EC313 Lecture #11
Treaties and existing regulation

Matthew A. Turner
University of Toronto
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Outline

- Biodiversity and leakage.
- Other mitigation policies.
- Description of the Kyoto Protocol.
- What might a 'serious' treaty look like? (Frankel, 2008)
- How does the EU Emissions Trading System work? How might it be expanded to the whole world?

Biodiversity and CO_2 leakage

- The effect of warming on biodioversity. This is clearly interesting and important, but apart from the IPCC's claims for large effects, I don't know much about it, nor how to value it.
- Trade and CO_2 leakage. This is a very important problem. If we regulate CO_2 in one jurisdiction, does the production of CO_2 intensive goods simply move to a different jurisdiction? (which then ships them to the regulated jurisdiction).

  There is a small literature addressing this issue which suggests (I think) that this problem is non-trivial and could undo much of the CO_2 reductions in the regulated jurisdiction. The obvious fix is to impose a CO_2 'tariff' on imports from unregulated jurisdictions.

  This will, however, complicate already difficult trade relationships.

Policies other than taxes

A number of mitigation policies other than taxes or cap-and-trade are sometimes considered. Among these are:

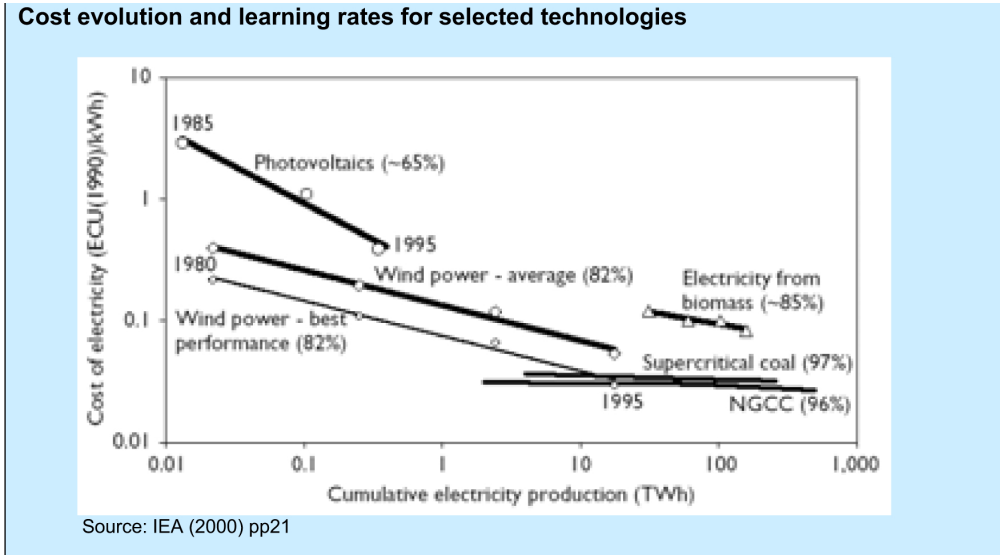
- Mitigation policies other than taxes/tradable permits. In particular:
  1. *Urban planning*. The IPCC calls for changes to urban form as a way of reducing CO_2 emissions. California's 'Assembly Bill 32: Global Warming Solutions Act' requires substantial CO_2 reductions from urban planning.

     There is, at present, suggestive (but not conclusive) evidence that (1) people in cities consume less energy than people in rural areas (2) that people in denser cities consume less energy than people in less dense cities.

     There is, to my knowledge, no basis for assessing whether

urban planning is a cost-effective way to reduce emissions. If the benchmark is a tax on CO_2 , I conjecture that it is not.

2. Subsidies for particular technologies, e.g., wind, solar, nuclear, biofuels. This is where we recall the graph describing technological progress in energy production:



If we could just pick one of these and scale it up, our problems would be over! Whether we should pursue such a policy is subject to some, but not much debate among

economists.

The near consensus view is that (1) innovation is important and then some sort of public support of basic science is warranted, and (2) that governments should try not to pick particular technologies. As much as possible, this choice should be left to the private sector.

The experience with biofuels in the US and 'Solyandra' is suggestive.

3. Geo-engineering, is scary but appears to be cheap.
4. Reforestation. As part of the Durban round of climate negotiations, the IPCC enacted the 'Reducing emissions from deforestation in developing countries' program. This program subsidizes developing countries for not cutting down trees. This program, presumably, reduces deforestation in developing countries. This may be partly or substantially offset by changes in developed countries. I

don’t think anyone knows.

Kyoto Protocol

The United Nations Framework on Climate Change is the UN body 'in charge' of climate change.

The Kyoto Protocol is part of this framework, and came into effect in 2005. While it was never ratified by the US, and is almost expired, and has some problems we've talked about, it is still the only substantive international agreement on climate change.(I think).

The Kyoto Protocol requires mitigation of about 8% from 1990 base on 'Annex I' countries. This mitigation was to begin in 2008 and be completed by 2012. A second four year commitment period is intended to follow the first.

Loosely, 'Annex I' countries are Europe, the US, Japan, Canada, and Australia. Non-Annex I countries don't have mitigation obligations under Kyoto.

Under Kyoto, each country receives an allowance of CO_2e emissions. These allowances are denominated in AAUs, or

'assigned amount units', each of which permits the emission 1000kg of CO_2e .

AAUs cover CO_2e emissions from the following sectors: Energy, Industry, Solvents, Agriculture, solid and sewer waste. They do not cover emissions associated with changes in land use, in particular the conversion of land to or from forest.

Annex I countries can choose whether AAUs apply to 'Land Use, Land use Change, Forestry' (LULCF) at the beginning of the commitment period. If so, then they must also account for deforestation (and afforestation) in their mitigation budget. In this case, LULCF changes act by changing a countries stock of AAUs. That is, growing trees adds to your AAUs, cutting them down subtracts. Growing trees generates 'ReMoval Units' (RMUs) which convert to AAUs in the obvious way.

Annex I countries can change their stock of AAUs in three ways.

(1) Trading with other Annex I countries. The Kyoto protocol clearly envisions an international market in AAUs. It is a giant cap-and-trade program.

(2) If one Annex I country invests in mitigation in another Annex I country, the investing country can receive credit through ERUs (emission reduction units). This allows the investor to receive emissions credit for the investment, even though the investment is not on their own soil. This is called the 'Joint Implementation' program.

The treaty calls for the necessary bureaucracy to verify and keep track of these transactions.

(3) The Clean Development Mechanism (CDM) credits generate AAUs from mitigation or afforestation in non-Annex I countries.

This process is complicated. The problem is that this process is clearly open to abuse because non-Annex I countries don't have

any mitigation obligations at all. The treaty calls for a bureaucracy to verify CDMs and to keep track of them.

Note that through CDMs the treaty provides a mechanism for exploiting low cost mitigation opportunities in Non-Annex I countries. This means that regarding only Annex I countries as 'participants' in the sense used in Nordhaus' analysis of participation rates, is not really fair.

The Kyoto protocol also establishes a bureaucracy to monitor and assess compliance. A country is determined to be in compliance if they have less emissions than AAUs in any commitment period. What happens if they are not in compliance? Not much, they are not allowed to trade AAUs until the administrator determines they are on the road to compliance.

The interesting thing to notice in all of this is that the mechanics of global pollution regulation are hard. Setting up the institutional framework in which to monitor emissions and keep track of allowances is a big deal. It will take a lot of work and a lot of tinkering to do it. This is a big, and completely separate issue from the work that will need to be done to reduce emissions in order to comply with such a program.

The treaty negotiation problem.

Consider the following:

1. World Carbon Emissions are currently about 10.5Gt/year. To stabilize atmospheric concentrations we will, ultimately need to reduce this dramatically, say to 3Gt/year (this may be high).
2. Per capita Carbon emissions are currently: 7t/year (US/CA/AU), 1.6t/year(China), 1.6t/year (world average).
3. With 7b people and 3Gt/year of emissions, each person get about 0.4t/year of Carbon emissions. This is a 94% reduction for (US/CA/AU), a 73% reduction for China and the rest of the world.

Stern/Gore/Hansen/Nordhaus disagree about the rate at which we should approach this goal, but not about the goal.

NB: Multiply by 44/12 to get numbers in terms of CO_2 .

Frankel (2008) proposal

Our problem is to get the world from 10.5Gt year (and growing) of C to about 3Gt year (or less).

The developing world won't want to do this because (1) they are poor and want to be rich (2) they didn't cause the problem (3) per capita emissions are still much higher in the developed world.

The developed world won't want to bear the full cost of mitigation, in the developed and developing world, particularly when much of the cost of warming will fall (we think) on the developing world countries.

These are not favorable pre-conditions for negotiating a global warming treaty, so it is no surprise that progress is slow.

Given this environment, Frankel suggests that any successful agreement must be consistent with the following conditions

1. The US will not commit to an agreement if China does not because of fears of leakage.
2. China will not make sacrifices because the US has not done so.
3. The developing world will not make sacrifices that are different from this made by the wealthy countries.(This is vagues, but he has something precise in mind).
4. No country can be rewarded for ramping up emissions before joining.
5. No country will comply if its cost is more than 1%/year of GDP on average.
6. No country will comply if its cost is more than 5%/year of GDP in any year.
7. If one major country drops out, others may too.(Also vague).

Can we find an emissions reduction path for all countries that

satisfies all of these conditions/statements?

Frankel's idea for satisfying these conditions is that developed countries begin mitigation now, and that developing world countries reduce emissions *relative to business as usual* as they become wealthy. Developing world countries accept a cap at business as usual levels in the meantime and there is a world market for CO_2 .

Note that there is no mention of climate or CO_2 targets here.

Details

1. The EU will follow a path laid out by 2008 policy. In 2012 emissions will be 8% below 1990 and will decrease at a constant rate until 2052 when they will be 50% of 1990 levels. Note that this is fast. Stern wants WORLD levels at 35% of 1990 by 2050, while Nordhaus wants to hold world emissions constant.
2. The US will follow a path laid out in a failed, but almost passed, bill by Leiberman and Warner in 2008. In this bill emissions levels in 2012 are equal to 2005, and drop to 62% of 1990 by 2050. This is also pretty fast.
3. China and India accept a binding cap on their emissions at the projected business as usual levels until 2030. This entails a large increase in their emissions. After 2030, when they are wealthier, they begin to approach the EU and US 2050 levels.

Comments:

- That China and India accept caps at BAU levels is important. It prevents leakage.
- Using these rules, with a few details filled in, and a model of how economies grow and emissions evolve, Frankel comes up with particular emissions targets for each country for each year.
- In the end, CO_2 path looks like Nordhaus' optimum, with CO_2 capped at about 500ppm. This is driven not by an optimization problem, but by US and EU commitments to reductions and the fact that the rest of the world, eventually, follows them along this path.
- Note that this path requires aggressive action (or allowance purchases) by developed countries now.

EU Emissions Trading Program

In response to Kyoto obligations, the EU started an emissions trading program.

This is the biggest such program in the world, and it is useful to understand how they set it up. At the end of the day, the organization that lies behind a CO_2 trading scheme looks a lot like the organization behind a stock market or a currency: it's complicated and the details matter.

Of particular interest, the trading scheme encompasses about 30 countries, and so teaches us about how to organize a supra-national authority to manage emissions.

New EU countries must sign up for the cap-and-trade program as a condition for gaining entry into the EU. This highlights the importance of connecting trade and emissions. Note that it's already hard to get trade agreements, and trade agreements are

important, so putting another barrier to these agreements in place is not something to be done lightly. With this said, there doesn't seem to be any other way to induce countries to comply with emissions targets.

The EU-ETS is a 'cap-and trade' program. It covers CO_2 emissions only from power plants and most industrial activities, not buildings or transportation. Only about 40% of EU CO_2 equivalent is covered.

The program was initially to cover the 15 original EU countries. It has expanded to 30 with EU expansions.

Kyoto came into effect in 2008. The EU-ETS trial period went from 2005-7. The first real trading period was 2008-12, the next one is 2013-17.

During the trial period the EU ETS had a barely binding cap with a pressure valve price. There were no binding Kyoto caps during

this time, so the object was to figure out how to make the program work. Monitoring and trading procedures are established. No banking of permits was permitted (this means that at the end of the period, the quota price had to be zero or the penalty price).

The EU-ETS faced two following problems during its trial period.

First, there was a lack of establishment level data on emissions. This made allocating emissions permits across establishments on the basis of historical emissions rates difficult. However, even Bulgaria was able to overcome this problem fairly quickly. For power plants, it is easy to infer emissions from recording fuel use.

Second, the administrative authority was weak – it is the EU government and then can't arrest people etc. Over time it became more powerful. This seems like a natural course of events. Once the permits are issued, they become an asset and the owners of these assets become a constituency for preserving the value of this

asset. This constituency does not exit before the permits are issued. There is some evidence for a similar phenomena in fisheries – fisheries seem to be better run after they adopt ITQ regulation.

The operation of the EU ETS leaves a number of issues to be resolved.

First, what if we end up with lots of little trading programs, e.g., New England and California have them, and Australia is likely to get one. Thee different programs may not have the same quota price, which means that we are not accomplishing whatever reduction is mandated at least cost. We'll need to find some way of converting credits in one market to credits in another.

Second, existing programs have incomplete coverage, e.g., they don't cover agriculture or transportation or F-gases. How can these emissions be brought into the program? This is important because these may be cheap sources of mitigation.

One mechanism for doing this is 'certified emissions reductions'. Here, someone outside the program undertakes mitigation, e.g., methane capture at a water treatment facility, and has this action 'certified' as a CO_2 reduction. This person can then sell credits in the permit market to equal the mitigation of their project.

This is good, but suspicious. As a nice example of this, consider the REDD program (Reducing Emissions from Deforestation and forest Degradation in developing countries). Under this program, developed countries pay developing countries to preserve forests. This is good since deforestation is a big source of emissions (about 15%).

Let's think about this more carefully however. Much of the deforested land is used for crops or pasture. Without this new land for crops or pasture, some land elsewhere will be used for crops or pasture. If this land would otherwise have been in forest, this offsets the CO_2 mitigation accomplished by the REDD program.

Now suppose that a reduction in deforestation under REDD is certified as an emissions reduction, and the host country is permitted to sell these mitigation credits in the quota market. Then what we have just accomplished is an increase in our total emissions equal to the emissions associated with the land that is deforested elsewhere to substitute for land protected under REDD. That is, it is easy to imagine situations where Certified Emissions Reductions actually lead to emissions increases.

This is clearly a difficult problem. Given a mitigation program, we would like to be able to exploit cheap mitigation opportunities outside the program. However, there is the real risk that (even without obvious and deliberate efforts to cheat) this process will end up increasing emissions.

Conclusion

In this course we have investigated:

- the physical science behind climate change: measured temperature, measured change to atmospheric CO_2e ,the physics of global warming, and the carbon cycle. The culmination of all of this work was an understanding, however uncertain, of the relationship between CO_2e emissions and climate change.
- the effect of climate change on human welfare. This culminated in a damage function relating warming to gdp loss. There is less, and less conclusive research on this topic than might be expected given the gravity of the topic. Clearly much uncertainty remains
- the problem of choosing an optimal mitigation path. This optimal path is sensitive to the choice of discount rate and to

our treatment of uncertainty. The conclusion that an immediate reduction in emissions at least equal in magnitude to that caused by about a 50$/ton CO_2e tax is desirable. Much larger or more rapid reductions are justified by some defensible assumptions.

Given the current inequality of per capita emissions rates across countries, and the probable convergence of these rates as these countries develop, much of this mitigation effort must fall on developed countries (like Canada). This means much higher levels of mitigation effort in these countries (or efforts to induce comparable mitigation in developing world countries – we want to be sure to do the easy mitigation first)

- the reason that we are not on an optimal path. This is, arguably, a bit surprising. The 'tragedy of the commons' provides an intellectual framework in which to understand this, and also a foundation for thinking about the effects of

regulation.

- We have also investigated the design of regulatory programs to accomplish a given emissions reduction. Taxes or cap and trade program are probably preferable to other options. This is not really an 'either or' choice. By adding reserve prices, and auctioning a portion of permits, a cap and trade program approaches a tax. Revenue recycling is probably important.

Together, this leaves us with a reasonable foundation for contemplating actual mitigation policies, and so we have substantially completed the goals of the course.

In fact, implementing a carbon tax or cap-and-trade program requires us to surmount significant obstacles. These obstacles are of two sorts.

The first is technical, how do we keep track of emissions and carbon? The Kyoto protocol sketches out the institutions required

to accomplish this, though they will surely need adjustment. Our experience with the EU-ETS also informs us about how to set up a global cap and trade.

The second is distributive. How do distribute mitigation across time and countries in such a way that everyone will want to participate. This is probably very hard. Frankel(2008) suggests how it might be done, but neglects to consider that his plan is not cost minimising.

A number of issues remain to be addressed, but are beyond the scope of this course.

- Technological progress, as Nordhaus suggests, is clearly very important. It seems improbable that we will achieve sufficient reductions in emissions to stabilize the climate at anything near current temperatures without dramatic improvements in technology. Public policies to promote such innovation are

important. This is a difficult problem we should beware of ‘picking winning technologies’ as governments, historically, are not good venture capitalists.

- Geo-engineering
- urban planning.