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COMPENSATING SURPLUS AND EQUIVALENT SURPLUS IN LONG-TERM PUBLIC INVESTMENT EFFECTS VALUATION

Summary: The effects of investments changing public goods that influence many generations, meet various obstacles in the appraisal process of such projects. The use of contingent and equivalent surpluses for public good changes valuation in the intergenerational perspective involves establishing the connection between purely economic assessment and some of ethical approaches that define the assignment of rights to the contemporary or future generations. When one of the ethical rules is assumed, it significantly influences the definition of the scope of intergenerational effect valuation.

Key words: public investments, project appraisal.

1. Introduction

Investment projects create various effects, starting with immediate, purely commercial profits for the owner, ending with social effects affecting some public goods. In each case a major problem is to appropriately include outputs into the appraisal process to ensure that the optimal investment decision will be taken.

Public investment project appraisal with long term effects creates complex challenges due to the fact that a substantial portion of the outputs affects public goods or creates some externalities. The valuation problem here consists of the following issues: first, there is a question of uncertainty in the measurement of physical aspects of the effects; second, the ambiguity of estimating value for public good changes; third, the problem of comparing effects that are distant in time. In addition, intergenerational outputs face serious problems such as taking into account future persons rights and future preferences.

The aim of the article is the analysis of the adjustment possibilities of theoretical measures of compensating and equivalent surpluses for intergenerational investment effects valuation. Compensating surplus and equivalent surplus are used in short perspective to assess the value of improvement or deterioration in some public goods. The article raises the question how those measures can be applied in the intergenerational context under different ethical rules. The paper also considers the

impact of the philosophical concepts on the level of the discount rate that is one of the major variables in long-term investment appraisal¹.

2. Long-term effects in the investment effectiveness measurement

Public investment can be defined as a project that is held by some public authorities and aimed at satisfaction of social needs by changing (improving) the quantity or quality of public goods. Those projects are usually not profitable in a financial sense, however, it is necessary to measure their effectiveness. Especially the long-term effects encounter various obstacles in the appraisal process. Intergenerational effects, analyzed in the paper, are the impacts that affect more than one generation or future generations only that have not been born yet at the time the investment decision is taken.

The evaluation of investment projects that shapes public goods in the very long perspective is far more demanding than usual commercial project appraisal due to several factors. Optimal investment decision needs appropriate estimation of all costs and benefits of the projects. Of course, if the former exceeds the latter, the decision in terms of effectiveness is justified.

It is crucial in the appraisal process to measure the inputs and outputs and their comparison through time. The main problematic areas can be divided into three groups presented in Figure 1:

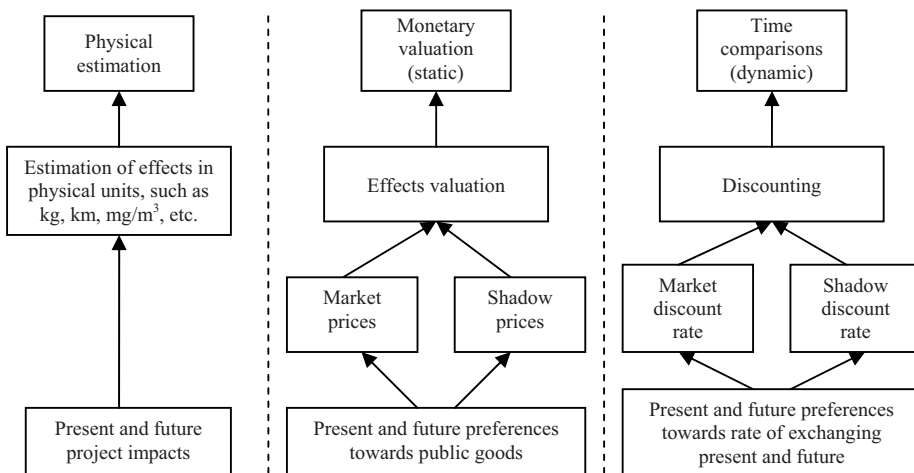


Fig. 1. Major problematic areas in public long-term investments appraisal

Source: own study.

¹ The problem of appropriate measurement of project inputs is omitted here based on the assumption that the inputs are investments outlays incurred immediately after the decision is taken, so the issue of long-run effects does not apply to them.

The first area, physical measurement of effects, involves the estimation of all impacts now and in the future on physical units. Engineering as well as economic knowledge is needed to estimate those values. However, the paper omits the problem, assuming that moving the physical assessment into the long term perspective will just increase the uncertainty of impacts and the difference, compared with the short perspective, is irrelevant here.

In the second area, the question of the possibilities to measure all impacts in money terms is raised. The valuation depends heavily on the features of the effect. When those impacts create a change in private goods that are effectively traded on the market – they can be properly valued with the use of market prices. However, if the change relates to public goods, the valuation process becomes significantly complicated as such goods possess two features that make using market prices impossible. The characteristics of pure public goods are non-rivalousness and non-excludability from consumption that can be defined as the situations where respectively: the consumption of one individual does not diminish the consumption of the other and no-one can be excluded from consuming the good [Boardman, Greenberg, Vining, Weimer 2001; Pearce, Barbier 2000]. Those features cause that a market does not exist or, even if it does, the prices are substantially distorted and those goods are usually undersupplied (i.e. in public health care)². Because market prices cannot be used properly, shadow prices³ have to be estimated in order to reveal true preferences, even if they are not shown on the market⁴. Additional difficulty that emerges here is the measurement of future preferences – attitudes of people that have not been born yet, which will be analyzed later on.

The third problem in the evaluation process is discounting future effects. Determining the present value of all project benefits enables the comparison with the investment expenditures. The crucial point here is to estimate the appropriate level of discount rate which faces several obstacles. First, if capital markets are distorted, using the market discount rate can lead to biased results. That turns analysis to social discount rate which should be resistant to market faults in order to assess social inter-temporal preferences correctly. Second, in the long perspective, the problem of measuring future generation preferences emerges (similar to the static valuation in money). Third, some ethical questions arise, concerning the intergenerational

² The reason for this is that people do not have incentives to reveal their preferences because the good once supplied is available for everyone and its quantity is fixed: even if willingness to pay exceeds costs, the individual hides the preferences (“free rider” effect). On the other hand, some individuals would pay, but for a smaller amount of the good which they cannot choose freely.

³ Shadow prices are used in cost-benefit analysis for public goods valuation as well as in other cases where private (market) valuation differs from social valuation due to distortions such as taxes, duties, monopoly, etc.

⁴ The methods of estimating shadow prices are numerous, i.e. household production function, related markets approaches or contingent valuation methods. See: [Londero 2003; Zerbe, Bellas 2006; *A Primer on Nonmarket...2003; Determining the value...1997*].

welfare distribution and the rights of future generations. In fact, the appropriate level of discount rate is becoming overwhelmingly important as the time span expands, because future effect becomes extremely sensitive for small changes in this variable.

All the above dilemmas are followed by uncertainty issue, which affects all the elements of the evaluation process. A very long perspective makes this uncertainty grow stronger and the usual methods of assessing the project risk can prove insufficient in that case.

The article concentrates on the problem of theoretically correct measures for intergenerational public effects valuation including some elements of discount rate level estimation.

3. Effects valuation in short perspective – CS and ES as theoretical measures of public goods changes

The idea behind the valuation of public goods is the assumption that those goods have their place in a person's preferences even if they are not traded on the market. Based on the individual map of preferences, he or she can order all goods in terms of desirability as well as assign some value (in money or in other goods that he/she resigned from) to public goods, i.e. clean air in the city.

The individual enjoys some welfare level based on marketed and non-marketed goods that can be presented in the form of a utility function:

$$U(M,N)$$

M – marketed goods (transferable to income by the use of market prices),

N – public goods, nonmarket goods.

Of course the choice between *M* and *N* is restricted by the income (*Y*), which can be spent on buying marketed goods or on public goods (via i.e. taxes that finance public investments). The increase in public goods is usually connected with the decrease in marketed goods⁵. The value of the change in the public good can be measured by the value of the private good someone resigned from.

The literature proposes two measures of public outputs: compensating surplus and equivalent surplus⁶ that are used when the individual cannot freely choose the level of consumption of the good (non-divisibility of consumption) [Spash, Hanley 1994]⁷.

⁵ The term “usually” is applied to the situation where an individual has a right to the initial level of utility and has to pay (reduce the consumption of marketed goods) for an increase in public goods. It is just one example of the possible right assignments. The others are discussed later on.

⁶ There are also measures of compensating variation and equivalent variation, but they are used for marketed goods, where an individual can choose the amount of goods he or she consumes. Compensating and equivalent variations are based on Marchalian consumer surplus.

⁷ In theory for WTP and WTA assessment for public goods Hicksian demand function should be used as it eliminates income effect present in Marchalian demand function and leaves only the substitution effect that describes the change in demand for public goods assuming the constant level of utility.

Compensating surplus is the amount of money an individual is willing to pay for the improvement in the quantity or quality of public good or is willing to accept for the deterioration in the public good. In both cases it is at his original level of utility. It can be denoted as follows:

$$\begin{aligned} \text{Improvement [Opaluch 1996]:} & \quad U(Y-WTP, 1) = U(Y, 0) \\ \text{Deterioration:} & \quad U(Y+WTA, -1) = U(Y, 0) \end{aligned}$$

Y – a portion of income that is spent on marketed goods,
 1 – the improved quality/quantity of public good,
 0 – the original state of public good,
 -1 – the deteriorated quality/quantity of public good,
 WTP – compensating surplus for the improvement measured as willingness to pay,
 WTA – compensating surplus for the deterioration measured as willingness to accept compensation.

Equivalent surplus is the amount of money the individual is willing to accept for not having the improvement in the quantity or quality of the public good or is willing to pay for avoiding deterioration in the public good. In both cases the level of person's utility moves after the change, but the level in each case differs. It can be denoted as follows:

$$\begin{aligned} \text{Improvement:} & \quad U(Y+WTA, 0) = U(Y, 1) \\ \text{Deterioration:} & \quad U(Y-WTP, 0) = U(Y, -1) \end{aligned}$$

CS and ES measures differ in the rights assignment. Compensating surplus guarantees the individual the right to stay at the original level of welfare, whereas equivalent surplus gives the right to enjoy the level of utility after the investment. It is worth highlighting that in case of equivalent surplus there are two separate levels of utility: in case of improvement the person will enjoy (have the right to) the higher level of welfare, whereas in deterioration situation he will be in a lower utility level.

Both welfare measures use two concepts: willingness to pay and willingness to accept which refer to the income changes. Willingness to pay (WTP) is defined as the maximum amount of money the individual is willing to pay for a certain increase in supply (quantity or quality) of public good (or for avoiding deterioration) [Boardman, Greenberg, Vining, Weimer 2001]. Willingness to accept compensation (WTA) is the minimum amount of money the individual is willing to accept for resigning from present public good quantity (quality), in other words, for the decrease in supply (or for not having the improved supply)⁸.

In practice, economists suggest that using Marchalian demand function does not create significant distortions. [Boardman, Greenberg, Vining, Weimer 2001; Perman, Ma, McGilvray, Common 2003].

⁸ For perfectly functioning markets WTP and WTA are given in market prices (they reflect the preferences of the society). Graphically, aggregate WTP (WTA) is represented by the area under the demand function [Boardman, Greenberg, Vining, Weimer 2001].

WTP and WTA illustrate shadow prices for nonmarket goods and are used to calculate the value of the supplied public goods in project evaluation process⁹. To assess WTP or WTA different estimation methods are used. Shadow prices can be derived, among others, by observing the existing markets of some related goods (like real estates prices – hedonic pricing – used to value environmental goods) or some questionnaires about a hypothetical market (like contingent valuation method)¹⁰.

4. Future generation and the assignment of rights – ethical concepts

The major question that arises when discussing the valuation of investments effects overlapping more than one generation is the uncertainty about the future preferences. The effects apply to the generation that does not take the decision – future people have no power to influence the investments being made today and do not have the opportunity to express their preferences on any market or in some other form.

There are several issues that are worth mentioning here:

- do future generations possess any rights?
- if they do, how should they be treated in comparison with the contemporary persons?
- how to measure future preferences (future prices and future discount rates)?

The issue of future rights lies more in the field of ethics than economics [*Handbook of Intergenerational...* 2006; Hausman, McPherson 2009]. It means that any economic decision considering intergenerational effects is taken on the basis of some ethical concept that defines those rights. Such projects extend the area of the analysis from the question of purely efficient allocation to the issue of just allocation and fair decision, because the effectiveness criterion is not sufficient here any more. If future generation depends in every aspect on the decision taken today and present generation possesses all the power to improve their living or reduce their welfare, so to any such long-term decision some ethical rules have to be applied, even if they are not consciously revealed and defined in the decision process.

To answer some of the above dilemmas the concept of intergenerational theory of justice is proposed. The intergenerational theory of justice is a basis that explains the nature and the content of our duties (if they exist) towards future generations, that are defined as people that have not been born yet [Wolf 2005]. The major question is then to make a decision about the welfare allocation between present and future.

⁹ Shadow prices, efficiency prices or accounting prices are the prices adjusted or calculated (when there is no market) to reflect the correct prices on an efficient market (a market without failures). Shadow prices can be used in the following cases: imperfect competition, government intervention, externalities, the absence of the market (public goods) [Spash, Hanley 1994].

¹⁰ Those methods are described i.e. in [Boardman, Greenberg, Vining, Weimer 2001; Garrod, Willis 1999; Spash, Hanley 1994; Mishan, Quah 2007; Campbell, Brown 2003].

Main ethical approaches in that field can be divided into the following: utilitarian, libertarian, egalitarian, elitist and naturalist¹¹ [Spash 2002]. The concepts presented here are an attempt to explain the scope of our rights and duties towards future and a sketch of the consequences to future effects discounting.

1. Neo-classical utilitarianism assumes that the just allocation is the allocation that leads to the maximization of the sum (weighted sum) of all generations utility [Perman, Ma, McGilvray, Common 2003]. The allocation has to satisfy the needs of the consumer. The individual decides what is good (utility enhancing) or bad (utility diminishing) [Singer 2002]. Intergenerational transfers are justified if the marginal utility of present generation payment is lower than the marginal utility of benefits of the future generation [Hausman, McPherson 2009; Foltyn-Zarychta 2010]. If the utility loss is smaller than the utility gain, the overall welfare increases. Future generations possess rights, but they are considered less important than today. The intergenerational sum of the utility is weighted by discount factor ($0 \leq \lambda_t \leq 1$) calculated on the basis of some positive discount rate.

2. Libertarian ethical approach is based on Pareto efficiency criterion. The basic ethical rule is that every individual possesses a bundle of inviolable rights [Perman, Ma, McGilvray, Common 2003]. Allocations are just if they are consequences of free choices [Connelly, G. Smith 1999]. The intergenerational transfers are acceptable if no generation will find itself in the worse position after the change than it was before. If any effect of the project is adverse, the decrease in welfare should be compensated or the project should be abandoned if the compensation is impossible. Unfortunately, the definition of the original welfare level is ambiguous, although it can be assumed that it should not be worse than the present state. That makes the rights of future people as important as of the today's. The proposed level of a discount rate under this rule should be zero, although some suggest using positive rate of discount [Spash, Hanley 1994; Pearce, Barbier 2000]. That is especially justified if Pareto criterion is replaced by Kaldor-Hicks criterion, where compensations are only potential. Then the rights of the future generations are not preserved any more – next generations can find themselves poorer if the loss is lesser than the gain, which makes it similar to the utilitarianistic approach.

3. Egalitarian approach is based on Rawls' intergenerational rule of justice that states that allocations are justified if they are accepted by everyone [*Handbook of Intergenerational...* 2006]. The decision must be taken freely, impartially and rationally. To guarantee fair choice the individuals (generations) are put in the starting point behind "a veil of ignorance", which means they do not know what will be their position after the change [Wolf 2005; Singer 2007; *Contemporary Moral...* 2009]. Then the right decision is taken and it leads to the improvement in welfare of the poorest individual (generation) based on the strategy that minimizes the negative effects [Connelly, Smith 1999]. The aim is to equalize the level of utility over time –

¹¹ Naturalist ethics applies to certain types of public goods (environmental resources).

to distribute the welfare by allocating it to the poorest generations. The consequence of this is applying zero discount rate because all the generations under the egalitarian rule are equally important.

4. Elitist rule requires that the welfare of the richest generation (the elite) is maximized. Future persons rights are taken into consideration only as a part of utility function of the elite generation. Transfers are justified if they lead to the improvement in the welfare of the richest [Foltyn-Zarychta 2010]. Under this rule future generations do not possess any right – the approach take into account only the short perspective and applies commercial (market) discount rate based solely on the present generation preferences¹².

5. Naturalist ethics is rooted in a deep ecology approach that assumes the rights should be assigned not only to humans, but also to other creatures (animals or plants). The approach applies to some certain types of public goods that need special treatment, such as environmental resources that are scarce and their loss is irreversible (i.e. endangered species). The ecosystem or natural capital, as well as future generations, possess the value for themselves [Light 2005]. The worth of such goods suppose to rise over time – that leads to applying negative discount rate.

All those philosophical concepts, if applied to intergenerational investments appraisal, will affect valuation of the impacts, both at the stage of defining the theoretical measure and during the estimation of the discount rate level.

5. Moving the valuation to the intergenerational perspective – measures CS and ES for long-term effects

Taking into account philosophical viewpoints towards future generations presented above, five concepts determining rights assignments can be listed¹³.

1. all rights are assigned to the future generations,
2. moral obligations to the future exist, and more weight is assigned to the future than the present,
3. rights and interests of future persons are the same as those of contemporary persons,
4. moral obligations to the future exist, but less weight is assigned to the future than the present,
5. no moral obligation beyond the immediate future exists.

Depending on the rights assignment the weights of the utility of generations in the total intergenerational welfare measurement will differ. Assuming there are only two generations: present (denoted as $t = 0$) and future ($t = 1$), the weight λ_t of the

¹² Assuming no market distortions.

¹³ From the second to the fifth are based on [Spash, Hanley 1994]. The first is added by the author.

contemporary and future persons varies from 0 to 1 under different ethical concepts. Figure 2 presents major findings:

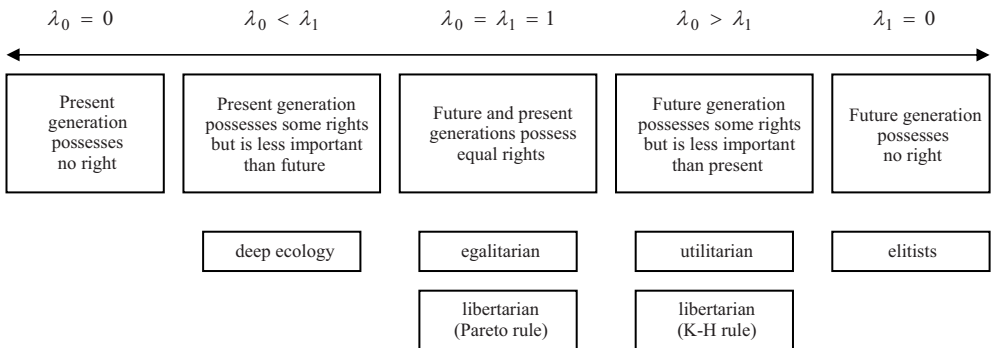


Fig. 2. Rights of future and present generations under different ethical rules

Source: own study.

The first rule, where present generation possesses no right is only a hypothetical concept, not followed by any ethical rule. This approach defines the weight of contemporary utility as zero, ($\lambda_0 = 0$). The discount rate aims at minus infinity ($r \rightarrow \infty$). In practice, under the full assignment of rights to the future it is not possible to value any impact, as the present does not have any rights and the ability to implement the project today. In spite of that the alternative is added here to maintain the comprehensiveness of the analysis. The second rule, limited rights of the present, lesser than of the future, is defined under naturalists ethics: the present utility weight is less than of the future persons ($\lambda_0 < \lambda_1$), while the discount rate is negative ($r < 0$). The third, equal assignment of rights, under the egalitarian and Patero rules, leads to the identity of weights ($\lambda_0 = \lambda_1 = 1$) and zero discount rate. The following approaches are libertarian (based on Kaldor-Hicks criterion) and utilitarianistic, that assume weights of the future to be less that of the present ($\lambda_0 > \lambda_1$) and a positive discount rate ($r > 0$). The last alternative is to give all rights to the present, under the elitist ethics, where the weight of the future persons utility is zero ($\lambda_1 = 0$ and $r \rightarrow -\infty$).

Those weights can be used to define the categories of compensating variation and equivalent variation in the long run.

The question of using SC and ES in future effects valuation will be considered on the example of a project which aims at increasing public goods for future generations under three separate cases: future possesses no right at all, future and present generations are equal, present possesses no right¹⁴. It is assumed that the

¹⁴ The other two intermediate cases will be discussed afterwards.

allocation relates to two generations: present (0) and future (1). The outlays are incurred by present generation and the effects apply to the future generation. The utility function depends on consumption level (C_t) that comprises of the level of income (Y) switchable to some amount of marketed goods and a public good. The level of income is similar for both generations ($Y_1 = Y_2$). The effect of the planned investment is the increase in public good denoted as a change from 0 to 1¹⁵.

The CS and ES measures under the assumptions can be defined as follows:

1. All rights are assigned to present generation:

$$\lambda_0 = 1 \wedge \lambda_1 = 0 \Rightarrow U(Y_1, Q_1) = 0$$

$$\sum_{t=0}^1 U(C_t) = \lambda_0 U(Y_0 - WTP_0, 0) + \lambda_1 U(Y_1, 1) = U(Y_0 - WTP_0, 0)$$

In this case future effects are not valued. The short perspective is assumed. The willingness to pay that measures compensating variation for a future change is worthless as the future impacts are simply not counted. Any investment involving present outlays combined with future changes is rejected.

The hypothetical question asked on the basis of the equation in assessing people preferences would be then: "How much are people willing to pay for no increase in public good?"

2. Present and future are equally important:

$$\lambda_0 = \lambda_1 = 1$$

$$\sum_{t=0}^1 U(C_t) = \lambda_0 U(Y_0 - WTP_0, 0) + \lambda_1 U(Y_1, 1) = U(Y - WTP_0, 1)$$

Under the assumption of equal rights assignment all generations can be treated as one – the valuation is based on the present generation preferences, provided the impacts hypothetically affect present (not future) generation. The next generation possesses the right to the initial welfare level and CS measure is used as in the short perspective:

$$U(Y - WTP_0, 1) = U(Y, 0)$$

The question for estimating preferences would be then: "How much are people willing to pay at present for the future increase in public goods assuming the increase will refer to the same generation?"

3. All rights are assigned to future generation:

$$\lambda_1 = 1 \wedge \lambda_0 = 0 \Rightarrow U(Y_0 - WTP_0, 0) = 0$$

$$\sum_{t=0}^1 U(C_t) = \lambda_0 U(Y_0 - WTP_0, 0) + \lambda_1 U(Y_1, 1) = U(Y_1, 1)$$

¹⁵ Compare CS and ES in short term perspective.

All rights are assigned to future persons that possess the right to the improved quality/quantity of public goods. All the investments that improve the utility of future generations are accepted, independently of present costs incurred. The change is valued in ES measure:

$$U(Y_1, 1) = U(Y_1 + WTA_1, 0)$$

The question here would be: “How much is future generation willing to accept for not having the increase in public goods?”.

The other two cases of rights assignment are transitional. They involve calculating the weighted sum of effects to assess the effectiveness of a project.

4. Future generation possesses some rights, but is less important:

$$\lambda_0 = 1 \wedge \lambda_0 > \lambda_1$$

$$\sum_{t=0}^1 U(C_t) = \lambda_0 U(Y_0 - WTP_0, 0) + \lambda_1 U(Y_1, 1)$$

The utility of future persons is weighted less than of the contemporary. To assess the value of the good future, changes should be diminished by the discount factor reflecting the lesser importance of the future. The rate r is the rate at which present people are willing to postpone their consumption. The increase in public goods is diminished only because it will happen in the future.

$$U\left(Y - WTP_0, \frac{1}{(1+r)}\right) = U(Y, 0)$$

The question about preferences can be asked in the following form: “How much are people willing to pay at present for future increase in public goods assuming the increase refers to the same generation and due to that it is properly diminished?”.

5. Present generation possesses some rights, but is less important than future:

$$\lambda_1 = 1 \wedge \lambda_0 < \lambda_1$$

$$\sum_{t=0}^1 U(C_t) = \lambda_0 U(Y_0 - WTP_0, 0) + \lambda_1 U(Y_1, 1)$$

As the present generation is given less weight than the future persons, the task here is to assess what the rate of increase in the importance of the future impacts is while leaving today preferences unchanged¹⁶.

¹⁶ Alternatively, WTA measure can be applied here: $U\left(Y_1, \frac{1}{(1+i_a)}\right) = U(Y_1 + WTA_1, 0)$. The value of the future effects will be reduced by a discount factor calculated on the basis of i_a , which is the discount rate at which present people diminish the value of future public goods changes.

$$U(Y - WTP_0, 1 \times (1 + i)) = U(Y, 0)$$

The future increase is reflected by the multiplication by the factor $(1 + i)$, where i is the rate at which people perceive future public goods as more valuable. The growth in public goods is multiplied by the factor $(1 + i)$ only because it will happen in the future and affects future persons that were given more importance.

The question eliciting people's preferences is: "How much are people willing to pay at present for future increase in public goods assuming the increase accrues the future, more important generation?"

The measures presented here are a theoretical attempt to present CS and ES in the light of different ethical concepts towards future generation rights and their influence on the valuation of intergenerational investments effects. However, the above theoretical measures meet various difficulties when applied in practice.

The major problem is the elicitation of the preferences of the unborn persons. In case of public goods the question can be answered by using some hypothetical market method like contingent valuation or contingent ranking, where a questionnaire is designed and people are directly asked about their willingness to pay or willingness to accept compensation about effects that fall to future persons. Some proposals of the questions are mentioned above, although they should be preceded by a detailed description of future conditions as well as inclusion of a question about the individual perception of future generation rights, the inclinations to altruism, etc. However, this approach must assume that unborn persons possess some rights. Otherwise, the valuation is purposeless as a future impact does not matter¹⁷. Other problems can arise from the method of preferences elicitation, where i.e. WTA and WTP differ for identical goods valuation¹⁸.

Another issue is the level of discount rate r or i that switch future effects to present values. When talking about public investments in intra-generational perspective the private point of view is insufficient. Although the market works without any failures, the market interest rate can be also used for the evaluation [*Guidelines for Preparing...* 2000]. If some failures appear, the need to calculate social discount rate (SDR) arises. SDR can be defined as a rate at which society is willing to trade consumption between periods and it is also referred as a shadow price of capital. It can be calculated as the rate of return from private sector investments or a consumption rate of interest [Stiglitz 1994]. Although intergenerational impacts appear, those valuations are insufficient, even if they reflect private preferences.

¹⁷ Compare case #1 above.

¹⁸ WTA can be from 2 to 5 times larger than WTP for the same good [Garrod, Willis 1999; Pearce, Turner 1990]. Boardman (et al.) points out that WTA can exceed WTP by 4 to 15 times. It is justified by people's preferences like endowment effect (people tend to put higher values on goods they already possess than on those they are willing to acquire in the future) [Boardman, Greenberg, Vining, Weimer 2001; Foltyn-Zarychta 2008].

The problem of using private discount rate for intergenerational effects valuation emerges from the divergence between the private and social perspective [Spash 2002]. The former constitutes the marginal rate of time preference and the opportunity costs, but it is limited by the life time of the individual. Assuming that he or she is an adult (capable of making financial decisions and investments), the perspective is no longer than about three or four decades and this time span is the basis for estimating the rate of time preference. On the other hand, the social perspective of life time depends in fact on the date of the end of human civilization. That may form a divergence between the private and social discount rate as the private may not count the effects for future generations.

6. Conclusion

Long-term public investment appraisal meets various obstacles, starting with physical impact measurement and ending with static and dynamic effects valuation. The latter issue in the intra-generational perspective is handled with the use of shadow prices for public goods and capital that should provide the information about people's preferences when markets are distorted.

In the short perspective compensating surplus and equivalent surplus measures are used to reflect in money terms the changes in public goods, where consumption is indivisible. Willingness to pay as well as willingness to accept are the concepts that are used here to express the changes in utility due to the improvement or deterioration in public goods. In practice, various methods of estimating WTP or WTA are used in the appraisal process to elicit the monetary expression of people preferences towards project impacts.

However, extending the investment life cycle to several generations, some ethical questions arise about the treatment of unborn persons and taking into account their preferences. There are several philosophical theories that explain the assignment and importance of rights of contemporary and future generation. The distribution of rights varies from giving all the power to the present generation, through equal allocation, ending with equipping future people with all the rights. The valuation of the impacts that affect future persons will differ under each of those ethical rules.

Applying contingent and equivalent surpluses in the light of the identified ethical approaches leads to applying zero worth to the future or present utility changes in extreme cases or to the treatment of many generations as one. The measures of WTP and WTA can be used here, although their interpretation differs from the static approach version. In addition, the intermediate alternatives involve applying some positive or negative discount rate to reflect the lesser importance of, respectively, future and contemporary persons.

Unfortunately, theoretical measures presented in the article suffer from various problems at the stage of social preferences elicitation procedures. The non-existence of the future affected generations as well as the divergence between public and

private inter-temporal valuation are some examples of additional issues that should be tackled besides the difficulties arising in short-term public effects valuation.

The measurement of intergenerational public effects of investments involves broadening the purely economic approach towards efficiency issue in the appraisal process by ethical questions that inevitably influence the future impacts valuation process. The precise definition of the ethical approach clarifies the assumptions of the analysis and the grounds of the investment decision to be taken.

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NADWYŻKA KOMPENSUJĄCA I NADWYŻKA EKWIWALENTNA W WYCENIE DŁUGOTERMINOWYCH EFEKTÓW INWESTYCJI PUBLICZNYCH

Streszczenie: Efekty inwestycji zmieniających dobro publiczne, które oddziałują na przestrzeni kilku pokoleń, napotykać na szereg trudności w procesie oceny efektywności tego rodzaju projektów. Wykorzystanie miar nadwyżki kompensującej i ekwiwalentnej do oszacowania pieniężnej wartości zmian w dobrach publicznych w perspektywie międzygeneracyjnej wymaga powiązania aspektów czysto ekonomicznych z jednym z podejść etycznych definiujących zakres praw przypisanych obecnemu bądź przyszłemu pokoleniu. Przyjęcie jednej ze zidentyfikowanych reguł etycznych określa w istotny sposób zakres wyceny efektu o charakterze międzygeneracyjnym.