A FORMAL MODEL ON HOW THE CLEAN DEVELOPMENT MECHANISM OF THE KYOTO PROTOCOL PRODUCES PERVERSE EFFECTS

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ABSTRACT

One of the main environmental problems in the contemporary society is global warming. In 1997, as a result of negotiations on that issue, several countries signed the Kyoto Protocol that institutes the Clean Development Mechanism (CDM) as an ancillary instrument to decrease the global emissions of greenhouse gases (GHG). We argue that the current CDM design, contrary to many suppositions, produces the perverse effect of increasing the global emissions of GHG. In this study we propose a formal model to support our central argument. Initially, we use game theory to formalize our explanation about how the two players (Kyoto Protocol ANNEX1 and NON-ANNEX1 countries) cooperate by such mechanism, in a non-zero sum game. Eventually, microeconomic theory is used to model the dynamic of interactions of Carbon Tradable Offsets (CTO) buyers and sellers, thereby demonstrating that the cooperation between players produces the perverse effect. This explanatory study used rational choice theory and gathered data in books, scientific articles and official documents purposing to figure out how the CDM works and to support the argument. The main conclusion of our model is that after the CTO demanded quantity be supplied, NON-ANNEX1 countries will use the revenue from CTO markets to increase their productive capacity, so that there will be a turn over in the engagement for reducing GHG emissions by these countries, and the perverse effect of global increasing at such emissions level will follow.

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1. INTRODUCTION

The Industrial Revolution presented innovative enterprises that altered the paradigm of living in society. These innovations simplified tasks and works of the daily basis. Since then, the individualist and social lives have become more comfortable and societies have grown in this paradigm.

However, such technological advance has also contributed to the aggravation of diverse environmental problems due to its manufacturing processes. One of these problems is global warming. According to the World Bank (1991), the Greenhouse Gases (GHGs) emission increasing is one cause of the global temperature growing. As it is explained, the Greenhouse Effect is a natural component of Earth climate in which some atmospheric gases absorb some warm radiations emitted by the Earth after receiving solar energy. This phenomenon is essential to life in Earth, once its absence would decrease the global average temperature in 30° degrees. Notwithstanding the Greenhouse Effect primary utility, some human activities have potential to amplify such effect by emitting GHGs in the atmosphere, causing a concentration of them. What follows is a climatic warming.

Purposing to deal with these environmental problems, the international community has realized several conferences to discuss them. In 1992, 172 government representatives met in the United Nations Conference on Environment and Development (Rio de Janeiro – Brazil), that originated the United Nations Framework Convention on Climate Change (UNFCCC), and where was consolidated the concept of sustainable development. The UNFCCC encouraged industrialized countries to stabilize GHG emissions, but only five years later a mechanism aiming to commit these countries to do so would be established: the Kyoto Protocol. This protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005.

The Kyoto Protocol divides the signatory countries in two groups: the first is formed by the countries with a high level of industrialization, also known as the ANNEX1 Countries; the second is formed by developing and agrarian economy countries, here called NON-ANNEX1 countries. The protocol determines binding targets for ANNEX1 Countries for reducing GHG emissions. These amount to an average of 5% (five per cent) against 1990 levels over the five years period 2008 – 2012.

The Kyoto Protocol, Article 10, states the necessity of “taking into account the common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, without introducing any new commitments for Parties not included in Annex I, […] in order to achieve sustainable development’. With the intent of attracting developing and agrarian economy countries to cooperate with the enterprise of reducing the GHG emissions, as well as offering the Kyoto Protocol signatory countries an additional mean to achieve their targets, three market based mechanisms were established: emission trading, joint implementation and the clean development mechanism (CDM). “The mechanisms help stimulate green investment and help Parties meet their emission targets in a cost-effective way.”

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1 To know the GHGs, see the Appendix A.
3 To know the current list of ANNEX1 countries, check this link: http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php
4 http://unfccc.int/kyoto_protocol/items/2830.php
5 http://unfccc.int/kyoto_protocol/items/2830.php
We argue, however, that the CDM, as it is currently designed and contrary to many suppositions, produces a perverse effect\(^6\) of increasing the global emissions of GHGs, primarily due to the Kyoto Protocol deadline for achieving the targets- 2012, and because no restriction is made to NON-ANNEX1 countries regarding the use of the revenue provided by the Clean Development Mechanism. We will demonstrate that after the demanded quantity of Carbon Tradable Offsets (CTO) begin to decrease and finally be extinguished, NON-ANNEX1 countries will use the revenue from CTO markets to increase their productive capacity, so that there will be a turn over in the engagement for reducing GHG emissions by these countries, and the perverse effect of global increasing at such emissions level will follow.

In order to defend our argument, we developed a formal model\(^7\) with game and basic microeconomics theories. Initially, we apply game theory to demonstrate the first two lemmas of our argument: 1) the CDM is a non-zero sum game\(^8\), with two players (ANNEX1 and NON-ANNEX1 countries); and 2) both players are intended to cooperate as a strategy to maximize their interests. Finally, we claim that such cooperation by the CDM produces the mentioned perverse effect. We do it by demonstrating a last, third lemma: 3) the strategy of cooperation by the CDM brings an increase at the GHGs emission level.

We conclude that, although the CDM presents an equilibrium in its design, been succeed regarding the task of setting incentives for ANNEX1 and NON-ANNEX1 countries for cooperating, the lack of continuity of the mechanism post-2012 decrees a foreseeable extinction of the CTO market for NON-ANNEX1 countries. Because the mechanism makes no restriction on the use of the CTO market revenue, NON-ANNEX1 countries will tend to return to conventional, environmentally more aggressive technologies of production in large scale and lower costs.

2. THE CLEAN DEVELOPMENT MECHANISM GAME AND ITS PLAYERS

We consider that the CDM game is set by the strategic interaction of CTO buyers and sellers in the market. There are two players, ANNEX1 and NON-ANNEX1 countries, whose interests are to achieve their targets of reducing GHG emissions and to earn revenues from CTO markets, respectively. CDM game rules as well as the players’ binding targets are defined in the Kyoto Protocol and its annexes.

Possible results of the CDM game are basically three: i) if both players cooperate, ANNEX1 countries count on the CTO support to reduce their internal costs\(^9\), and to

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\(^6\) It consists in a negative, undesired and non-anticipated effect caused by an intentionally positive action of its author (Boudon, 1977).

\(^7\) A formal model is a model that has explicitly stated suppositions, in abstract and symbolic terms, about a “real world” from which the previsions are derived. However, given the fact that it is a model, some of the suppositions are false, or not directly verifiable. In other worlds, the model is an abstraction of the reality and its suppositions are details explicitly stated from the abstraction (Morton, 1999).

\(^8\) “A non-zero sum game (…) is not exclusively competitive, in the sense that what one gains, another must lose. […]. There is room in this type of game for elements of both conflict and cooperation; on some plays, both or some parties might win and, at the end of the game, both or some parties might be ahead by varying amounts.” (Dougherty and Pfaltzgraff, 2001: 564)

\(^9\) We consider that internal costs are all the investments made by a country in its industry, in order to achieve the targets of GHG emissions reduction (for ANNEX1 countries) or to attend the requisites for producing CTOs and selling them (NON-ANNEX1 countries). The internal costs for ANNEX 1 countries exclude any spends with the purchase of CTOs, of course, because they are not considered investments in their industries.
achieve their targets established in the Kyoto Protocol, and NON-ANNEX1 countries earn revenue from the CTO markets; ii) if both players do not cooperate, neither ANNEX1 countries get the CTO support to achieve their targets, nor NON-ANNEX1 countries earn revenue from the CTO market; iii) if NON-ANNEX1 countries produce and supply CTOs but ANNEX1 countries do not purchase these credits, the formers do not earn revenue from the CTO market, and ANNEX1 countries do not count on the CTO support to achieve their targets.

**LEMMA 1: the CDM is a non-zero sum game, with two players (ANNEX1 and NON-ANNEX1 countries)**

Players’ interests are basically two, in the CDM game: 1) ANNEX1 countries purpose to achieve their targets by using the important CTO support\(^{10}\); 2) NON-ANNEX1 countries intend to earn revenue from the CTO market.

The game dynamics consists of price negotiations between both players. An equilibrium price will be reached depending on the CTO demanded and supplied quantities as well as the buying, selling and payment modalities.

The CDM is a non-zero sum game because it is not necessarily competitive and both parties might win, simultaneously. Both players may be benefited when cooperating\(^{11}\).

**LEMMA 2: both players are intended to cooperate as a strategy to maximize their interests**

In this game, the cooperation is a decisive factor regarding the results to be achieved by the players. The more cooperation between both players, the higher the earnings they will achieve. So, there is space for both the players to maximize their interests, with ANNEX1 countries achieving their targets of GHG emission reduction and NON-ANNEX1 countries absorbing revenue from the CTO market. The less cooperation between both players, the more complex will be the consequences for global warming and environmental degradation, and the higher the internal costs for ANNEX1 countries will be (if they still remain intended to achieve their targets of GHG reduction).

We represent the possible payoffs of the CDM game as follows:

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\(^{10}\) The Kyoto Protocol establishes a limit for each ANNEX1 country to use CTOs to achieve their targets.

\(^{11}\) According to Dougherty and Pfaltzgraff (2001: 564) “A non-zero sum game (NZSG) is not exclusively competitive, in the sense that what one gains, another must lose. The sum of gains and losses need not add up to zero. […]. There is room in this type of game for elements of both conflict and cooperation; on some plays, both or some parties might win, and at the end of the game, both or some parties might be ahead by varying amounts.”
As we shall see, one of the three possibilities is cooperation (C₁, C₂), in which NON-ANNEX1 countries produce and supply CTOs, and ANNEX1 countries buy these CTOs. In this option, the payoff is positive for both players, indicating that NON-ANNEX1 countries earn revenue from CTO markets and that ANNEX1 countries get the CTO support to achieve their targets of GHG reduction. A second possibility is cooperation-non cooperation (C₁, N₂), when NON-ANNEX1 countries produce and offer CTOs, but ANNEX1 countries do not purchase such credits. In this case, NON-ANNEX1 countries have the worst possible payoff, because no revenue is transferred to NON-ANNEX1 countries, and they cannot recover the internal costs of these CTOs production and supply. By the other hand, no CTO is delivered to help ANNEX1 countries to achieve their targets, so that they cannot minimize their internal costs. The last possibility is non cooperation-non cooperation (N₁, N₂), in which NON-ANNEX1 countries do not offer CTOs as well as have no internal costs, and ANNEX1 countries do not buy CTOs and cannot minimize their internal costs. Therefore, no revenue is transferred to NON-ANNEX1 countries and no CTO helps ANNEX1 countries to decrease their internal costs and to achieve their targets.

Now, let the strategy of multiple cooperation (C₁, C₂) be denominated (R₁; R₂); the possibility of both NON-ANNEX1 and ANNEX1 countries defect (N₁, N₂) become (P₁; P₂); and the combination of cooperation of NON-ANNEX1 countries and defection of ANNEX1 countries (C₁, N₂) be (S₁; T₂)\(^{12}\).

Given these possibilities, we shall set NON-ANNEX1 countries’ possible payoffs as follows:

\[(R₁; R₂) \gg (P₁; P₂) \gg (S₁; T₂)\]

and the ANNEX1 countries’ ones:

\[(R₁; R₂) \gg (P₁; P₂) ; (S₁; T₂)\]

\(^{12}\) R of recompense, P of penalty, S of stupid, and T of temptation.
We shall, then, conclude that both CDM players will opt for the cooperation as the strategy to maximize their interests. In this case, the CDM game approximates of what Tsebelis (1990) called Assurance Game. According to the author, the assurance game best payoff is when both players prefer the cooperation ($R_i$). The second best payoff for a player is its defection combined with cooperation of the other one ($T_i; S_i$). The third payoff is when both players defect ($P_i$). The fourth and worst payoff for a player is its cooperation with defection of the other one ($S_i; T_i$) (Tsebelis, 1990, p. 71):

$$R_i >> T_i >> P_i >> S_i$$

Differently of the Assurance Game, in the CDM game ANNEX1 countries have no direct gains at the costs of NON-ANNEX1 countries’ prejudices regarding the uncovered internal costs. So, we do not consider any CDM incentive ANNEX1 countries would have to defect when NON-ANNEX1 countries decide to cooperate ($S_1; T_2$). Notwithstanding our model does not consider the existence of ANNEX1 countries’ incentives to a defection strategy when NON-ANNEX1 countries decide to cooperate, the real world’s complexity may show the opposite. In this case, the most probable effect would be NON-ANNEX1 countries exiting the CDM game, given the fact that they have no targets. The cooperation-defection may also happen when ANNEX1 countries succeed in the achievement of their targets, and the CTO demanded quantity decreases until they no more need purchase CTOs. So, the CTO supplied quantity will tend to stand following the decreasing behavior of the demanded quantity. This situation will be explained in the section of CDM and perverse effects.

2.1 The cooperation as a fundamental factor to achieve the best result

The game theory shows us that in this non-zero sum game, the more cooperation, the higher the payoff. Therefore, the two players are under an equilibrium held by the economical incentives of the CDM game. They achieve a Nash Equilibrium. According to Tsebelis (1990), in a Nash Equilibrium situation, the equilibrium is a stable result because no player has incentives to change its strategy if the other one does not so. This CDM equilibrium is also a Pareto Optimum. This happens because one cannot increase a player’s payoff without decreasing the other’s one.

The figure 2 shows the hierarchy between the CDM game payoffs, including the position of the Nash Equilibrium and the Pareto Optimum.

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13 This NON-ANNEX1 countries’ gap of compromise may explain the reluctance of some countries to sign the Kyoto Protocol as an ANNEX1 country.
Although the economical incentives are clearly present in the game, we should also register the need to take in consideration the ecological and preservationist principles, on the other hand. This implies in a second and more basic equilibrium urged by the concept of sustainable development: how to balance the task of protecting the environment and the task of keep the economies in development.

In this puzzle, ANNEX1 countries have high labor costs as well as an expansive development of productive process technology (the “green” technology). At the other side, NON-ANNEX1 countries face the challenge of developing their economies, under the temptation of conventional technologies that provide lower production costs with high environmental damages, however.

Despite the CDM game has a strong internal equilibrium (the mutual cooperation is a Nash Equilibrium and a Pareto Optimum), its design do not guarantee the continuity of NON-ANNEX1 countries’ engagement with the collective interest of decreasing the GHG emissions, since the CTO demanded quantity begins to decrease and specially after it be finished. This will first tend to a position of NON-ANNEX1 countries’ cooperation and ANNEX1 countries’ defection (S1; T2), and finally to the position of both players’ defection (P1; P2). In this case, although ANNEX1 countries do not gain at the costs of NON-ANNEX1 countries’ prejudices regarding the uncovered internal costs, a situation of cooperation-defection may be possible.

3. THE CLEAN DEVELOPMENT MECHANISM AND PERVERSE EFFECTS

In this section we will demonstrate that the current CDM design does not guarantee the engagement of NON-ANNEX1 countries regarding the GHG emission reductions, and that the perverse effect of global increasing at such emissions level will follow.
LEMMA 3: the strategy of cooperation by the CDM brings an increase at the GHGs emission level

We divide this lemma demonstration in two times.

Time 1: NON-ANNEX1 countries produce CTOs and supply ANNEX1 countries. Reciprocally, a revenue flow from the CTO buyers to the CTO suppliers occurs.

ANNEX1 countries are supposed to achieve their targets, in order to reduce an average of 5% against 1990 levels over the five years period, 2008 – 2012. Under the constraints of the Kyoto Protocol, ANNEX1 countries cannot achieve their targets only by purchasing CTOs. They must assume a minimal internal cost, so that CTOs may be used by them.

In order to proceed with our demonstration, let’s suppose the following conditions:

Condition I: ANNEX1 countries will only demand and purchase CTOs if the market option minimal internal cost \( (c_d') \) plus CTOs represents a lower cost than that of the option of targets achievement by full internal costs \( (c_d) \)^14.

Condition II: ANNEX1 countries are intended not to gamble away their industries to NON-ANNEX1 countries

Coeteris paribus, a) ANNEX1 countries will demand and purchase a quantity of CTOs \( (q_d) \) when the Condition I is true; b) they will provide incentives intending to avoid the transference of their industries, by minimizing the internal costs and purchasing the necessary CTO quantity to achieve their targets. This quantity is \( q_d \).

Regarding NON-ANNEX1 countries’ behavior, some conditions are also necessary to be stated. Let suppose that:

Condition III: NON-ANNEX1 countries will produce only the necessary CTO quantity to supply the demand of credits, because (coeteris paribus) when the supplied quantity is higher than the demanded quantity, the CTOs price will tend to be decreased;

Condition IV: NON-ANNEX1 countries will not be disposed to assume internal costs \( (c_s) \) to produce CTOs beyond that level the demanded quantity of credits is at \(^{15}\);

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^14 Achieve targets by taking only internal costs (without purchasing CTOs).

^15 Given that NON-ANNEX1 countries do not have targets regarding GHG emissions reduction, they have no incentives to reduce their GHG emissions under the level at which they can produce the ideal CTO quantity to supply the demanded quantity.
**Condition V:** NON-ANNEX1 countries will not be disposed to supply CTOs at a level of price that brings lower revenue than the internal costs taken in the credits production.

_Coeteris paribus_, c) NON-ANNEX1 countries will produce and supply a CTO quantity ($q_s$) that is equivalent to the CTO demanded quantity ($q_d$). Under these conditions we have:

$$q_d = q_s \quad (3.1)$$

If the CTO demanded and supplied quantities are equal (3.1), it follows that both quantities tend to an equilibrium ($q_e$):

$$q_d = q_s = q_e \quad (3.2)$$

At this level of quantity there is an equivalent level of price ($p_e$), as illustrated in the Figure 3, below.

![Figure 3: the equilibrium ($q_e$, $p_e$) between the CTO demand (D) and supply (S) curves.](image)

Complementing the *Condition I*, when ANNEX1 countries’ full internal costs ($c_d$) are lower than the costs of the option minimal internal costs ($c_d'$) plus CTOs, then ANNEX1 countries will not purchase CTOs. Complementing the *Condition V*, when NON-ANNEX1 countries’ internal costs ($c_s$) are lower than the revenue acquired in the CTO market, they will prefer to supply CTO. Under these conditions and their complements, we have:
The inequality 3.5 expresses that NON-ANNEX1 countries’ revenue \( (q_e p_e) \) is higher than their internal costs associated to the CTOs production, and that revenue to be paid to NON-ANNEX1 countries \( (q_e p_e) \) is lower than the difference between ANNEX1 countries’ full internal costs \( (c d) \) and their minimal internal costs \( (c d') \).

In conclusion, NON-ANNEX1 countries will produce and supply ANNEX1 with CTOs. On the other hand, ANNEX1 countries will send revenue for NON-ANNEX1 countries.

**Time 2:** the revenue absorbed by NON-ANNEX1 countries in the CTO market promotes the growth of their productive capacity, thereby increasing the global emissions of GHGs.

According to Conditions IV and V, NON-ANNEX1 countries will not be intended to produce and supply more CTOs than the demanded quantity, because this would decrease the CTO prices, bringing a new equilibrium \( (p_e') \). Furthermore, the internal costs associated to the CTO surplus would not be covered by the revenue acquired under the new equilibrium price.

A percentage of the revenue \( (c_s + \{q_e p_e\}) \) arrived in NON-ANNEX1 countries will be used to cover their internal costs \( (c_s) \) associated to the production of CTOs, and the surplus \( (q_e p_e - c_s) \) will be invested in the improvement of CTOs production (only if there is demand for more). As of the CTO demanded quantity begins to decrease, until it be extinguished (this must be no more than 2012, according to the Kyoto Protocol deadline for achieving the targets) this surplus will be gradually invested to improve NON-ANNEX1 countries’ productive capacity, as it can not find allocation in new CTOs production.

This improvement will not be engaged with projects of GHG reduction. The lack of targets regarding GHG reduction, as well as the lack of restriction on NON-ANNEX1 countries regarding the use of CTO market revenues, will avoid these countries to assume new internal costs, so that there will be a turn over in the engagement for these countries for reducing GHG emissions. New unities of GHG emission will arise. *Coeteris paribus*, the GHG emission level will globally increase after 2012.

### 4. GLOBAL GOVERNANCE AND POLITICAL INSTITUTIONS IN AN ENVIRONMENTALLY CHANGING WORLD

We now turn to discuss the consequences this foreseeable failure in the Clean Development Mechanism may have for the global governance.

First, is this failure directly related to the issue of climate change as a new form of governance? We believe that it is. If there is a continuous will to reduce GHG emissions, NON-ANNEX1 countries will play an important role. Emerging countries will have a decisive task regarding the environmental governance building. By leading
NON-ANNEX1 countries, they will face collective action problems in the decision of NON-ANNEX1 countries’ stand regarding the continuity of the GHG emission reduction projects. Like a “mermaid’s sing”, the low acquisition and operational costs of conventional production technologies will, for a long time, attract NON-ANNEX1 countries. They constitute a strong incentive for NON-ANNEX1 countries to defect of the task of decreasing GHG emissions.

In the other hand, it is at stake the status of the sustainable development paradigm. NON-ANNEX1 countries will have hard work to commit their industries with technological adjustments and the internal costs associated to these adjustments, while there is not a permanent mechanism capable of committing such countries’ industries with GHG emissions mitigation and of reducing the conventional technologies incentives. A challenging collective action problem emerges from this issue.

A second important issue that can not be ignored is transference of technology. NON-ANNEX1 countries are predominantly users of conventional technologies. Although the public opinion has emphasized the role of the companies with the environmental responsibility, developing countries still emit high levels of GHGs. It seems that now the question is not whether developed countries are disposed to transfer the “green” technology for developing countries, but whether or not the latter are intended to use such technology and lose the advantage of large scale production with lower costs provided by the conventional one. Would the paradigm of sustainable development be at the edge of the crisis?

A last critical issue regarding the role of developing countries in the environmental governance building is that of the Kyoto Protocol post-2012 negotiations. We can not foresee which will be the results of such negotiations, yet. They have been carried out by the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP), since December 2005 and it is set to complete its work by the end of 2009. Developing countries are expected to be engaged in these negotiations and to take part in the task of designing the new institutions that will result. This negotiations will take a form of new type of game, called institutional project by Tsebelis (1990). According to the author, the institutional project game focuses on the interaction between players and rules. In this scenario, the players know that the rules will shape their future behavior, and so they engage in defining the rules of the game according to their individual interests. We believe that this will be a critical moment in the construction of the environmental governance, so that it deserves specialists and researchers’ attention.

5. CONCLUSION

We aimed to make an effort to support our argument that the current CDM design produces the perverse effect of increasing the global emissions of GHG. We showed that this happens due to the Kyoto Protocol deadline for achieving the targets (2012) and because no restriction is made to the NON-ANNEX1 countries regarding the use of the CTO market revenues. According to our demonstration, since the CTOs demanded quantity begins to decrease until it gets extinguished, NON-ANNEX1 countries will use the revenue from CTO market to increase their productive capacity, so that there will be a turn over in the engagement of these countries for reducing GHG emissions, and the perverse effect of global increasing at such emissions level will follow.

We observed that the CDM design does not take in consideration the outcomes the CTO market oscillation and the Kyoto Protocol deadline for achieving the targets.
(2012) have on the GHG emissions level. Its performance is absolutely perfect in a scenario of CTOs constant demand, but it flaws when such credits demanded quantity decreases and gets extinguished.

This foreseeable failure has also consequences on the environmental governance construction. It exhibits NON-ANNEX1 countries’ challenges of achieving a common stand on how the Clean Development Mechanism should work, and on the green technology establishment. Furthermore, the problem that we aimed to present here evidences the importance of developing countries in the negotiations of a post-2012 institutional web for the environmental governance, as well as the challenges for the status of the sustainable development paradigm.

A final note is addressed to the empirical analysis of this proposed model. We recognize that, while this model has not empirical support, its conclusions are not beyond the field of previsions. When analyzing it empirically, analysts should expect difficulties on tracking the path of the CTO market revenue, since it arrives in NON-ANNEX1 countries. In other words, how to turn the variable *CTO market revenue allocated in conventional technologies* operational? Unavoidably, the analyst will need to break the level of analysis used in this study (ANNEX1 and NON-ANNEX1 countries) in more agential levels of analysis (micro). They will need take in count the organizations that supplied ANNEX1 countries with CTOs (what can be found in reports of the UNFCCC), but the challenge resides in finding out how the CTO market revenue was allocated in such organizations. According to Coleman (1990), social science explanations should account for a widening “gap” between theory and research, emphasizing the internal processes of the world social system, including its components or units, at a lower level than that of the system. We agree that this is a methodological and epistemological requirement of the contemporary political science.

**BIBLIOGRAFY**


KYOTO PROTOCOL (1997).


APPENDIX A
Kyoto Protocol Annex A

Greenhouse gases

Carbon dioxide (CO2)
Methane (CH4)
Nitrous oxide (N2O)
Hydrofluorocarbons (HFCs)
Perfluorocarbons (PFCs)
Sulphur hexafluoride (SF6)

Sectors/source categories

Energy
  Fuel combustion
    Energy industries
    Manufacturing industries and construction
    Transport
    Other sectors
    Other
  Fugitive emissions from fuels
    Solid fuels
    Oil and natural gas
    Other

Industrial processes
  Mineral products
  Chemical industry
  Metal production
  Other production
  Production of halocarbons and sulphur hexafluoride
  Consumption of halocarbons and sulphur hexafluoride
  Other

Solvent and other product use

Agriculture
  Enteric fermentation
  Manure management
  Rice cultivation
  Agricultural soils
  Prescribed burning of savannas
  Field burning of agricultural residues
  Other

Waste
  Solid waste disposal on land
  Wastewater handling
  Waste incineration; Other