Department of Economics and Business, Thesis in Industrial Organization and competition theory

Cooperation : the key to success? The CO2 problem and the American Thesis

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Academic year : 2015/2016

“*Perciò chiunque ascolta queste mie parole e le mette in pratica, sarà simile a un uomo saggio, che ha costruito la sua casa sulla roccia.”*

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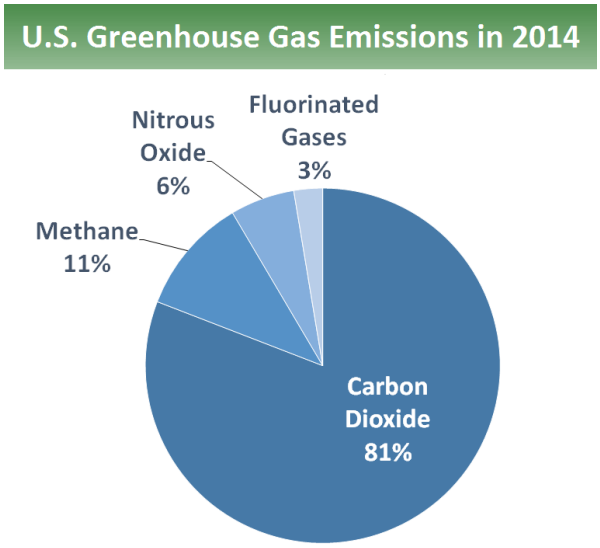
Introduction

Greenhouse Gas Emissions

Gases that retain heat in the atmosphere are called greenhouse gases. This introductory chapter provides information about the main greenhouse gases and the consequences that their production provide to the atmosphere.

- Carbon dioxide (CO2): Carbon dioxide affects the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions (e.g., manufacture of cement). Carbon dioxide can be “removed” from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.
- Methane (CH4): Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from agricultural practices such as livestock and by the organic waste in municipal solid waste landfills.
- Nitrous oxide (N2O): Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
- Fluorinated gases: Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. These gases are typically emitted in smaller quantities, but because they are significant greenhouse gases, they are sometimes referred to as High Global Warming Potential gases ("High GWP gases").



The gas effects on the climate change depends on one main factor:
quantity of gas emissions in the atmosphere.
Concentration, or abundance, is the amount of a particular gas in the air. Larger emissions of

greenhouse gases cause higher concentrations in the atmosphere. Greenhouse gas concentrations are measured in parts per million, parts per billion, or parts per trillion.

The Other CO2 Problem

Ocean acidification (OA) is the major problem which causes environmental degradation. Within a few decades, OA has devastated some marine ecosystems and put in danger the productivity of our sherries. Practically,whenever we burn oil, coal, or gas, scientists have recently shown, we are transforming the chemical equilibrium of the oceans, also making the water more acidic.

What Is Ocean Acidification?

The process of ocean acidification is incredibly simple. Carbon dioxide generated from the burning of fossil fuels accumulates in the atmosphere, where it causes global warming. But it also affects our oceans, as we can notice. Once carbon dioxide mixes with the ocean, it suddenly reacts with sea water to form carbonic acid. "Since the start of the Industrial Revolution about 150 years ago, approximately one-quarter to one-third of all CO2 from fossil fuels—or 500 billion tons— has been absorbed by the seas, increasing the average acidity by 30 percent." (Nrdc.org)
Changes in ocean acidity are so evident that we cannot avoid to say that they are linked to human activities. Carbon dioxide produced from the burning of fossil fuels can be identified and measured in ocean water and the acidification effect of the CO2 is unavoidable.

Now, actually we reach a dilemma. The ocean's absorption of CO2 helps keeping atmospheric change in check. For decades, climate scientists described the up taking levels of CO2 as a positive issue for society, and ocean chemists hoped that calcium carbonate sediments on the seafloor would dissolve in sufficient quantities to offset the drop in pH levels in salt water. But research has shown that the rate at which sediments dissolve cannot be compared to the one of acidification. Society can continue to depend on the ocean for help, but the cost is a rising threat to all marine life.
The fossil record shows that our oceans have suffered from massive extinctions during periods of rapidly rising carbon dioxide levels. Marine acidic water will acidify body fluids, likely raising respiratory stress and lowering metabolism.
Some organisms may tolerate a certain amount of change, but thinner fish will be more vulnerable to damage or bigger predators. Some organisms might also tolerate acidification of internal fluids to a point, but expending more energy to maintain their optimal acid-base balance or will struggle to supply their body with oxygen and to sustain cellular functions vital to life.
"The extra expense of coping with acidification may make them more prone to dying. These stresses will be particularly severe for deep-sea animals, which have adapted to an extremely stable environment. And even if animals survive, the stresses will sap energy they would otherwise use for growth and reproduction."(Nrdc.org)
These creatures migrate massively to the surface layer of the ocean at night to feed and then turn to sink to deeper water during the daytime to avoid predators. In doing so, they form a critical link between the warm, oxygenated surface layer and the cold, oxygen-depleted waters of the ocean ground, as well as a link in the oceanwide food chain.

Solutions to Save Our Seas

The idea of beating the acidification requires reducing CO2 emissions so to improve the overall health of the oceans.

What can you do? Obviously, we need to search new power resources for our lives without emitting huge quantities of CO2. To accelerate the process of studying a clean energy future, we need to enact federal carbon cap-and-trade legislation and adopt an energy policy that fuels efficiency and encourages renewable sources based on wind and sun.

To sum up…

As we will see in the next two chapters, the history of the long lasting effort to document and understand climate change is often complex, linked to successes and failures, and has followed a very unstable path. The necessity of auto critique has been agreed by every country, and that's what my examination of the CO2 problem is about. Climate change science is now contributing to the foundation of a new, innovative approach needed to understand better our environment. Consequently, much published research and many notable scientific advances have occurred since the Kyoto protocol onwards, which I will analyze here, including advances in the understanding and treatment of uncertainty.

The results are the American models labeled by Cramton and Stoft, which I will present here, and which are the latest attempts to overcome to this major problem.

Chapter One.
From Kyoto Protocol to the present days.

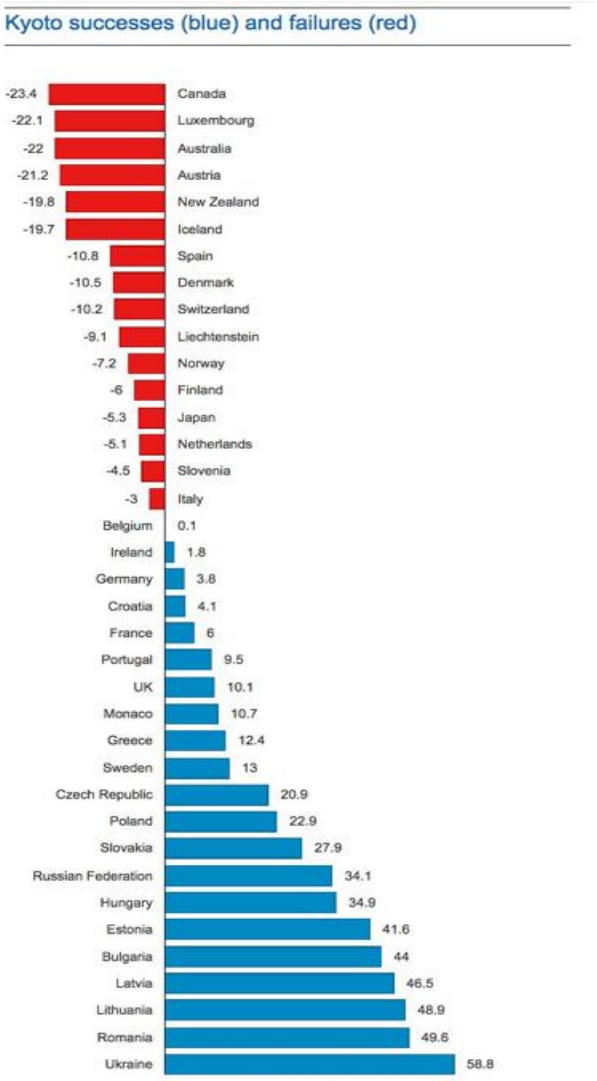
KYOTO PROTOCOL

The Kyoto Protocol is an agreement negotiated in December 1997 by many countries and established thanks to Russia's ratification on February 16, 2005.
One of the terms of Kyoto required at least 55 parties to ratify the agreement and ,for all the parties, emissions to be at least 55% of global production of greenhouse gases.
The protocol was developed by the UNFCCC - the United Nations Framework Convention on Climate Change, which were obliged to commit to cut emissions of not only carbon dioxide, but of also other greenhouse gases, such as: Methane (CH4),Nitrous oxide (N2O),Hydrofluorocarbons (HFCs),Perfluorocarbons (PFCs),Sulphur hexafluoride (SF6).
Another important issue about the protocol, which was brand new in the environment, was that if countries went on making emissions above the targets, then they would have to be engaged in emissions trading, for example, buying "credits" from other participants which were able to exceed their reduction targets instead.
The principal goals of Kyoto were to see participants collectively reducing emissions of greenhouse gases by 5.2% below the emission levels of 1990, in 12 years time.
In addition to this general achievement, individual countries were assigned higher or lower personal targets with due exeptions . For example, the USA was expected to reduce emissions by 7%.
As for India and China, they indeed have ratified the Kyoto protocol, but were not obligated to reduce greenhouse gas production at that moment as they were considered as developing countries; in other words they weren't seen as the main blamers for high emissions during the period of industrialization or to be the cause for the global warming issue.
This was the very first mistake, followed by many others, of the Kyoto Protocol, mostly because China was and still is about to overtake the USA emissions, also taking into account that much of the production of these countries is achieved thanks to a considerable demand from the Western countries. For this reason, we can conclude now,that the West has effectively outsourced much of its carbon emissions to China and India, during the last decade.
This phenomenon, was the major hole in the Kyoto Protocol.

Kyoto – criticisms

The exclusion of these two enormous developing economies was not the only poverty of this treaty.
The Kyoto Protocol, against all provisions, appeared to be everything but flawless, and to be condemned to fail its objectives even before the 2008-2012 period began. Carbon dioxide levels in the atmosphere are rising at a frightening rate with no sign of slowing down, and the same situation was applicable in the past, as well as the global temperatures' problem, which continued to frighten the nations involved .

Most of the criticisms are based on the fact that thee science behind Kyoto was imprecise, mostly due to the limited availability of data and knowledge of the time; and it is exactly for the same reason that scientists studying global warming were surprised to find out the new ways in which Nature was fighting back, in response to the climate changes.
It started to be clear, during the following years, that if USA and China hadn't been able to accomplish the targets suggested by the treaty, the goals would have never been met**.**
To get an idea of how countries have performed against their targets, in the charts below we can see plotted the gap between each nation's percentage target (data from the Guardian.com) and its actual percentage change between 1990 and 2010 .



As we can see from the plot, much of the growth in China and other emerging economies has been driven by the production of goods and services exported to developed nations. According to a study of the Guardian reported in 2011, when we look at total carbon footprint of each nation

(including imports and excluding exports), the achievements made under Kyoto look extremely poor, viewing that the developed world as a whole has seen its emissions rising by 7% in the same period.
Overall, the result is that global emissions have showed no sign of slowing down, as the chart above shows. Which is an evident fact that, the Kyoto protocol has been a failure, on one hand. On the other hand, moving deeper into this idea, it would unreasonable to say that Kyoto was not a first step into a more responsible world. The question, after 2012, was whether there could have been a greater impact on society or not.

Here we have another chart, explaining how several countries behaved from the beginning to the year 2007, and as Michael Chavez claims:
"Chart shows the change in greenhouse gas emissions for several countries between the years 1992 and 2007. As you can see, many countries have increased dramatically rather than decrease their emissions since the introduction of the Kyoto Protocols."

Country	Change in Greenhouse Gas Emissions 1992-2007
India	+103%
China	+150%
United States	+20%
Russian Federation	-20%
Japan	+11%
Worldwide Total	+38%

Even if the protocol was signed in 1992, it was only attained in 2005, so more than 10 years later, which is indeed an explanation why the objectives were so difficult to be achieved.
Moreover, the United States, the largest gas emitter,refused for a long time to ratify the treaty, which represented another obstacle to the Kyoto's goals. The reason why the United States did not ratify lies in the absence of binding targets for developing nations, such as India and China, whose emissions have increased dramatically :103% and 150% respectively. Without binding targets for those nations, United States feels that they are going to increase even more their emissions, rather than decreasing them.

The positive side

The greatest goal of the Kyoto Protocol is that nations finally faced the fact that they needed to reduce their greenhouse gas emissions and protect our environment. Even if the goals of the Protocol were not met, it has been a great starting point. The Protocol is still helping the world

nowadays to work together in order to protect our planet, showing that many countries are serious about environmental protection.

DID IT SUCCEED?
Twenty-one countries met their emission targets, but most of these countries were not top emitters. For example, Latvia, Lithuania, Romania and Ukraine. “You have to judge Kyoto to have been a failure. Just on the merits of what was done as a result of the agreement and countries not actually living up to their commitments or staying with the agreement,” said Kenneth P. Green, an environmental scientist at the Fraser Institute.
However, Kyoto did contribute to an extent on a greater consciousness : “Kyoto was a first attempt, a testing ground for all these various ideas including these mechanisms like emissions ratings and developing systems of accounting,” claims Jutta Brunnée, an environmental law professor at the University of Toronto.

THE COPENHAGEN AGREEMENT

The Copenhagen Agreement is a document that was created at the 15th session of the Conference of Parties (COP 15) which, the United Nations Framework Convention on Climate Change, agreed to submit at the final plenary on 18th December 2009.
The Accord, drafted by the United States and by, in the so called “ BASIC countries”(China, India, South Africa, and Brazil), is not legally binding and does not commit countries to agree as it was an automatic process after the Kyoto Protocol, which in turn ended in 2012.
For the sake of clarity, I must underline some of the most interesting characteristics of this agreement. First of all, it is thought as the direct continuation of the Kyoto Protocol , and thought as to prevent dangerous “anthropogenic interference” with the climate system; it recognizes "the scientific view that the increase in global temperature should be below 2 degrees Celsius"(Wikipedia), to limit as much as we can the climate change.
In addition, the agreement states that it "enhanced action and international cooperation on adaptation is urgently required to... reduc[e] vulnerability and build.. resilience in developing countries, especially in those that are particularly vulnerable, especially least developed countries (LDCs), small island developing states (SIDS) and Africa", and agrees that "developed countries shall provide adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation action in developing countries" (From the agreement).
It strongly recommends that developing countries report their actions once every two years via the U.N. climate change secretariat, as much as recognizes "the crucial role of reducing emission from deforestation and forest degradation and the need to enhance removals of greenhouse gas emission by forests", and recognizes the need of financial resources from developed countries to help achieve the goals required. The total amount of funds needed has been calculated around $30 billion, from 2010 to 2012, and it is established that those funds should be risen up to $100 billion per year by 2020.
Moreover, it gives birth to the Copenhagen Green Climate Fund, an operating entity which has the aim "to support projects, programme, policies and other activities in developing countries related to mitigation".

Success or failure? An open discussion .

In February 2010, a discussion was held at MIT, where Henry Jacoby presented the results of an analysis claiming that ,assuming that the projections made by the countries involved in the Accord were fulfilled, global emissions would have reachedt heir peak in 2020. As for the rising temperature,Jacoby claimed that emission reductions below the 2 °C target indeed could help reducing the magnitude of future climate changes.
In March 2010, Nicholas Stern gave a talk at the London School of Economics on the results of Copenhagen conference. Stern was actually disappointed with the outcome , but saw the agreement as a possibility to improve the "business-as-usual" greenhouse gas (GHG) emissions. The amount of gas emissions would, according to his studies, be nearer to 50 gigatons, rather than 44 gigatons, which is the needed amount of emissions in order achieve the 2 C degrees objective, even if all the countries fulfilled their commitments. Stern compared this incredibly positive projection to a "business-as-usual" emissions one (which is the amount of emissions that countries might have reached without the Accord). His "business-as-usual" projection suggested that without the Accord, emissions might have been above 50 gigatons in 2020.
Obviously, some critics were well defined, and I chose some of them to be enlisted here:
* The accord itself is not legally binding
* No decision was taken on whether to agree a legally binding successor or complement to the Kyoto Protocol.
* The accord sets no real targets to achieve in emissions reductions.
* The accord was drafted by only five countries.
* The deadline for assessment of the accord was drafted as 6 years, by 2015.
* The mobilisation of 100 billion dollars per year to developing countries will not be fully in place until 2020.
* There is no guarantee or information on where the climate funds will come from.
* There is no agreement on how much individual countries would contribute to or benefit from any funds.
* COP delegates only "took note" of the Accord rather than adopting it.
* There is not an international approach to technology.

PARIS SUMMIT

The 2015 United Nations Climate Change Conference (COP 21 or CMP 11) was held in Paris,from 30th November to 12th December 2015.
The conference gave birth to the Paris Agreement, a global agreement on the reduction of climate change, which represented a consensus of all the parties collaborating. On 22nd April 2016, during the Earth Day memorial, 174 countries signed the agreement in New York,and began adopting it soon after.
The main goal of the Accord was and still is to limit global warming to less than 2 degrees Celsius (°C) compared to pre-industrial levels, which is to be reached during the second half of the 21st century. Moreover, the parties will also "pursue efforts to" limit the temperature increase to 1.5 °C, that will require to reach zero emissions between 2030 and 2050.
World Pensions Council (WPC) argued that the key to success is to convince countries such as U.S. and China to be particularly active: "As long as policy makers in Washington and Beijing didn't put all their political capital behind the adoption of ambitious carbon-emission capping targets, the laudable efforts of other G20 governments often remained in the realm of pious wishes. Things

changed for the better on 12 November 2014 when President Obama and General Secretary Xi Jinping agreed to limit greenhouse gases emissions."
Indeed President Obama insisted on America's essential role too :"We've led by example […] from Alaska to the Gulf Coast to the Great Plains [...] we've seen the longest streak of private job creation in our history. We've driven our economic output to all time-highs while driving our

carbon pollution down to its lowest level in nearly two decades. And then, with our historic joint announcement with China last year, we showed it was possible to bridge the old divide between developed and developing nations that had stymied global progress for so long […] That was the foundation for success in Paris."

On 12th December 2015, the participating 195 countries agreed, to the final document, the Paris Agreement, to reduce emissions in order to reduce greenhouse gas. In particular, the members agreed to reduce their carbon output "as soon as possible" and to do their best to keep global warming "to well below 2 degrees C". However, some sections of the pact are considered as "promises" or aims and not true commitments.

Pros and cons of the Paris Agreement.

Some critical views have observed that the aims and goals of the Paris Agreement are “predicated upon an assumption – that member states of the United Nations, including high polluters such as China, the US, India, Canada, Russia, Indonesia and Australia, which generate more than half the world’s greenhouse gas emissions, will somehow reduce carbon pollution without any binding enforcement mechanism and without any specific penalty gradation or fiscal pressure (for example a carbon tax) to discourage bad behaviour”,which is an interesting point to evaluate.
Professor James Hansen, a former NASA scientist and an expert regarding these topics , also sustained the thesis that most of the agreements consist of "promises" or aims and not firm commitments.
These doubts could be somehow overcome because the United States publicly committed, in a joint Presidential Statement with China, to join the Agreement in 2016. This particular feature, sums up the idea that the Paris deal is the world’s first comprehensive climate agreement.

Al Gore stated that "no agreement is perfect, and this one must be strengthened over time, but groups across every sector of society will now begin to reduce dangerous carbon pollution through the framework of this agreement."
According to a study published on the newspaper “Nature”, in June 2016, current undertakings of the majority of the countries are too low to lead to a temperature rise below the limit of 2 °C.
Although some critics, the agreement was also encouraged by many, including French President Francois Hollande and UN Secretary General Ban Ki-moon.

Long term goals- Paris Summit

The Paris Agreement prescribes two long-term emission goals: first, a peaking of emissions as soon as possible (with a recognition that it will take longer for developing countries); then, a goal of net greenhouse gas neutrality (expressed as “a balance between anthropogenic emissions by sources and removals by sinks”) in the second half of this century, precisely up to 2030.
With respect to countries’ individual efforts, the agreement prescribes a set of binding procedural commitments: to “prepare, communicate and maintain” an NDC; to provide information necessary for clarity and transparency; and to communicate a new NDC every five years. It also provides the expectation that each following NDC will “represent a progression” beyond the previous one and reflect a party’s “highest possible ambition.” But I will talk about ambition later on.
Furthermore, the agreement commits parties to “pursue domestic measures with the aim of achieving the objectives” of its NDC, but does not make the implementation or achievement of NDCs a binding obligation. It also encourages, but does not require, which is kind of a point to underline, countries to develop and communicate long-term low emission strategies.
The principal commitments are common to all parties, but there is some differentiation in the expectations set: developed countries are expected to show more ambitious reduction targets, while developing countries “are encouraged” to move toward economy-wide targets over time. In addition, developing countries must receive support to implement their commitment, but actually no source of it is specified.

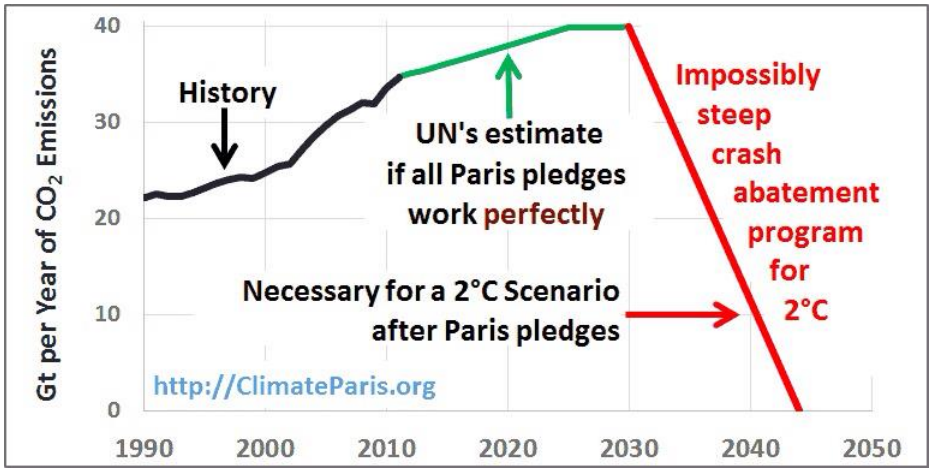
To understand even better the point, I would like to use Stoft’s words on Paris Summit:
“On average, the pledges will be kept roughly as the UNFCCC reports predicts. And so, in 2030, we will find there is not a chance in hell of achieving a 2°C scenario. This will also mean that no

effective “ratchet” mechanism has been discovered, and that Christiana Figueres’ analysis of the current pledges has continued to hold, so almost nothing was done to save the planet.”
—Steven Stoft, 12 December 2015.

Has COP21 found the magic bullet? Steven Stoft analysis

Until now, they tried very hard to convince us that a final point has been reached, but once again Stoft gives us a new way of thinking the whole story, mainly focusing on 5 key points.
Before analyzing them, we must say that the predictions are discouraging, as current pledges leave us much worse off in 2030. Moreover, China only pledged what it was going to do anyway.

Something’s going wrong, so let’s take it step by step, following the Stoft analysis.
Step 1. Even if pledges work perfectly, still it seems impossible to reach the 2 degrees scenario.



On the graph I reported,the black line shows global CO2 emissions, including China’s CO2 burst from 2002 until about 2011. The green line shows the UN’s most optimistic prediction for the Paris pledges. This is less steep mainly because China is ending its CO2 burst to avoid killer smog in its cities. But CO2 emissions continue to increase through the end of the pledges in 2030. The red line shows what’s required to stay under 2°C, given the situation in 2030.

Scientists estimate that to have a 66% chance of warming less than 2°C (which is not a very promising one), we should emit less than 1000 more gigatons of CO2 after 2011. By their end in 2030, the UN says the pledges would use up at least 723 Gt of that and would increase emissions to 40 Gt per year. At that rate, the rest of the CO2 budget would be gone in seven years. MIT estimates that pledges won’t be perfect, and so five years is more likely.

Well, the Stoft graph just shown claims this is impossible. It shows us precisely that reducing the rate of emissions before we run out, would be impossible now, and after 15 more years of building

new coal plants in China and India and more cars everywhere, it will be beyond impossible. Fair enough.

Step 2. Can pledges be improved before 2030?
If the pledges are dramatically improved, we have a chance, in Stoft's opinion. If they are improved only a little, as he claims they will be, the graph above shows we will miss the goal for sure, dramatically. So the hope is that there will be a review, after at most at 5 years, in order to restore the situation and increase the magnitude of the interventions.

Basic assumption :
Paris pledges show a big increase in ambition, so countries will see that others are ambitious and they will follow up, resulting in a "ratcheting up" of ambition, a "race to the top", as S. declares.

Step 3. Paris is not yet working.
Climate ambition means doing something for the climate — doing more than you would do if you ignored global warming completely. It means more than trying to achieve egoistically your own economic self-interest; it's doing at least a small part of the job to "save the planet."
This could result in giving money to poor countries so they can afford renewable energy (instead of traditional fossil one), for example.
Everyone, from Al Gore to UN climate chief Christiana Figueres has said we need countries to be more ambitious.
In particular, Christiana Figueres says the pledges are just economic self-interest and none are intended to help "save the planet." At least, in her opinion, not ambitious at all. .
"They're doing it [their pledges] for what I think is a much more powerful political driving force, which is for the benefit of their own economy."
"The United States or China or Tuvalu … none of them are doing this to save the planet."
In other words the INDCs are not motivated by climate-change issues, rather by their own national interests. She is very clear that countries like China are just pledging because "they are listening to their citizens who actually would like to breathe [less polluted] air" or because they simply want to "make money on renewables". And she says that in general, "The United States or China or Tuvalu … none of them are doing this to save the planet." It's not for the climate. None are showing ambition in their pledges.
Let's have a look at the UN reports on pledges. These reports have found significant "effects" of the pledges, but this is only because they ignore what Figueres is actually on the right path.
China's pledge is pure self-interest, in Stoft's opinion, and it was planned without any thought for the climate or thanks to the Paris negotiations. In fact, it seems that China just wrote down what it was doing anyway, with or without the summit. Anyway, UN takes credit for it, and pretends that China's smog reduction was caused by their intimidations.

Step 4. Science tells us: periodic reviews will not "ratchet up ambition."
Step 3 showed that Paris has not raised ambition noticeably so obviously doing it twice more will not save us either.

The second reason for hope, given back in Step 2, was that "Countries will see that others are ambitious and they will try to outdo them." But now we know they will not see that others are ambitious. So we are back to the beginning.
They will see exactly what Figueres is trying to explain — that other countries are simply following their self-interest. This will not lead to ambition, it will just make countries more determined to

stick to their economic self-interest and do nothing “to save the planet.” Or at least, this is what Stoft is sure of.

Behavioral sciences — political science, behavior economics, psychology — have studied this type of situation for several years. Researchers, such as Elinor Ostrom, a political scientist, have done lots of experiments on this, in the past 40 years. He actually won the 2009 Nobel Prize in economics for a lifetime of study of how this works.
So we know what happens usually:

With individual commitments, like the Paris pledges, players start out about half-way cooperative and then turn out to be almost pure narrow self-interested.
That’s what happens in real-life situations. Since countries have been pledging and reviewing each other’s actions for over twenty years now, they have already turned down their initial commitments.

Step 5. The danger: When the world wakes up it will be too late

“Almost everyone now believes COP21 is a tremendous success. But this is because of (a) optimistic miscalculations by the UN and other parties, (b) pretending all pledges will be kept, and (c) counting “pledges” that promise big results if they get big bucks.” Steven Stoft

In reality, countries are still just doing what’s in their self-interest and ignoring the climate. Paris has already passed its first round of review and it failed. The chance of a common sense of ambition has disappeared.

According to S., the danger is that the Paris agreement is set up so that the “pledgers” are safe. Their pledges don’t even start until 2020 and cannot be fully checked until 2030. By then we will have used 75% of our carbon budget (according to the UN INDC report) and it will be too late. A 2°C path will be impossible. And we will be emitting more than now and will have locked in even more emissions with long-term fossil-fuel investments. Pessimistic, but reasonably true.
So the false optimism of the UN cheerleaders is truly dangerous. It is not too late, unless we lock this system in place. But that is exactly what we are doing. We are locking in an agreement that makes sure that no country, not the “United States or China or Tuvalu … none of them are doing this to save the planet [Christiana Figueres, October 2, 2015].”

Chapter 2

US vs EUROPE- from 2012 to now

Now that I drafted the situation of the last fifty years, it is worth underlining some differences between US and Europe countries, in order to better focus on the problem and relative resolutions proposed by the economists I chose to focus on.
First, of course, we are comparing a single federal system of the United States with the many countries of the European Union (EU). From 1960s, environmental policy became more and more centralized in the United States, while in Europe, each country has adopted its own policies according to its weight on the global scenario. For this reason, we can say that environmental policy in Europe is now a mix of country-specific and European wide measures.
Second, there are major differences between the United States and Europe in the approach to pre-regulatory studies and researches. Because the U.S. requirement for environmental agencies (such as the U.S. Environmental Protection Agency) is to conduct a "Regulatory Impact Analysis" before giving birth to any action, much more information is available about the expected benefits and results of their policies. In addition, there is a greater concern for taxation as a possible regulatory solution in Europe compared to the United States. A considerable number of European nations uses taxes — sometimes combined with incentives— to achieve environmental objectives; while in the United States, environmental taxes are virtually nonexistent.
To sum up, from my researches, despite some differences in approach, there are no such inconsistencies among European countries and United States; in some cases one or more European nations acted sooner or more aggressively to address environmental problems while in other cases the United States acted better.

Command and Control

What is the command-and-control approach? And how is it imposed as part of the country's environment policy?
"Command-and-control approach (CAC) is one where political authorities mandate people, by enacting a law, to bring about a behavior and use an enforcement machinery to get people to obey the law"(source).
In environmental policy, the CAC approach basically is a set of rules drafted to protect or improve environmental quality. It represents a company's performance enforced through a legislation. A few examples are the limits set on the volume of timber that could be harvested, bans on the cutting the trees, maximum levels allowed for pollution emissions...etc .
There are three types of environmental quality standards: ambient, emission and technology. Ambient standards refer to "never-exceed" levels for pollutants in a particular environment. The Philippine Clean Air Act, which repeals the National Pollution Control Act, for example, establishes ambient air quality standards for specific air pollutants, such as sulfur oxide and carbon monoxide.

For water quality, meanwhile, the ambient standards refer to minimum levels needed to be maintained for the PH, for example. Reaching that minimum level would lead to a harmful situation, and while ambient standards cannot be directly enforced, legal measures can be imposed on polluters to regulate their emission-producing activities.
As for emission standards, they still are "never-exceed" levels, but applied directly to the quantities of emissions from pollution sources per unit of time. For example, the Philippine Clean Air Act of 1999 allows maximum emission of specific pollutants from vehicles.
The thing is, setting emission standards does not necessarily mean meeting ambient standards. Even if emission standards are imposed on firms but no control on the number of polluting firms is made, the total environment quality in terms of ambient standards is not directly checked.
Last, but not least, technology standards. These standards specify the technologies or practices, including design, engineering, input and output standards, that polluters must adopt to protect the environment. In contrast to emission standards, technology standards allocates some decisions to companies as well as the technologies to be used. This is some form of "technology forcing" for polluting industries to adopt technological change in order to meet environment standards.

Key differences in the last years

From 2013, there have been many differences with respect to carbon trading, such as, for example:

- A single, EU-wide cap on emissions, versus the previous system of national caps;
- Auctioning is the main method used for allocating allowances, versus free allocation, and "harmonised allocation rules" apply to the allowances still given away for free;
- More sectors and gases are now included.

ECONOMIC INCENTIVES VS COMMAND AND CONTROL

Cramton-Stoft analysis

"EI instruments are more efficient than CAC instruments: that is, they result in a lower unit cost of abatement."
What is the rationale behind this statement?
Accoring to Steven Stoft and Peter Cramton, (respectively, founder and director of the Global Energy Policy Center/ professor at the University of Meryland) EI instruments are more cost effective at achieving a given emissions reduction. But from this starting point to an idea of efficiency requires additional assumptions, including perfect competition and emissions not specifically allocated. But, as they claim, CAC instrument could be as efficient only if the emissions standards are chosen so that the "marginal costs of abatement equal the marginal social costs of pollutant damage."
In their studies, they analyzed several cases that show EI is generally more efficient tan CAC. For example,EI achieved substantial cost savings in the elimination of CFCs and lead in gasoline, in part because of the differences among costs that could be exploited during the so called " phase-down" period. However, in case the standards are so stringent that all available abatement measures must be taken, there is little scope for choosing the most cost-effective ones, and EI instruments do not help, as well as CAC ones.
The real advantages of EI instruments are only achievable over time, because they provide a continuos reduction of emissions also promoting new technologies, and maximum flexibility for pollutants.

In addition, the effects of CAC on technology are potentially complex, since discovering new ways to reduce emissions can lead to even more regulations. As an example, they provide the one of the U.S. SO2 trading policy, which led many non-patentable boiler- specific innovations on utility boilers. Elsewhere, the Netherlands became a world leader in water purification technologies which its industries adopted.
Innovation also occurs under CAC, but the results are different, even though regulated firms are more likely to oppose EI regulations than CAC because they fear they will face higher costs, despite the greater efficiency of EI instruments.
Although EI instruments may have lower social costs, firms pay higher costs under EI than CAC. Under CAC, firms pay to abate pollution; under many EI instruments, firms pay the cost of abatement plus a fee for the remaining pollution it discharges. In the majority cases, governments are returning the fees to the firms. They present two interesting examples to support this idea :"For example, in France, revenues collected through NOx discharge fees subsidized the firms' abatement investments, while in Sweden the fees were re- turned to the firms on the basis of the energy they produced. In the United States, where the EI instrument of choice is a tradable permit, the permits have always been given away rather than auctioned off."
Historically, since the late 1980s, whenever a new policy is proposed, policymakers often select an EI instrument. Which means, almost all the policies began as a CAC policy and then ended as EI.In the 12 cases studied by the economists, only a few (reduction of SO2 emissions in Germany, TCE in Germany and Sweden) had no EI elements in their design

The evolution of Kyoto

Cap and trade

Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units permitted to them but not "used" , to sell this excess capacity to countries that are over their targets.
Thus, two new forms of commodity were created : emission reductions and emission removals. Since then, Carbon has been traded like any other commodity and as carbon dioxide is the principal greenhouse gas, people speak simply of trading in carbon.

Into the 'cap and trade' system

Trading carbon in EU ETS works on the "cap and trade" principle.
A cap is a portion which is established in the total amount of certain greenhouse gases that can be emitted by a system. The cap is reduced over time, so that total emissions fall.
It is a system, specifically designed to control pollution by providing economic incentives in order to achieve consistent reductions in the emissions of pollutants.
Companies receive or buy emission allowances which they can trade with other respective companies as needed. They can also buy portions of international credits from emission-saving projects around the world, as said before, from countries which managed to "save" credits. These allowances are limited, and for this reason the are valuable, they actually have a value.
Year by year each company must detain enough allowances to cover up all its emissions,

otherwise heavy fines are imposed. If it is able to reduce its emissions, it can keep the remaining allowances to cover its future needs or sell them to another company, obviously.
This kind of trading ensures emissions are cut when and where it is more efficient to do so, rather than keep emitting. This means that polluters who can reduce emissions most cheaply will do so, achieving the emission reduction at the lowest cost to society. Cap and trade is meant to provide to companies the flexibility required to reduce emissions while improving technological innovation and economic growth.
A robust carbon price is the basis to which this particular kind of trade has grown up to these days, also in order to promote low-carbon new technologies.
A central authority (usually a governmental body) allocates or sells a limited number of allowances as quantities of a specific gas per time period. Companies, states or organizations are required to hold them with respect to their emissions.
The largest greenhouse gases trading program is the European Union Emission Trading Scheme, which trades primarily in European Union Allowances (EUAs); the Californian scheme trades in California Carbon Allowances, the New Zealand scheme in New Zealand Units and the Australian scheme in Australian Units.The United States has a national market to reduce acid rain and several regional markets in nitrogen oxides.

Game theory – applications

Game theory is "the study of mathematical models of conflict and cooperation between intelligent rational decision-makers." Principally used in economics, political science, psychology, as well as logic, computer science, biology and poker. The commonly used form is the zero-sum game, in which one person's gains result in losses for the other participants. Today, game theory applies to a wide range of behavioral relations, which include humans and animals.

Modern game theory began with the idea of the existence of mixed-strategy equilibria in two-persons zero-sum games, which was drafted and proved by John von Neumann. Von Neumann's original proof used Brouwer fixed-point theorem on continuous mappings into compact convex sets, which became a standard method in game theory and mathematical economics. This methodology was followed by the Theory of Games and Economic Behavior book, which considered cooperative games of several players. The second edition of this book provided an axiomatic theory of expected utility, which allowed mathematical statisticians and economists to treat decision-making under a new framework : uncertainty.

This theory was followed by many others starting from the 1950s by many scholars. Game theory was later explicitly applied to biology in the 1970, and it has been widely recognized as an important tool in many fields. With the Nobel Memorial Prize in Economic Sciences going to game theorist Jean Tirole in 2014, eleven game-theorists have now won the economics Nobel Prize.
As a method of applied mathematics, game theory has been used to study a wide variety of human and animal behaviors. It was initially applied to a large field of economic behaviors, including behaviors of firms, markets, and consumers. The first use of game-theoretic analysis was by Antoine Augustin Cournot in 1838 with his solution of the Cournot duopoly.

This work has the name "game theory", but it shares many important features with many fields. The developments in economics were later applied to biology largely by John Maynard Smith in his book Evolution and the Theory of Games.

In addition, Game theory has also been used to develop theories of ethical or normative behavior and to describe such behavior. In economics and philosophy, scholars have applied game theory to help understanding the good or proper behavior. Game-theoretic arguments of this type can be found back to the Greek school .
Applications include a wide array of economic phenomena and approaches, such as auctions, bargaining, mergers & acquisitions pricing,fair division, duopolies, oligopolies, social network formation, agent-based computational economics, general equilibrium, mechanism design, and voting systems; but also broader areas as experimental economics,behavioral economics,] information economics, industrial organization, and political economy.

The main results which this study focuses on , are particular sets of strategies known as "solution concepts" or "equilibria". The principal assumption we need to set is that players act rationally. In non-cooperative games, the main result of the ones studied is the Nash equilibrium. “A set of strategies is a Nash equilibrium if each represents a best response to the other strategies. If all the players are playing the strategies in a Nash equilibrium, they have no unilateral incentive to deviate, since their strategy is the best they can do given what others are doing.”

The payoffs of the game are generally taken to represent the utility of individual players.

Into the game

In order to explain the failures of the cap theory, Cramton drafted a global cap-and-trade game, carbon trading, of an eight-country world, and focused on the fact that it will lead to a single global price for carbon. Moreover, he states that all countries will abate until their marginal cost of abatement equals that single carbon price. This is, in Cramton’s opinion, the condition for globally efficient abatement. Which means that abatement will be more efficient under a global cap-and-trade game than under an uncoordinated public- goods game, mainly because in the first targets are also selected to maximize national net benefit.
It is helpful to compare both the public-goods game and the cap-and-trade game with the optimal outcome, which are related to the country-specific net-benefit functions which he simplifies as:

$$NB_j = b_j A - c_j A_j^2 + P \cdot (A_j - T_j), \text{where } A = \sum_{i=1}^{N} A_i.$$

The first term gives the climate benefit which increases with total global abatement,A , which, in turn, increases with Aj . The second term gives the cost of abatement, which increases quadratically (a typical assumption). The third term, present only in the cap-and-trade game, represents the gains from selling carbon credits when a country’s abatement differs from its target. The condition for globally optimal abatement and the rules of the games are given in Table 1.

Table 1. Definitions of Optimization by Model

Table 1. Definitions of Optimization by Model

Model	Definition
Optimal Cooperation	Choose all A_j to maximize $\sum NB_j$. (no trade)
Public-Goods Game	Countries choose A_j to maximize NB_j for each country j. (no trade)
Cap-and-Trade Game	Countries choose T_j to maximize NB_j with $2c_jA_j = P$, for all j.

Note that when countries choose Aj and Tj they assume their choices will not affect the choice of other countries. This is the condition for a Nash equilibrium. In the specific game we will analyze first, Country 1 has , while Country 2 has . From these values the outcome of the game can be determined, as shown in Table 2.

Table 2. A Two Country Example of the International Cap-and-Trade Game

	Optimal Abatement			Public-Goods Game			Cap-and-Trade Game			
j	A_j	MC_j	NB_j	A_j	$P_j = MC_j$	NB_j	T_j	A_j	$P = MC_j$	NB_j
1	1.50	3	0	0.5	1.0	0.75	0.38	0.75	1.5	1.13
2	0.75	3	3.38	0.5	2.0	1.50	0.75	0.38	1.5	1.41
Total	**2.25**		3.38	**1.0**		2.25	1.13	**1.13**		2.53

A_j is country j's abatement. $MC_j = 2c_jA_j$, its marginal cost of abatement. NB_j its net benefit, and T_j its abatement target.

As we can see, abatement is below optimal in both games, and it would be much lower with more countries. But, even though countries act purely in their self interest in both games, abatement is greater in the cap-and-trade game. Cap and trade succeeds in this example because Country 2 gains the most benefit from abatement but finds it most expensive to abate. Trade allows it to buy abatement from Country 1, which benefits less from abatement, but can abate more cheaply. Changing the parameters to for Country 1, and to for Country 2, causes the cap-and-trade game to reduce abatement, and to increase emissions. In fact, Country 1, simply sets a negative target and profits from selling essentially fraudulent carbon credits. A negative abatement target is simply an emissions cap set higher than "business as usual," the amount that would have been emitted without a carbon policy. These two examples do not prove the cap-and-trade game a failure, but a simple theoretical result does.

To sum up, although the cap-and-trade game shows little promise, it does prove that changing the game from the public-goods game to the cap-and-trade game can, under the right assumptions, improve cooperation. Since this is possible, perhaps a different game can induce even more cooperation. (All references at the end of the chapter)

Cheating possibility

"Gaming the rules" means taking advantage of the rules in a way that is detrimental to the collective outcome and unexpected by the designers of the game- Peter Cramton.

Setting low targets to profit from carbon trade is a form of gaming the cap-and-trade rules. This possibility is accounted in the game explained above. Cheating is breaking the rules,and that's predictable in Cramton explanation.

The most obvious way for a country to cheat would be the selling of fraudulent carbon credits. This form of cheating adds a new strategic parameter in the calculus, the emissions subsidy rate, (whose negative values indicate a tax).
The result will be that Country 1 abates less, and Country 2 more, than shown in Table 1 under cap- and-trade. Consequently, if this form of cheating is carried out by each country, the resulting national abatements will be identical to those found in the public-goods game. With the positive result that t here , however, still be carbon trading.

Table 3. The Table-1 Games with Cheating in the Cap-and-Trade Game

	Public-Goods Game			Cap-and-Trade Game with Emission Subsidies				
j	A_j	$P_j = MC_j$	NB_j	T_j,	s_j	A_j	$P^* = MC_j$	NB_j
1	0.5	1	0.75	0.33	0.67	0.5	1.67	1.03
2	0.5	2	1.50	0.67	−0.33	0.5	1.67	1.22
Total	**1.0**		2.25	1.00		**1.0**		2.25

A_j is a country's abatement, MC_j its marginal cost of abatement, NB_j its net benefit, T_j its abatement target, and s_j is the country's subsidy rate. Both countries end up worse off than in honest cap and trade, but they are stuck in a prisoner's dilemma: if either does not cheat it will lose even more.

As seen in Table 3, countries will go for the abatement levels equal in the public-goods game. Country 1 will see the global carbon price as too high at 1.67 monetary units, when it would have chosen a price of 1 on its own, as seen in the public goods game. So Country 1 subsidizes its domestic price of carbon back down to 1. The result is that the Country 1 abates at its public-goods level and targets even less abatement and sells carbon credits to the more willing-to-pay country. This strategy is the most similar to the real-world one.
The most obvious conclusion to draw is that enforcement of efficient cap-and-trade rules require internal monitoring of the carbon price level, just as does enforcement of harmonized carbon prices. (All references at the end of the chapter)

Cramton and Stoft- How to fix cap and trade inefficiencies.

"The Kyoto approach focused on the outcome—declining carbon emissions—but failed to analyze the process of getting there." Peter Cramton
As I stated before , nations used to adopt strategies in order to follow their individual interests, that will lead to the desired outcome. To succeed, the attention of international negotiations should shift from the design of institutional rules to the determination of the desired outcomes.

Two policy games- global cap VS global price.

As they claim, "International cap and trade equalizes the global price of emissions and hence leads to efficient abatement across countries, but it encourages countries to choose abatements that are inefficiently low." Countries act out of self-interest, so modeling global cap and trade as a game based on self-interest , would be so uncooperative that it may even increase total emissions! We could have countries select a global cap rather than national targets, but then the problem would become how to allocate the responsibility for the cap.
To explain their views, they idealized a comparison of two policy games, one that selects a global cap and one that selects a global price. If all countries were identical, the two policy games would

both produce the optimal outcome. However, national differences seem to cause the capping game to fail, while the price-target game to produce the optimal outcome.
But even the global-price game can fail. Introducing a Green Fund can, however, rescue the carbon- price game, by inducing cooperation from both rich and poor countries.

Now, if we change the game by letting nations choose targets instead of abatements and by introducing carbon trading, we can see that any country which has no more of its target can buy credits from a country that exceeds its target. Which in the end generates efficiency.
Cap and trade solves the lack-of-trading inefficiency, but it does nothing to reduce the much worse public- goods inefficiency.

The necessity of a global price target

"The cap has no obvious method of allocation, while a global price is associated with a widely accepted method of allocating responsibility."
Peter Cramton and Stoft illustrate this idea thanks to a pair of games, one of which leads to the Green-Fund game.
These are games of "voting" for a collective commitment. By "vote" they mean that each country names its preferred level of global commitment. The outcome of voting has to be the least- strict preferred commitment, the one that determines the minimum price or highest cap. Voting succeeds because each country realizes that, if its vote is accepted, its vote will determine abatement in every country. So, unlike with global cap and trade, adopting a stronger policy does not just impose a national burden that mainly benefits others. Instead, adopting a stronger policy causes all others to abate more, which benefits the voting country. Hence voting for a collective commitment succeeds, where choosing individual commitments fails.
With the voting method, both a global cap and a global price would lead to an optimal allocation, because, with identical countries, there is an obvious way to divide responsibility. Each country gets its proportional share of the cap. But when countries differ by climate, history, geography and type of energy resources, there is no obvious way to allocate a global cap, and the capping game will end with no cooperation. However, this problem can have a solution in a collective price target, so that every country should commit to the price.
There would be no more paying other countries for carbon credits, which will certainly lead to efficiency, and which will end the game with an agreement. Now, commitment to a global price target does not require national taxes, obviously. Furthermore, cap and trade can be used to meet a price target, so it' up to countries to adopt national cap-and-trade policies with or without international trading. They recommend a global price target, because equal pricing is a focal point in the global climate game.

The Green – Fund Game
Cramton's thesis

The Green fund game provides incentives for wealthy countries to make strong Green-Fund commitments and for poor countries to accept a higher global price target, in order to be equal. The Fund is designed to maximize the carbon price that countries have to agree. Respectively, they

will receive payments of G·ΔE·PT, where G is the strength of the Green Fund; ΔE is a country's emissions shortfall relative to the global per- capita average, and PT is the global price target. Note that high-emission countries will have a negative ΔE, and hence will make payments rather than receive them. It is a three stages game.
First, a group of neutral countries chooses a certain amount of G as to maximize the carbon price target that will be agreed. Second, the countries interested in cooperating vote for PT, as described in the previous section. Third, countries price carbon and make and receive Green-Fund payments.
Because the Green-Fund game is based on a price instead of thousands of subsidies, it is strongly not expensive at all. For the U.S., the cost of abatement is 11.5¢/per- son per day, while the cost of the Green Fund is 4¢/capita-day, for a total of $17 bil- lion/year. The cost for China is 3.2¢/capita-day, while the abetment cost in India is 1¢/capita-day, and Green-Fund revenues are 1.2¢/capita-day.

A Green Fund, which makes equity transfers from rich to poor countries, has been widely proposed as a way of accommodating international income disparities and the corresponding differences in emissions levels. A Green-Fund rule should be simple and appear naturally suited to its task in order to improve its chance of being accepted as focal. We propose basing it on emissions per capita because that will turn Green-Fund payments into an incentive for all countries to reduce their emissions (Cramton and Stoft 2010).

Cramton's analysis on Kyoto-Copenhagen failure.

At the Kyoto and Copenhagen climate summits, the world attempted to negotiate a system for pricing carbon globally. But, rather than choose a global price, the focus was on negotiating individual national caps. Trading carbon credits issued under the caps would then have established a uniform global price. Although the point of international cap and trade is the efficiency of a uniform price, it was the caps that captured the imaginations of environmentalists. As Fred Krupp, president of the Environmental Defense Fund, said to the Wall Street Journal, "You've heard a thousand times that the whole point [of a cap] is to send a price signal." But his point was that we had been misinformed a thousand times, and he concluded, "The whole point is really a declining cap. The cap drives innovation which lowers the costs."2 But, no inventor cares about a cap, except that the cap will raise the price of carbon, which will make his carbon-cutting invention profitable. It is the price, and only the price, that changes behavior.
Caps are also seen as the only possible basis for a "legally binding agreement," but President Obama summed up the situation nicely at the end of the Copenhagen conference when he said "Kyoto was legally binding and everybody still fell short anyway." Although an exaggeration, in the absence of a world government, the point is well taken.
Finally, the focus on caps has made a fetish of selecting the true "scientific" cap for the next fifty years. Strangely, each new "scientific" answer is the numerological focal point of some popular movement—80% by 2050, 20% by 2020, or 350 ppm of CO_2.
Together, these two misconceptions, that caps directly control individual behavior and that they are the only basis for certainty, along with the numerical fetish, have had a devastating effect on climate negotiations. They have distracted from the real problem facing the world, which is how to induce cooperation in the most uncooperative of games—a public-goods game with many players facing distant and uncertain global payoffs.

As this paper will show, the game of negotiating caps is doomed to failure because it punishes cooperative behavior at the bargaining table and rewards the free-riding behaviors that are the heart of the climate problem.

A summary on the Green Fund concept

The proposed Green-Fund treaty contains several useful features. It solves a huge conceptual problem by suggesting that the right level for the Green Fund is the level that maximizes cooperation on climate policy. This makes sense because it suggests who should be the trustee regarding the Green-Fund level—those who are affected least by Green-Fund payments and who are therefore motivated only by a desire for cooperation on climate policy. Countries who must pay into the Green Fund are protected by the global carbon price, since Green-Fund payments are proportional to that price. Countries which require a high Green-Fund if they have to set a higher carbon price are also protected by that price.
Linking this solution with the global price, as suggested but not yet modeled, solves two problems: how to assure Green-Fund donors that they are gaining effective cooperation, and how to motivate those who receive funds to participate in an efficient global policy. Moreover, connecting payments to emissions provides an additional incentive for all countries to reduce emissions.
Another important point I would like to make is that the real problem of the emissions' issue is cooperation in the most uncooperative of games—a public-goods game with many players facing distant and uncertain global payoffs. To solve this problem you should look to the next sub-chapter.

Focus on public goods game

The public goods game is a standard of experimental economics. Subjects secretly choose how many of their private tokens to put into a public pot. The tokens are generally multiplied by a k generic factor (greater than one and less than the number of players, N) and this "public good" payoff is then evenly divided among players. Surprisingly, even if the group's total payoff is maximized when everyone contributes all of their tokens to the public pot, the Nash equilibrium of this game is simply zero contributions by all; which means that any rational agent does best contributing zero, regardless of whatever anyone else does.

We easily conclude that a Nash equilibrium happens very rarely, as people do tend to add something into the pot. The average contribution typically depends on k (the multiplication factor). Depending on the experiment's design, those who contribute below average or nothing are called "defectors" or "free riders", as opposed to "cooperators".

Are people conditionally cooperative?
Urs Fischbacher, Simon Gächter and Ernst Fehr Experiment on public goods

In the yearly 2000, three economists of the Institute for empirical economics in Zurich, focus on a particular characteristic of the public goods games, which they called “conditional cooperation”. They basically meant that in a public goods game framework, there are some subjects who are willing to cooperate more intensively as much as they see cooperation by the other participants Conditional cooperation can be seen as motivation its self, or as a consequence of a fair choice of “altruism”, as they claim.

The experiment was based as a linear standard goods game, and it was conducted in Zurich, with 44 first and second semester undergraduates, from all fields, except from economics.
Each individual could choose how to spend its own 20 tokens: investing into a so called “project” or keeping them . The public good problem was explained to subjects properly, in a way that they could fully understand the problem. After this phase, they had to choose between tho main decisions : unconditional contribution and contribution table.
First of all they chose how much of the 20 tokens they wanted to invest into unconditional contribution decision, then they turned to the contribution table. They were told that they had to invest a given amount of tokens in each of the 21 possible contribution levels of the other subjects, and they had also to decide how much to invest for each of them. This experiment was only played once , in order not to take into account for inter temporal considerations of the participants.
They’re main interest were obviously the contribution decisions regarding the contribution tables, which represented the willingness of the participants to contribute given the average contribution levels of the others.
Results were clear, 22 subjects fell into the category of conditional cooperators, which means that these people always wanted to match the contributions of others, although they also registered a tendency to self-serving, which was evident in at least 80 percent of the 22 cooperators.
Thirteen subjects were purely selfish and motivated by free-riding , while six subjects displayed a contribution behavior up to ten tokens of the other group members. Only one subject was willing to contribute with one token for all contributions of the other members.
To sum up, these results were a tentative to interpret why we actually observe the phenomenon of conditional cooperation into the public goods game, and to understand whether this behavior could represent a positive trend for the future. This is nor actually the case, in Fischbacher, Gächter and Fehr’s position, since even though the majority of people tend to cooperate conditionally to what the others do, free riding “will always be pervasive under conditions of anonymous interactions “.

Why the green fund game is so important for society?

While the Green-Fund game provides a far better approach than cap and trade backed by arm twisting, we believe there is a more fundamental lesson. In the most uncooperative of games—a prisoner’s dilemma with many players facing distant and uncertain payoffs—the problem to focus on is cooperation. To solve this problem, we should look to the science of cooperation and to economic models of self-interest, and design a treaty that encourages cooperative behavior.

Conclusions

Having said that being conscious of the fact that climate change is a problem for all countries and that it can only be solved thanks to cooperation, we cannot going on thinking about humanity as a demanding machine which is not able to maintain a certain balance for our nature. In fact, this equilibrium has been grossly altered in the last decades, primarily because of uncontrolled GHG emissions due to a capitalist development model based on the extraction of fossil fuels, which has to be stopped (or at least contained) now. The Earth is calling insistently : when will men respond to that call?

I have strongly agreed with the Cramton-Toft thesis based on the principle of common but differentiated responsibilities and it is in this context that they encouraged all countries , from the smallest to the largest, to ingage in combating climate change and its adverse effects on our ecosystem.

In the past, we have noticed that the Kyoto Protocol has established the market mechanisms as one of the ways for developed countries to reach their domestic GHG emission reductions goals, and that this treaty has also been deeply revised during the years. We cannot and must not forget that developed countries adopted this legally binding instrument, even though they actually increased their emissions by the 11% from 2009 to 2012, despite their commitments assumed in the Kyoto Protocol. It was evident that their commitments were violated, and that the world needed another chance to commit to a more valuable cause.

That's where the Cramton-Stoft's idea came from, the necessity to finally find a solution to the basic problem that all the treaties made since then: cooperation and trust among countries, regulated by a Green-Fund Game.

Now, decades after the first environmental laws are passed in these countries, policymakers face many choices when seeking to solve environmental problems, but I believe that the American one suits best, and that's what I tried to underline and present in this project. Will policy makers be for more effective with respect to the polluters than fining them for not meeting certain emissions standards? Will a reg- ulatory agency find it less costly to enforce a ban or oversee a system of

tradable permits? Which strategy will reduce a pollutant the quickest? We cannot give a precise answer yet, but this thesis is an attempt to present an hot topic that is still brand new.
To conclude, I would like to say that the proposed Green-Fund treaty contains several useful features. It solves the conceptual problem presented above, and tries to state that the right level for the Green Fund is the level that maximizes cooperation on climate policy. Thus, again, cooperation is the key to success. This idea also suggests who should be accounted for the decision concerning the Green-Fund level, which are those who are affected least by Green-Fund payments and who are only engaged by a desire for cooperation on climate policy. In addition, countries who must pay into the Green Fund are protected by their global carbon price, since Green-Fund payments are meant to be proportional to that price. Countries which require a high Green-Fund are also encouraged to set a higher carbon price which will ensure them to be protected by the price.
Balancing Green-Fund disbursements with a global price, as suggested but not yet modeled, solves our main two problems: how to assure Green-Fund donors that they are gaining from a full cooperation, and how to motivate those who receive funds to participate in a truly efficient national policy making process. Balancing Green-Fund payments to emissions' levels provides an additional incentive for all countries to reduce emissions.
To sum up, in my opinion, we are now finally approaching to the most important point we would like to be solved, which is that the major issue about the climate problem is not about selecting scientifically the possible and most efficient emission caps good for the next ten, twenty or fifty years. The real key to focus on is cooperation in what we found to be the most uncooperative of games—a public-goods game with many players facing distant and uncertain global payoffs. Instead of looking to the most efficient quantity cap, we should start looking at the economic models of self-interest in order to design a treaty for cooperation, finally.

Alessia Anela

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April 2012

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Peter Cramton and Steven Stoft1
1 December 2011 (from 14 August 2011)

Thanks to…

First of all I would like to thank my department, and in general University LUISS Guido Carli, for the opportunity of attending an international program, such as the one proposed for Economics and Business.
Secondly, I thank professor Gian Luigi Albano, for having accepted my thesis and having encouraged me to follow my dreams and ambitions.
Of course I have to thank all my university mates, who were my strength during the last months and years of struggle! I owe everything to you!
My beloved friends of San Tommaso Moro, my parishioners, who support me whenever I need to, and whatever I do, accepting all my imperfections and flaws.
My priest, don Andrea Celli, for being my guide, my mentor, and basically my second father.
All my family, especially my mom. She is my inspiration everyday, and her love is the only thing that puts me on track whenever I feel insecure.
Last but not least, I thank my little nephew Matteo, for bringing the purest joy into my life, as well as a little craziness, which enlightened my days. And of course the new born, Chiara, whose blue eyes remind me of our beloved sea of Salento.

Alessia Anela