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## The social welfare function of forests in the light of the theory of public goods

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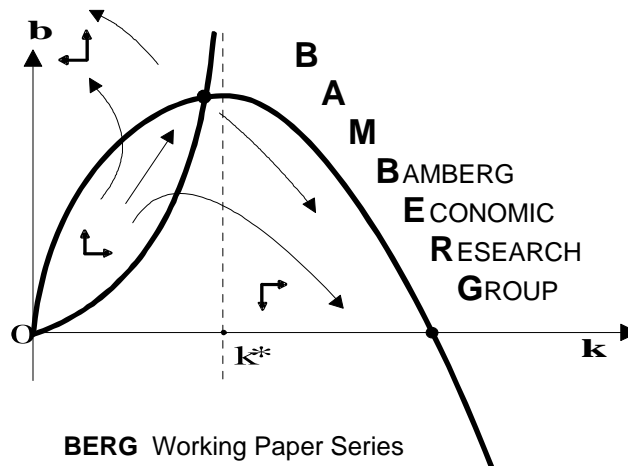
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Working Paper No. 87

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# **The social welfare function of forests in the light of the theory of public goods**

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## **Abstract**

Differentiation between public and private goods is very complex and difficult. In this article, authors overview these definitions and also the theories about private and public goods to apply this knowledge in the determination of the social welfare functions of forests, the utilization and the tasks of the government. The welfare functions of forests, the tasks of the owner and also the way of utilization of the forest is differing between public and private forests. This overview can help to determine these functions and tasks and also find the best ways of utilization.

**Keywords:** Social welfare, Private and public goods, Government

## **1. Introduction**

While we studying the social welfare functions of forests, we regularly have to face with questions that economically difficult to consider. In case of private forests, the owner or user information, individual preferences, short and long-term economic interests will help a lot in the choice of the forest utilization, and also in the combination of different possibilities that do not exclude each other. In case of forests owned or used by the state the situation is basically different, because besides the economical criteria of forest utilization other macro economic and social factors have to be considered. These include for example the protection of natural environment, national wealth and national values, protection of historical relics, the role of tourism in preservation of health, the love of nature and also the education of patriotism or just the increase of people's happiness and well-being without the measurable increase of GDP. It can be an important task to involve the public goods of private forests (for example blue hiking trail, a part in private forest) in free of charge with the help of the state.

It does not offer solution for the above mentioned problem, but it helps to understand it if we overview the theoretical definition of the economic characteristics of certain goods (particularly the public goods). We reviewed some important steps of reference systems in the history of economical theories and also how they can support the making of optimal social decisions. Finally, we return to the starting point and look over how they are applicable in the economical award of social welfare utilization of the forests.

## **2. Theories about the distinction of private and public goods**

The distinction between private and public goods is a substantive issue in the terms of establishing the extent and budget of the government involvement. If we can decide irrefutably that something is private or public good, the necessity of state or non-state implementation can be clearly assigned. The question is actually occurs in transition states: how government participates in the establishment of these? (Of course, we are aware that to answer this and also the actual construction, never withdrawal from the rights required in the past, can be a barrier of clear economic—rational—consideration.)

Review the historical alternation of the definition of public good (*Blankart, 2011*). Already SAX from the late Kameralists, draw attention to appropriate the ruler's incomes to revive (also) economy. At the beginning 20<sup>th</sup> century MAZZOLA and

WICKSELL thought the goodness of public good if it was available for someone, it was also available for everyone. However WICKSELL draw attention to the annoying stowaway behavior that is an optimal strategy individually but it occurs as a problem at the social level. The solution would be that all the affected sit down and decided to put up the money together. LINDAHL (1919) examined how to finance the production of public goods from optimal tax. The most people refer to the definitions that SAMUELSON (1954) (*Samuelson, 1954*) and MUSGRAVE (1959) used, later we will describe the categories that they used. BUCHANAN (1968) brought change, he regarded important the examination of the manners of common-pool resources. His innovation was considering the public consumption of public goods, not like the previous approaches that classified the goods according to features (rivalry, excludability). MALINVAUD and DRÉZE (1970–1971) observed the classification according to the features, but basically make a distinction between rivalries; excludability was only a secondary element. JOHANSEN (1971), CLARKE and GROVES (1971–1973) applied a decision theory approach (*Blankart, 2011*). In the Hungarian literature STIGLITZ (2000) (*Stiglitz, 2000*) és VÍGVÁRI (2002) (*Vígvári, 2002*) had similar statements about the definition of public goods.

Classification of goods along two dimensions by BLANKART (2001); according to MUSGRAVE (1973) *Figure 1*.

	<b>Rivalry</b>	<b>Non-rivalry</b>
Excludability	Private goods (1) Bread, flat	“Toll” goods (3) Television, motorway
Non-excludability	Public goods (2) Fishing, downtown streets	Pure public goods (4) Foreign policy

*Figure 1* **Classification of goods along two equal criteria**

To do this classification of certain goods, the decision should be made clearly, for example it is characterized by excludability or not, it cannot be said that a „bit” excludable. However, for a more analytical work quantifiability—a real scale—needed. The tool of measurement can be the marginal cost of the exclude of a non-paying consumer (stowaway) or include of a new consumer. If the previous is high exclusion is

impossible, if the latter is higher we talk about rivalry. It should be emphasized that exclusion always means technical exclusion (for example not moral exclusion). The only exception is cost-based impracticability, because the costs of it exceeded the deficits of stowaway behavior.

Rivalry can be explained by the features of the certain good. It reduces the usefulness of eat an apple if someone eat from that previously, whilst listening to the radio is an experience and will not change if someone else listen it, too. Of course, sometimes certain facilities or a certain cultural situation determines the occurrence of competition. When we brush our teeth with a toothbrush we do not like to give it to another person, but if we clean our shoes with it, give it to other family members does not mean a problem. For a Hungarian woman monogamy is natural, but in the earlier Mormon world “husband consumption” between wives did not rival.

In MUSGRAVE approach state does not related to private goods (1), the „invisible hand” serves perfectly in their markets, government should not interfere (*Musgrave, 1996*). Pure public goods (4) (like national defense, flood control, environmental protection, protection of private properties, etc. that benefits for all) in fact relates to the state, almost it has obligate rights and it has to provide it. Private production can work in a non-profit form or in a very small community (see 1). The other two elements (2 and 3) of the table, the degree of intervention is a determinative question, need consideration of the effects of market and government failures. Public goods (2) include fishing (though the fact that the boundaries of international waters in the shoreline farther tighten, the degree of exclusion can be increased the coastal countries). Downtown streets also belong to the category of public goods, because no one can be excluded, but the drivers competing with each other for parking space. In “toll” goods (3) exclusion give space for payment, besides when a motorway is not crowded cars do not bother each other, and also does not mean a problem that more people watch the television at home.

ZIMMERMANN and HENKE form groups in one dimension, which creates the applicability of simple function analysis (*Zimmermann and Henke, 2005*). They make a distinction between private and public goods along rivalry (in intermediate state we can speak about mixed goods), in these categories they make distinction according to exclusion (still technical and cost-based) (*Figure 2*).

<b>Rivalry</b>	<b>Excludability</b>	<b>Non-excludability</b>
Total	<i>Private goods</i>	
	Car	Crowded street
Partial	<i>Mixed goods</i>	
	Protection of vaccinated	Effect on non-vaccinated
Negative	<i>Public goods</i>	
	Non crowded motorway	Lighthouse

*Figure 2 Degree of rivalry with the subordination of excludability*

If vaccines are not mandatory, exclusion is made by only those people get it who voluntary go to the doctor. At the same time , if the majority vaccinate themselves to a communicable disease, the non-vaccinated also protected, because the risk of infections become lower, in this way they cannot be excluded from this major protection. Lighthouse is a typical good example for pure public goods, because if it helps to a ship in orientation, it would not be less helpful for another or not available, it cannot light for just one of them.

CANSIER and BAYER according to *Table 1* create groups in a one dimension scale (*Cansier and Bayer, 2003*).



*Table 1 The explanation of mixed goods*

Pure private goods	Mixed goods		Pure public goods
	Quasi-private goods	Quasi-public goods	
Excludability and rivalry	<ul style="list-style-type: none"> <li>– Incomplete excludability and rivalry (private goods with extern effect)</li> <li>– Excludability and missing rivalry (club goods)</li> </ul>	<ul style="list-style-type: none"> <li>– Missing excludability but rivalry</li> <li>– Common-Pool (public resources)</li> </ul>	<ul style="list-style-type: none"> <li>Neither exclusion nor rivalry</li> <li>– Produced goods</li> <li>– Natural goods</li> </ul>

The quasi (also called practical) private goods include the private goods that have external effects. For example, when an old diesel car passes in front of someone he cannot exclude himself from its discomfort. Of course, not all effects are bad: when a teacher pays for a PowerPoint course he cannot exclude the students from the positive effects of it. Club goods are quasi-private goods that have the possibility of exclusion, but there is no rivalry in consumption (till the membership does not reach an extremely high level). For example, fishing is a quasi-public good such as a community resource. In pure public goods we have to differentiate produced and natural public goods. Clean air belongs to the latter category, but if pollution takes the level when cleaning is necessary it becomes a produced public good.

BUCHANAN (1968) examined that consumption is private or public (*Cullis and Jones, 1998*). (The problem with this approach is that it does not answer for the question to produce the good individually or commonly.) He examined two dimensions. One of them is divisibility; the other is the size of the consuming group. Private good is consumed individually (in a very small group), everybody has an own part. For example, fire-extinguisher in the hall is a partly divisible good, can be consumed in small groups (2). Not everyone needs an own fire-extinguisher till the rush does not endanger the fire-fighting. Swimming pool is an example for indivisibility (4) that we

use individually, but do not parcel it to decide which square is whose. Moderately divisible and crowds of people can avail (3) for example vaccine (not everyone avails it, but it protects also the others). Pure public goods (5) are indivisible and large groups can consume them.

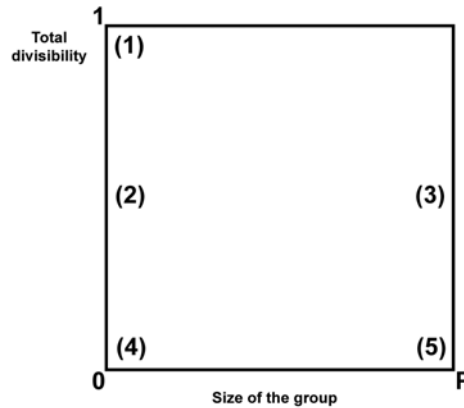


Figure 3 Division of consumption

Figure 4 and 5 show the demand of private and public goods (according to Cullis and Jones, 1998; and Musgrave, 1996).  $D_a$  and  $D_b$  mark the demand of 'a' and 'b' people's demand for a certain private good,  $D_{a+b}$  is the total demand ( $D_a$  and  $D_b$  is the horizontal amount).  $D'_a$  and  $D'_b$  show 'a' and 'b' people's marginal propensity to pay for a certain public good,  $D'_{a+b}$  is the vertical amount of them. The optimum is  $D_{a+b} = MC$  and  $D'_{a+b} = MC$ .

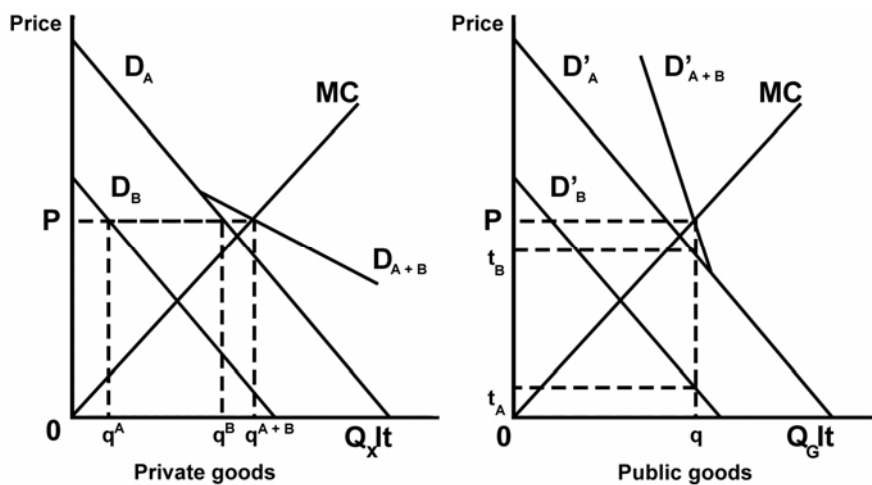
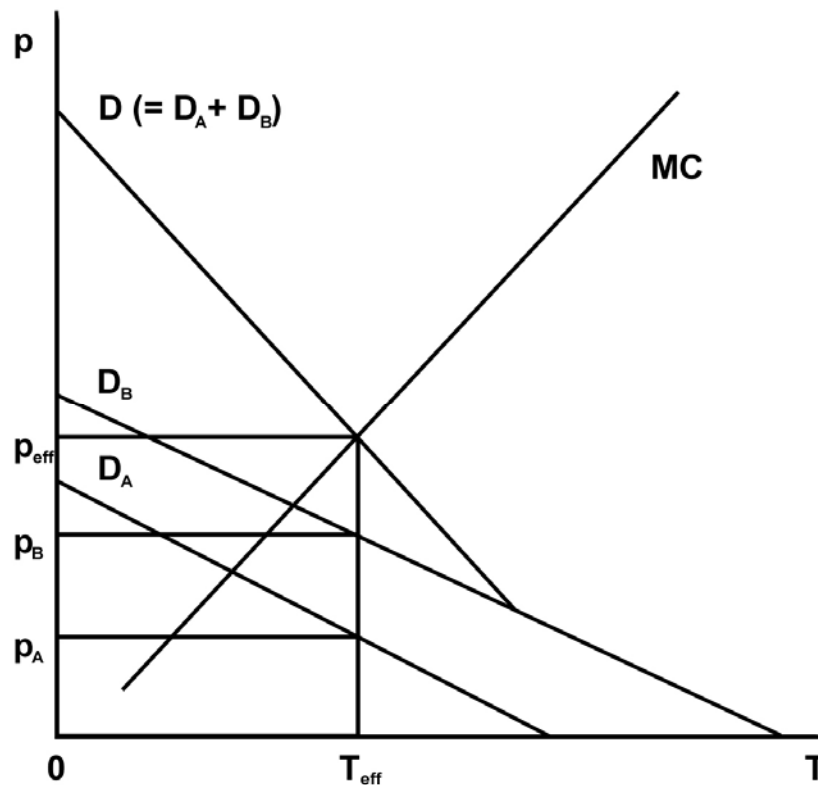


Figure 4 Total demand: public decisions and private goods

The next figure is the same with the previous, the only difference is that LINDAHL marked the marginal propensity to pay for public goods with  $D$ , the marginal costs with  $MC$ . The effective point  $(T_{\text{eff}}, p_{\text{eff}})$  of public good production, and everyone has to pay the amount of tax that is equal with his  $D$  besides the amount of  $T_{\text{eff}}$  (in the figure it is  $p_A$  and  $p_B$ ). The problem with the establishment of theoretical balance in practice is that we do not know the preferences of certain people and if we ask them they may be say lower  $D$  to pay lower tax while they use public goods according to their real needs.



*Figure 5 The balanced amount of public goods in case of LINDAHL-tax*

PARETO, KALDOR and HICKS also searched for the balanced solution, they assumed a horizontal  $MC$  that is usually the same as the price in the optimum. Since we cannot divide fairly the costs, simply pay the goods fifty-fifty with the two performers. At this time according to the KALDOR–HICKS criteria, when the balance point is the same as LINDAHL, 'A' comes off badly, because besides  $T_{\text{eff}}$  he pays higher tax than his willingness. 'B' get in the right position because he would be willing to pay more than he has to. Under PARETO-criteria produce the amount of  $T_A$  besides appropriate tax, so the total revenue tariff will be  $p \times T_A$ . (This satisfies the conditions of PARETO-efficacy:

no one can improve the situation of someone without worsen the situation of someone else.) The following figure shows these two solutions.

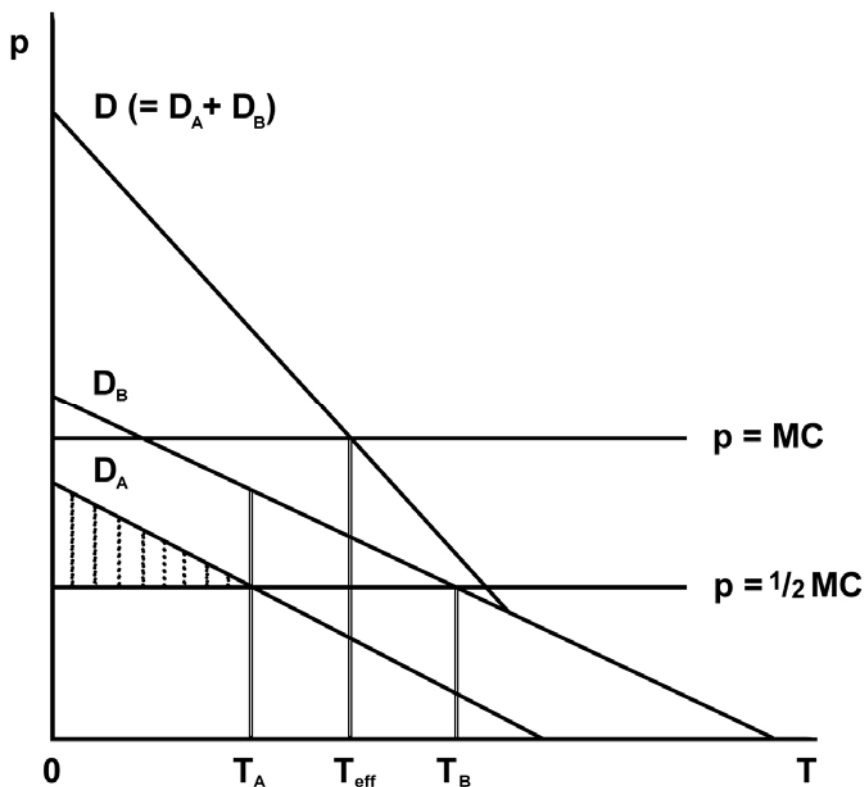


Figure 6 The balanced amount of public goods in case of lump-sum tax

Finally, have a look at what will be the overall balance in the production of private and public goods (Cansier and Bayer, 2003). In our model, we examined a binominal society ('A' and 'B' people), one kind of public (T) and one kind of private goods (X). Suppose that 'B' person's welfare level is given by  $I_B$  indifference curve. The concave curve from the figure above shows the limit opportunities of the production of T and X goods, minus  $I_B$  we get the cd curve in the figure below. Since the usefulness of 'B' is fixed, we get the balance point with the optimization of the position of 'A' that will be in the tangent point of the residual curve and the  $I_A$  indifference curve. Here we produce public goods in 'M' (they both consume it, because there is no rivalry), besides this we can produce 'N' amount of private goods (Figure 5). From this 'N' unit 'F' remains for 'B' (figure above) and remains 'E' for 'A' (Figure 6), because of the derivation of cd, it is true that:  $N = E + F$ .

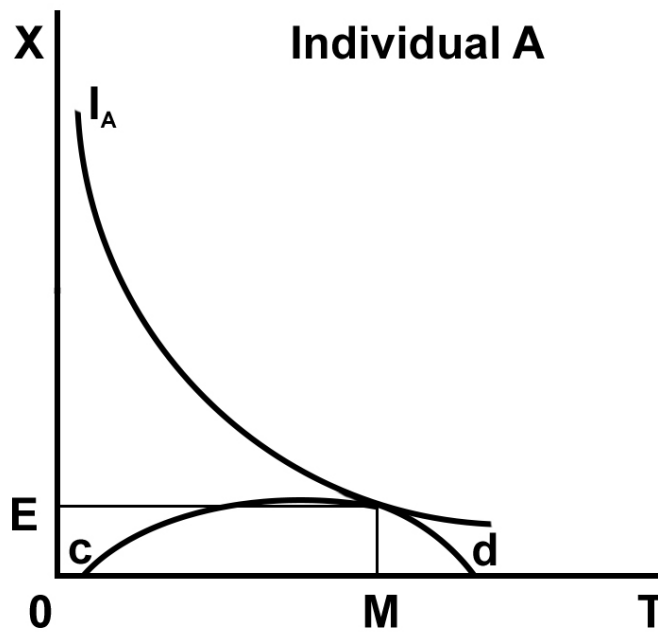
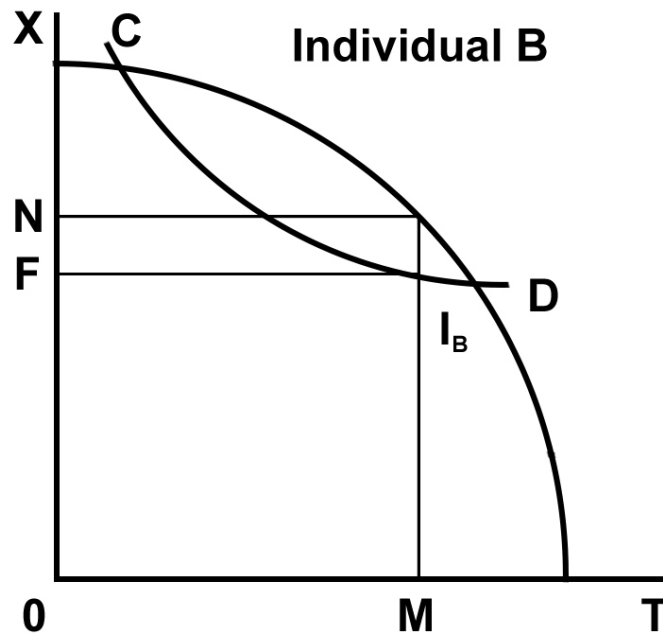


Figure 7 Effective production of private and public goods

In the issue of the efficient production of public goods it is unavoidable and also in case of „toll” and „public goods” the previously mentioned stowaway effect is a frequent problem, so a significant part of the consumers try to use them while they brake out themselves from the burden during production.

Stowaway behavior can be clearly pictured with the game theory of the classical situation of prisoner's dilemma. In this case, the parties concerned make decisions about goods production isolated from each other (like separated and separately interrogated prisoners). They have to consider that the other can act cooperatively or non-cooperatively. *Table 2* shows the possible example of the expected values structure (*Cansier and Bayer, 2003*).

*Table 2 The profit of A and B in case of different strategies*

	<b>K<sub>B</sub></b> <b>B cooperating</b>	<b>N<sub>B</sub></b> <b>B non-cooperating</b>
<b>K<sub>A</sub>, A cooperating</b>	10/10	-10/12
<b>N<sub>A</sub>, A non-cooperating</b>	15/-8	0/0

The given numbers show the result of decision for A and B. For example: A can choose a cooperative solution  $K_A$  or a non-cooperative solution  $N_A$ , B can also do this. Do not cooperate is better, because for A  $15 > 10$  and  $0 > -8$ , for B  $12 > 10$  and  $0 > -10$ , so the dominant strategy will be the non-cooperating. If both of them choose the directly favorable solution, the maximal total utility (20 units) will be inaccessible for the community. In other words, in case of public goods the so-called NASH-equilibrium (the strategic point from which the parties have not to change, because of supposing the rational behavior of the other) will be the stowaway behavior. With fair market conditions, assuming perfect competition nobody will produce public goods. The total utility maximum of the society can be reached with intervention of non-market (usually state) tools. Of course, the dominant strategy will be different, if one of the parties can force his willing to the other, or they can control the decisions of each other.

The theory of public goods can help to economically understand better the theory of HOBBS about the state contracts. If we define the freedom rooted in internal security as a public good, we can understand why the imagined "natural" state lead to anarchy and why it is only stop with the intervention of the state. The case of prisoner's dilemma can be applied well for "natural" state. People only think of their own profit and they always insult each other's interests. Who act cooperatively, abstain from insult the other's interests will suffer disadvantages. Based on the previous game "A" and "B" can

practice their natural freedom ( $N_A$ ,  $N_B$ ) or they can regard each other ( $K_A$ ,  $K_B$ ), if they were at peace with each other, overall it would be better, but the dominant strategy will be the fight. HOBBS thinks that the prisoner's dilemma is solvable at the level of arrangement. "B" give up the crossing of interests with the terms that "A" will also do this. This agreement can be understood as decentralized consensus quest. HOBBS sees the legitimacy of the state that a third party with power is needed who forces "A" and "B" to dependably keep the agreement.

Interesting exception in case of the few goods or in small communities, public goods can be developed without external interference. This can occur if the rate of contribution increases more than its realized utility for the consumer. The difference between it and private goods is that the utility enjoyed by others. In this case, consumers will use the disposal income for purchase till the marginal utility exceeded the marginal utility of the use of private goods. In small communities, for example in small villages, the other participants' relatively direct control on each other will decrease the possibility of stowaway behavior.

There is a group of goods that does not fit in the previously examined relation system that does not belong to public goods, but the need for government's intervention may occur in allocation. MUSGRAVE used the words meritoric and demeritoric goods (*Musgrave, 1996*).

We talk about meritoric goods if the amount of consumption is not sufficient under pure market conditions. With other words, the amount of individual optimum is less than the social optimum. Only those goods are demeritoric that the society—due to the individual optimization—consumes in a higher amount, than the level that is optimal for the community. Use of the seat-belt is a typical example of meritoric goods, at the same time traveling by car is demeritoric. The theoretical analyses of meritoric goods pay attention to important things. In a scientific way this is not result in a clear categorization or such a formal analytic possibility than the previous theory of public goods. Later MUSGRAVE also admitted it in an article (*Musgrave, 1996*). There are people who consider the practical consequences drawn from the theory of meritoric good very dangerous because governmental intervention to the market relations (spending public money and the removal of additional taxes from the economy) may occur without its cause and the mechanism of action would be sufficiently determined

and assessed. Achieving the individual or social optimum usually originated in informational asymmetry (the consumer is not aware of danger or the long-term consequences, or underestimate them) or in strong external effects (benefits and harms appear not only for the consumer who make the decision but for everyone) or in the appearance of both effects.

On pure theoretical base only external effects need allocative governmental intervention. Informational problems should be remedied not with providing public goods, but for example with informative work. Of course serious questions may arise about how the propaganda against smoking and alcohol consumption is effective. Or even publishing annual percentage rate of mandatory disclosure how much influence the decisions of borrowers.

Finally, we have to mention that not only the production of public goods can occur at the level of private level (not for state order, but entirely without state intervention), but it is also frequent that private goods are produced at the level of the state or their distribution with governmental tools. A reason for this is the above mentioned problem of meritoric goods. Close relation of a certain public good or common goods provided by the state or a toll good due to technology or traditions also result in the governmental allocation of private goods. For example, beside medical services the so-called additionally provided „hotel services” (food, accommodation, laundry, etc.) at the hospital. In many places—also in Hungary—an important dilemma of the health care financing reform how these financially two different types of services can be separated from each other. On an equitable basis it can be tolerated that the quality of hotel services may depend on solvency stronger within certain limits than medical service.

### **3. Distinction of forests**

One of the studies that deal with the economical issue of the free use of Bavarian Forest National Park follows the next logical system (*Allinger – Guleszkij, 2000*). In the aspect of allocation it is reasonable if both excludability and rivalry do not exist. In case of a national park the exclusion of non-paying visitors is possible, but it has very high additional costs due to the technical construction of fencing, access control system and further identification. The problem of rivalry also appears partly. It should be determined that the increase in the number of visitors which kind of extra costs will cause (for example garbage collection). In the analyses it can be considered as negligible.



A significant part of the additional costs is the so-called crowding costs. Due to the high number of the visitors the hedonic value (utility) of the tranquility of the park and the smooth immersion in nature will decrease. Here, as so often this is not a pure public good. The state allocation: decision can be made about establishment and use after serious analyses of costs and benefits.

Free use is appropriate if:

- The costs resulting from crowding do not appear till the actual needs do not guarantee.
- The costs of toll exceed the losses that can be avoided with the payment.

The above mentioned BAVARIAN problem also appears in the practice of national forest holdings in Hungary. In many cases we found that according to the original MUSGRAVE classification neither pure public nor pure private goods are concerned. Obviously, there are differences between large forests far from densely populated cities, park forests around the cities and the arboretums containing special plant rarities.

In the first case, the realization of exclusion is economically not rational and also the establishment of some kind of toll system. If we can achieve with proper communication that visitors stay away from activities that directly damages nature, the crowding costs related additional—if they are not negligible—but certainly less than the costs of exclusion, and also the expected revenues are not likely to could financed the additional costs.

With arboretums the situation is completely different, because the protection of the rare plants that they contain (prevention of excessively high additional costs in the aspects of economy) alone explains the control of the number of visitors. Although in many cases the entrance to arboretums owned by the national forest holdings is free (due to social reasons). Thus the costs of exclusion will exceed the additional reduction of costs that can achieve. Added to this is also suggested that at certain times (for example rhododendron bloom) the demand for visiting arboretums is so high, that it may be appropriate to reduce the payment and also due to high demand fees—even modest—can contribute to the maintenance of the institution.

The case of park forests that located near cities is between the previous two examples, where the additional costs are outstanding due to the huge number of visitors, at the same time due to smaller extent; fencing and the exclusion of incompetent visitors

are in a technically and economically possible range. It should be also consider that what are the health and cultural benefits that regular visits of the forests cause and how much it will reduce if it will also act on the solvent demand.

After this problem cannot be solved with positivist approach, application of utility variables derived from social preferences are needed, without this only premature, shortsighted pro or contra decisions can be made. Significant methodological and practical advances can be achieved if the above mentioned theoretical, historical problems of public goods production can be applied empirically for some partial aspects of social welfare utility of national forest holdings in Hungary with the tools of cost-benefit analysis.

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