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# Intergenerational equity with individual impatience in a model of optimal and sustainable growth

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ABSTRACT

Among the ethical objections to intergenerational impartiality is the violation of consumer sovereignty given that individuals are impatient. We accommodate that concern by distinguishing intra- and inter-generational discounting in an OLG model suitable for analyzing sustainability issues. Under the assumption of constant elasticity of marginal felicity, the optimum trajectory of aggregate consumption is guided, via the Ramsey condition, by the intergenerational discount rate but not the personal discount rate. In an economy with produced capital and a renewable resource, intergenerational neutrality results in a sustained growth path, without the necessity of a sustainability constraint, even in the presence of intragenerational impatience. We also find that green net national product remains constant along the optimal approach path to golden rule consumption.

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If I am not for myself, then who is for me? If I am not for others, who is for me?

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## 1. Introduction

The debate surrounding discounting, especially as it applies to the prospect of sustainable growth, has only intensified in the context of climate change (Stern, 2006; Nordhaus, 2007; Weitzman, 2007; Sterner and Persson, 2008; Heal, 2009). Intergenerational equity, and sustainability more generally,[2] are inherently normative inquiries (Solow, 2005, 2006). Nonetheless, social welfare functions are typically assumed to embody consumer sovereignty, including time preferences.[3] But how can we reconcile social preferences that respect *intergenerational neutrality*[4] and still base the social welfare function on individual lifetime utilities and the personal rates of time preference that they embody? A way out of the dilemma is to differentiate intragenerational impatience from the planner's utility discount rate.[5]

In order to engage the sustainable growth literature, we develop a continuous time overlapping generations model (Yaari, 1965; Blanchard, 1985; Blanchard and Fisher, 1989; Calvo and Obstfeld, 1988) with produced capital as well as natural resources, which incorporates the distinction between inter- and intra-generational utility discounting. While others have shown that intergenerationally neutral and optimal economic development is sustainable in the presence of renewability and/or a backstop (Heal, 2000; Ayong Le Kama, 2001; Endress et al., 2005),[6] the question of how to include individual impatience remains unaddressed. A key result of this paper is that incorporating information about intragenerational impatience into the model does not affect the level of aggregate consumption, which is governed solely by the intergenerational discount rate, $\rho$. Consequently, the conditions required to implement Koopmans' (1965) method of imposing intergenerational neutrality ($\rho = 0$) are satisfied.[7] We find that the optimal trajectory of aggregate consumption is rising, which implies that a sustainability constraint, if imposed, would be non-binding in the model.[8] Relatedly, sustainable income, defined as Green Net National Product (GNNP), is actually sustained along the optimal path, avoiding a paradox in the conventional approach.

Our focus is on sustainability and intergenerational equity, which distinguishes the present paper from others that also employ the OLG framework, some involving a two-stage optimization process that we adapt and apply. Calvo and Obstfeld (1988) analyze aspects of optimal fiscal policy for economies with capital accumulation and finitely lived, heterogeneous agents. For a particular utilitarian social welfare function, the problem faced by a central planner is broken down into two

[1] Arrow (1999, p. 16).

[2] While there are many different definitions, "sustainability" in this paper is taken as founded on the *three pillars* of intergenerational equity, interlinkages between the environment and the economy, and dynamic optimization (Stavins et al., 2003).

[3] As noted by Sandmo (1983), "The Bergson–Samuelson social welfare function is usually taken to reflect the principle of consumer sovereignty; social welfare evaluations should respect individual preferences."

[4] For reasons detailed in Section 2, we believe that "intergenerational neutrality" Koopmans (1965) is a compelling answer to Solow's (1986) challenge: "How much of the world's – or a country's – endowment of a nonrenewable resources is it fair for the current generation to use up, and how much should be left for generations to come who have no active voice in contemporary decisions?" Of course other ethical positions are possible (see, e.g. Dasgupta, 2011).

[5] Arrow (1999) and Dasgupta (2001) criticize zero utility discounting, albeit without discussing this distinction (see Section 2).

[6] Valente (2005) provides conditions for optimal growth to be sustainable in a model with positive utility discounting, resource renewability, and technical change.

[7] Koopmans (1965) has not enjoyed the prominence in the growth literature that Koopmans (1960) and Koopmans et al. (1964) have. Perhaps this is due to its original publication in a volume of essays rather than in a prominent journal. Nonetheless, Koopmans (1965) presents a way out of the dilemma of "timing neutrality" identified in the earlier papers. An alternative approach, based on the overtaking criterion, is presented in Weizacker (1965), wherein Weizacker proves a theorem about sufficient conditions for the existence of an optimal path. The theorem is then shown to be a generalization of Koopmans' (1965) theory of optimal growth in an economy with population growth, no technical progress and no (i.e. zero) time preference. Gale (1967) extends this analysis to optimal development in a multisector economy. Becker and Boyd (1997) and Dana and Le Van (2006) present modern versions of Weizacker (1965) overtaking. So called "good programs," based on Gale (1967) and analogous to Koopmans' (1965) "eligible paths," approach golden rule utility.

[8] See Endress et al. (2005) for a derivation of rising consumption with intergenerational neutrality albeit without intragenerational impatience.

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