References

Barrett, S. (1994), 'Self-enforcing international environmental agreements', *Oxford Economic Papers* **46**(3): 878–894.

Barrett, S. (2003), *Environment & Statecraft: The Strategy of Environmental Treaty-Making*, New York: Oxford University Press.

Dasgupta, P. (2004), *Human Well-Being and the Natural Environment*, 2nd edn, Oxford: Oxford University Press.

Dasgupta, P. and P. Ehrlich (2013), 'Pervasive externalities at the population, consumption, and environment nexus', *Science* **340**(6130): 324–328; doi:10.1126/science.1224664.

Dasgupta, P. and G. Heal (1979), *Economic Theory and Exhaustible Resources*, Cambridge: Cambridge University Press.

Jorgenson, D.W., R. Goettle, M. Ho, and P. Wilcoxen (2013), *Double Dividend: Environmental Taxes and Fiscal Reform in the US*, Cambridge, MA: MIT Press.

Jones, C.I. (2004), *Introduction to Economic Growth*, 2nd edn, New York: W.W. Norton.

MEA (Millennium Ecosystem Assessment), R. Hassan, R. Scholes, and N. Ash (eds) (2005a), *Ecosystems and Human Well-Being, I: Current State and Trends*, Washington, DC: Island Press.

MEA (Millennium Ecosystem Assessment), S.R. Carpenter, P.L. Pingali, E.M. Bennet, and M.B. Zurek (eds) (2005b), *Ecosystems and Human Well-Being, II: Scenarios*, Washington, DC: Island Press.

MEA (Millennium Ecosystem Assessment), K. Chopra, R. Leemans, P. Kumar, and H. Simmons (eds) (2005c), *Ecosystems and Human Well-Being, III: Policy Responses*, Washington, DC: Island Press.

MEA (Millennium Ecosystem Assessment), D. Capistrano, C.K. Samper, M.J. Lee, and C. Raudsepp-Hearne (eds) (2005d), *Ecosystems and Human Well-Being, IV: Multiscale Assessments*, Washington, DC: Island Press.

Southerton, D. and A. Ulph (eds) (2014, forthcoming), *Sustainable Consumption: Multidisciplinary Perspectives*, Oxford: Oxford University Press.

Stiglitz, J.E. and B. Greenwald (2014, forthcoming), *Creating a Learning Society: A New Paradigm for Development and Social Progress*, New York: Columbia University Press.

World Bank (1992), *World Development Report 1992: Development and the Environment*, Washington, DC and Oxford: World Bank and Oxford University Press.

Developing the economics of change

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It was a visionary initiative, 20 years ago, to start a journal devoted to the intersection between environmental, resource and development economics. At the time, the 'Brundtland Report' was old enough to be recognized in policy discussions at many possible levels, IPCC had already

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published its first and second assessment reports, and the Kyoto Protocol was just shaping up. Over the first 20 years of EDE's life, interest in environment and development grew quickly if not explosively, both in research and in the (policy) field, as was witnessed by the Millennium Development Goals in 2000, 'Green Growth' initiatives (from 2008 onwards at UNEP, OECD and World Bank), and at Rio +20 in 2012; IPCC's fifth assessment report is expected this year.

Why does the same question, how to reconcile growth and the environment, need to return time and time again to the political agenda? It would be wrong to conclude that there is no progress, and it would be too easy to complain that the pace of changes is too slow. From a historical perspective, several changes have been dramatic – both in the good direction (growth) and in the opposite direction (resource use and emissions). The key question is why the process toward sustainability is so slow and why the crucial changes or the balanced combination of changes prove difficult to realize. Future research would be most fruitfully devoted to analyzing how the inertia is rooted in slow responses from research, politics, economic forces, or technology.[10]

Inertia, lock-in, or gridlock all seem to be relevant concepts in the context of politics and technological developments. In economics, the choice not to introduce new technology or not to undertake policy can be analyzed as an equilibrium, maybe a bad equilibrium or development trap, that emerges from the structure of the economy and the initial conditions it starts from. This view, however, leads to a rather static and often deterministic approach – 'things are as they are' – and this makes analyzing the very concept of change difficult. The challenge for the coming years is to (further) close the gap between traditional economics and ideas about transition management and sustainability.

The Environmental Kuznets Curve (EKC) hypothesis illustrates the point. The EKC became a popular hypothesis and has been tested numerous times, but the reputation of these studies seems to have moved along the downward-sloping part of the inverted U curve over at least the last few years. Yet the question about the link between growth and environment remains key. It is fruitful to look for EKCs in new incarnations. When looking at the relationship between income levels and emissions, the literature poses the right question in the wrong framework. Rather than looking for *turning points*, we should look for '*speeding moments*', i.e., think dynamically and relate changes in emissions and environment to changes in GDP.

This brings us to economic growth, the analysis of which should be by definition on changes rather than levels. Yet, in practice, the models we use look very similar to static models: the static equilibrium is replaced by a balanced growth path along which the economy grows without any

[10] A long list of references could be attached to this essay if space permitted (a brief version is available upon request). Talking to and reading the newest working papers of Antoine Dechezleprêtre, Rick van der Ploeg, Ingmar Schumacher, David Stern, Mike Toman (and many more), and participating in the workshops of the FP7-funded GLAMURS project allowed me to learn about the newest developments in the economics of change and to see into the future.

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structural change. This is very far from the idea of development. To analyze change in the context of development, growth and Green Growth, in future we will definitely need to pay more attention to 'transitional dynamics', potentially very rich or complex transitional dynamics. Structural change in the traditional sense is part of this. Economic growth goes together with rapid technical change in agricultural sectors and shifts towards the industry sector, with major implications for resource use and emissions. As long as these shifts are inevitable across countries, change (as defined above) may be hard. However, structural change at different times involves different technologies and occurs in a different world with different international trade flows and specialization patterns. Also this implies that the sectoral changes are not linked to levels of GDP, but to changes in GDP and technology in the world economy.

It has been almost obligatory to say that Green Growth cannot arise without appropriate policy changes. Maybe here there is an important difference from the EKC, for which also policies are deemed necessary: the commonly accepted interpretation of the EKC is that the policy changes will be introduced with the increase in income, while in regard to Green Growth – defined as continued GDP growth without environmental degradation – we are commonly less optimistic that the needed policies will arise. To contribute to our common future it is probably relevant to focus less on first-best policies and more on the question of where our current (lack of) Green Growth policies come from and what changes are feasible in a political economy setting. Institutional economics and political economy are back in development research, in particular for research on the persistence of poverty and dictatorship. So why not also apply them to development and environment?

Twenty years ago, we were much less used to the idea that technology is non-autonomous and manmade, i.e., endogenous, than we are now. In the meantime bottom-up models in which nascent clean technologies slowly penetrate the economy at substantial cost are complemented with alternative models in which technical change can be redirected from brown to green, maybe without big implications for aggregate GDP and growth. Of course, change is much easier in the latter newer view, but at the cost of being possibly locked into brown innovation. Serious empirical research is needed to see which of the two views on innovation is more relevant. Fortunately we can nowadays build on patent statistics and firm-level data to study innovation to test the different views.

While endogenous policies and endogenous technologies are well accepted now, endogenous preferences might seem a bridge too far for economics. If preferences are not stable, what can we, economists, say? Yet the behavioral economics revolution changes our view on how consumers make decisions. And certainly the idea of the malleability of preference will help us to deal with the statement that recurs in almost every policy document on sustainability but is most neglected by research, namely that we should change drastically our way of living to make our society sustainable. Choices of lifestyles may be similar to choices of technology, with possibilities for inertia, lock-in and tipping points as a result of peer effects, bandwagon effects and status consumption. Lifestyles could

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change because of sudden 'contagious' outbreaks of 'green fads'. In social interaction, conformity to group norms and distinguishing oneself from other groups make changes in behavior matter much more than behavior itself. The static model of Maslov is replaced by a dynamic and less deterministic model, with much more scope for large changes. The crucial question is if and how this can be important for sustainable development. We need to investigate if the wide variety of lifestyles in modern societies aggregates up to a culture of environmental awareness and real emissions reductions, and whether local green initiatives can be scaled up sufficiently in the growing world economy.

The field of environmental and development economics is already developing the economics of change. We have a whole repertoire of new models, valuation methods and empirical findings that were not available 20 years ago and which will be needed to understand better how we can change growth into Green Growth.

The political economy of innovation and technological change

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Population growth and growing incomes in developing and developed countries are leading to increased demand for energy and food, placing significant stress on the environment. At the same time, the increased scarcity of natural resources, and especially concerns about climate change and other environmental side effects, are constraining the traditional supplies of food and fuel. Failure to provide both energy and food in an affordable as well as in an environmentally sustainable manner, as well as climate change, will negatively affect our society, especially the global poor. Finding solutions to food energy problems is both a policy and technological challenge.

The human response to changing conditions has been the development of new, and sometimes disruptive, technologies. For example, fertilizers and pesticides enabled increases in food supply, the engine and electronics have reduced the costs of transportation, communication as well as human effort, and modern medicines have improved human health and wellbeing. However, many of these technologies have negative side effects and their optimal development and use requires both supportive economic policies

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