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Chapter Title: Comment on "Setting the Initial Time-Profile of Climate Policy: The Economics of Environmental Policy Phase-Ins"

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Comment

Stephen P. Holland

How can we regulate carbon emissions from factories and power plants, many of which were built years or decades ago? One potential solution is to "phase-in" any regulations so that businesses have time to anticipate and prepare for the regulations.

Williams's chapter analyzes whether and how environmental regulations should be phased in when capital adjustment is costly. In the context of the model, the chapter shows that quantity regulations—such as cap and trade—generate the greatest social welfare when they are phased in over time (become more stringent). However, on the same criterion, price instruments should *not* be phased in and possibly should be set initially at a higher level and reduced over time.

The chapter makes the intuition for these slightly counterintuitive results quite clear. As capital equipment adjusts over time, it becomes cheaper to attain a given level of emissions. The optimal environmental regulation takes advantage of this either by tightening quantity regulations or by relaxing price regulations.

Given this surprising result, Williams's chapter nicely discusses several reasons outside the model for phasing in environmental taxes. In particular, distributional concerns or the development of regulatory capacity may be reasons for phasing in regulations. Moreover, the chapter describes an additional reason for phasing in a carbon tax: increasing marginal damages with a stock pollutant. Although this case receives only brief mention, it is probably the most relevant case for current climate policy.

To understand this rationale for phasing in a carbon tax, consider equation (15) of Williams's chapter:

$$\mu_t = \int_0^{\infty} \frac{\partial D}{\partial P_{t+i}} e^{-(r+\eta)i} di. \tag{15}$$

When damages are a function $D(P_t)$ of the stock of the pollutant (e.g., the atmospheric concentration of carbon), this equation shows that the optimal carbon tax should equal the sum of the present value of marginal damages.[1] If marginal damages are constant, then this equation implies that the optimal carbon tax should be constant, that is, should not be phased in.

But are marginal damages constant? While damages from global warming are notoriously tricky to specify, it is likely that marginal damages are

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1. For simplicity, I discuss the equivalent discrete version of Williams's equation (15), in which the integral is a summation.

increasing.[2] In this case, Williams states that the optimal carbon tax gradually *falls* over time. However, this rests on the unrealistic assumption that climate policy reduces the atmospheric concentration of carbon from one steady state to another.

In the more realistic case where climate policy simply slows the growth of the atmospheric concentration of carbon, the model's implications are quite different. If the atmospheric concentration of carbon is growing, then marginal damages are increasing over time. As shown in equation (15), the optimal carbon tax in the first year is then the sum of the present values of future marginal damages beginning with the first year. Similarly, the optimal carbon tax in the second year is the sum of the present values of future marginal damages beginning with the second year. Because each year the marginal damages are higher than in the preceding year, the sum of their present values beginning with the second year is higher. Thus, the optimal carbon tax in the second year is higher than in the first year; that is, the optimal carbon tax is phased in.

As Williams points out, this phase-in arises due to increasing marginal damages rather than from adjustment in the capital stock. Because increasing marginal damages and a rising atmospheric concentration of carbon imply a rising carbon tax, but capital adjustment costs imply a falling carbon tax, theory alone cannot tell whether an optimal carbon tax should be phased in.

2. See Martin Weitzman "What is the 'Damages Function' for Global Warming—and What Difference Might It Make?" forthcoming in *Climate Change Economics.*