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Lessons From The Kyoto Protocol

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Lessons From The Kyoto Protocol¹

Eliezer Martins Diniz*

Abstract

The purpose of this paper is to make a critical evaluation of the Kyoto Protocol. The evolution of the discussions that produced the final document is sketched, using as sources the official documents of the United Nations Framework Convention on Climate Change (UNFCCC), some relevant papers and material from the press. We also stress the factors that put into doubt the continuation and feasibility of the Protocol. Prospects for an international agreement related to the emissions of greenhouse gases are discussed. Some implications for developing countries are analyzed, with an emphasis for the Brazilian case.

Key words: environmental agreements, sustainable economic development.

JEL codes: O13.

1. United Nations Framework Convention on Climate Change

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

The importance of the topic can be evaluated by the document United Nations Framework Convention on Climate Change,² a result of the above mentioned conference. Several preliminaries pointed out by the document are worthy of mention:

- Developed countries are responsible for the actual level of emissions (and stocks) of greenhouse gases.
- Developing countries need to increase their levels of emissions as a result of their efforts to catch up with the developed countries. Their priorities are the achievement of sustainable economic growth and the eradication of poverty.
- Principle of common but differentiated responsibilities (“(...) *the widest possible cooperation by all countries and their participation in an effective and appropriate*

¹ I acknowledge financial support from CNPq (grant n. 301040/97-4 (NV)) and Banco Santos in distinct stages of the research. Some results of the paper were obtained when the author was Banco Santos Research Fellow in Economics at the Centre for Brazilian Studies, St Antony's College, University of Oxford, during the academic year 1999-2000. Comments on a previous version at the Beijer Research Seminar on Ecological Economics in December 2001 were helpful.

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² United Nations (1992).

international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions.”³).

- Environmental standards need to be tailor-made for each country. Inappropriate legislation can produce high economic and social costs.
- Policy measures to minimise climate change in developing countries need to avoid adverse effects on economic development. Increases in energy consumption as a result of development need to take into account the possibilities of greater energy efficiency and reduction of emissions.
- Intergenerational concern (“(...) *protect the climate system for present and future generations (...)*”⁴).

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 to obtain a smaller flow of emissions in order to decrease the above mentioned concentrations. Cooperation is essential for a meaningful final result.

To attain this goal the following measures were devised:⁵

- National inventories of greenhouse gases.
- Programmes to mitigate climate change.
- 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.*”⁶).
- 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.*”⁷).
- 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 one time each 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. Sometimes reports made by third parties are also examined (like the Intergovernmental Panel on Climate Change (IPCC), for instance).

³ United Nations (1992), p. 2.

⁴ United Nations (1992), p. 6.

⁵ The Convention and another official documents use the terms “Annex I Parties” and “Non-Annex I Parties”, that we may roughly identify with developed and developing countries, respectively.

⁶ United Nations (1992), 4.1.c, p. 10.

⁷ United Nations (1992), 4.1.d, p.10-11.

2. The Brazilian position

The position of Brazil since the first Conference of the Parties (COP 1) in Berlin on 1995 has consistently stressed two points:

- The necessity to evaluate properly the share of responsibility of each country in the process of curtailing emissions (*principle of common but differentiated responsibilities*). This is achieved using the state of art of knowledge and taking into account the right of developing countries to experience sustainable economic development according to his own priorities.
- The fundamental contribution of the transfer of cleaner technologies to developing countries and to the success of the Protocol.

In Brazil (1997), the government of Brazil puts forward a formal proposal for a protocol. It was presented to the Ad Hoc Group on the Berlin Mandate on August 1997. The focus of the document is on the above mentioned two points. Solutions are proposed.

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 measure is comprehensive as it reflects the impact of emissions of many greenhouse gases.

The paper suggests that one can set reduction targets 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 according to this criterion the largest burden in terms of reduction targets.

A penalty is imposed on countries that do not comply with their commitments (reduction targets). 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 the climate change and its target. 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 is used for climate change mitigation and a small share to adaptation projects.

The countries that produced a temperature increase lower than its target may sell this difference at the market price to any country that did not comply with its targets. This is known as *emissions trading*. Any country shall contribute to the CDF if it does not comply with the targets and does not buy emissions from another 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 at the time of writing being the subject of technical discussions in the subsidiary bodies of the convention. A controversial point is the use of temperature instead of emissions of gases to evaluate the relative responsibility of countries and the targets to reach. This point can be better evaluated using the available evidence on growth and pollution.

Grossman and Krueger (1995) and Grossman (1995) show empirical evidence on the relationship between pollution and growth.⁸ In many cases we can find the following behaviour: in the beginnings of 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

⁸ A survey on the empirical papers related to these two can be found in de Bruyn (2000).

say that economic development itself creates the conditions to diminish pollution. 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* (adoption 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) makes a theoretical analysis on this subject and shows under what conditions the EKC appears in the most common growth models. Dasgupta, Laplante, Wang and Wheeler (2002) is a recent survey on the theoretical underpinnings and empirical evidence of the EKC with an optimistic view on its relevance. De Bruyn (2000) is another survey worthy of mention.

Taking the above evidence into account, one can say that the same type of argument perhaps may be valid in the matter of greenhouse gases (GHGs). If some type of EKC emerges naturally, then the passage of time is sufficient to diminish the GHGs. In the case that 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: noncooperation 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 do 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 adopts measures to diminish GHGs emissions). Cooperation would force a turning point. There are many ways to induce cooperation. In this matter, it was chosen the adherence to a protocol with emission targets. 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 induce naturally a cooperative result can be found, for instance, in Axelrod (1984).⁹ 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 to obtain the same result. The first one is more desirable, but the protocol need to 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, Stoker and Judson (1998) obtain 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. The book obtains that the scale effect is prominent and there is no evidence of an EKC with the downward sloping part. Barossi-Filho, Diniz and Silva (2002) represents an attempt to attack the problem with the same methodology of Diniz (2001) but using panel data methods for the largest number of countries.

The Brazilian position to adopt an index related to temperature can be questioned by the fact that it does not take into account the huge amount of empirical evidence and theoretical analysis just sketched. Models that try to integrate economic aspects of the question with other disciplines present problems not yet satisfactorily solved.¹⁰ Nevertheless there is a growing body of research on these models, for instance the excellent book by Nordhaus and

⁹ A summary of the main results is in the following section.

¹⁰ See, for instance, the discussion in de Bruyn (2000).

Boyer (2000). We think there is a cost involved that surpasses the benefits of this new temperature index. So we can identify a dispute between the Brazilian proposal of using a temperature target and the dominant position of adopting an emissions target, a conflict apparently not yet solved.

3. The Kyoto Protocol

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

The protocol consists of a set of explicit targets to be achieved by developed countries, allied to some programs related to: incentives to increase the removals by sinks; transfer of cleaner technologies to developed countries (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 gives to the investor a reduction in his own emissions. The main objective is to reduce the emissions globally because every emission contributes to the greenhouse effect. The same elements of the Convention and the bulk of the Brazilian proposal on the CDF are present at the Kyoto Protocol. More attention is given to the role of private investment in the transfer of technology. Data cited in Forsyth (1999) show for the period 1990-1997 the growing importance in environmental problems 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 on the Brazilian proposal of a CDF. The nature of the fund changed. The CDF was conceived as a non-compliance mechanism, that is a penalty to the developed countries that did not succeed to perform at least as well as the proposed targets. The CDM has a function to help the developed countries to achieve their targets. The first was a punitive device, the second an additional instrument.

Some problems of the Kyoto Protocol need to be discussed in what follows:¹¹

- The use of increasing removals by sinks as a form to mitigate climate change is controversial. It is argued that reforestation projects shall not attack the main causes of greenhouse gas emissions (industrialisation and energy use). Another argument against this type of investment says that projects have focused mainly on sinks rather than the transfer of environmentally sound technologies because they are cheaper. Developed countries investors tend to invest in the cheapest projects, leaving the more expensive ones to the 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 tradeoff can be useful for policy purposes.¹²

¹¹ For a more detailed discussion see Barrett (1999), Forsyth (1999) and Grubb, Vrolijk and Brack (1999).

¹² One need to evaluate the response of each factor in order to assess its importance. An attempt to do this for the Brazilian case is in Diniz (2001). The main results are summed up in a later section on Brazil.

- There are no side payments as an incentive for developing countries to assume targets. The targets are set only for developed countries. This contributes to a smaller fall of emissions at a higher cost.¹³
- Developing countries may increase additionally 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 targets. 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.
- Emission reductions cannot be measured precisely. This is the so-called *baselines problem*. This puts into doubt the effectiveness of the environmental investments for climate change mitigation. One need to establish a methodology to measure liquid gains in GHGs emissions that have a consensus between researchers in the field. The task to establish baselines in order to measure the liquid gains need to be given to an independent body like the International Organization for Standardisation (ISO).¹⁴
- Emission limits are temporary (only for 2008-2012), fixed 5% below the 1990 levels.¹⁵ Amendments are possible. This factor may undermine the long run results of the protocol if there is not a voluntary adhesion to the cleaner standard after this period.
- The minimum participation clause (at least 55 developed countries responsible for at least 55% of carbon dioxide emissions)¹⁶ 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.
- There is no mechanism to enforce compliance of the targets. 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 proportionally to the difference between actual data and targets. In the actual system there are stimuli but no sanctions.

Some other points made by several authors may be listed. An argument always invoked in these discussions is that pollution reductions should be attained by each country mainly by policies and measures on the domestic side. The argument is faulty because climate change is a global phenomenon, so that every reduction in GHGs' emissions is beneficial to the whole world. Then, economic reasoning guide us to select the investments that produce lower emissions and higher returns. That is, if we have many investments that lower emissions by the same amount, we choose the alternative with the highest return, independently of the country where it is made. Other points frequently stressed are: mechanisms must promote capacity building in the host country; mechanisms must promote the transfer of appropriate technology; implementation of mechanisms with transparency and public participation; implementation of mechanisms allied to an enforceable legal framework.

In order to implement mechanisms, the Executive Board of the World Bank approved the Prototype Carbon Fund (PCF) in July 1999. The objective is to perform emissions trading

¹³ This is one point attacked in Bush (2001) and used to justify the current U.S. position (see next section).

¹⁴ 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 sustentability at the firm level. The methodology on GHG emissions would be an additional step towards the same end.

¹⁵ *Kyoto Protocol* 3.1.

¹⁶ *Kyoto Protocol* 24.1. The protocol refers explicitly to the countries from Annex I (that are predominantly developed).

by means of a fund of carbo-reducing investments in which the World Bank shall be an intermediary to bring capital from industrialised countries to developing countries. By this way the developed countries can meet their targets of emission reductions stated on the Kyoto Protocol. It is expected that Brazil shall have some participation in these funds since it is one of the twenty largest emitters of carbon dioxide.¹⁷ In fact, at the moment of writing Brazilian newspapers revealed that there is one approved Brazilian project working with biomass that can be used in the CDM.

In order to make the discussion more complete, we recall now the possibility to consider the climate problem as a Prisoner's Dilemma. The above discussion was made assuming that an EKC with its turning point can emerge only by an artificial means of cohesion. This analysis is reasonable if the downward sloping part of the EKC does not appear or if it appears only 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 goes 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 by the interaction of at least a small group of countries. The former case changes only 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 present stage of the Kyoto Protocol, since only a small group of countries interacts and a compromise is firmed up. 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 produces consistently 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 did 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:

- 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.
- Cooperation can evolve if individuals have a sufficiently large chance to meet again. In this context we have three stages:¹⁸
 1. 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.
 2. The strategy of reciprocity have good results even if there are many other strategies interacting with each other.

¹⁷ Brazil is the 17th largest carbon dioxide emitter, corresponding to 1% of the total world emissions. Information for 1998 provided by the Oak Ridge National Laboratory and published in Marland, G., Boden, T. A., Andres, R. J., Brenkert, A. L. and Johnston, C. (2001).

¹⁸ We follow the summary of results in Axelrod (1984), ch. 1.

3. 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 on climate change issues can emerge in the 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 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. The possible result without any mechanism of cohesion is noncooperation.

In the next section, we relate the steps taken to implement the protocol until the latest Conference of the Parties (COP7), stressing the role of the United States in recent events and the resulting effect on the feasibility of the protocol.

4. Developments after the Kyoto Protocol

The main document released at the COP4 in Buenos Aires was called *The Buenos Aires Plan of Action*, to be implemented in the two years following its formulation. Its purpose was to prepare to put into force the Kyoto Protocol by deepening the design of the mechanisms. The COP5 was mainly directed to monitoring the implementation of the plan of action.

The COP6 was expected to pave the way for the details of implementation of the protocol. There were problems to reach a consensus on many points and the summit ended unexpectedly. The disagreement occurred on the *modus operandi* of the mechanisms, the ways to enforce compliance, the restriction in the use of flexibility mechanisms and other matters. On that occasion the countries accorded to try a new Conference of the Parties to discuss the same matters of COP6. The frustration of the delegates of the summit to reach a consensus was the reason of the new COP6.5 (the so-called COP6bis).

Before the COP6.5 meeting, something happened that put the feasibility of the Protocol into doubt. The United States of America openly declared its desire not to adhere the Kyoto Protocol. The U.S. position can be found in Bush (2001), where he states what follows:

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 multipollutant strategy to power plants to reduce emissions of sulfur dioxide, nitrogen oxides and mercury.¹⁹ There is no interest to reduce emissions of carbon dioxide, that is not a pollutant according to the Clean Air Act. More than half of the energy in U.S. is produced by thermal power plants using coal, generating a large amount of emissions of carbon dioxide. According to data from Oak Ridge National Laboratory, the U.S. were responsible for 22% of carbon dioxide emissions in 1996. If we take the twenty largest emitters, they are responsible for 76% of emissions. With the exclusion of U.S. it will be more difficult to obey the minimum participation clause.

¹⁹ The American strategy was divulged in a recent document, called *The Clear Skies Initiative*.

Especially if we consider that the developing countries are not obliged to adhere to the 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. In a second moment, the efforts were directed to unify the countries in order to implement the protocol even without the U.S.

A discussion concomitant with the U.S. decision and the COP6.5 was the research report from Bjorn 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 (2001c), 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."

The COP7 , held in Marrakesh, adopted most of the recommendations of COP6 and, among others decisions, adopted a Compliance Committee and an Enforcement Branch in order to make the implementation feasible and to punish those countries that do not attain their targets.

Aside from all the discussions, the CDM is currently being structured. The admissible methodologies to measure greenhouse gases emissions reductions by the implementation of projects are currently being object of discussion in the Executive Board of the CDM and in the scientific community.

If we consider all the arguments presented at this paper, then we are able to have a notion on the kaleidoscope of pros and cons suscitated by the Kyoto Protocol. The inference of any conclusion in favour of one or another position is not possible at the moment. The following section aims at summing up some empirical results for the Brazilian case concerning policy options related to the protocol. A similar type of study can be made for any other country.

5. The Brazilian evidence and the Kyoto Protocol

The evidence reported in Diniz (2001) point some alternatives of policy out that are more suitable to the Brazilian case. It is based on Brazilian carbon dioxide emissions data from the Oak Ridge National Laboratory (total and from many sources)²⁰ and a real GDP series from IPEA (Instituto de Pesquisa Econômica e Aplicada)²¹ for the period 1947-1996. The main empirical result is that the scale effect prevails over the composition and technique effects (an intuitive result for a developing country). Our attention is then directed to policies that can mimic an EKC on the short to medium run. Regarding the choice between adoption of cleaner technologies and incentives to increase removals by sinks, we saw that both policies impact negatively on output and do not produce an EKC. A possible interpretation of the results is that reduction of emissions with an increase in the growth of output may be the result of incentives to removals by sinks (for instance, reforestation policy) allied to promotion of economic development. An alternative mix (interpreted as an adoption of cleaner technologies allied to a reduction of forests) may produce higher emissions with a decrease in the growth of output.

It was objected that the reforestation policy does not attack the causes of the problem of climate change. On the other hand, this policy allied to economic development produces according to our simulations a desired combination similar to the Environmental Kuznets Curve.

The adoption of cleaner technologies, an option preferred by many authors, produce according to our simulations a negative impact to the growth of output. If allied to deforestation, the results are disastrous, with higher growth of pollution allied to lower growth of output. It seems that Brazil (and the majority of countries) prefer the alternative of cleaner technologies than reforestation. The new Forestry Code under discussion in the Brazilian chamber proposes a reduction in the protected areas in Amazon jungle. Then the alternative discussed in this paragraph is the most probable for the Brazilian case, and the one with the worst results (if the simulation results are sufficiently robust).

The alternative of policy more suitable to Brazil is, according to our simulations, to adopt a reforestation policy and pursue economic development. This alternative of policy is robust according to various assumptions tested. There are also many sectoral policies that can be applied, according to the previous analyses, and we ask the reader to obtain the details in the third chapter of Diniz (2001). Besides the robustness, we need to mention that the explanatory power of the sectoral policies is higher than the one from the aggregate model.

Brazil is not oblivious to environmental problems. The creation of the Brazilian Climate Change Forum (Fórum Brasileiro de Mudanças Climáticas) by President Fernando Henrique Cardoso showed the interest to address these questions and to attract investments related to the implementation of the CDM. Brazil is searching for a path of sustainable economic development and wants also to attract foreign investment. This is a new way to proceed, and we expect that the country shall not fail in its task.

²⁰ See Marland, G., Boden, T. A., Andres, R. J., Brenkert, A. L. and Johnston, C. (2001).

²¹ Applied Economic Research Institute.

6. Conclusions

We presented in this paper a panel of the positions related to the implementation of the Kyoto Protocol. The pros and cons are stressed and some comments show that this question is not easy to evaluate. The arguments favorable to the protocol stress the necessity to diminish emissions of GHGs in order to avoid problems related to health, agriculture, etc. The arguments contrary to it emphasise that the costs of implementation are extremely high if compared to the benefits or to the alternative uses to the resources. It is necessary to stress the variability of the research results and the paucity of data. If we invoke the *precautionary principle*, then we can say that independently of the quality of the information, if there is doubt on some matter it is better to do something than nothing. Summing up, it is better to try to implement the Kyoto Protocol until we have results that allow us to establish a conclusion on this matter. In order to implement the protocol, we need to consider the criticisms above mentioned to assure the attainment of the goals.

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