ASSESSING COSTS OF DELAY IN CLIMATE POLICY

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Overview

Postponing action against climate change will require more drastic measures when a climate policy eventually is implemented. We assume that climate change need to be addressed through a climate policy sooner or later, and consider tax on emissions as an efficient measure to cap total emissions. Further, we assume that when the emissions tax is implemented, it is set optimally according to a simple welfare model. The model include supply and demand for fossil fuels, convex damages from climate change, and maximization of consumer and producer surplus subject to a dynamic constraint on natural uptake of atmospheric carbon. Prior to implementation of the emissions tax, emissions follows a business-as-usual path. Thus, the core decision problem is reduced to when the tax is implemented. Inherent to the problem of postponing implementation are trade-offs between saved tax expenses and higher consumption of fossil fuel on one hand, and damages from increased emissions and a higher future tax rate on the other. We investigate these trade-offs in light of uncertainty about the environment's capacity to absorb atmospheric carbon, both in terms of the functional relationship between the level of atmospheric carbon and the rate of absorption, and in terms of future development of this rate. Whether the future environment's absorption capacity increases in some relationship with the atmospheric carbon level, or levels off at some maximum rate, or starts to decline as irreversible climate change takes place has profound implications for climate policy in general, and the trade-offs we investigate in particular. Preliminary results show that the initial tax rate may increase from 0.5 to 30 per cent for each year implementation is delayed, depending on various model assumptions. In an extension of our model, we consider the effect of investments in research and development with potential to reduce the emissions intensity of consumption. This extension introduces a second decision variable and implies further trade-offs between current investments and future consumption levels, and interaction with existing trade-offs in the model.

Methods

We formulate our model in continuous time and apply dynamic, stochastic optimization to derive the optimal tax path. The optimal emissions tax is formulated as a closed loop feedback function of the level of atmospheric carbon. The parametrization of the economic model is based on the existing, empirical literature (Steinshamn *et al.* 2011). The stochastic, environmental carbon absorption function is fitted to data with the ensemble Kalman filter (Evensen 2003). Various specifications, with various levels of damage and with various implications for the future development of the absorption capacity and for the emissions intensity of consumption, are investigated.

Results

Our numerical analysis is centred around three major scenarios with differing levels of damage, as damage is perhaps the most uncertain, or unknown, element in our model. The scenario with low damages, where present damages are almost negligible, have the optimal, initial tax rate increasing with approximately a half per cent per year of postponement. After initiation, the optimal tax rate increases with the rate of interest. The scenario with intermediate damages, where present damages amounts to approximately two and a half per cent of gross world production, has the initial tax rate increasing with almost seven per cent per year of postponement. If implementation is postponed 40 years, the optimal tax will curb all production. In the scenario with high damages, with present damages approximately twice as high as in the intermediate case, the initial tax rate increases with 11 per cent per year of postponement. After twenty years of delay in climate action, the optimal solution curbs all production.

Conclusions

Assessment models at extreme levels of aggregation, such as our model, obviously has a number of weaknesses, and while we have done our very best to make it representative in terms of economic and environmental parameters, the numbers we arrive at can at best be taken as indicative. Our stochastic formulation notwithstanding, damages are unknown, presently and in the future. But it remains without doubt that, if we accept the premise that climate change will need costly mitigation at some point, inherent costs increase when mitigation is delayed. And it likely qualifies as a political fact that the costlier the action, the less likely its implementation. Thus, delayed action will probably be suboptimal. And, for what its worth, our model suggest that mitigation costs increase surprisingly fast and are very sensitive to the level of damages.