Open access and external regulation of recreational common pool resources

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Abstract

This paper presents a game theoretic model of a tourism destination producing nature-based tourism services. Natural resources are used by the tourism industry both as input factors for production and amenities being part of the tourism product. The model captures this complexity and demonstrates that for the open access situation non-tragedy equilibria are achievable for certain value of parameters. Public intervention is shown to be capable of improving resulting environmental quality when sufficiently enforced. However, public intervention can also result in lower environmental quality in the equilibrium due to crowding-out of motivation for voluntary initiatives, imperfect monitoring, corruption or the existence of unregulated firms. Thus, the model is a first contribution to analyze implications of different institutional designs on the economic incentives to undertake environmental initiatives by tourism firms.

Keywords: Game Theory; Renewable Resources and Conservation; Tourism; Corruption; Environmental Standards.

1 Introduction

Improvement of living conditions and development of environmental consciousness have popularized recreational uses of natural resources which in many societies are related to tourism. Tourism is a growing industry around the world that transforms regions and countries into service-oriented economies. In nature-based tourism areas recreational uses of natural resources by tourism operators partially substitute traditional extractive uses. In these areas environmental quality constitutes a relevant competitiveness factor (Albrech, 1998; Butler, 1980; Goeldner & Ritchie, 2003; Hassan, 2000; Hjalager, 1996; Hudson, Ritchie, & Seldjan, 2004; Huybers & Bennett, 2002a, 2003a; Ritchie & Crouch, 2003; Ritchie & Crouch, 2000; WTO, 2004). Environmental quality influences selection of which region to visit (Alegre & Pou, 2003; Stonich, 1998; WTO, 2004), satisfaction derived from the experience (Alegre & Cladera, 2006; Kassinis & Soteriou, 2003, 2005) and the price that visitors pay for tourism products (Alegre & Juaneda, 2006; Dodds & Joppe, 2005; Huybers & Bennett, 2002b; Kassinis et al., 2003, 2005; PATA, 2007; Rivera, 2002). However, as regions become more popular for recreational uses of its natural resources, its environmental quality decreases due non-extractive pressures, constraining future developments (Butler, 1980; WTO, 2004). Tourism expansion is generally described as accompanied by congestion, degradation of natural assets, weak management of wastes and effluents and other negative impacts (for some examples see Davies & Cahill, 2000; Knowles & Curtis, 1999; Morgan, 1991; Tisdell, 2001). Therefore, the tourism industry has a two-fold relation with natural assets at destinations, characterized by simultaneous dependency and impact.

Environmental policy to preserve the basis of tourism attraction has increasingly emphasized the role of voluntary initiatives in a regulatory environment mostly driven by command and control mandates. Corporate environmental performance is gaining prominence among business leaders, academics, investors, and governments (Andrews, 1998). In OECD countries, this comes from criticism of the effectiveness of command and control regulations as well as an increasing belief in potential cost-efficiency improvements when industries are given flexibility to select their methods of pollution control (Khanna, 2001). In this policy scenario, environmental management of recreational natural resources should promote more suitable mechanisms for the governance of natural assets to enable voluntary environmental actions. As Marshall (2005) states, in no way does this deny a vital role for the state. Self-regulation may correct some private inefficiencies and may support efficient regimes to manage externalities and common pool resources, but it is not a viable substitute for environmental governance (Andrews, 1998). Therefore, the government should reinvent itself such that it complements rather than displaces or absorbs self-organizing capacities at smaller levels of social interaction (Marshall, 2005). Empirical examinations in Costa Rica suggest that in addition to market incentives, adequate institutional pressures may also be necessary conditions for adherence to environmental management systems by hotels in order to promote compliance above and beyond regulated environmental behavior (Rivera, 2004).

Within this discussion, more rigorous analyses of modification of incentives by environmental regulations are required to better re-design policies to complement voluntary action. Outcomes resulting from environmental policies are crucially dependent on the incentive structure of agents. In fact, wrong or incomplete information about agents' incentives can be an important source of policy failure. If policymakers do not understand how particular combinations of rules affect actions and outcomes in particular situations, policy changes may produce unexpected and, at times, disastrous outcomes (Ostrom, 2005a).

Overall, the paper aims to highlight the importance of accurate policy designs to improve environmental quality. We show that particularities in the incentive structure of recreational uses of natural resources in the open access determine that tragedy is not the only possible equilibrium. Subsequent discussion on public regulation of uses is build on the basis of the open access model, and therefore it is placed in a context in which there is scope for voluntary action. Results show first, the intuitive finding that when undercompliance costs are lower than non-monetary motivational costs in the open access, regulation might entail lower environmental quality. Second, a more complex result is obtained which shows that when premiums from bribery in a corrupt environment are sufficiently high to neutralize incentives towards "green" differentiation, which were present in the open access, firms follow pooling strategies and extreme equilibria result. And finally, consideration of unregulated firms in destinations - which is a widespread phenomenon in tourism - also makes evident particularities in incentive structures for recreational uses. It is demonstrated that environmental regulation might modify unregulated firms' strategic behavior even though these are not directly affected by regulatory mandates.

The structure of the rest of the paper is as follows: Section two presents some stylized facts on the management of recreational natural resources extracted from empirical evidence. Next, section three develops the model for voluntary environmental contribution by firms exploiting natural resources with recreational purposes under an open access situation. This model combines the industrial economics literature (Brander & Spencer, 1983; Spencer & Brander, 1983; Ulph, 1996, 1997) and the tourism literature (Calveras, 2003, 2007; Calveras & Vera-Hernández, 2005; Candela & Cellini, 2006; Gómez, Lozano, & Rey-Maquieira, 2008; Pintassilgo & Albino, 2007) by including green differentiation as in industrial economics and the positive contribution of environmental quality on firms' prices considered in the tourism literature. Moreover, it extends previous contributions insofar: (i) firms are allowed to be asymmetric; (ii) agents might be motivated to undertake voluntary environmental initiatives due to personal attachment to the region or to positive recognition by the community and; (iv) the model addresses strategic environmental behavior of firms within a destination and not competition between destinations based on environmental concerns. The open access model is extended in section four to introduce the imposition of an environmental standard by governmental agencies. According to empirical evidence, the model considers that public intervention might crowd-out voluntary action. Different sources of imperfect monitoring of compliance are analyzed; namely imperfect detection rates, corruption, and the existence of unregulated firms in the industry. As a result the conditions upon which regulation can lead to lower levels of environmental contribution by tourism firms under command-and-control imposition with respect of open access situations are identified. Lastly, section five concludes and highlights some policy implications.

2 Management of recreational uses of natural resources

Environmental policy increasingly emphasizes the role of voluntary initiatives in a regulatory environment mostly driven by command and control mandates (Andrews, 1998). In OECD countries, this comes from criticism of the effectiveness of command and control regulations as well as an increasing belief in potential cost-efficiency improvements when the industry is given flexibility to select their methods of pollution control (Khanna, 2001). Recreational firms, including tourism firms, can undertake environmental initiatives which reduce environmental pressures associated with the use of natural resources or investments to improve the status of natural assets at the destination[1]. For example, in order to make a better use of the environment as an input, firms may include environmental considerations in their operational management. These are aimed to reduce environmental pressures generated by the firm in its operational processes. This type of initiative includes more efficient use of raw materials, reduction of pollution emissions, greener purchasing, etc. Environmental management systems (e.g., ISO 14001) address this type of environmental efforts, enabling organizations to implement policies and objectives affecting those environmental aspects that the organization can control. Another example would be investments to directly improve the status of the environment. This would include a hotel improving the quality of the beach next to it, a coral reef excursions company cleaning its diving area, etc.

However, policy considerations based on voluntary environmental initiatives has both its defenders and its detractors. Detractors stress the limited potential for such approach. Given their non-mandatory nature, firms must obtain short-term net economic gains from voluntary initiatives to promote "greener" behavior (Andrews, 1998; Rivera, 2002), and these are questioned. There is a broad literature on the "pays to be green" debate, analyzing the existence of such economic gains and derived policy implications (see Claver-Cortés, Molina-Azoín, Pereira-Moliner, & López-Gamero, 2007; Wagner, 2001 for partial reviews of this literature). No consensus has been yet achieved on empirical results and consequently some authors defend public intervention. They argue that under the existence of externalities or common-pool resources it is required an enforceable regime for environmental protection (Andrews, 1998). More specifically, discussions on the management of natural resources for recreational uses related to tourism activities are very much conditioned by a focus on regulatory imposition (Garrod & Fyall, 1998; Hjalager, 1996; Huybers & Bennett, 2003b). However, in general there are two main factors that are largely neglected when public intervention is defended: crowding-out of non-monetary motivational aspects and the difficulty associated with correct monitoring of compliance.

[1] It can be noted that reductions in environmental pressures by the industry will also indirectly derive in improved status of natural resources.

2.1 Crowding-out of non-monetary motivational factors.

The model developed in this paper considers that in the open access situation, where there is no public intervention, players might include non-monetary motivational aspects on their calculation of payoffs in addition to pure rent maximization. In the open access we allow the possibility that players hold information about each other and information about the context in which the social interaction happens. These pieces of information are defended to transform material payoffs of an externally-defined game into an internal game (Cardenas & Ostrom, 2004). This internal game, represented by utility measures rather than monetary payoff, would include: (i) intrinsic motivation and (ii) norms of behavior or shared strategies between the representative players of the game.

The inclusion of intrinsic motivation is supported by Motivational Crowding Theory, which incorporates psychological theories to standard economics and proposes a systematic interaction between extrinsic and intrinsic motivation (Frey & Jegen, 2001). Agents are considered to be intrinsically motivated to perform an activity when one receives no apparent reward except the activity itself (Deci, 1971). In a game theoretic context this is translated to certain players' behavior being partially based on preferences related to how they prefer to behave (disregarding the monetary outcome) and the outcomes they whish to obtain for themselves and possibly also for others (Ostrom, 2005b). This intrinsic motivation may differ between economic agents. For instance, in tourism it is defended that local owners of firms might be more motivated to undertake responsible environmental strategies due to personal attachment to the destination compared with foreign owners (Brohman, 1996; Duffy, 2000; Kusluvan & Karamustafa, 2001; Sekhar, 2003).

In addition to intrinsic motivation, the non-monetary components of the game might be also composed by informal social benefits derived from following certain shared strategies in a community. Cooperation in the management of a natural resource can be positively recognized by other community members using this resource, entitling that user to become part of a group and receive certain privileges as a result (Osés & Viladrich, 2007; Tarui, Mason, Polansky, & Ellis, 2008). According to Osés and Viladrich (2007) users can receive from that group: social inclusion and public consideration, everyday favors and signs of approval that make life easier and more pleasant, moral support in difficult circumstances and, certain bestowals and positions. Following the previous example, it might be assumed that local owners are also more affected by social motivation, since these are more deeply embraced in the destination's community.

However, in our model public intervention can crowd-out non-monetary motivational factors. When the voluntary character of environmental investments is replaced by regulated obligations, intrinsic motivation and/or informal group-oriented motivations might be reduced and eventually disappear. According to Ostrom (2000b), much of the contemporary policy analysis and the policies adopted in many modern democracies crowd out endogenous cooperative behavior. Consistently, the review by Frey and Jegen (2001) presents several laboratory and field experiments studies demonstrating the crowding-out effects of environmental external intervention. Examples are increased egoistic behavior of forest users when a regulatory approach is imposed (Cardenas, Strandlund, & Willis, 2000) and higher compliance with pollution standards that have lower fines for noncompliance (Livernois & McKenna, 1999). In general, it is suggested that external intervention crowds out intrinsic motivation if the affected individuals perceive it to be controlling. In addition, Ostrom (2000b) considers that the prevailing public intervention sends two rather devastating messages to users of common pool resources: first, that only short-term, selfish actions are expected from them; and second, that they do not have the knowledge or skills needed to design appropriate institutions to solve collective-action problems[2].

2.2 Imperfect monitoring of compliance.

This paper considers three main determinants of imperfect monitoring of compliance related to recreational uses of natural resources: (i) imperfect detection rates, (ii) corruption and, (iii) unregulated firms.

First, the model considers imperfect detection rates. These would result from the fact that recreational uses of resources entail environmental impacts which are mostly diffuse and soft in nature. Users might be spread out on a resource which can be large in extension and difficult to observe. Moreover, the type of activities undertaken by users might slightly pressure individually the environmental quality of the resource whilst aggregate impacts might potentially compromise resource's maintenance. Examples would be tropical forest excursions seeking for biodiversity experiences or boat trips to coral reef scenarios for scuba-diving. As a result, observing infractions of regulations and being capable of attributing such infractions to particular users might constitute a difficult task. Ostrom (2000a) defends that imposition of rules by external authorities which can only achieve weak monitoring and sanctioning is the worst management scenario. It discourages the formation of social norms due to crowding-out of non-monetary motivation at the same time that makes it attractive for some players to undercomply and face low expected penalties. Empirical evidence for extractive uses of forest services shows that average individual welfare of players were lower under regulatory regimes than in the absence of external intervention (Cardenas et al., 2000) and that there is very little difference across different levels of penalty when there is imperfect detection of infractions (Cardenas, 2004). The theoretical model developed in this paper provides an explanation of these results.

Second, the model considers the effect of corruption on the monitoring of infractions. Corruption is considered one of the main sources of environmental damage in developing countries (Damania, 2002; Wilson & Damania, 2005). Examining firms in transitional economies in Europe and Central Asia, the World Bank (Anderson & Gray, 2006) has found that natural-resource-exporting countries (as most regions based on nature-tourism are) tend on average to have higher levels of corruption than countries with a more diversified export

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[2] However, it must be recognized that exogenous institutions can also crowd in intrinsic motivation. This would be the case if the individuals concerned perceive it as supportive (Frey et al., 2001), i.e., self-esteem is fostered, and individuals feel that they are given more freedom to act, enlarging their self-determination. Empirical examinations in Costa Rica suggest that in addition to market incentives, adequate institutional pressures may also be necessary conditions for adherence to environmental management systems by hotels in order to promote compliance above and beyond regulated environmental behavior (Rivera, 2004). For the purpose of this research, regulatory intervention is assumed to crow-out voluntary action, as most of the literature supports.

base. This paper considers the particular case of corruption addressed to obtain individualized exceptions or favorable application of rules for firms through bribery of inspectors. Bribery of environmental inspectors has been reported as a frequent activity by around 5% of firms in the World Bank survey of transitional economies (Anderson et al., 2006). In Belize, the inability of the formal state to enforce environmental legislation in the ecotourism industry has been mostly attributed to bribery of government officials (Duffy, 2000). Similarly, Sekhar (2003) reports that corruption at various levels of government in Rajastan, India makes it convenient for the private agencies to ignore environmental regulations. In another Indian region, in Goa, Wilson (1997) describes the incapacity of the government to control building along the coastal strip due to its inefficiency and corruption, resulting on a haphazard and uncontrolled development. Despite the relevance of corruption through bribery, its effects have not been widely addressed by existing environmental policy literature (some examples being Damania, 2002; Wilson et al., 2005), which has mainly focused on the economic and environmental consequences of funding provision to policy makers to shape regulations.

Third, a last source of imperfect monitoring of compliance included in the model is the existence of unregulated firms. There are many tourism destinations where there is an informal tourism economy. The most typical example in this respect is unregulated rural houses not declared for tourism rental. These types of operators are part of the black economy as they do not comply with fiscal requirements. But in addition, and most importantly for this paper, these firms are not subject to monitoring by environmental public agencies, and therefore eventual undercompliance with environmental regulation can not be detected. Consequently, unregulated operators are de facto under an open access institutional framework since they are not subject to environmental regulations at the destination.

3 The model for open access

This section presents a simple game model of the use of natural resources for tourism related activities, based on Blanco et al.(2008). The game considers two representative tourism firms that are potentially asymmetric, hold complete information and undertake single, simultaneous, and independent decisions on recreational uses of natural resources. Available strategies for each player are whether or not to undertake voluntary environmental actions by the means most appropriate to them to achieve a certain level E of environmental improvement. Environmental investments (E) are open to two different interpretations, either more efficient use of natural inputs or direct investments to improve the quality or increase resistance of natural resources to pressures. Payoffs can be asymmetric in the sense that the benefits and costs derived from actions and outcomes can differ for each player, which depend on the environmental strategy selected.

Consistent with evidence found by Kassinis and Soteriou (2003), this contingency of payoffs on environmental strategies does not derive from cost effects, but it is motivated by a demand effect that generates a competitive/comparative advantage for the firms that undertake voluntary environmental actions. Specifically, as Rivera (2002), Huybers et al. (2002b), and the Asia Travel Intentions Survey (2007) defend empirically, this advantage is reflected on increased prices of firms. Therefore, we assume that the price at which player *i* sells its tourism product is equal to:

$$P_i = x + \delta(n_{-i}^g) \cdot d_i + \gamma(n^g) \qquad \text{, for } \forall n^g \geq 0 \text{ and } \forall n_{-i}^g \geq 0 \qquad (1)$$

Where *x* is a part of the price which is independent of environmental actions and d_i={0,1} is a dummy variable, which is equal to 1 when the firm undertakes voluntary initiatives and 0 when the firm does not. Minimum attributes to define $\delta(n_{-i}^g)$ and $\gamma(n^g)$ are,

$$\delta(n_{-i}^g) = \begin{cases} z_i \geq 0 & \text{if } n_{-i}^g = 0 \\ 0 \leq \delta(\cdot) \leq z_i & \text{if } 0 < n_{-i}^g < N-1 \\ 0 & \text{if } n_{-i}^g = N-1 \end{cases} \qquad \text{, and } \frac{d\delta(\cdot)}{d(n_{-i}^g)} < 0$$

$$\gamma(n^g) = 0 \qquad \text{if } n^g = 0 \qquad \text{, and } \frac{d\gamma(\cdot)}{d(n^g)} \geq 0$$

On one hand, when player *i* (*i*={1,2}) undertakes voluntary environmental actions it is capable of charging an extra price, $\delta(\cdot)$, with respect to the other firms at the destination due to its environmental differentiation. This $\delta(\cdot)$ differential is always positive for firms improving their environmental performance and diminishes with the number (n_{-i}^g) of other firms at the tourism destination undertaking voluntary environmental actions. On the other hand, environmental initiatives by player *i* might increase the quality of local public goods or common pool resources that are part of the tourism experience, and in this way may have a positive effect on tourism prices. Due to the non-excludability of these types of resources, other firms can also partially take advantage of it. Then, all the tourism firms using that natural resource may charge extra, $\gamma(\cdot)$, for their products with respect to other tourism products of firms at the same or at different destinations. $\gamma(\cdot)$ is independent of d_i, which implies that all firms using the natural resource will benefit from an increased price independent of who is making the environmental contribution.

Utility of firms exploiting recreational services of natural resources in the region might include motivational preferences in addition to self-interested utility maximizing. Either intrinsic motivation or group pressures as explained in section 2 derive in increased payoffs from undertaking voluntary environmental investments with respect to not doing so. Therefore, a parameter β_i is introduced into agents' utility functions which enter additively when undertaking environmental investments, and includes the specific case where non-economic motivation has no sizeable effect ($\beta_i \geq 0$).

A payoff function for players can be constructed as follows:

$$U_i = q_i\left[x + \delta(n_{-i}^g) \cdot d_i + \gamma(n^g)\right] - c_i \cdot d_i - co + \beta_i \cdot d_i \qquad \text{for } \beta_i \geq 0 \qquad (2)$$

where q_i is the quantity produced by the *i*-th firm that, for simplicity, is assumed to be one, c_i is the cost to undertake the environmental initiatives, and *co* are other costs that are independent of environmental behavior. This specification shows that only firms undertaking voluntary efforts (d_i=1) incur in environmentally related costs (c_i), which will be specific to each firm, and might obtain intrinsic rewards (β_i). Given equation 2, asymmetries can arise from differences in parameter values. For simplicity we rule out asymmetries in *x* and *co*, but allow for differences in $\delta(\cdot)$, $\gamma(\cdot)$,c_i; and β_i. A simple linear functional form has been used to represent the effect of $\gamma(\cdot)$ to reduce the complexity of the notation, $\gamma(n^g) = \gamma_i \cdot n^g$, $\gamma_i \geq 0$. The normal form representation of the resulting game for recreational uses of natural resources is presented in figure 1 where payoffs for (NG, NG) have been normalized to (0,0).

Insert figure 1.

In this game necessary and sufficient condition to avoid tragedy equilibria, i.e. for at least one of the firms to undertake voluntary environmental contributions in equilibrium is:

Condition I^{open}: $c_i < \gamma_i + z_i + \beta_i$ for i=1 and/or 2

According to condition I^{open}, the competitiveness improvement that stems from the environmental actions that firm *i* undertakes to differentiate itself from other firms at the destination (generating a $\delta(\cdot)$ and $\gamma(\cdot)$ effect), jointly with its non-economic motivation, compensate their implementation costs.

In addition, a necessary and sufficient condition to guarantee that full cooperation is achieved in equilibrium can also be defined as:

Condition II^{open}: $c_i < \gamma_i + \beta_i$ for i= 1 and 2

According to condition II^{open}, increases in price for firm *i* resulting from a "green" behavior that does not contribute to differentiation (when both firms undertake environmental investments, therefore only generating a $\gamma(\cdot)$ effect) and which generates non-economic motivation, still compensate for the extra costs. Since whenever condition II^{open} is met, condition I^{open} holds for i= 1 and 2, condition II^{open} implies that both firm 1 and firm 2 have dominant strategies to follow "green" strategies, i.e. to undertake voluntary environmental investments in equilibrium.

Empirical evidence (Kassinis et al., 2003; Parra, García, & Guitiérrez, 2004; Rivera, 2002) shows situations where those firms that undertake voluntary environmental contributions perform better in pure economic terms (without considering non-economic motivations) than those that do not. In our game setting this would imply that:

$$z_i + \gamma_i - c_i > \gamma_{-i} \quad \text{for } i=1 \text{ and/or } 2 \qquad (3)$$

That is, extra profits from environmental actions that accrue to contributing firms are higher than non-contributing firm's gains from free riding behavior. It can be noted[3] that equation 3 implies condition I^{open}. Therefore empirical evidence supporting equation 3 shows condition I^{open} as a reasonable possibility for both firms. Note that all these considerations stand for values of β_i=0 and the transformation of the game to include non-economic motivations only reinforces the validity of non-tragedy outcomes as it expands the range of values of firms' abatement costs for which firms voluntarily contribute to environmental conservation.

This result should not be interpreted as a claim of the existence of an "invisible hand" that would lead actors behaving selfishly to achieve social optimum outcomes. First, there is no evidence that contribution of *E* units of environmental quality by firms coincide with the social optimum. Second, empirical literature on management of natural resources for tourism uses is still scarce and, therefore, we cannot know yet how general are non-tragedy outcomes. Results may be specific for the upper level accommodation establishments under analysis, the type of environmental management

[3] If $z_i + \gamma_i - c_i > \gamma_{-i}$, taking into consideration that $\gamma_{-i} \geq 0$, then necessarily $z_i + \gamma_i - c_i > 0$ and therefore $z_i + \gamma_i + \beta_i - c_i > 0$.

practices considered (mostly operational management), the weak intensity of the environmental practices under study, or the nature-based character of the tourism destinations to which firms analyzed belong. Even so, this section has shown that for recreational uses of natural resources by tourism operators an alternative empirically founded game to a prisoner dilemma can be designed where non-tragedy outcomes can arise under reasonable restrictions on the parameter values.

4 The model for Public Intervention

This section aims to evaluate repercussions on firms' environmental behavior resulting from command-and-control intervention by a regulatory agency on non-extractive uses of natural resources by tourism operators. The objective of the external regulator is to design a standard that induces firms to approach to certain environmental targets. For comparability purposes with section 3 let us assume that a government agency introduces an environmental standard which requires firms to undertake environmental investments to achieve an E level of environmental improvement or otherwise a fine f will be imposed on them. When setting the standard, the government is assumed to have incomplete information. It only observes overall values of material payoffs. Therefore it ignores components of payoffs and does not consider non-economic motivational components of the firms' utility.

The introduction of a standard forces the government to include a new player into the game. As in Damania (2002) the regulator cannot directly observe the behavior of firms and therefore employs an environmental inspector to monitor investment levels. All three agents, the two firms and the inspector, have complete information and undertake single, simultaneous, and independent decisions. Since the primary interest of this paper is not on reward schemes to inspectors to favor monitoring, for simplicity and realistic description the inspector receives a fixed wage from the regulator which after incorporating costs of monitoring and the opportunity costs of alternative tasks derives in net wage w. This net wage is assumed to be positive and therefore inspectors are sufficiently rewarded as to induce them to monitor.

This section comprises three applications of such a standard. In the baseline case we assume the simple situation in which detection rates may be imperfect. The second part allows for corruption on monitoring. That is to say, inspectors might show self-interested behaviors to exploit delegate powers for personal gain through bribes. Finally, the third part analyzes the existence of unregulated firms offering their leisure products related to nature activities in the black economy.

4.1 The public intervention baseline case

The baseline case of public intervention modifies the open access model by including an expected fee from undercompliance of the environmental standard jointly with the dissipation of non-monetary motivations (as explained in section 2.1) [4].

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[4] In addition, the introduction of an environmental standard could entail an increase in abatement costs. In the open access situation firms are capable of making use of a wide array of abatement methods which provide a flexible abatement costs structure, whereas environmental regulations have been alleged to entail inflexible abatement mechanisms leading to increased costs of compliance (Johnston, (2004).

A common and realistic assumption in models is to recognize that inspectors are not capable to perfectly monitor firms' environmental behavior. Therefore the model considers a certain probability α ($1 \geq \alpha \geq 0$) of detection of undercompliance. As a result fines have a lower repercussion on firms' strategic decisions, since expected fees are lower ($f^e = \alpha f$; $f^e < f$). After the Standard is introduced, the utility function of firms is expressed in equation 5, and figure 2 presents the derived normal form representation of the game:

$$U_i = \Pi_i = q_i\left[x + \delta(n^g_{-i}) \cdot d_i + \gamma(n^g)\right] - c_i \cdot d_i - co - f^e \cdot (1 - d_i) \qquad (5)$$

Resulting equilibrium conditions (I,II)[standard,m] are as follows:

Condition I[standard,m]: $c_i < \gamma_i + z_i + f^e$ for i= 1 and/or 2

Condition II[standard,m]: $c_i < \gamma_i + f^e$ for i= 1 and 2

It can be easily seen that a sufficient condition for the standard not worsening environmental contributions is:

$$f^e > \beta_i \quad \text{for} \, \forall i \qquad (6)$$

That is, for a successful policy the governmental agency must take into consideration that fines not only need to enhance the incentives to follow green strategies by firms which did not undertake voluntary action in the open access (which was the original motivation of the standard) but additionally that expected costs of fines need to compensate crowding-out of non-monetary motivational incentives by public intervention. Put in a different way, if the expected penalty for undercompliance is not high enough, crowding-out of non-monetary motivations by the standard might generate lower environmental provision[5].

Provided that (6) is satisfied, the standard will effectively induce a better environmental behavior for certain particular values of abatement costs[6]. It should be noted that it can also be the case that intrinsic rewards are different among firms so that $\beta_i > f^e > \beta_{-i}$,where firm i could be for example a local-owned firm while firm $-i$ could be a foreign-owned firm. In this case the standard would improve environmental contributions in equilibrium for certain abatement costs[7] while it would worsen environmental contributions for others[8].

The increase abatement costs due to the introduction of an environmental standard would only strengthen the effect derived from the opportunity costs of loosing β_i.

[5] Whenever abatement costs are set within the ranges $c_i \in (\gamma_i + f^e, \gamma_i + \beta_i) \cap c_{-i} < \gamma_{-i} + \beta_{-i}$ and/or $c_i \in (\gamma_i + z_i + f^e, \gamma_i + z_i + \beta_i) \cap c_{-i} > \gamma_{-i} + z_{-i} + f^e$, the introduction of a standard whose fee does not meet equation 6 entails lower contributions in equilibrium with respect to the open access situation.

[6] $c_i \in (\gamma_i + \beta_i, \gamma_i + f^e) \cap c_{-i} < \gamma_{-i} + f^e$ or $c_i \in (\gamma_i + z_i + \beta_i, \gamma_i + z_i + f^e) \cap c_{-i} > \gamma_{-i} + z_{-i} + \beta_{-i}$

[7] $c_{-i} \in (\gamma_{-i} + \beta_{-i}, \gamma_{-i} + f^e) \cap c_i < \gamma_i + f^e$ or $c_{-i} \in (\gamma_{-i} + z_{-i} + \beta_{-i}, \gamma_{-i} + z_{-i} + f^e) \cap c_i > \gamma_i + z_i + \beta_i$

[8] $c_i \in (\gamma_i + f^e, \gamma_i + \beta_i) \cap c_{-i} < \gamma_{-i} + \beta_{-i}$ or $c_i \in (\gamma_i + z_i + f^e, \gamma_i + z_i + \beta_i) \cap c_{-i} > \gamma_{-i} + z_{-i} + f^e$

These results of our modeling setting would explain Cardenas et al. (2000) empirical evidence showing that some environmental regulations that standard theory predicts to induce increased environmental preservation do not have a sizeable effects on average choices with respect to open access. This may be due to fees in the experiments do not meeting equation 6, since authors attribute their result to subjects tending toward purely self-interested behavior when confronted with a regulatory constraint, while undertaking choices significantly more group-oriented (that is, showing non-monetary motivations) in the absence of regulatory control. Moreover, the model can explain empirical results of Cardenas (2004) showing very little difference in average pressures on a resource across weak (f^{e}_{low}) and strong (f^{e}_{high}) enforcement of environmental regulation. According with our model, expending public resources to improve detection rates or enhancing the values of fees, would only improve environmental choices in equilibrium for certain values of abatement cost[9]. For any other combination of abatement costs, necessary investments to increase enforcement of regulations would not be compensated by any improvement of the environmental situation in equilibrium.

4.2 Corruption

Inspired in Wilson and Damania (2005) principal-agents model of administrative corruption, this section extends the model of public intervention to consider corruption addressed to obtain individualized exceptions or favorable application of regulations for firms through bribery of inspectors.

The resulting game is as follows: in the fist step each firm decides whether to comply or not with the environmental standard. In the second step firms which have undercomplied with the standard can simultaneously and independently offer a bribe (B_i) to the inspector to induce her to pass over their respective sanction, or otherwise face a certain expected fine. In the third step the inspector can either accept bribes and do not monitor bribing firms or reject them and monitor as usual[10]. And lastly, in the forth step the government can commission an audit to deter non-compliance. In case of an audit, with a certain probability λ corruption is uncovered and leads to a successful prosecution of bribing firms and the inspector with penalties p and P respectively [11].

Solving by backward induction, in third step an inspector would be ready to accept a bribe when she expects a positive gain from corrupt behavior ($\Psi^m>0$). Monitors will compare its expected payoffs from accepting bribes (the term inside square brackets in equation 7) with its payoff aside of corruption (w).

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[9] Within the ranges $c_i \in \left(\gamma_i + f^{e}_{low}, \gamma_i + f^{e}_{high}\right) \cap c_{-i} < \gamma_{-i} + f^{e}_{high}$; or $c_i \in \left(\gamma_i + z_i + f^{e}_{low}, \gamma_i + z_i + f^{e}_{high}\right) \cap c_{-i} > \gamma_{-i} + z_{-i} + \beta_{-i}$.

[10] It is assumed that bribing behavior can not be used by the inspector as a signal of environmental compliance of firms and therefore, in case of rejection of a bribe offered, a firm faces the same expected fine as if no bribe was offered (monitoring intensity does not change).

[11] According to Wilson and Damania (2005) the probability of successful prosecution after an audit is initiated (λ) captures (i) the ability of the policy maker to detect cheating and (ii) the ability of the legal system to convict guilty offenders, i.e. the efficiency of the judiciary.

$$\psi^{m} = \left[w + \sum_{i} B_i - P^e \right] - w \qquad \text{for } B_i \geq 0 \text{ and } P^e = \lambda P \qquad (7)$$

Corrupt behavior by the inspector would result in positive gains for her whenever bribing income is higher than the expected value of punishment for illegal behavior. As a result, condition B^m is a necessary condition for emergence of corruption:

Condition B^m: $\sum_i B_i > P^e$

In the second step firms are in predisposition to offer a bribe to the inspector when there are positive expected gains from bribery. Therefore, firms compare expected payoffs from uncorrupt behavior (equation 8.a) with that of corrupt behavior (equation 8.b).

$$U_i^e = \Pi_i^e = q_i \left[x + \delta(n_{-i}^g) \cdot d_i + \gamma(n^g) \right] - k_i \cdot d_i - co - f^e \cdot (1 - d_i) \qquad (8.a)$$

$$U_i^e = \Pi_i^e = q_i \left[x + \delta(n_{-i}^g) \cdot d_i + \gamma(n^g) \right] - k_i \cdot d_i - co - (B_i + p^e) \cdot (1 - d_i) \qquad (8.b)$$

where $p^e = \lambda p$

where, resulting premium from bribery for firm *i* (ψ_i^f) is:

$$\psi_i^f = f^e - (B_i + p^e) \qquad (9)$$

Then, expected gains from corrupt behavior for a firm depend on the expected value of undercompliance (f^e) and the expected cost of bribery ($B_i + p^e$). Note that the premium from bribery does not depend on the value of profits obtained by the firms but only on the change in payoffs resulting when switching to corrupt behavior once undercomplied with the standard. An undercompliant firm will be willing to bribe whenever $\psi_i^f > 0$, as expressed in condition B^f.

Condition B^f: $B_i < f^e - p^e$ for $B_i > 0$

Therefore, undercompliant firms have identical incentives to offer bribes to inspectors. Whenever $f^e > p^e$ firms are willing to offer a positive bribe [12]. Consequently, condition B^f is also a necessary condition for corruption to emerge.

If and only if conditions B^m and B^f hold simultaneously, corruption arises. Given B^m and B^f are met, the game has two different scenarios: when firms can corrupt the inspector in isolation (scenario 1); and when only combined bribery by both firms reaches enough magnitude to corrupt the inspector (scenario2).

Scenario 1

Firms are capable to induce corruption unilaterally when the bribe that each firm is willing to offer meets itself both conditions B^m and B^f, that is, $f^e - p^e > B_i > P^e$. The normal form of this scenario is represented in figure 3.a..

Insert figure 3.a

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[12] Despite willingness to offer bribes are equal for both firms when they do not comply, it is maintained the possibility that the actual bribe being paid differs for each firm. Conditions B^f and B^m set a range of values of B_i which generate corruption but do not determine the actual bribe paid by each firm. Depending on the mechanism upon which the actual payment by each firm is determined, final values of B_i can be asymmetric, influencing on that result firm's negotiating power, its profits or alike.

When each firm is capable of bribing in isolation, equilibrium conditions are:

Condition I[corruption1]: $c_i < \gamma_i + z_i + B_i + p^e$ for i= 1 and/or 2

Condition III [corruption1]: $c_i < \gamma_i + B_i + p^e$ for i= 1 and 2

In this game, the cost of bribery just substitutes for the expected fee and, therefore, the game is qualitatively identical to the baseline one once equation 6 is substituted for the following one:

$$B_i + p^e > \beta_i \quad \text{for } \forall i \tag{10}$$

Scenario 2

More interesting results can be obtained if firms are not capable to corrupt the inspector in isolation. It can be the case that the threat of punishment by the government to corrupt inspectors through auditing makes the inspector demanding so high bribes to become corrupt that single firms can not offer enough bribes in isolation ($P^e > B_i$) and only combined bribes from both firms can corrupt the inspector ($\Sigma B_i > P^e$). The resulting game of this scenario is presented in figure 3.b.

Insert figure 3.b

Now, equilibrium conditions (I,II) are not equally modified with respect to the open access situation.

Condition I [corruption2]: $c_i < \gamma_i + z_i + B_i + p^e$ for i= 1 and/or 2

Condition II [corruption2]: $c_i < \gamma_i + f^e$ for i= 1 and 2

Depending on the relative magnitude of the gains for firms to differentiate upon “green” behavior (z_i) and the premium from bribery three different possible equilibria arise

Equilibria pattern 2.1: $f^e - (B_i + p^e) < z_i, \ \forall i$

When the premium from bribery is lower than potential gains for players for “green” differentiation the expected cost of bribery becomes relevant to determine the possibility of tragedy outcomes while the fee influences the emergence of full compliance results. Specifically, the standard reduces the range of values for which full cooperation can be achieved if the expected fee is small (condition 6 is not met) and it amplifies the tragedy scenarios if the expected cost of bribery is small (condition 10 is not met)[13].

Equilibria pattern 2.2: $f^e - (B_i + p^e) > z_i, \ \forall i$.

Second, when incentives resulting from firms’ “green” differentiation are weaker than those derived from potential premiums from bribery, the structure of equilibria varies substantially. Restrictiveness of conditions (I,II) switch, and

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[13] If $\beta_i < B_i + p^e$ for $\forall i$, non-tragedy results are expanded for values of $c_i \in (\gamma_i + z_i + \beta_i, \gamma_i + z_i + B_i + p^e) \cap c_{-i} > \gamma_{-i} + z_{-i} + \beta_{-i}$; if $\beta_i > B_i + p^e$ for $\forall i$, tragedy is expanded for values of $c_i \in (\gamma_i + z_i + B_i + p^e, \gamma_i + z_i + \beta_i,) \cap c_{-i} > \gamma_{-i} + z_{-i} + B_{-i} + p^e$; finally, if $\beta_i > B_i + p^e$ and $\beta_{-i} < B_{-i} + p^e$, non-tragedy is expanded for $c_{-i} \in (\gamma_{-i} + z_{-i} + \beta_{-i}, \gamma_{-i} + z_{-i} + B_{-i} + p^e) \cap c_i > \gamma_i + z_i + \beta_i$ and tragedy is enlarged for $c_i \in (\gamma_i + z_i + B_i + p^e, \gamma_i + z_i + \beta_i) \cap c_{-i} > \gamma_{-i} + z_{-i} + B_{-i} + p^e$.

now whenever condition I ^{corruption2} holds for any firm, condition II ^{corruption2} holds for that firm. Consequently, it is easier to achieve equilibria where both firms follow the same strategy than these where only one of the firms complies. This is the case because now (under)compliance is either the result of firms' dominant strategies to (under)comply, i.e. conditions I and II ^{corruption2} (do not) hold, or of firms' *induced* (under)compliance.

For a firm to show *induced* behavior it is necessary that condition II ^{corruption2} holds but that condition I ^{corruption2} does not for this firm. Under this situation, firms' strategic behavior change with respect to previous sections. Now, given that the other firm does not comply, a firm's incentive to differentiate by becoming "green" is no longer relevant, since the cost of compliance (c_i-γ_i-z_i) is higher than that of bribing the inspector (condition I ^{corruption2} does not hold). Further, given that the other firm complies, the *induced* player complies too. As condition II ^{corruption2} is satisfied, it is cheaper for the firm to comply and enjoy increased environmental quality (c_i -γ_i) than to face the expected fee, which is the cost of undercompliance in isolation[14].

The result is that, when comparing the equilibria pattern in this section to the open access case, it can be seen that pooling equilibria result for wider ranges of abatement costs. Not meeting equation 6 by any firm is a sufficient condition for the standard to generally induce undercompliace by both firms; even for values of abatement costs for which full cooperation was present in the open access[15]. This is a remarkably relevant result: when environmental standards for recreational uses of natural resources is not sufficiently enforced and potential gains from corrupt behavior are significant, tragedy might replace full cooperation as the resulting outcome. On the contrary, equation 10 is sufficient for public intervention to expand full cooperation. That is to say, since there are significant premiums from bribery at the same time that the cost of corruption is higher than non-monetary motivations were, firms undertake environmental contributions for wider values of parameters.

In addition to these comments, it is particularly noteworthy to mention that when both firms undertake *induced* behavior two equilibria in pure strategies emerge where either both firms comply or both firms undercomply. Therefore, firms are indifferent between full compliance and tragedy outcomes. According to Camerer (2003) a mixed-strategy equilibrium can be interpreted as reflecting a certain population (in this case nature-tourism regions) where half the players (regions) always choose to invest in environmental improvements and the other half do not. This finding can thus be an explanation of opposite results from environmental management of natural resources for recreational uses related to tourism in different regions which are similar in regulatory contexts and on the industry structure (similar value of parameters): in some of these regions all firms engage in tragedy strategies whereas in other regions all firms comply with environmental standards.

Equilibria pattern 2.3: $f^e - (B_i + p^e) > z_i$ and $f^e - (B_{-i} + p^e) < z_{-i}$.

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14 $f^e > c_i - \gamma_i$

15 Note that this extreme shift from full cooperation in the open access to full undercompliance after the standards is introduced was not possible in previous sections.

Third, when premium from bribery is large for one of the firms with respect to potential gains from "green" differentiation (let us assume without any loss of generality that this happens for player 1) whereas it is small for the other firm (player 2) a different pattern of equilibria emerges. In this case condition II ^{corruption2} is stricter (less strict) than condition I ^{corruption2} for firm 1 (firm 2). As a result, there are situations in which player 2 shows *induced* behavior (condition II ^{corruption2} holds only for firm 2 while condition I ^{corruption2} does not) and others in which player 1 shows *discouraged* behavior (condition I ^{corruption2} holds while condition II ^{corruption2} does not).

Discouraged behavior entails that, as condition I ^{corruption2} holds for firm 1, the costs of compliance (c_i-γ_i -z_i) is smaller than the expected cost of bribery, so the firm prefers to comply if the other player undercomplies. Put in a different way, firm 1 prefers to comply with the standard to obtain the price premium from "green" differentiation (z_i) rather than saving abatement costs and bribe inspectors. But if the other firm complies, the *discouraged* player prefers to undercomply, as condition II ^{corruption2} implies that the costs of compliance when it does not entail "green" differentiation in the region (c_i -γ_i) is higher than facing a certain probability of being fined, which is the cost of undercompliance in isolation.

The fact that now not all firms follow *induced* behavior but that some follow *discouraged* behaviors determines that pooling equilibriums are not so widely present. As in equilibria pattern 2.2, tragedy results are widely expanded for *induced* players (firm 2) whenever equation 6 is not met for that firm; even switching from full cooperative results in the open access. And on the contrary, full compliance is boosted if equation 13 is met by firm 2. Regarding firm 1, not meeting equation 6 reduces full cooperation while it is not meeting equation 13 which determines expansion of tragedy results. In any case, when compared with equilibrium pattern 2.2, appearance of *discouraged* behavior amplifies the ranges of values for which at least one of the firms complies in equilibrium.

Quite interesting, this pattern of equilibria generates a range of values of abatement costs for which no equilibrium in pure strategies exist due to the opposite behavior of both players. When firm 1 follows *discouraged* strategies at the same time that firm 2 follows *induced* ones the result is one equilibrium in mixed strategies where none of the players is totally predictable. In this equilibrium firm 1 defeats with the environmental standard more often than not while firm 2 follows compliance strategies more usually. The actual probabilities of following each strategy depend on the relation between the parameters of the game.

4.3 Unregulated tourism operators

An alternative context which can induce to imperfections in monitoring of environmental standards for recreational uses of natural resources is where unregulated firms operate. Unregulated firms are not subject to monitoring by environmental public agencies, and therefore eventual undercompliance with environmental regulation can not be detected. Consequently, unregulated operators are de facto under an open access institutional framework since they are not subject to environmental regulations. Conventional game theory would suggest that as a result, unregulated firms will free-ride on compulsory environmental provision by regulated firms. However, as demonstrated in section 3, there are values of the parameters for which players under open access situations voluntarily engage in activities to improve the environment.

Taking this result into consideration a scenario where the introduction of an environmental standard crowds-out environmental behavior of agents can be built. Let us present an open access situation such as that in section 3. Let us assume that the values of the parameters for each firm are such that condition I^{open} holds only for one of the firms (let us assume that is for firm 1) while condition II^{open} does not for any firm. This combination of conditions determines that firm 2 has a dominant strategy to do not make environmental investments whereas firm 1 has no dominant strategy. Given that player 2 has a dominant strategy, the only relevant condition for firm 1 is condition I^{open}, which determines its preferred strategy contingent on firm 2 not undertaking environmental standards. Since for firm 1 green differentiation (z_i) jointly with the environmental quality provided at the destination (γ_i) compensates abatement costs (c_i), firm 1 will voluntarily make investments to improve the environmental quality at the destination.

Let us further assume that firm 1 is an unregulated firm that does not report its economic activity to the government while firm 2 is legal and subject to governmental mandates on operations. Let us now consider that governmental agencies introduce an environmental standard such as presented in section 4.1. Under the scenario presented in this section, the environmental regulation affects only firm 2, and therefore payoffs for each firm become:

$$U_1 = \Pi_1 = q_1\left[x + \delta(n_{-i}^g)\cdot d_1 + \gamma(n^g)\right] - c_1 \cdot d_1 - co + \beta_1 \cdot d_1 \quad (11)$$

$$U_2 = \Pi_2 = q_2\left[x + \delta(n_{-i}^g)\cdot d_2 + \gamma(n^g)\right] - c_2 \cdot d_2 - co - f^e \cdot (1 - d_2) \quad (12)$$

The normal form representation of the resulting game is represented in figure 4[16]. And resulting equation conditions where there are unregulated firms are:

Condition $I^{unregulated}$: $c_1 < \gamma_1 + z_1 + \beta_1$

$c_2 > \gamma_2 + z_2 + f^e$

Condition $II^{unregulated}$: $c_1 < \gamma_1 + \beta_1$

$c_2 > \gamma_2 + f^e$

Insert Figure 4

As a result, when the threat of the sanction is sufficient to induce firm 2 to undertake invest in environmental quality (equation 6 being met only for firm 2), the relevant decision of firm 1 is its environmental behavior contingent on firm 2 complying with the standard, i.e. condition $II^{unregulated}$ (which is equal to condition II^{open}). As previously mentioned it has been assumed that condition II^{open} does not hold for firm 1 and therefore, after the standard is introduced firm 1 no longer undertakes environmental initiatives.

Therefore, introducing an environmental standard under this context would induce a shift on the firms undertaking environmental initiatives. The aggregate environmental quality at the destination does not improve while payoffs for both firms are reduced. This is a highly relevant result insofar it stands even relaxing some of the assumptions of the model: for situations where firms are not considered to be non-economically motivated to undertake

[16] When monitoring is not sufficiently rewarded (w<0), the game does not change with respect to the open access situation for both firms. Note that in this case β_i are not considered.

environmental protection (β_i=0); and perfect detection rates (α=0) are achieved by inspectors. Moreover, it is based on a widespread situation in tourism, that is to say, the existence of unregulated firms. Considering β_i>0 and/or 1<α<0 strengthens this result.

This section models a situation defended by Ostrom (2000b) to exist, where public intervention transforms what has been a de facto community property into government property, which in turn might become a de facto open access under weakly enforced government-imposed regulation.

5 Conclusion

This paper has developed a game theoretic model to analyze environmental policy for the management of recreational natural resources. It has been first presented an open access game where tourism firms decide whether or not to undertake voluntary environmental contributions to preserve natural resource in the region. We show that an alternative empirically founded game to a prisoner dilemma can be designed where non-tragedy outcomes can arise under reasonable restrictions on the parameter values. Since the outcomes resulting from environmental policies are critically dependent on the incentive structure of agents, considering the possible existence of incentives for private agents to implement voluntary environmental actions becomes crucial.

This is proven by shifts in equilibrium selection of agents after a standard is introduced. Public intervention can result in lower environmental quality when the government does not consider that moving from voluntary to compulsory environmental behavior might crowd-out non-monetary motivation for voluntary initiatives and that imposition is not perfect. Firms which are affected by the regulation decide their environmental strategy based on expected fees from undercompliance or on expected costs of bribery; whatever is cheaper. In addition, under certain scenarios of corruption, firms modify their selection of best strategies and converge to pooling equilibria. This is the case when incentives to "green" differentiation by firms which were present in the open access are surpassed by premiums from bribery in highly corrupt environments. Consequently, potential improvements or detriments of environmental quality resulting from government's intervention are more intense. In addition, this paper has considered the existence of unregulated firms, which are widely extended in the tourism industry. It is shown that firms operating in the black economy, which by definition are not affected by regulations, might modify their environmental behavior as a result of strategic decisions after a standard affects competing firms.

If regulations are to be designed to better consider voluntary self-regulation by the industry it is necessary that these key factors are considered. Since corporate environmental performance is gaining prominence among business leaders, academics, investors, and governments (Andrews, 1998), public agencies should design their policies taking into account potential voluntary action. As Marshall (2005) states this alternative entails the government reinventing itself such that it complements rather than displaces or absorbs self-organizing capacities at smaller levels of social interaction. To do so, the government needs to understand incentive structures of agents and modification of them derived from public intervention. In fact, wrong or incomplete information about agents' incentives can be an important source of policy failure. Policies may change the contextual factors in which the firms operate without controlling the consequences. This is why it is necessary for environmental policy at tourism destinations to consider: in first place, the possible existence of incentives for private agents to implement voluntary environmental actions; and in second place, that public intervention modifies firms' strategic environmental decisions.

Several aspects still remain unclear in the literature on governance structures for environmental policy at nature-based tourism regions. Future research in this area should first require a meta-analysis of the case studies of voluntary environmental initiatives at tourism destinations. This can provide researchers with the regularities of the institutions within both successful and failed initiatives and the differences between them. By comparing the rules that are present in successful scenarios with those in failure situations, the critical mechanisms that determine outcomes in open access may be identified. Second, other specifics of consumer services in general and the tourism industry in particular that have not been analyzed in this paper should be considered in order to extend the literature about the institutional management of natural resources to tourism. As an example, the existence of tour operators as intermediaries between the demand and supply of the industry conditions the market factors and competition, introducing principal agent strategic incentives in addition to strategic environmental behaviors. The soft environmental pressures generated by tourism are relevant for future analyses and are comparable to pressures introduced by residents, increasing the importance of simultaneously considering the environmental behavior of the industry and residents. Along with these, the close interaction between production and consumption, the perishability of services, the heterogeneity of firms in the tourism industry means that an extension of the literature on the institutional management of natural resources to tourism settings is not straightforward. And finally, further analyses on limitations of public intervention on recreational natural resources would be valuable. Here we have explored implications from imperfect detection rates motivated by environmental impacts which are mostly diffuse and soft in nature on a resource which can be large in extension and difficult to observe, but other factors could also be explored. Uncertainty on effects related to climate change on natural resources with tourism appeal or conflicting uses with extractive activities which generate different pressures on resources are only two examples of other possible extensions of research.

References

Albrech, J. (1998). *Environmental regulation, comparative advantage and the Porter Hypothesis* (Vol. 59): Fondazione Eni Enrico Mattei

Alegre, J., & Cladera, M. (2006). Repeat visitation in mature sun and sand holiday destinations. *Journal of Travel Research*, 44, 288-297.

Alegre, J., & Juaneda, C. (2006). Destination loyalty: Consumers' economic behavior. *Annals of Tourism Research*, 33 (3), 648-706.

Alegre, J., & Pou, L. (2003). El turismo de sol y playa desde la perspectiva de los consumidores Europeos. Un nuevo desafío en el desarrollo turístico de Baleares. In *Serie Estudios Regionales Islas Baleares* (pp. 149-176): Servicio de Estudios BBVA.

Anderson, J., & Gray, C. (2006). *Anticorruption in transition 3: Who is succeding and why?* World Bank.

Andrews, R. (1998). Environmental regulation and business `self-regulation´. *Policy Sciences*, 31, 177-197.
Blanco, E., Rey-Maquieira, J., & Lozano, J. (2008). Economic Incentives for Tourism Firms to Undertake Voluntary Environmental Management. *Tourism Management*, forthcoming.
Brander, J. A., & Spencer, B. J. (1983). Strategic commitment with R&D: the symmetric case. *The Bell Journal of Economics*, 14 (1), 225-235.
Brohman, J. (1996). New directions in tourism for third world development. *Annals of Tourism Research*, 23 (1), 48-70.
Butler, R. W. (1980). The concept of a tourist area cycle of evolution: implications for management of resources. *Canadian Geographer*, 24 (1), 5-12.
Calveras, A. (2003). Incentives of international and local hotel chains to invest in environmental quality. *Tourism Economics*, 9 (3), 297-306.
Calveras, A. (2007). Expansion of a hotel chain and environmental quality. *Investigaciones económicas*, XXXI (2), 263-295.
Calveras, A., & Vera-Hernández, M. (2005). Quality externalities among hotel establishments: What is the impact of tour operators? *Tourism Economics*, 11 (4), 571-593.
Camerer, C. (2003). *Behavioral game theory: Experiments in strategic interaction*. New Jersey: Princeton University Press, (Chapter 3).
Candela, G., & Cellini, R. (2006). Investment in tourism market: a dynamic model of differentiated oligopoly. *Environmental and Resource Economics*, 35, 41-58.
Cardenas, J. (2004). Norms from outside and from inside: an experimental analysis on the governance of local ecosystems. *Forest Policy and Economics*, 6, 229-241.
Cardenas, J., & Ostrom, E. (2004). What do people bring into the game? Experiments in the field about cooperation in the commons. *Agricultural Systems*, 82, 307-326.
Cardenas, J., Strandlund, J., & Willis, C. (2000). Local environmental control and institutional crowding-out. *World Development*, 28 (10), 1719-1733.
Clarkson, P. M., Li, Y., & Richardson, G. D. (2004). The market valuation of environmental capital expenditures by pulp and paper companies. *The accounting review*, 79 (2), 329-353.
Claver-Cortés, E., Molina-Azoín, J. F., Pereira-Moliner, J., & López-Gamero, M. D. (2007). Environmental strategies and their impact on hotel performance. *Journal of Sustainable Tourism*, 15 (6), 663-679.
Damania, R. (2002). Environmental controls with corrupt bureaucrats. *Environment and Development Economics*, 7, 407-427.
Davies, T., & Cahill, S. (2000). *Environmental implications of the tourism industry*: Resources for the Future,
Deci, E. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*, 18 (1), 105-115.
Dodds, R., & Joppe, M. (2005). *CSR in the tourism industry? The status of and potential for certification, codes of conduct and guidelines*. I. C. Department, International Finance Corporation, World Bank Group.
Duffy, R. (2000). Shadow players: ecotourism development, corruption and state politics in Belize. *Third World Quarterly*, 21 (3), 549-560.

Frey, B., & Jegen, R. (2001). Motivation crowding theory. *Journal of Economic Surveys*, 15 (5), 589-611.
Garrod, B., & Fyall, A. (1998). Beyond the rhetoric of sustainable tourism? *Tourism Management*, 19 (3), 199-212.
Goeldner, C. R., & Ritchie, J. R. B. (2003). *Tourism: principles, practices, philosophies* (10th ed.). New Jersey: John Wiley & Sons, Inc.,
Gómez, C., Lozano, J., & Rey-Maquieira, J. (2008). Environmental policy and long-term welfare in a tourism economy. *Spanish Economic Review*, 10, 41-62.
Hassan, S. H. (2000). Determinants of market competitiveness in an environmentally sustainable tourism industry. *Journal of Travel Research*, 38 (3), 239-245.
Hjalager, A. M. (1996). Tourism and the environment: The innovation connection. *Journal of Sustainable Tourism*, 4 (4), 201-218.
Hudson, S., Ritchie, B., & Seldjan, T. (2004). Measuring destination competitiveness: An empirical study of Canadian ski resorts. *Tourism and Hospitality Planning & Development*, 1 (1), 79-94.
Huybers, T., & Bennett, F. (2002a). *Environmental management and the competitiveness of nature-based tourism destinations*. Cheltenham: Edward Elgar Publishing,
Huybers, T., & Bennett, F. (2002b). *Environmental management and the competitiveness of nature-based tourism destinations*. Cheltenham: Edward Elgar Publishing, (Chapter 6).
Huybers, T., & Bennett, F. (2003a). Environmental management and the competitiveness of nature-based tourism destinations. *Environmental and Resource Economics*, 24 (3), 213-233.
Huybers, T., & Bennett, F. (2003b). Inter-firm cooperation at nature-based tourism destinations. *Journal of Socio-Economics*, 32, 571-587.
Kassinis, G. I., & Soteriou, A. C. (2003). Greening the service profit chain: The impact of environmental management practices. *Production and Operations Management*, 12 (3).
Kassinis, G. I., & Soteriou, A. C. (2005). Greening service organizations: environmental management practices and performance. In S. Sharma, & J. A. Aragón-Correa (Eds.), *Corporate environmental strategy and competitive advantage* (pp. 115-138). Cheltenham: Edward Elgar.
Khanna, M. (2001). Non-mandatory approaches to environmental protection. *Journal of Economic Surveys*, 15 (3), 291-324.
Knowles, T., & Curtis, S. (1999). The market viability of European mass tourist destinations. A post-stagnation life-cycle analysis. *International Journal of Tourism Research*, 1 (2), 87-96.
Kusluvan, S., & Karamustafa, K. (2001). Multinational hotel development in developing countries: an Exploratory analysis of critical policy issues. *International Journal of Tourism Research*, 3, 179-197.
Livernois, J., & McKenna, C. J. (1999). Truth or consequences. Enforcing pollution standards with self-reporting. *Journal of Public Economics*, 71, 415-440.
Marshall, G. R. (2005). *Economics for collaborative environmental management: Renegotiating the commons*. Sterling: Earthscan,
Morgan, M. (1991). Dressing up to survive. Marketing Majorca anew. *Tourism Management*, 12 (1), 15-20.

Osés, N., & Viladrich, M. (2007). On the sustainability of common property resources. *Journal of Environmental Economics and Management*, 53, 393-410.
Ostrom, E. (2000a). Collective action and the evolution of social norms. *The Journal of Economic Perspectives*, 14 (3), 137-158.
Ostrom, E. (2000b). Crowding out citizenship. *Scandinavian Political Studies*, 23 (1), 3-16.
Ostrom, E. (2005a). *Understanding institutional diversity*. Princeton, N.J.: Woodstock: Princeton University Press, (Chapter 1).
Ostrom, E. (2005b). *Understanding institutional diversity*. Princeton, N.J.: Woodstock: Princeton University Press, (Chapter 4).
Parra, E., García, F. J., & Guitiérrez, D. (2004). Importance of environmental resources and capabilities for firm's competitiveness. The case of the hotel industry in the Canary Islands. *Anatolia*, 15 (2), 183-199.
PATA. (2007). *Asia Travel Intentions Survey. April 2007*. Pacific Asian Travel Association.
Pintassilgo, P., & Albino, J. (2007). "Tragedy of the commons" in the tourism accommodation industry. *Tourism Economics*, 13 (2), 209-224.
Ritchie, B., & Crouch, G. (2003). *The competitive destination: a sustainable tourism perspective*. Wallingford: CABI Publishing, (Part II).
Ritchie, J. R. B., & Crouch, G. I. (2000). The competitive destination: A sustainability perspective. *Tourism Management*, 21 (1), 1-7.
Rivera, J. (2002). Assessing a voluntary environmental initiative in the developing world: The Costa Rican Certification for Sustainable Tourism. *Policy Sciences*, 35, 333-360.
Rivera, J. (2004). Institutional pressures and voluntary environmental behavior in developing countries: Evidence from the Costa Rican hotel industry. *Society and Natural Resources*, 17, 779-797.
Sekhar, N. (2003). Local people's attitudes towards conservation and wildlife tourism around Sariska Tiger Reserve, India. *Journal of Environmental Management*, 69, 339-347.
Spencer, B. J., & Brander, J. A. (1983). International R&D rivalry and industrial strategy. *Review of Economic Studies*, 50 (4), 707-722.
Stonich, S. (1998). Political ecology of tourism. *Annals of Tourism Research*, 25, 25-54.
Tarui, N., Mason, C., Polansky, S., & Ellis, G. (2008). Cooperation in the commons with unobservable actions. *Journal of Environmental Economics and Management*, 55, 37-51.
Tisdell, C. (2001). National gains from international tourism in the light of environmental factors: Further considerations. In C. Tisdell (Ed.), *Tourism economics, the environment and development: Analysis and policy*: Edward Elgar.
Ulph, A. (1996). Environmental policy and international trade when governments and producers act strategically. *Journal of Environmental Economics and Management*, 30 (3), 265-281.
Ulph, A. (1997). International trade and the environment: A survey of recent economic analysis. In H. Folmer, & T. Tietenberg (Eds.), *The International Yearbook of Environmental and Resource Economics 1997/1998: A Survey of Current Issues*. Lyme, NH: Edward Elgar.

Wagner, M. (2001). A review of empirical studies concerning the relationship between environmental and economic performance. What does the evidence tell us? Lüneburg: Center for Sustainability Management e.V.

Wilson, D. (1997). Paradoxes of tourism in Goa. *Annals of Tourism Research*, 24 (1), 52-75.

Wilson, J., & Damania, R. (2005). Corruption, political competition and environmental policy. *Journal of Environmental Economics and Management*, 49, 516–535.

WTO (2004). *Indicators of Sustainable Development for Tourism Destinations: A Guidebook.* Madrid: World Tourism Organization,

Figure 1. Normal form representation of the game of environmental contributions in open access.

$\mathbf{II}^{\mathbf{open}}$

$\mathbf{II}^{\mathbf{open}}$ (left) — $\mathbf{I}^{\mathbf{open}}$ (right)

		PLAYER 2	
		G	NG
PLAYER 1	G	$2\gamma_1 - c_1 + \beta_1$, $2\gamma_2 - c_2 + \beta_2$	$z_1 + \gamma_1 - c_1 + \beta_1$, γ_2
	NG	γ_1 , $z_2 + \gamma_2 - c_2 + \beta_2$	0, 0

$\mathbf{I}^{\mathbf{open}}$

Figure 2. Normal form representation of the game of environmental contributions under baseline public intervention ($1 \geq \alpha \geq 0$, and $w > 0$)**.**

$\mathbf{II}^{\mathbf{standard,m}}$

$\mathbf{II}^{\mathbf{standard,m}}$ (left) — $\mathbf{I}^{\mathbf{standard,m}}$ (right)

		PLAYER 2	
		G	NG
PLAYER 1	G	$2\gamma_1 - c_1$, $2\gamma_2 - c_2$, w	$z_1 + \gamma_1 - c_1$, $\gamma_2 - f^e$, w
	NG	$\gamma_1 - f^e$, $z_2 + \gamma_2 - c_2$, w	$0 - f^e$, $0 - f^e$, w

$\mathbf{I}^{\mathbf{standard,m}}$

Figure 3. Normal form representation of the game of environmental contributions under corrupt public intervention.

Figure 3.a. Each firm can unilaterally induce corruption

$\mathbf{II}^{\text{corruption,s1}}$

		PLAYER 2: G	PLAYER 2: NG
PLAYER 1	G	$2\gamma_1 - c_1$, $2\gamma_2 - c_2$, w	$z_1 + \gamma_1 - c_1$, $\gamma_2 - B_2 - p^e$, $w + B_2 - P^e$
	NG	$\gamma_1 - B_1 - p^e$, $z_2 + \gamma_2 - c_2$, $w + B_1 - P^e$	$0 - B_1 - p^e$, $0 - B_2 - p^e$, $w + B_1 + B_2 - P^e$

$\mathbf{II}^{\text{corruption,s1}}$ $\mathbf{I}^{\text{corruption,s1}}$

$\mathbf{I}^{\text{corruption,s1}}$

Figure 3.b. Conditional bribery.

$\mathbf{II}^{\text{corruption,s2}}$

		PLAYER 2: G	PLAYER 2: NG
PLAYER 1	G	$2\gamma_1 - c_1$, $2\gamma_2 - c_2$, w	$z_1 + \gamma_1 - c_1$, $\gamma_2 - f^e$, w
	NG	$\gamma_1 - f^e$, $z_2 + \gamma_2 - c_2$, w	$0 - B_1 - p^e$, $0 - B_2 - p^e$, $w + B_1 + B_2 - P^e$

$\mathbf{II}^{\text{corruption,s2}}$ $\mathbf{I}^{\text{corruption,s2}}$

$\mathbf{I}^{\text{corruption,s2}}$

Figure 4. Normal form representation of the game of environmental contributions under public intervention and unregulated firms.

$\mathbf{II}^{\mathbf{unregulated}}$

		PLAYER 2	
		G	NG
PLAYER 1	G	$2\gamma_1 - c_1$, $2\gamma_2 - c_2$, w	$z_1 + \gamma_1 - c_1 + \beta_1$, $\gamma_2 - f^e$, w
	NG	γ_1, $z_2 + \gamma_2 - c_2$, w	0, $0 - f^e$, w

$\mathbf{II}^{\mathbf{unregulated}}$ $\mathbf{I}^{\mathbf{unregulated}}$

$\mathbf{I}^{\mathbf{unregulated}}$