

Abstract

The Cost-Benefit Analysis denotes a methodology for a project evaluation and also a fundamental concept on economic matters. In this respect, the present article reviews some plain concepts which, if misjudged, may lead to assign an economic meaning to usual results having a strictly financial scope. Lying on this premise, the conclusion focuses on the needing for broader categories to evaluate the economic cost-benefit relationships of an investment project.

Cost-Benefit Analysis: Abstract Answer or Empirical Relevance?

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The analysis of the benefits and costs of a project aims to evaluate the economic rationality of a possible investment decision. Regarding this, a review on the meaning of that singular methodology known as the “cost-benefit analysis”, **CBA**, here is proposed based on the premise that it focuses on a narrow definition of the economic matter.

The **CBA** provides an accurate conceptual ground to assess business decisions in a market economy, where the production initiatives are assumed at their entrepreneurs' risk. That foundation goes beyond the particular way in which the analysis is performed, pursuing to know whether it can be expected an investment will have a value higher than its cost. Would the latter situation hold, the difference between both amounts will be granted as an extraordinary retribution to the entrepreneurial initiative. On this subject, a simple model explains how that differential of values comes into evidence when the financial principles of valuation get differentiated from those economic outcomes submitted to evaluation.

Conversely, the extension of the above mentioned principle to the field of wider economic and environmental evaluations does not seem to have the same accurate meaning, because it pays attention only to a partial matter. What argued is the need to enlarge the categories and approach of the analysis when evaluating, for the society as a whole, the economic performance of a project and the economic consequences derived from environmental matters (and in any other case where to deal with the long run was required).

In item **I** the **CBA** methodology will be described by means of a formal analysis, to settle an interpretation over its meaning and scope. Next, in item **II**, the answer previously obtained will be analyzed in terms of its adequacy for a private business under the context of a monetary economy. The third item will describe those restrictions observed on the **CBA** applicability for business and on its economic meaning either for society or for an environmental issue. Finally, item **IV** proposes some reflection lines to address an analysis regarding the economic evaluation of an investment project.

I. THE CBA MODEL

1) Basic analytical framework ⁽¹⁾

Within this context, the term “evaluation” will be restrictively referred to that evaluation based on the cash flow expected from the performance of a project. For that purpose, the whole amount of $\$I$ required for the investment is assumed as disbursed at the first period. Afterwards, and along a succession of “ n ” (undetermined) periods, the gross operating incomes $\$B_i$ generated by the project will be reimbursed in each i th period. The operating costs are considered as coming from two main categories, those intermediate inputs required for production, $\$X_i$, and wages, $\$W_i$. Consequently, the expression $NB_i = B_i - (X_i + W_i)$ denotes the net operating incomes for every period, which are identical to the accounting dividends (also supposed in cash), according to the assumptions made in footnote (1). Lastly, the amount to be recovered from the initial investment, IR_n , comes added at the end of the evaluation horizon. Hitherto, this estimation comes from an economic relationships, determined by the relative prices of inputs and outputs. The cash flow before described is symbolized as follows:

$$F = -I; NB_1; NB_2; \dots; NB_n, IR_n \quad [1]$$

A subsequent step is to determine whether its earnings will pay, or not, for the investment. Therefore, to enable this kind of evaluation in order to comply with the principle for the financial equivalence for capitals, all the succession of monetary benefits needs to be valued to a same moment. For that purpose it is assumed the period at which the investment would be implemented. Formally, to assess the result from a project, this criterion is summarized by means of the following formula:

$$NPV = -I + \sum_{i=1}^n \frac{NB_i}{(1+r)^i} + \frac{IR_n}{(1+r)^n} \quad [2]$$

In the above expression r represents the opportunity cost of money that, for simplicity, is assumed to be a constant rate between periods. To the gross benefits expected from a project this procedure deducts, successively, the three kind of costs to be charged to carry it on: 1) the operation costs, 2) the opportunity cost of the capital to be invested and 3) the investment cost. Consequently, by means of [2], that project’s evaluation result commonly known as the **NPV** (Net Present Value) was represented. But, does this kind of result merely denote an abstract indicator? Or, does the **NPV** get embodied somewhere?

Previous to answer those questions it is important to note that for the result of an evaluation to be of relevance, further than the reliability of the projections on which it is based, it is also necessary to adopt a relevant estimation of the interest rate. This matter has a particular importance, having in mind that the opportunity cost for capital is the return to be alternatively obtained, would that money be financially invested. Hence, this means to say that:

- The opportunity cost is the alternative return to get by the entrepreneur of a project, would him or her buy the financial assets of an already operating firm in a similar activity to that of the foreseen project.

The latter concept also means that,

- The opportunity cost ought to be that return to be reasonably expected by any financial investor buying shares of this project once it was operating.

As a consequence, anytime that the opportunity cost of capital was lower than the project's return a positive **NPV** will be obtained. Otherwise, it would have been better to buy the financial assets of the alternative already operating firm. This fact is a well known one, and it remarks that the true problem is not to determine the Internal Rate of Return **IRR** of a project, but to guess what financial cost the market will assign to the expected benefits. Its adequate inference, has an importance that is more empirical than academic, because it appears as a determinant fact on whether the result to get from the evaluation will be, or not, a benefit to be effectively collected. In this respect, when a project is carried out, as well as when a new firm is created, there are two kinds of assets,

- The capital outlay required to perform the business, and
 - The shares of stock entitling to collect those earnings to be generated in the future.
- But the cost that already has been paid by those people who have created that firm was the initial budget spent in the firm's capital outlay. Therefore, the **NPV** estimation is not seen as focusing on an abstract result, but on the differential between the value of the claims over the firm's results and the value of the required outlay. That differential will denote a net earning to get in terms of a financial wealth, after subtracting to the operating incomes the three kinds of costs already described.

2) Value of shares: the value of a firm and the Cost-Benefit Analysis

The function which follows was adopted by Brealey and Myers ⁽ⁱⁱ⁾ to explain the equilibrium price of a share, showing its value determinants in a simple way:

$$p_0 = \frac{R_1}{1+r} + \frac{R_2}{(1+r)^2} + \dots + \frac{R_n + p_n}{(1+r)^n} \quad [3]$$

Where

p₀	Equilibrium price of the share at the present time
R_i	Cash dividends expected from a share in each <i>i</i> th period
r	Opportunity cost of the money or capital invested in that share
p_n	Price of the share at the end of the valuation horizon
n	Number of periods of the valuation horizon

The successive numerators in [3] represent the sums of money that are expected to be collected along time due to the performance of the firm's economic activity but the last one, which also adds the price estimated for that share at the end of the valuation horizon. In the denominators the interest rate discounts value to the formers, as representative of both costs inherent to a financial goods "production function": the cost of the time to wait for collecting those sums of money and the risk of not strictly collect those initially expected amounts. However, that formula is used in an only didactic way, because it is an expression with undoubtedly formal validity but which has little empirical relevance. Would a market operator infer the price of any share under these terms? The reliability on the prediction of the results needed to integrate it

would be at least suspected. Nevertheless, if that function does introduce any doubts on its applicability, it should not be disregarded that it has the same procedure adopted in the **CBA**. In effect, to determine the **NPV** the investment cost is subtracted from the present value of the net operating benefits, **NBV**, plus the value to recover on the investment **IR_n** at end inclusive. In this respect, it is to be noted that **NBV** represents exactly the same algorithm than [3] but for all the shares. Consequently, would there be predictable results to evaluate a project but not to value a firm?

An ongoing firm is acquired in concordance to the price of its shares. Under this situation a zero **NPV** operation would be performed because, for the future incomes expected from that business, its exact financial value at the present time would have been paid. Hence, this operation provides as return that same average rate discounting the expected future benefits. Instead, if what is being considered is to create a firm, it can render an additional benefit -a positive **NPV**- whenever the market value of the expected results **NBV** comes to be higher than that of the investment budget for its outlay requirements. In respect to this, the purpose here is not to analyze the reliability on any particular methodology but to highlight in what way the economic matter differs from the financial one: while the projected earnings come from economic relationships, its valuation to a given moment is a financial fact.

3) Benefits and Capitalization

The meaning of the **NPV** is easier to be formally observed when introducing some additional assumptions. Supposing that the net benefits have an expected value of **\$NB**, as a constant average amount along time and for a sufficiently large number of periods as to be considered at perpetuity, the value **IR_n** to be recovered from the initial investment at end can be neglected (ⁱⁱⁱ). Hence, it is:

$$NBV = \frac{NB}{r} \quad \text{and, by IRR definition,} \quad I \equiv \frac{NB}{IRR} \quad [4]$$

In the former expression of [4], **NBV** represents the value of all the financial assets **FA** of an all equity firm whereas, at the latter, **I** represents the value of the whole outlay or real assets **RA** required by the firm for its operation. Therefore, the Net Present Value expression comes to be,

$$NPV = -I + \frac{NB}{r} = -I + NBV \quad [5]$$

The **NPV** estimates the capital benefit to be obtained through the financial assets **FA** over the investment budget to be spent in the real assets **RA**. An indicator also applied for a project evaluation is the quotient of the **NPV** over the investment **I**, a coefficient which -under the present assumptions and operating under the terms of the expressions [4] and [5]- comes to be

$$\frac{NPV}{I} = \frac{NBV}{I} - 1 = \frac{FA - RA}{RA} = \frac{IRR - r}{r} \quad [6]$$

From the succession of relationships shown in [6] it can be seen that the coefficient **NPV/I** denotes a Net Capitalization Rate **NCR**, or net rate of the capital gain to be obtained over each \$ invested in a project, a result which comes from:

- The relative differential between the value of the financial assets **FA** representing the claims over the project's results, with respect to the value of the investment in the real assets **RA** or, which is the same,
- The relative differential between the project's return **IRR**, with respect to the opportunity cost **r** for the money to be invested.

Particularly, from the relationship $NCR = \frac{FA - RA}{RA}$, it can be cleared away that,

$$FA = RA(1 + NCR) \quad [7]$$

Under the terms of [7], the value of the firm's outlay and the Net Capitalization Rate that its performance provides are the arguments explaining the value of shares, because the **NCR** also is a function of the return of the firm regarding its opportunity cost. In turn, the term between brackets expresses the Gross Capitalization Rate, **GCR**, as it comes denoted by the following quotients,

$$GCR = 1 + NCR = \frac{FA}{RA} = \frac{IRR}{r} \quad [8]$$

Those relationships verify that the present value of the stream of net benefits **NBV** depends both on the amount of the economic benefits and also on the expectations discounting them at the financial market. Would a rising opportunity cost for money overcome the return of a project (or a firm), the **NPV** will come to be negative as well as the **NCR**, with a **GCR** smaller than unity.

Accordingly to [8], **GCR** has a meaning which is analogous to that of the **Tobin's q**, in as much as **FA** represents the market value of a firm and **RA** its cost of capital (^{iv}). In plain terms, this fact evidences how, as a business cycle indicator, that ratio is associated to the markets' expectations. In this respect, not only the prospective earnings of a firm -as an endogenous behavior- has incidence over its value, but also all those exogenous facts derived from its operating context. Would an adverse macroeconomic prospective weight more than the results from a particular business, a soaring opportunity cost for money -for the same expected benefits yet- may determine that a firm would come to be cheaper than its assets value. Conversely, a stimulus cycle would operate whenever the return from investing at the real sector of the economy comes to be higher than that of a financial alternative or, in other words, when the entrepreneur gets that extraordinary benefit denoted by a positive **NPV** for an investment project.

In concordance with the analysis presented before, the **CBA** evidences to have a financial scope given by the kind of answer provided by its main indicator of results. The **NPV** has a financial meaning, derived from comparing the amount of the present money to invest in regard of the present value of the future money expected from that investment.

II. MEANING OF THE CBA

Money has three primary functions, as unit of account, as a means of payment and as a store of value (^v). Besides, as the first financial good, money expresses by itself the value of all the other financial goods which, generically, may be defined as those instruments representing the claims over future sums of money. This is the reason by which the linkage between present and future is a financial fact qualified in monetary terms where, except money, all the other financial instruments vanish once the rights given by them become effective into present.

Those enounced primary functions grant to money another meaningful condition of a monetary economy, which is to provide a pattern to differ payments. A monetary economy does not only mean that it enables to go beyond barter, but also to have the means for exchanging those values coming from the uncertainty about future. In this respect, those three functions of money are what enable the expectations arbitrage through the other financial instruments, because

- as a store of value, money enables to add or to subtract those costs inherent to time and risk which are associated to the claims over future payments;
- as unit of account, money denotes the relative value of every other financial instruments, therefore, enabling to infer their differential costs; and
- as a means of payment, money has the power to cancel at present the claims over future payments.

Under financial events, money does not express those economic relationships derived from the relative prices of the real goods, which are unknowable at future. What a financial fact denotes is the commercialization of those expectancies exposed to the uncertainty on future, under the terms linking present money with future amounts.

On its own, to compare the cost of capital of an investment with the present value of its expected outcomes, the Cost-Benefit Analysis appeals to both dimensions of a monetary economy. This solution is enabled by money because the relative prices for goods, as well as the relative prices for money along time, are what define the business. Therefore, the stream of money earnings coming from an economic activity can be reduced to a single value at present. This matter is what explains the Net Present Value to be obtained from investing at the real sector of the economy which, being positive, would be pointing out a benefit feasible to be immediately collected (^{vi}). Although that estimation is referred to an ideal, non-temporal “present”, it will effectively get some value at any given time because it associates to matters which are traded by markets.

In reference to the evaluation process, the kind of target considered above is accomplished by the **CBA** because it rests on a singular definition of benefit. In effect, the benefits to be taken into account represent the accounting concept for the earnings of a firm, but corrected in order to allow the deduction of the opportunity cost of capital. For this purpose, the accounting depreciation is substituted by the assignment of the whole investment at the moment it would be implemented. As a consequence, this answer has a microeconomic scope because it focuses on the results pertinent for a production unit. As a matter of fact, what these characteristics denote is a criterion lying on the economic earnings of a firm as well as on the financial procedures for its

valuation, because those results can be traded in advance. What these reasons reaffirm, is the **CBA** adequacy for a business analysis.

III. REFLECTIONS ON THE MODEL

Those arguments previously exposed lead to some considerations, either of a generic nature or specific on some particular fields, under the premise that a project is submitted to evaluation in search of the economic rationality availing to carry it out. On this matter, the concern for reviewing methodologies focuses on a different risk from that which is inherent to the performance of any economic activity. Either the omission of categories meriting to be analyzed or the empirical relevance of the models adopted to perform the analysis expose to another risk, which comes from the evaluation process in itself. That is to say, to the possibility of falling into any of the two kinds of errors when testing hypothesis: to reject a correct one or to accept that one which is not.

Usually, it may be observed that the selection of a project was presented as something on which its economic consequences could be solved by means of its **NPV** and **IRR**, for any scope and field of the analysis. On this matter, the following comments can be raised:

- Those indicators only denote the financial meaning of a business decision, in terms of the incremental wealth to be accrued from a project.
- To the extent that the opportunity of a project may need also to be defined inserted into the context of some strategy, that alternative rendering the higher financial results could well be not the better one.
- The **NPV** and the **IRR** are static indicators, with validity for an ideal and referential moment, whereas any financial instrument puts into evidence that those values change merely as time goes by.

To focus on these matters places the evaluation of a project as a more complex process, even under an economic and financial scope. First, in this respect, it is necessary to distinguish the purpose of the analysis, under the assumption that different targets will be conditioners for the adequacy of the criterion to adopt. This fact is already recognized by the **CBA**, would it be applied for a financial (private) or an economic (social) evaluation. Consequently, the following considerations will be distinctively referred to those both fields and, also, to the economic evaluation of environmental matters, as issues that may deserve to widen the concepts involved by the cost-benefit relationships.

1) The Financial (private) Evaluation of an Investment Project

As “financial” or “private” it is understood the evaluation of those projects conceived for business purposes, ground on which the **CBA** has a precise meaning. Nevertheless, and related to the methods for a project appraisal, the following observations emerge:

- The likelihood of the estimations, beyond the quality of the projections adopted, lies on the empirical relevance of the methodologies for the financial valuation. Was this

requisite for “relevance” not fulfilled, the meaning of the **NPV** will not go further than that of being an abstract indicator.

- Under this approach, the efficiency of an investment is weighted only in terms of the higher financial capitalization. Whenever a project may have a great scale relative to that of a firm, with an outstanding incidence over its business plan, the evaluation process also deserves a strategic analysis.

The first comment is related to the valuation method implicit at the formula of the Net Present Value on its traditional form. As a matter of fact, the **NPV** expression [2] includes the same algorithm than that of [3] to explain the price of a share, this last one complying with the Dividend Discount Model of John Burr Williams, 1937^(vii). The development of the **NPV** criterion, although not under that name, is found in *Wirtschaftlichkeitsrechnung* of Erich Schneider (1951)^(viii), who applied that valuation method to determine “*the capital [financial] value of an investment*”. It would be noted that the article “Portfolio Selection” of Harry Markowitz, who introduced the relationship between risk and return on investment for an efficient portfolio selection, was published afterwards, in 1952. Also, the systematic introduction of risk to the financial analysis appeared as the core of the Modigliani and Miller’s article of 1958. Risk, as well as the expectancies of the financial agents^(ix), are the factors affecting a forecast coming from models with an undoubtedly formal validity. Presumably, this fact was earlier acknowledged in finance than for a project appraisal, because the last one bears an “economic” interpretation which may lead to neglect the financial meaning of the valuation methods on which it rests^(x).

More recently, those methods recognizing a conjectural meaning for projections under risk were shaped. The relative prices may come modified along time, and what seemed to be a good business may derive on the opposite. The experience gained by an entrepreneur and changes occurring in a macroeconomic scenario may throw out unfavorable results related to those initially expected; as well as may demonstrate that those previously rejected alternatives have become preferable to the selected one (of course, favorable changes also proceeds). Hence, the introduction of risk led on the one hand to a probabilistic estimation of the **NPV** of a project and, on the other hand, to the application of the methods for a financial option valuation^(xi). On this ground, an also relevant alternative could be found by introducing a fuzzy mathematics analysis, particularly, to acknowledge the effect of the uncertainty amplification as long as the periods under valuation moves away^(xii).

How long the extension of the lapse under analysis could be deserves particular attention because, as prospective results, the projections adopted are the better inference on future feasible under the terms of the present knowledge. Hereinafter, to refer that set of values to a single moment is a financial fact which, once uncertainty was introduced, led to those models denoting the evolution of thought to deal with risk. Nevertheless, the extension of the horizon for an evaluation may introduce another restriction to link economic and financial matters, coming from an asymmetrical lapse for a business maturing. In effect, the financial business is based on a short run management of the return and risk of a portfolio. But a real investment, instead, is comparatively slower for its implementing and seasoning and, also, to be reshaped or, even, to leave it out, a matter recognized as its indivisibility and irreversibility. This fact just entails a different

exposition to risk, where the financial principles may introduce some biases against a long run prospective of results, a problem on which a qualitative pondering of strategic factors may acquire more relevance.

The latter paragraph shifts the attention to the second comment at the beginning of this item. Financial indicators are helpful to rank projects, but to decide may demand a deeper analysis. Erich SCHNEIDER considered that “*the quantitative factors expressed in money only represent an instance on all those characteristics involved by an investment. But, to judge the difference between two or more investments, those factors lacking quantitative characteristics which therefore are not expressed in money, have the same importance.*”^(xiii) This proposition remarks that a project selection needs to evaluate its monetary prospective but, above all, that to take a decision must also pay attention, i.e., to those weaknesses and strengths endogenous to the firm, and to those opportunities and threats associated to its operating context. In this way, he has presented the Cost-Benefit Analysis as an instrument restricted to give an answer on the money benefits to expect from investing, but far from assuming that it would be the only rational principle for deciding on business. More over, even if it could be thought that the better strategic alternative will also denote the higher **NPV** for a firm, a question arises in relation to the timely extent to be recognized as relevant for a financial valuation under uncertainty conditions. Or, in other words, that due to the limitations of financial concepts for assessing the long run, a rational evaluation also needs to weight qualitative, non monetary issues.

Nevertheless, even though a classical **NPV** estimation on the market value for a project could not be relevant, its formal validity brings a meaningful microeconomic indicator to comparatively analyze the efficiency of alternative projects or to compare alternatives of a same project. For that purpose, on the one hand it is necessary to assume that such alternatives do not alter the risk profile of a business or, on the other hand, that those risk changes can be recognized through differentials of the interest rate.

2) The Economic (social) Evaluation of an Investment Project

Under the terms “economic” or “social” it is understood that evaluation addressed to determine what economic result could be expected from an investment project, for the Nation (for the society as a whole) where it would be carried out. For that purpose the **CBA** comes extended to this field by means of the same function depicted at [2] but, as distinctively from a private evaluation, some changes are introduced to focus on those benefits and costs, and rate of interest, which are pertinent for this case. Those corrections are referred to:

- The inclusion of all the externalities and indirect effects, under the form of costs or benefits attributable to the performance of a project, but which were not previously internalized in the private appraisal.
- The adoption of shadow prices for substituting the market prices, everywhere the latter were considered as distorted.
- The adoption of contingent valuations when dealing with goods or services lacking a market price.
- The elimination of the tax costs.

- The adoption of an interest rate as representative of the social opportunity cost of capital.

Regarding the application of this criterion for an economic evaluation, a set of observations emerges as a corollary of the meaning assigned to the **CBA** method, as it was described in the previous items. Particularly referred to the scope of its main indicator, the **NPV**, the following propositions argue on some limits to the length of its meaning for a social analysis.

a) Economic significance

Under a private analysis, the **NPV** points out a benefit to be appropriated by a particular agent, who is the entrepreneur of a project, given that a **Private NPV** becomes expressed through the value of a share of stock. Due to this same characteristic, that result denotes a financial magnitude not recognized by the economic result known as “Product”. A **Social NPV**, in turn, has no incidence over macroeconomic aggregates also and its value cannot be recognized through any known financial instrument. Accordingly to these reasons, the **NPV** does not seem to be a meaningful indicator for the economic result of a project.

b) Scope of the interest rate

If the social rate of interest was determined as a single value, it would be presupposing either the absence of risk differentials between projects, i.e., considering only a sovereign risk, or that a project lacks risk under a social evaluation. Besides, the main problem is seen in that the financial discount seems to proceed when applied to sums of money to be effectively collected. That is to say, whenever somebody would have the disposition to pay for the present value of the claims on a future stream of money inflows, in concordance to its amount, time terms and risk. Instead, the discount on amounts that are not a subject of market dealing, what suggests is to become in an abstract indicator. It is worth to be noted that with a **Social NPV** may happen the same than with collective goods, where nobody can particularly appropriate that result. Perhaps, neither the society as a whole, to the extent that it is a financial expression of benefits lacking a market where to anticipate them. Therefore, the only remaining way will be to wait for collecting the future economic benefits at those periods on which it will be generated (^{xiv}). Hence, given the abstract meaning that the **NPV** gets for this context, the scope for the interest rate is seen analogous to that of settling a time parameter for the investment recovering.

c) Prices at the base of calculus

It comes just from the unbalance between prices that private projects may have a positive **NPV**, where investors may well be playing a role of arbitrageurs at the real sector of the economy. With everything under equilibrium prices, an extraordinary retribution could not be expected and, obviously, nobody would mind to hold a private evaluation removing market prices. Conversely, the problem from applying that remotion for a social evaluation arises from two matters. On the one hand, in that the retribution to the productive factors will come from those prices prevailing at markets. And, on the other hand, in that facing monopoly distortions shadow prices are introduced for correcting the social valuation of a project but, necessarily, markets will continue assessing priorities in terms of the true market prices. In respect to the latter, it

does not seem that what matters is to have a result in terms of the benefits a project would provide under competitive prices, but to effectively evaluate if it would help to correct any monopoly distortion.

For the purpose of an economic evaluation, what in effect is seen like a necessary correction is the elimination of the private tax costs of a project, given that taxes merely represent a shift of Product to Government hands.

d) Strategic frame

The social qualification of an investment deserves a strategic and deontological consideration not spanned by financial indicators. In respect to this matter, Stephen Marglin (^{xv}) remarked that *“...when we speak of cost-benefit analysis we are talking about questions of tactics and not of strategy, and tactics, however good they may be, can never replace strategy. Tactics have significance only within the context of a rational, articulated development strategy.”*

The indicators of the **CBA** denote a tactic result because what it qualifies is the efficiency for the production processes, but not efficiency in terms of the goals expected from a project. More over, due to the kind of financial answer provided, those indicators may lead to confound the purpose of a project with a target for maximizing an amount of present money. And, in respect to the latter, the monetary measurement of efficiency is restricted to be a result coming from prices in terms of the present knowledge. However, the long run effects of a project, or a set of them, may have an incidence on future scenarios able to modify those price relationships as today are known. Once those events derived from investing come to be present, the evaluation result comes to pertain to an ideal past. Therefore, the **NPV** magnitude gets a meaning analogous to that of “future prices” at a financial market: only denote the link between present prices and the market’s interest rate, but for prices remaining unknown at future. On this matter a social evaluation would deserve to go beyond a static reductionism to present, to evaluate and rank the goals and targets pursued by an investment under a strategic scope.

In accordance to the preceding concepts the solution provided by the **CBA** is not perceived as representative of an economic result for society: the **Social NPV** measures an unverifiable magnitude, because a financial expression whose value is not charged on account by any financial instrument is an ideal one. What in effect is found, is a convenient tool to set a scale of efficiency for projects, able to guide its formulation process and for the social evaluation of those matters whose values effectively come expressed through any market.

What is expected from an investment at the real sector of the economy? Paying attention to a proverbial definition of “economy”, an investment must comply with rationality principles to rank the priority for the human necessities satisfaction, accordingly to the allowable resources. When these resources are invested, present consumption comes interchanged for a future one, where the rationality must base on enhancing the latter. In turn, under a market economy, it is assumed those priorities will be solved through the market prices.

As units of consumption and saving, families will benefit from the value added from investing not only by the financial returns but also by the retribution to labor coming from a new productive investment. That is to say, that the economic result of a project is the whole retribution to the productive factors or value added by a project in compensation for the value added previously assigned to the investment and not only the extraordinary differential retribution to the entrepreneurial initiative ^(xvi). As a consequence, to evaluate for the society as a whole the results from investment projects evidences two meaningful sides: one looking for efficiency at the process –the means- and the other one looking over its effectiveness in terms of its incremental contribution to rise Product –the purpose-. On the first matter, the **CBA** provides a method to select alternatives under an entrepreneurial management scope, addressed to get the higher productivity for capital by means of the inputs to be wasted. But, due to the definition of “benefit” which is implicit in the **CBA**, the retribution to labor must be taken necessarily as a cost and, therefore, to liberate working force is seen as a benefit for the society. In reference to the kind of answer provided on this matter it merits to be noted that, for a project carried out by a foreign investor, the benefit recognized for a country could come limited only to “*the changes over the tax to be collected or the public expenditures and the royalties the entrepreneur of the project would pay to nationals*” ^(xvii). Would it be additionally supposed that that same project will be financed by a foreign loan, the tax shield provided by the interest to be paid will reduce that social benefit or, even, to vanish it. However, it is understood that the wages going to the local workers will remain as an economic benefit, under the form of National Product. In short, the **CBA** is not able to recognize the value added supplied by a project, being it its meaningful economic effect. That is why it also seem necessary to have a method addressed to evaluate the dynamic contribution of a project to growth, as it could be the Product to expect along time and its opportunity. ^(xviii)

The desirability for the estimation of an economically meaningful and verifiable result also lies on that the **NPV** denotes a magnitude to be subsequently modified by the evolution of real scenarios. Money emission beyond the Product growth is clearly identified as an inflationary event, a kind of trouble also borne by all those financial instruments different from money. If afterward to its emission those instruments were perceived as not backing the expectancies previously hold it will lead to those papers’ devaluation. What this kind of problem puts into evidence is that the present value for promises on future payments -or benefits- will evolve associated to the evolution of the real Product, as one of the determinants for those promises to be accomplished. To evaluate the borrowing capability of any private agent, his performance and prospective to self generate the money necessary to meet commitments is taken into account. Likewise, for the society as a whole, such kind of criterion can be correlated to the capability for self generating Product, a ground on which the **CBA** may lead to paradoxical solutions. Hypothetically, for instance, it could be imagined an international lending for a domestic project, with a sufficiently high **Social NPV** coming from “intangible benefits”, but whose contribution to the Product growth was unable to self generate those funds needed to repay that loan.

In respect to the answer provided by the **CBA**, would it be correct to suppose the better aggregate solution to invest will be obtained under a scope limited to a microeconomic and commercial efficiency indicator? In the ’90 decade, for example,

many firms of Argentina doubled their productivity in respect to labor. Reasonably, it may be supposed that that result was achieved by implementing actions and investments which, when previously evaluated, might have thrown out a positive **NPV**. At present, the country has more efficiently microeconomic units which, in turn, cannot accomplish their business planning under a market reduced by a soaring unemployment and a falling Gross Domestic Product. This matter faces a problem of subordination to goals. On the one hand, it is whether it may be assumed that the organization of a society can be solved strictly as a function of business principles. On the other hand, it is whether it may be considered that the society is the entity defining a strategic horizon for her future, including the economic matter, where business will contribute with efficiency for a short run resources management. Under the latter circumstance, the efficiency is not seen as a target in itself, but like rationality applied to the means, to also evaluate a result in terms of its purpose. To a great extent this problem comes simplified for business, in as much as means and purposes converge into a same monetary dimension, hence, with effects easier to be reduced to a microeconomic present.

3) Economic Evaluation of Environmental Matters

To deal with the environmental matter faces an analysis of cumulative processes having effects in and for the long run. Hence, is the interest rate meaningful when comparing present and future on this subject?

Markets are a strictly human construction on which there is not any reference at Genesis^(xix). Also, the interest rate is not a good existing in nature except only as a creation coming from the human mind. The interest rate comes from the simplest financial model constructed by means of the analogical thought^(xx): it states the relationship of proportionality existing between an amount of money to be collected in the future and its value at present accordingly to the market prices. Notwithstanding it is a referential element to analyze markets or to operate over their behavior, the market set of prices of the financial goods is the very only objective fact to determine the interest rate. This matter lets us paraphrase Sartre -with the advantage to be on a ground lacking any theological controversy-, about that “*existence precedes essence*”^(xxi). That is to say, that the market prices precede those criteria and models contrived to explain them^(xxii).

As a unit of measure, the interest rate has a scale in concordance with the object to be measured, a matter which here derives in that those amounts of money going beyond the time of a human life have near no value at present. This represents a problem for the environmental events valuation to the extent that, because of that scale, the interest rate will ignore the results for future generations. This particularity suggests the needing for some analytical procedure able to conciliate business and environmental decisions. Licitly, a business is solved under monetary rules but environment focuses on the evolution of real scenarios. In this way, the experience lets us verify that the social attention goes faster than the formality of theoretical constructions, as the development of the standards ISO 14.000 and the firms’ adherence to them puts it into evidence.

To the extent that an economic resource becomes exhausted, it can be waited that its price sometimes will be rising in order to compensate for an increasing marginal cost of production allowing, therefore, the access to previously disabled sources. From the scope of the solution to be obtained by means of the cost-benefit equation, the **NPV** criterion may lead to contradictory results. For instance, everywhere a maximized **NPV** could promote incorrect practices for the use of land, exhausting it, future resources will be diminished for an increased population. Paradoxically, the short run answers of a financial solution could well continue justifying “rationality” for the resources destruction, whenever the afterwards future incremental prices overcompensate for higher costs. ^(xxiii)

The economic activity adds value but also can subtract it when injuring the environment. The rationality of the **NPV** is not blind to this kind of problems, and some private projects would become unprofitable if all its environmental costs were to be afforded. Alternatively, all those costs may be internalized only in a social evaluation, addressed to identify by means of its difference with the private analysis, if there is some feasible “price” to get or sell the rights, for instance, for contamination. Notwithstanding, the trouble for this kind of solution is always seen in that the social value will be an abstract one, except by the sums to be collected under the form of “rights for contamination”. Subsequently, given the kind of the financial units of measure adopted, that amount would well come to be an insufficient compensation for the value added that afterward might be consumed by environmental damages, with an also negative impact over the public finances ^(xxiv).

The environmental issue might ask for reconsidering the approach to benefits and costs, in a way to allow reviewing its cumulative effects in terms of the future. That answer needs to enable a more realistic weighting of the consequences coming from the time asymmetries arising everywhere the commercial benefits fade before the environmental damages and its associated costs. In this field, under the absence of market prices, the inference of shadow prices may be meaningful for reviewing alternative future scenarios. Therefore, as a question to be answered remains is if it is pertinent, or not, to use the interest rate when dealing with this kind of long run matters.

IV. CONCLUSION

Human rationality is not only a monetary phenomenon, in as much as not only whatever that has a value nominated in money has rationality. For a monetary economy, however, nothing looks more rational than to compare costs and benefits by means of money. Would it be possible a cost-benefit analysis at a barter economy? From long ago it seems there is no experience about it. Nevertheless the problem does not rely on finding a barter economy, but to have in mind that any society takes decisions whose economic consequences are also to barter, in this case, means for purposes through many actions and results lacking a market to deal with. In this respect, a great economic infrastructure project, a Nation’s educational project or the change of its electoral system will have very different economic consequences going further than the **CBA** financial reductionism previously analyzed.

The **CBA** has a strong rationality for a private economic decision under a mimesis with finance at monetary economies, which comes from a monetary concept pertinent for the earnings of a firm. Consequently, this kind of answer may confound an economic evaluation with a monetary target, in a way to reach a financial unit of measure that lacks relevance on its social meaning. In this field, as well as in the environmental one, it would be desirable a deeper analysis, keeping distance from dogmatic positions, would it lead to disregard the vast experience acquired by means of the **CBA**.

Although the market is the most efficient procedure for the resources allocation, necessarily, it is a manager favoring a short run rationality derived from the financial world. Notwithstanding a financial market trades claims over long run money it does not mean its pertinent prices will be based on such time scale expectancies. On the contrary, the prices for long run money emerge and change in concordance to the expectancies for the short run. Hence, would that characteristic lead to a careless long run environmental management, its rational consequence will be a progressive reduction of the economic bases for the productive business. That is to say, on its own, to reduce the access to the markets. Leaving aside any deontological consideration, that circumstance could not necessarily be an irrational one, was it coming, for instance, from a Malthusian strategy to prevent the overpopulation of the planet. However, it might lean on the premise that the effects from destroying resources from nature will have a smaller impact than that of the people drawn out from markets. But, as strategy, it deserves a deeper analysis to the extent that environmental matters would not have the temporal reversibility bestowed by the financial equivalence for capitals. For that reason, where economics are mimetic to finances, the long run for the environmental is seen mimetic with economics to conceive those needed analytical instruments. That mimesis, however, would not endow transitivity from finance to environment, was it not being accepted reversibility for time.

The latter proposition refers, as an analogy, to actual concepts on physics. In respect to this, the resonance coming from a steady interaction between a diversity of particles breaks the time symmetry found at the deterministic physics. The classical mechanics applied to the trajectory of a single particle comes to be an exception, because single particles are neither solids nor liquids. The rule, instead, is that throughout the interaction between particles the condition of a substance can be recognized. Briefly for intuitive comprehension, those concepts produced a shift to the non-equilibrium statistical mechanics, like a dynamic for correlation instead of trajectories: under non-equilibrium conditions *“long range correlations not existing at an equilibrium stage appears”*. ...*“This formulation breaks the symmetry between past and future as hold by the traditional physics, quantum mechanics and relativity inclusive. Traditional physics associated complete knowledge and certainty in that under initial adequately given conditions endorsed future predictability and the possibility to retro-explain past ... At statistical levels, resonance cause the determinism fracture: it introduce uncertainty into the classical mechanics breaking the symmetry for time”*.^(xxv)

To evaluate an investment project, the financial fact eases to mask the set of economics (particles?) interactions (resonance?), under the premise that future can be

reduced to an only monetary magnitude for an ideal present. It deserves to be noted that, even under a financial dimension, the theory for options valuation -under the terms of the Black and Scholes formula- also evidences a fracture with a deterministic scope, as a construction lying on the principles of the “brownian movement” for shifting between phases -although not with strictly equiprobability-. What remains is to acknowledge economics decisions as a factor for transforming future, in line to the claim expressed by Wiseman on “*the needing for a new kind of economy*”^(xxvi). Given that the results of a project come from the unbalances at the real sector, not only a short run scope for efficiency is what matters in a social analysis, but also to identify where a lack of equilibrium is highly critical on its long run prospective. In this respect, the convergence of the economic and the financial facts on a single indicator, like the **NPV**, may be limited to those events where the effects of both facts also converge on its time consequences only. The financial value of a project or a firm synthesizes present expectations but it is a poor inference on what future economic consequences an investment decision could have. “*The Arrow of Time*”^(xxvii) is left aside, because the **NPV** value is restricted to the present consciousness on today. In other words, it is prevailing an economic thought that avoids to consider how an economic decision may alter entropy, or that simply denies the possibility of the entropy existence in the social dynamics of economics. Hitherto, finance does not represent the only principle to base rationality, to the very extent that an entrepreneur should be characterized as a transformer of reality, bringing into existence a future that may well be not acknowledged at present by that market.

The reviewed principle has paid attention to a common, elementary precept: to assume that when anybody is taking any decision he will evaluate its benefits to be greater than its costs. The analysis was centered on a theoretical construction to get a singular answer to that common precept. In respect to that criterion, and for somebody deciding over the economic consequences for his or her own life, would be rational to solve it under the terms of an **NPV** obtained for a long run situation? Possibly yes, for a reasonable amount of money if in effect it could be immediately obtained, whenever it would be anticipating to present better conditions to solve the uncertainties on the becoming, no matter what will happen in the long run. Instead, the analysis would have more complexity if, as a trade-off for present sacrifices, he was getting only promises about a future to be verified when it comes to be present.

REFERENCES

- Aliberti**, C.A. (1998). Rentabilidad de un Proyecto y Valor de la Inversión. *Universo Económico*, magazine of the Consejo Profesional de Ciencias Económicas de la Ciudad Autónoma de Buenos Aires, Argentina, 39:54-56.
- Bernstein**, P. L. (1993). *Capital Ideas. The Improbable Origins of Modern Wall Street*. The Free Press. U.S.A.
- Brealey**, R., Myers, S. (1991). *Principles of Corporate Finance*. Mc. Graw-Hill, 4th edition. U.S.A.
- Contraloría General de la República del Perú**. Videocassettes over environmental interventions 1999 and 2000.

- Copeland, T., Weston, J. F.** (1980). *Financial Theory and Corporate Policy*. Addison-Wesley Publishing Company, 3rd edition. U.S.A.
- Coss Bu, R.** (1998). *Análisis y Evaluación de Proyectos de Inversión*. Limusa
- Cox, J.C., Rubinstein, M.** (1985). *Options Markets*. Prentice-Hall. U.S.A.
- Damodaran, A.** (1999). *Value Creation and Enhancement: Back to the Future*. Stern School of Business, NYU website.
- Dixit, A., Pindyck, R.** (1994). *Investment Under Uncertainty*. Princeton University Press. U.S.A.
- Elton, E.J., Gruber, M.J.** (1991). *Modern Portfolio Theory and Investment Analysis*. John Wiley & Sons, 4th edition. U.S.A.
- Fanelli, J.M.** (1991). Tópicos de Teoría y Política Monetaria, *Centro de Estudios de Estado y Sociedad (CEDES)*, Serie docente Nr 5, Buenos Aires, Argentina.
- Ferrá, C., Botteon, C.** (2000). Metodología de Evaluación Socioeconómica de Inversiones Nacionales y Extranjeras, *Anales de la XXXV Reunión Anual de la Asociación Argentina de Economía Política* (www.aaep.org.ar)
- Fontaine, E.** (1999). *Evaluación Social de Proyectos*. Universidad Católica de Chile, 12^a edición. Chile.
- Glenday, G.** (1996). Risk Sharing Contracts in Project Appraisal, *Harvard Institute for International Development*, U.S.A.
- Hawking, S.** (1988). *Historia del Tiempo*. Editorial Crítica, 21st Spanish edition, 1999, México.
- Hicks, J.** (1967). *Critical Essays in Monetary Theory*. Oxford University Press. U.K.
- Hofstadter, D.R.** (1981). How might analogy, the core of human thinking, be understood by computers? *Scientific American*, September: 18-29.
- Hull, J.** (1991). *Introduction to Futures and Options Markets*. Prentice-Hall. U.S.A.
- Jenkins, G., Harberger, A.** (1997). *Cost-Benefit Analysis of Investment Decisions*, Harvard Institute for International Development. U.S.A.
- Lazzari, L., Machado, E., Pérez, R.** (1998). *Teoría de la Decisión Fuzzy*. Ediciones Macchi. Argentina.
- Layard, R.** (1972) *Análisis de Costo-Beneficio. Selección de temas por Richard Layard*. 1st Spanish edition Fondo de Cultura Económica, 1978, México.
- Marglin, S.** (1973). The Essentials of the UNIDO Approach to Cost-Benefit Analysis. In: Schwartz H., Berney R. (ed.) *Social and Economic Dimensions of Project Evaluation*, , Inter-American Development Bank, 1977. U.S.A.
- Modigliani, F., Miller, M.H.**, (1958). The Cost of Capital, Corporate Finance and the Theory of Investment, *The American Economic Review*. June: 261-297.
- Modigliani, F., Miller, M.H.** (1963). Corporate Income Taxes and the Cost of Capital: a Correction, *The American Economic Review*, June: 433-443.
- ONUDI** (1972). *Pautas para la Evaluación de Proyectos*. Organización de las Naciones Unidas.
- ONUDI** (1978). *Guía para la Evaluación Práctica de Proyectos*. Organización de las Naciones Unidas.
- Prigogine, I.** (1996). *El Fin de las Certidumbres*. Editorial Andrés Bello. Chile.
- Ross, S.A., Westerfield, R.W., Jordan, B.D.** (1995). *Fundamentals of Corporate Finance*. Irwin, 3rd edition. U.S.A.
- Sartre, J.P.** (1946). *L'existencialisme est un humanisme*. Nagel, France.
- Sapag Chain, N.** (1993). *Criterios de Evaluación de Proyectos: cómo medir la rentabilidad de las inversiones*. Mc Graw Hill. U.S.A.

- Savvides, S.**(1994). Risk Analysis in Investment Appraisal, *Project Appraisal*, Beech Tree Publishing, Vol. 9, Nr. 1: 13-18.
- Schneider, E.** (1951). *Wirtschaftlichkeitsrechnung*, Spanish edition as *Teoría de la Inversión. Cálculo de Economicidad*, Editorial El Ateneo, 1956, Argentina.
- Thaler, R.H.**, Editor (1993). *Advances in Behavioral Finance*. Russell Sage Foundation. U.S.A.
- Thieme, A., Ceran, N.** (1995). *A Summary Users Manual On Cristall Ball 3.0 For Analyzing Risk In Project Analysis Using Microsoft Excel*. Educational Series, Learning and Leadership Center, The World Bank, U.S.A.
- Tobin, J.** (1982). Money and Finance in the Macroeconomic Process, Nobel Lecture, *Journal of Money, Credit and Banking*, vol. 14, no. 2.
- Trigerogis, L., Mason, S** (1987). “Valuing Managerial Flexibility”, *Midland Journal of Corporate Finance*, Spring: 14-21.
- Universo Económico** (1996). “ISO 14.000: Investment Project Evaluation”. *Magazine of the Professional Council of Economics of the Autonomous Buenos Aires City*, Nr. 31: 81-83.
- Wiseman, J.** (1987). La Economía Política del Federalismo, *Anales de las 20 Jornadas de Finanzas Públicas*, Universidad Nacional de Córdoba, Argentina.
- Zambra, M.** (2001). Utilización de Indicadores No Convencionales, Difusos, para la Evaluación y Selección de Proyectos, a desarrollar en un contexto de objetivos y restricciones múltiples. *Tesis doctoral en preparación*, Facultad de Ciencias Económicas, Universidad de Buenos Aires.

FOOTNOTES

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- i For this stage of the analysis the following assumptions were adopted:
- There are no taxes.
 - There is no financial leverage; that is to say, it refers to all-equities firms.
 - There is no depreciation for the capital outlay. Hence, dividends are coincident with the cash flow of the firm.
- ii Brealey and Myers (1991), with changes in notation.
- iii These additional assumptions are adopted in accordance to those of Modigliani and Miller (1958), where the net operating income of the firm is considered like an expected value, that is to say, with some mean and variance.
- iv Tobin (1982), where it is “ q^K : ratio of market price of equities to standard replacement cost of a unit of capital”.
- v Hicks (1967).
- vi Yet as “a project”, the prospective derived from the potentiality of an investment already has a commercial value to the extent that it was acknowledged by markets. So it is evidenced by the cost to acquire the rights for a mine exploitation, the cost of land or the shares’ price anywhere a market may discount in advance those prospectives.
- vii A reference to that model can be seen in Bernstein (1992).
- viii That title was translated to Spanish as “Investment Theory. An Economicity Calculus”.
- ix E.g. see Thaler (1993).
- x It is a remarkable comment that of Bernstein (1992) about that “*At most universities, the business school and economics faculties barely greeted each other on the street.*”
- xi Savvides (1994), Glenday (1996), Trigeorgis & Mason (1987), Dixit and Pindyck (1994)
- xii Zambra (2001).
- xiii Schneider (1951), chapter IV of the Spanish edition, “*los factores cuantitativos, expresados en dinero, representan solamente una parte de todas las características de una inversión. Igual importancia para el juicio de la diferencia entre dos o más inversiones revisten los factores que carecen de carácter cuantitativo y que por eso no pueden expresarse monetariamente.*”
- xiv Here, the **Social NPV** is referred like a generically result without discriminating some singular beneficiaries. As a matter of fact, there are particular cases where some portion of the social results can be privately captured, for instance, throughout a rising value for land as a consequence of an economic infrastructure project.
- xv Marglin, S.(1973).
- xvi The “normal” retribution to capital, as stated by the financial market, must be already deducted as the opportunity cost adopted to discount benefits.
- xvii Ferrá and Botteon (2000).
- xviii Schneider (1951) distinguished between private and public or collective investments, placing the pertinence of his analysis for both situations, but whenever the target of an investment was to make a profit by selling the goods or services to be produced. Consequently, the goal of the analysis was limited to identify the maximum money profit to get over the invested capital under a business scope.
- xix THE BIBLE, Genesis or Book One from Moses.
- xx An interesting note on the analogical thought may be seen in Hofstadter (1981).

^{xxi} Sartre (1946).

^{xxii} The author is particularly grateful to his Professor Eduardo Melinsky, for his help in understanding that notion by means of a relevant distinction between reality and models when teaching on Financial Derivative Instruments: “*market commands*”.

^{xxiii} That situation was verified when the northwest agricultural border of Argentina was expanded at the middle of the '60 decade. The case was exposed at a the seminar on economics and environmental management at the Professional Council of Economics of the Autonomous Buenos Aires City, with a reference published in *Universo Económico* (1996).

^{xxiv} On this matter, a suggestive reference are the reports of the Contraloría General de la República del Perú over the following interventions:

- Environmental Management at the Bahía Pisco-Paracas, Proyecto Delta, March 2000.
- Environmental Management at the Cuenca del Río Mantaro, Proyecto Alfa, 1999.

^{xxv} Prigogine (1996). From the Spanish edition, “Esta formulación rompe la simetría entre pasado y futuro que afirma la física tradicional, mecánica cuántica y relatividad inclusive. La física tradicional vinculaba conocimiento completo y certidumbre, que en ciertas condiciones iniciales apropiadas garantizaban la previsibilidad del futuro y la posibilidad de retrodecir el pasado. ... A nivel estadístico, las resonancias ocasionan la ruptura del determinismo: introducen la incertidumbre en el marco de la mecánica clásica y rompen la simetría del tiempo.”

^{xxvi} Wiseman (1987)

^{xxvii} Hawking (1988).