects, especially in those domains where large investments are implemented frequently. A special stress is put on the calculation proposals for some frequently met benefits: reducing the number of hospital days, reducing the number of sick days for road accidents, improving quality of life through healthy life expectancy, reduce time spent in traffic, shorter flight track pending, reducing unemployment, and reduce potential damage from flooding.

KEYWORDS: *benefits, CBA, valuation*

JEL CLASSIFICATION: *D61 (Cost–Benefit Analysis)*

1. INTRODUCTION

Cost Benefit Analysis (CBA) is used to evaluate the opportunity to implement investment projects by predicting the cash flows of the project. In private sector, CBA is not mandatory, but it is used on a large scale. In public sector, CBA is widely used for large investment projects where it is necessary to prove with solid financial tools that the investment project is feasible and the public

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money are not spent in vain. CBA in public sector is more useful because this instrument take into account monetized social benefits.
Each CBA presents o series of calculations which conducts the analyst to the final conclusion. These calculations are focused around the financial analysis, respectively the economic analysis. Financial analysis is based on financial indicators (mainly revenues and costs), while economic analysis incorporates also the social benefits obtained by implementing an investment project.
Benefits in CBA are vital, both in financial and economic analysis, because of the important influence upon the results. Benefits are those who make difference between financial and economic analysis: while financial revenues are taken into account in financial analysis, any kind of benefit are considered in economic analysis.
The most challenging part of CBA is to monetize benefits because these are not easy to be identified, involve difficulties to be quantified and require numerous calculations and presumptions in order to associate a monetized value to each piece of benefit. Identification of benefits is a long process during which all positively affected parties should be nominated presuming that the investment project will hold added value to their life, environment or wealth. In the second stage, all benefits should be quantified exactly by comparing the "business as usual" scenario with the possible state of the art after implementing the investment project. The last stage of monetisation requires the ascertainment of the value of each unit of benefit in order to calculate the monetized value of all benefits.

2. BENEFITS IN PROJECT VALUATION PROCESS

Benefits are defined as increases in human wellbeing or utility (OECD, 2006). The benefits of a project should include all the advantages generated to the society. In this category we should take into account the benefits to all implied in the project (or targeted by the project) and for the society seen as a whole. Thus, the benefits include direct and indirect positive effects.
Public investment projects generate in few cases revenues because these investments are meant to offer added value to the entire society free of charge in order not to restrict the access of people. These eventually monetary revenues are accompanied by a broad range of indirect benefits, which mark positively the society by improving life conditions, macroeconomic environment, assuring smaller risks etc.
Direct revenues of private investments are represented by the incomes obtained by selling the products resulting from operating the investment. Direct revenues of public investments are mainly charges asked for the public services offered to those who explicitly demand such services. These charges can be cashed as the value of entrance tickets, tariffs for certain services (for example medical services, water supply, use of highway or railway infrastructure), price for goods (meal, for example). In addition, there can be identified also other revenues such those from rents.
All direct revenues are established in accordance with the market because similar goods and services are offered by other entities (private or public) in the same area or in the neighbourhood. The valuation of direct revenues is easier due to this fact and it is taken in consideration for both financial and economic analysis.
In opposition with direct revenues, social benefits usually affect, in a positive way, not only the direct beneficiaries of the investment project, but the whole society. This is why these are indirect benefits which are not subject to a commercial transaction, being rather externalities. The rigors of CBA impose that also these benefits to be evaluated in monetary expression, in order to compare them with costs (in constant prices).
Indirect benefit valuation in CBA imposes an inventory of positive effects that could be obtained by implementing the investment project. Identification is done by comparing the presumed benefits with "business as usual" scenario. Due the difficulty of valuating social benefits, the analysis should

emphasize only the relevant indirect benefits which can be estimated using available data. The rest of benefits will appear in case of proper implementation, but will not influence de CBA results.
Before accomplish the list of benefits, it is vital to reveal possible couples of benefits which are interrelated and which would conduct to a double counting of the benefits (duplication of effects). For example, reduction in climate gases may be associated with reduction in jointly produced air pollutants and regarded as a benefit of climate change policy, but care needs to be taken that the procedure does not result in double counting (OECD, 2006).

3. METHODS USED IN ESTIMATING SOCIAL BENEFITS

The social benefits resulted by implementing public investments are related, in most cases, with the improvement of the peoples' life conditions: improvement of life quality, reduction of periods with illness or discomfort, assurance of better access to water, reduction of wasted time in traffic, employment etc.
All benefits should be valued in a monetary form, in order to fulfil the CBA. Economists create artificial prices for benefits by studying what people would be willing to pay for them (Heinzerling & Ackerman, 2002). In this regard, it is recommended to have two stages which help to estimate the value of all identified benefits generated by the investment. These two stages are:

- establishing quantitative positive effects of the investment;
- estimating the monetary value of the benefit determined in the previous stage.

Benefit estimates, in quantitative expression, should be considered in comparison with a basic scenario with no supplementary investment to those already existing.
Benefits should always be valued based on willingness-to-pay, but where market values are not available (e.g. value of life, value of time), other techniques can be used (CEEU, 2012). However, there are various techniques for making quantitative estimates, which allow more proposals to be appraised using CBA. The two main general approaches are known as 'revealed preference' and 'stated preference' methods (Commonwealth of Australia, 2006).
Revealed preference technique is based on comparisons of behaviour of consumers or producers in similar cases to the scenarios presented in CBA. In most cases, this technique is based on hedonic pricing (by trading market goods, consumers are thereby able to express their values for the intangible goods, and these values can be uncovered through the use of statistical techniques), but also other approaches are available. One of them is travel cost method, which presumes the fact that market and intangible goods can be complements, to the extent that purchase of market goods and services is required to access an intangible good (OECD, 2006).
Stated preference technique is based on hypothetical values obtained from different surveys or studies. These are presumptions of the consumers which are asked to present their possible behaviour in case they would benefit by the investment project (their willingness to pay or accept).
This is a contingent valuation method, which is a powerful tool for the area of estimating the economic benefits of preserving or enhancing environmental quality, in the determination of the willingness to pay for potable water and sewerage services or similar expansions of public services (Harberger & Jenkins, 2002).
To reduce the concerns about the validity and reliability of the findings of contingent valuation studies, the use of another method has been growing steadily in recent years: choice modeling (it is an often used approach for valuing multidimensional environmental problems) (OECD, 2006).

4. EXAMPLES OF ESTIMATING BENEFITS

The main challenge in estimating revenues is to find out the right method to determine the monetary value of benefits. For example, it seems particularly difficult to value ecosystem services (estimate the total economic value of ecosystem change). Considerable efforts have been made to value

specific services, such as the provision of genetic information for pharmaceutical purposes (OECD, 2006).
This is why examples provided in this paper are useful as guidelines because can represent o possible solution. These are not mandatory rules, just suggestions from the practice.
The major investment projects are focused in developing the public service infrastructure: roads, hospitals, water supply networks, soil management etc. Deriving from this investment types we can find the most frequently used benefits associated to them. As follows, we will stress on the calculation proposals for some of benefits: reducing the number of hospital days, reducing the number of sick days from road accidents, improving quality of life through healthy life expectancy, reduce time spent in traffic, shorter flight track pending, reducing unemployment, reduce potential damage from flooding, and offer better services.

4.1. Benefits regarding the improvement of life quality

The projects targeting the improvement of life quality (by better health conditions, less accidents, better air quality etc.) are focused on reducing the number of hospital days which should be paid by those persons which have deteriorated health conditions. The benefits are these hospital day reductions, each of them being valued using medical statistics offered by hospitals, medical insurance companies or public health insurance houses. It could be used average costs of medical care, or specific cost values if investments are focusing in reduction of certain disease. The number of hospital days is available in medical statistics.
In case of adults whom are capable of working, the benefits are supplemented by the gains resulted from their work instead of staying inactively and getting compensations from the public budget. These benefits can be estimated using average value of labour and the average number of sick days. Usually, statistic offices have detailed reports about the averages cost of labour, including different breakdowns on different categories of workers. The average number of sick days could be found in medical statistics.
General improvement of life quality is strongly associated to healthy life expectancy. Healthy life years (HLY) are the number of years spent free of activity limitation, being equivalent to disability-free life expectancy; HLY are calculated annually by Eurostat and EHLEIS for each EU country using the Sullivan method; the underlying health measure is the Global Activity Limitation Indicator (GALI), which measures limitation in usual activities, and comes from the European Union Statistics on Income and Living Conditions (EU-SILC) survey (OECD, 2012). Value of statistical life is the amount that a group of people is willing to pay for fatal risk reduction in the expectation of saving one life (Miller, 2000); it is provided in most cases by life insurance companies. Monetized value of the benefit is obtained by multiplying the number of healthy life years won with the value of statistical life.

4.2. Benefits for transport investment projects

Road investment projects are not targeting only reduction of accidents by offering better access routes, but also reduction of time spent in traffic. Amount of the benefit is determined by multiplying the marginal cost of transporters with the number of hours saved by shortening the distances. The marginal cost must include the cost of fuel, maintenance services and labour. The data can be obtained from the companies which offer such services.
In the field of transportation, numerous projects propose to improve air transportation. The aviation industry has significant impacts on the level of regional employment and economic activity, being a consumer of fuel, research and development, equipment, and generates employment in these sectors; more efficient air travel therefore improves the productivity (added value) of labour in the transport sector, which should positively affect wages and contribute to lower prices of tickets,

imports and exports (SDG, 2005). Barrett and Applegate (2011) list the benefits of a project from the third runway at Sydney's Kingsford Smith Airport: passenger time saving, aircraft operating costs saved, extra aircraft landings, economic multiplier impacts, and reduced noise.
In the transport sector also occur network effects, which are indirect effects on other elements of the transport system. For instance, the introduction of a high-speed rail link is partly intended to attract road and air travelers, and the improvement of a road link can affect traffic volumes elsewhere in the network. These kinds of benefits must also be valued.

4.3. Benefits for environmental projects

In case of environmental investments, the emphasis is put on the improvement of indicators which measure the quality of the air (quantity of emissions of carbon dioxide, sulphur dioxide, nitrogen oxides, dust emissions, emissions of heavy metals, etc.), water (degree of pollution) or land (level of infestation). A decrease in harmful chemicals improves the activity in the area and has a direct effect on assets. In most cases, the value of the land is increasing due the better neighbourhood conditions. The valuation of benefits could be fulfilled by comparing actual land prices with prices used for non-polluted lands or by surveying people about their life quality improvement expectations.
In the field of environmental CBA, in which external costs are used to derive a monetary value for the benefits of assessed investment, a tendency is observed to move from avoidance costs to damage costs (Maibach et. al., 2008). The costs of sea level rise could be expressed as the capital cost of protection and the economic value of land and structures lost in the absence of protection. Agricultural impact can be expressed as costs or benefits to producers and consumers, and changes in water runoff might be expressed in new flood damage estimates. Another example is the use of term Social Cost of Carbon, which denotes damage cost as opposed to Marginal Avoidance Costs (costs of avoiding CO_2 emissions).
Drinking water networks contribute to a better life quality by reducing the incidence of diseases. In CBA analysis usually are captured the benefits of reduced illness in terms of health care costs and lost productive activity, although there are other benefits which could not be meaningfully quantified, but there are still valid and should be considered alongside the benefits that were able to be valued (Moore et al., 2010).
In the category of investments which aim to reduce the impact of natural processes and disasters we can include those referring to prevent damages produces by floods, shoreline erosion, soil pollution etc. In relation to natural disaster risk, benefits arise from the savings in terms of avoided direct, indirect, and macroeconomic costs as well as the reduction in variability of project outcomes (Mechler, 2003). Benefits can be calculated by multiplying the affected areas with a mean damage calculated for each type of land / building part. Data to substantiate the value of benefits can be obtained from statistics on natural disasters and data on compensation paid by insurance companies. Other benefits are represented by the touristic potential of well conserved natural areas in terms of the economic activity of hotels, museums, amusement parks etc.; from agricultural point of view, soil quality changes affect soil fertility and therefore agricultural and livestock production (Ruijs, 2008).

4.4. Benefits for projects in other sectors

Numerous investment projects consist in creating new facilities which require labour to be in service. In this way new working places are created which becomes an important contribution in fighting against unemployment. Reduction of unemployment is an important benefit even there are created new permanent jobs, or only temporary ones. New jobs generate additional revenue to public budgets by contributing with taxes (income tax) or social insurance contributions (to social

security budget, unemployment budget and health insurance budget). The value of benefits to state budget (from income tax) is determined by multiplying the number of jobs, average wage , number of months jobs are offered, and income taxation rate. The value of benefits to social insurance budgets (from contributions) is determined by multiplying the number of jobs, average wage, number of months jobs are offered, and aggregate average contribution rate (based on fiscal legislation). Statistical data are obtained from tax legislation and statistics on wage levels from the economy.

New technologies are developing each day, so public investments can offer better services to citizens. For example, in case of completing digital switchover in UK the identified benefits were: channels of clear radio spectrum released by ceasing analogue transmission rise the availability for the first time to a substantial part of the population, and possibility to offer a wider range of services (DTI and DCMS, 2006).

In CBA of educational projects, the benefits that must get quantified are represented by the difference in the person's stream of earnings over an entire (post-university) working life. In this type of analysis, the base data are usually age earnings profiles attaching to different levels of educational attainment (Harberger and Jenkins, 2002).

For investment projects implying IT systems, an example of an intangible benefit is flexibility (different people can perform the same job without significant training expense, so the system is kept operational, no matter the circumstances). The value of this benefit would depend on the impact of a portion of a system being inoperable for a period, the length of that time, and the frequency of that situation occurring. Similar examples of intangible benefits for investments in IT systems are: accuracy (reducing the number of data entry errors), compatibility (less training of personnel or less new equipment or software), modularity (reduce maintenance costs and may increase the portability of the software) etc. (SDLC, 2003).

5. CONCLUSIONS

Monetizing benefits is a crucial activity in any CBA, because they represent a vital factor in calculating NPV and IRR. NPV and IRR are the most important financial indicators which prove if a project could be accepted for implementation or it should be rejected.

Identification and valuation of benefits represent a challenging activity because it requires pointing out numerous complex indirect positive effects, which are not always obvious. A high quality work involves multidisciplinary approach, where economics is intertwined with chemistry, medicine, physics, aeronautics, pedology etc.

The need of estimating possible benefits in monetary expression emphasizes the complexity of CBA practitioners' work. Since investment projects used to be projected for long time horizon (mostly over one decade), the benefit valuation becomes extremely difficult because it should reflect the presumed behaviour of society in all this period of time.

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