
CHAPTER SEVEN

Improving Paris: Credibility, Technology, and Conservation

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Introduction

The United Nations approach to climate policy is and has been to focus on emission caps. Since emission of greenhouse gases is the direct cause of human-made climate change, capping country-specific emissions may at first appear to be a precise policy instrument. Thus, both the Kyoto Protocol and now the Paris Agreement aim at limiting country-specific emissions of greenhouse gases (UNFCCC 2016).

At the same time, it is well recognized that to be able to deal with reduced consumption of fossil fuels, the world must develop alternatives. Green technologies, such as abatement technologies and renewable energy sources, are necessary if we are to sustain our way of life. Despite this fact, the treaties have not discussed or attempted to pin down technology investments.

Ideally, one would think that technology will be driven by demand if countries and companies are limited in their capacities to emit. With such limits, the demand for technology will increase and firms will find it profitable to develop, invest in, and purchase new and green technology.

This chapter discusses these mechanisms and argues that one may need to question whether capping emissions will lead to the right development of new and green technology. After all, countries may act *strategically* when they contemplate how to invest or support the private sector's investments in technology. To account for, and to even take advantage of these strategic concerns, the climate treaty must be carefully designed, for example regarding how it is reviewed and revised over time.

Similarly, existing climate treaties, from Kyoto to Paris, have not attempted to regulate (or even discuss) the *supply side*. Since demand equals supply in a global market, one may hope and expect that regulating the demand for fossil fuels will necessarily lead to less fossil fuels being extracted from the ground. In some ideal settings, regulating only the demand side can be sufficient. In the real world, however, there are several reasons why it may be both beneficial and necessary to consider an additional regulation of the supply side, and thus the countries' extraction levels of fossil fuels. This chapter will be quite precise and concrete on how to go ahead with such supply-side regulation.

Paying countries to reduce deforestation in the tropics is also a type of supply-side environmental policy. In contrast, a demand-side policy would be to boycott timber or agricultural products produced on land converted from forests, but such a boycott is likely to reduce the price for other buyers, who will then purchase more. This type of *leakage* can be avoided by a well-designed supply-side environmental policy.

As discussed in the final section, some of the discussed reasoning is illustrated by the 2017 notification to the UN that the United States intends to withdraw from the Paris Agreement. At the same time, this possibility strengthens the below arguments for focusing on technology and the supply side, and challenges our views on whether one needs to view climate agreements and international trade together.

1. Treaties, Technology, and the 2016 Nobel Prize in Economics

Technology requires investments. By definition, investments are costs paid today in return for benefits tomorrow. It is thus essential that one anticipates that the technology is likely to be useful later, before private companies can be expected to invest, and also before individual countries are willing to support investments in environmentally

friendly technology. By *green* technology, I am referring to any type of environmentally friendly technology, such as renewable energy sources, abatement technology, or even carbon capture and storage (CCS) technologies.

Naturally, private investors will invest more in green technology if countries have credibly promised to emit less greenhouse gases in the future. However, as long as future commitments are *expected*, companies will invest more today in order to maximize profits. No *guarantees* are necessary to motivate firms to invest.

Instead, the main problem arises when countries negotiate and quantify emission levels without at the same time negotiating how much they should invest and thus tie their hands to a sustainable path going forward. The problem is that once a country has invested heavily and succeeded with a green transition in its economy, this country has less clout in future climate negotiations since it is no longer a threat to other countries fearing emissions from the others. In a typical bargaining game, such a country can be requested to cut emissions by more since that would be cost effective, and, in fact, also *fair* in an ex post perspective where one perceives past investments as sunk. When one anticipates that today's investments will be met by larger demands tomorrow, the incentive to invest is naturally diminished.

This underinvestment problem is the so-called *hold-up problem* in economics. The hold-up problem is a central issue in the research of Oliver Hart, the 2016 Nobel Prize winner in Economics (Grossman and Hart 1986). Hart's research, and the subsequent literature, has shed light on how the hold-up problem can be managed and dealt with by setting up clever agreements between the negotiators.

Climate negotiators can learn from this insight. In particular, the problem of underinvestment will be smaller, and investments will be larger, if the duration of the commitment period is longer. If investments in green technology are believed to be important, then the duration of the commitment period should be longer (Harstad 2016a).

2. Reviewing the Review Mechanism

The review mechanism in the Paris Agreement states that countries should revise and update their commitments every five years. It is necessary to ratchet up the commitments over time as we improve

technology and thus our ability to make larger cuts. It has not been specified exactly how the revised commitments are to be decided or negotiated, however, and here the *devil's in the details*, it turns out.

In particular, suppose that countries (re)negotiate their commitments every five years under the presumption that if these negotiations halt and break down, then one moves forward without any commitments at all. For this type of bargaining game, it is the technology laggards that will be rewarded with larger emission allowances in the equilibrium bargaining outcome, because giving the laggards larger quotas will be necessary to secure their continued support. Anticipating this, countries will be reluctant to invest up front, exactly as described in the previous section, where the hold-up problem was explained.

If instead, the default outcome of the (re)negotiation is the past set of emission cuts, or commitments, then there is a limit as to how much the laggards can expect to gain by holding back on technology investments. In fact, the countries that have already invested and prepared for the previously-agreed-to emission cuts will be comfortable with the status quo, and thus they will be in a good bargaining position. In order to obtain that good bargaining position, countries will invest more than in the situation in which the default outcome were no commitment at all.

Note that trade liberalization talks are organized in the latter way. Trade liberalization has occurred over multiple trade talks in recent decades. The commitments to liberalization have (rarely) been car-marked with expiration dates, and the presumption has always been that if one new round of trade talks fails, one returns to the existing set of trade agreements rather than to autarky. This way of organizing negotiations is more efficient, according to the reasoning explained above. In other words, climate negotiators can learn from successful trade liberalization negotiations.

In fact, an even better system for climate treaties is to return to an ever more ambitious plan for emission cuts, if later (re)negotiations should happen to fail. That is, the best treaty design is to negotiate and commit to a long-term path in which emission caps are forever decreasing, even though countries periodically (for example, every five years) may return to these commitments and revise or renegotiate them, depending on the circumstances. As long as the negotiators expect that the default outcome is not the business-as-usual scenario, but instead a path with decreasing emission caps, then they

will not have to reward countries that have underinvested when they (re)negotiate new caps. As a consequence, countries will invest more (Harstad 2012a).

3. Credibility in the International Prisoner Dilemma Game

International treaties cannot easily be enforced by third parties or harsh penalties. At most, a country that emits more than it promised may expect to lose goodwill or the other countries' willingness to comply with their parts of the treaty. Therefore, international climate treaties must be self-enforcing: Complying with the treaty must be in the best interest of the country.

One problem with a self-enforcing agreement is that climate change and environmental problems can be viewed as a prisoner dilemma game. That is, in a one-shot setting, it may be in the interest of a single country to emit rather than abate, but all countries may be worse off when everyone follows this strategy. A better outcome for everyone would be that every country abates, but that may not be individually rational when each country takes as given the actions of the others.

Cooperation in a prisoner dilemma game can be sustained when the game is repeated and countries worry that if one cheats by emitting today, other countries will do the same in the future. For cooperation and abatement to be individually rational in this context, two conditions must be satisfied. First, countries must care sufficiently about the future. Second, the temptation to *cheat* and emit rather than abate cannot be too large.

The gains from cheating and emitting rather than abating depend on a country's stocks of "green" and "brown" technologies. If a country has renewable energy sources, or if it is able to clean emissions effectively, then the cost of abating relative to emitting is smaller, and the temptation to cheat in the prisoner dilemma game is diminished. If instead, a country is endowed with a *brown* industry structure, as after advancements in the extraction of (unconventional) fossil fuels, then the country will be more tempted to emit. These perspectives may shed some light on President Trump's announcement in 2017 that he seeks to withdraw the United States from the Paris Agreement.

When other countries find it credible that a country with more green than brown technology is likely to cooperate by abating, then

these other countries may also be willing to comply with their promises to prevent cooperation from breaking down. Thus, to raise the likelihood for compliance and ensure that the treaty is self-enforcing, it may be necessary to require countries to invest more in green technology and correspondingly less in brown technology (Harstad, Lancia, and Russo 2017).

It is evidently complicated to require a country such as the United States to invest more in green and less in brown technologies. There are few but some alternative ways in which one can raise credibility and the countries' willingness to cooperate. One method is to introduce sanctions on countries that do not comply or participate. Sanctions can make a climate treaty self-enforcing; even if no sanction will ever need to be imposed in practice (because, when the sanction is credible, countries will find it in their self-interest to comply). The term *sanction* has a negative connotation, but such a mechanism can be framed positively by stating that a country that complies will be granted the so-called *most favored nation* status when it comes to international trade, implying larger market access and/or lower tariffs or nontariff border measures.

Another way to motivate compliance and participation is to reduce the benefits of free riding by influencing the (global) supply of fossil fuels. This mechanism is discussed in the next section.

4. The Supply Side: Regulate Fossil Fuel Extraction?

Demand equals supply in a global market. Thus, the sum of countries' fossil fuel consumption equals the amount that is extracted from the ground or the sea. If one side of the market is regulated, then the other side of the market will adjust accordingly. In other words, if countries cap their consumption of fossil fuels, then fossil fuel producers will face lower demand and they will find it profitable to reduce extraction by the same amount. Nevertheless, it can be highly beneficial to keep an eye on the supply side as well, for several reasons.

1. Since regulating the consumption of fossil fuels will reduce demand and thus the global fossil fuel price, the temptation to cheat by exploiting the low price and consuming more fossil fuel becomes more tempting. As explained in section 3, an agreement

on reducing emissions is more likely to be self-enforcing if the temptation to emit more is reduced. The temptation is reduced if the price of fossil fuel is high. The price is high if one seeks to reduce global supply (by requiring countries to extract less) in addition to reducing consumption and demand.

2. Relatedly, the higher fossil fuel price that follows if extraction is regulated will also reduce the countries' willingness to free ride by not participating in the treaty in the first place. For example, importers of fossil fuel will prefer that their country does not participate in a climate treaty if only consumption is regulated, since the associated lower price makes it particularly profitable to remain a nonparticipant. Therefore, the pressure from lobbyists to not sign/ratify a treaty can be larger if the focus is exclusively on regulating end-of-the-pipe emissions.
3. Even countries that do end up free riding will find it beneficial to invest in green technology, if the fossil fuel price is also high for them (i.e., if extraction is reduced); see Harstad (2012b).
4. Since an exclusive focus on regulating consumption will lead to a low global price, fossil fuel producers and exporting countries will be severely harmed by such a climate treaty, and they will work against it. To secure their support and participation, and to end up with a fair outcome in which the price is stabilized, one may want to regulate countries' extraction levels in addition to their emissions.
5. Regulating both sides of the market works as a global insurance in the risk of a failed treaty. If the Paris Agreement succeeds, so that the consumption of fossil fuels is reduced, then extraction will also be reduced, as explained at the beginning of this section. In this light, an additional regulation of extraction will have little impact on efficiency (except that it will lead to a larger fossil fuel price, as discussed above). However, if the Paris Agreement happens to fail, in the sense that countries end up consuming and emitting more than they pledge, or if other countries follow President Trump's lead in withdrawing from the agreement, then an additional agreement on reducing extraction levels may ensure that global emissions cannot elevate to a very large level. With this perspective, an additional agreement on extraction will have no downside, but the upside is that it can function as an insurance, if the demand-side policy works less effectively than we hope.

5. A Moratorium on Arctic Resources?

Given the benefit of regulating fossil fuel extraction, one may argue that one geographical area that is particularly suitable for such a regulation is the Arctic. There are several justifications for this claim.

1. Fossil fuel resources in the Arctic will be costly to extract, and they are thus not among the most profitable natural resources, neither from a private nor from a public perspective.
2. These resources are also environmentally risky to extract, since the ecological system in cold water is particularly sensitive to oil spills.
3. The technology required for an effective exploration in the Arctic has yet to be developed. The cost of this investment can be avoided if one abandons the plans for drilling in the Arctic.
4. The property rights or extraction rights in the Arctic Sea are claimed by several countries. Thus, multiple countries will bear the burden of not being able to extract in the high North. These countries are also relatively rich, so they should be able to bear this burden without making it necessary to compensate them with explicit side transfers. In fact, limiting extraction will lead to a larger fossil fuel price, as explained above, and the larger price is beneficial to fossil fuel exporters.
5. The claims to property rights in the Arctic Sea are to some extent overlapping. A moratorium will reduce the tension and the potential for conflict over these resources.
6. As of 2018, the world is still uncertain about (i) who will be able to secure which property rights in the Arctic Sea, (ii) the exact values or locations of the resources that can be extracted, and (iii) the cost and effectiveness of the technology that one needs in the process. These uncertainties imply that the countries with claims are all *behind the veil of ignorance*, to some extent. That is, for these countries the expected benefits of exploration are more similar today than they will be in a decade or so, when some of the uncertainty is clarified. This similarity should make it easier to sign a moratorium for the Arctic today, than it will be later in the future. One thus has a unique possibility to negotiate a moratorium for the Arctic Sea today; an opportunity that may be lost in some years.

7. It is certainly challenging to negotiate a moratorium for Arctic resources. However, the Antarctic Treaty (banning military operations and later resource extraction in Antarctica) was negotiated and signed at the midst of the Cold War (1959–1962). So, an analogous treaty for the Arctic should be possible in our time, even when one recognizes that the Arctic is a sea, and that the *Laws of the Sea* are different from the laws that were present (or absent) for Antarctica.

6. Deforestation and Forest Conservation

The policy discussed in sections 4 and 5, on regulating fossil fuel extraction, is related to the policy of incentivizing reduced deforestation. To see this, a demand-side approach to reducing deforestation in the tropics would be to reduce consumption and to boycott timber or agricultural products from such areas. Such a boycott will reduce the price of such products, and buyers/countries that are not participating in the boycott will purchase more. Given such a leakage, it is more effective to conserve particular areas of forests and regulate extractions of these resources directly (in other words, focus on the supply side of the market).

An important difference to fossil fuel resources is that the countries owning tropical forests are few and relatively poor. Thus, it is clearly necessary to offer explicit compensation to them in exchange for conserving their forests.

Such a policy is extremely cost effective, according to a number of studies. Not only is a large share of global greenhouse gas emissions coming from deforestation in the tropics, but deforestation also leads to huge losses of biodiversity and the homes of the world's last indigenous tribes. The global costs of deforestation amount to \$2–\$4.5 trillion a year, according to *The Economist* (2010). At the same time, estimates suggest that deforestation can be halved at a cost of \$21–\$35 billion per year, or reduced by 20–30 percent at a price of \$10/tCO₂ (IPCC 2014; Busch et al. 2012).

To succeed with forest conservation, it is urgently needed to announce and promise funds to be used for compensations. If countries in the tropics fear that demand for their products will be reduced in the future, they become motivated to log and remove forests today

(this is related to the so-called “Green Paradox” [Sinn 2008]). If instead, one can credibly expect to be compensated for conserving forests in the future, then countries will be motivated to conserve today, even if the funds are expected to be released only at some point in time in the future (Harstad 2016b).

7. When Countries Withdraw or Fail to Comply

In August, 2017, U.S. President Trump notified the United Nations about the White House’s intention to withdraw from the Paris Agreement. This decision followed the 2016 U.S. election in which the winner was a candidate that is often claimed to be unusually non-traditional and populist. At the same time, the notification is consistent with much of the reasoning above: Only binding commitments to cut emissions may sufficiently motivate (discourage) the development of green (brown) technology, and the United States did not face such commitments during the previous agreement, the Kyoto Protocol. Without a transition from brown industry structures, the temptation to emit rather than abate naturally dominated. Since there is no trade sanctions/carrots associated with participation, a large country faces few consequences when deciding to free ride.

The possibility to withdraw and free ride documents the challenges of relying on self-enforcing agreements. It is simply not credible that the defection of one country should trigger other countries to raise their emission levels, particularly since renegotiation is always possible in the real world. These possibilities strengthen the above conclusion that participants ought to invest more in green and less in brown technology for compliance to be credible. Withdrawals and free riding also show that it is necessary to accompany the regulation on demand with regulation of the extraction of fossil fuel and deforestation in order to limit carbon leakage.

While optimists may hope that the policies discussed above can be sufficient to motivate participation and participants, pessimists fear they are not. Since there is no world government in international politics, it is hard for progressive countries to motivate unwilling countries to participate. At the end of the day, the only instruments available in international politics may be to tie one type of agreement to another. Although the international community has thus far been reluctant to

risk the world trading system as an enforcer of environmental agreements, the future will show whether such a bundling is necessary to motivate participation and compliance.

Note

This chapter is based on my presentation at the IMF-OCP Columbia University Seminar on “The Energy Transition, NDCs, and the Post-COP21 Agenda,” held in Marrakech, Morocco, September 8–9, 2016.

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