Other-Regarding Preferences and Social Norms in the Intergenerational Transfer of Renewable Resources when Agent has Present-Biased Preferences

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Abstract:

The paper analyses the effects of present-biased preferences on the welfare of future generations in the framework of renewable resources harvesting. In particular, this study queries the behavioral traits that emerge when the agent is present-biased, and he has other-regarding motivations for future generations, which are expressed through the adherence to genuine other-regarding preferences or social norms.

This investigation demonstrates that the strategic short-sightedness imposed by the "dictatorship of the present" causes a reduction in the well-being of future generations, despite the existence of social preferences. Faced with this problem, this study argues that if the social preferences of the individuals are not left exclusively to their own spontaneous behavior, and if social preferences are also expressed through social norms that prescribe to not reevaluate the harvesting decisions, a mitigation of the effect of present bias on the intergenerational equity can occur.

Keywords: Present bias, naïve agent, intergenerational resource management, renewable resources, other-regarding preferences, social norms.

JEL Classification : D01**,** D03, D15, D90, D91, Q20

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1. Introduction

In the last few years, some studies have started to explore the applications of the non-constant discount rate in resources management (Settle and Shogren, 2004) and in contexts related to the environment (Brekke and Johansson-Stenman, 2008; Karp, 2005). They start to show the dichotomy between the present-biased agents and the rational ones (Hepburn et al., 2010; Winkler, 2006). However, as Gsottbauer and van den Bergh (2011) remarked, the studies that investigate non-constant discounting in resources management have excluded from their analysis the other-regarding preferences. The assertion is well-founded. In the analysis of the impact of present-bias on agents' behaviors, excluding the other-regarding and social preferences limits the analysis of the real peculiarities of people. In fact, other-regarding preferences are found in everyday life, with the evidence that individuals have carefulness concepts such as fairness (Gintis, 2000), and they adopt pro-social behaviors in a wide range of situations (Alpizar et al., 2008; Frey and Meier, 2004; Meier and Stutzer, 2008) and in different cultures (Henrich et al., 2005). Furthermore, there are several robust studies that show the validity for an inclusion of the other-regarding motives in the study of the economic behaviors (Fehr and Gächter, 2002, 2000; Gächter, 2007; Gintis et al., 2005).

Often renewable resources assume, for intrinsic nature, an intergenerational dimension. In this context, it is evident that the externalities derived from the behavior of a single agent within a community often generate effects not only on other members of the community that take their actions at the same time. But frequently, negative externalities can affect future generations whose welfare depends on the level of impoverishment to which the resources were previously exposed.

When the resource management suffers the risk related to the present bias, it is necessary to understand in what manner present-biased behaviors affect the intertemporal dynamic in relation to the intergenerational preferences of a naïve agent who has social preferences for his successors. Present bias and the resulting reversal preferences can change the outcome of the other-regarding choices posed at the beginning by the agent who has to leave some part of resources for future generations. For these reasons, the purpose of this work is to investigate the effects of present-bias in renewable resource management, analyzing the impact of myopic behaviors on the transfer of resources from one generation to the next one, taking care of other-regarding and social preferences of the first generation. Besides, this work also focuses on the different way in which an agent can express his social and other regarding preferences. In fact, they can be expressed with the spontaneous choices taken in accord with other-regarding preferences without social or institutional interventions, but also with the compliance to the specific social norms that the community defines. The capability of human society to define social norms is one of the elements that characterize the sociability itself. In fact, communities and individuals express their other-regarding preferences also through the social norm. Hence, this work will provide a model that explicate how present bias can affect the intergenerational equity in presence of other-regarding preferences of the present generation, and it will address the opportunity to adopt social norms that sustain the intergenerational distribution of the resources, keeping in mind that the capability of building a behavioral norm inside a community is one of the most important and peculiar features of human sociality.

2. Intertemporal myopia in resource management

Resources management is not an easy task for individuals, in particular when they have important decisional myopia (Pevnitskaya and Ryvkin, 2013). The intergenerational management of resources can suffer the conflict between long-run preferences and immediate choices when due to the present biased preferences there emerges a conflict between the early intention of the agent and the choice made in the present. The conflict arises due to the time dependency of the discount rate, generating time-inconsistent decisions. A time inconsistency situation implies that an optimal choice defined in the present could be revisited in the future (Strotz, 1955). The origin of this phenomenon is the present bias that determines the emergence of preference reversals. When the task involves intertemporal decisions, the absence of a constant discount rate determines the condition of possible revaluation of the choices made, changing it from what was estimated before. Behaviors that contradict the time-consistence assumption are widely studied (Frederick et al., 2002; Loewenstein and Prelec, 1992). The systematic tendency of a greater discount in the near future rather than in the distant one is a consequence of people's impulsivity and lack in self-control (Laibson, 1997; O'Donoghue and Rabin, 1999), and it is clear that the exponential discounting cannot represent this phenomenon (Laibson, 1997).

The effects of present bias have been investigated in several areas: low saving rate (Ashraf et al., 2006; Harris and Laibson, 2001; Laibson, 1997; Laibson et al., 1998), health contexts (van der Pol and Cairns, 2002), drugs, smoking or buying addictions (Frederick et al., 2002; Gruber and Koszegi, 2001; Thaler and Shefrin, 1981; Wertenbroch, 1998), and behaviors of procrastination (Benabou and Tirole, 2003; O'Donoghue and Rabin, 1999). As well as the areas just mentioned, resources management is a field where present bias has a strong potential impact. In fact, the risks associated with preference reversals and the "dictatorship of the present" increase in settings where long-term interests may conflict with immediate consumptions. This conflict can typically emerge in all the fields of public and common goods — in public goods, this is emphasized by Winkler (2006) — and this conflict strongly characterizes the intergenerational resource management. For instance, the harvesting of natural resources is a typical area where this conflict can emerge. In this case, present biased decisions can potentially lead to excessive resource depletion. It is shown that if non-constant discount rates are applied in the management of a stock of natural resources, without a commitment to the policy implemented, the possibility that the governance planner revaluates the plan will lead to a collapse of the resources (Hepburn et al., 2010). Settle and Shogren (2004) showed that non-constant discounting affects the optimal resource management because it makes possible offering a justification of a future change in the decisions of the policymaker. Therefore, in the intergenerational management, present-biased preferences could compromise the wise management of the resource stock. The use of a higher discount rate in the short-term can determine that the community's welfare — which also includes the well-being of future generations — would be jeopardized by the excessive weight of the present.

However, when the query involves renewable resources from the intergenerational perspective, the discussion is not limited merely to the impoverishment of the stock of resources for effect of the allocation of the harvesting amounts over the time by the present generation for their own consumption preferences. In fact, the issue also involves the social dimension in relation to the intergenerational equity and the welfare of future generations. In fact, as it will be discussed in the next section, individuals have social preferences such that they assign a positive value to the welfare of the future generations. Therefore, in the intertemporal resources management, present generations also include the welfare of the future generations in their decisional process. In this manner, the present generation has the aim of behaving in accordance with its own social preferences, leaving a given amount of resources for the consumption of the following generations. As long as the intertemporal choices of the individual are time-consistent, it is clear that the outcome of the decision taken also responds to the social preferences of the individual himself. But, in the absence of time-consistency, when the agent behaves myopically under the effect of present bias, the coherence between improved action and early intention of the individual can fade away.

3. A retrospective on other-regarding motives

In a common resource dilemma, the economic theory prescribes the overexploitation of resources, synthesized by the famous expression “tragedy of the common” used by Hardin (1968). This phenomenon depends on the benefit that the agent obtains from an extra unit of consumption of the common when the cost of the reduction of the stock of resources is divided between all the members of the community that can use it, not only between those who consume the extra units. Therefore, agents who take decisions in conformity with their own exclusive self-interest without caring about the consequences on the wealth of others, contribute to the overexploitation of the common resources. These kinds of behaviors are prescript and predicted because the assumptions on the economic behavior of agents are built on the axiom of self-interest. This axiom is a behavioral assumption that is defined in function of a coherent adhesion to the three logical processes that define the behavior of a homo oeconomicus: self-centered welfare, self-welfare goal, and self-goal choice (Sen, 1985) —

building a theoretical system of economic interactions composed of exclusive selfish agents. However, events that contradict this assumption are observable daily in the reality of human interactions. The exclusive self-interested axiomatization does not appear to represent the peculiarities of human behavior. Interdependence between one's own wealth and the others one exists, and this is the foundation of human society. Hence, economic issues that involve the social dimension of human behavior require to economists to relax the assumption that agents are only self-interested.

Several studies have investigated the real foundation of economics when the agents take decisions within a social context, showing with undoubted clarity that individual decisions are mediated by other-regarding motives and by social preferences, such as fairness, cooperation, and reciprocity (Andreoni, 1990; Bolton and Ockenfels, 2000; Charness and Rabin, 2002; Falk and Fischbacher, 2006; Fehr and Schmidt, 1999; Rabin, 1993).

To understand the role of other-regarding preferences in social dilemmas, there are abundant contributions in the literature that show that fairness principles contribute to the formulation of the agent's choices (Fehr and Gächter, 2000; Gächter, 2007; Ostrom et al., 1992). Several analyses and investigations have confirmed the ability of humans to voluntarily sustain cooperation in the case of resource dilemmas (Andreoni, 1988; Casari and Plott, 2003; Charness and Villeval, 2009; Chaudhuri, 2011; Fehr and Leibbrandt, 2011; Ledyard, 1994; Ostrom et al., 1992). Furthermore, the consequences of the introduction of other-regarding preferences in the theoretical framework of the management of commons and in environmental and resource issues have acquired great attention more recently (Brekke and Johansson-Stenman, 2008; Carlsson and Johansson-Stenman, 2012; Frey and Stutzer, 2006; Gowdy, 2008; Gsottbauer and van den Bergh, 2011).

The other-regarding motives have an important role in the management of renewable resources in terms of equity distribution. As Fehr and Fischbacher (2005) pointed out, "other-regarding preferences" means that the agents show these preferences when they give value to the payoffs of the reference agents. In the context of renewable resources, the fairness principle becomes a diriment element in the decisional process that occurs to determine how much to harvest and consume in order to behave in conformity to one's own other-regarding preferences. The others are not only those that simultaneously harvest the same resources but also the successors who will start to harvest in future, when the resources are assigned for an intergenerational use. Hence, the inclusion of other-regarding preferences is essential for the equity distribution principles that affect the harvesting strategies taking care of the intergenerational externalities.

Because on one side, there are no doubts about the existence of cooperation and equity distribution capabilities of people — and that these capabilities are part of the success of human evolution (Gintis, 2009); on the other side, the reason why societies sometimes fail to reach the level of fairness and intergenerational equity that they desire is unclear. For this reason, in the following sections, the effects of the present-bias will be investigated in relation to the welfare of future generations.

4. Harvesting model and behavioral assumptions

The model involves the harvesting activity from a stock of renewable resources: at time *t* the stock of resources is $R(t)$ and the amount harvested is $h(t)$, the growth rate is $f\big(g, R(t)\big)$ and the stock grows following:

$$R(t+1) - R(t) = f\big(g, R(t)\big)R(t) - h(t), \quad (1)$$

where $f\big(g, R(t)\big) \geq 0 \; \forall \; t$ in $[0, T]$, and g, strictly positive, is the natural growth rate when the stock size does not affect the growth rate.[1] Resources are materials, it is not possible to have a negative stock of resources, and the initial level of the stock is strictly positive:

$$R(t) \geq 0 \; \forall \; t \in [0, T] \quad (2)$$

with

$$R(0) = R_0 \, , \; R_0 > 0. \quad (3)$$

The amount harvested is not restorable such that:

$$h(t) \geq 0 \;\; \forall \;\; t \in [0, T]. \quad (4)$$

[1]The resources of the stock are not perishable, for this reason the growth rate is non-negative. And when $\frac{\partial f(g,R(t))}{\partial R(t)} = 0$ the growth rate is a constant exponential one.

According to the resource constraint, the agent cannot harvest at time *t* more than the stock of resources available at the same time:

$$h(t) \leq R(t) \; \forall \; t \in [0,T]. \tag{5}$$

In the model, there are two generations, a first one that harvests for *T* periods, and a second one that starts to harvest after the first generation.

The welfare's agent of the first generation depends only on the amount harvested, and the utility function is expressed in the usual form:

$$U = \sum_{t=0}^{T} \delta(t) u(h(t)), \tag{6}$$

where $u(h(t))$ is monotonic and strictly concave:

$$u'(h(t)) > 0\,, \; u''(h(t)) < 0. \tag{7}$$

Continuity on the harvesting amount is assumed. $\delta(t)$ represents the discount factor. The cases of neutrality in the harvesting time and of pleasure in procrastination are excluded, such that:

$$\delta(t) > \delta(t+1) \; \forall \; t \in [0,T]. \tag{8}$$

The first generation is affected by present-bias, which implies:

$$\begin{cases} \dfrac{\delta_t}{\delta_{t+1}} > \dfrac{\delta_s}{\delta_{s+1}} \quad \text{with} \;\; t < s \;\; \text{and} \;\; s \in [0,T] \;\; \text{for } t = 0, \\ \dfrac{\delta_t}{\delta_{t+1}} = \dfrac{\delta_s}{\delta_{s+1}} \quad \text{with} \;\; t < s \;\; \text{and} \;\; t,s \in [0,T] \;\; \text{for } t > 0. \end{cases} \tag{9}$$

Of course, in this condition, time consistency is impossible.

The second generation starts harvesting from the residual stock of resources left unharvested by the first generation. Thus, there is an intergenerational transfer, the amount not harvested in the last period by the first generation is the initial stock for the subsequent generation:

$$\{[1+f\big(g, R(t)\big)]R(T) - h(T)\} = D, \tag{10}$$

where *D* represents the initial stock for the second generation.

Of course, if the first generation is absolutely selfish, nothing will be left to the next generation. However, total selfishness is not the real behavior of agents, as it is explicated in the retrospective on the other-regarding behaviors. Hence, in this model, the agent of the first generation takes care of the amount available for the successor because he has social preferences about the intergenerational distribution. So, the first generation leaves a given amount, D, unharvested at the end of the period T for the second generation.

The amount D depends on the lifetime-expected enjoyed revenue that the first agent (or generation) obtains, π, given the instantaneous utility of the agent such that:

$$\pi = \sum_{t=0}^{T} u\big(h(t)\big). \tag{11}$$

The transferred amount also depends on the intergenerational equity of the first generation, represented by a generic constant parameter, α, exogenous and unchangeable; hence,

$$D = f(\alpha, \pi). \tag{12}$$

The amount transferred to the second generation increases with the increase in the lifetime enjoyed revenue of the first generation:

$$\frac{\partial D(\alpha, \pi)}{\partial \pi} > 0. \tag{13}$$

At any period, the agent of first generation defines the harvesting plan including the expected amount to transfer to the second generation.

5. Consequences of present-biased behaviors on the welfare of future generations in presence of other-regarding preferences

The issue that it is questioned here is how the adoption of the harvesting strategy influenced by present-biased preferences affects the intergenerational transfer, given the assumption about the presence of social preferences.

The intertemporal harvesting plan of the agent is given by the maximization of the utility function (6) under the constraints expressed in (2), (3), (4) and (5), the growth of the stock is given by (1) and the agent face the (10). To show the effect of present biased preferences on the intergenerational transfer, in the first step, the effect on the lifetime-expected revenue enjoyed by the first generation must emerge.

Hence, at time 0 the agent formulates the optimal harvesting plan for his lifetime:

$$H_{opt} = \{h_{opt}(0), \dots, h_{opt}(t_b), \dots, h_{opt}(T)\}. \tag{14}$$

But, the first generation adopts present-biased decisions so there are no guarantees about the time-consistency of the choices time after time. In this manner, the strategy effectively implemented by a biased agent does not coincide with the initial long-run optimal plan formulated at time 0, so the harvesting plan effectively implemented will be a biased one, expressed as:

$$H_{bias} = \{h_{bias}(0), \dots, h_{bias}(t_b), \dots, h_{bias}(T)\}, \tag{15}$$

where H_{bias} is defined as the amounts that are derived time after time by the instantaneous maximization of the utility expressed in (6), under the constraints defined before, when the discount factor has the features expressed in (9).

Because (9) implies that, with $0 < t_b < s$, at time 0:

$$\frac{\delta(t_b)}{\delta(t_b + 1)} = \frac{\delta(s)}{\delta(s + 1)}, \tag{16}$$

but later at time t_b:

$$\frac{\delta(t_b)}{\delta(t_b + 1)} > \frac{\delta(s)}{\delta(s + 1)}, \tag{17}$$

thus the agent harvests an amount greater in the biased harvesting plan, such that:

$$h_{bias}(t_b) > h_{opt}(t_b). \tag{18}$$

The direct consequences will be that the lifetime-expected enjoyed revenue that the first agent obtains in the biased harvesting plan adopted, H_{bias}, is lower than in the hypothetical optimal plan evaluated at time 0, H_{opt}:

$$\sum_{t=0}^{T} u\big(h_{bias}(t)\big) < \sum_{t=0}^{T} u\left(h_{opt}(t)\right). \tag{19}$$

Hence, the present bias induces the agent of the first generation to adopt a strategy that implies an expected enjoyed revenue, π_{bias}, lower than that one expected at the beginning,

π_{opt}.[2]

Considering that at time 0 the agent had defined a given harvesting plan, H_{opt}, such that he had predicted to obtain a given expected enjoyed revenue π_{opt}, the predicted amount to leave for the future generation predicted at time 0 was defined in relation to the predicted revenue π_{opt}, such that,

$$D_{opt} = f(\alpha, \pi_{opt}). \tag{20}$$

At time t_b, the present bias induces the agent to reevaluate his harvesting plan. The consequence, as shown in (19), is that the enjoyed revenue derived from the biased harvesting plan, π_{bias}, is lower than π_{opt}, such that at time t_b, the transfer amount is reevaluated in the function of the new level of expected enjoyed revenue, π_{bias}:

$$D_{bias} = f(\alpha, \pi_{bias}) \tag{21}$$

Thus, taking into account (13), a decrease in π determines a decrease in the transfer amount such that:

$$D_{bias} < D_{opt}. \tag{22}$$

At this point, it is trivial to show that period after period, when the effect of present biased preferences emerges, the predicted transferred amount becomes smaller and smaller. In the final period *T*, the amount effectively left for the future generation will be lower than the amount that the agent would have left given the same intergenerational preferences but without the present-bias that swept him from his long-run harvesting path.

Therefore, a biased harvesting plan determines a reduction in the maximum welfare available for the future generation. The second generation, hence, suffers the consequences of a bias that affects the previous generation, without, for obvious reasons, having the opportunity to

[2] The proof of (19) is in the appendix. For a detailed explanation of the effect of the present biased preferences on the welfare of the agent in the framework of intertemporal renewable resources harvesting see Persichina (2018).

avoid the reductions of the initial stock of resources that he receives despite the initial intentions of the first generation.

6. Advantage of the implementation of social norms

When a naive agent is induced by present bias to leave to the future generation less than he originally desired, it may be decisive if the individual has the chance to not merely follow his spontaneous biased behavior, but to find the support of some social norm that can make him apply some sort of commitment to his original choices.

In fact, if the spontaneous social preferences of the agent are not sufficient to avoid the risks related to present biased discounting, the compliance to given social norms that require leaving an amount to the future generation not amenable to revision could offer an opportunity to commit the behavior of the agent to his first intentions. The social norm, in this case, will be a nudge to facilitate the agent to behave conformal to his initial intergenerational equity intention (Sunstein, 2014).

The implementation of a social norm that prescribes to follow the initial harvesting plan can improve the intergenerational equity. In fact, when individuals act in compliance with their own spontaneous intergenerational preferences, without being bound by any social norms, there is not a constraint that guarantees the conservation of resources for the benefit of future generations avoiding the revaluation of the transfer amount. Conversely, the situation of the transferred amount is different if the agent manifests his own intergenerational preferences via compliance with a social norm that prescribes to donate to the future generation a determined amount, set out before the harvesting period, and thus, defined according to the initial stock of resources.

When the social norm prescribes that the amount transferred, defined at the beginning, must not be subject to re-evaluation, the social norm is designed to commit the behavior of the agent. So, the presence of constraints arising from social norms can lead the individual to mitigate the re-evaluation of the amount to leave to the future generation.

In order to have effects on the agent's behavior, a social norm has to affect the perceived utility of the agent; in particular, the agent's utility must be reduced when he does not behave in compliance with the social norm. However, it is important to avoid a situation where the reduction in the utility generated by non-compliance behavior induces the agent to further increase his harvesting amount.

At time t_b, when the agent is induced by the present bias to reevaluate his harvesting plan, the amount $h_{bias}(t_b)$, with $h_{bias}(t_b) > h_{opt}(t_b)$, is the only amount harvestable at time t_b such that:

$$H_{bias} \succ H_j \;\forall\; H_j \in H, \tag{23}$$

where H is the set that includes all the harvesting plans feasible by the agent, with

$$H_j : h_j(t_b) > h_{bias}(t_b). \tag{24}$$

So, taking into account the disutility derived by the violation of the social norm, the condition that guarantees that (23) is still true requires that the disutility increase with the increasing differences between the amount harvested at time t_b and the amount initially planned $h_{opt}(t_b)$. In fact, the agent will not harvest an amount $h_j(t_b)$ higher than $h_{bias}(t_b)$ if the utility that can be obtained from the H_{bias} harvesting plan - considering also the reduction in the utility that the agent receives when he does not behave in compliance with the social norm - will still be higher than the utility obtainable with the H_j plan inclusive of the reduction derived from the violation of the social norm. So, calling the disutility derived by a violation of the social norm as η, will be:

$$\sum_{t=t_b}^{T} \delta(t)u\big(h_{bias}(t)\big) - \eta_{h_{bias}} > \sum_{t=t_b}^{T} \delta(t)u\left(h_j(t)\right) - \eta_{h_j}, \tag{25}$$

where is $\eta \geq 0$.

The relation (25) is always satisfied for every $h_j(t_b) > h_{bias}(t_b)$ when

$$\frac{\partial \eta}{\partial \gamma} \geq 0, \tag{26}$$

where $\eta = \begin{cases} 0, & h(t_b) \leq h_{opt}(t_b) \\ f(\beta, \gamma), & h(t_b) > h_{opt}(t_b) \end{cases}$

with $\gamma = h(t_b) - h_{opt}(t_b)$ and $f(\beta, \gamma) > 0$,

where β is a parameter that represents the value that the agent assigns to follow the social rules. Such that the disutility that the social norm generates when the agents violates the norm, $f(\beta,\gamma)$, increases with an increasing of β:

$$\frac{\partial f(\beta,\gamma)}{\partial \beta} > 0. \tag{27}$$

Furthermore, the social norm, in order to have the possibility to reduce the effect of present bias on the harvesting amount and consequently on the transferred amount to the future generation, needs to generate a strictly marginal increasing disutility that the agent receives on the increasing of the difference between the amount effectively harvested and the amount initially planned, $h(t) - h_{opt}(t)$, such that:

$$f(\beta,\gamma) \rightarrow \frac{\partial \eta}{\partial \gamma} > 0 \; \forall \; h(t) > h_{opt}(t). \tag{28}$$

Hence, to have a positive effect, the social norm has to target the present behavior of the agent reducing his utility in relation to the increasing of his present harvesting with respect to the amount initially planned. Strictly increasing disutility on the amount harvested in excess of $h_{opt}(t)$ in no case will induce the agent to move further away from the initial harvesting path. A social norm with this peculiarity can reduce the effect of the present bias on the amount transferred to the future generation. The magnitude of the effect of the social norms to obtain the goal of preservation of the resources strongly depends by the intrinsic value that the agent assigns to the social norm, expressed with β. It means that the social norm to be effective needs to be accepted and internalised in the personal belief of the agent. An effective social norm must then have to stigmatize the present behavior of the agent. If the social constraint is sufficiently strong and the social disutility that the agent receives from the violation is sufficiently high, with a compliance strategy to a social norm representing the agent's other-regarding preferences, it is possible to ensure a higher transfer amount of resources to future generations, mitigating or avoiding the present-bias effects.

The social constraint that arises from this norm, while an expression of the same other-regarding preference, offsets the effects of short-sighted behaviors — where a naive agent takes his own decisions only under the influence of present-bias — that in absence of social norms are without substantial barriers. It is so demonstrated that, in the context of intertemporal management of resources, the social norms should have the crucial role of expressing the other-regarding preferences of the agent such that the he can keep the harvesting path as close as possible to the optimal one with a high compliance to the social norm. In fact, if the presence of the other-regarding preferences - that are necessary and essential - is not sufficient to guarantee the intergenerational equity, the agent's behavior need to be sustained by specific institutional mechanisms and brought into the community by social norms that prescribe the behaviors more appropriately for guaranteeing the equity and availability of the resources between the different generations.

7. Discussion and final remarks

It is clear that in the context of renewable resources the acts of one generation impose externalities on the subsequent generations. In fact, a community is composed not only of the actual members but also of the future ones. This work has shown that the effect of present-bias is a problem for a community, not only for the effects on the single myopic agent and on a group with a more-or-less high presence of present-biased agents, but because intergenerational negative externalities exist.

It has been shown that the choices influenced by present-bias lead the first generation to leave to the second less than what the first generation itself wanted. It is essentially an intergenerational reversal preference, in which the original intentions of people managing the resource stocks gradually get influenced by the strong temptation of the present, slowly eroding the resource volumes to leave to future generations. In fact, here we observed the contrast between the individual's preferences when they are not subject to pressures from the present and the choices actually made when their own preferences are influenced by present-bias. Thus, the strategic short-sightedness imposed by the "dictatorship of the present" causes the agent's choices to divert away from optimal choices causing a reduction in the well-being of future generations despite the existence of strong social preferences.

Thus present-bias causes serious damages in terms of intergenerational equity and sustainability of resource levels for future generations, even when the welfare of future generations is supported by other-regarding preferences. The lone other-regarding preferences of a naïve agent do not guarantee that the harvesting path will match with what is considered desirable and initially optimal. Resources management and conservation for future generations appears to be a complex task, which cannot be solved fully by the spontaneous behavior of naïve agents alone.

Even if a generation has spontaneous and intrinsic intergenerational preferences to ensure sustainability of resources for future generations, there is the limit that in the process of decision-making over time, the choices made are insufficient to keep the harvesting plan that leaves the resources amount initially suggested. If this amount had been defined in terms of sustainability for the future generation, the very sustainability of resources, even if desired by the present generation, would be compromised.

Faced with this problem, this study has shown that if the social preferences of the individual are not left only and exclusively to their own spontaneous behavior, and if these social preferences are expressed by social norms charged with representing the individual's social preferences, a mitigation of the effect of present bias on the intergenerational equity can occur. In particular this work shows that, in order to have the possibility to reduce the effect of present bias on the transferred amount to the future generation, the social norm needs to generate a strictly marginal increasing disutility that the agent receives on the increasing of the difference between the amount effectively harvested and the amount initially planned. So the sanctioning effect of the norm has to target the present behavior of the agent reducing his utility in relation to the increasing of his present harvesting with respect to the amount initially planned.

In fact, individuals in a social context also express their preferences through specific social norms that they believe in. Hence, by compliance with these norms, individuals express their own preferences toward other members of the community. Individuals with social preferences do not act in isolation from the community they belong to. The manner in which social norms mediate individuals' behavior is one of the prerogatives of human society. A community is also based on the relatively widespread adoption of specific social norms and clearly identifiable habits, whose adoption by an individual qualifies him in very specific terms. The compliance with social norms, in fact, elicits the self-image of the agents. Agents receive a benefit from expressing themselves through behaviors that are in compliance with their self-image and social identity, so compliance to social norms is in this way an expressive utility (Sunstein and Reisch, 2014). Furthermore, the social disapproving can induce individuals to behave conformally to the social norm in order to avoid being disapproved, obtaining from the social endorsement social or moral utility(Levitt and List, 2007).

This, therefore, suggests that the welfare of future generations can be preserved by respecting the preferences of the current generation and implementing a social norm that defines given behavioral heuristics. Heuristics must be designed in a manner such that the social preferences of the members of the community are expressed not only by the volume of resources they leave to the next generation but also according to how this amount matches the amount initially assessed. Indeed, this would facilitate the effective maintenance of resource stocks to be allocated to future generations initially defined according to the individual's preferences, which, though affected by present-bias would have a balancing effect due to compliance with social norms.

Appendix

Proof of (19):

In order to show the assertions, a lifetime of 3 periods is considered where the lifetime-expected enjoyed revenue is:

$\pi = u\big(h(0)\big) + u\big(h(1)\big) + u\big(h(2)\big)$.

At time 0, the harvesting plan is defined by:

$H_{opt} = \{h_{opt}(0), h_{opt}(1), h_{opt}(2)\}$,

where $H_{opt} \succ H_i$, $\forall\, H_i \in H$, and where H is the set that includes all the harvesting plans feasible by the agent.

At time 1, the agent reformulates his harvesting plan for the present and future periods, implementing a different strategy in these periods:

$H_{bias} = \{h_{bias}(1), h_{bias}(2)\}$.

But, H_{bias} is one of all other feasible harvesting plans different from H_{opt}, meaning that at time 0, $H_{opt} \succ H_{bias}$, which implies:

$$\delta(0)u\big(h_{opt}(0)\big) + \delta(1)u\big(h_{opt}(1)\big) + \delta(2)u\big(h_{opt}(2)\big) > \delta(0)u\big(h_{opt}(0)\big) + \delta(1)u\big(h_{bias}(1)\big) + \delta(2)u\big(h_{bias}(2)\big),$$

thus:

$\delta(1)u\big(h_{opt}(1)\big) - \delta(1)u\big(h_{bias}(1)\big) > \delta(2)u\big(h_{bias}(2)\big) - \delta(2)u\big(h_{opt}(2)\big)$, then,

$\delta(1)\big[u\big(h_{bias}(1)\big) - u\big(h_{opt}(1)\big)\big] < \delta(2)\big[u\big(h_{opt}(2)\big) - u\big(h_{bias}(2)\big)\big]$, hence,

$$\frac{\delta(1)}{\delta(2)} < \frac{\big[u\big(h_{opt}(2)\big) - u\big(h_{bias}(2)\big)\big]}{\big[u\big(h_{bias}(1)\big) - u\big(h_{opt}(1)\big)\big]}.$$

Because $\frac{\delta(1)}{\delta(2)} > 1$, then $\frac{\big[u\big(h_{opt}(2)\big) - u\big(h_{bias}(2)\big)\big]}{\big[u\big(h_{bias}(1)\big) - u\big(h_{opt}(1)\big)\big]} > 1$. So,

$u\big(h_{opt}(2)\big) - u\big(h_{bias}(2)\big) > u\big(h_{bias}(1)\big) - u\big(h_{opt}(1)\big)$, and finally,

$u\big(h_{opt}(1)\big) + u\big(h_{opt}(2)\big) > u\big(h_{bias}(1)\big) + u\big(h_{bias}(2)\big)$ such that:

$u\big(h_{opt}(0)\big) + u\big(h_{opt}(1)\big) + u\big(h_{opt}(2)\big) > u\big(h_{bias}(0)\big) + u\big(h_{bias}(1)\big) + u\big(h_{bias}(2)\big)$,

where $u\big(h_{bias}(0)\big) = u\left(h_{opt}(0)\right)$.

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