GLOBAL CLIMATE CHANGE MITIGATION: STRATEGIC INTERACTIONS OR UNILATERAL GAINS?

Sigit PERDANA, Business School, University of Western Australia, Phone +61 8 6488 5649,
E-mail: sigit.perdana@research.uwa.edu.au
Rod TYERS, Business School, University of Western Australia, Reseach School of Economics,
Australian National University,
Phone +61 8 6488 5632, E-mail: rod.tyers@uwa.edu.au

Overview

Preventing global warming has been the focus of international agreements that include the Kyoto Protocol and the more recent climate convention on COP Paris 21. Recent evidence suggests these commitments are in "gridlock" (Victor 2011), weakened by unilateral concerns over growth performance and debates over burden sharing (Fehr & Gächter 2000, Falkner et al. 2010, Hovi et al. 2010, Clarke & Waschik 2012). Alternative approaches are reviewed by Aldy et al. (2003), one of which is uniform carbon taxation, proposed by Cooper (1998, 2001 & 2007) and Nordhaus (2007 & 2013) as an alternative to heterogeneous policy frameworks nominally designed to achieve a collective emission target. To be effective, however, all the alternative approaches to emission control place prices on carbon emissions and so, while roles of governments may differ, the effects resemble those of carbon taxation. Standardising the policy framework in this way makes it possible to examine the strategic interactions between countries, each of whom can choose either to implement the tax in full or to free ride.

Scope remains in the current literature to analyse these strategic interactions quantitatively and to test the common presumption that the incentive structure takes the form of a coordination game under which collective gains are only available if all countries, or at least a large critical mass of countries, agrees to implement the tax simultaneously. This paper examines this point quantitatively. First it offers a comprehensive survey of the potential economic costs of ignoring climate change, which links economic growth to atmospheric carbon concentrations and, in turn, to global temperature changes and, finally, to the associated scale of global economic costs wrought by climate change. Second, it provides modelling of global economic performance that measures the immediate costs of carbon tax implementation. Finally, the analysis proceeds to multi-player, normal form games with pay-offs derived from both the survey and the modelling.

Methods

1. A meta-analysis to construct alternative quantifications, from the available literature, of the costs of unmitigated atmospheric carbon accumulation, temperature rise and climate change.
2. Dynamic, global, computable general equilibrium modelling of economic performance on 21 regions, substantially modifying the approach of Golub et al. (2013), with various combinations of regional carbon tax implementation.
3. The analysis of pay-offs in multi-player, normal form games.

Results

The meta-analysis reveals considerable uncertainty as to the costs of accumulating atmospheric carbon. It yields three different paths of global economic welfare reduction by level of unmitigated atmospheric carbon accumulation over the period to 2050. The modelling then links carbon taxation at regional levels to mitigation and thence to offsets to these welfare losses that take the form of global common property. Most regions experience impaired performance from unilateral implementation, though collective implementation causes terms of trade gains and losses, with net benefits tending to accrue to Japan and Europe. The modelling then yields pay-offs in multi-player, normal form games that are then analysed for equilibria. The anticipated coordination game structure does not emerge. Instead, for the large emitters that include the US, Europe, and China, individual effects on the global climate are large enough to justify unilateral implementation. Small emitters are shown to be best off by free riding, however, since the climate benefits from their participation are small by comparison with their implementation costs. Yet the gains to large emitters are larger if the smaller regions do participate and it is shown that there exists a set of side payments that would induce this participation while at the same time making all regions better off.

Conclusions

The absence of coordination game structure means that large emitters have clear incentives to restrain carbon emissions unilaterally. To the extent that they seek greater gains from further reductions in climate impairment that depend on participation by other regions, or that they find the free riding of smaller emitters politically distasteful, it is significant that there exists a set of side payments that would induce small emitters to participate, improving the climate sufficiently to retain net benefits to large emitters. This suggests the focus of negotiations on carbon emissions should be on incentives to encourage participation by small emitters, which could take the form of direct payments or, more practically, investments in efficient energy technologies.

References

Aldy, JE, Barrett, S & Stavins, RN 2003, 'Thirteen plus one: a comparison of global climate policy architectures', *Climate Policy*, vol. 3, no.4, pp. 373-397. Available from: http://dx.doi.org/10.1016/j.clipol.2003.09.004. [24 July 2016].

Clarke, H & Waschick, R 2012, 'Australia's Carbon Pricing Strategies in a Global Context', *Economic Record*, vol. 88**,** no. s1, pp. 22-37. Available from: http://onlinelibrary.wiley.com/doi/10.1111/j.1475-4932.2012.00798.x/full. [13 May 2016].

Cooper, RN 1998, 'Toward a real global warming treaty'. *Foreign Affairs***,** vol: 77, no. 2, pp. 66-79. Available from: http://www.jstor.org/stable/20048789. [14 September 2016].

Cooper, RN 2001, 'The Kyoto Protocol: A Flawed Concept', *FEEM Working Paper*, no. 52.2001. Available from: https://ssrn.com/abstract=278536 or http://dx.doi.org/10.2139/ssrn.278536. [14 September 2016].

Cooper, RN 2007, Alternatives to Kyoto: The case for a carbon tax. Cambridge, MA: Harvard Department of Economics. Available from : http://www.environment.harvard.edu/docs/faculty_pubs/cooper_alternatives.pdf. [12 September 2016].

Falkner, R, Stephan, H & Vogler, J 2010, 'International climate policy after Copenhagen: Towards a 'building blocks' approach', *Global Policy*, vol. 1**,** no. 3, pp. 252-262. Available from: http://onlinelibrary.wiley.com/doi/10.1111/j.1758-5899.2010.00045.x/full. [21 June 2016].

Fehr, E & Gächter, S 2000, 'Fairness and retaliation: The economics of reciprocity', *The Journal of Economic Perspectives*, vol. 14**,** no. 3, pp. 159-181. Available from : http://www.jstor.org/stable/pdf/2646924.pdf. [24 May 2016].

Golub, A, Hertel, T & Kemal, S 2013, 'Analysis of Climate Policies with GDyn-E', *GTAP Technical Papers*, no.32. Available from : https://www.jgea.org/resources/download/6632.pdf. [08 January 2016].

Hovi, J, Sprinz, DF & Bang, G 2010, 'Why the United States did not become a party to the Kyoto Protocol: German, Norwegian and US perspectives', *European Journal of International Relation*, vol. 18, no. 1, pp. 129-150. Available from: http://journals.sagepub.com/doi/pdf/10.1177/1354066110380964. [27 June 2016].

Nordhaus, WD 2007, 'To tax or not to tax: Alternative approaches to slowing global warming', *Review of Environmental Economics and Policy*, vol. 1**,** no. 1, pp. 26-44. Available from: http://reep.oxfordjournals.org/content/1/1/26.full.pdf+html. [07 June 2016].

Nordhaus, WD 2013, 'Chapter 16 - Integrated Economic and Climate Modeling' in PB Dixon & WD Jorgenson, (eds), *Handbook of Computable General Equilibrium Modeling Set*, vol. 1A & 1B, pp. 1069-1131. Elsevier Science & Technology, North-Holland.

Victor, DG 2011, *Global warming gridlock: creating more effective strategies for protecting the planet*, Cambridge University Press, Cambridge.