Economics
The Open-Access, Open-Assessment E-Journal

Vol. 3, 2009 | July 16, 2009 | http://www.economics-ejournal.org/special-areas/special-issues/

Special issue on Discounting the Long-Run Future and Sustainable Development

Editor's Introduction

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> "There is something awkward about discounting benefits that arise a century hence. For even at a modest discount rate, no investment will look worthwhile."[1]
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> "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[2]

The major aim of this special issue is to demonstrate that in the eighteen years since that comment in The Economist, the nature of the problem with long-run discounting and its compatibility with the concept of 'sustainable develeopment', as used by the Brundtland Commission, has become clearer.

The practice of discounting the future has long been controversial both within the economics profession, and in the philosophical critiques of welfare economics and its counterpart, cost-benefit analysis.[3] Discounting involves lowering the weight given to a unit of cost or benefit in the future compared with the present. The further into the future the costs and benefits occur, the lower the weight tends to be. The higher the discount rate, and hence the lower the weight, the less likely it is that investments or policies that incur short-run costs and long-run benefits will be sanctioned by cost-benefit analysis. Conversely, projects with short-run benefits and long-run costs are more likely to be sanctioned by cost-benefit analysis. The resulting 'tyranny of the

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1 *The Economist* (1991), March 23, p 73.

2 United Nations. 1987."Report of the World Commission on Environment and Development." General Assembly Resolution 42/187, 11 December 1987.

3 See, for example, Portney and Weyant (1999).

present' is well known. This 'tyranny' is illustrated in the conclusion of the Copenhagen Consensus[4] in which different public investment projects have been examined by a panel of prestigious economists. Using standard cost-benefit analysis, they ranked projects with distant benefits (e.g. global warming) at the lowest level of priority compared to programs yielding almost immediate benefits (e.g. fighting malaria and AIDS, and providing sanitation in developing countries).

However, if, at the very least, current generations should have some regard to the interests of the long-run future, due account needs to be taken of the intergenerational effects of positive discounting. This special issue is not concerned with the choice of an ethical stance towards the interests of future generations, except to say that achieving the goal of sustainable development, widely espoused in international policy-making, will require some attention to be paid to the intergenerational effects of current decisions.

The last few years have witnessed important advances in our understanding of time preference and social discounting.[5] In particular, several rationales for the use of time varying—particularly declining—social discount rates have emerged. These rationales range from the ad hoc to the formal, with some founded solely in economic theory, while others consider principles of intergenerational equity. My view of the relevant, admittedly complicated, literature is that there are three powerful reasons why the social time preference rate might decline as the time horizon extends. First, uncertainty about the future, whether in terms of future economic growth, or future social time preference rates themselves, results in a declining rate. Second, considerations of intergenerational equity and future fairness argue against a discount rate that grants to the present generation a dictatorship over future generations. Third, experimental work by both psychologists and economists on individual choice has recently revealed that individuals discount the future at a declining rate, and that the discount rate follows a hyperbolic path. This special issue is focuses on theoretical and empirical attempts to define the trajectory of interest rates that is consistent with the goal of sustainable development. In doing so, the challenges raised by climate change are the prime policy issue addressed.

In recent years, the climate change debate has stepped in to drastically change economists thinking about discount rates. The climate change phenomenon makes it quite possible that actions taken today, notably the emission of greenhouse gases, will have significant consequences on people living 100 or 200 years hence. Indeed, this phenomenon has concerns of time, but also uncertainty in the forefront. There are uncertainties related to cloud formation, feedback from methane in melting permafrost and ecosystem responses to rapid change, to mention just a few. Hence it may come as a surprise to some non-economists that the main source of uncertainty in estimates of the economic consequences of climate change is something else: the discount rate. In fact, much of the critique of the Stern Review (2006) has focused not on the climate science embodied in the report or its assessment of the costs and benefits of climate change mitigation, but on the low discount rate used in the analysis and how this drives the

[4] Copenhagen Consensus is a project that seeks to establish priorities for advancing global welfare using methodologies based on the theory of welfare economics. Lomborg (2004) summarizes the Copenhagen Consensus 2004 conclusions. See project website: http://www.copenhagenconsensus.com/CCC%20Home%20Page.aspx.

[5] See Groom et al. (2005) and Pearce et al. (2003) for inclusive literature reviews.

central results of the Review (see, e.g., Dasgupta 2006; Yohe 2006; Nordhaus 2007; Weitzman 2007a).

We now review our papers in more detail. Based on economic theory, Christian Gollier (2009), one of the leading authors in this literature, attempts to answer the question: Should we discount the far-distant future at its lowest possible rate, as suggested in Weitzman (1998)? While answering this question the author builds a bridge between the two branches of the theoretical literature[6] on discount rates: the one based on consumption growth, and the one based on the productivity of capital. Theory suggests that (in an uncertain economic environment) it is the persistence of the shocks on the growth rate of consumption (consumption-based approach) or the persistence of the shocks on short-term interest rates (production-based approach) which determines the shape of the term structure of the socially efficient discount rate (Gollier et al. 2008: 760).[7] Gollier's main point in this paper is that Weitzman's (1998) result relies heavily on the assumption that shocks on the rate of return on capital are permanent. Alternatively, Gollier considers a model in which shocks are only transitory. In this alternative context, the term structure is flat, in which case one should not discount the far-distant future at its lowest possible rate.

The paper by Garciella Chichilnisky (2009) derives from the social choice literature, which introduces the notion of intergenerational equity and sustainability and shows that a declining discount rate, is consistent with a rule whereby current (future) generations must always take into account the well-being of future (current) generations; the 'non-dictatorship' of one generation over another. In particular, in this paper Garciella Chichilnisky (2009), one of the prominent authors in this literature, summarizes her work of many years, on alternatives to standard intertemporal social welfare functions, in attempt to show that avoiding extinction can be achieved through equal treatment of the present and the future. Equal treatment of the present and the future was required in the two axioms for sustainable development introduced in Chichilnisky (1997). In combination, these two axioms require that neither the present nor the future should play a dictatorial role in society's choices over time. Moreover, the axioms require that the ranking of alternative consumption paths is sensitive not only to what happens in the present and immediate future, but also to what happens in the very long run. Sensitivity to the present means that there is no date before which events are given zero weight. Sensitivity to the long-run future means that there is no date where changes after that date do not matter, in the sense of affecting the ranking.

In this special issue Chichilnisky (2009) shows that the two axioms are equivalent to awareness of physical limits in the long-run future. In particular, she proves that two optimization problems are equivalent: maximizing discounted utility with a long-run survival constraint and maximizing utilities that treat equally the present and the future. The equal treatment axioms are therefore the essence of sustainable development. The

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[6] See Groom et al. (2007) and Hepburn et al. (2008), for recent empirical (econometric) attempts to operationalize this literature.

[7] Bringing the two branches of economic theory together, in a frictionless economy, these two explanations are coherent with each other: persistent shocks on growth expectations translate into persistent shocks on interest rates, and both imply a declining pattern for discount rates. Hence it is irrelevant to know whether the new marginal investment project would be financed by a reduction in current consumption or by a reallocation of capital, since the equilibrium interest rates equals the return on capital and the marginal rate of intertemporal substitution.

weight given to the long-run future is identified with the marginal utility of the environmental asset along a path to extinction. An existence theorem is provided for optimizing according to the welfare criterion that treats equally the present and the future.

A related strand of recent literature on cost-benefit analysis of climate change suggests 'dual-rate discounting', where goods consumption is discounted with a consumption discount rate and environment consumption is discounted with an environmental discount rate. The motivation for dual-rate discounting is to justify substantial emission reductions, as possibly in this framework the environmental discount rate might be lower than the consumption discount rate and possibly in a model with endogenous dual-rate discounting both discount rates might decline over time. Tomas Kögel's paper focuses on the relation between dual-rate discounting and substitutability (Kögel 2009). He shows that whether or not this dual-rate discounting approach succeeds in justifying substantial emission reductions depends on whether or not environment and consumption goods are substitutes in the Hicks–Allen sense (i.e. the Hicksian goods demand is not decreasing in the relative price of environmental goods) and in the Edgeworth–Pareto sense (i.e. the marginal utility of consumption goods is decreasing in environment consumption). Moreover, Kogel shows that a low intra-temporal elasticity of substitution between the environment and consumption goods within a period, contributes to a low environmental discount rate in comparison to the consumption discount rate, while low intertemporal elasticity of substitution between composite consumption of different periods contributes to declining discount rates over time.

There is strong experimental evidence that individuals discount the future in their daily choices about consumption, and that they apply a declining discount rate. Furthermore, the decline of the discount rate follows a hyperbolic path (see Groom et al. (2005) for a review of this literature). The effect, compared with exponential discounting, is to lower the discount factor for near-term gains and losses, and to raise it for distant gains and losses. The economic literature has used hyperbolic discounting with considerable success to explain otherwise difficult and irrational phenomena, such as drug addiction, procrastination, and under-saving. In this special issue, Ralph Winkler (2009) examines the optimal intertemporal investment plan in environmental protection for a society where the agents use hyperbolic discounting. In such an environment he finds that agents give higher weight to future outcomes compared to the exponential discounting case. Using three different scenarios for the agents that the author calls, 'committed', 'naïve' and 'sophisticated', he shows that under some circumstances the agents may postpone investment for future periods leading to an inefficient outcome. This does not happen when the agents can commit to their initial plan. These results are consistent with real world observations and thus provide a new explanation for weak environmental policy performance.

The paper by Giles Atkinson, Simon Dietz, Jennifer Helgeson, Cameron Hepburn and Hakon Saelen is an empirical attempt to clarify the concepts of social preferences for risk, inequality and time in discounting climate change (Atkinson et al. 2009).[8] Indeed, arguments about the appropriate discount rate often start by assuming a

[8] See the 2008 special issue in *Journal of Risk and Uncertainty* on 'Discounting Dilemmas' for an excellent attempt to clarify these concepts (Zeckhauser and Viscusi 2008).

utilitarian social welfare function with isoelastic utility, in which the consumption discount rate is a function of the (constant) elasticity of marginal utility along with the (much discussed) utility discount rate. In this model, the elasticity of marginal utility simultaneously reflects preferences for intertemporal substitution, aversion to risk, and aversion to (spatial) inequality. While these three concepts are necessarily identical in the standard model, this need not be so: risk can be separated from intertemporal substitution. Separating the three concepts might have important implications for the appropriate discount rate, and hence also for long-term policy. Atkinson et al. investigate these issues in the context of climate-change economics, by surveying the attitudes of over 3000 people to risk, income inequality over space and income inequality over time. The results suggest that individuals do not see the three concepts as identical, and indeed that preferences over risk, inequality and time are only weakly correlated: the three concepts are just 'siblings and should not be treated as triplets'. As such, relying on empirical evidence of risk or inequality preferences may not necessarily be an appropriate guide to specifying the elasticity of intertemporal substitution.

David Anthoff, Richard Tol and Gary Yohe (Anthoff et al. 2009) use FUND, an integrated assessment model, to explore systematically the social cost of carbon and how it varies with the pure rate of time preference, the income elasticity of marginal utility (in its triple role of consumption growth discount rate, risk aversion, and inequity aversion), the time horizon used in the analysis, the income elasticity of climate change impacts, and emission scenarios. Depending on the assumptions, high or low estimates of the social cost of carbon emerge. That is, one can choose a set of parameters, based on "ethical" or other considerations, to defend any position on climate policy. This result leads them to argue that climate change is a moral problem, and different people would reasonably take a different position on the urgency of climate policy. Furthermore, extreme values of the social cost of carbon are associated with positions that are at odds with revealed preferences on time preference and risk aversion. For middle of the road choices of the most sensitive parameters, the range of social cost of carbon estimates is much more limited.

Finally, I would like to refer to the discussion paper by Vouvaki and Xepapadeas (2009) on 'The Productive Base Sustainability Under Climate Change'. This paper was not published in this special issue as the authors were not interested to respond to the comments and criticism of one referee who reviewed their paper. However, I believe that the discussion paper is an interesting addition to the relevant literature, hence I briefly describe its results. The authors use the concept of 'productive base sustainability'—i.e. non-declining social welfare—to develop empirically useful sustainability criteria and indicators, which can inform the design of policies promoting sustainable development. In particular, the authors determine a criterion that measures the current change of the productive base of an economy by taking into account the environmental damage created by the global warming phenomenon. They consider a non optimizing growth framework and derive results for the productive base sustainability of two large groups of developed OECD and developing non-OECD economies. They then apply their methodology by using three different scenarios of global CO2 emissions' growth and they obtain results for the current productive base sustainability in each one of them. The main empirical finding of the paper under the two alternative utility function specifications is that under the scenario of increased

global CO2 emissions, the productive base sustainability criterion is negative for almost all the countries under analysis. When global CO2 emissions remain constant, the productivity base sustainability criterion is positive both for the case of developed and for the case of developing countries. In sum, the empirical findings of this paper confirm that the perception that the intensification of the global warming phenomenon can erode the productivity base sustainability of modern economies.

In closing this introductory article I just want to mention that in analysing such problems we are pushing economic analysis to its limits. The real difficulty is that the analytical methods of expected utility theory are ill-equipped to handle issues involving uncertainty about crucial parameters evolving over long periods of time. Yet there is no well-developed alternative, so I hope that the policy-makers are listening to us economists when contemplating the choice of discounting procedure to assess long-term risks such as climate change!

References

Anthoff, D., Tol, R.S.J., Yohe, G.W. (2009). Discounting for Climate Change. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 3, 2009-24. http://www.economics-ejournal.org/economics/journalarticles/2009-24

Atkinson, G., Dietz, S., Helgeson, J., Hepburn, C., and Sælen, H. (2009). Siblings, Not Triplets: Social Preferences for Risk, Inequality and Time in Discounting Climate. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 3, 2009-26. http://www.economics-ejournal.org/economics/journalarticles/2009-26

Chichilnisky, G. (1997). What is Sustainable Development? *Land Economics* 73(4): 467–491.

Chichilnisky G. (2009). Avoiding Extinction: Equal Treatment of the Present and the Future. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 3, 2009-32. http://www.economics-ejournal.org/economics/journalarticles/2009-32

Copenhagen Consensus (2004). http://www.copenhagenconsensus.com/CCC%20Home%20Page.aspx

Dasgupta, P. (2006). Comments on the Stern Review's Economics of Climate Change. Available from: http://www.econ.cam.ac.uk/faculty/dasgupta/STERN.pdf

Gollier, C., Koundouri, P., and Pantelides, T. (2008). Decreasing Discount Rates: Economic Justifications and Implications for Long-Run Policy. *Economic Policy* 56: 758–795.

Gollier C. (2009). Should We Discount the Far-Distant Future at Its Lowest Possible? *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 3, 2009-25. http://www.economics-ejournal.org/economics/journalarticles/2009-25

Groom, B., Hepburn, C., Koundouri, P., and Pearce, D. (2005). Discounting the Future: The Long and the Short of It. *Environmental and Resource Economics* 32(4): 445–493.

Groom, B., Koundouri, P., Panopoulou, K., and Pantelides, T. (2007). Discounting the Distant Future: How Much Does Model Selection Affect the Certainty Equivalent Rate? *Journal of Applied Econometrics* 22: 641–656.

Hepburn, C., Koundouri, P., Panipoulou, K., and T., Pantelides (2008). Social Discounting under Uncertainty: A Cross Country Comparison. *Journal of Environmental Economics and Management*. http://dx.doi.org/10.1016/j.jeem.2008.04.004

Kögel T. (2009). On the Relation between Dual-Rate Discounting and Edgeworth-Pareto Substitutability. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 3, 2009-27. http://www.economics-ejournal.org/economics/journalarticles/2009-27

Lomborg, B. (2004). *Global Crises, Global Solutions*. Cambridge: Cambridge University Press.

The Economist (1991), March 23.

Stern, N.H. (2006). The Economics of Climate Change. Available at: http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

Nordhaus, W. D. (2007). A Review of the Stern Review on the Economics of Climate Change. *Journal of Economic Literature* 45(3): 686–702.

Pearce, D., Groom, B., Hepburn, C., Koundouri, P. (2003). Valuing the Future: Recent Advances in Social Discounting. *World Economics* 4(2): 121–141.

Portney, P., and Weyant, J. (eds). 1999. *Discounting and Intergenerational Equity*. Washington DC: Resources for the Future.

United Nations (1987). Report of the World Commission on Environment and Development. General Assembly Resolution 42/187, 11 December 1987. Retrieved: 2007-04-12.

Vouvaki, D., and Xepapadeas A. (2009). Productive Base Sustainability under Climate Change: Theoretical Results and Empirical Evidence. Economics Discussion Papers, No 2009-11. http://www.economics-ejournal.org/economics/discussionpapers/2009-11

Weitzman, M. (1998). Why the far-distant future should be discounted at its lowest possible rate? *Journal of Environmental Economics and Management* 36(3): 201–208.

Weitzman, M.L. (2007a). A Review of the Stern Review on the Economics of Climate Change. *Journal of Economic Literature* 45(3): 703–724.

Winkler, R. (2009). Now or Never: Environmental Protection under Hyperbolic Discounting. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 3, 2009-12. http://www.economics-ejournal.org/economics/journalarticles/2009-12

Yohe, G. (2006). Some Thoughts on the Damage Estimates Presented in the Stern Review—An Editorial. *The Integrated Assessment Journal* 6(3): 65–72.

Zeckhauser, R.J., Viscusi, W.K. (2008). Discounting Dilemmas: Editors' Introduction. *Journal of Risk and Uncertainty* 37(2): 95-269. (DOI 10.1007/511166-008-9055-8).