Bottom Up Climate Policies

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Abstract

In this paper we make two points about bottom-up approaches to climate policy. First, we argue that it is more productive to work with a small group of countries to establish the basis of a global climate regime than tackling the issue with all countries, as in the United Nations Framework Convention on Climate Change (UNFCCC). Secondly, we argue that negotiators should also work explicitly to encourage the development and deployment of clean technologies as a way to reduce future emissions, and suggest how this might be achieved.

Key words: Climate change, climate negotiations, UNFCCC, tipping, clean energy, greenhouse gases

JEL Classification: Q28, Q42, Q 54, Q 58

I. Introduction

In this paper we make two points about bottom-up approaches to climate policy. First, we argue that it is more productive to work with a small group of countries to establish the basis of a global climate regime than tackling the issue with all countries, as in the United Nations Framework Convention on Climate Change (UNFCCC). Secondly, we argue that negotiators should also work explicitly to encourage the development and deployment of clean technologies as a way to reduce future emissions, and suggest how this might be achieved.

The first point draws on recent results in game theory that reveal that certain games have many equilibria, some of which are efficient and others not. Typically, the inefficient outcomes are more stable than the others, and it’s to these that we tend to gravitate. Think of a group of negotiators considering whether or not to sign a climate treaty. There is a tendency for countries only to reduce carbon emissions if

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others follow suit. So it is easy to be locked into an equilibrium where everyone refuses to reduce emissions – an outcome which is clearly inefficient from an overall economic perspective: if all countries agree to reduce their emissions, then all could be made better off than they currently are. More generally, there is often a tendency for individuals/countries to maintain the status quo rather than embark on a new trajectory.

A point that we explore here is that if one is at an inefficient equilibrium, then there may be a subset of players who, by changing their strategies, will lead others to do the same. These participants, labeled the tipping set, play a very important strategic role: by agreeing to implement the policies associated with an efficient outcome, they motivate all others to follow suit. Changing the behavior of a small number of these players may thus change behavior of the entire group in the same direction.³

Heal and Kunreuther (2010) characterize games for which there is such a tipping set, and then apply these concepts to climate change in Heal and Kunreuther (2012).⁴ They observe that the signing of the Montreal Protocol by the United States led many other countries to follow suit.⁵ They suggest how agreement by as few as two countries could foster an international treaty on greenhouse gas emissions by tipping a non-cooperative game from an inefficient to an efficient equilibrium.

The concept of a tipping set implies that negotiating with a large group of countries makes the task of reaching a more efficient equilibrium for dealing with climate change unnecessarily difficult. For example, one might speculate that if the U.S. and China agreed to implement effective policies to reduce greenhouse gas (GHG) emissions then they could persuade some countries to do the same which in turn would lead others to follow suit. This cascading process could eventually result

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³ In general parlance tipping refers to a situation where there is a sudden change in the behavior of a system. In the present context a change of policy by members of a tipping set leads to a change by all others. The timescale is not explicit but one can imagine the change to be abrupt.

⁴ Technical details of this approach are developed further in Cremeans, Lakshmivarahan and Dhall (2012) and Shafran and Lepore (2011).

in most, if not all countries, in the world adopting a similar strategy of reducing GHG emissions.

Tipping and cascading are two closely related but slightly different concepts. *Tipping* is used to describe a situation where a change of strategy by a subset of players leads all others to follow suit simultaneously: first the tipping set moves and then all others respond at the same time to this move. *Cascading* refers to a situation where a change of strategy by the initial subset leads to some but not all of the remaining participants following suit, and these second round moves again lead to some but not all of the remainder following along, until all have eventually followed suit. The analogy with a row of dominoes on edge falling is helpful here.\(^6\)

The second point – that we should pay attention to the development and deployment of clean technologies – reflects the obvious fact that a sufficient condition for a major reduction in GHG emissions is that clean technologies be available at a cost less than continuing with fossil-based technologies.\(^7\) It may be possible to provide direct incentives for developing these clean technologies rather than relying on restricting carbon emissions. An additional point is that the development of new technologies is frequently associated with the generation of positive externalities or public goods. Knowledge is a classic public good, as one person’s use does not interfere with that of another, and the development of a new technology by a firm in one industry may help firms in another, an externality. Markets do not reward the production of public goods or positive externalities, justifying governmental intervention.\(^8\)

II. *Clubs for Mitigating GHG Emissions*

In his Presidential address to the American Economic Association in January 2015, William Nordhaus highlighted the role that climate clubs can play in reducing GHG emissions. He defines a club as an agreement by participating countries to

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\(^6\) This distinction between tipping and cascading was first formalized by Dixit (2003).

\(^7\) There could still be a timing problem, in that the replacement of fossil fuels by carbon-free ones, though guaranteed to happen eventually, might not occur fast enough to ensure that we stay within the widely-accepted 2 degree C target.

\(^8\) For more discussion of this point see Jaffee et al 2005.
undertake harmonized emissions reductions: as a part of the agreement, non-participants are penalized. Nordhaus then characterizes a climate-economic model with trade sanctions to determine the size of a uniform tariff on all goods and services to be imposed on imports from non-participants to induce them to join the climate club. In Nordhaus’ example, joining the club requires the country to set a domestic carbon price at least as high as a pre-set international target carbon price (Nordhaus, in press).

Stewart et al (2015) highlight the importance of a club strategy that involves voluntary participation by countries to reduce GHG emissions by pre-specified amounts via a set of non-climate benefits reserved exclusively for all or most of the members. They point out that these non-climate benefits can be in the form of reduced energy costs, energy security, profitable R&D innovations and competitive advantage.

We view clubs as a bottom-up strategy for inducing tipping or cascading to provide the basis of a climate change regime. In some situations a club might involve as few as two countries agreeing to cooperate by incurring the upfront costs of a new technology to reduce GHG emissions. Other countries would then be willing to follow suit because they only have to incur the much smaller marginal costs. As we will note below, this was the case when the United States and Japan were in the forefront in developing unleaded gasoline.

A more recent example that could result in tipping or cascading is the 2014 U.S.-China Agreement to reduce GHG emissions. As illustrated by the Montreal Protocol, a single firm or industry can be a dominant agent, causing a country to reduce GHG emissions and leading others to follow suit.

**U.S.-Japan Blazing the Trail in Moving to Unleaded Gasoline**

The role of a few countries incentivizing others to change from a dirty to a clean technology can be illustrated by examining the industrial world’s transition from leaded to unleaded gasoline. In moving from leaded to unleaded gasoline, there are three major fixed costs: (1) the expense of research and development (R&D) to
find an alternative to lead as an additive; (2) the costs of adapting refinery capacity to deal with the new additive; and (3) modifying automobile engines to burn the reformulated fuel. Each of these steps requires significant effort.

Japan and the U.S. moved first to adopt unleaded gasoline, and in so doing incurred the upfront costs associated with the first and third elements: they found a new additive as an alternative to lead and determined how engines needed to be modified to utilize unleaded gasoline. Japan began to regulate the use of lead in gasoline in 1972 and the U.S. did the same in 1973. The use of lead in gasoline was completely phased out in Japan by 1986 and was largely eliminated in the U.S. by 1988.9

Once these two elements of the problem were solved, the incremental costs of adoption of unleaded gasoline for other countries were only the expenses associated with modifying refinery capacity and the costs of modifying engines to a new but now known design. In 1985 the European Union moved to limit the use of lead in gasoline. In fact, adoption was made even easier because the European motor industry exported cars extensively to the United States. European manufacturers therefore had to start constructing engines for lead-free fuel as soon as the U.S. made its move to change to this type of fuel.

An interesting detail is that in Europe, Germany went lead-free before Italy did. Many affluent German tourists visit Italy by car in the summer, so many Italian refineries and gas stations were forced to provide unleaded gasoline several years before Italy formally adopted unleaded fuel. Though there are no formal studies of this, it is reasonable to assume that the incremental cost to Italy of formally adopting lead-free fuel was very low indeed. Leaded gasoline has now been phased out around the entire world with the exception of North Korea and Myanmar.

This example illustrates how the global economic system was tipped from leaded to unleaded gasoline by the initial actions of just two countries: Japan and the United States. These two started a cascade that continued until most countries in the

world had followed suit. In the global automotive market, the U.S. clearly is a strategically important player, in that every major automaker wants to sell in the U.S. market, which gave it leverage in tipping the industrial world. Japan sells a large number of its automobiles around the world, so these countries had an incentive to adopt unleaded fuel so that their residents could purchase these cars.

**The Montreal Protocol and the Role of a Dominant Firm**

The Montreal Protocol is a more widely-studied case of a successful global treaty to prevent a global environmental harm. Here it seems clear that the United States again played the role of a tipping agent due to a dominant firm: DuPont. DuPont, the main U.S. producer of CFCs, had initially been vociferously opposed to restrictions on their use, categorizing the science relating to CFCs’ impacts on the ozone layer as “utter nonsense.” (Wikipedia, [http://en.wikipedia.org/wiki/Montreal_Protocol](http://en.wikipedia.org/wiki/Montreal_Protocol), January 10 2014.)

The position of DuPont began to shift in 1986, apparently as a result of significant progress in producing safe substitutes for CFCs. More specifically, DuPont developed an alternative to CFCs that would not damage the ozone layer and then it saw the banning of CFCs as a move that would give them a competitive advantage. The result was a sharp increase in the U.S.’s support for such a treaty (Benedick 1998). While still arguing that CFCs produced no imminent hazard, DuPont supported an international freeze on CFC emissions, seeing that step as a justified precautionary measure after the discovery of the Antarctic ozone hole. Indeed, DuPont and other producers pledged to phase out production by an early date and also supported international controls (Sunstein 2007).

At a meeting in Montreal in September 1987, twenty three countries agreed to cut their consumption of CFCs and other ozone-destroying chemicals by half before the end of the 20th century. The critical innovation here was development of a new technology by DuPont coupled with an agreement to make compensatory payments to poor countries to cover the costs of replacing CFC. Thus, a change of attitude by
one company led the United States to agree to signing the Montreal Protocol and as of January 2015, 196 other countries followed suit.

III. Tipping in a Climate Context

Can one use the unleaded gas example and the Montreal Protocol to speculate on how climate negotiations can be tipped, moved to a new and more productive regime, by countries that have strategic power? Heal and Kunreuther (2010) show that tipping is induced by a pattern of positive reinforcement, also known more formally as supermodularity, strategic, complementarity or increasing differences. In other words, if the choice of the efficient strategy by one agent raises the net return to other agents choosing this strategy, we are likely to have a tipping set as was demonstrated in the case of the unleaded gas example and may also prove to be true if the 2014 U.S.-China agreement encourages other countries to follow suit (see below). More generally if the economic benefits for joining or the penalties for not joining are sufficiently high, then there will be incentives for other countries to join a club. Box 1 provides a hypothetical numerical example as to how one determines a minimal tipping set.
We can now apply these concepts and results to our main question: Is there a tipping set for joining climate agreements, and if so, how can it be characterized? In the case of climate change, the factors generating increasing differences associated with being a party to an agreement for reducing GHG emissions are the side-benefits from joining the climate club or the penalties for not being a participant.

There are several reasons to think that there are increasing net benefits for joining such a climate agreement as more members join. For one thing, reducing GHG emissions is likely to require the development of new technologies that involve relatively high fixed costs as illustrated by the example of introducing unleaded gasoline. A reasonable assumption is that the fixed costs of developing new

**BOX 1: Determining a Minimal Tipping Set**

Consider a game with ten agents, each of whom has two strategies generically denoted $S_i$ for the $i$-th agent which we can take values N and J. We can think of N as not joining and J as joining a climate change treaty. The payoffs to the agents $i$ denoted $U_i$ in this game are $U_i = 0.5$ if $S_i = N$ and $U_i = \#(J)$ if $S_i = J$ where $\#(J)$ is the number of other agents choosing J. Thus, your utility for choosing N, not to join, is always 0.5 whatever the others do and your payoff for choosing to join, J, is equal to the number of others who also choose J. If you choose J and no one else does, you fare badly, but if many others do, you fare well. And the more that choose J, the better. This captures what we think of as a key aspect of climate change: if all countries make a move, all gain, but if only one or two move, then they may not gain and may regret what they have done.

This game has two Nash equilibria: all choose N and all choose J. The latter clearly is efficient, Pareto dominant, because everyone gets a payoff of nine (the number of others choosing J). If none of the others choose J, you are also better off making the same choice, N, since $U_i$ is .5 with a choice of N rather than zero with a choice of J. If at least one person chooses J you will also want to choose J, because the payoff to J is now one. The key point for our purposes is the following: if the system starts with all choosing N, not joining, and one agent – any agent – changes to J, joining, then every agent will respond by changing to J. The best response when one agent [or more] chooses J, is J. So if the system is at the inefficient equilibrium of all Ns, and one agent can be persuaded to change to strategy J, then the system moves in response to the efficient equilibrium. The smallest tipping set for this problem is any one agent.
technologies are shared amongst those who commit to reducing GHG emissions. (Stewart et al. (2015) suggest that a club of countries could share the costs of developing a technology for carbon capture and storage. The more countries who are party to the agreement, the less the cost per party, leading to an increase in net benefits to all other countries that are already part of the agreement.

Another cost often associated with reducing GHG emissions is a loss of competitiveness and the risk of carbon leakage. Competitiveness, it is argued, may be reduced by the requirement that domestic industries use carbon-free energy sources, which may be more costly than fossil fuels. As more countries join the climate agreement, there is less risk of a loss of competitiveness vis-a-vis trading partners. Similarly, the fewer countries that are outside an agreement to reduce GHG emissions, the less is the risk of carbon leakage by carbon-intensive industries migrating to non-member states. So it is reasonable for the costs of joining a GHG-abatement agreement related to a possible loss of competitiveness to drop as more other countries join-- another reason that the increasing difference condition is likely to be satisfied.

Heal and Kunreuther (2012) assume that a country’s benefits are not affected by whether or not it joins a climate agreement, as the benefits from the agreement are a pure public good and accrue to all, joiners or not. But in reality there may be some benefits that are in fact specific to joining, perhaps preferential access to technologies, better relations, and trade agreements with other member countries. There are also co-benefits from joining and reducing greenhouse gas emissions in the form of decreases in many other pollutants associated with the combustion of fossil fuels.

Finally, there is likely to be a cost to not joining the agreement that increases with the number of countries that have joined. This could be an explicit cost imposed by treaty members on non-members, such as a carbon tariff on imports as Nordhaus (in press) proposes, something that has been seriously discussed in both the U.S. and the E.U. It could also be an implicit cost associated with not being party to important negotiations or a member of an influential group of countries.
We thus conclude that the net benefits to joining an agreement increase with the number that have joined, as illustrated by such measures as the green trade liberalization club discussed in Stewart et al. (2015). Hence, negotiating a climate treaty can be seen as a non-cooperative game with several non-cooperative equilibria, only one of which is efficient, and which meets the increasing differences or strategic complementarity condition.

Due to the opportunity to free ride by not incurring the costs associated with joining a climate treaty, the natural equilibrium is the inefficient one. But because of the positive reinforcing effects or strategic complementarities between agents’ choices of strategies to reduce emissions, it may be possible to create a cascade and tip the system from an inefficient to an efficient equilibrium. There is likely to be a small subset of countries who, by adopting greenhouse gas abatement policies, can trigger a movement by others to follow suit. If so, working with these countries is strategically the best direction for the international community.

The recommendation that emerges from this line of argument is that rather than the UNFCCC policy of involving the participation of all countries in the world in climate negotiations, we should rely on a smaller group that are likely to constitute a tipping set. These countries will be sufficiently important to the world economy that if they adopt climate-friendly policies then all others will follow suit. In addition, these countries are likely to be major GHG emitters, so their decision to take steps to reduce the role that carbon plays in their economy will signal to others that they are serious about dealing with climate change and will be a model for these countries to emulate.

Working with such a small group of “major emitters” has other obvious advantages. In the UNFCCC framework, any country can block a proposed agreement as outcomes are reached by consensus. This means that an oil-producing country that stands to lose from moving away from fossil fuels can block a climate agreement. Generally, they have used their influence this way. By focusing on a set of countries that are sympathetic to reducing their carbon emissions, one avoids this problem.
Potential Impact of U.S.-China Announcement on Tipping Other Countries

The “U.S.-China Joint Announcement on Climate Change”\textsuperscript{10} touches on many of the issues discussed above. In this announcement the two countries express the intention of reducing their GHG emissions substantially, in the hope that they “inject momentum into the global climate negotiations and inspire other countries to join ...”. They don’t use the word “tip” here but it certainly sounds as if that is what they have in mind. They also announce moves to expand joint clean energy research and development, establish carbon capture and storage demonstration projects, and enhance collaboration on various other ways of reducing GHG emissions.

All of this is precisely what we are recommending: clearly, the U.S. and China could be the nucleus of a tipping set.\textsuperscript{11} Adding the European Union and perhaps one big developing country, such as Brazil, would almost surely be sufficient to break the international logjam and deliver real motion on reducing GHG emissions.\textsuperscript{12} Such a group would generate about two-thirds of global emissions and would certainly have the technological sophistication to implement clean energy policies. Indeed, Brazil, China and the E.U. are world leaders in such policies. The positions the E.U. has already adopted suggest that it would almost surely be amenable to being part of such a group.

One of the perennial fears of those opposed to climate policies in the western world is that they will lead to the migration of heavy industry to China or other developing countries, and will give those countries a competitive advantage. Clearly the presence of China in a clean energy coalition would go far to undermine these objections, and the presence of an emerging economy such as Brazil would reinforce this. This is one of the reasons we suggested that climate negotiations show


\textsuperscript{11}In fact it is possible that the US-China agreement was important in generating the momentum that led to the Paris agreement of 2015.

\textsuperscript{12}To date the European Union has been the only entity willing to go ahead and reduce emissions on its own, and it’s linkages to the rest of the world have not been great enough to produce the tipping effects we are seeking.
increasing differences or positive reinforcement: the more countries that agree, the more attractive it is for others to join them.

The moves to expand joint clean energy research and development, establish carbon capture and storage demonstration projects, and enhance collaboration on various other ways of reducing GHG emissions, are also all consistent with what we suggested above. The costs of bringing new technologies to the point of deployment are large and fixed, and the more countries share them, the less they cost each country. This is again part of the reasoning behind our seeing climate agreements as subject to positive reinforcement, and so having tipping sets. Emphasizing cooperation and sharing in the development of new technologies is clearly a way of reducing the barriers to developing and deploying new technologies, and any successful climate policy ultimately depends on this happening on a large scale.

IV. Development and Deployment of Clean Technologies

In addition to changing the structure of the negotiations via bottom-up approaches, there are reasons to frame the problem so that one understands that in order to reduce greenhouse gas emissions to a safe level we have to replace fossil fuels, and that this should be the focus of climate change negotiations.

Reducing the Cost of Non-Fossil Fuels

By reducing the cost of non-fossil fuels sufficiently, they can be deployed as replacements for fossil power stations without any politically unacceptable increase in the cost of power. The cost of electricity is measured by the levelized cost of electricity (LCOE), a measure of the long-run average cost of electric power, taking capital and operating costs into account. Currently in the U.S., the private costs of different power sources (before applicable subsidies for renewables) are roughly as follows:

<table>
<thead>
<tr>
<th>Fuel</th>
<th>LCOE in cents/kWh</th>
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</thead>
<tbody>
<tr>
<td>New coal</td>
<td>6-8</td>
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</table>

13 That is not including external costs.
The wholesale price of electric power varies by time of day and year and by state, but is generally in the range 4-10 cents/kWh, with retail prices again varying by state and in the range 12-23 cents/kWh. So, wind is competitive in all markets, but is intermittent and often located far from demand centers. On the other hand, solar PV power’s LCOE is less than the retail power price. Hence solar is now clearly competitive in the retail market, which is why we see so many off-grid solar installations.

The growth of behind-the-meter companies like Sun Edison and Solar City, which install solar power off grid on clients’ sites and meet capital costs in exchange for a power purchase agreement at less than retail prices, has been one of the striking phenomena of the electricity industry in recent years. Solar costs have fallen dramatically in the last decade, and are expected to fall further, to be under 10 cents/kWh for large-scale generation soon. The key conclusion from these numbers is that at least in the United States, renewable energy is competitive or close to being competitive with fossil sources. Encouragement by the U.S. government through a wide range of policies at their disposal could push solar over that last hurdle to being competitive. Available strategies range from renewable portfolio standards to carbon taxes and feed-in tariffs of the type used effectively in Germany.

While these data are for the U.S., the situation in other countries is likely to be at least as favorable to non-fossil energy sources. Fossil fuel prices in other countries are generally higher than those in the U.S. Gas, for example, is just under $4 per mmBTU in the U.S. compared with $12 in the E.U. and $20 in Asia. Crude oil is also generally less costly in the U.S. that in other industrial countries. So other countries can compete more easily with renewable energy than in the U.S.
More generally, there is a real prospect of renewable electricity sources being cost-competitive within the next decade. (The introduction of taxes on greenhouse gas emissions would speed this process up.) Biofuels (derived from sugar or cellulosic materials) are now competitive with gasoline in tropical or subtropical countries as a power source for vehicles and significantly reduce greenhouse gas emissions. If these and other renewable fuel sources become competitively priced, market mechanisms will result in lower GHG emissions without international agreements having to specify GHG emission targets and timetables for achieving them. A key role for governments and international agreements is to speed up the attainment of this state by measures that encourage R&D and learning about clean fuels.

Another dimension of the deployment of non-fossil energy is increasing the use of battery-powered vehicles, which, when powered with electricity from non-carbon sources, can provide greenhouse-gas free transportation. A major obstacle to the use of battery-powered vehicles (though certainly not the only one) is the absence of a network of charging stations. There is a classic chicken-and-egg problem here: consumers are reluctant to buy electric vehicles before there is a network of charging stations, and investors are reluctant to construct the charging stations until it is clear that there is a demand for them. There is thus no economic incentive to move away from the status quo. This can be viewed as an inefficient equilibrium in the sense that having enough charging stations would increase demand for electric vehicles sufficiently for the stations to be profitable and hence reduce carbon emissions from their current level.

The transition from one fueling system to another is characterized by network externalities – an electric vehicle is more useful to its owner as more people purchase them. Not only will there be a more extensive system of charging stations within a given region but there will be more repair shops that specialize in this type of vehicle. Exactly the same would be true of hydrogen-fueled vehicles, which are now available on a small scale in California, and require for adoption a widespread network of hydrogen refueling stations. Both these technologies face the challenge of
how to move from a niche phenomenon to the mass market given that current gas powered vehicles benefit from positive network externalities. In Europe, where people regularly drive from one country to another, governmental intervention will be needed to internalize these network externalities.

These new technologies may be able to gain ground in parts of the market where these network effects are minimal. To illustrate, vehicle fleets that all return to a common base at the end of the day can have conveniently located recharging stations that are profitable. Fleets of vehicles that travel a fixed route can lead to charging stations that will be highly utilized by them. But widespread adoption throughout the market will generally require subsidies to both the initial users of the vehicles and to those who install charging stations. Agreements to promote such technologies by sharing costs and coordinating the installation of the necessary infrastructure could again productively be a part of the international climate negotiations.

Talking about the deployment of renewable energy changes international climate negotiations from a zero sum to a positive sum game. Posing the issue in such terms as “The global community must cut back emissions by 20 gigatons of CO₂: let’s divide this reduction between us all” establishes the negotiations as a zero sum game: “the more you reduce, the less I have to,” whereas setting them up with the aim of finding policies to deploy clean energy sources as fast as possible avoids the zero sum property – this is something all countries can do - and also suggests that countries that are successful may be able to gain from this success by competing in the growing markets for clean energy.

V. Conclusions

There are two main themes to this paper, both of which imply that the current UNFCCC process for reaching an agreement on climate policy can be greatly improved.

One theme is that the focus of negotiations should be a bottom-up approach where a small group of influential countries form a climate club by adopting GHG
emission reduction policies. This climate club is likely to lead to cascading or tipping so that many other countries follow suit. We have argued that it will be far easier to get the relevant countries to agree to form a small club than to require the entire world to reach consensus. We gave an example of such a process at work in the adoption of unleaded gasoline and anticipate that the U.S-China GHG emissions agreement will have a similar effect.

A second theme is that negotiations should focus on policies that aid the adoption of clean energy, rather than focusing on targets and timetables for emission reductions. The deployment of clean energy is a sufficient condition for resolution of the climate problem, and making clean energy cost competitive is clearly within the bounds of possibility. However, there are innumerable obstacles in the form of market failures, external costs and limited demand for energy efficient products. Framing the problem and creating incentives that address these issues and hasten the competitiveness of clean energy should be a major part of the global negotiating agenda.

Future research should consider the role that risk and uncertainty play with respect to negotiating climate change agreements. Barrett (2013) has investigated the role of catastrophic, low probability events on the likelihood of cooperation with respect to a global climate agreement. Several analyses, including Victor (2011) and Hafner-Burton et al. (2012), contend that the likelihood of a successful comprehensive international agreement for climate change is low because of the sensitivity of negotiations to uncertain factors, such as the precise alignment and actions of participants. Keohane and Victor (2011), in turn, suggest that the chances of a positive outcome would be higher in the case of numerous, more limited agreements.

References


