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SOLVAY BRUSSELS SCHOOL OF ECONOMICS AND MANAGEMENT

THE ECONOMICS OF CLIMATE CHANGE AND THE CHANGE OF CLIMATE IN ECONOMICS: *THE IMPLICATIONS FOR CLIMATE POLICY OF ADOPTING AN EVOLUTIONARY PERSPECTIVE*

Kevin Maréchal

Thèse présentée en vue de l'obtention du grade de Docteur en Sciences Economiques et de Gestion sous la co-direction des Professeurs Assaad Azzi et Walter Hecq

Membres du Jury Restreint :

Françoise Bartiaux, Professeur *(Université Catholique de Louvain)*
Jean-Luc Demeulemeester, Professeur *(Université Libre de Bruxelles)*
Geoffrey M. Hodgson, Professeur *(University of Hertfordshire)*
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Executive summary

1. Contextual outline of the PhD Research

Climate change is today often seen as one of the most challenging issue that our civilisation will have to face during the 21st century. This is especially so now that the most recent scientific data have led to the conclusion that *the globally averaged net effect of human activities since 1750 has been one of warming* (IPCC 2007, p. 5) and *that continued greenhouse gas emissions at or above current rates would cause further warming* (IPCC, 2007 p. 13). This unequivocal link between climate change and anthropogenic activities requires an urgent, world-wide shift towards a low carbon economy (STERN 2006 p. iv) and coordinated policies and measures to manage this transition.

The climate issue is undoubtedly a typical policy question and as such, is considered amenable to economic scrutiny. Indeed, in today's world economics is inevitable when it comes to arbitrages in the field of policy making. From the very beginning of international talks on climate change, up until the most recent discussions on a post-Kyoto international framework, economic arguments have turned out to be crucial elements of the analysis that shapes policy responses to the climate threat. This can be illustrated by the prominent role that economics has played in the different analyses produced by the Intergovernmental Panel on Climate Change (IPCC) to assess the impact of climate change on society.

The starting point and the core idea of this PhD research is the long-held observation that the threat of climate change calls for a change of climate in economics. Borrowing from the jargon used in climate policy, *adaptation measures* could also usefully target the academic discipline of economics. Given that inherent characteristics of the climate problem (e.g. complexity, irreversibility, deep uncertainty, etc.) challenge core economic assumptions, mainstream economic theory does not appear as appropriately equipped to deal with this crucial issue. This makes that new assumptions and analyses are needed in economics in order to comprehend and respond to the problem of climate change.

In parallel (and without environmental considerations being specifically the driving force to it), the mainstream model in economics has also long been (and still is) strongly criticised and disputed by numerous scholars - both from within and outside the field of economics. For the sake of functionality, these criticisms - whether they relate to theoretical inconsistencies or are empirically-based - can be subsumed as all challenging part of the Cartesian/Newtonian legacy of economics. This legacy can be shown to have led to a model imprinted with what could be called "mechanistic reductionism". The mechanistic side refers to the *Homo oeconomicus* construct while reductionism refers to the quest for micro-foundations materialised with the *representative agent* hypothesis. These two hypotheses constitute, together with the conjecture of perfect markets, the building blocks of the framework of general equilibrium economics.

Even though it is functional for the purpose of this work to present them separately, the flaws of economics in dealing with the specificities of the climate issue are not considered independent from the fundamental objections made to the theoretical framework of mainstream economics. The former only make the latter seem more pregnant while the current failure of traditional climate policies informed by mainstream economics render the need for complementary approaches more urgent.

2. Overview of the approach and its main insights for climate policy

Starting from this observation, the main objective of this PhD is thus to assess the implications for climate policy that arise from adopting an alternative analytical economic framework. The stance is that the coupling of insights from the framework of evolutionary economics with the perspective of ecological economics provides a promising way forward both theoretically as well as on a more applied basis with respect to a better comprehension of the socioeconomic aspects related to the climate problem. As claimed in van den Bergh (2007, p. 521), ecological economics and evolutionary economics "share many characteristics and can be combined in a fruitful way" - which renders the coupling approach both legitimate and promising.

The choice of an evolutionary line of thought initially stems from its core characteristic: given its focus on innovation and system change it provides a useful approach to start with for assessing and managing the needed transition towards a low carbon economy. Besides, its shift of focus towards a better understanding of economic dynamics together with its departure from the perfect rationality hypothesis renders evolutionary economics a suitable theoretical complement for designing environmental policies.

The notions of path-dependence and lock-in can be seen as the core elements from this PhD research. They arise from adopting a framework which is founded on a different view of individual rationality and that allows for richer and more complex causalities to be accounted for. In a quest for surmounting the above-mentioned problem of reductionism, our framework builds on the idea of 'multi-level selection'. This means that our analytical framework should be able to accommodate not only for upward but also for downward causation, without giving analytical priority to any level over the other. One crucial implication of such a framework is that the notion of circularity becomes the core dynamic, highlighting the importance of historicity, feedbacks and emergent properties.

More precisely, the added value of the perspective adopted in this PhD research is that it highlights the role played by inertia and path-dependence. Obviously, it is essential to have a good understanding of the underlying causes of that inertia prior to devising on how to enforce a change. Providing a clear picture of the socio-economic processes at play in shaping socio-technical systems is thus a necessary first step in order to usefully complement policy-making in the field of energy and climate change. In providing an analytical basis for this important diagnosis to be performed, the use of the evolutionary framework sheds a new light on the transition towards low-carbon socio-technical systems. The objective is to suggest strategies that could prove efficient in triggering the needed transition such as it has been the case in past "lock-in" stories.

Most notably, the evolutionary framework allows us to depict the presence of two sources of inertia (i.e at the levels of individuals through "habits" and at the level of socio-technical systems) that mutually reinforce each other in a path-dependent manner.

Within the broad perspective on path dependence and lock-in, this PhD research has first sketched the implications for climate policy of applying the concept of 'technological lock-in' in a systemic perspective. We then investigated in more details the notion of habits. This is important as the 'behavioural' part of the lock-in process, although explicitly acknowledged in the pioneer work of Paul David (David, 1985, p. 336), has been neglected in most of subsequent analyses. Throughout this study, the notion of habits has been studied at both the theoretical and applied level of analysis as well as from an empirical perspective.

As shown in the first chapters of the PhD, the advantage of our approach is that it can incorporate theories that so far have been presented opposite, partial and incomplete perspectives. For instance, it is shown that our evolutionary approach not only is able to provide explanation to some of the puzzling questions in economics (e.g. the problem of strong reciprocity displayed by individual in anonymous one-shot situations) but also is very helpful in bringing a complementary explanation with respect to the famous debate on the 'no-regret' emission reduction potential which agitates the experts of climate policy.

An emission reduction potential is said to be "no regret" when the costs of implementing a measure are more than offset by the benefits it generates such as, for instance, reduced energy bills. In explaining why individuals do not spontaneously implement those highly profitable energy-efficient investments[1], it appears that most prior analyses have neglected the importance of non-economic obstacles. They are often referred to as "barriers" and partly relate to the 'bounded rationality' of economic agent. As developed in the different chapters of this PhD research, the framework of evolutionary economics is very useful in that it is able to provide a two-fold account (i.e. relying on both individual and socio-technical sources of inertia) of this limited rationality that prevent individuals to act as purely optimising agents.

[1] This problem is known as the "efficiency gap" or the "efficiency paradox" in energy.

Bearing this context in mind, the concept of habits, as defined and developed in this study, is essential in analysing the determinants of energy consumption. Indeed, this concept sheds an insightful light on the puzzling question of why energy consumption keeps rising even though there is an evident increase of awareness and concern about energy-related environmental issues such as climate change. Indeed, if we subscribe to the idea that energy-consuming behaviours are often guided by habits and that deeply ingrained habits can become "counter-intentional", it then follows that people may often display "locked-in" practices in their daily energy consumption behaviour. This hypothesis has been assessed in our empirical analysis whose results show how the presence of strong energy-consuming habitual practices can reduce the effectiveness of economic incentives such as energy subsidies. One additional delicate factor that appears crucial for our purpose is that habits are not fully conscious forms of behaviours. This makes that individuals do not really see habits as a problem given that it is viewed as easily changed.

In sum, based on our evolutionary account of the situation, it follows that, to be more efficient, climate policies would have to both shift the incumbent carbon-based socio-technical systems (for it to shape decisions towards a reduction of greenhouse gas emissions) and also deconstruct habits that this same socio-technical has forged with time (as increased environmental awareness and intentions formulated accordingly are not sufficient in the presence of strong habits).

Accordingly, decision-makers should design measures (e.g. commitment strategies, niche management, etc.) that, as explained in this research, specifically target those change-resisting factors and their key features. This is essential as these factors tend to reduce the efficiency of traditional instruments. Micro-level interventions are thus needed as much as macro-level ones. For instance, it is often the case that external improvements of energy efficiency do not lead to lower energy consumption due to the rebound effect arising from unchanged energy-consuming habits. Bearing this in mind and building on the insights from the evolutionary approach, policy-makers should go beyond the mere subsidisation of technologies. They should instead create conditions enabling the use of the multi-layered, cumulative and self-reinforcing character of economic change

highlighted by evolutionary analyses. This means supporting both social and physical technologies with the aim of influencing the selection environment so that only the low-carbon technologies and practices will survive.

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