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Threshold preferences and the environment

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ABSTRACT

In this article we study the implication of thresholds in preferences. To model this we extend the basic model of John and Pecchenino (1994) by allowing the current level of environmental quality to have a discrete impact on how an agent trades off future consumption and environmental quality. Thus, we endogenize the semi-elasticity of utility based on a step function. We find that for low (high) thresholds, environmental quality converges to a low (high) steady state. For intermediate levels it converges to a stable p-cycle, with environmental quality being asymptotically bounded below and above by the low and high steady state. As policy implications we study shifts in the threshold. Costless shifts of the threshold are always worthwhile. If it is costly to change the threshold, then it is worthwhile to change the threshold if the threshold originally was sufficiently low. Lump-sum taxes lead to a development trap and a proportional income tax should be preferred.

1. Introduction

It is public opinion that drives governments' actions, decisions, laws, changes the political agenda and sometimes even its direction. But public opinion tends to be sticky and requires enough pressing issues for it to change. However, if sufficiently pressing problems are identified, then preferences undertake radical changes. This has been observed to be especially true for concerns directed to the environment. In this respect, Erskine (1972) noticed that "[a] miracle of public opinion has been the unprecedented speed and urgency with which ecological issues have burst into American consciousness". She then continues by saying that "[t]he environment does approach top priority today for expanded governmental spending in the opinion of the citizenry". In this article we model this radical change in the preferences and study its effects. To do so, we introduce the idea of threshold preferences to investigate the impact of discrete changes to preferences on the trade-off between consumption and the environment. In other words, we endogenize the semi-elasticity[2] of utility based on a step function.[3] Specifically, we suggest that if environmental quality is below a threshold then this increases agents' semi-elasticity of environmental quality in utility. In contrast, if agents are faced with a state of abundant environmental quality above that threshold, then their preferences are directed relatively less towards the environment, in the sense that the agents' semi-elasticity of environmental quality in utility will be low. In other words, we suggest that the current level of environmental quality has a discrete impact on how an agent trades off future consumption and future environmental quality.

The point that we develop here is that preferences should be viewed as being endogenous, but changes to the preferences require sufficiently strong impulses. Consequently, the model that we propose here has some relation to the class of models based upon lexicographical preferences (Sen, 1970; Gelso and Peterson, 2005). Lexiographical preferences are an interesting modeling approach since they allow to deal with the crossing of thresholds that are tacitly important for a society. This is relevant especially for the environmental domain. Specifically, actions devoted to environmental protection tend to be undertaken when situations are dire or pressing enough. As an example, the Cuyahoga River in the USA

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2 The semi-elasticity of a function $f(x)$ is defined as $f'(x)x$.

3 Prieur and Bréchet (2013) endogenize the semi-elasticity of utility via education expenditure, while Goulao and Pérez-Barahona (forthcoming) endogenize it via health capital.

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was so polluted that it caught fire several times. In consequence of this extreme pollution the Environmental Protection Agency was established, as well as a multitude of water quality regulations.

Our modeling approach is based upon the overlapping generations model of consumption and the environment by John and Pecchenino (1994). We extend their work by introducing the idea of *threshold preferences*.[4] As we shall show, our model of threshold preferences has further effects than a mere acceleration one. Crucially, the position of the threshold determines the dynamics and implications of this model. We show that for sufficiently high threshold levels, which would, for example, be the case for an ecologically-oriented society, our model predicts that this society will grow monotonically towards a high level of environmental quality. Instead, societies will be likely to converge to a low level of environmental quality if they only place priority on the environment in dire situations. This would be the case if the threshold is sufficiently low. However, for mixed societies, namely those that are in neither of these two extreme cases, we find that environmental quality will not converge to any steady state. Instead, when environmental quality is bad, then their preferences will be directed relatively more towards environmental quality, and consequently the state of the environment will improve. Once it has improved sufficiently (i.e. crossed the threshold), then the society's preference will shift back towards a more consumption-oriented one, implying less effort directed towards the environment. This will therefore induce a never-ending cycle. One could say this occurs simply because societies in this case are not sufficiently far-sighted and their reference point of environmental quality, or their status quo, essentially only depends on today's environmental quality. Or, in a slightly different interpretation, society's preferences lack sufficient consistency in a sense that they are too easily shifted by a reference point.

Though we take a black-box approach to the threshold in the model, there exist several ways in which the underlying mechanics can be derived. In particular, previous works in political science, regulation and standards, cultural economics as well as ecological economics can be readily used to argue that thresholds should be viewed as a fundamental structural component in utility (see our working paper Schumacher and Zou, 2015). These approaches do not provide a full-fledged micro-foundation for our threshold, but they can nevertheless help in supporting our reduced-form threshold model based on existing research from different fields.

We also show that there is a certain complementarity between the environmental quality that an individual or a society faces today, and the one that he or she is confronted with in the future. Thus, in a sense, our article borrows from the literature on intertemporally-dependent preferences (Ryder and Heal, 1973; Wan, 1970). Specifically, in our context this means that environmental quality today impacts how the individual or society values future environmental quality, and thereby affects the trade-offs between polluting and abating behavior. In this respect, an approach that is related to ours is the one presented in Schumacher and Zou (2008). In that article we pursue the idea that agents perceive the state of environmental quality not based on the actual level, but with reference to the status quo. In other words, agents cannot fully relate to the environment as it was before they were born, and are thus more strongly concerned with changes in the environment than with the level itself. The main result in that article is that, for a large set of parameters, the model would generate cycles which would lead to violations of standard criteria of intergenerational equity. In the current work we introduce a different yet complementary approach by suggesting that changes to the preferences only occur once a certain threshold has been crossed. The implication of this threshold is again that cycles are possible and therefore standard criteria of intergenerational equity will be violated, but the underlying reasons are different. In Schumacher and Zou (2008) cycles occurred because agents got habituated to pollution, while in the current approach agents change their preferences if society feels sufficient environmental pressure.

Our work also links to the article by Prieur and Bréchet (2013) as well as Goulao and Pérez-Barahona (forthcoming). In Prieur and Bréchet (2013), the authors endogenize the semi-elasticity of environmental quality via human capital, and call this expenditure in environmental awareness. They study whether education in environmental awareness may lead to sustained growth, or induce society to converge to a steady state. These authors show that, if environmental awareness is sufficiently sensitive to human capital, then society may not converge to the sustained growth equilibrium any longer but only to the steady state. Thus, the authors show how an endogenous environmental awareness can lead to a qualitative change in the dynamics. However, they obtain this by allowing for a balanced growth path, while we solely focus on a steady state economy. Also, we obtain much richer dynamics, and focus on a different source of endogeneity. In the article Goulao and Pérez-Barahona (forthcoming) the authors also endogenize the semi-elasticity of utility, but this time they study the impact of health capital on survival probabilities. The main mechanism in common with us is the authors' focus on a step-function. For high health capital, the semi-elasticity (probability of survival) of health in utility is high, while for low health capital this semi-elasticity takes a low value. These authors also find the existence of two stable steady states in their case. In contrast, our dynamics are much richer, and the reason for this is that, in our case, the endogenous feedbacks are more complex.

Our work also links to the class of endogenous preferences (Bowles, 1998) and cultural traits (Bisin and Verdier, 2001), even though we neither explicitly model the underlying cultural dynamics nor group heterogeneity. However, we show how a simple model of endogenous cultural traits can result in the type of utility function that we use in our model. This approach is in line with Schumacher (2009). In contrast to our current work, the modeling approach in Schumacher (2009) lacked an endogenous, explicit dynamic choice mechanism. In this article we present one way in which this choice mechanism can be modeled. While the results in Schumacher (2009) are based on an implicit decision progress, those presented here are based on an explicit, dynamic one.

Our results are that the location of the threshold determines both the potential steady states as well as the dynamics. For low (high) thresholds, environmental quality converges to a low (high) steady state. For intermediate levels it converges to a stable p-cycle, with environmental quality being asymptotically bounded below and above by the low and high steady state. We discuss implications for intergenerational equity and policy making. As policy implications we study shifts in the threshold. Our results are that, in case it is costless to shift the threshold, it is always worthwhile to do so. If it is costly to change the threshold, then it is worthwhile to change the threshold if the threshold originally was sufficiently low. Lump-sum taxes may lead to a development trap and we suggest that, in general, it may be better to rely in a proportional income tax.

The paper is organized as follows. Section 2 introduces the model and studies its dynamics and steady state properties. Here we also discuss the results and relate it to John and Pecchenino (1994) and Schumacher (2009). In Section 2.5 we discuss lessons for intergenerational equity and under what circumstances the model predicts convergence to a disastrous level of environmental quality. We look into possible policies in Section 3. In Section 4 we conclude.

[4] We came across this idea due to an article by Goulao and Pérez-Barahona (forthcoming).