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Methodological Challenges in Cost-Benefit Analysis

Summary: The aim of the study is to examine the theoretical and methodological challenges of cost-benefit analysis in the light of practical application. After a short overview of the development of cost-benefit analysis, the author seeks to examine the methodological problems of the analyses applied in the case of public projects in the course of decision-making at social level. The study analyses, inter alia, the problem of the multiple counting of benefits, the uncertainty of the applied estimates, the determination of the value of the social discount rate, the consideration of the social cost of public funds and the role of cost-benefit analysis in practical decision-making. In relation to the methodology of Hungarian cost-benefit analyses, the study puts forward two concrete proposals. Based on calculations, the study estimates the fiscal correction factor of labour costs (0.2851), and points out the fact that in the case of the effects emerging in secondary markets, the use of the multipliers observed in the Hungarian practice cannot be regarded as an economically adequate instrument.

Keywords: cost-benefit analysis, project appraisal, social welfare, externalities, social discount rate
JEL codes: D61, D62, D71, H43

Today's social, economic and environmental challenges render the social and financial allocation of available resources increasingly important. Consequently, *ex ante* appraisal plays a key role on the preparation of decisions at government level, as well, as decision alternatives with different technical content (costs) have diverse effects. Only some of these effects can be tracked in financial transactions. Most of them are indirect effects which, as a result of complex mechanisms of action, affect social, economic and environmental systems, and they are fairly difficult to quantify.

From the very wide range of tools for project appraisal, our study focuses on cost-benefit analysis *(cost-benefit analysis, CBA)*, in particular the methodological issues of social or – in other words – economic cost-benefit analysis. It is also important to note that numerous other appraisal procedures are applied in practice, depending on the subject matter and purpose of the analysis, such as the *economic impact analysis (GVA approach)* that provides the means for the quantification of the multiplicative effects, or the *cost effectiveness analysis*. The former quantifies the effects of a given investment on GDP or the labour market, while the second method should be applied if the goal is to choose the least costly technical version and the effects can be aggregated in-kind.

As opposed to the approaches above, cost-benefit analysis principally seeks to answer the question whether an investment project is worth implementing, and which alternative to choose from several feasible alternatives. The questions above can be examined from the

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point of view of a participant of the project (usually the investor or the operator). In this case, the revenue and expenditure flows generated during the review period are evaluated in the course of a *financial cost-benefit analysis*. Alternatively, the analysis may focus on a larger community, a town or a country affected by the investment. *Economic cost-benefit analysis* assesses the effects of the project from the point of view of the society, quantifying costs and revenues arising at the social level, as well as additional indirect social, economic and environmental effects. At the same time – being a welfare approach – it does not provide information on the impacts of the investment project on the economy, GDP and employment. The approach suitable for providing such information is economic impact analysis, which applies multipliers based on input-output models and econometric models.

The next part of our study gives a short overview of the evolution and development of cost-benefit analysis. Next, we attempt to examine the theoretical problems of cost-benefit analysis. We seek to provide a comprehensive view of all relevant methodological issues. In many cases, we suggest a novel approach or make a proposal (see: the conclusions related to the practical use of fiscal correction and the multiplier effect in Hungary); however, a deeper analysis of certain theoretical problems goes beyond the scope of this article. At the end of the study, we draw general conclusions and put forward a number of proposals on the methodology of the Hungarian practice of cost-benefit analysis.

THE DEVELOPMENT OF COST-BENEFIT ANALYSIS

The evolution of cost-benefit analysis goes back to the 19th century. Its development is affected, even today, both by the theory of economics and the practical applications influenced by changing socio-economic needs. The method was first used in the 1800s, mainly in solving practical problems in the field of technology. In 1808, *Albert Gallatin,* as the US Secretary of the Treasury, attempted to estimate the costs and benefits of a water management programme (*Hanley – Spash,* 1993). A Frenchman, *Jules Dupuit* – originally a qualified civil engineer – estimated the optimal value of a bridge toll in relation to the construction of a bridge in 1844 (*Dupuit,* 1844). In the 1830s, when arguing for the construction of the Chain Bridge and, in order to ensure the financing of the project, against the free passage of noblemen, *István Széchenyi* applied a logic that can be considered as a forerunner of the CBA method (*Orosz – Princz-Jakovics,* 2001). His traffic bill in 1848 was also based on the same thought process (*Széchenyi,* 1848).

In public decision-making, cost-benefit analysis was first used in practice in the United States of America: the Flood Control Act of 22 June, 1936 stated that cost-benefit analysis should be conducted in the case of public projects. In Europe, CBA appeared only in the second half of the 1950s: this method was used to prepare the study plans for the M1 motorway (London-Birmingham) in England (*Coburn et al.,* 1959), the Victoria Line in London (*Foster, Beesley,* 1963) and the Chunnel under the La Manche (*Ministry of Transport, UK et al.,* 1963). Since the 1960s, it has been used in diverse fields of public decision-making, such as in transport, the construction of the electricity network, healthcare or education (*Mishan,* 1982, pp. 26–44).

It appears that the publication of theoretical works on cost-benefit analysis were brought about by practical applications (*McKean,* 1958, *Krutilla – Eckstein,* 1958, *Pearce,* 1968), despite the fact that the roots of the theoretical background of the model go back

to a much earlier period of the development of economics. *Mishan* (1982, p. 21) also referred to this, claiming that cost-benefit analysis is basically the practical application of welfare economics. The methodology assumes the existence of a social welfare function, which can be defined even if its empirical understanding is hampered by considerable obstacles. This function allows for the optimisation of the distribution and use of our resources at the social level. The conceptual framework applied by this methodology draws on the general equilibrium theory (preference system, utility, Pareto-optimum, supply and demand price and quantity, profit). The definition of consumer surplus, which plays a key role in the measurement of social benefit is also built around this concept; indeed, Dupuit's work (1844) had recourse to it already.

In Hungary, theoretical works (e.g. *Sóskuti,* 1983, *Jasper,* 1986) were inspired by the publication of E. J. Mishan's book (1971), which summarised the basics of the scientific field in Hungarian in 1982, while the broad-based practical application of the methodology started to spread from the 2000s. Interestingly, practical and theoretical works appeared in the opposite order in Hungary. The fact that access to European Union resources is regulated by law significantly contributed to the appearance of empirical analyses in Hungary: in the case of many sectors, the preparation of a financial and social cost-benefit analysis is a tender requirement. *Table 1* classifies practical examples for analysis in the Hungarian literature by area of application.

As the table shows, the use of CBA is very widespread: in addition to the classical fields of application (transport, water management, environmental protection), it is applied in social integration, volunteer programmes and sports projects, even though the methodology cannot be described as matured or uniform in any of the fields. In each sector, the development of cost-benefit analysis is surrounded by several questions and continuous professional debate. In the following part the study, we seek to map these methodological questions.

Table 1

AREAS OF APPLICATION OF COST-BENEFIT ANALYSIS IN HUNGARIAN PRACTICE

Review area	Relevant literature, examples for application
Healthcare	Fekete (2010), Koppány (2016)
Energy management	Pintér (2013), Mezősi, Szabó (2013)
Waste management	Nádudvari (2010), Nováki (2001)
Environmental protection	Vajda (2000)
Transportation	Orosz et al. (2006), Juhász et al. (2013)
Agriculture	Kovács et al. (2014), Ózsvári, Bíró (2003)
Education	Veres (2012)
Volunteer programmes	Solt, Takács (2015)
Sports facilities	Vörös (2017)
Social integration	IFUA (2016)
Regional development	Hegyi-Kéri (2013), Hatvani (2003)
Water management	Czeglédi, Kovácsné (2008)

Source: own editing

METHODOLOGICAL QUESTIONS IN COST-BENEFIT ANALYSIS

One of the major advantages of applying cost-benefit analysis is that this methodology enables us to consider external effects or externalities that are manifested only indirectly – if at all – in monetary transactions. Obviously, as *Solt and Takács* (2015, p. 47) pointed out, this appraisal system is suitable for quantifying not only indirect benefits but also costs that cannot be expressed in monetary terms. Consequently, performance indicators based on CBA tests – net present value (NPV), benefit-cost ratio (BCR) and the internal rate of return (IRR) – contain information not only on the direct financial impacts of the reviewed project, but also on its wide-ranging social, economic and environmental impacts. On the other hand, however, it is the criticism of the methodology at the same time, because decisions are made on very complex impact systems considering a single or only a few figures. Nor should we forget the limits of the methodology of cost-benefit analysis, the arising problems, challenges and questions. Several problems are general methodological questions, independent of any fields of application. By contrast, other problems are sector-specific; for example, the methodological questions of the quantification of certain benefit elements. The questions above will be addressed systematically in the following sub-sections, attempting to illustrate the theoretical approach with practical examples.

The problem of measurability – the limits of quantifiability

In cost-benefit analysis, financial revenues and costs can be measured exactly; however, benefits are more difficult to quantify. It is not even easy to prepare a list of the socially relevant impacts of a project. It is even more difficult to decide which benefit elements can be involved in quantitative appraisal and which are the ones where qualitative appraisal is more effective. Where are the limits of quantifiability? This question is different in each sector, and is closely related to the methodological questions of the social evaluation of resources. In the course of CBA, expressing the value of human life, time or environmental pollution is widespread, but in the case of a complex transport project – such as the renovation of a public square or the construction of a level platform at a railway station – the quantitative appraisal of the increase in user comfort is a highly debated question. In addition to the methodological problems of the monetarisation of individual benefit elements, the separation of benefits – i.e. that one impact is assessed only once, in one form of appearance – is also important.

The problem of the multiple counting of benefits

During the evolution of cost-benefit analysis, the monetary counting of the arising benefits gradually became a part of the methodology. For example, when examining traffic infrastructure projects, in addition to the appraisal of the time and vehicle operating costs saved, the assessment of the impairment losses arising from accidents and environmental externalities (air pollution, climate change, noise pollution) is also internationally accepted nowadays. At the same time, several additional indirect effects appear in secondary markets (e.g. in connection with traffic, in the commodity, real estate and labour markets), the consideration of which – assuming perfect competition – would mean the *double counting* of benefits (*Mohring,* 1993, *Rouwendal,* 2012, *Sartori et al.,* 2014 p. 54). In the case of a

public transportation development project, such a methodological mistake would be, for example, to take into account the appreciation of the area's value as extra benefit. This is because the estimated increase in the value of the real property is only another manifestation of the benefits arising in the primary market (in this example, the benefits of time saved and the improvement in environmental conditions), and not a new, independent benefit element.

If we cannot use the assumption of perfect competition, however, there might be impacts in the secondary market that cannot be captured by counting the benefits arising in the primary market (*Laird et al.,* 2014, *Nash,* 2011, pp. 463–465). As the theoretical hypotheses of economics on perfect competition are only good approximations of reality at best, several research projects have aimed to develop the counting procedure of *wider economic benefits* arising in secondary markets (*Mackie,* 2011, Laird et al., 2014, *Eliasson – Fosgerau,* 2017). Through the example of traffic, *Mackie et al.* (2011) pointed out that market failures (imperfect competition in the primary market, the existence of externalities, non-constant return-to-scale) may lead to such a surplus in the commodity and labour markets that cannot be fully captured by the estimated consumer surplus in the primary market.

That notwithstanding, in the absence of a uniform, consensus-based methodology, the cost-benefit analysis guide of the European Union (Sartori et al., 2014) does not suggest the consideration of any indirect benefits at this time. At the same time, we can find numerous methodologies among the national guides that were developed, as a result of national research, on the basis of different benefit elements. For example, the United Kingdom quantifies the impacts of transportation projects on the agglomeration and the change in output due to the imperfection of secondary markets; in addition, it has developed a methodology for a number of labour market effects that can be considered as extra benefits in the CBA (*Department for Transport,* 2013).

The appraisal of multiplicative effects in CBA

Above, we pointed at the importance of the classification of impacts, the quantification of benefits and the avoidance of multiple counting. In this context, it is worth mentioning the fact that the multiplier effects of projects are considered among the benefits in domestic practice, which raises several methodological questions. In the recent period, several studies have included the economic spillover effects of different projects among social benefits. In the following part of our article, some of these studies are analysed (*Pro Urbe et al.,* 2013; *Utiber et al.,* 2013; *Trenecon COWI et al.,* 2014a, 2014b).

The detailed feasibility study on the development of transport in the Buda Castle and its surroundings considers the total assumed GDP growth generated by the planned transport projects as social benefit in the cost-benefit analysis (Pro Urbe et al., 2013, pp. 461–463). The study assumes that the nominal value of the new investment amounts to HUF 16,626 million, after multiplying the nominal economic investment cost of HUF 13,319 million – divided into two parts – by multipliers 1.2 and 1.3. Economic CBA takes into account the aforementioned investment increment, as a contribution to GDP, distributed over a 5-year period (35 percent, 30 percent, 20 percent, 10 percent, 5 percent). The multiplier effect can be regarded as the biggest benefit element, as it makes up 56 percent of the total benefits discounted to present value.

The detailed feasibility study on the devel-

opment of the intermodal railway station of Kaposvár and the related public transport considered the impact of the investment on GDP with a multiplier value of 0.7, with descending percentages over a 10-year period (24 percent, 23 percent, 20 percent, 15 percent, 9 percent, 4 percent, 3 percent, 2 percent, 1 percent, 0 percent) (Utiber et al., 2013, pp. 388–396). The social analysis assumes that, calculated at present value, a net benefit of HUF 14,154 million is generated in total by the multiplier effect of GDP growth. This amounts to 45.44 percent of the total economic benefit. Similarly to the previous elements, it is one of the biggest item among the benefits. In addition, the study quantifies a further benefit element under the term "multiplier effect of the investment", which is "the value of the projects generated by the railway infrastructure" constituting the subject of the project (Utiber et al., 2013, p. 391).

Applying the same methodology, the feasibility studies entitled Pécs Intermodular Public Transport Hub (Trenecon COWI et al., 2014a) and The Development of the Public Transport Network of Pécs (Trenecon COWI et al., 2014b) consider and refer to the multiplicative effects of the investment as "other regional economic impact". A 0.7 multiplier is used in the calculations; therefore, the calculated economic impact amounts to 31.75 percent and 25.72 percent of the total economic benefit, respectively.

With respect to the reviewed studies we found in general that the multiplier effect – which is referred to in different names – constitutes a significant percentage of the total social benefit, representing a magnitude that is larger than or similar to the traditional benefit elements commonly used in the appraisal of transport investment projects based on professional consensus and a well-established methodology (time saved, reduction of the risk of accidents, change in the cost of vehicle operation, environmental benefits: impacts on climate change, air and noise pollution). This combined with the fact that the existence of benefit elements measuring multiplicative effects is always crucial with respect to the return on the projects – in each case, there is a fairly low benefit-cost ratio that barely exceeds the threshold value (BCR=1) – render the theoretical review of the applied method particularly important. The data of the examined studies are summarised in *Table 2*.

Therefore, the weight of the scientifically extremely important question of whether the quantification of different multiplicative effects is methodically adequate within the framework of cost-benefit analysis is increased even further by the fact that practical applications attribute fairly high benefit values to this effect, which can shape the judgement of a project significantly. It indicates the crudeness of the methodology that none of the examined studies includes the exact interpretation of the term 'multiplier' and that of its type or a consensus-based explanation of the numerical value of the applied multiplier. Nor was the precise calculation of the application included in some of the publications. We attempt to examine this question from a theoretical viewpoint, as this approach may contribute significantly to clarifying whether the multiplier effect can be applied in CBA.

Irrespective of the accurate definition of the type of the multiplier, the question of distinguishing cost from revenue, as well as cost from benefit arises. Based on the logic of the operation of the macro-economy, a specific cash flow is revenue for one economic operator, while it is expenditure for another. At the same time, it is an important feature of cost-benefit analysis that it seeks to define cost and benefit from the point of view of society. For example, in the case of the study on the transport development of the Buda Castle, the approach according to which the cost of in-

Table 2

A REVIEW OF THE PRACTICAL USE OF THE MULTIPLIER EFFECT IN COST-BENEFIT ANALYSIS BY ANALYSING DOCUMENTS

The methodological hypotheses of the studies reviewed and the result indicators of the examined projects	Transport development in the Buda Castle and its surroundings Detailed feasibility study Pro Urbe et al. 2013	Intermodal railway station in Kaposvár and the related public transport developments Detailed feasibility study Utiber et al. 2013	The development of an intermodal public transport hub in Pécs Feasibility study Trenecon COWI et al. 2014a	The development of a public track transport network in Pécs Feasibility study Trenecon COWI et al. 2014b
Total economic investment costs (net present value, HUF millions)	14,716	26,845	13,602	31,434
Value of the applied multiplier	1.2–1.3	0.7	0.7	0.7
Economic benefit assumed by the multiplier effect – GDP increment (net present value, HUF millions)	11,404	14,154	4,199	8,033
Total social benefit (net present value, HUF millions)	20,376	31,148	13,224	31,228
The share of the economic benefit assumed by the multiplier effect within the total amount of social benefits (%)	55.97	45.44	31.75	25.72
BCR (benefit-cost ratio)	1.08	1.11	1.04	1.17

Source: own editing

vestment is counted on the cost side and then multiplied by some kind of multiplier (e.g. m=1.2) also on the benefit side is highly questionable. This question leads us to the importance of defining the "without" case. None of the studies refers to considering multiplicative effects in cases without a project, even though an amount of money spent in any sector has a multiplier effect. This is because the spill-over effect of the additional final demand that appears in the lifecycle of the examined economy due to the new investment generates further

demand in the economy alongside the related value chains *(Koppány,* 2017). Of course, the degree of the effect on the local economy depends on the extent to which the incoming supply chains rely on the local economy and the rate of "leakage" (*Little – Doeksen,* 1968). No matter how we measure the multipliers that quantify these processes, we should not forget that examining the multiplicative processes of the alternative application is inevitable for the incremental method of cost-benefit analysis. When examining the applicability of the multiplier effect in CBA, our analysis can only be based on the difference between the multiplier effects in the case of our project and its alternative, in consideration of the fact that any spending that generates final demand has a multiplier effect. Obviously, this raises another difficult issue: the definition of the term 'alternative project'. In the case of public projects, it can be supposed with a high degree of certainty that the source of financing will be utilised. Even if the benchmark cannot be determined, it is very likely that, irrespective of the definition, the difference between the multiplicative effects will be much less than the numerical values applied in the aforementioned studies.

Nor can we dispense with the definition of the applied multiplier when examining this issue. The studies reviewed mainly seek to quantify the effect of the investment on GDP. Upon determining the adequateness of this effect in cost-benefit analysis, we face the obstacle of interpreting the concepts of economic performance and social welfare. The example mentioned by *John Maynard Keynes* (1936, p. 129), namely, that digging and then burying an enormous pit from public funds has the same positive effect as spending the money on building apartment blocks, throws light on the problem in a very expressive way. There is an example of the opposite, as well: the fuel saving quantified in transport CBAs reduces GDP, while social welfare improves with the lower level of environmental pollution resulting from reduced vehicle mileage.

Consequently, upon examining the question of applying the multiplier effect in CBA, our starting point could be only that part of the extra multiplier effect (compared to the alternative project) that increases social welfare. When quantifying the welfare effect within the multiplier effect, a number of additional important questions should be examined: firstly, whether we committed the mistake of multiple counting or not; secondly, whether it is only about the realignment of resources in the economy and thirdly, we also need to address the effects that increased GDP but at the same time, decreased welfare. For example, in connection with the first question, the GDP growth related to a motorway investment project might arise from the fact that people living in the area achieve better economic performance due to faster traffic. However, at least a part of this phenomenon was quantified when we considered the time saved in the form of the economic operators' time value. The second assumption leads us back to the problem of the alternative use of resources. As far as the third question is concerned, GDP growth might have further unfavourable effects on social equality or the state of the environment.

Based on our empirical and theoretical analysis, we may conclude that the consideration of multiplicative effects as social benefit is professionally unsubstantiated according to Hungarian practical applications. Consequently, the way in which multipliers are used in practice in Hungary is an economically inappropriate tool for the quantification of the effects appearing in the secondary markets *(wider economic benefits).* This finding is affirmed by the fact that, reviewing the European practice, we cannot find a single country that has incorporated this approach into its application of the CBA.

Criticism of the methodology of willingness to pay and willingness to accept

One of the most common methods for the quantification of benefits is the quantification of individuals' *willingness to pay (WTP)* or *willingness to accept (WTA).* Basically, this method is the *contingent valuation method (CVM),* which is counted among the *stated preference methods* for economic appraisal. By definition, its most important criticism is that it is not based on the observation of real market events; therefore the results are largely influenced by the behaviour and cognitive abilities of the respondent and the methodological features of the appraisal. The method also carries the general problems typical of questionnaires, such as the sampling bias, the non-response bias or bias caused by the pollster (*TÁRKI,* 2005). Numerous studies (*McFadden,* 1994, *Portney,* 1994; *Hausman,* 2012) attempt to address these problems. In this study, with no intention of being exhaustive, we provide only a brief overview, emphasising the existence of the problem as it arises in CBA.

Due to the so-called framing effect, examining the same question from different perspectives may lead to different results, as it is difficult to guarantee the objectivity of the subject matter of the examination. Assuming the sincerity of the respondent is a requirement that is also hard to meet: the strategic behaviour of the respondents is another factor that may strongly distort the analysis. For example, this happens when the respondents are certain that they will not have to pay the amount at all or, on the contrary, when they believe that there is a real chance of having to pay the offered amount. The methodological approach itself may lead to similar under-or over-estimation: several surveys demonstrated that the WTA values tend to be multiple times higher than the WTP values (*Dubourg et al.,* 1994, *Tuncel – Hammit,* 2014).

This approach is related to the so-called Scitovsky-paradox; namely, that under certain conditions, the shift from allocation "A" to allocation "B" – and its opposite – are found to be Pareto-efficient, depending on the definition of the rights of economic operators (*Scitovsky,* 1941). On the other hand, this statement contradicts the well-known Coase theorem, according to which, irrespective of the definition of property rights, the outcome of the allocation is the same. For example, think of a railway line that crosses a territory with 1,000 inhabitants. Depending on the crossing speed of the trains, the inhabitants will suffer a different degree of externality. If the train goes more slowly, there will be fewer accidents and less noise pollution. If the train goes faster, there will be more accidents and the noise pollution will be higher. At the same time, slower trains impose additional costs on the train operating railway company (increased operational costs, losses arising from time costs). Based on the calculation summarised in *Table 3*, it is clear that, depending on the declaration of rights, the extra costs of the railway and the judgement of society, both the fast and the slow railway traffic can be considered Pareto-optimal.

In our example, the difference between willingness to pay (WTP/person=100 units) and willingness to accept (WTA/person=400 units) was estimated to be fourfold, assuming that the participants are perfectly informed and gave honest answers. Research studies on the topic show an extremely wide-ranging difference (twofold or even sixteen-fold) between willingness to pay and willingness to accept. That notwithstanding, the literature is far from agreeing on how to interpret the phenomenon's existence and volume (*Kahneman et al.,* 1990, *Plott – Zeiler,* 2005, *Ginsburgh,* 2017). Regarding the railway operator's additional costs associated with "slowing down" the rail-

Table 3

SCITOVSKY-PARADOX EMBEDDED IN THE COASE THEOREM

Definition of rights	The extra costs of the operation of the railway with slower speed			Social evaluation
	50,000	200,000	500,000	
The train has a right to go fast	the train slows down	the train stays fast	the train stays fast	WTP = 100*1000 (citizens' willingness to pay for a slower train)
Citizens have a right to slow trains	the train stays slow	the train stays slow	the train accelerates	WTA = 400*1000 (citizens' willingness to accept in order to bear the externalities caused by faster trains)

Source: own editing

way, we used three different parameters in our study: 50 000<WTP, WTP<200 000<WTA and WTA<500 000.

"Optimism bias": the uncertainty of estimations

In addition to the uncertainty of the parameters of the CBA methodology described above, variables integrated into the model by expert estimate are also considerably shrouded in uncertainty. Several *ex post* studies pointed out the feature of *ex ante* project appraisals according to which the underestimation of the expected costs, while the overestimation of the demand for the planned facilities, as well as that of the arising revenues and benefits can be observed in practice (see, for example, *Flyvbjerg et al.,* 2002). A large body of professional works (*Barclay,* 2009, Flyvbjerg et al., 2002, 2004, 2005; Eliasson – Fosgerau, 2013) addresses the problem, which has several consequences of social significance in practice, in addition to its aspects of scientific interest. On the one hand, the phenomenon poses a serious problem in the planning and maintenance of the financing system of the government budget, especially in the case of public investment. On the other hand, the significant difference between inaccurate predictions as well as the results of analyses and the realised values could have a negative effect on the social judgement and acceptance of the appraisal methods that are based on scientific theories, e.g. cost-benefit analysis. The possible reasons for the problem, which is referred to in the literature as *optimism bias*, can de identified as follows:

- the psychological inclination for optimistic assumptions as a characteristic of human behaviour (risk averse attitude in the case of benefits, while risk seeking attitude in the case of costs),
- the technical content of the reviewed project is insufficiently detailed,

- the lack of adequate expertise on the part of the expert estimating the costs and benefits,
- methodological errors in cost estimate and in the estimates of the parameters that affect the benefits,
- those who are interested in the realisation of the project promote their interests in the phase of project appraisal.

Research studies investigating the reasons for the aforementioned inaccuracies in estimation primarily attempt to decide whether the phenomenon is politically motivated or it can be considered as deliberate fraud, whether it is related to the cognitive processes of the individuals participating in the preparation of decision-making or we face methodological problems. Finding the answer to these questions is highly important, as in the light of the answer, different recommendations can be made on possible ways to improve the methodology and practice of the cost-benefit analysis.

Lavello and Kahneman's (2003) behavioural economic approach draws our attention to the individual's excessively high willingness to take risks in highly uncertain situations and the limits of our cognitive abilities in decision-making processes. These factors are usually accompanied by the allure of the expected benefits and the prospects of success, as well as the pressure exerted by the client or by the management of the organisation through their expectations about positive results.

Based on the examination of infrastructure investment projects, Flyvbjerg et al. (2002, 2004, 2005) pointed out that the anticipated investment costs were significantly lower than the actual costs arising during the implementation of the project. Based on their conclusions, the reason for this is the influence of those with an interest in the implementation of the project over the decision-making process. Flyvbjerg (2009) uses especially harsh words: due to fraudulent estimations, he believes that the results of cost-benefit analyses are downright misleading *(Garbage in, garbage out.)*. In contrast, the study by Eliasson and Fosgerau (2013), which is also based on the analysis of real data, pointed out that, as a result of the selection bias, predictions are inaccurate irrespective of the existence of the errors of the estimates. In other words, even if the anticipated value of the errors in *ex ante* cost estimates is zero, due to the selection process. the expected value of the estimation errors of the projects selected from a specific set of projects may be different from zero. This refutes the finding of Flyvbjerg et al., namely, that any *ex post* differences are most likely deliberate. Furthermore, the quantitative analysis refutes the criticism of the applicability of CBA, demonstrating that the projects selected as a result of the CBA appraisal have a significantly higher return than the ones selected on the basis of random sampling.

At the same time, it is not only for theoretical science that the problem is a subject of interest. Over the past few years, special methodological guidebooks on the practical application of the CBA method have been published in several countries (*WebTAG, The Green Book, ATAP*), recommending the use of different correction factors for the costs and the benefits. Although this advice will not eliminate the errors caused by the selection bias, calculating the correction factor based on the data of historical time series may have a positive effect on budgetary planning. Such analyses can not only improve the accuracy of cost estimates, but also contribute to a more precise prediction of the benefits for future appraisal years, which are more difficult to estimate. In addition, it is important to note that this methodological problem underpins the importance of the risk analysis and sensitivity analysis linked to cost-benefit analyses.

Equity in the model – the question of weighting benefits

As regards the questions concerning benefits, we should bear in mind that the traditional methodology does not distinguish between two things: which members of the society realise a benefit of HUF 1, and which social groups bear the costs. In other words, if two projects have the same performance indicators, BCR or NPV, they can be considered by the decision maker as identical from the aspect of the society. However, in many other regards – for example, their impact on social inequality – they can be very different. On the other hand, the redistribution of income resulting from the projects considerably affects the – geographically as well as socially manifested – differences in development levels.

Theoretical research papers offer several proposals (*Stiglitz,* 2000, pp. 296–303, *Adler,* 2012) on how to consider the impact of investment projects on distribution. In general, they suggest that the benefits realised by different income groups should be weighted on the basis of expert consensus. At the same time, the relative scale of weights necessarily reflects the subjective points of view of the participants of the study. Partly for this reason, cost-benefit analysis weighted by income distribution is not common in practice. Omitting the weighting of benefits, however, poses similar problems as is the case with value-free economics that considers a market described by first-degree price discrimination to be identical with a perfectly competitive market, only because no dead-weight is generated in either case. However, even lay observers feel that it is better when the consumer surplus and the producer surplus are not concentrated in the hands of one social group. The weighting of benefits, therefore, is a crucial issue: it can modify the relative opportunity costs of the examined projects to such an extent that it changes the absolute project ranking defined on the basis of social aspects.

Fiscal corrections

The estimate of the economic costs and revenues of a project is based on financial costs and revenues. The correction of financial items is required, as the items considered at market prices do not necessarily correspond to their social value. In view of the above, three important corrections are needed:

- the fiscal correction of the financial costs and revenues,
- the calculation of the social cost of the goods considered at market price (conversion from market price to transfer price, for example, in the case of a plot of land assigned by the local government free of charge), and
- the counting of external effects.

The purpose of fiscal or budgetary correction is not to consider any financial costs and revenues that do not qualify as social costs and revenues in the economic analysis. One of the most important of such items is the value-added tax,[1] which cannot be included in economic analyses, because it cannot be considered as a social cost as "it is merely put from one pocket of the state into the other". The Hungarian cost-benefit analysis guidebook contains the following rule on fiscal corrections: "the economic analysis should not include indirect taxes" (Trenecon, 2016, p. 43). In the case of indirect taxes, the taxpayer and the subject of taxation is not the same person, while in the case of direct taxes, the subject of taxation and the person who pays the tax in the economic sense is one and the same.

In our view, the logic of fiscal correction should not be based on the direct or indirect nature of a tax item. Based on the theory of

cost-benefit analysis, the adequate guiding principle should be whether a specific financial item spent on the project can be considered as a sunk cost from a social perspective. Of course, the value-added tax does not belong to this category, as it is a source of public revenue. Regarding personnel expenses among the costs of the project, it should be examined which items can be considered to be social costs and which cannot. For example, *Evans's* (2006) study stresses that the part of the gross wage spent on social security should be interpreted as the deferred salary or consumption of the employee. Consequently, it does not need to be deducted from financial costs upon the preparation of economic CBA analyses. In line with this, in its Guide to Cost-Benefit Analysis (Sartori et al., 2014, pp. 44–45), the European Union emphasises that fiscal correction factors should be determined based on national characteristics.

Applying the principles above to the Hungarian tax system,[2] from the total cost of the labour force's employment, the following items can be considered social costs (their proportion to the gross wage is indicated in brackets):

- net wage (66.5 percent)
- pension insurance contribution (10 percent)
- health insurance contribution (7 percent)
- labour market contribution (1.5 percent)
- vocational training contribution (1.5 percent).

Except for the first item, the taxes and contributions listed above can be interpreted as the employee's deferred consumption demand. Practically, even these items are part of the wage, but the purpose of their use is regulated by law and not subject to the individual's own discretion. On the other hand, the following items cannot be considered as social costs as, similar to the value-added tax, they are public revenues and as such, they cannot be part of an economic CBA (their ratio to the gross wage is indicated in brackets):

- personal income tax (15 percent)
- social contribution tax[3] (19.5 percent).

Based on the above: if the project costs include personnel costs, 71.49 percent of the total wage and contribution bill can be considered as social cost as a result of the following:

$$1-\frac{0{,}15x+0{,}195x}{1{,}21x}=1-0{,}2851=0{,}7149$$

where x represents the gross wage.

The fiscal correction factor of labour costs is 0.2851, which measures the share of those personnel expenses within the total wage and contribution bill that are not classified as social costs. In other words, 28.51 percent of the wage and contribution bill need to be deducted in cost-benefit analysis when converting financial costs. In conclusion, from the perspective of taxation theory, it is irrelevant whether a financial item can be classified as indirect or direct tax upon the calculation of economic revenues and costs; adequate correction can only be based on whether the cost element concerned can be regarded as sunk cost from a social perspective.

Determining the value of the discount rate

Of course, the social discount rate (*SDT*) should also be examined in determining the parameters of the CBA. Through the ratio of the arising costs to the arising benefits in the review period, the definition of the social discount rate fundamentally affects the resource allocation of public projects. While in the case of the business-based projects of the corporate sector the methodology of the examination of financial return is fairly

well-defined and the value of the applied discount rate usually reflects the riskiness of the expected cash flows, the value of the social discount rate applied in the appraisal of cross-generation investment projects serving public interests is surrounded by numerous open questions (*Pálinkó – Szabó,* 2012).

Basically, the social discount rate reflects the preference system of society in the sense of how the community evaluates the conversion from present welfare to future welfare. In other words, it is the proceeds for the sake of which the society is willing to defer its current consumption in exchange for greater future consumption. Without the use of the discount rate, the current consumption of society would crowd out the public projects that span several decades and serve the interests of the society as a whole. In addition, another important function of the social discount rate is that it includes the opportunity cost of public resources, as well, determining the minimum expected return on projects. The literature refers to four different methods for its quantification: the Social Rate of Time Preference (SRTP), the Shadow Price of Capital (SPC), the Social Opportunity Cost of Capital (SOC) and the Weighted Average Method (WAM) (*Healthware,* 2010). All four theoretical approaches are applied in the practice of cost-benefit analysis (Sartori et al., 2014, pp. 289–291).

A more in-depth analysis of the theoretical background on the accurate definition of the social discount rate goes beyond the scope of this study. In addition to raising the question, this study is merely intended to draw attention to a number of consequences stemming from the defined value of the parameter. A common argument against raising the discount rate is that the arising benefits will be deflated in later appraisal years. The higher the applied discount rate, the lighter the weight of the arising benefits against the investment cost. On the other hand, the reduction of the discount rate "undervalues" public funds, which are considered to be a scarce resource, as a significant part of the costs typically arises at the beginning of the appraisal period. Consequently, two opposing considerations confront each other regarding the discount rate: demonstrating the benefits of public funds for future generations and the costs related to the use of public funds in the present. Practice has shown that the international trend is to reduce the value of the discount rate (*Meunier et al.,* 2016). As a result, we need to use methods which allow, while applying a low discount rate, the weighting of public funds without "spoiling" the project by decreasing the present value of the benefits.

Considering the social cost of public funds

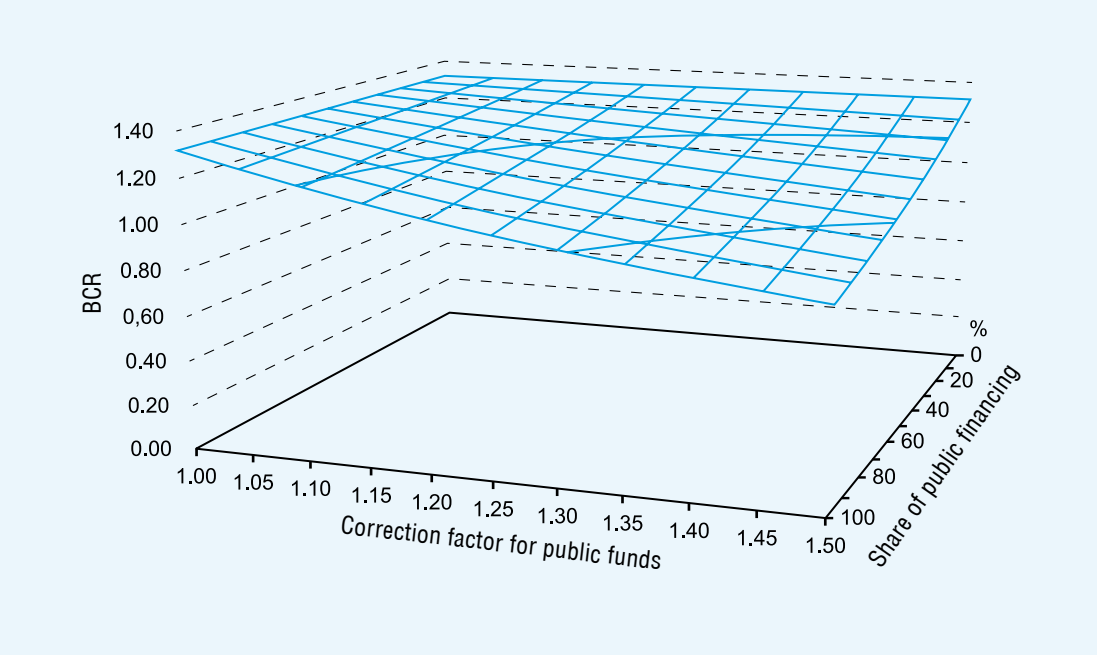
When analysing public projects, we cannot ignore the source of financing. This is because, as opposed to market-based implementation, a significant amount of *additional burden* is generated when the financing comes from tax revenues. In the literature, additional burden is usually known as deadweight loss. The theoretical methods of its measurement, e.g. *Mohring's* (1972) equivalent variation method and *Diamond-McFadden's* (1974) compensating variation method, usually estimate the degree of change in social welfare based on the change in consumer surplus. Moreover, the realisation of tax revenues also entails "indirect costs" such as the associated administrative costs. Such social welfare losses emerge during public projects financed from tax revenues. The measurement of such losses and their consideration in the course of practical decision-making has become increasingly important in the light of the socio-economic challenges of the 21st century.

As a result of the aging society, the increase in the per unit economic burden on the active population, the health of the society, the mounting need for energy, the appreciation of the significance of knowledge, the quality of education or the uncertainty surrounding the allocation of EU resources all underpin the exponentially increasing need for efficiency in the areas of public services and public spending.

Consequently, the crucial issue is not only the method of public spending but also the cost of its generation. In practice, the indicator of the latter *(marginal cost of public funds, MCF)* shows how much it costs for the society to produce one monetary unit for the financing of public duties. There are different estimates for the quantification of this indicator, which are obviously strongly affected by the structure of the examined tax regime. *Browning* (1974) estimated a value between 1.09 and 1.16 and *Ballard et al. (*1985) a value between 1.17 and 1.56 for the United States, *Dixon et al.*'s (2012) value for Finland was 1.5, while *Beaud* (2008) estimated a value of 1.2 for France. The result of the latter calculation has been incorporated into practical decision-making, as well. The French cost-benefit analysis guide suggests the use of the 1.2 multiplier for public funds upon the examination of public projects (*CGSP,* 2013). Currently, the cost-benefit analysis guides of the European Union and Hungary do not discuss this problem. We believe that it is especially important to underline in the analyses that public funds involve additional burden, as this provides the means for differentiating between market-based financing and financing from public funds. This problem is illustrated by the calculation shown in *Figure 1*.

Figure 1

THE INFLUENCE OF THE MARGINAL COST OF PUBLIC FUNDS AND THE RATIO OF MARKET-BASED/PUBLIC FINANCING ON SOCIAL EVALUATION



Source: own editing

Figure 1 points out that in the case of a given project, in addition to the correction factor applied for public funds, the different share of public funds and market-based resources may lead to different decisions. In view of the above, the weighting of public funding resources could even change the list of priorities on a project list. In the calculation, the benefit-cost ratio was used as the proxy for social utility, which was represented as the function of the change in the marginal cost of public funds (1<MCF<1.5) and the ratio of public financing to market-based financing.

The role of cost-benefit analysis in practical decision-making

Our last comment is related to the role of cost-benefit analysis in the practice of decision-making. The fundamental purpose of CBA is to facilitate the efficient use of the available scarce resources by closely integrating the examination method into the process of the preparation of decisions and the ex-post evaluation of the project. Based on the above, the ideal place of *ex ante* cost-benefit analyses in the social decision-making process should be between the conception of the project idea and the preparation of the detailed implementation plan. If the technical preparedness of the investment is at a very advanced stage already and an *ex-post* cost-benefit analysis is to be prepared, based on specific criteria, for a technical version that has been defined precisely already, the methodology is no longer useful in selecting the socially most efficient version from the various technical versions. In such a case, the practical role of cost-benefit analysis is often called into question: does it really support decision-making and the justification of decisions?

In relation to practical application, the assessment of *ex post* analyses requires special attention. Such assessments provide information also in consideration of the costs and benefits arising during the first few years of the operation of already realised projects. In this way, *ex post* cost-benefit analyses can also contribute to a learning process. This is why it is extremely important, at this point, to prepare ethical analyses without any information bias, as it can reveal, among other things, the degree, structure and cause of the underestimation of costs or the overestimation of benefits. In this way, such extremely important pieces of information can/could be integrated into subsequent analyses. However, we should note for practical reasons that the financial stakes involved in *ex post* analyses are not insignificant. Indeed, most of such analyses are prepared during the follow-up of projects funded by the European Union, which means that the lack of return may entail financial sanctions.

Although the preparation of cost-benefit analyses is professionally justified and desirable in the world of social decisions, the integrity of the participants in the decision-making process is not necessarily compatible with the use of this methodology. In this context, in order to interpret the concept of integrity, we follow the model proposed by *Erhard – Jensen – Zaffron* (2010), where social players possess integrity if they "*honour their word. To put it plainly, this kind of integrity means keeping one's word, immediately notifying the relevant parties if honouring one's word becomes impossible, and accepting liability for the damages caused*" (*Scharle,* 2017, p. 20). An important consequence of the interpretation of integrity as a concept that is independent of value judgement is that it can influence operability and performance, which means that similar to knowledge or technology, integrity is a key factor of production (Erhard et al., 2010, Scharle, 2017). This feature connects the fact

that social players can be characterised by integrity with cost-benefit analysis. According to the model of Erhard et al. (2010), "*if honouring your word depends on the results you can achieve through your actions, you cannot have integrity*" (Scharle, 2017, p. 21). If we accept the role of integrity in affecting performance, we cannot link it to the concept of cost-benefit analysis consistently, as the consequences of uncertainty associated with the latter cannot be attributed to those who prepare the analysis. The decision-makers relying on the analysis, in turn, will not assume liability for the unforeseen consequences of the implementation. If actors characterised by rational behaviour are considered as persons who follow their own interests, they must necessarily have integrity, due to the performance-enhancing feature of integrity as a behaviour. Therefore, in the world of social decision-making the behaviour of the implementer may get into conflict with the professional justification of cost-benefit analysis. This conflict is perceived by those involved in the decision-making practice at community level.

SUMMARY, CONCLUSIONS

In our study, we reviewed the main methodological questions of cost-benefit analysis. In addition to critical comments, we offered two specific proposals that can be integrated into the practice of Hungarian cost-benefit analysis. Based on our theoretical research, we pointed out the inadequate use of the multiplier method, which is currently widespread in Hungarian practice, and recommended the use of fiscal corrections. Concerning the latter, based on theoretical considerations, we published the calculation of a specific parameter value in the context of the Hungarian tax system. Although the methodology raises several questions and it can be heavily criticised, we believe that the careful use of cost-benefit analysis with the appropriate professional expertise may significantly contribute to public decision-making facilitating socio-economic development. Further research on the methodological questions listed above could support this process.

Notes

[1] Note: the value-added tax must be deducted irrespective of whether it arises as part of investment or operational costs or in connection with some kind of financial revenue. The question is also independent of whether the value-added tax is reclaimable or not.

[2] In this chapter, our analysis is based on the Hungarian tax regime in effect on 1 January 2018. The calculation needs to be corrected if the tax system is either paradigmatically or parametrically changed.

[3] Note: regarding the social contribution tax, which had to be paid as contribution earlier, the idea may arise that at least a part of it could be considered as social cost, as the contributions paid by the employee do not fully cover the future pension and healthcare of the individual. However, owing to quantifiability problems and to the "non-earmarked" nature of the tax, we consider social contribution tax as an item that should be deducted from the economic analysis and can be used by society.

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