

# LESSONS FROM THE KYOTO PROTOCOL\*

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ELIEZER MARTINS DINIZ<sup>1</sup>

## 1 *United Nations Framework Convention on Climate Change*

Since the United Nations Conference on Environment and Development (Earth Summit) in Rio de Janeiro in 1992, the discussion of environmental issues has produced some concrete results. The problem of climate change has gained a special position within the research agenda.

The importance of the topic can be evaluated by the document United Nations Framework Convention on Climate Change (UNITED NATIONS, 1992), a result of the above mentioned conference. Several preliminaries pointed out by the document are worth mentioning:

- a) Developed countries are responsible for the present level of emissions (and stocks) of greenhouse gases;
- b) Developing countries need to increase their levels of emissions as a result of their efforts to catch up with developed countries. Their priorities are the achievement of sustainable economic growth and the eradication of poverty;
- c) The principle of common but differentiated responsibilities.

(...) the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions. (UNITED NATIONS, 1992, p. 2).

- d) Environmental standards need to be tailor-made for each country. Inappropriate legislation can produce high economic and social costs;
- e) Policy measures to minimise climate change in developing countries must avoid adverse effects on economic development. Increases in energy consumption as a result of development should take into account the possibilities of greater energy efficiency and reduction of emissions; and

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<sup>1</sup>Professor of Economics, Universidade de São Paulo – USP.

**Corresponding author:** Eliezer Martins Diniz, Departamento de Economia, Faculdade de Economia, Administração e Contabilidade – FEA-RP, Universidade de São Paulo – USP, Av. dos Bandeirantes, 3900, CEP 14040-900, Ribeirão Preto, SP, Brazil. E-mail: elmdiniz@usp.br

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- f) Intergenerational concern “(...) protect the climate system for present and future generations (...)”. (UNITED NATIONS, 1992, p. 6).

The ultimate aim of the Convention is to stabilise greenhouse gas concentrations without harm to sustainable economic development, food production and natural adaptation of ecosystems. Developed countries should take the lead in obtaining a smaller flow of emissions in order to decrease the above mentioned concentrations. Cooperation is essential for a meaningful final result.

In order to attain this goal, the following measures were devised<sup>2</sup>:

- a) National inventories of greenhouse gases;
- b) Programmes to mitigate climate change; and
- c) Incentives to the adoption of cleaner technologies.

Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors. (UNITED NATIONS, 1992, 4.1.c, p. 10).

- d) Promote an increase in removals by sinks.

Promote sustainable management and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forest and oceans as well as other terrestrial, coastal and marine ecosystems. (UNITED NATIONS, 1992, 4.1.d, p. 10-11).

- e) Return by the end of the decade to earlier levels of emissions of greenhouse gases.

The implementation of the Convention is performed by the supreme body of the Convention, the so-called Conference of the Parties (COP). This body meets at least once every year to evaluate the implementation in the light of the reports provided by the Subsidiary Body for Scientific and Technological Advice (SBSTA), the Subsidiary Body for Implementation (SBI) and the countries themselves. Reports made by third parties are also sometimes examined (like the Intergovernmental Panel on Climate Change (IPCC), for instance).

## 2 *The Brazilian position*

Since the first Conference of the Parties (COP 1) in Berlin, in 1995, Brazil has consistently stressed two points:

- a) The need to properly evaluate the share of the responsibility of each country in the process of curtailing emissions (principle of common but differentiated responsibilities). This is achieved by using state-of-the-art knowledge and by taking into account the right of developing countries to experience sustainable economic development according to their own priorities; and

- b) The fundamental contribution of the transfer of cleaner technologies to developing countries and to the success of the Protocol.

In Brazil (1997) the Brazilian government puts forward a formal proposal for a protocol. It was presented to the Ad Hoc Group on the Berlin Mandate in August 1997. The document focused on the above mentioned two points and proposed solutions.

Regarding the first point, the paper suggests the adoption of the growth in global mean surface temperature as the sole variable to measure climate change. This is a comprehensive measure as it reflects the impact of emissions of many greenhouse gases. This is an alternative to the traditional measure of emissions in a common carbon measure that uses the global warming potential to convert measures of different greenhouse gases.

The paper suggests that one can set reduction commitments for developed countries based on the induced temperature increase. It is possible to share the burden among countries and determine relative responsibilities based on this criterion. The countries responsible for larger increases in temperature would have the largest burden in terms of reduction commitments according to this criterion.

A penalty is imposed on countries that do not comply with their reduction commitments. It is the so-called polluter pays principle. The non-compliance mechanism devised by the Brazilian proposal is the Clean Development Fund (CDF). The monetary contribution to this fund is proportional to the difference between the effect of a country to climate change and its commitment. The resources are directed by the financial mechanism of the Convention to the developing countries with the highest flow of emissions. The bulk of the funds are used for climate change mitigation and a small share for adaptation projects.

The countries that have produced a temperature increase lower than their commitments may sell this difference at market price to any country that has not complied with its commitment. This is known as emissions trading. Any country must contribute to the CDF if it does not comply with the commitments and does not buy emissions from other countries in a sufficient amount.

As we shall see in the next section, the ideas related to the Clean Development Fund were partly used in the Kyoto Protocol. Other propositions related to the share of the burden and the measure of climate change were the subject of technical discussions in the subsidiary bodies of the convention at the time of writing this paper. A controversial point is the use of temperature instead of gas emissions to evaluate the relative responsibility of countries and the commitments to be reached. This point can be better evaluated using the available evidence on the relationship between pollution and economic development.

Grossman and Krueger (1995) and Grossman (1995) show empirical evidence on this relationship between pollution and economic development<sup>3</sup>. In many cases we can find the following behaviour: at the beginning of economic development there is a direct relationship between pollution and output; after a point, we have an inverse relation. This curve with the shape of an inverted U is called the Environmental Kuznets Curve (EKC for short). Using these findings, we can say that economic development itself creates the conditions for pollution reduction. A detailed analysis decomposes the total effect in three parts isolated by Grossman: the scale effect (higher output is associated with higher pollution); the composition effect (a change in the composition of output by sector can diminish pollution if the cleaner sectors conquer a higher share); and the technique effect (adop-

tion of cleaner technologies diminishes pollution). We can explain the behaviour of less developed countries by the predominance of the scale effect. Developed countries that are in the negative sloped part of the curve have strong composition and technique effects, so that the scale effect ceases to be prominent. Stokey (1998) presents a theoretical analysis of this subject and shows the conditions under which the EKC appears in standard economic growth models. Chimeli and Braden (2002) take the previous analyses of Stokey and others as a starting point to make an alternative and less restrictive modelling of the EKC. Dasgupta, Laplante, Wang and Wheeler (2002) carried on a survey on the theoretical underpinnings and empirical evidence of the EKC with an optimistic view of its relevance. De Bruyn (2000) carried on another survey worth mentioning.

Taking the above evidence into account, one can say that the same type of argument may be valid for the matter of greenhouse gases (GHGs). If some type of EKC emerges naturally, then the passage of time is sufficient to diminish the GHGs. If the scale effect is prominent and no curve emerges (or emerges only for extremely high levels of income), then it is necessary to force a turning point in the curve. The non-emergence of the EKC may be seen as a Prisoner's Dilemma with two agents: non-cooperation is good for one of the agents if both parts take opposite decisions (e.g. one agent adopts measures to curb GHGs emissions and the other does not – the latter takes the benefits without any cost); cooperation allows the agents to attain the best result for the group (e.g. both agents adopt measures to diminish GHGs emissions). Cooperation would force a turning point. There are many ways to induce cooperation. In the case of GHGs emissions, the adherence to a protocol with emission commitments has been chosen. If we have more than two agents, the analysis turns out to be a little bit more complex. A more complete analysis on forms to naturally induce a cooperative result can be found, for instance, in Axelrod (1984). Dasgupta, Laplante, Wang and Wheeler (2002) also discuss the role of the enforcement of environmental laws moving the EKC downwards and lowering the turning point. A protocol (cooperation by consensus) or a law (imposed cooperation) are two ways of obtaining the same result. The first one is more desirable, but the protocol must have no flaws in order to attain its objectives.

There is some empirical evidence related to GHGs and the EKC. We cite two papers representing different research strategies. Schmalensee et al. (1998) obtained an EKC for per capita carbon dioxide emissions and per capita output using cross-section data. The authors use their projections to criticise the IPCC's methodology. Diniz (2001) studies the relationship between carbon dioxide emissions and output on the time domain for the Brazilian case. This incipient study sustains that the scale effect is prominent and there is no evidence of an EKC with the downward sloping part.

Models that try to integrate economic aspects of the question with other disciplines present problems not yet satisfactorily solved<sup>4</sup>. Nevertheless there is a growing body of research on this class of models, called integrated-assessment models, for instance Nordhaus and Boyer (2000) and Islam (2001). The main objections for this class of models are: the necessity to calibrate models using many different sources to provide estimates for some equations, instead of obtaining econometric reliable estimates from the available data for smaller-scale models; and the simulation of large-scale models of the black-box type that prevent any intuitive interpretation of the results.

Both classes of models that relate economic growth and environment do not encompass all the aspects related to the greenhouse gases: it is necessary to have different models to study greenhouse gases from fossil fuel use and from land use change, for instance.

Brazil's proposal to adopt an index related to temperature can be questioned by the fact that it fails to consider the huge amount of empirical evidence and theoretical analysis just sketched. My personal opinion is that the cost involved surpasses the benefits of using a temperature index, as this type of analysis may be embedded in the integrated-assessment models, a class subject to a great deal of criticism. So we can identify a dispute between the Brazilian proposal of using a temperature commitment and the dominant position of adopting an emission commitment, a conflict apparently not yet solved. Despite this, it seems that the Brazilian negotiators are convinced that a temperature commitment is the best alternative to this day.

### 3 *The Kyoto Protocol*

The need to force a turning point in the emissions of some gases responsible for the greenhouse effect (the most important of which are carbon dioxide, methane, hydrofluorocarbons, nitrous oxide, perfluorocarbons, and sulphur hexafluoride, all of them with high global warming potential) led to a worldwide agreement known as the Kyoto Protocol. It deserves its name from the Japanese city where the compromise was reached in the third Conference of the Parties (COP 3) in December 1997.

The protocol consists of a set of explicit reduction commitments by developed countries, along with some programmes related to incentives to increase the removals by sinks and the transfer of cleaner technologies from developed countries to developed (Joint Implementation- JI) and to developing countries (Clean Development Mechanism – CDM). An investment that produces properly certified emission reductions in developed (through JI) or developing (through CDM) countries acts as if the investor had reduced the emissions of his own country. The main objective is to globally reduce the emissions as every emission contributes to the greenhouse effect (i.e. greenhouse gases have global effects). The same elements of the Convention and the bulk of the Brazilian proposal on the CDF are included in the Kyoto Protocol. More attention is given to the role of private investment in the transfer of technology. In the case of environmental problems, data cited in Forsyth (1999) for the period 1990-1997 show the growing importance of private-sector transfers from foreign direct investment: nearly US\$ 250 billion against US\$ 5.25 billion from Global Environment Facility.

The CDM was inspired by the Brazilian proposal of a CDF. The nature of the fund changed. The CDF was conceived as a non-compliance mechanism, with a penalty on developed countries that fail to perform at least as well as the proposed commitments. The CDM has a function to help developed countries to achieve their commitments. The first was a punitive device, and the second an additional instrument.

Some problems of the Kyoto Protocol must be discussed<sup>5</sup>:

- a) The use of removals by sinks as a form to mitigate climate change is controversial. Some argue that reforestation projects do not address the main causes of greenhouse gas emissions (industrialisation and energy use). Another argument against this type

- of investment claims that projects have focused mainly on sinks rather than on the transfer of environmentally sound technologies because the former are cheaper. Investors from developed countries tend to invest in the cheapest projects, leaving the more expensive ones to governments or international agencies. This is known as the cherry-picking problem. On the other hand, the impact of each measure is differentiated and the implicit trade-off can be useful for policy purposes;
- b) There are no side payments as an incentive for developing countries to assume commitments. Commitments are set only for developed countries. This problem contributes to a smaller fall of emissions at a higher cost<sup>6</sup>;
  - c) Developing countries may additionally increase their emissions because of the leakage from developed countries. That is, investors may favour developing countries because of a less stringent environmental law and absence of environmental commitments. Absence of a leakage prevention mechanism in the form of sanctions and trade restrictions between countries is a potential problem in a protocol if there is not an almost total adhesion;
  - d) Emission reductions cannot be precisely measured. This is the so-called baselines problem. It questions the effectiveness of the environmental investments for climate change mitigation. One needs to establish a methodology to measure liquid gains in GHGs emissions that have a consensus between researchers in the field. The task of establishing baselines in order to measure the liquid gains should be given to an independent body like the International Organization for Standardization (ISO)<sup>7</sup>. Nowadays the methodologies submitted to the Executive Board of the CDM are referred by independent researchers and may be approved or not;
  - e) Emission commitments are temporary (2008-2012), fixed at 5% below the 1990 levels<sup>8</sup>. Amendments are possible. This factor may undermine the long run results of the protocol if there is no voluntary adhesion to the cleaner standard after this period. The discussions about the post-Kyoto period (after 2012) are currently under way and have revealed another problem: the lack of a mechanism to extend the compromise to other periods. This would lower the cost of implementation of measures to curb emissions and could produce long run results;
  - f) The minimum participation clause (at least 55 developed countries responsible for at least 55% of carbon dioxide emissions)<sup>9</sup> acts to deter free-riding until this limit is reached. From this point on there is no incentive to adhesion and the countries shall have the benefits without cost; and
  - g) There is no mechanism to enforce compliance of the commitments. The initial Brazilian proposal of CDF would work to enforce compliance, with incentives in the form of emissions trading and punishment in the form of a monetary contribution to a fund proportional to the difference between actual data and commitments. In the CDM system, there are stimuli but no sanctions.

Some other points made by several authors may be listed. An argument sometimes invoked in these discussions is that pollution reductions should be attained by each country with policies and measures on the domestic side. The argument is faulty inasmuch climate change is a global phenomenon, so that every reduction in GHGs emissions is beneficial to the whole world. Then, economic reasoning leads us to select the investments that produce lower emissions and higher returns. That is, if we have many investments that lower emis-

sions by the same amount, we choose the alternative with the highest return, independently of the country where it is available. Other points frequently stressed are: mechanisms must promote capacity building in the host country; mechanisms must promote the transfer of appropriate technology together with tacit knowledge; implementation of mechanisms with transparency and public participation; implementation of mechanisms allied to an enforceable legal framework.

In order to make the discussion more comprehensive, we now recall the possibility of considering the climate problem as a Prisoner's Dilemma. The above discussion was made assuming that an EKC with its turning point can only emerge from an artificial means of cohesion. This is a reasonable analysis if the downward sloping part of the EKC does not appear or if it only appears at an extremely high level of income. If the artificial means of cohesion is the adoption of a protocol, then we may discuss two cases: if the protocol is imposed to all countries, then all the payoffs of the game change and the economy turns to cooperation as a natural equilibrium (for a well designed compromise). The other case is the situation where the countries do not approve a general environmental agreement. In this context, we need to evaluate the possibility of two cases: a protocol involving a small group of countries; and the emergence of cooperation in a natural way from the interaction between at least a small group of countries. The former case only changes the payoffs of the countries that signed the protocol and may attain a cooperative outcome if it is well designed and some additional conditions occur. It is quite similar to the Kyoto Protocol, since just a few countries interact (and make reduction commitments) and a compromise is reached. The latter case (cooperation arising naturally from the interaction of agents) is studied by Axelrod (1984), who obtains the conditions for the cooperation to emerge in this context. He simulated what types of strategies produce the best results by means of a computer tournament between many researchers using different strategies. The winner was the simplest strategy known as tit for tat, the policy of cooperating on the first move and then doing whatever the other player has done on the previous move. This can be called the strategy of reciprocity. Subsequently, he analyses the results and obtains the conditions for the emergence of cooperation. His results can be summarised as follows:

- a) If the discount rate that the agent uses to evaluate the future is sufficiently high, then there is no optimal strategy independently of the other agent's strategy. The interaction is essential for practical purposes since we assume that the agents are egotistical. Cooperation emerges as a means to reach one's own objectives; and
- b) Cooperation can evolve if individuals have a sufficiently large chance to meet again. In this context we have three stages<sup>10</sup>:
  - Cooperation can occur even in a world of unconditional defection. The condition is that there are groups of individuals who interact with each other and cooperate based on reciprocity;
  - The strategy of reciprocity has good results even if there are many other strategies interacting with each other; and
  - Cooperation based on reciprocity, once established, will resist to the emergence of less cooperative strategies.

Applying the above results to our problem, we see that cooperation in climate change issues can emerge in cases where there is not a protocol (that is, there is no change



in payoffs) if there is at least a small group that interacts and cooperates on the basis of reciprocity (for instance, the group of developed countries). We may therefore conclude that cooperation is possible. One may question the incentives to cooperate, since there is the risk of free-riding, when the agent has all benefits without cost.

In the next section, we summarise the role of the United States in recent events and its resulting effect on the feasibility of the protocol.

#### **4 Reactions to the Kyoto Protocol**

Something that happened before the COP6.5 meeting (the so-called COP6 bis) disputed the feasibility of the Protocol. The United States of America openly declared its refusal to adhere to the Kyoto Protocol. The U.S. position can be found in Bush (2001), where he states the following:

As you know, I oppose the Kyoto Protocol because it exempts 80 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy. The Senate's vote, 95-0, shows that there is a clear consensus that the Kyoto Protocol is an unfair and ineffective means of addressing global climate change concerns.

The document states the interest to implement a multi-pollutant strategy to power plants to reduce emissions of sulfur dioxide, nitrogen oxides and mercury<sup>11</sup>. There is no interest to reduce emissions of carbon dioxide, which is not a pollutant according to the Clean Air Act. More than half of the energy in the U.S. is produced by thermal power plants using coal, generating a large amount of emissions of carbon dioxide. According to data from the Oak Ridge National Laboratory, in 2003 the U.S. were responsible for 21.6% of total carbon dioxide emissions and 28.7% of carbon dioxide emissions of the twenty largest emitters. If we take the twenty largest emitters in 2003, they are responsible for 75.4% of total emissions. The latest data show the same pattern of previous data and the percent figures are extremely close to previous ones. According to the data, it would be more difficult to obey the minimum participation clause with the exclusion of the U.S. from the Kyoto Protocol. Especially if we consider that the developing countries are not obliged to adhere to the Protocol.

The U.S. decision was based on previous research in the area. Nordhaus and Boyer (2000), for instance, after studying the impacts of the climate change, evaluated the Kyoto Protocol:

...we conclude that the Kyoto Protocol has no economic or environmental rationale. The approach of freezing emissions for a subgroup of countries is not related to a particular goal for concentrations, temperatures, or damages. Nor does it bear any relation to an economically oriented strategy that would balance the costs and benefits of greenhouse-gas reductions. (...) Finally, the Kyoto Protocol has significant distributional consequences. The United States bears most of the costs of implementing



the current version of the Kyoto Protocol. These costs will come either through abatement activities or through purchase of permits. The United States is a net loser from all variants of the protocol, while other high-income countries and the rest of the world either break even or benefit from the Kyoto Protocol. (NORDHAUS; BOYER, 2000, p. 177-178).

This citation shows that, at least for a part of scientists, the Kyoto Protocol would have negative consequences for the economy of the United States. As this is a voluntary agreement, there is no clear incentive for the U.S. to ratify it. One can argue that the U.S. were egotistic in their decision, but this is the way national decisions are made.

A discussion concomitant with the U.S. decision and the COP6.5 was the research report from Bjørn Lomborg, an academic from the University of Aarhus, in Denmark. Some portions of it were published in the English newspaper *The Guardian*. In short, his position is that scarce resources will be misallocated if we invest to revert global warming. The following citation from Lomborg (2001a), written at the time of the COP6.5, has the flavour of his argument.

(...) we need to be very careful in our willingness to act on global warming. Basically, global warming will be expensive (\$ 5 trillion) and there is very little good we can do about it. Even if we were to handle global warming optimally which would mean cutting emissions a little fairly far in the future, we can only cut the cost very little (about \$ 0.3 trillion). However, if we choose to enact Kyoto or even more ambitious programmes, the world will lose. And this conclusion does not just come from the output from a single model. Almost all the major computer models agree that even when chaotic consequences have been taken into consideration “it is striking that the optimal policy involves little emissions reduction below uncontrolled rates until the middle of the [twenty-first] century at the earliest”.

See also this citation from Lomborg's best seller:

Despite our intuition that we naturally need to do something drastic about such a costly global warming, economic analyses clearly show that it will be far more expensive to cut CO<sub>2</sub> emissions radically than to pay the costs of adaptation to the increased temperatures. The economic analyses indicate that unless Kyoto is implemented with global trading, thus also ensuring a commitment from the developing countries, it will actually constitute a net loss of welfare. Moreover, the effect of Kyoto on the climate will be minuscule – in the order of 0.15 °C in 2100, or the equivalent of putting off the temperature increase just six years. (LOMBORG, 2001b, p. 318).

The last citation shows his point that the Kyoto Protocol is an expensive way to carry out an ineffective environmental policy. Lomborg's views eventually reinforced America's arguments against the Kyoto Protocol.

The reaction to the American decision was immediate. There was some pressure, especially from European countries, for the U.S. to change their decision. Afterwards, efforts were made to unify the countries in order to implement the protocol even without the U.S., which is not an easy task as the payoffs of the game would change and it would not be clear for some countries whether they would win or lose in this new scenario. Finally, after countless efforts, the protocol entered into force on 16 February 2005. Nowadays, the debates are about either the implementation of the protocol or the post-Kyoto period after 2012.

## 5 *The post-Kyoto period*

Olmstead and Stevens (2006) describe the basic features of a climate agreement in the post-Kyoto period. First, it is necessary to include all key developed and developing countries. Developing countries would make “growth commitments”, that is commitments which become more stringent as the countries become wealthier. These changing commitments would balance the equity motive and the effectiveness and efficiency motive, one pointing to the opposite direction of the other. Second, it is necessary to extend the time length for action and consider two classes of commitments: moderate ones in the short run, in order to not provoke obsolescence of capital prematurely; and more stringent (and flexible) ones in the long run, in order to give incentives to technological change. The commitments would have an increasing time path at first, then reach a maximum, decrease and become more severe than the Kyoto Protocol commitments. Third, it is necessary to employ market-based policy instruments. Domestic policy instruments encompass: tradable permits; carbon taxes; and a hybrid system of ordinary tradable permits with a government promise to sell additional permits at a stated price. International policy instruments include a system of international tradable permits (similar to the one employed in the Kyoto Protocol but including also developing countries).

Meaningful discussions about the post-Kyoto period and a future compromise need to consider the above-mentioned points and the considerations in Nordhaus (2006), Pizer (2006) and Barret (2006).

Today it seems that Brazil will need to make some reduction commitments for the post-Kyoto period. These fears arose when the national communication (a report of the national emissions inventory of the country) had been issued in Brazil (2004). Until then, Brazil was just one of the twenty largest emitters of carbon dioxide from fossil fuel use. Data from the Oak Ridge National Laboratory show that in 2003 Brazil was in the 20<sup>th</sup> position of the rank. Brazil (2004) shows that in 1994 the carbon dioxide emissions from fossil fuel use were only 25% of the total, and that 75% of the total emissions came from land use and land use change. The Brazilian situation is unusual, compared to the other countries, because of the Amazonian rainforest. Assuming that the same proportions apply to 2003 and that the other countries do not have a significant proportion of emissions from land use and land use change, Brazil would jump to the 6<sup>th</sup> position in the rank of total emissions. This rough estimate signals that Brazil probably will not be immune to commitments for the next compromise period.

## 6 Conclusions

We presented in this paper a panel of arguments related to the Kyoto Protocol. The pros and cons are stressed and they show that this topic is not easy to analyse. The arguments favorable to the protocol stress the need to diminish emissions of GHGs in order to avoid problems related to health, agriculture, etc. The arguments contrary to it either emphasise that the costs of implementation are extremely high if compared to the benefits, or point out the flaws in the design of the protocol. It is necessary to stress the variability of research results and the lack of data. If we invoke the precautionary principle, then we can say that, regardless of the quality of the information, as long as there is doubt about some matters, it is better to do something than to do nothing. In order to implement the protocol and discuss the next compromise period, we need to consider the criticisms mentioned. The Kyoto Protocol is certainly not adequate for this challenge. But it is a first step, and it may be improved in the post-Kyoto debates. The world as a whole surely hopes that the right measures will not be taken too late.

## References

- AXELROD, R. **The Evolution of Co-operation**. New York: Basic Books, 1984.
- BARRET, S. Climate Treaties and “Breakthrough” Technologies. **American Economic Review**, v. 96, n. 2, p. 22-25, 2006.
- \_\_\_\_\_. Montreal versus Kyoto – International Cooperation and the Global Environment. In: KAUL, I.; GRUNBERG, I.; STERN, M. A. (eds.), **Global Public Goods – International Cooperation in the 21<sup>st</sup> Century**, Oxford: Oxford University Press, 1999. p. 192-219.
- BRAZIL. **Comunicação Nacional Inicial do Brasil à Convenção-Quadro das Nações Unidas sobre Mudança do Clima**. Brasília: Ministério da Ciência e Tecnologia, 2004.
- \_\_\_\_\_. **Proposed Elements of a Protocol to the United Nations Framework Convention on Climate Change, Proposed by Brazil in Response to the Berlin Mandate**. Brasília: Ministry of Science and Technology, 1997.
- BRUYN, S. M. **Economic Growth and the Environment**. Dordrecht: Kluwer Academic Publishers, 2000.
- BUSH, G. W. **Text of a letter from the President to Senators Hagel, Helms, Craig, and Roberts**. Washington, DC: White House, 2001.
- CHIMELI, A. B.; BRADEN, J. B. **The Environmental Kuznets Curve and Optimal Growth**. Palisades, NY: Columbia University, 2002. (working paper)
- CHOMITZ, K. M. **Evaluating carbon offsets from forestry and energy projects: How do they compare?** Washington, DC: World Bank, c.1999. (working paper)
- DASGUPTA, S.; LAPLANTE, B.; WANG, H.; WHEELER, D. Confronting the Environmental Kuznets Curve. **Journal of Economic Perspectives**, v. 16, n. 1, p. 147-168, 2002.
- DINIZ, E. M. **Growth, Pollution and the Kyoto Protocol**. São Paulo/Oxford: Banco Santos/Centre for Brazilian Studies - University of Oxford, 2001.
- FORSYTH, T. **International Investment and Climate Change**. London: The Royal Institute of International Affairs/Earthscan, 1999.
- GROSSMAN, G. M. Pollution and growth: what do we know? In Goldin, I. and Winters, L. A. (eds.), **The Economics of Sustainable Development**, Cambridge: Cambridge University Press, 1995. p. 19-46.
- GROSSMAN, G. M.; KRUEGER, A. B. Economic Growth and the Environment, **Quarterly Journal of Economics**, v. 110, p. 353-377, 1995.
- GRUBB, M.; VROLIJK, C.; BRACK, D. **The Kyoto Protocol – A Guide and Assessment**. London: The Royal Institute of International Affairs/Earthscan, 1999.
- ISLAM, S. M. N. **Optimal Growth Economics**. Amsterdam: Elsevier, 2001.

- JOHNSON, K. Brazil and the Politics of the Climate Change Negotiations. *Journal of Environment & Development*, v. 10, p. 178-206, 2001.
- LOMBORG, B. *Global warming – are we doing the right thing?* Aarhus: University of Aarhus, 2001a.
- \_\_\_\_\_. *The Skeptical Environmentalist – Measuring the Real State of the World*. Cambridge: Cambridge University Press, 2001b.
- MARLAND, G.; BODEN, T. A.; ANDRES, R. J. Global, Regional and National CO<sub>2</sub> Emissions. In **Trends: A Compendium of Data on Global Change**. Oak Ridge: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U. S. Department of Energy, 2003.
- NORDHAUS, W. D. After Kyoto: Alternative Mechanisms to Control Global Warming. *American Economic Review*, v. 96, n. 2, p. 31-34, 2006.
- NORDHAUS, W. D.; BOYER, J. *Warming the World – Economic Models of Global Warming*. Cambridge: MIT, 2000.
- OLMSTEAD, S. N.; STAVINS, R. N. An International Policy Architecture for the Post-Kyoto Era. *American Economic Review*, v. 96, n. 2, p. 35-38, 2006.
- PIZER, W. A. The Evolution of a Global Climate Change Agreement. *American Economic Review*, v. 96, n. 2, p. 26-30, 2006.
- SCHMALENSEE, R.; STOKER, T. M.; JUDSON, R. A. World Carbon Dioxide Emissions: 1950-2050. *Review of Economics and Statistics*, v. 80, p. 15-27, 1998.
- SCHMIDHEINY, S.; ZORRAQUÍN, F.; THE WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT. *Financing Change – The Financial Community, Eco-efficiency, and Sustainable Development*. Cambridge: MIT, 1996.
- STOKEY, N. L. Are there limits to growth? *International Economic Review*, v. 39, p. 1-31, 1998.
- STRONG, M. *Where on Earth are We Going?* New York: Texere, 2001.
- UNITED NATIONS. *United Nations Framework Convention on Climate Change*. New York: United Nations, 1992.

## Notes

- <sup>2</sup> The Convention and other official documents use the terms “Annex I Parties” and “Non-Annex I Parties”, that we may roughly identify with developed and developing countries, respectively;
- <sup>3</sup> A survey on the empirical papers related to these two can be found in de Bruyn (2000);
- <sup>4</sup> See, for instance, the discussion in de Bruyn (2000);
- <sup>5</sup> For a more detailed discussion see Barrett (1999), Forsyth (1999) and Grubb et al. (1999);
- <sup>6</sup> This is one point attacked in Bush (2001) and used to justify the current U.S. position (see next section);
- <sup>7</sup> There is a standard (ISO 14000) that tries to attain eco-efficiency, a term that Schmidheiny, S., Zorraquín, F. and the World Business Council for Sustainable Development (1996) defines as sustainability at the firm level. A methodology applied to GHG emissions would be an additional step towards the same end;
- <sup>8</sup> Kyoto Protocol 3.1.;
- <sup>9</sup> Kyoto Protocol 24.1. The protocol explicitly refers to the countries from Annex I (predominantly developed countries);
- <sup>10</sup> We follow the summary of results in Axelrod (1984), ch. 1;
- <sup>11</sup> The American strategy was announced in the document called The Clear Skies Initiative.

# LESSONS FROM THE KYOTO PROTOCOL

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ELIEZER MARTINS DINIZ

**Abstract:** The purpose of this paper is to undertake a critical evaluation of the Kyoto Protocol. The evolution of the discussions that produced the final document is sketched through the analysis of official documents of the United Nations Framework Convention on Climate Change (UNFCCC), relevant papers and material from the press. We also discuss the factors that cast doubts on the continuation and feasibility of the Protocol and the prospects for the post-Kyoto period and a new compromise.

**Keywords:** Environmental agreement. Climate change. Global warming. Sustainable economic development.

## *Lições do Protocolo de Quioto*

**Resumo:** O objetivo deste trabalho é fazer uma avaliação crítica do Protocolo de Quioto. Descreve-se inicialmente a evolução das discussões que produziram o documento final, utilizando como fontes documentos oficiais da Convenção-Quadro das Nações Unidas para Mudança do Clima (CQNUMC), artigos importantes e material jornalístico. Enfatizam-se a seguir os fatores que colocam em dúvida a continuidade e a factibilidade do Protocolo. Discutem-se em último lugar as expectativas para o período pós-Quito e para um novo acordo.

**Palavras-chave:** Acordo ambiental. Mudança climática. Aquecimento global. Desenvolvimento econômico sustentável.

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