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The Impacts of Other-Regarding Preferences and Ethical Choice on Environmental Outcomes: A Review of the Literature

Ngo Van Long[*]

Résumé

Cet article offre un survol de la littérature sur les effets environnementaux des choix motivés par des considérations éthiques et des préférences qui portent sur les autres. On considère les préférences influencées par i) l'envie ou par ii) l'altruisme et l'aversion de l'inégalité. On compare l'approche basée sur ces préférences et l'approche basée sur l'éthique. Les modèles inspirés de la première approche ne donnent pas des résultats robustes. Par contre, les modèles basés sur la dernière approche sont beaucoup plus robustes.

Mots clés : Gouvernance d'entreprise; environnement; équilibre kantien

Abstract

This paper reviews the literature concerning the impacts of other-regarding preferences and ethical choice on environmental outcomes when agents behave strategically. We consider two types of other-regarding preferences: (i) envy or status concern, (ii) altruism and inequality aversion. We contrast the preference-based approach with the ethical approach in which some choices are made on ethical ground and thus are not necessarily utility-maximizing. Models exhibiting other-regarding preferences do not yield unambiguous results concerning the effects of strategic behavior on the environment. In contrast, models in which choices are motivated by Kantian ethics display more robust results.

Keywords: Corporate governance; environment; Kantian equilibrium

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The Impacts of Other-Regarding Preferences and Ethical Choice on Environmental Outcomes: A Review of the Literature

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20 February 2016

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Abstract

This paper reviews the literature concerning the impacts of other-regarding preferences and ethical choice on environmental outcomes when agents behave strategically. We consider two types of other-regarding preferences: (i) envy or status concern, (ii) altruism and inequality aversion. We contrast these preference-based approaches with the ethical approach in which some choices are made on ethical ground and thus are not necessarily utility-maximizing. Models exhibiting other-regarding preferences do not yield unambiguous results concerning the effects of strategic behavior on the environment. In contrast, models in which choices are motivated by Kantian ethics display more robust results.

1 Introduction

The 'Standard Model of Economic Behavior' assumes that the typical economic agent is a self-seeking entity with a utility function defined over the goods and services she consumes. She might be forward looking, but not outward looking: she does not compare her income or consumption with those of other agents. In the Standard Model, agents are not motivated by positional concerns, and they are devoid of any sense of ethics. They are supposedly 'rational' and make decisions on the basis of objective calculations. The Standard Model has been very successful in explaining many aspects of economic behavior, and has given rise to a number of beautiful and parsimonious theoretical constructs, such as the Tragedy of the Commons, the Prisoner's Dilemma, and so on.

The Standard Model however is not capable of explaining a number of important economic phenomena. In fact some Nobel laureates in economics won their prize for working outside the Standard Model.[1] Thus, Ostrom (1990, 1992, 2000) stresses the importance of institutional factors and documents instances where the common property regime does not lead to the tragedy of the commons, and Shiller (2005) shows that irrational exuberance is the main cause of many financial crises. Other Nobel laureates have pointed to behavior that is incompatible with the Standard Model. For example, Arrow (1973) argues that some aspects of behavior are motivated by moral considerations, and Sen (1993) believes that it makes sense to appeal to business ethics. Going back to the eighteenth century economic literature, we discover that Adam Smith (1790) finds that co-operation and mutual help are incorporated in established rules of behavior, and that

> "*upon the tolerable observance of these duties, depends the very existence of human society, which would* ***crumble into nothing*** *if mankind were not generally impressed with a reverence for those important rules of conduct.*"
> (Smith, 1790, Part III, Chapter V, p. 190.)

Thus, Smith seems to argue that for societies to prosper, one would need the working of two invisible hands, not just one. First, the moral invisible hand that encourages the observance of duties; second, the invisible hand of the price system, which guides the

[1] Similarly, the 2015 Nobel laureates in physics won their prize for working outside the 'Standard Model of Particle Physics.'

allocation of resources.[2] Unfortunately, writers of standard economic textbooks do not seem to be aware of Adam Smith's first invisible hand and present to many generations of students a distorted view of Adam Smith's vision.

Adam Smith also warns of the danger of irrational exuberance, and advocates banking regulations. In The Wealth of Nations, Smith (1776, p. 308) writes[3]

> "*Though the principles of the banking trade may appear somewhat abstruse, the practice is capable of being reduced to strict rules. To depart upon any occasion from these rules, in consequence of some flattering speculation of extraordinary gain, is almost always extremely dangerous, and frequently fatal to the banking company which attempts it. (...) Such regulations may, no doubt, be considered as in some respect a violation of natural liberty. But those exertions of natural liberty of a few individuals, which might endanger the security of the whole society are, and ought to be, restrained by the laws of all governments.*"

While moral concerns play an important role in human behavior, other psychological factors are also driving forces behind our actions. Perceptive economists such as Veblen (1899) and non-economists, such as Kahneman and Tversky (1984) have stressed these factors. Unfortunately, the Standard Model takes into account neither moral concerns nor psychological factors such as emulation, envy, status concerns, and so on. Fortunately, in the past two decades, there has been a growing economic literature that examines the implications of relaxing the standard economic assumptions on preferences (see, e.g., Frey and Stutzer, 2007).

In this paper, I review the literature concerning the impacts of other-regarding preferences and ethical choices on environmental outcomes when agents behave strategically. I consider two types of other-regarding preferences: (i) envy or status concern, (ii) altruism

[2] Smith's admiration for the working of the price system is not unqualified. In The Wealth of Nations, he warns about the agency problem: "The directors of such companies, however, being the managers rather of other's money than of their own, it cannot be well expected, that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own...Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company." (Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations, Edited by Edwin Cannan, The Modern Library, New York, 1937. Page 700, Book 5, Chapter 1.)

[3] See also Kay (2015, p. 106).

and inequality aversion. I contrast these preference-based approaches with the ethical approach in which some choices are made on ethical ground and thus are not necessarily utility-maximizing. The ethical approach I focus on is the Kantian approach: an action is chosen because it is morally compelling. This approach has been advocated by Laffont (1975), Sen (1977), and Roemer (2010).

This paper is organized as follows. Section 2 reviews the literature on envy and status concerns, with emphasis on the impacts of these factors on the environment. Section 3 turns to the class of preferences that exhibit altruism, inequality aversion, and the concerns for public goods and social efficiency. In particular, I will discuss the possible impacts of corporate environmentalism for the environment and social welfare. The implications of social preferences on the size of stable international environmental agreements will also be reviewed. In Section 4, I review some models with a Kantian flavor that focus on the environmenr, as well as models that use the right-based approach to study issues in resources and environmental economics.

2 Envy and Status Concern: Implications for the Environment and Natural Resources

Envy is an important fact of life. Veblen (1899) emphasizes the pervasiveness of emulation, which he defines as 'the stimulus of an invidious comparison which prompts us to outdo those with whom we are in the habit of classing ourselves.' He claims that 'with the exception of the instinct for self-preservation, the propensity for emulation is probably the strongest and most alert and persistent of economic motives proper.' Emulation can lead to direct contests, and to wasteful use of efforts and other real resources.[4]

Driven by emulation, the utility that an economic agent derives from her consumption, income, or wealth tends to be affected by how these compare to other economic agents' consumption, income or wealth. This has been established in different contexts. While I will refer to this as status concern, some authors have labeled it as envy, or positional externalities, or keeping up with the Joneses (Pollack,1976; Frank, 1985, 1990, 2007).[5]

The facts that relative performance reflects one's status in the community, and that

[4]For a recent survey of the theory of contests, see Long (2013).

[5]Rayo and Becker (2007) argue that evolutionary forces favor happiness that depends on relative performance.

status matters, have been well recognized in the theoretical and empirical literature on interpersonal comparison. Schoeck (1966) discusses the role of envy in social behavior. Rawls (1970, p. 545) writes about the implications of status concern for distributive justice:

> "*Suppose...that how one is valued by others depends upon one's relative place in the distribution of income and wealth. (...) Thus, not everyone can have the highest status, and to improve one person's position is to lower that of someone else. Social cooperation to increase the conditions of self-respect is impossible. Clearly this situation is a great misfortune.*"

Most studies in applied welfare economics are based on the assumption that preferences are independent of social context. Nonetheless, there is a growing body of empirical evidence showing that status concerns and envy seem to be a powerful driving force that motivates individual actions (Bowles and Park, 2005, Heffetz, 2011, Card et al. 2012). Empirical research by Neumark and Postlewaite (1998) reveals that relative income consideration is an important factor in women's decision to joint the work force. Using a sample of married sisters, they find that married women are 16 to 25 percent more likely to work outside the home if their sisters' husbands earn more than their own husbands. Another approach relies on questionaires and reported levels of happiness. Clark and Oswald (1996), using a sample of 5,000 British workers, find that workers' reported satisfaction levels are inversely related to their comparison wage rates, supporting the hypothesis of positional externalities. Using U.S. data, Luttmer (2005) finds that the levels of wellbeing of individuals, as reflected by several indicators, depend on relative income. Additionally, a growing body of experimental research (see for instance Johansson-Stenman et al., 2002), highlights the importance of consumption externalities. These experiments present the subjects with a series of hypothetical questions regarding their choice among alternative outcomes where these choices reveal their concern for their consumption relative to others. Roughly half of the participants are willing to accept a lower level of absolute income in order to achieve higher relative income.

Research on status concerns has been applied to environmental economics. Ng and Wang (1993) point out that the concern for social status leads to excessively high levels of consumption which contribute to environmental damages. Howarth (1996) explores the implications of a status race for the design of efficiency-inducing policies for the envir-

onment, in a static, competitive economy. Howarth (2000, 2006) argues that economists tend to over estimate the optimal level of emissions of green house gases, because they ignore the role of interdependence of preferences in consumption. He concludes that social welfare should not count pleasures derived from status, and therefore the optimal taxes on carbon dioxide emissions should be higher. Brekke and Howarth (2002) point out that relative economic status may lead agents to substantially underestimate the full social benefits of public goods and non-market environmental services. Extending the literature on the environmental Kuznets curve, they incorporate status motives and show that consumption interdependence exacerbates the rate of environmental degradation, because the desire to signal one's status leads to a significant bias in the trade-offs between pollution abatement and consumption. Brekke et al. (2002, 2003) point to various historical and anthropological studies that show that status-seeking behavior is common in societies with comparatively low consumption levels.

The impact of status concern on resource exploitation has recently been investigated in the natural resource literature. Alvarez-Cuadrado and Long (2011) show that relative consumption concerns can cause agents to over-exploit renewable resources even when these are private properties. They modify a standard model of renewable resource exploitation by specifying that preferences are defined over the individual's consumption level, her effort level, and the comparison of her consumption with that of other members of the community.Thus, the comsumption good is positional, and leisure is a non-positional good. They identify two dimensions along which consumption externalities distort the efficient extraction of resources. First, when effort is costly, envy distorts the marginal rate of substitution between consumption and leisure. This is the static distortion. Since status-seeking individuals overvalue consumption, their willingness to exert effort in order to achieve additional consumption is higher than the efficient level. Consequently they over-exploit the resource, resulting in a steady-state stock level that is lower than the efficient level. Second, even when effort is costless, consumption externalities might distort the willingness to shift consumption through time, resulting in an inefficient path of extraction. This is the dynamic distortion. The authors show that there exists an optimal tax scheme which induces the competitive agents to replicate the choices of the planner. The tax rate is positive and, in general, time-varying. Calibrating the model under widely used functional forms, they find that, due to status concern, the competitive steady-state resource stock is about 25% below the efficient stock. Moreover the welfare

costs associated with this over-exploitation are very large, about 20% of the laissez-faire steady-state level of consumption.

Avarez-Cuadrado and Long (2011) also investigate an environment where the resource is exploited under the open access regime. This case is particularly relevant for poor countries, where property rights to many natural resource stocks are not well defined or the enforcement is slack. Alternatively, the resource stock may be interpreted as the quality of the global environment, and the model is then applicable to the climate change problem. The concern for relative consumption reinforces the over-exploitation that characterizes imperfect property-rights arrangements. In their benchmark calibration the laissez-faire steady-state resource stock is smaller than one third of the efficient stock. Consumption externalities account for about one third of this gap while the remaining two thirds are attributable to over-exploitation due to behavior under common property.

In the model of Avarez-Cuadrado and Long (2011), agents do not behave strategically: in comparing her consumption level with the average consumption level, each agent, being atomistic, does no think that her own consumption would have any impact on the aggregate resource stock. The case where status-conscious agents are strategic are taken up in the papers by Long and Wang (2009), Katayama and Long (2010), and Long and McWhinnie (2012).

Katayama and Long (2010) explore the link between status concerns and the exploitation of a common-property exhaustible resource. The final good is produced using a stock of man-made capital and the extracted resurce. Extraction requires efforts.[6] Katayama and Long (2010) consider a differential game involving n infinitely-lived agents, and compare the Markov-perfect Nash equilibrium of this game with the outcome under cooperation. They find that the degree of status-consciousness has important impacts on the Markov-perfect Nash equilibrium. A higher degree of status-consciousness leads to greater excessive consumption, and lower capital accumulation. If extraction is costless, status-consciousness has no impact on the extraction/resource-stock ratio. However, with costly extraction, higher status-consciousness reduces this ratio. At first sight, this result might seem surprising. However, upon reflection, it is a plausible result. Since agents want to outdo each other in terms of relative consumption, they find it more advantageous to over-exploit the common man-made capital stock. Long and Wang (2009) turn attention

[6] This feature makes the model more general than the standard model of Solow (1974) and Dasgupta and Heal (1979, Chapter 8), where extraction is costless.

to renewable resource extraction by a finite number of status-conscious agents that interact strategically. The growth rate of the resource is linear, admitting endogenous growth. They find that status consciousness reduces the economy's growth rate.

Long and McWhinnie (2012) consider a finite number of agents playing a Cournot dynamic fishery game, taking into account the effect of the fishing effort of other agents on the evolution of the stock. In other words, they are dealing with a differential game of fishery with status concerns. In fisheries, anecdotal evidence suggests that status matter, particularly with respect to harvest. Examples include a captain being fired for having the lowest harvests, simple statements such as "I like fishing because it means going out each day to see if I can catch more than the next guy", and fishermen transferring the race-to-fish to species that are not covered by quota management or converting it to seeing how fast they can catch their quota. Using the logistic growth function and the harvesting function postulated by Schaefer (1957), Long and McWhinnie (2012) show that overharvesting resulting from the tragedy of the commons problem is exacerbated by the desire for higher relative performance, leading to a smaller steady-state fish stock and smaller steady-state profit for all the fishermen. This result is quite robust with respect to the way status is modelled. The authors consider two alternative specifications of relative performance. In the first specification, relative performance is equated to relative after-tax profits. In the second specification, it is relative harvests that matter. The authors examine a tax package (consisting of a tax on relative profit and a tax on effort) and an individual quota as alternatives to implement the socially efficient equilibrium.

The analysis of Long and McWhinnie (2012) relies on two key assumptions: first, each agent takes as given the time paths of resource exploitation of other agents (i.e., the authors restrict attention to open-loop strategies); and second, the agents take the market price of the extracted resource as given (i.e., the goods markets are perfectly competitive). Those assumptions have been relaxed by Benchekroun and Long (2015).

Benchekroun and Long (2015) model the situation where (a) each agent anticipates that at any point of time in the future, other agents will choose their harvesting levels based on their concurrent observation of the resource stock level[7]; and (b) each agent can influence the market price in each period, by controlling her supply to the market. Their model thus displays three types of externalities. First, there is the well-known common

[7]Technically, this means that they use the concept of Markov perfect equilibrium, as opposed to open-loop equilibrium. See Dockner et al. (2000) or Long (2010) for discussions on the relative merits of these equilibrium concepts.

pool externality. Second, there is status externality. Third, the oligopolistic market structure is a form of externality: when one agent increases her output, the market price falls, resulting in lower revenue for other firms.

Why might oligopolists be concerned about their relative output? One reason may be that a firm's relative output is a proxy for its market share. Companies are often ranked in terms of their market share. Another possible reason is that there is a high correlation between a firm's output and its employment level, or the size of its fleet. These can function as status symbols.

Benchekroun and Long (2015) show that when agents use feedback strategies and the transition phase is taken into account, the well established result that status concern exacerbates the tragedy of the commons must be seriously qualified. More specifically, when agents are concerned about their relative profit, the authors find that there exists an interval of the stock size of the resource for which the extraction policy under status concern is less aggressive than the extraction policy in the absence of status concern. Their analysis shows that the long-run and the short-run impacts of profit-based status concern may differ. Whether the short-run impact is important or not clearly depends on the discount rate. A higher discount rate corresponds to the case where agents care very little about the future. Interestingly, it can be shown that as the future is valued less (i.e. when the discount rate is higher) the interval of stocks for which there is a reversal of the standard impact of status concern expands.

What is the intuition behind the reversal of the standard impact of status on exploitation? At first sight, one might expect that if output-based status concern leads to a more voracious behavior, so would profit-based status concern. However the 'reversal result' found by Benchekroun and Long (2015) shows that this intuition may be misleading, because it ignores the stock effect. In a dynamic game the use of feedback rules gives firms an additional incentive to overproduce when the equilibrium strategies display a positive relationship between harvesting rates and stock level. Under these conditions, each firm knows that if it increases its exploitation today, that will have a negative influence on tomorrow's stock level, and this lower stock will induce a fall in tomorrow's rate of exploitation of the other firms. The greater the degree of responsiveness of extraction to changes in the stock level, the larger this incentive to overproduce. Benchekroun and Long (2015) show that the output-based status concern raises the extraction schedule uniformly but does not impact the responsiveness with respect to stock level, and thus it

leaves the feedback incentive for overproduction unchanged. In contrast, the profit-based status concern affects the degree of responsiveness of extraction to stock level, and thus modifies the overproduction incentive.

3 Altruism, Inequality Aversion, and Corporate Environmentalism: Effects on the Environment

That individual preferences may display altruism is well acknowledged. In fact, classical economists did not claim that human beings are pure egoists. Adam Smith's opening paragraph of The Theory of Moral Sentiments (1770, Part I, Section I, p.11) reads:

> "*How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it, except the pleasure of seeing it.*"

Smith (1770) argues that "humanity, justice, generosity, and public spirit, are the qualities most useful to others" (p.189). On the same vein, Edgeworth (1881, p.104) observes that "the concrete nineteenth century man is for the most part an impure egoist, a mixed utilitarian."[8] In fact, Pigou (1920) argues that his motivation for doing economic research is driven by altruism:[9]

> "*The complicated analyses which economists endeavour to carry through are not mere gymnastic. They are instruments for the bettering of human life. The misery and squalor that surround us... are evils too plain to be ignored. By the knowledge that our science seeks it is possible that they may be restrained. Out of the darkness light! To search for it is the task, to find it, perhaps, the prize, which the 'dismal science of Political Economy' offers to those who face its discipline." (Pigou, The Economics of Welfare 1920, p. vii.)*

[8] It has been argued that altruism is favored by evolution. See e.g. Dawkins (1976, 1986).

[9] Pigou was concerned with both efficiency and equity. In Chapter IX, Pigou analyzed the effects of various tranfer schemes from the rich to the poor. As far as mathematical gymnastics is concerned, Pigou relegated most of it to footnotes and Appendices.

3.1 The individual level

Models of public good contributions (such as charitable donations) are typically cast in terms of an individual's maximization of her utility function that contains as arguments not only one's own consumption but also the consumption of the persons who receive the donations. (Warr, 1983; Kemp, 1984; Bergstrom et al.,1986; Kemp and Shimomura, 2002; Kemp and Long, 2009). A possible interpretation of the canonical model of voluntary contributions to a public good (as in Bergstrom et al., 1986) is that the public good yields useful services to each contributor, and individuals are simply maximizing their standard utility functions, not taking into account the welfare of others. However, an alternative interpretation is that contributors value the public good because not only it yields services to them, but also to others. Thus, the model is applicable to situations where individuals have other-regarding preferences. In the simplest form, individual i has the utility function $u_i(x_i, G)$ where x_i is her private good consumption, and G is the public good, where $G = \sum g_j$ and g_j is individual j's contribution, subject to her budget constraint $x_j + g_j \leq Y_j$ (her income).[10]

The standard model of voluntary contributions to a public good has been extended in several directions. Andreoni (1990) adds the 'warm-glow' effect as an argument of the utility function: holding private consumption and the size of the public good constant, an individual is happier, the greater is her contribution g_i. Fehr and Schmidt (1999) suppose that individuals are averse to inequality. Basically, they assume that an individual's happiness depends not only on the private well-being level u_i but also on a social component which depends on the vector of well-being levels of all members of society, $(u_1, u_2, .., u_n) \equiv \mathbf{u}$. In Fehr and Schmidt (1999), the social component is assumed to represent inequality aversion:

$$S_i(\mathbf{u}) = -\frac{\gamma_i}{n-1}\sum_{j\neq i}\max(u_j - u_i, 0) - \frac{\beta_i}{n-1}\sum_{j\neq i}\max(u_i - u_j, 0)$$

where $0 \leq \gamma_i < 1$ and $0 \leq \beta_i < 1$. Thus $S_i(\mathbf{u})$ attains its maximum value when $u_i = u_j$ for all j. The individual's happiness is

$$V_i = \lambda_i u_i + (1 - \lambda_i) S_i$$

[10] There is a large empirical literature on altruism. See e.g. Bergstrom et al. (2009), Fischbacher et al. (2010), Andreoni (2006).

where $0 \leq \lambda_i \leq 1$. Suppose, for example, that there are only two individuals, i and j, and that initially $u_i = u_j$. Then, if $\lambda_i < 1$ and $0 < \gamma_i < \beta_i$, an increase in u_j by $\varepsilon > 0$ while u_i is unchanged will reduce i's happiness by $(1 - \lambda_i)\gamma_i\varepsilon$, while an increase in u_i by $\varepsilon > 0$ keeping u_j unchanged will reduce i's happiness by more, $(1 - \lambda_i)\beta_i\varepsilon$.

A simpler form of inequality aversion is proposed by Bolton and Ockenfels (2000). In a nut shell, they represent inequality aversion in the form of a function S_i such that

$$S_i = S_i\left(\frac{u_i}{\sum_{j=1}^{n} u_j}\right)$$

where it is assumed that S_i reaches its peak at $1/n$, i.e. when i's well-being equals the average well-being. In both Fehr and Schmidt (1999) and Bolton and Ockenfels (2000), the maximum value of the social component S_i does not depend on the size of the pie. However, Charness and Rabin (2002) present evidence which suggests that the size of the pie affects the individual's choice. For example, in the Prisoner's dilemma game, experimental evidence indicates that other things being equal, if an increase in the payoff when both players cooperate will increase the rate of cooperation. Thus, they propose that the social component takes the form

$$S_i = \delta_i \min_{j \neq i} u_j + \varepsilon_i \sum_{j=1}^{n} u_j$$

where $\delta_i > 0$ and $\varepsilon_i > 0$. Here $\delta_i > 0$ reflects the concerns for the least advantaged individual, and $\varepsilon_i > 0$ indicates that the size of the pie matters.

How does social preferences affect the environment? In particular, if individuals are heterogeneous in that they have different degrees of social preferences, how does that effect the Pigouvian taxes? This taxation question was addressed in a paper by Long and Stähler (2012) titled 'Should the Good and the Selfish be Taxed Differently?' The authors suppose that each individual i maximizes $u_i + \theta_i S$ where S is the sum of individual well-being levels, and θ_i (which measures the degree of social responsibity) differs across individuals. Assume that each individual's consumption of a particular good (e.g., travel) gives rise to emissions. They demonstrate that the socially optimal taxes are independent of the θ_i.

3.2 The firm level

Moving beyond the individual level, let us consider the case of polluting firms with different degrees of social responsibilty. Just as individuals are willing to take into account the welfare of others, it has been argued that some firms do (or should) care about things that are beyond their traditional boundaries. In contrast with the standard approach of maximizing 'shareholder value' (Rappaport, 1986; Jensen and Meckling, 1976), there have been appeals for firms to consider 'stakeholder value'. Tirole (2001, page 3) observes that

> "*To many people the economists' and legal scholars' sole focus on shareholder value appears incongruous. Managerial decisions do impact investors, but they also exert externalities on a number of 'natural stakeholders' who have an innate relationship with the firm: employees, customers, suppliers, communities where the firm's plants are located, potential pollutees, and so forth.*"

For this reason, Tirole defines corporate governance as 'the design of institutions that induce or force management to internalize the welfare of stakeholders' (p. 4). He adds that 'the provision of managerial incentives and the design of a control structure must account for their impact on the utilities of all stakeholders in order to induce or force internalization." Proponents of 'stakeholder value' argue that 'the firm should refrain from bribing officials in less developed economies even if the probability of being caught is small, or from polluting where pollution taxes or permits are not yet put in place.' (Tirole, p. 23).

The concept of stakeholder became popular since the publication of R. Edward Freeman's book, "Strategic Management: A stakeholder approach" (1984). The importance of 'Corporate Social Responsibility' (CSR) is widely acknowledged among multinational firms. Regarding the environment, the it might be argued that the 'stakeholder value' point of view is reflected in what has been termed "corporate environmentalism."[11] However, it is not clear that corporate environmentalism, defined as initiatives and self-regulation by firms concerning their impacts on the environment, is always good for society. Self-regulation may sometimes be no more than self-interest. As pointed out by

[11] Interbrand measures the leading brands' green efforts (environmental sustainability performance) and provides each year the Top 50 Best Global Green Brands ranking. For the year 2014, the top five are Ford, Toyota, Honda, Nissan, and Panasonic.

several authors (Maxwell et al., 2000; Lutz et al., 2000; Conrad, 2001), profit-maximizing firms may, for example, reduce pollution discharges in order to pre-empt or weaken anticipated regulations. On the empirical front, a study by Nakamura et al. (2001) finds that the utility maximization model (where managers' values and attitudes are included) performs better than the profit-maximization model in explaining differences among Japanese firms' environmental programs. [12]

There are some unexpected twists. In a model of strategic trade and environmental policies involving two countries, Home and Foreign, and two firms, Jinji (2013) investigates the impact of corporate environmentalism on the welfare of the Home country if the Home firm cares about its impact on the global pollution. Let D and D^* denote the environmental damages to Home and Foreign.[13] The Home firm seeks to maximize $\pi - \theta(D + D^*)$ where π is its profit, and θ is the Home firm's degree of environmental consciousness. The Foreign firm cares only about its profit. Both firms sell their entire output in a third market which is assumed to be not affected by pollution. The governments of Home and Foreign have two policy instruments: the pollution tax rate, and the export subsidy rate.

Jinji assumes that $D = E + \alpha E^*$ and $D^* = E^* + \alpha E$, where E and E^* are emissions by the Home firm and the Foreign firm. If $\alpha = 0$, pollution is local, and if $\alpha = 1$ the pollution is completely transboundary. Jinji (2013) finds that in the case of local pollution, the degree of environmental consciousness of the Home firm is irrelevant to social welfare, if both governments non-cooperatively set the levels of both policy instruments to maximize national welfare.[14] However, if pollution is transboundary, and θ is sufficiently great, Home's welfare is lower as compared with the counterfactual scenario where $\theta = 0$. This is because the Home firm cares about the effect of its emissions on Foreign's environmental quality, while Home's welfare (as perceived by Home's government) does not include this effect. Note that in Jinji's formulation, the Home firm cares about its own profits and its impacts on the environment, and not about other elements of social welfare (which would include government's revenue etc.) This is why Jinji's result differs from the optimal tax

[12] The theory of mixed oligopoly investigates the implication of co-existence of profit-maximizing firms and firms that partly care about social welfare. See e.g. De Fraja and Delbono (1989), Long and Stähler (2009).

[13] Foreign variables are marked with an asterisk.

[14] In Jinji's definition of social welfare, the firm's payoff is deemed to be non-inclusive of its distaste for its contribution to pollution. There are two opposing views on this issue; see e.g. Andreoni (2006) for a discussion.

results of Long and Stähler (2012), who show that in a society with heterogeneous agents having different degrees θ_i of social preferences the optimal tax design is independent of the distribution of these preferences.

Yanase (2013) investigates the implication of corporate environmentalism in a dynamic oligopoly. Unlike Jinji (2013), Yanase considers a closed economy. The firms'emissions result in a gradual building up of a stock of pollution. Their objectives inlude both profit and environmental damages. It is assumed that the damages at any time depends only on the current stock of pollution, not on the current flow of emissions. Firms use feedback stragegies. In the context of stock pollution, a feedback strategy is a rule that tells the firm how much to produce in the current period, given the currently observed stock of pollution. Each firm chooses its best strategy in response to the strategies of other firms. In the case of symmetric firms (i.e. they have the same emission technology and the same evaluation of environmental danages) Yanase finds that there is a continuum of equilibria, each giving rise to a different steady-state pollution level. However, if the firms focus on linear strategies, then the equilibrium is unique.[15]

Focusing on linear strategies, Yanase (2013) shows that in the case of symmetric firms, an increase in the degree of environmental consciousness of the firms will reduce welfare in the short run. In any given period, the stock of pollution (and hence the level of current damages) is given. Therefore an increase in environmental consciousness, which leads to output reduction, will increase the price and reduce consumers'surplus. Turning to the long run, Yanase (2013) shows that an increase in environmental consciousness will reduce the steady-state pollution stock and output. If the number of firms is large the output loss does not generate a great loss of consumers' surplus, and hence the net effect on welfare is positive. However, if there are just a few firms then the steady-state industry output level is small, and an increase in environmental consciousness will reduce welfare, because the resulting large loss of consumer surplus outweighs the reduction in pollution damages.

3.3 The national and international level

Let us now move beyond the levels of individuals and firms, and consider nations (or governments) as decision-making units. We suppose that governments have an objective

[15] This type of results is well known in the literature on dynamic games, see e.g. Dockner and Long (1993).

function to maximize. The typical assumption in economics is that nations are selfish: the welfare of other nations does not appear as an argument in their objective function. In the theoretical investigations of international environmental agreements (IEAs), most authors take this point of view. We now briefly review the standard results of the theory IEAs, before asking if 'other-regarding preferences' would change the results in any significant way.[16]

Establishing institutions such as voluntary international environmental agreements (e.g. the Kyoto Protocol) present formidable problems. There are two key issues here. First, what are the incentives for countries to be signatory of an IEA ? Second, what are the punishment mechanisms if a member of an IEA fails to carry out the actions that it has agreed to take (i.e. if it cheats)? Let us assume for the moment that the second issue (the enforcement problem) can be resolved, and every country knows that once they join an IAE they have to carry out the agreed upon level of abatement.[17] Several authors have developed models of IEA formation within the non-cooperative game framework (Barrett,1994, Carraro and Siniscalco, 1993, Rubio and Ulph, 2006, Diamantoudi and Sartzetakis, 2006). The game consists of two stages. In stage 1, each country decides if it wants to be a member of a proposed IEA or to be non-member. Countries that are not members are said to be long to the fringe. In stage 2, non-members choose their own abatement levels, while all members of the IEA must coordinate their abatement levels to maximize the sum of their welfare levels.

Consider the case of homogeneous countries. Let $\pi^s(m)$ and $\pi^{ns}(m)$ denote the equilibrium payoffs of the signatory and non-signatory (or fringe) countries, when the number of signatories is $m \leq n$. A given IEA with m members is said to be internally stable if no member wants to leave the IEA, i.e.,

$$\pi^s(m) \geq \pi^{ns}(m-1)$$

and externally stable if no country in the fringe has an incentive to join the IEA, i.e.,

$$\pi^{ns}(m) \geq \pi^s(m+1)$$

[16] For a more comprehensive review of IEAs, see Benchekroun and Long (2012).

[17] As is well known, with infinitely repeated games, cooperation can be sustained if the discount rate is sufficiently small. See e.g. Asheim and Holtzmark (2009).

An IEA is said to be *stable* if and only if it is internally and externally stable.[18]

Though their models are slightly different in details, Barrett (1994), Carraro and Siniscalco (1993), Rubio and Ulph (2006), Diamantoudi and Sartzetakis (2006), and others find that the free-rider incentives (i.e., the incentives not to join an IEA) are stronger than the incentives to join. Their models yield the pessimistic conclusion that, in the absence of additional mechanisms such as trade sanction and technology transfer, the size of the stable coalition is typically small- around 3- regardless of the total number of countries. A further result is that when further assumptions allow the existence of a large stable coalition, the gains relative to non-cooperation are small (Barrett 1997, Carraro 1999, Rubio and Ulph, 2006, Eichner and Pethig, 2013, 2014).[19]

What happens if nations have other-regarding preferences? Kosfeld et al. (2009) investigates coalition formation for providing public goods and find that when preferences include inequality aversion (in the sense of Fehr and Schmidt, 1999) a grand coalition can be stable. Lange (2006) finds that equity considerations give negotiating parties stronger incentives to reach an IEA.[20]Kolstad (2010, 2011, 2014) examines the role of other-regarding preferences on public goods provision and IEA formation in a world with n countries ($n \geq 2$).For tractability, Kolstad (2014) assumes that private wellbeing u_i is linear in both its private good consumption (equal to its actual emission level) , x_i, and in the public good, G, where G is aggregate abatement. It is the sum of the abatements of n countries: $G = \sum_k g_k$. The 'budget constraint' of country i is $x_i + g_i = Y_i$, where Y_i is its maximum potential emission level, which is exogenously given. Adapting the social preferences proposed by Charness and Rabin (2002), Kolstad (2014) assumes that country i's objective function is

$$V_i = \lambda_i \left[Y_i - g_i + aG\right] + \delta_i \left[Y_m - g_m + aG\right] + \varepsilon_i \left[\sum_{k=1}^{n} \left[Y_k - g_k + aG\right]\right]$$

where $\lambda_i + \delta_i + \varepsilon_i = 1$, and $\lambda_i > 0$, $\delta_i \geq 0$, $\varepsilon_i \geq 0$. Country m is assumed to be the

[18]This stability definition, based on d'Aspremont et al.(1983) is used in the IEA papers mentioned above. Other stability definitions exist; see e.g. Chander and Tulkens (1995, 1997, 2006), Diamantoudi and Sartzetakis (2015), Benchekroun and Long (2012).

[19]Barrett (1999) assumes linear payoff, and allow credible punishments in the context of repeated games. Eichner and Pethig (2013, 2014) allow international trade and capital mobility.

[20]Lange et al. (2007) report that delegates involving in climate change negotiations indicate they have a strong preference for equity.

country with the lowest well-being level. It is assumed that $1/(n-1) < a < 1$. Thus, in the absence of other-regarding preferences, (i.e. $\delta_i = \varepsilon_i = 0$), no country will abate.

Consider first the case of where all countries are identical. Clearly, in this case, if all countries cooperate, each will abate the maximum amount, i.e. $g_i = Y_i = Y$. If countries do not cooperate, and there is no proposal of forming an IEA, the non-cooperative Nash equilibrium will have the property that (i) $g_i = 0$ if $a < \overline{a}$ and (ii) $g_i = Y$ if $a > \overline{a}$, where $\overline{a} \equiv (\lambda + \varepsilon)/\left[1 + (n-1)\varepsilon\right]$. This corner solution property is due to the the assumption of a linear utility function. What happens if a subset of countries can form a coalition (an IEA) to coordinate their abatements?

Kolstad at first considers the coalition formation game with countries that are heterogeneous in many dimensions, and then specializes to the case where they differ only in their maximum potential abatements, Y_i. He finds that stable coalition must be of size $\widetilde{n}$, where $\widetilde{n}$ is the smallest integer that is greater than $\lambda/\left\{a + (a(n-1)-1)\varepsilon\right\}$, where $a(n-1) > 1$. This result is puzzling. It states that (i) an increase in ε (the concern for efficiency), keeping λ (the weight attached to social preferences) constant, will lead to a smaller stable coalition; and (ii) keeping ε constant, a fall in λ (i.e., an increase in the weight attached to social preferences) will lead to a smaller $\widetilde{n}$. These results seem to be in sharp constrast to the results of Kosfeld et al. (2009) which show that even the grand coalition can be stable if agents are inequality averse (in the sense of Fehr and Schmidt). However, upon reflection, the two set of results are not totally contradictory. In fact, taking into account Kolstad's restriction that $\lambda + \delta + \varepsilon = 1$, if we keep λ constant and increase δ (i.e. increase the concern for the least advantaged), then ε must fall, and thus $\widetilde{n}$ must rise. Thus Kolstad's result is at least partially consistent with the results of Kosfeld et al. (2009).

While the disadvantage of Kolstad's model is the linearity assumption, which leads to corner solution in abatement, a non-linear model, however, would be intractable analytically, and one would have to rely on numerical calculations.

4 The Kantian motive and its implications for the environment

The contributions surveyed in the two preceding sections have one point in common: the authors modify the utility function of the agent so as to include what they think are missing in the standard formulation of preferences. Given the modified utility function, the authors assume that each economic agent chooses the level of the variables under her control to maximize her modified utility, taking as given the actions (or strategies) of other agents. In this section, let us turn to an entirely different approach to the problem of choices that affect the environment: the Kantian approach.

There is a sharp contrast between the preference-based approach and the Kantian approach: in the latter approach, some choices are made on ethical ground and thus are not necessarily utility-maximizing for the individual. Thus, in some spheres of activities, an action is chosen because it is morally compelling. Modern proponents of this approach include Laffont (1975) and Roemer (2010). That an individual's well-considered choice need not be utility-maximizing has been repeatedly emphasized by Sen (1977, 1987, 1993). Unlike the utilitarian approach, the Kantian approach puts great emphasis on what is morally right. Rawls' influential work, A Theory of Justice (1970), is definitely Kantian. In this section, I review some models that address environmental issues with explicit reference to Kantian ethics, as well as models that use the right-based approach inspired by the Kantian tradition to study allocation problems in resource and environmental economics.

One of the first modern economists who explicitly refer to the Kantian ethics is Laffont (1975). He motivates his article 'Macroeconomic Constraints, Economic Efficiency and Ethics: An Introduction to Kantian Economics' with the following question concerning environmental consciousness:

"Why is it that (at least in some countries) people do not leave their beer cans on the beaches?"

This question is difficult to answer using the Standard Model of Economic Behaviour. The impact on an individual's own 'welfare' of throwing his own beer cans on the beach is certainly negligible, and it is quite tiresome for him to walk to a dustbin located a few hundred meters away; yet this is what he does.[21] Laffont asks, 'What is the best way to

[21] Laffont added: "A classical argument may rest on the hope that a demonstration effect will work:

describe the decision process of these people?'

Laffont's explanation is very simple, yet compelling: "Every economic action takes place in the framework of a moral or ethics." According to him, Kant's rule can explain well the observed pro-social behavior.[22] Laffont's article refers to the categorical imperative formalised by Kant (1785). While Kant's book offers several formulations of this concept, for our purposes it seems adequate to present it as follows: *Act as if the maxim of your action were to become through your will a general natural law.*[23]Laffont's beach example shows that "in some countries citizens have appreciated their responsibilities" toward the environment.[24]

It is important to formalize the decision process of individuals motivated by Kantian ethics, and to characterize the equilibrium reached. Recall that in the standard game theory, a Nash equilibrium is a situation in which each player finds that if she deviates from her current action, she will get a worse payoff, assuming that everyone else is not deviating. We may say that a player's '*Nash counterfactual*' describes the payoffs that she would receive if she were to deviate while all other players do not. A profile of actions is a Nash equilibrium if for each player all Nash counterfactuals give her a lower payoff. Laffont supposes that, when confronting an ethical choice problem, Kantian agents do not make decisions on the basis of Nash counterfactuals. Instead, they consider only *Kantian counterfactuals*: "If I were to deviate, what payoff would I get, were all other agents to do likewise?"[25]

Refering to Laffont (1975) and his simplifying assumptions of identical individuals, Roemer (2010) proposes a formulation of the concept of 'doing likewise' in a more general model in which agents are heterogeneous in terms of cost parameters or utility parameters, but at the same time they are morally alike in that they consider only Kantian counterfactuals. In Romer's formulation, an agent is at a Kantian equilibrium if and only

however, with anonymous people the strength of this argument can easily be weakened."

[22]Laffont cites Arrow (1973) as the source of his inspiration.

[23]See Bertrand Russell's *A History of Western Philosophy.* As explained by Russell (1945, p. 737) 'There are two sorts of imperative: the hypothetical imperative, which says "You must do so-and-so if you wish to achieve such-and-such and end"; and the categorical imperative, which says that a certain kind of action is objectively necessary, without regard to any end.'

[24]Laffont's observation is concordant with Adam Smith's view on social norms. See Adam Smith (1790, p. 190).

[25]Laffont points out that "It is clear that the meaning of 'the same action' will depend on the model and will usually mean 'the same kind of action'. However to simplify the argument we choose economies with identical agents...Our purpose is to illustrate an idea rather than to present a complete model".

if she would receive a lower payoff upon scaling up (or down) her activity level by a factor $\lambda > 0$, were other players to follow suit by scaling up (or down) their activity level by the same factor. For example, when I carry out a conversation in a restaurant setting, I would consider that the level of noise I make is appropriate if by raising my voice above that level, I would feel worse off, assuming everyone would do likewise.

Roemer (2010) shows that if all agents are Kantian, they will overcome the tragedy of the commons: Even though they do not explicitly coordinate their harvesting efforts, when they harvest at the Kantian level, the common property resource will be efficiently exploited in the sense that the outcome is Pareto efficient. Ghosh and Long (2015) generalize Roemer's model in two directions. First, they allow for interaction between two types of agents: Kantian agents, who use Kantian counterfactuals in deciding on their action, and Nashian agents who use Nash counterfactuals. The resulting equilibrium is called a Kant-Nash equilibrium. They consider a game of voluntary contributions to a public good, and find that in a Kant-Nash equilibrium, the payoff to Nashians is higher than the payoff to Kantians, but the difference in payoff falls as the proportion of Kantians in the population becomes larger.[26]Despite having a lower utility payoff, Kantians do not defect to become Nashians, because utility is not the only thing that counts.[27]

Ghosh and Long's second extension is to define the concepts of a dynamic Kantian equilibrium and a dynamic Kant-Nash equilibrium. They find that in a dynamic game of common-access resource, the symmetric dynamic Kantian equilibrium is Pareto efficient. In a further generalization, Long (2015) proposes the concept of virtual co-mover equilibrium, which contains the Nash equilibrium and the Kantian equilibrium (and a variety of Kant-Nash equilibriums) as special cases. In that formulation, each player has a non-empty set of virtual co-movers: she behaves as if her virtual co-movers would act like her. A Nashian player's set of virtual co-movers is a singleton: it contains only herself. In contrast, a Kantian's set of virtual co-movers is the set of all players in the game. Moving beyond individuals, Long (2015) considers a dynamic game of pollution abatement among m countries. Assuming that n of these countries act in a Nashian way, while the remaining $k = m - n$ countries adopt the Kantian behavior, Long (2015) finds that the

[26]In contrast, Long (2016) shows that in a Bertrand oligopoly with differentiated products, in a Kant-Nash equilibrium, the Kantian firms can achieve higher payoffs than the Nashian firms. This is related to the result in industrial organization theory that if in an oligopolistic industry consisting of m firms competing in prices, a merger between k firms can be profitable, even if k/m is small.

[27]Sen (1987) argues that it sometimes make good sense to make a 'counter-preferential' choice.

quality of the environment in the steady state is higher if the proportion of countries that are Kantian is larger.

To summarize, Kantian models differ from models of social preferences in that Kantian agents do not include other agents' welfare in their utility function. In making an ethical choice, a Kantian agent does not ask if her action would maximize her utility given the actions of other agents. She asks instead if her action would maximize her personal utility if other agents were to act likewise, even though she does not necessarily believe that some or all of them would act likewise. Thus, the emphasis is what is the right thing to do, rather than what is the privately most profitable thing to do.

There is a related literature in resource and environmental economics that follows the Kantian-Rawlsian tradition in that it puts the emphasis on rights. The motivation is that the standard utilitarian approach in economics fails to take rights seriously. The Rawlsian criterion is right-based: society should maximize the life prospect of the least advantaged and ensure that all individuals have the fundamental liberties, and the right to a decent standard of living, inclusive of access to natural capital, and access to public offices. This 'maximin' criterion has spawned a stream of economic literature on sustainable development. Solow (1972) explores the implication of the Rawls-inspired maximin criterion in an economy with an exhaustible resource stock. Burmeister and Hammond (1977) study maximin paths in a model with heterogeneous capitals, with a focus on steady states. Stollery (1998) and d'Autume et al. (2010) characterize the maximin path in the context of climate change. Cairns and Long (2006) generalize the Solow approach to define sustainability in an economy with many types of assets, renewable and non-renewable. In the same vein, Cairns and Martinet (2014) propose a measure of sustainable development based on the maximin criterion.

Sustainable development has been described in the Brundtland report (WCED, 1987) as development "that meets the needs of the present without compromising the ability of future generations to meet their own needs." Current growth patterns induce concerns for sustainability, in particular with respect to environmental degradations. Intergenerational equity and environmental issues are cornerstones of sustainability. Reflecting the concerns for rights, environmental issues are often addressed by setting objectives in terms of quantitative targets. Along these lines, it has been argued that society should impose constraints, in the form of floors or ceilings, on various variables of the development path (Martinet and Doyen, 2007; Martinet, 2012). For example biodiversity should not fall

below a certain level, while emissions of pollutants should not exceed a certain level.[28] These thresholds can be interpreted as *minimal rights* to be guaranteed to all generations. Of course, if floors are too high and ceilings are too low, the set of possible actions will be empty. To rule out such a case, one has to address the trade-offs among minimal rights, as described in Martinet (2011).

In Martinet (2011) there is no mention of welfare or utility function. Instead, the social trade-offs are among levels of a variety of rights. Martinet's dynamic model is used to address only the issue of sustainability of rights, not intertemporal utility trade-offs. Economic growth is not a concern in Martinet's model. In contrast, Rawls (1970) acknowledges that economic growth is necessary, because without adequate material resources a society cannot develop institutions that guarantee equal liberties to all.[29] Wealth creation is necessary for the effective defense of rights and liberties. Welfarist considerations cannot be ignored. Along this line of reasoning, Long (2007) investigates the implications of the Rawlsian concept of 'just saving' and Alvarez-Cuadrado and Long (2009) propose a new criterion called Mixed Bentham-Rawls (MBR) criterion, which ranks social alternatives by taking into account both the endogenously chosen floor on consumption, and the time path of utility. The MBR criterion has been applied to the evaluation of climate change policies (Tol, 2013), and renewable resource exploitation (Figuieres et al., 2013).

Long and Martinet (2012) develop an approach, called Rights and Welfare Indicator (RWI), which encompasses both welfarist considerations and the concern for rights. They emphasize that, if minimal rights are imposed to the development path, one should account for the consequences of these rights on welfare when setting their levels. They show that a criterion combining an index based on minimal rights with a welfare index can be used to define endogenously the levels of the minimal rights, accounting for the associated cost in terms of present-value welfare. This could represent the choice of a society defining (economic and environmental) minimal rights to be guaranteed over time to embody the idea of sustainability along a development path. They apply the RWI approach to

[28] Socio-economic thresholds could also be mentioned, for instance on health and education.

[29] The need for adequate savings is a major concern for Rawls, because, "to establish effective, just institutions within which the basic liberties can be realized"society must have a sufficient material base. Noting that the unmodified difference principle would lead to "no savings at all," Rawls pointed out that the difference principle must be modified to allow for economic growth. For this purpose, he sketched a theory of "just saving" in which generations must "carry their fair share of the burden of realizing and preserving a just society." See Long (2007) for a discussion of this issue.

the standard Dasgupta-Heal-Solow model[30] of non-renewable resource exploitation and capital accumulation, and show that in the decentralized implementation, there must be a wedge between the consumer's interest rate and the producer's rental rate. This wedge between producer's interest rate and consumer's interest rate implies tax or subsidy on savings, to ensure minimal consumption rights. The gap is negative early in the program, and positive toward the end of the program.

5 Conclusion and Directions for Future Reseach

The Standard Model of Economic Behavior has much to offer, and yet, at the same time, it cannot account for an important class of economic phenomena which arguably have significant impacts on the environment and on society's wellbeing. In this paper, I have reviewed the main body of research in environmental and resource economics that falls outside the Standard Model. As we have seen, this body of work consists of two streams of literature: the preference-based stream, which is utilitarian in outlook, and the ethics-based stream, with a strong emphasis on rights. We have seen a few surprising results when agents have other-regarding preferences. For example, in a dynamic model of resource exploitation, while envy tends to exacerbate the tragedy of the commons, this result need not hold when the common is exploited by oligopolists whose envy is based on relative profits. Similarly, when social preferences include the concern for efficiency, an increase in this concern can cause the size of stable coalition for an international environmental agreement to become smaller. Nevertheless, when choices are made on the basis of Kantian ethics rather than preferences, we obtain a robust result: the greater the number of Kantians, the greater is social welfare.

There are a number of directions for future research outside the Standard Model. What happens to Kantian-Nashian interactions when Nashian agents themselves have other-regarding preferences (reflecting envy or altruism, or inequality aversion)? What happens if each individual sometimes act as a Kantian, and at other times as a Nashian? How is the ratio of Kantians to Nashians change over time? Would a model using replicator dynamics be able to shed some light on the evolution of this ratio?[31]

[30] See Dasgupta and Heal, (1974, 1979), and Solow (1974).

[31] For some examples of economic models with replicator dynamics, see Bala and Long (2005), Breton et al. (2010). For a continuous-time model of replicator dynamics with three types of behavior, see Sethi and Somanathan (1996)

Let me end this paper with a note of hope. Environmental policies, like other policies, are determined by an interplay of political forces that to some extent reflect voters' preferences, perceptions, and behavior. Social changes will take place when the balance of forces changes. If, for example, more people can be convinced to become Kantian, the prospects of improvement for the environment could become brighter. The economic profession may have a role to play here. Economists' use of the word 'rationality' should be heavily qualified, lest their students misconstrue that acting in a Nashian manner is always a 'smart choice' regardless of the social context. Changes in voters' perception can lead to changes in a country's environmental policies, for example policies concerning carbon taxes, cap-and-trade, etc. The following passage from Kay (2015), taken from a somewhat different context, is quite relevant here

> "*The limits of what is politically possible have changed so much and so often in the course of my lifetime - Britain's coal mines have been closed and its railways privatized, gay couples are now allowed to marry, and a black president of U.S.A. has been elected- that to feel constrained by what is 'politically possible' is simply a failure of imagination.*" (Kay, 2015, p. 307.)

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