Optimal taxation versus amenities provision and pricing: a contribution to the foundation of amenities funding mechanism.

Asma BEN OTHMEN*

Abstract

This paper poses the problem of the funding of amenities conservation as a problem of setting a price for whether an impure or excludable public goods. We look at the lightening of nuances existing on this issue.

Furthermore, the paper develops the basis of an integrated model of nonlinear income taxation, amenities provision and pricing in a large economy with private information about amenities preference. With regards to amenities as an excludable public good, a first best allocation is driven with emphasis on the multi attribute character of amenities. Incentive compatibility and individual rationality conditions are involved in the analysis process. A renegotiaiton proofness condition on the consumption side of allocation is used to write the incentive constraints for the multidimentional hidden characteristics as multiple unidimensional constraints.

Jel Classification: D 82, Q57, H41.

Introduction

In the developed as developing countries, the major aim of amenities policies is to exploit their value for rural development. Clearly the valorization of amenities is the best incentive for their conservation. But beyond this, the goal is to help rural territories recover the value of their amenities from the users and, thereby, to exploit not only crucial resources for development but also to ensure amenities conservation funding instruments.

Hence, a market for amenities appears to be a convenient framework in order to ensure such financial incentives; however, this is not the case in the real world. Market do not produce the optimal an optimal supply of amenities. One way of improving market is to limit access to amenities and charge beneficiaries for their use. Such a strategy makes sense when the amenities

* PhD Student at The Research Institute in science and technology for the environment. Amenities and rural area dynamic Unit - CEMAGREF – France.
Research Group in Theoretical and Applied Economics: GREThA – University Montesquieu Bordeaux IV – France.

is a private good, for example, if it can be fenced or has only a limited number of access points. It also makes sense when enjoyment of the amenity depends on the use of infrastructures and services that are themselves excludable. Hence access rights can be paid for at the same time as services. An example is a high amenity landscape that visitors can enjoy while staying at a farm gust house. Sometimes payment is indirect, for example for parking. Furthermore, here it should be mentioned that among developing and developed countries, there was a sense that nature-based tourism involving special amenities and natural area as a touristic destination, should contribute towards conservation of biodiversity, threatened species and amenities, and not just be a marketing ploy of the tourism industry. Indeed, involving directly biodiversity and natural amenities, nature-based-tourism can be perceived as an effective funding conservation tool under certain conditions, if these are met, the evidence indicates that nature-based tourism can make a significant contribution to amenities' conservation.

These considerations coupled with the increasing awareness about the importance and urgency to ensure a viable funding mechanism of the conservation of natural amenities implies the design of policies to change the economic ground rules. Mainly by establishing financial incentives, the aim is to compensate providers for supplying amenities and to tax action which have a negative impact on amenities that forcing the provider to internalize costs. When amenities have public good characteristics and-or generates externalities, the government effectively substitutes for the market by using financial incentives to send signals to providers.

It should be outlined that when dealing with the inquiry of how to ensure a reliable source of amenities conservation, economists' attention is increasingly addressed to the economic, social, cultural and environmental repercussion of nature-based related activities, regarded as externalities on one hand. On the other hand, emphasis is putted on the fact that if the economic benefits associated with nature tourism are to provide an increased incentive for conservation, then realize benefits will need to outweigh costs at national as well as at local level. One way to increase benefit capture is by increasing prices or taxes either for protected area entry or for goods and services supplied by the private sector (transport, accommodation, food and drink, guides, and so on)

The aim of this research is to integrate the analysis of amenities and natural area seen as a multi attribute public good with the theory funding mechanism design. As a first step, by exposing a literature review, the analysis takes a step towards integrating the three subfields into which normative public economics has traditionally been divided: the theory of public good provision, the theory of indirect taxation and public sector pricing. Then, by integrating the specific property of amenities as being multi attribute goods referring to a specific microeconomic theory (Lancaster and Gorman, 1971). The aim is to integrate both microeconomic public economic theory of income taxation with the mechanism design approach to the provision of amenities perceived as a multiattribute public good. For public finance, the question is how the availability of income taxation as a source of funds affects the provision and admission pricing of multiattribute public good under private information. Underlying these questions is a multidimentional mechanism design problem that we intend to analyze.

Indeed, inspired from a wide literature dealing with optimal income taxation, public good provision and public sector pricing, in this paper, we intend to take the analysis one step further by integrating the analysis of amenities and natural area seen as multi attribute public goods with the funding mechanism design theory.

Among many other authors, Helwig (2003), carried out numerous development of integrated models of optimal non linear income taxation and public good provision and pricing in a large economy. He have mainly adopted a model which is considered as useful for determining under what conditions and in what sense the availability of income taxation, as a source of governmental finance, alleviates the tension between incentives constrains and efficiency with regards to redistribution concerns and financing needs in the provision of public goods.

This paper is organized as follow, firstly we intend to emphasize on the specific character of amenities and natural areas for recreational use as being - non excludable or impure - public goods whose economic treatment involves specific economic theories.

Related literature

Amenities and natural area for recreational use: A public good regarded as an externality.

In many countries government has assumed the main responsibility for supplying parks and natural recreation areas. Obviously amenities and natural areas for recreational use have the feature of being a pure and continuous public good due to their non-use value. In fact, amenities and recreational areas have the feature of being nonexclusive continuous public good.

Here we should note that most of rural amenities are to same extent public good, which can be characterized as good that are non rival and non excludable. However, the extent to which a natural amenity is characterized by non-rivality varies for their mare existence, making them completely non rival. In contrast the number of fish, outdoors activities or local products decreases as peoples hunt or visit making them entirely rival goods.

Actually most amenities are somewhere in between, in general natural area can only absorb a limited number of visitors because congestion starts to reduce each person's enjoyment.
Also, a good is excludable when it is impossible to exclude anyone from its use. Non excludabililty often renders the establishment of amenity market difficult and sometimes impossible. In most cases, private goods are excludable and it is at this base that markets are constructed through which people pay in order to enjoy and consume a particular good.

Table 1: illustrate how amenities fall along a continuum from public to private goods; depending on the degree to which they are non-rival and-or non excludable. Some have both characteristics and are more purely public goods, others have one of the other characteristics and are semi-public good, and some have neither and are effectively private goods.

Table 1: Amenities classification – OCDE 1999

	Rival	Non rival
Excludable	Craft enterprise in Finland Coarseware pottery in Greece Tanada wner system Labeled products of French natural parks	Canadian national parks Canadian historical sites
Non-excludable	Everyman's right to harvest natural products in Sweden Game fishing in Kasumigaura	Austrian mountains farming French regional nature parks Asuka rural landscape Traditional farming in Yufuin Greek pottery village.

Source OCDE (1999)

In the following we will not extend the literature or the approach dealing with amenities seen as externality. However we should mention that externalities and more particularly positive externality are critical to understand rural amenities issues. In fact, many rural amenities are by-products, and in effect created by the production of other product.

The celebrated rural landscape in southern france were shaped by a particular kind of agriculture but are not intentionally created as an amenity. Not all amenities however are externalities, by contrast, natural reserves are examples of non-externality amenities where the amenity is deliberately produced and managed.

Setting prices for amenities

Amenities: From excludable public goods to impure public goods.

Many authors have dealt with the issue of setting up a user fee for public good. Particulary, concerning the establishment of a user fee for the use of environmental goods, Kotchen (2005), have developed an impure public good model in order to analyze the consumption of environmentally friendly good by consumers. The Kotchen's model admits that "green" products are treated as impure public good that arises through joint production of private characteristics and environmental public characteristics. His model is distinct from existing impure public good models because of the way it considers the availability of substitutes.

Reported to the specific framework of the analysis of amenities demand and consumption, this conceptualization mode admits that dealing with amenities as a public good is indeed, dealing with a problem involving interdependence between agents' choice, mainly externality and public good problem. In particular, according to Sandler and Cornes (1985) when considering consumer receiving an externality, for his own choice problem to be non-trivial, we must assume at least two commodities between which he can allocate his budget and whose quantities appears in his utility function.

Hence, our analysis of amenities provision and funding as an impure public good draws heavily on the characteristics approach to consumer behavior developed by Gorman (1980) and Lancaster (1971). According to this approach, impure public good model is based on the characteristics approach to consumer behavior, which implies that consumers derive utility from characteristics of the goods rather from goods themselves.

It is not difficult to price amenities which resemble private goods because the price can be determined through the market, when amenity has public good characteristics. In this context dealing with the problem of setting us of a user fee mechanism to these amenities means that we consider somewhat these amenities also as “excludable public goods”. By excludable public good we mean, good that allow the provider to exclude consumers from access, but nevertheless, are fully non-rival in consumption.

Since the seminal works of Samuelson (1954) the theory of public goods provision has mainly focused on goods that exhibit non excludability as well as non rivalry in consumption. According to Helwig (2005), less works has focused on goods that exhibit non rivalry in conception but allow the possibility of individual exclusion. This neglect reflect the assessment that, in a first best world, people should not be excluded from a good that exhibits non rivalry and whose use involves no externalities from crowding or from mutual annoyance of participants which is the case of tourism in natural area for recreational use if does not cost anything to provide additional person with opportunity to enjoy the public good to exclude individual should be resorted to (Samuleson, 1958).

Pricing amenities access: the main implications of public economic theory.

Focusing on the study of natural amenities as an excludable public good implies involving precepts from public economic theory. More specifically we intend to make emphasis on treatment of issues related to optimal taxation, efficient pricing and public good provision. These issues have been usually treated within the normative public economic framework which is divided into three main subfields: the theory of public good provision, the theory of indirect taxation and public sector pricing and the theory of optimal income taxation. These subfields have mostly been studied separately and relation between them has been little explored (Helwig, 2003). The theory of public good provision deals mainly with the elicitation of preference for public versus private goods. Conventionally, normative public economics have divided the analysis of tax systems and the revelation of preferences for public goods. Indeed, most of the research on income taxation which includes public good provision assumes that preferences for public goods are common knowledge. They focus on how the distortion associated with taxation affect the level of public goods provision, under the premise that a question such as “how many individuals have a high, medium or low valuation of the public good have already somehow been answered (Atkinson and Stern, 1974; Wilson, 1991; Boadway and Keen, 1993; Nava et al, 1996; Sandmo, 1998; Gaube, 2000; Hellwig, 2004; Kaplow, 2006 or Gahvari, 2006).

By contrast, public good provision under asymmetric information literature focuses on the problem how to determine the social benefit of a public good, given that preferences of individuals are not observable. Besides, this literature does not allow for taxation as a source of fund (Clarcke, 1971; Groves, 1973; Aspremont and Gérard-Varet, 1979; Maillah and Postlewait, 1990; Hellwig, 2003 or Norman, 2004). The theory of income taxation studies mainly the tradeoff between efficiency and equity that arises when earning abilities are unobservable while the theory of the indirect taxation and pricing following the Ramsey-Boiteux rules is interested in the combination of the indirect taxes and public sector prices used to finance a given public sector spending requirement when lump-sum taxation is unavailable.

Clearly the correct dividing line between taxes and access prices is not between instruments used for redistribution and those ones used for finance, but between instruments that are vulnerable to arbitrage through side-trading among participants and instruments that are not vulnerable to such arbitrage (Norman, 2002).

Mechanism Design approach: Incentive compatibility, individual rationality and renegotiation proofness conditions.

Establishing a pricing policies for amenities appears to fit in the framework commonly used in the field of public economics, optimal income taxation and the provision and pricing of public goods treated as a matter of Bayesian mechanism design approach. This approach focuses on the revelation of preferences as a basic contribution. Within this framework, the form of a payment scheme is determined endogenously as a part of the solution to the incentive problem.

When considering the case of a large economy in which people have private information about their public good consumption preferences, but through a large number of effects, the cross-section distribution of preferences is fixed and commonly known. In this case, the problem of provision of the public good is hampered by information problems. Besides, the fact that preferences are private information is considered as a major constrain in any process aiming to relate financial contribution to the benefit that people draw from the public good.

If everybody is allowed to access freely to natural amenities, the only incentive compatible financing scheme stipulate equal lump-sum payment from all individuals, whether they benefit from amenities access or not. Under such financing scheme, people that have no desire to visit amenities at all are negatively affected by their provision, and their participation must be based on coercision rather than voluntary contribution. Thus Mailath and Postlewaite (1990) show that, in a large economy, there is no way at all to provide a non excludable public good on a voluntary basis. Thus Shmitz (1997) and Norman (2004) when dealing with the provision of public goods with use of exclusion, argue that to avoid coercision, an excludable public good should be financed by admission fee if this is possible.

Regarding the Ramsey-Boiteux analysis, its commonly known that, when there is a single excludable public good, Ramsey-Boiteux pricing can be identified with a second best incentive mechanism (Laffont, Tirole, 1993). Particularly, incentive compatibility condition appears as useful tools in the analysis mechanisms designs. Indeed, incentive compatibility conditions are characterized in general for problem in which several goods are to be allocated and agent's type are multidimentionnal (McAfee and McMillan, 1988). Among other authors, McAfee and McMilan (1988) were able to find the optimal non linear pricing scheme when the monopolist knows only the distribution of an arbitrary parameterized family of demand curves.

Another condition imposed in mechanism design problem is individual rationality; indeed, we can argue that a mechanism is individually-rational if both, the user and the provider are expected to gain higher utility from participating in the mechanism than from avoiding it (Byde, 2006).

It is difficult to solve a mechanism with multidimensional incentive constraints. Following an approach introduced by Hammond (1997, 1987) and further developed by the Helwig's (2004), we will just impose an additional requirement of renegotiation proofness. This late concept stipulates that if a proposed mechanism might be renegotiated then it is impossible to ensure that it indeed achieves the goal it was designed to accomplish (Neeman and Pavlov, 2007).

Under this requirement, the final allocation of private goods and of admission tickets for excludable public goods must not provide participants with any incentive to engage in side trading out of sight of mechanism designer. Here we should note that in a large economy, the renegotiation proofness condition is satisfied only and only if the final allocation of private goods and the admission tickets for public goods is Walrasien, ie-supported by a price vector. For the usual quasi-linear specification of public goods preferences, it follows that final holdings of admission tickets for a public good depend only on the value of the preference parameter for that public good. Besides, it is known that the imposition of a renegotiation proofness condition reduce the m+1 dimensional mechanism design problem to a problem involving m+1 unidimentional incentive constrains, one for each public good and one for output provision. This problem can be handled with standard method.

In the following section we will lays out the basic model with multi-attribute excludable public goods explaining the requirement of incentive compatibility, individual rationality and recognition proofness showing how recognition proofness and incentive compatibility together turn under a mechanism design approach which attempts to answer the question of when and how it is possible to design a game form of consumers contribution to the funding of the natural areas and amenities, whose equilibrium outcomes are optimal with respect to some criterions of social welfare and according to the characteristic consumer theory.

Bayesian mechanism design in a model with a collection of amenities' characteristics

- *The model:*

We will study the provision of public goods in a large economy with one private good and m public goods (amenities, public parks, natural areas for recreational use). Amenities are considered as excludable.

Also, we assume at the outset, in this model that all amenities' characteristics are quantitative and objectively measured so that the assertion that b_{ij} is the quantity of the i^{th} characteristic possessed by a unit amount of the j^{th} good that has universal and (in principle) empirical meaning according to Lancaster (1971).

If b_{ij} is the quantity of the i^{th} characteristic possessed by a unit amount of the j^{th} amenitie or natural area, Q_i, w_i, are quantities of the i^{th} characteristic and j^{th} good respectively, the essential assumption of the model are presented as follows:

- Linearity: $Q_i = b_{ij} q_j$, that is, quantity q_i of the j^{th} good posseses x_i, time as much of each characteristics as does unit quantity of that good.
- Additivety: $Q_i = b_{ij} q_j + b_{ik} q_k$, that is given quantities of the two goods q_i and q_k, the total amount of the i^{th} characteristics possessed by the goods collection q_j, q_k is the sum of the amount of characteristics possesed by q_j, q_k separately.

It follows that, in a system of r characteristics and n goods the collection of characteristics possessed by some collection $q_1,\ldots\ldots,q_n$ of the n good is given by:

$$Q_i = \sum_{i=1}^{n} b_{ij} q_j \quad i = 1,\ldots,r$$

Concerning our specific model, an allocation must determine provision of characteristics collection levels Q_1, Q_2, $Q_3 \ldots Q_n$ of amenities and natural areas, as well as the production level of its respective collection of goods:

$$Q_i^1 = \left(\sum_{i=1}^{n} b_{ij} q_j \right)^1, \ Q_i^2 = \left(\sum_{i=1}^{n} b_{ij} q_j \right)^2 \ldots Q_i^m = \left(\sum_{i=1}^{n} b_{ij} q_j \right)^m$$

For each individual h in the economy, an amount c^h of private good consumption and a set J^h of public goods to which the individuals are admitted, and Q^1, Q^2,…Q^m.

According to Helwig (2009), the consumer obtains the payoff :

$$c^h + \sum_{i \in J^h} \theta_i^h \left(\sum_{i=1}^{n} b_{ij} q_j \right) \quad (1)$$

The vector $\theta^h = (\theta_i^h,\ldots,\theta_m^h)$ of parameters determining the consumer's preferences for the different characteristic collection of the public goods is the realization of a random variable $\tilde{\theta}^h$, taking value in $[0,1]^m$ which is defined in some interlined probability space (X, F, P).

Private good consumption and amenities admission will typically be made to depend on $\tilde{\theta}^h$.

In addition, they will also be allowed to depend on the realization of a further random variable n^h taking values in [0,1]. This random variable is introduced in order to allow individual randomization in amenities admissions and private good consumption.

The random variables $\tilde{\theta}^h$ and n^h are assumed to be independent. Their distribution F and v, are assumed to be the same for all agents. Moreover the distribution F of the vector $\tilde{\theta}^h$ of preference parameters has a strictly positive, continuously differentiable density f ( ) for i = 1,.., m the marginal distribution of $\tilde{\theta}^h$ the i-th component of the ransom vector $\tilde{\theta}^h$, is denoted Fi its density is f_i.

The set of participants is modeled as an atomless measure space (H, *H*, μ). We assume that the random variables $\tilde{\theta}^h$ and n^h, $h \in H$ are independent and that, by a large number effect, with probability one, the probability distribution F can be taken to be the cross distribution of the pair $\tilde{\theta}^h(w), \tilde{n}^h(w)$ in the population is P-almost surely equal to the probability distribution F x v. Thus, for almost every $w \in \Omega$, we can write

$$\frac{1}{\mu(H)} \int_H \varphi\left(\tilde{\theta}^h(w), \tilde{n}^h(w)\right) d\eta(h) = \int_{[0,1]^{m+1}} \varphi(\theta,n)dF(\theta)\, dv(n) \quad (2)$$

For every F x v integrable function φ from $[0,1]^{m+1}$ into IR. As the model conception adopted by Helwig (2003, 2004, 2007, 2008), we intend to restrict the analysis to allocation that satisfy an ex-ante neutrality or anonymity condition. The level c^h of an individual's private good consumption, the set J^h of public good to which the individual is admitted are assumed to depend on h and on the state of the word w only the realization† $n^h(w) = n^h$ and $\theta^h(w) = \theta^h$ of the random variables n^h and θ^h

An allocation is thus defined as an array:

$$A = \left(\left(\sum_{i=1}^{n} b_{ij} q_j \right)^A, c^A(.,.), \chi_1^A(.,.), \ldots, \chi_m^A(.,.) \right) \quad (3)$$

With $\left(\sum_{i=1}^{n} b_{ij} q_j \right)^A$ is a vector of characteristic collection provision level. And $c^A(.,.), \chi_1^A(.,.), \ldots, \chi_m^A(.,.)$ are functions which stipulate for each $(\theta, n) \in [0,1]^{m+1}$ a level $c^A(\theta, n)$ of private good consumption, and indicator $\chi_i^A(\theta, n)$ for admission to the public good i = 1,…,m, to be applied to any participant h in the state w if $(\theta^h(w), n^h(w),) = (\theta, n)$.

† In principle, according to Helwig (2003), ch and Jh, h sould also depend on the cross section distribution of the other agents' parameters realization $n^{h'}(w) = n^{h'}$ and $\theta^{h'}(w) = \theta^{h'}$ in the population, but because this cross-section distribution is constant and independent of w there is no need to make this dependence explicit. This is a major advantage from working in a large economy specification with the law of large numbers.

The indicator $\chi_i^A(\theta,n)$ take value one if the consumer is admitted and value zero if he is not admitted to the attribute of the public good i.

Here it should be outlined that the economy has an exogenous production capacity permitting the aggregate consumption Y of the private good if no public good with no link with amenities are provided. If a vector of the characteristics collection $\left(\sum_{i=1}^{n} b_{ij} q_j\right)^A$ are to be provided, n aggregate amount $K\left(\sum_{i=1}^{n} b_{ij} q_j\right)^A$ of the private good consumption must be foregone.

Thus an allocation *is feasible* if:

$$\frac{1}{\mu(H)}\int_H c\left(\tilde{\theta}^h(w),\tilde{n}^h(w)\right)d\eta(h)+K\left(\sum_{i=1}^{n} b_{ij} q_j\right)^A \le Y \quad (4)$$

For almost every $w \in \Omega$, so the sum of the aggregate consumption and public-good provision costs not exceed Y. By the large numbers conditions (2) this requirement is equivalent to the following inequality:

$$\int_{[0,1]^{m+1}} c(\theta,n) f(\theta)\, d\theta\, dv(n) + K\left(\sum_{i=1}^{n} b_{ij} q_j\right)^A \le Y \quad (5)$$

The cost function K ( ) is supposed to be increasing, strictly convex and twice continuously differentiable, with K(0) =0, and with partial derivatives K_i ( ) such that $\lim_{k\to\infty} K_i\left(\sum_{i=1}^{n} b_{ij} q_j\right) = 0$ for any i, and for any sequence $\left\{\left(\sum_{i=1}^{n} b_{ij} q_j\right)^k\right\}$ with $\lim_{k\to\infty}\left(\sum_{i=1}^{n} b_{ij} q_j\right)^k = 0$ and $\lim_{k\to\infty} K_i\left(\sum_{i=1}^{n} b_{ij} q_j\right)^k = \infty$ for any sequence $\left\{\left(\sum_{i=1}^{n} b_{ij} q_j\right)^k\right\}$ with $\lim_{k\to\infty}\left(\sum_{i=1}^{n} b_{ij} q_j\right)^k = \infty$ (Hellwig, 2004, 2007).

The allocation $A=\left(\left(\sum_{i=1}^{n} b_{ij} q_j\right)^A, c^A(.,.), \chi_1^A(.,.), \ldots, \chi_m^A(.,.)\right)$ provides consumer h with the ex-ante expected payoff :

$$\int_{[0,1]^{m+1}} c(\theta,n)+\sum_{i=1}^{m}\chi_i(\theta,n)\theta_i\left(\sum_{i=1}^{n} b_{ij} q_j\right) f(\theta)\, d\theta\, dv(n) \quad (6)$$

Because of the ex ante neutrality property of allocation, the equation (6) is independent of h. All participants are therefore in agreement about the ex ante ranking of allocation. Taking this ranking as a normative standard, we will refer to an allocation as being *first-best* if it maximizes the equation (6) over the set of feasible allocation.

By the equation (2) the ex ante expected payoff for any one participant is equal to the aggregate per capita payoff:

$$\frac{1}{\mu(H)}\int_{H}(c^{A}\left(\tilde{\theta}^{h}(w),\tilde{n}^{h}(w)\right)+\sum_{i=1}^{M}\chi_i^{A}\left(\tilde{\theta}^{h}(w),\tilde{n}^{h}(w)\right)\tilde{\theta}^{h}(w)_i(\sum_{i=1}^{n} b_{ij} q_j))\, d\eta(h) \quad (7)$$

For almost every $w \in \Omega$, first best allocation is therefore is also best if the mechanism designer is concerned with this cross-section aggregate of payoffs in the population. In taking expression (7) and (6) to be suitable welfare indicator, like Helwig (2007), we implicitly assume that there is no risk aversion on the side of participants and no inequality aversion on the side of the mechanism designer.

- *First best allocation, incentive compatibility and individual rationality*

The first best welfare problem is to choose an allocation so as to maximize:

$$\int_{[0,1]^{m+1}} (c(\theta)+\sum_{i=1}^{m}\pi_i(\theta)\theta_i(\sum_{i=1}^{n} b_{ij} q_j)) f(\theta)\, d\theta \quad (8)$$

Under the constrain that:

$$\int_{[0,1]^{m}} c(\theta) f(\theta)\, d\theta + K(\sum_{i=1}^{n} b_{ij} q_j) \le Y \quad (9)$$

Where

$$c(\theta) := \int_{[0,1]^{m+1}} c(\theta,n)\, dv(n) \quad (10)$$

$$\pi_i(\theta) := \int_{[0,1]^{m+1}} \chi_i(\theta, n) dv(n) \quad (11)$$

Are the conditional expectation of a consumer's private good consumption and admission probability for public good I, given the information that $\tilde{\theta}^h = \theta$

By standard arguments we obtain, an allocation is first best if and only if it satisfies the feasibility condition (5) with equality and , for I = 1….m one obtains:

$$K_i(\sum_{i=1}^{n} b_{ij} q_j) = \int_0^1 \theta_i d F_i(\theta_i) \quad (12)$$

And $\pi_i(\theta) = 1$ for almost $\theta \in [0,1]^m$

In the first best allocation, the ability to exclude people from the enjoyment of a public good is never used. Moreover, the levels of public good provision are chosen so that, for each i, the marginal cost $K_i(\sum_{i=1}^{n} b_{ij} q_j)$ is increasing the level at which public good I is provided is equal to the aggregate marginal benefits that consumers in the economy draw from the increase.

Given the assumption that $\lim_{k\to\infty} K_i\left(\sum_{i=1}^{n} b_{ij} q_j\right) = 0$ for any i, and for any sequence $\left\{ (\sum_{i=1}^{n} b_{ij} q_j)^k \right\}$ with $\lim_{k\to\infty} (\sum_{i=1}^{n} b_{ij} q_j)^k = 0$, it follows that, in a first-best allocation, provision levels of public goods are positive and so is $K(\sum_{i=1}^{n} b_{ij} q_j)$.

In order to more specify information; we assume that each consumer knows the realization θ of his own preference vector. Nevertheless, the consumers know nothing about the random variable n^h except v. Thus the information about θ is private. Except the distribution F x v nobody knows nothing about the pair $\left(\tilde{\theta}^h, \tilde{n}^h\right)$. Given this information specification, an allocation is said to be incentive compatible if and only if, for all θ and $\theta' \in [0,1]^m$ we obtain the following payoff function:

$$v^A(\theta)^3 c^A(\theta') + \sum_{i=1}^{m} \chi_i^A(\theta)\theta_i(\sum_{i=1}^{n} b_{ij} q_j) \quad (13)$$

Then $v^{A}(\theta) \geq c^{A}(\theta') + \sum_{i=1}^{m} \pi_{i}(\theta')\theta_{i}(\sum_{i=1}^{n} b_{ij} q_{j})$ (14)

Where $v^{A}(\theta) := c^{A}(\theta') + \sum_{i=1}^{m} \pi_{i}(\theta')\theta_{i}(\sum_{i=1}^{n} b_{ij} q_{j})$ (15)

Here it should be outlined that according to Rochet (1987) who provided existence proofs and characterization results for the multidimentional version of the multiproduct monopolist problem of Moussa and Rosen (1978), and found results directly applicable to the multidimentional non linear princing problem studied by Watson (1993) and Armstring (1996); an allocation is incentive compatible if and only if the expected payoff function presented by the equation (15) is convex and has partial derivative vi (.) satisfying :

$$v_{i}(\theta) = \pi_{i}(\theta)(\sum_{i=1}^{n} b_{ij} q_{j}) \quad (16)$$

For all i, and almost all $\theta \in [0,1]^{m}$ this is equivalent to the requirement that $c(\theta)$ is independent from θ

A characterization of incentive compatible allocation is beyond the scope of this paper. As discussed by rochet and Choné (1998), in fact that the incentive problem is multidimentional and that the payoff function (15) is not affine in n makes it all but impossible de find a simple characterization. Nevertheless, as stipulated by Hellwig (2007) we can state that a first-best allocation is incentive compatible only and only if:

$$c(\theta) = Y - K(\sum_{i=1}^{n} b_{ij} q_{j}) \quad (17)$$

For all i, and almost all $\theta \in [0,1]^{m}$. The preposition presented by the equation (16), indicates that, in a large economy studied here, a first-best allocation can be implemented if and only if the characteristic collection of rural and natural amenities provision is entirely financed by a lump-sum which people make regardless their preferences.

This lump sum payment account to $K(\sum_{i=1}^{n} b_{ij} q_{j}) > 0$ per person. Amenities provision then hurts people who do not care for that public good and benefit prople who care a lot for them.

People who do not care for natural areas and environement are strictly worse-off than they would if they could have just the private good consumption Y.

Always, following the same line of Hellwig's (2003, 2004, 2007) works who intrendet to articulate this problem by introducing the concept of individual rationality, we will assume that each individual h has the capacity to produce Y units of the private good (at no further costs of himself) and thus without any agreement on the provision of the public good, each participant simply consumes these Y units of the private good out of his oun production. Given this assumption , an allocation is said individually rational if the expected payoff presented by the equation 15 satisfies $v(\theta) \geq Y$ for all $\theta \in [0,1]^m$.

According to this definition, the equation (17) poses that a first-best incentive compatible allocation cannot be individually rational. Indeed, any incentive-compatible allocation with $K(\sum_{i=1}^{n} b_{ij} q_j) > 0$ and $\pi_i(\theta) = 1$. for almost $\theta \in [0,1]^m$ fails to be individually rational.

One of the main statements advocated by Hellwig (2007) is that this result does not depend on either the exogeneity of production or the homogeneity of individuals[‡].

Furthermore, the assumption that public-goods provision is not financed from taxes on production capacities or production activities stands in the tradition of Lindhal (1919). As a reminder, Lindhal tax conception is a form of taxation in which individuals pay for the provision of a public good according to their marginal benefits derived from the public good. Eg: if a loves scenic beauty and likes to be close to nature he might be ready to pay 5 € per day for sitting in a park, whereas a housewife who does not visit the park very often will not be ready to pay so much, but might agree to pay. So persons who value the good more, pays more. For these reasons, Lindhal taxes are also called benefit taxes. At the basis, based on the individual share of the collective tax burden of an economy, the theory of Lindhal was also designed as an interpretation of government activities in terms of *voluntary exchange*. Moreover, Lindhal equilibrium describes how efficiency can be sustained in an economy with personalized prices, under Lindhal analysis, the government was described to be first providing the equity effect through redistribution and then providing and sustaining an efficient provision of the public

‡ According to Hellwig (2007), the impossibility result holds, whenever the government refrains from using the taxes on people's production capacities or people's outputs to finance the public good.

good through voluntary contracting. The voluntariness of exchange at the second stage of the governmental activity corresponds precisely to the individual-rationality presented here and which we intent to involve in our analysis.

- *Second best mechanism design*

A second best allocation is defined as an allocation that maximizes the aggregate surplus (8) over the set of all feasible, incentive compatible and individually rational allocations. In the following section we will refer to Rochet and Choné (1998) who has, as previsousely mentioned, dealt with natural extension of nonlinear pricing models studied by Mussa and Rosen (1978), Roberts (1979), Spence (1980), Maskin and Riley (19984) and Wilson (1993). The major argument advanced by these authors is that optimal screening of agents with unknown characteristics cannot be ruled out easily. Indeed, the analysis of optimal screening of agents with unknown characteristics has been the subject of a large theoretical literature; this is partly justified by the great variety of context to which such an analysis can be applied. In fact, one of the metric of this theoretical literature has been to show that such diverse questions as non linear pricing, product lines design, optimal taxation, and regulation of public utilities...could be handled within the same framework (Rochet and Choné, 1998). Although, it is often recognized that agents typically have several characteristics and that principals have several instruments; this problem has most of the time been examined under the assumption of a single characteristic and a single instrument. By considering the typical multiplicity of characteristics and instruments Rochet and Choné (1998) have discussed the problem of finding an incentive compatible and individually rational allocation, which can be formulated in terms of the provision levels of the characterist collection of excludable public goods and any convex function v (.)

The equation (16) implies that for any $\sum_{i=1}^{n} b_{ij} q_j = \left[\left(\sum_{i=1}^{n} b_{ij} q_j \right)^1 ,....., \left(\sum_{i=1}^{n} b_{ij} q_j \right)^m \right]$ which partial derivative satisfies $v_i(\theta) \in \left[0, (\sum_{i=1}^{n} b_{ij} q_j) \right]$, for all I, and almost $\theta \in [0,1]^m$, an <u>incentive compatible allocation</u>, is obtained by setting :

$$\pi_i(\theta) = \frac{1}{\left(\sum_{i=1}^{n} b_{ij} q_j \right)_i} \lim_{\theta_i^{'} \downarrow \theta_i} v_i(\theta_i^{'}, \theta_{-i}) \text{ if } \sum_{i=1}^{n} b_{ij} q_j > 0 \quad (17)$$

$$\pi_i(\theta) = 0 \text{ if } \sum_{i=1}^{n} b_{ij} q_j = 0 \quad (18)$$

And $c(\theta)=v(\theta)-\sum_{i=1}^{m}\theta_i v_i(\theta)$ (19)

And specifying $c^{A}(.,.)$ and $\chi_1^{A}(.,.),\ldots,\chi_1^{m}(.,.)$ accordingly, by the equation (19) condition (5) is equivalent to the inequality:

$$\int_{[0,1]^{m+1}}\left[v(\theta)-\sum_{i=1}^{m}\theta_i v_i(\theta)\right]f(\theta)d\theta \le Y-K\Big(\sum_{i=1}^{n} b_{ij}q_j\Big)^{A} \quad (20)$$

The problem of finding a second best allocation is equivalent to the problem of choosing a provision level of the charactersitc amenities collection, and a convex function v with partial derivative that satisfies $v_i(\theta)\in\left[0,\sum_{i=1}^{n} b_{ij}q_j\right]$, for all i, and almost all θ so as to maximize the surplus described by the equation (8) subject to the feasibility constraint $v(\theta)\ge Y$ for all θ

Regarding the study of the case of a single excludable public good which may be provided by a natural monopoly, with zero marginal cost, as studied by Norman (2004), consumers are informed about their preferences, so provision mechanisms are required to be consistent with incentive compatibility. In addition, Shmitz ans Norman (2004) require the provision mechanism to be sel-financing, and assume that individuals who are left with a negative net benefit cannot be compelled to participate. Particulary, the main aim of Norman (2004)'s works was to demonstrate that simple pricing schemes, third degree price discrimination, the ability of price discriminate, average cost pricing, can be justified in a large economy without an exogenous restriction on the ability to price discriminate.

Furthermore, in the case where m=1, Shmitz (1997) and Norman (2004) have shown that the above mentioned problem of finding a second-best allocation has a single solution. Indeed, for any second-best allocation $\left(\sum_{i=1}^{n} b_{ij}q_j, c(.,.), \chi_1(.,.)\right)$ there is some $\hat{\theta}\in[0,1]$ such that $C(\theta)=Y-\hat{\theta}\left(\sum_{i=1}^{n} b_{ij}q_j\right), \pi(\theta)=1$ for $\theta>\hat{\theta}$ and there is some user fee $p=\hat{\theta}\sum_{i=1}^{n} b_{ij}q_j$, so that people for whom the benefit $\theta\sum_{i=1}^{n} b_{ij}q_j$ from the enjoyment of the different characrersitcs collection of amenities exceeds p pay the fee and are given access, and people for whom the benefit $\theta\sum_{i=1}^{n} b_{ij}q_j$ is less than p do not pay the fee and are not given access. The critical $\hat{\theta}$ and the fee $\theta\sum_{i=1}^{n} b_{ij}q_j$ are chosen so that the agregate revenu $p(1-F(\hat{\theta}))$ just cover the cost $K(\sum_{i=1}^{n} b_{ij}q_j)$ of providing the multiattribute public good[§]

In the case where m>1, a general characterization of second-best allocation does not seem to be available. A usual in the problem of multi-dimensional mechanisms design, the second order condition for incentive compatibility (convexity of the expected pay-off function v()), and integrability condition (equality of the cross derivative $v_{ij}(\theta)$ and $v_{ji}(\theta)$ i-e $\frac{\partial \pi_i(\theta)}{\partial \theta_j}(\sum_{i=1}^{n} b_{ij}q_j)_i$ and $\frac{\partial \pi_j(\theta)}{\partial \theta_i}(\sum_{i=1}^{n} b_{ij}q_j)_j$ are difficult to handle analytically) .

Fand and Norman (2003/2006) have studied optimal provision mechanism for multiple excludable public goods for a class of problem and binary valuation where m=2. They fully characterized the optimal mechanism and demonstrate that it involves bundling if regulatory condition, akin to a hazard rate condition, on the distribution of valuation is satisfied. Nevertheless, according to Thanassoulis (2004) and Manelli and Vincent (2006), who has mainly dealt with the problem the problem of the profit maximization by a multiproduct monopolist, has suggested that, for m>1, nonseparability and randomization in admission are the rule, rather than the exception (Helwig, 2007)

- *Renegotion proofness condition.*

Considering only incentive compatibility may lead to implausible results (Biebrauer, 2008). In the flowing section we will discuss the possibilities of characterizing a third best allocation that is defined as an allocation that maximize aggregate surplus subject to feasibility incentive compatibility, individual rationality and to an additional conditional condition of renegotiation proofness.

The renegotiation proofness and incentive compatible allocation is a strict subset of the set of allocations induced by the price schedules. In fact, the mechanism designer is assumed to be unable to verify the identities of peoples who present tickets to be admitted to the enjoyment the

§ According to Manelli and Vincent work's if the function $\theta \to g(\theta) := \theta - \frac{F(\theta)}{f(\theta)}$ is increasing the solution is actually unique. If the function $\theta \to g(\theta)$ is not increasing, there may be more than one solution, including solution that involves randomized admissions. Nevertheless, event in this case, at least one solution has the simple interpretation in terms of any entry fee.

amenity. In particular he is unable to check whether the people who present tickets for admission to the natural areas, public parks and rural amenities are in fact the some people to whom the ticked has been issued.

As in Hammond (1979, 1987) and Guesnerie (1995), he is also unable to prevent people from trading admission tickets and the private good among each other. If the initial allocation of tickets leaves room for a Pareto improvement through such trading, then as discussed by Hammond and Guesnerie, in the absence of transactions costs, such trading will occur and the initial allocation will not be actually the final allocation.

Imposition of renegotionation proofness in our special setting when dealing with amenities and natural areas access corresponds to the idea that, regardless of the allocation that initially chosen by the mechanism designer, in the absence of transaction costs, any allocation that is finally implemented must itself be renegotiation proof. If the mechanism designerin is aware of the possibility of renegotiation and if he cares about allocation that is finally implemented rather than the one that is initially chosen, his choice may be directly expressed in terms of the final renegotiation proof allocation. Indeed if he chooses a renegotiation proof allocation from the beginning, in the absence of transaction costs, this initial allocation will also be the final allocation. Given these facts, in the following, we will refer to an allocation as third best, if and only if if it maximizes the aggregate surplus expressed by the equation (8), over the set of all feasible, incentive compatible , individually rational and renegotiation proof allocations.

In order to set formal treatment, we will introduce the concept of – *net trade allocation* – for private good consumption and characteristic collection amenities admission tickets as an array $\left(z_c(.,.), z_1(.,.),..., z_m(.,.)\right)$ such that for each (θ, n) , $z_c(\theta, n)$ and $z_1(\theta, n),...z_m(\theta, n)$ are the net addition to private good consumption and admission tickets holdings for characteristic collection amenities admission, for a consumer with preference parameter vector θ and an indicator value n .

Given the initial allocation A, a net-trade allocation $\left(z_c(.,.), z_1(.,.),..., z_m(.,.)\right)$ is feasible if

$\chi_i^A(\theta, n) + z_i(\theta, n) \in \{0,1\}$ for all $(\theta, n) \in [0,1]^{m+1}$ and moreover,

$$\int_H z_i\left(\tilde{\theta}^h(w), \tilde{n}^h(w)\right) d\eta(h) = 0 \quad (20)$$

For i = c, 1,…, m and almost all $w \in \Omega$ which by the equation (20) is equivalent to the requirement that:

$$\int_{[0,1]^{m+1}} z_i(\theta,n)\, f(\theta)\, d\theta\, dv(n) 0 \quad (21)$$

For i = c, 1,…, m; Given A, *the net-trade allocation* $\left(z_c(.,.), z_1(.,.),..., z_m(.,.)\right)$ is *incentive compatible* if and only if:

$$z_c(\theta,n) + \sum_{i=1}^{m} z_i(\theta,n)\theta_i(\sum_{i=1}^{n} b_{ij}q_j)^A \geq z_c(\theta^{'},n) + \sum_{i=1}^{m} z_i(\theta,n)\theta_i(\sum_{i=1}^{n} b_{ij}q_j)^A \quad (22)$$

For all (θ,n) and $(\theta^{'},n^{'})$ in $[0,1]^{m+1}$ for which $\chi_i(\theta,n) + z_i(\theta^{'},n^{'}) \in \{0,1\}$ for all i. the idea is that the holdings $\left(c^A(\theta,n), \chi_1^A(\theta,n),..., \chi_m^A(\theta,n)\right)$ of private good consumption and public good admission tickets of a given agent as well as the realization (θ,n) of $(\tilde{\theta},\tilde{n})$ are not known by anybody else. Therefore, if the agent claims that the realization of $(\tilde{\theta},\tilde{n})$ is $(\theta^{'},n^{'})$ he obtains the net trade $\left(z_c^A(\theta^{'},n^{'}), z_i^A(\theta^{'},n^{'}),..., z_m^A(\theta^{'},n^{'})\right)$ that is available to an agent with parameters $(\theta^{'},n^{'})$. Incentive compatibility of the net trade allocation require that such a claim must not provide the agent with an improvement over the stipulated net-trade $\left(z_c^A(\theta,n), z_i^A(\theta,n),..., z_m^A(\theta,n)\right)$.

An allocation A is said to be renegotiation proof, if starting from A, there is not feasible and incentive compatible net-trade allocation which provides a Pareto improvement in the sense that for all $(\theta,n) \in [0,1]^{m+1}$, the utility gain from the net trade $\left(z_c^A(\theta,n), z_i^A(\theta,n),..., z_m^A(\theta,n)\right)$ is nonnegative i.e

$$z_c(\theta,n) + \sum_{i=1}^{m} z_i(\theta,n)\theta_i(\sum_{i=1}^{n} b_{ij}q_j)^A \geq 0 \quad (23)$$

And the aggregate utility gain is strictly positive, i-e.

$$\int_H (z_c\left(\tilde{\theta}(w),\tilde{n}(w)\right) + \sum_{i=1}^{m} z_i(\tilde{\theta}(w),\tilde{n}(w)\tilde{\theta}^h(w)(\sum_{i=1}^{n} b_{ij}q_j))d\eta(h) > 0 \quad (24)$$

With positive probability, by (21), the latter inequality is equivalent to the inequality:

$$\int_{[0,1]^{m+1}} (z_c(\theta,n) + \sum_{i=1}^{m} z_i(\theta,n)\theta_i(\sum_{i=1}^{n} b_{ij}q_j)dF(\theta)\,dv(n) > 0 \quad (24)$$

Hellwig (2007), shows that an allocation is renegotiation proof if and only if there exists a price system which supports the allocation as a competitive equilibrium of the exchange economy is which people trade the private good as well as admission tickets for a bundle of the attributes of the public goods taking the vectors of the public good attribute $\sum_{i=1}^{n} b_{ij} q_j$ as given.

This is to say that an allocation A is renegotiation proof if and only if there exist prices $p_1^A, ..., p_m^A$ such that for i = 1,…,m, and almost all $(n, \theta) \in [0,1]^{m+1}$, one has :

$$\chi_i^A(\theta,n)=0 \text{ if } \theta_i(\sum_{i=1}^{n} b_{ij} q_j)^A < p_i^A \quad (25)$$

And

$$\chi_i^A(\theta,n)=0 \text{ if } \theta_i(\sum_{i=1}^{n} b_{ij} q_j)^A > p_i^A \quad (26)$$

Thus, renegotiation proofness implies for each public good a simple division between participants with high θ_i and participants with low θ_i. The former get admission to the public good I, with probability one. The latter do not get admission to the public good i at all.

The simplicity of admission rule provided by equalities (25) et (26) provides a useful simplification of the incentive compatibility condition. $p_1^A, ..., p_m^A$ can be interpreted as prices and hence as admission fees.

People who would like to enjoy the different characteristics collection of amenities have to pay the fee pi. Consumers with $\theta_i\left(\sum_{i=1}^{n} b_{ij} q_j\right)_i$ less than pi do not pay the fee and are excluded from the access to amenities. And Consumers with $\theta_i\left(\sum_{i=1}^{n} b_{ij} q_j\right)_i \succ p_i$ pay the fee and enjoy amenities acces for an net benefit that equal $\theta_i\left(\sum_{i=1}^{n} b_{ij} q_j\right)_i - p_i$, consumer with $\theta_i\left(\sum_{i=1}^{n} b_{ij} q_j\right)_i \prec p_i$ do not pay the fee and are excluded from the public good.

This price characterization of renegotiation proof allocation can be used used to provide an analytically tractable characterization of incnetive compatible allocation that are also renegotiation proof. With renegotiation proofness, one can see that the m+1 dimensional incentive constraints can actually be decomposed into m+1 unidimensional constraints. This charachterization is beyond the scope of this paper.

Concluding remarks:

In this paper, we intended to search for solution to both, alleviate nature-based tourism environmental damage and collect revenue to ensure a sustainable funding of rural amenities and natural areas preservation. In theory, setting up a tax or an admission fees to amenities appears to be an appealing option. However, taxing or fixing a price based on derived benefits is both a complex and incomplete method.

The theory of income taxation public good provision and pricing studies maximizing tax policies for an environment where the distribution of abilities is known, whereas individual abilities are unobservable. This paper have analyzed a large economy model that combine public economic theory with a specific multiattribute demand theory in a context where individual have not incentive to hide their true preference regarding amenities and natural ares characteristics collection consumption. However uncertainty about preferences induces randomness into optimal tax or fee and expenditure policy to provide rural amenities. We introduced the requirement of individual rationality and a renegotiation proofness condition in order to better specify our mechanism design.

The main prepositions of this paper could be extended in order to further investigate distribute concern of income taxes or admission fees and amenities finance by the study of the allocation that maximize the aggregate surplus over the set of admissible allocations where in addition to incentive compatibility and renegotiation proofness, admissibility also involves a requirement of individual rationality. These requirements seem to be of considerable interest in further understanding the role of taxation or user fees as a source of amenities and natural area provision finance.

References

Atkinson, A.B., and J.E. Stiglitz (1976), The Design of Tax Structure: Direct versus Indirect Taxation, Journal of Public Economics 6, 55 -75.

Cremer, H., P. Pestieau, and J.C. Rochet (2001), Direct versus Indirect Taxation: The Design of Tax Structure Revisited, International
Economic Review 42, 781 - 799.

Cremer, H., and J.J. Laffont (2003), Public Goods with Costly Access,
Journal of Public Economics 87, 1985 - 2012.

Diamond, P.A., and J. Mirrlees (1971), Optimal Taxation and Public Production I: Production Efficiency, and II: Tax Rules, American Economic Review 61, 8 - 27 and 261 - 278.

Fang, H., and P. Norman (2003/2006), Optimal Provision of Multiple Excludable Public Goods, mimeo, Yale University and University of Wisconsin, Madison 2003; revised version, Yale University and University of British Columbia 2006.

Hammond, P. (1979), Straightforward Individual Incentive Compatibility in Large Economies, Review of Economic Studies 46, 263 - 282.

Hammond, P. J. (1987), Markets as Constraints: Multilateral Incentive Compatibility, Review of Economic Studies 54, 399 - 412.

Hellwig, M.F. (2005), A Utilitarian Approach to the Provision and Pricing of Excludable Public Goods, Journal of Public Economics 89, 1981.2003.

Hellwig, M.F. (2007 a), The Provision and Pricing of Excludable Public Goods: Ramsey Boiteux Pricing versus Bundling, Journal of Public Economics 91, 511 .540.

Hellwig, M.F. (2007 b), A Contribution to the Theory of Optimal Utilitarian Income Taxation, Journal of Public Economics 91, 1449 .1477.

Hellwig, M.F. (2008), A Maximum Principle for Control Problems with Monotonicity onstraints, Preprint 04/2008, Max Planck Institute for Research on Collective Goods, Bonn, Germany.

Laffont, J.J. (1993), A theory of incentives and procurements. Elsevier.

Mirrlees, J.M. (1971), An Exploration in the Theory of Optimum Income Taxation, Review of Economic Studies 38, 175 - 208.

Mirrlees, J.M. (1976), Optimal Tax Theory: A Synthesis, Journal of Public Economics 6, 327 - 358.

Norman, P. (2004), Efficient Mechanisms for Public Goods with Use Exclusion, Review of Economic Studies 71, 1163 – 1188.

OCDE. (1999), Cultivating rural amenities – An economic development perspective.

Rochet, J.-C., and P. Choné (1998), Ironing, Sweeping, and Multidimensional Screening, Econometrica 66, 783 - 826.

Samuelson, P.A. (1958), Aspects of Public Expenditure Theories, Review of Economics and Statistics 40, 332 - 338.

Schmitz, P.W. (1997), Monopolistic Provision of Excludable Public Goods Under Private Information, Public Finance/Finances Publiques 52, 89 - 101.