NEXUS-NESS

NEXUS NATURE ECOSYSTEM SOCIETY SOLUTION

Fair and sustainable resource allocation demonstrator of the multiple WEFE Nexus economic, social and environmental benefits for Mediterranean regions

GRANT AGREEMENT NUMBER 2042

Deliverable D5.3
Economic assessment of WEFE Nexus strategies
V1.1 30 November 2022

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WP5 Leader FEEM, Filippo Tessari, Task 5.3 Leader FEEM, Davide Bazzana

NEXUS-NESS - NEXUS NATURE ECOSYSTEM SOCIETY SOLUTION: FAIR AND SUSTAINABLE RESOURCE ALLOCATION DEMONSTRATOR OF THE MULTIPLE WEFE NEXUS ECONOMIC, SOCIAL AND ENVIRONMENTAL BENEFITS FOR MEDITERRANEAN REGIONS

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Funding Instrument	PRIMA: To achieve, support and promote integration, alignment and joint implementation of national R&I programmes under a common research and innovation strategy to address the diverse challenges in water scarcity, agriculture, food security.		
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WP- Main Beneficiary	FEEM		
WP-Leader	Filippo Tessari, filippo.tessari@feem.it		
Task No and Title	5.3: Multi-sector economic analysis and measures for WEFE Nexus costs, revenues, and wealth distribution		
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Abstract	Cost benefit analysis (CBA) is a fundamental evaluation tool that helps to support the decision-making process concerning the co-financing of public interest and infrastructure projects. It is used to appraise an investment decision in order to assess the welfare change attributable to it and, in so doing, the contribution to European Union's Cohesion Policy objectives. The main aim of this deliverable is to provide an overview of the most important aspects of CBA as well as a more detailed description of its phases.		
Key words	Cost-benefit analysis, EU cohesion policy, investment projects		
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Table of Contents

Figures

1 Introduction

The Cost Benefit Analysis (CBA) has been a very active field of research and study since at least the early 1960s (Ray, 1984). Its development has had much to do with the evaluation of public sector investment projects but subsequently, cost-benefit analysis has undergone continuous evolution, broadening its content and its field of application (Ray, 1984). This evolution on the theoretical side was followed by the growing application of evaluation techniques in decision-making processes, especially in industrialised countries, encompassing an increasing number of sectors of public intervention in the economy (Ray, 1984).

In the context of the European Union (EU), the CBA is a fundamental evaluation tool that helps to support the decision-making process concerning the co-financing of public interest and infrastructure projects. In particular, it is an analytical instrument to be used to appraise an investment decision in order to assess the welfare change attributable to it and, in so doing, the contribution to European Union's Cohesion Policy objectives (Florio et al., 2018). The purpose of CBA is thus to facilitate a more efficient allocation of resources, demonstrating the convenience for society of a particular intervention rather than possible alternatives (European Commission, 2014).

Cohesion Policy is the most significant European Union's investment policy, and it aims to reduce the wide regional disparities that exist in Europe by promoting economic development and the long-term sustainability of cities and regions, endorsing employment generation and business competitiveness, and enhancing the quality of life for EU citizens, particularly in regions that are lagging behind (European Commission, 2016a). The key element of this policy is a coordinated system of investment, provided by the EU to the Member States, in addition to their domestic public spending, primarily in the form of capital grants (European Commission, 2016a).

The main aim of this deliverable is to summarise the concept of cost-benefit analysis, delving into all the steps envisaged by the European Union in order to implement it. In addition, it also aims to clarify the usefulness of this tool in project evaluation.

Therefore, the structure of the document is the following: the first section is devoted to the framing of the CBA tool in the European Union framework; then, a section devoted to the general principles needed to carry out a CBA is presented. Lastly, seven different parts describes each phase of the process[1].

[1] All subsequent parts have as their main source of reference: "*European Commission (2014). Guide to Cost-Benefit Analysis of Investment Projects, Economic Appraisal Tool for Cohesion Policy 2014–2020, European Commission, December 2014*". If the reference source differs from this one, the correct reference is appropriately indicated in brackets.

2 The importance of cost-benefit analysis in the context of the European Union

The CBA was originally launched at the level of the European Commission (EC) in 1994 with the publication of the first CBA Guide by the Directorate General for Regional Policy.

Since that moment, the Cohesion Policy has steadily pushed the use of CBA and now it is an important prerequisite for big projects (the so-called "major projects") applications whose total eligible cost exceeds 50 million. The guidelines for project appraisal have been outlined in five consecutive editions of the Guide.[2] This document, to date, represents the main, most up-to-date and agreed upon source for assessing the welfare generated by the implementation of projects or investments. Although the guidelines were initially compiled for the purpose of assessing large projects to be co-financed, its scope of use has rapidly expanded towards projects of lower economic value or towards those financed by private entities (Florio et al., 2018).

In addition to all the other phases that have to be completed, Member States are expected to submit a financial and economic analysis of the investment proposal in order to apply for EU funds, given that an important component of the overall strategy is selecting the projects that are of the highest quality, provide the most value for the money, and have a substantial influence on employment and growth. Moreover, the project must not be financially attractive to capital markets while being economically effective from the perspective of society in order to qualify for the grant (Florio et al., 2018).

In reality, the requirement that financing applications include estimates of both projects' financial rate of return (FRR), and economic rate of return (ERR) is a distinctive feature and significant benefit of the EC approach to CBA. The former indicates whether a project will be financially profitable and must be negative (or below the profitability threshold), whereas the latter demonstrates whether a project will be socially helpful and must be higher than the social discount rate (SDR).

3 General principles

As previously outlined, the EU Guidelines were initially drafted for the evaluation of large projects to be co-financed; subsequently their scope of use was extended to projects of lower economic value or financed by private entities. Over time, this was made possible by the generality of the methodologies provided by the guidelines: these methodologies proved to be applicable in contexts other than those initially outlined.

Despite the different possible methodologies, there are certain principles on which CBA is based and which must always be taken into account.

[2] The most recent edition dates back to 2014 (the other versions have been released in 1997, 2002 and 2008).

The basic principles are:

- **Opportunity cost**: it is the lost gain resulting from the failure to use the best possible alternative to achieve a goal. Often the cause of this lost gain is that investment decisions are made on the basis of mere profit assessments that do not always coincide with socially desirable outcomes. Since CBA takes into account the opportunity costs of inputs and outputs, this method is able to measure the contribution of a project to social welfare.
- **Long-term perspective**: CBA is based on a long-term time horizon (usually between 10 and 30 years) in order not to neglect the long-term effects of the benefits generated by a project. Costs, on the other hand, especially those related to the initial investment, occur over shorter periods.
- **Calculation of performance indicators expressed in monetary terms**: in order to allow comparability between different projects, all performance indicators are expressed in monetary terms, thus also quantifying benefits that are social or environmental in nature and, therefore, difficult to measure.
- **Microeconomic approach**: the CBA is typically a microeconomic approach that, through the calculation of economic performance indicators, allows the impact of the project on society as a whole to be assessed, thus providing an evaluation of the expected changes on social welfare.
- **Incremental approach**: the CBA allows to choose between different investment possibilities:
    1. A counterfactual scenario ("as-it-is"), which describes the cash flows and assesses the externalities generated without making any investment;
    2. One or more scenarios corresponding to different project implementation methods.

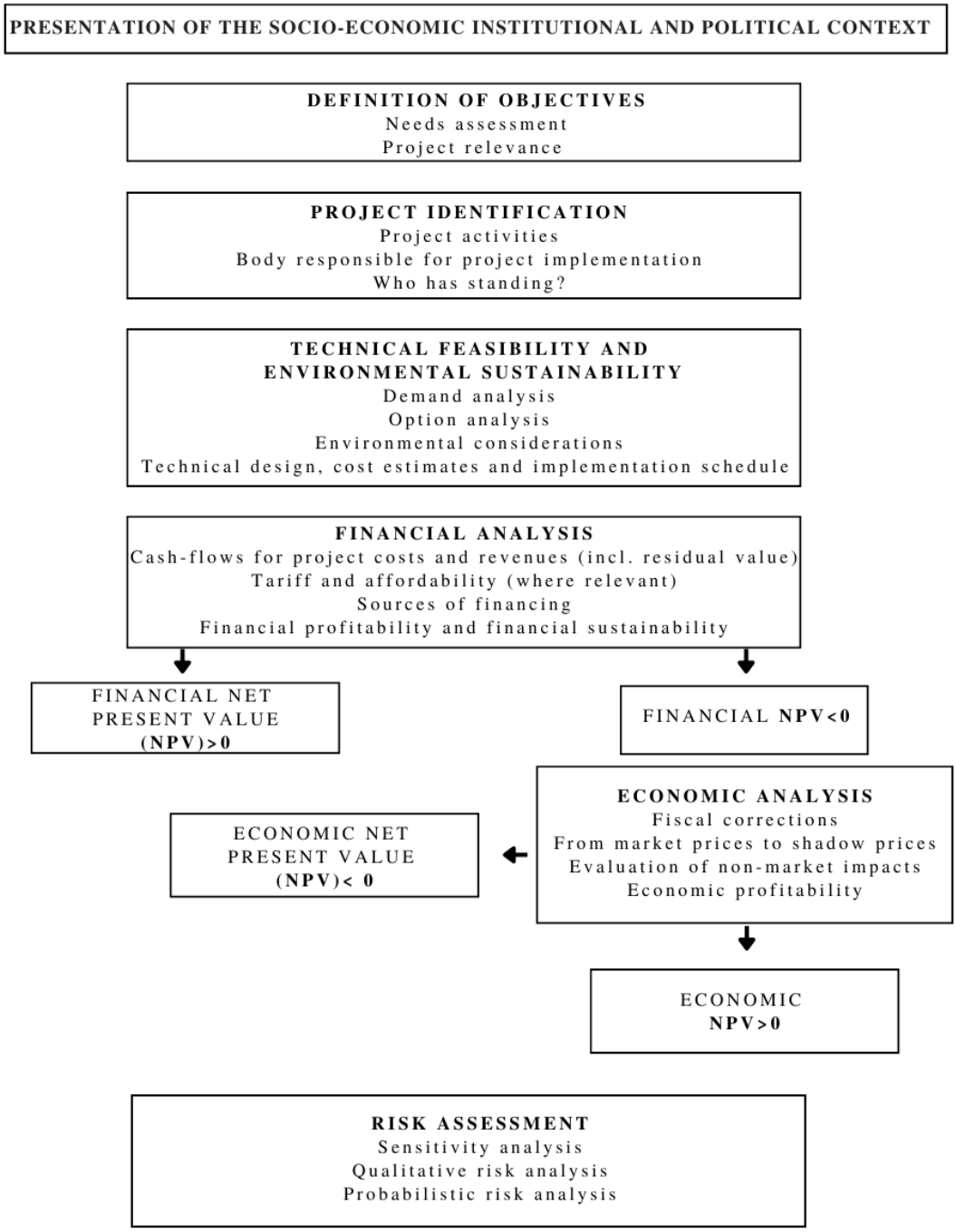
In addition, the comparison of the performance indicators, described above and related to the different scenarios, allows the choice to be directed towards investment, and possibly towards the most efficient mode of intervention.

4 Project appraisal steps

Standard CBA usually involves seven different steps, that are:

1. Description of the context
2. Definition of objectives
3. Identification of the project
4. Technical feasibility and environmental sustainability
5. Financial analysis
6. Economic analysis
7. Risk assessment

Figure 1. The steps of the appraisal



Source: adapted from "Guide to Cost-Benefit Analysis of investment projects. Economic appraisal tool for Cohesion Policy 2014-2020" (Dec. 2014, European Commission).

4.1 Description of the context

As shown in *Figure 1*, the first stage of project appraisal is the description of the context in which the project will be carried out outlining the institutional, political, social, and economic framework. This step is essential because it helps to forecast future trends, especially from demand analysis. In addition, this exercise aims to verify that the project is appropriate in relation to the context in which it is going to be realised: it must always be considered that any new project fits within systems that already exist and that already have their own rules and characteristics, and this is a very complex aspect that cannot be overlooked.

Furthermore, during this phase, it is also necessary to outline and describe all the actors who might be called upon to intervene in the context of project implementation. What needs to be further emphasised is the fact that a favourable environment at the outset makes it easier to implement the project or investment: a sound economic policy and strong institutions lead to greater benefits.

Moreover, during the initial planning and evaluation phase, it is necessary to take into account certain content-specific characteristics, outlined below.

Some of the aspects that should be taken into account are:

- the socioeconomic circumstances of the country or region that are important for the project, such as demographic trends, expected GDP growth, labour market conditions, unemployment trend, etc.;
- the institutional and policy aspects, such as current economic policies and development plans, the organisation and management of the services that the project will provide or develop, and the capacity and quality of the institutions;
- the existing infrastructure endowment and service provision, including information on service coverage and quality, current running expenses, and tariffs, fees or charges paid by users, if applicable;
- other relevant information that helps to better define the context (for example, environmental issues).

4.2 Definition of objectives

According to the European Commission CBA guidelines, the second step of the project appraisal is the definition of its objectives. In short, the project objectives must be defined in explicit relation to the regional and the sectoral needs, identified as a result of the context definition (first step). The objectives must, as far as possible, be quantified and targeted by indicators, which may concern, for example, improving the quality of a product or improving accessibility to a service.

Project objectives are clearly defined when:

- the effects that the project should produce have been identified: the clearer the definition of the objectives, the easier the identification of the project effects;
- the relevance of the project has been verified by demonstrating that it responds to a priority of the territory. This is achieved by assessing the project's coherence with European policy goals as well as national and regional development plans.

4.3 Identification of the project

The third step involves the concrete and outlined identification of the project. A project is clearly identified when three different conditions are satisfied:

a) **The physical elements and the activities that will be implemented are well-defined**

Given that a project is defined "*as a series of works, activities or services intended in themselves to accomplish an indivisible task of a precise economic or technical nature which has clearly identified objectives*" (Article 100 of Regulation (EU) No. 1303/2013), these works, activities or services must be instrumental in achieving the previously defined objectives. Some description of the project itself is therefore necessary, such as the type of intervention to be carried out or the type of service provided.
In this regard, the key aspect is that the preliminary evaluation must focus on the entire project as a self-sufficient unit of analysis, i.e. no essential feature must be left out of the scope of the evaluation. In general, a project can be defined as technically self-sufficient if it is possible to produce a functionally complete infrastructure and put a service into operation without depending on other new investments. Just as we should not leave out any element relevant to the project, it is also crucial to avoid the inclusion in the project of components that are not essential for the provision of the service under consideration.

b) **The project promoter is identified, and its technical, financial and institutional capacities are checked**

The project owner, i.e. the body responsible for the implementation of the project, must be identified and described with regard to its technical capacity – which refers to the resources and skills of available staff –, financial capacity – which refers to the body's financial capacity – and institutional capacity. Should it be necessary to recruit additional staff, it will be necessary to demonstrate that there are no constraints on finding the missing skills on the local labour market.

c) **The impact area, the final beneficiaries and all relevant stakeholders are duly identified**

After describing the project activities and the body responsible for project implementation, the boundaries of the analysis must be defined. The spatial area affected by the project's effects is defined as the impact area (may be local, regional or national). A good description of the impact area requires the identification of the final beneficiaries of the project, i.e. the population that directly benefits from the project. In addition, all entities, public and private, affected by the project must be described.

4.4 Technical feasibility and environmental sustainability

Although these two phases are not formally part of the CBA, the outcomes resulting from technical feasibility and environmental sustainability are two elements of information that must necessarily be provided for the financing of major projects.

In particular, detailed information must be provided on:

a) **Demand analysis**

This kind of analysis aims to identify the need for investment by evaluating both current demand and future demand, which are essential to formulate demand projections and to design a project with the appropriate production capacity.

b) **Analysis of options**

The decision to implement a project leads to eliminating, and therefore not undertaking, any of the other available options. Thus, to assess the technical, economic and environmental viability of a project, it is necessary to consider an appropriate range of options to compare. The approach to selecting options should involve first drawing up a list of alternative strategies and then analysing them using certain qualitative criteria. The final goal is to identify the most suitable strategy.

c) **Environmental and climate change considerations**

There are several requirements for the project promoter to demonstrate the environmental sustainability of the project. Among these, the promoter is required to show the extent to which the project contributes, for example, to resource efficiency and climate change objectives, complies with the Directive on the Prevention and Remedying of Environmental Damage (2004/35/EC), as well as with any other legislation requiring an environmental assessment to be carried out, respects the polluter pays principle, the principle of preventive action and the principle according to which environmental damage should be rectified at source. In addition, the impacts of climate change on the project must also be addressed during the design process, when necessary.

d) **Technical design, cost estimation and implementation schedule**

A summary of the project solution must be proposed, showing (i) location (description of the project location, including a graphic illustration), (ii) technical design (description of the main components of the work, technology adopted, design standards), (iii) production plan (description of the capacity of the infrastructure and expected utilisation rate), (iv) cost estimates, and (v) implementation schedule.

4.5 Financial analysis

Financial analysis is one of the most important steps while performing a CBA because it allows to calculate the financial performance indicators of the project.[3]

The financial analysis is usually carried out for several reasons:

- assess the consolidated profitability of the project;
- assess the profitability of the project for the project owner and some key stakeholders;
- verify the financial sustainability of the project;
- outline the cash flows that underpin the calculation of socio-economic costs and benefits.

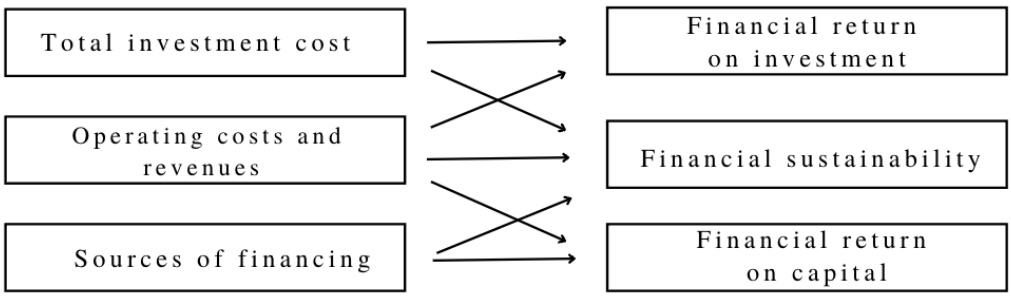
The financial analysis must be conducted from the point of view of the infrastructure owner following some implementation rules. Firstly, only cash inflows and outflows are considered without taking into account reserves or depreciation and an appropriate financial discount rate (FDR), reflecting the opportunity cost of capital, is used to calculate the present value of future cash flows.

In addition, project cash flow forecasts should cover a period appropriate to the economically useful life of the project and its likely long-term impacts: the number of years for which forecasts are provided should correspond to the project's time horizon.[4]

In addition, the financial analysis should be conducted at constant (real) prices, i.e. with prices set to a base year, and must always be carried out net of VAT on both costs and revenues if this is recoverable by the project developer (when VAT is not recoverable, it must be included).

Finally, direct taxes (e.g. capital or income taxation) are only taken into account for the verification of financial viability and not for the calculation of financial profitability, which is calculated before these tax deductions. The rationale is to avoid the complexity of capital income tax rules and the variability over time in different countries.

Figure 2. Structure of financial analysis



Source: adapted from "Guide to Cost-Benefit Analysis of investment projects. Economic appraisal tool for Cohesion Policy 2014-2020" (Dec. 2014, European Commission).

[3] See Article 101 of Regulation (EU) No 1303/2013 for the legislative references.

[4] In this regard, the European Commission provides reference periods for different sectors: for example, for the "urban transport" sector the reference period is 25-30 years; instead, 15-25 years are forecast for the "energy sector".

As shown in *Figure 2*, financial analysis is composed of the following stages:

a) Analysis of the amount and the distribution over the years of the total investment costs, which are divided between initial investment and replacement costs.

b) Calculation of total operating costs and possible revenues. The former include all operation and maintenance (O&M) costs of the new or upgraded service, labour costs for the employer, materials needed for maintenance and repair of the assets, consumption of raw materials, fuel, energy and other consumables for the process, etc; on contrary, project revenues are defined as "*cash flows directly paid by users for the goods or services provided by the operation, such as charges directly incurred by users for the use of infrastructure, the sale or rental of land or buildings, or payments for services*" (Article 61 of Regulation (EU) 1303/2013).

c) Identification of the different sources of funding covering the investment costs. In the context of EU co-financed projects, the main sources can be:
   - Union assistance (the EU grant);
   - National public contribution;
   - The project promoter's contribution (loans or equity), if any;
   - Private contribution, if any.

Determination of investment costs, operating costs, revenues and sources of financing (a, b, c) enables the assessment of the project profitability, which is measured by the financial net present value on investment (FNPV(C)) and the financial rate of return on investment (FRR(C)). FNPV(C) and FRR(C) compare investment costs to net revenues and measure the extent to which the project net revenues are able to repay the investment, regardless of the sources or methods of financing.

The financial net present value on investment is defined as the sum that results when the expected investment and operating costs of the project (discounted) are deducted from the discounted value of the expected revenues.

$$\text{FNPV (C)} = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \cdots + \frac{S_n}{(1+i)^n}$$

where:

- S_t is the balance of cash flow at time t;
- a_t is the financial discount factor chosen for discounting at time t;
- i is the financial discount rate.

The financial rate of return on investment is defined as the discount rate that produces a zero FNPV, i.e. FRR is given by the solution of the following equation:

$$0 = \sum \frac{St}{(1 + FRR)^t}$$

While the FNPV(C) is expressed in money terms and must be related to the scale of the project, the FRR(C) is a pure number and is scale-invariant. When the FRR(C) is lower than the applied discount rate (or the FNPV(C) is negative), it means that the revenues generated will not cover the costs and the project requires external (e.g. EU) financial support.

The project is financially sustainable when the risk of running out of cash in the future, both during the investment and the operational stages, is expected to be null and void. Project promoters should show how the sources of financing available will consistently match disbursements year-by-year, because it is essential to ensure that the project, even if assisted by co-financing, does not risk suffering from a shortage of capital.

4.6 Economic analysis

As shown in *Figure 1*, after the financial analysis, an economic analysis is required to assess the project's contribution to welfare. In this case the key measures are the shadow prices which reflect the social opportunity cost of goods and services instead of observed market prices, which may be distorted by inefficient markets, administrative fees, tax requirements etc. This analysis expands on previous findings by including information useful for assessing the project's contribution to social well-being. There are two major differences with the financial analysis: i) market prices and labour costs are replaced with shadow prices and shadow wages; ii) non-market impacts are evaluated.

Starting from the account for calculating the return on investment, the following corrections should be made:

- tax adjustments;
- conversion from market prices to shadow prices;
- evaluation of non-market impacts and correction for externalities.

Shadow prices are obtained applying fiscal corrections and the following conversion factor:

$$\text{FCS} = \frac{X + M}{M + X + (Tm - Sm)}$$

where export (X), import (M) and corresponding subsidies (T*m* and S*m*) are needed.

Shadow wage, that measure opportunity cost of labour, without taking into account distortions as income tax, unemployment and undeclared work, is obtained as:

$$SO = S(1 - i)(1 - d)$$

where income tax (i) and unemployment rate (d) are used.

Concerning the evaluation of non-market impacts and correction for externalities it must be said that usually this is performed using appropriate methodologies that could be different according to the project under analysis. For example, a first set of externalities that could be evaluated correspond to the consequences that a project could have on the environment as well as on the health and so on the population. Another example could be the possibility to take into account the impact of the project on real estate.

Economic analysis is completed when economic NPV and economic return are computed, using shadow prices/wages and considering externalities. In order to represent the effectiveness of the project it is possible to consider an additional indicator which is the ratio between economic benefits and economic costs.

4.7 Risk assessment

The last step of the CBA aims to address the uncertainty, that always permeates investment projects involving a risk assessment performed as follows:

a) **Sensitivity analysis**

Sensitivity analysis enables the identification of the "critical" variables of the project whose variations, be they positive or negative, have the largest impact on the project's financial and economic performance.

b) **Qualitative risk analysis**

The qualitative risk analysis aims to include the following elements: a list of adverse events to which the project is exposed and a risk matrix for each adverse event. These risk matrices should include the assessment of acceptable levels of risk, a description of mitigation and prevention measures with the clarification of who is responsible for the applicable measures to reduce risk exposure.

c) **Probabilistic risk analysis**

The probabilistic risk analysis is required where the residual risk exposure is still significant. This type of analysis assigns a probability distribution to each of the critical variables of the sensitivity analysis, defined in a precise range of values around the best estimate in order to recalculate the expected values of financial and economic performance indicators.

d) **Risk prevention and mitigation**

The implementation of the steps described above defines the risk prevention and mitigation strategy of the project. Generally, a neutral attitude towards risks is recommended because the public sector might be able to pool the risks of a large number of projects.

5 Conclusion

One of the main objectives of this document was to describe the different steps that make up the evaluation of a project required at EU level in order to access funding. What needs to be emphasised, however, is the versatility of the cost-benefit analysis tool, which was created for a specific purpose but has been adapted and extended over time to the evaluation of different projects.

Furthermore, it is worth highlighting the development of the CBA approach, from the first edition of the EC Guide in 1994 to the current one (2014), especially in response to the evolution of EU regional policy. In this context, the CBA has contributed to the creation of a common assessment framework among the 27 EU Member States, despite the presence of great variability in national socio-economic conditions, institutional capacity and administrative and legal specificities among them.

From an initially general approach, this framework has now become mandatory in the evaluation of major projects under the EU Structural Funds: this not only shows the evolution of the CBA's role but at the same time demonstrates its flexibility and success in increasing the homogeneity of evaluation mechanisms. Indeed, the EC Guide has developed consistently over its five editions through an increasing number of case studies and technical refinements and nowadays it represents a European project that provides a common evaluation framework for regional policy projects in an otherwise highly fragmented landscape.

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