Incentives for Research and Development in Emission Reductions

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(1) Overview

There is now overwhelming evidence that global warming takes place and human activities at least partially contributes to global warming, see IPCC (2001). Accordingly, there is currently great interest in analysing optimal public policies for climate change mitigation, both price-based and quantity-based instruments, see Sandmo (2004) for an overview. Further, Stern (2007), chapter 16, argues that research and development must play an important role for making emission reductions as economical as possible. Accordingly, the set of policies applied must give firms economic incentives to reduce emissions by investing in research and development.

IPCC (2001), chapters 3 and 9, also notes that among the industries polluting the most are the energy industry, the transportation industries and the manufacturing industries. The current paper argues that (at least) three aspects related to these industries are important for analysing potential for emission reductions. First, these industries are best described as oligopolistic, either on a world-wide basis or nationally. Second, firms in these industries are in many instance private entities, or regulated according to economic principles. Third, these industries are also characterised by having several sectors in vertical relationship, in particular a construction sector upstream and a production sector downstream. As an example one may think of the airline industry, where there are a few large constructors (e.g. Boeing and Airbus), and a few large carrier firms (e.g. Lufthansa, British Airways and KLM).

The aim with the current paper is to analyse incentives for investing in research and development with the aim of reducing emissions in an industry as described above. Specifically, firms downstream (e.g. Lufthansa) faces public policies for emission reductions but have restricted potential to undertake research and development activities that substantially reduce emissions. On the other hand, firms upstream (e.g. Airbus) are not subject to public policies for climate change mitigation, but have larger potential to affect emissions. What is more, incentives to reduce emissions from public policies should not reduce private incentives to undertake investments in research and development for emission reductions.

(2) Methods

In the current paper, I use standard theoretical modelling frameworks earlier applied in leading academic journals for studying similar issues. First, I use the standard partial equilibrium model to investigate the impacts of public policies for climate change mitigation, for an overview see Baumol and Oates (1988). Second, in order to model investments in research and development, I apply the modelling framework applied in D'Aspremont and Jacqemin (1988) allowing for oligopolistic competition. Third, in order to analyse the impacts of vertical chains of firms, I use the standard framework used to analyse vertical relations in industrial economics, see chapter 4 in Tirole (2000) for an overview.

By combining these frameworks, I am able to analyse incentives for undertaking research and development activities with the aim of reducing emissions in an oligopolistic

vertically (unintegrated) industry. First, I compare how incentives to reduce emissions (via research and development) differ among firms located upstream and downstream in a vertical industry structure. Second, the paper discusses various public policies used in order to reduce emissions, prices-based mechanisms (taxes and subsidies and tradable emission rights) and quantity based instruments. Finally, the paper combines these approaches to analyse how various public policies affect decisions to invest in research and development for reducing emissions.

(3) Results

The results obtained in the paper can best be described as threefold. First, the paper illustrates differences in incentives to invest in emission reductions (via research and development) between firms located upstream and downstream. In particular, I find that firms located downstream have stronger incentives to undertake investments in research and development in general. The second result of the paper relates to optimal public policies for climate change mitigation, when the industry structure is as described above. I find that subsidies may perform better than taxes when downstream firms may reduce emissions, but that the effect decreases when only firms located upstream are able to affect emission levels. The third result demonstrates that public policies for climate change reduction in fact may reduce incentives for research and development in the case when only firms located upstream are able to affect the level of emissions.

(4) Conclusions

The conclusions of the paper relates to the optimal policies among firms in oligopolistic industries when it comes to investing in research and development in order to reduce emissions. In particular, the paper discusses the incentives for firms to undertake investments in research and development when also exposed to public policies for climate change mitigation. With the current paper, I hope to add to the literature on economic policies for climate change mitigation by considering the case mentioned in the introduction. That is, the case where only firms located upstream in a vertical industry structure (the construction sector) can reduce emissions by investments in research and development, but only firms located downstream is subject to public policies for climate change mitigation.

References

Agnar Sandmo (2004) "The Public Economics of the Environment", *Oxford Scholarship Online Monographs*

Intergovernmental Panel on Climate Change (2001) "Third Assessment Report"

Jean Tirole (2000) "The theory of Industrial Organization", *MIT Press*

Sir Nicholas Stern (2007) "The Economics of Climate Change, The Stern Review", *Cambridge University Press*

Claude D'Aspremont and Alexis Jacquemin (1988) "Cooperative and Noncooperative R&D in Duopoly with Spillovers", *American Economic Review*, 78(1988)5, 1133-1137

William J, Baumol, and Wallace E. Oates (1988) "The theory of environmental policy, 2nd edition", *Cambridge University Press*