Regional integration in Latin America and dynamic gains from macroeconomic cooperation

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Abstract

The objective of this paper is to present and illustrate from a game-theory perspective, the main concepts and challenges behind macroeconomic policy cooperation in Latin America and the Caribbean. Examples are taken from fiscal, monetary and exchange rate policies in a regional framework. Translating these concepts and examples into the economics of sub-regional integration, when countries have increasing commercial and financial relations, interact frequently and cannot escape from the consequences their decisions have on their partners, the paper contend that entering into a cooperative dynamic will be beneficial for all cooperative participants. Moreover, it is shown that because the welfare gains from regional cooperation are endogenous, cooperation will eventually become stable, even in the presence of a Prisoner's Dilemma.

The concepts of static games are initially introduced to identify some of the costs and benefits of regional macroeconomic coordination. The arguments are developed using the example of tax and subsidy policies and the competition to attract foreign investment. Then, the document incorporates the dynamic aspects of cooperation, in particular the notion of time consistency. A review of the costs and benefits of regional coordination of macroeconomic policies is presented, from a dynamic point of view. The notion of endogenously determined criteria to form an optimal currency area is then introduced. We demonstrate that even when initial conditions are less than optimal, macroeconomic policy coordination within sub-regional integration schemes can lead to a stable cooperative situation. Nevertheless, at the initial stage of coordination, the benefits are uncertain and cooperation is unstable; consequently a formal institutional setting is necessary to start and coordinate the cooperative process, at least in its earlier stage.

I.   Introduction

The objective of this paper is to present some of the most important concepts behind the potential dynamic welfare gains to be obtained from macroeconomic policy cooperation in Latin America and the Caribbean. This work was conducted in the framework of the REDIMA programme of activities, a network of macroeconomists from national and regional institutions interested in studying and promoting regional open integration in Latin America and the Caribbean. The paper uses basic concepts of game theory and its application to the dynamic of regional integration, to identify opportunities for the coordination of macroeconomic (fiscal, monetary and exchange rate) policies.

Game theory has been defined as the "Interactive Decision Theory" (Aumann, 1987).[1] It incorporates explicitly in its assumptions the existence of interdependence between agents, including the possibility for a given player to adopt strategies that try to influence the decisions of other agents for his/her own benefit. Contrary to more traditional textbook approaches, where economic policies are exogenous, governments' rationality, their interaction in an international setting and their relation with private agents' objectives are at the core of the game theory approach to macroeconomics. Uncertainty is also explicitly modelled, at least as far as it arises from the behaviour of other agents. By explicitly incorporating strategies and policy alternatives, game theory is potentially much more relevant

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[1] When game theorists use the word game, they do not refer to what is commonly called games (cards or board games) but to any social situation (either human societies or other biological entities) involving two or more players in which interests and behaviour of the actors are explicitly interconnected. Underlying the theory is the key assumption that players are rational utility maximizers. For a review of the main concepts, results and issues related with game theory, see Aumann (1987).

for actual decision making than the naïve traditional approaches. An interesting corollary is that any macroeconomic approach using game theory has, by definition, an explicit microeconomic foundation.

The incorporation of intertemporal strategic interactions between government and the private sector has been at the core of the discussion about the coordination of fiscal and monetary policies and the time-consistency of stabilisation policies. The debate has been particularly intense in Latin America in the 1980s, due to the specific nature of hyperinflation in this region where interaction between inflation, monetary and exchange rate policies, salaries and income distribution, as well as distrust among parties, made for a very complex and volatile environment. Taylor (1983 and 1989) illustrates the structuralist approach where inflation is determined, inter alia, by social and institutional settings, as well as by a conflict of interests among agents over redistributive effects.[2] Yet, this "sociological" analysis generally stops at identifying the conflicts of interest between players and their economic consequences, without looking at the possibility of cooperation between them. Game theory, in turn, not only incorporates as its building block the existence of a conflict of interests, but also goes further and studies the possibility of reconciling defiant or competing agents, as reviewed by Velasco (1987) in the case of the stabilisation policy debate.

Our paper explores some of the conditions for economic policy coordination among sovereign states in a regional framework, first in a static case of positive-sum games, and later in a dynamic context. Building on examples from the three main components of macroeconomic policy (i.e., fiscal, monetary and exchange rate policies) the essay makes use of the findings coming form the traditional discussion of repeated games to analyze regional integration processes, and concludes that in this particular setting, dynamic games have a potential of bringing about endogenously determined gains. When considered within a regional integration framework, dynamic gains from cooperation provide a way out of the famous Prisoner's Dilemma. The paper also reviews some of the risks and constraints that are associated with a cooperative strategy, and stresses the need for a proper institutional setting if sustained cooperation is to be attained.

The structure of the paper is as follows: after this introduction, we explore in the second part the concepts developed in the analysis of static games to identify some of the costs and benefits of regional macroeconomic coordination. The arguments are presented using the example of tax and subsidy policies and the competition to attract foreign investment. In particular, we consider fiscal cooperation or lack of it in attracting investment, and the so-called "race to the bottom". Examples and applications to the Latin American and Caribbean region are offered. The following section presents the concepts behind dynamic games, where the notion of time consistency is introduced. This section includes a discussion on uncertainty and the costs and benefits of regional coordination of macroeconomic policies from a dynamic point of view, in particular when the criteria for optimality are endogenous. We then examine the criteria for forming an optimal currency area in the Latin American framework. The final section presents conclusions of the paper.

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[2]   The roots of this approach can be found in the post-Keynesian school.

II. Static gains from cooperation: concepts and application to tax and subsidy policy

1. Games in a static setting

Walrasian approach can be considered as similar to a single person game, where an agent makes a decision in the face of an environment assumed to be given, and indifferent (neither hostile nor cooperative). To have an interaction, however, at least two players are required, a player being an individual, a group of individuals or an organisation forming a decision-making unit. Decisions produce outcomes, and options available to players to bring about particular outcomes are called strategies.

Strategies themselves can be decomposed into a sequence of decisions called choices. Strategies are linked to outcomes by a mathematical function that specifies consequences of various combinations of strategies chosen by all of the players in a game.[3]

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[3] Despite this simplistic presentation and the reference to "games", it should be remembered that game theory is formally a branch of applied mathematics that was created initially as a type of normative theory of rational choices. Formal developments and analytical solutions of games are generally quite complex. In this paper, we use the game theory approach in a descriptive and (pro)positive manner.

a. Strictly competitive games

A good starting point to explore the basic concepts of game theory is the non-cooperative competitive game, where one player wins at the expense of the other. Here, there is no point in cooperation or joint action of any kind. In the extreme case called a zero-sum game, one player wins what the other loses; the sum of the utilities is zero, which makes the players real opponents. How do players choose their strategies in that type of games? They know that their interest is directly opposite to that of the other player. Because of that, there is no room for cooperation. Players cannot improve their welfare if they cooperate, so they opt for a different kind of strategy. If the game is such that my loss is a gain for my opponent, the most reasonable strategy is to try to minimise that loss. More precisely, players choose a strategy that maximises the minimum payoff. This is called the maximin principle, or security level that a player can guarantee independently of what other players do. A solution is the pair of strategies where each player maximises his or her minimum payoff.

In a macroeconomic development framework, these concepts can be illustrated by the following example based on the competition among countries to attract foreign direct investment (FDI). To attract FDI and divert it from installing in a neighbouring country, a government may offer more generous incentives to investors, at the cost of reducing the net present value of benefits from the investment. The authorities have incentive to extend subsidy (either by sharing part of the investment cost, or by reducing the tax rate on future income) up to the point where costs of subsidising equals total benefits (direct and indirect) and net present value is zero.[4]

To set a very simple example of this strictly competitive game, suppose that two countries are competing to attract investment, in a two-period framework. In the first period the public sector has to invest in order to provide a flow of public services and attract investment. In the second period the government receives taxes. In both countries taxes are based on wages, and technology and returns are scale-invariant. The transnational company (TNC) maximises profit, based on the following function:

$$Y_i = k(\alpha_i) + (P_i - W_i) - t_i W_i$$

where:

i : country index

α_i : a structural variable, based on the initial quality in period 1 of public services, human capital, infrastructure, etc, in country i, determining total factor productivity.

P_i : value of the output Q_i ($P_i = p_i Q_i$) in period 2

$t_i W_i$: taxes paid in period 2

W_i : salaries ($W_i = w_i Q_i$)

p_i, t_i, w_i : price, tax rate and salary, respectively

All values are expressed in international monetary unit.

The benevolent government's objective function is to maximise W_i (the citizens' income) subject to the budget constraint:

$$t_i W_i - G_i \geq 0$$

where G_i is additional public cost of providing the services α_i in period 1.

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[4] We do not consider the case where fiscal resources used for subsidies are larger than the expected fiscal revenue from the FDI.

When country i is considering this simple problem without taking into account other competitors, to attract the TNC´s investment, it will invest G to offer α_i (the level of public services) up to the amount that compensate exactly for the expected tax income $t_i W_i$, so that $t_i W_i - G_i = 0$.

This decision-making process is comparable to the Walrasian case, where the agent –here, the government– takes its decision independently of other agents' strategies.

Suppose now that two small open developing countries i and j, are competing to attract one large transnational corporation (TNC). Being small open economies, the law of one price applies to both countries ($p_i = p_j$). They also, by hypothesis, have the same labour costs and tax rates ($w_i = w_j$; $t_i = t_j$), but have different levels of structural services and total factor productivity. Let's suppose that country i has a better initial situation than country j. Country i can always offer the same quality of structural environment as country j, but at a lower cost for its budget.

$\forall \ \alpha_i = \alpha_j \, , \, G_i < G_j$

Countries i and j have two typical strategies.[5] One is to try to look for the biggest net benefit for its budget, the other is to do the maximum possible to attract the investment, and offer to spend all the expected tax receipts to upgrade its public services. Obviously, knowing that its competitor j is facing a handicap in terms of its initial endowment in infrastructure, i is no more obliged to spend all the expected benefits to upgrade its public services in order to attract the investment, but just the amount necessary to maintain its advantage over its competitor. Thus, country i can always choose $G_i < G_j$ so that $\alpha_i \geq \alpha_j$ (in Table 1, this is the case corresponding to $\alpha^1_i \geq \alpha_j^2 : t_i W_i - G^1_i > 0$) and gain the contract while making a net budgetary surplus. In this game, country j cannot compete, and country i will always receive all the investment.[6]

Table 1
STRICTLY COMPETITIVE FDI GAME

Country i\ Country j	$\alpha^1_j : t_j W_j - G^1_j > 0$	$\alpha_j^2 : t_j W_j - G^2_j = 0$
$\alpha^1_i \geq \alpha_j^2 : t_i W_i - G^1_i > 0$	$t_i W_i - G^1_i \ , - G^1_j$	$t_i W_i - G^1_i \ , - G^2_j$
$\alpha^2_i \ : t_i W_i - G^2_i = 0$	$0 \ , - G^1_j$	$0 \ , - G^2_j$

In this very simple setting,[7] the solution of the game is always in favour of the player i, whatever the strategy adopted by the other one. As a matter of fact, country j has no interest in entering into the competition for FDI by undertaking the initial investment, as it cannot compensate for the initial disadvantage. However, this example illustrates a simple case where the optimal solution for i ($t_i W_i - G^1_i > 0$) is different from the textbook one ($t_i W_i - G^1_i = 0$).

It opens also the possibility of interesting developments in relation to the strategies and policies available to small developing economies trying to diversify their export-base. In particular, if it cannot compete on the quality of infrastructure (the so-called "horizontal" policies) it can decide to reduce its tax rate (t_j) to compensate for the difference in the quality of infrastructure (see box 1 in section 3) or devaluate to lower the labour portion of the production cost (W_j).

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[5] Those typical strategies are selected for the purpose of illustration; in reality the players have a continuum of admissible possibilities.

[6] We follow the standard convention where the players ´row´ and ´column´ receive the first and the second payoffs in each payoff pair, respectively.

[7] Please note that this is not a zero-sum game, albeit countries are in direct competition.

b. Coordination and cooperation

Many social or economic interaction games are non zero-sum games, not even strictly competitive ones. If country *j* can level off the playing field in terms of infrastructure at no cost for its budget (for example by receiving official development assistance), it would be able to compete effectively with country *i* to attract foreign direct investment and create additional employment for their citizens. Both countries can make the maximum sacrifice of all the expected tax receipts, as in the Walrasian case, and will share the total investment on an equal basis (or with equal probability, if investment is not divisible). Nonetheless, they have also the possibility of "cooperating" [8] to avoid this "race to the bottom" by setting a prearranged level of public cost and tax rate, that will be enough to attract the FDI but will still allow for a budgetary surplus. As in the previous case, table 2 shows the resulting payoffs when tax rates are constant and equal in both countries ($t_i = t_j$).

Table 2
COOPERATIVE GAME

Country i\ Country j	$\alpha^1_j = \alpha^t_l : t_jW_j - G^1_j > 0$	$\alpha^2_j : t_jW_j - G^2_j = 0$
$\alpha^1_i = \alpha^1_j : t_iW_i - G^1_i > 0$	$[t_iW_i - G^1_l]/2$, $[t_jW_j - G^1_j]/2$	$- G^1_i$, 0
$\alpha^2_i : t_iW_i - G^2_i = 0$	0 , $- G^1_j$	0 , 0

Unlike the previous example, the result of the players' interactions is a cooperative game where it is possible to find a set of strategies that produce a win-win result. These games depict more accurately interactions in the realm of economics since one of the premises of economics is that economic agents interact only if trade brings them some benefit.

What is the appropriate course of action for *i* and *j*? It depends on the strategy that the other player chooses. If *i* opts for the high initial investment α^2_i, (bottom row) the best response of *j* is also the high investment α^2_j (right column) since choosing another option would result in a negative payoff. On the other hand, if *i* chooses the minimum initial investment α^1_I (upper row), the best strategy for *j* is the minimum initial investment α^1_j (left column). Choosing the alternative α^2_j would result in a payoff of 0, with a negative outcome for *i*, while the minimum/minimum combination brings a positive result to both.

This brings us to a concept called the Nash equilibrium. As it is evident from our example, it is the equilibrium where each participant chooses the best strategy, given the strategy of the other player. In other words, the Nash equilibrium is reached when each player's strategy is an optimal response to the other player's strategies, and neither player has a unilateral incentive to change his or her own strategy. A Nash equilibrium is produced when no single player can obtain higher utility by changing its own part (strategy) if other players stick to their parts. Suppose that in a particular game, players by some means unspecified at this moment arrive at an "agreement" as to how each one will play the game. This specifies a particular strategy choice by each player. To be self enforcing, this agreement must form a Nash equilibrium. This, as we will see, does not mean that every Nash equilibrium is a self-enforcing agreement.

There exists a possibility that the Nash equilibrium is not a unique solution to a game, and also that it is not the best equilibrium from the point of view of the participants. In our example we

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[8] Strictly speaking, games are called cooperative if commitments and other agreements are fully binding and enforceable. Coordinated, or correlated equilibrium, refer to a situation where non-cooperative players may do better by using an external referee that act to correlate their actions. Under this section we adopt a general definition of cooperation more akin to one that Axelrod proposed in his 1984 book "The evolution of cooperation", and will indiscriminately refer to cooperative or coordinated games situation where, either through sheer rationality, explicit cooperation or implicit coordination, selfish players optimize their payoffs by adopting cooperative (or "nice") strategies.

have two Nash equilibria, one if both players pay the high initial price to enter into the competition, and one if they both pay the low price. Thus, it is not possible to find a unique solution for that game with the available data. Obviously, one of the Nash equilibria is better from the point of view of both participants. It is the one with the low initial price, since both receive a positive payoff in terms of budgetary surplus, compared to the payoff of 0 in the other Nash equilibrium. This "better"[9] equilibrium is called Pareto equilibrium and has the property of being the equilibrium where no player can increase his or her payoff without reducing the payoff of the other players. This is equivalent to the concept of Pareto-optimality in economics.

If players know that the cooperative equilibrium is superior to other solutions, could we expect them to cooperate to get there? Given the available data in the game, we cannot be sure. Let us see why. Although the upper-left corner is the best solution for both i and j, each can lose a lot if the other player does not choose the minimum investment strategy. In particular, if i plays the minimum investment, while j opts for the maximum one, the payoff for i is negative while j gains all the investment and the jobs, and still equilibrates its budget. The same reasoning applies to j, so in case of uncertainty about the other player's behaviour, security reasons force both players to choose the maximum investment strategy, and they end up in the inferior Nash equilibrium.

If we allow for the possibility of communication, the probability of cooperation increases. Players (governments in our case) could coordinate their actions in order to attain the cooperative equilibrium, which also happens to be the Pareto equilibrium in this case. However, even with communication, the attainment of the cooperative equilibrium is not guaranteed.

In effect, it is very difficult to assure that there will be no defection. Thus, unless i could be hundred percent sure that j would play the minimum investment option, the strategy of opting for the highest initial cost is more reasonable in order to minimize the risks (maximin strategy). And since there are no penalties in a game that is played only once, i has every reason to suspect that j would try to renege on its promise to play cooperatively. Since the same logic applies to the reasoning of j, the Pareto-optimal, cooperative equilibrium is not necessarily the outcome of that game, even if we allow for the possibility of communication before the game.

c. Prisoner's Dilemma and the problem of inefficient equilibrium.

As we have seen in the previous example on fiscal incentives, not all games have dominant strategies that coincide with social optimum. One of such games is the so-called Prisoner's Dilemma, where each player has an incentive to play the non-cooperative way, either because playing foul maximises one's personal reward if the other part plays fair (i.e., follows the cooperative strategy), or minimise its loss if the other part decides to defect and play foul.

This game comes from a story used by A.W Tucker to illustrate its structure: two suspects are taken into custody. The suspects are separated (i.e., they cannot communicate) and are told that they have two choices: either to confess or not to confess the crime. If both confess, neither will receive a special consideration from the jury and will receive a jail sentence of five years. If neither confess, they will not be charged for this crime, but will probably be convinced of minor offences and receive a one-year sentence each. But if one confesses and the other does not, the suspect who confesses will be set free while the other will receive a ten-year sentence. In this game, the individual (non-cooperative) dominant strategy is to confess. Technically, the equilibrium in this game is not a Pareto optimum: both players would be better off it they opt for not confessing.

Table 3 represents symbolically the strategies and outcomes of a 2x2 ordinal game. Strategies C are for cooperation, and D for defection. R stands for the reward for mutual

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[9]   To be more precise, this is the best equilibrium possible in the game as it is described, if we leave aside the interest of the TNC.

cooperation, T for the temptation to defect from that outcome, P for the punishment in the mutual defection, and S for the sucker's payoff to the player who cooperates when the other does not.

Table 3
SYMBOLIC REPRESENTATION OF A 2X2 PRISONER'S DILEMMA GAME

Player A \ B	Cooperate (C)	Defect (D)
Cooperate (C)	(R,R)	(S,T)
Defect (D)	(T,S)	(P,P)

A game is basically defined as a Prisoner's Dilemma when, for both players, **T>R>P>S**.[10] This ranking ensures that each player has a dominant strategy that results in equilibrium that is a Pareto-inferior outcome. In such a situation, players – individuals, firms or states – that follow purely rational and selfish strategies may find themselves caught in a sub-optimal situation: the irrefutable logic of the dominant strategy dictates that each player should defect and follow a non-cooperative strategy.

In our previous example of two countries competing for foreign direct investment, there was a Pareto equilibrium because **T<R** (the temptation to defect and finance high initial investment to attract all the FDI led to a lower reward than cooperation with the competing country). But this situation can be easily transformed to fall into the Prisoner's Dilemma category. For example, if there are some positive externalities related to the location of firms (e.g. clustering, technological spillovers, etc.), it becomes of strategic importance for each country to attract as much FDI as possible. This is so because the marginal cost of attracting new FDI will be decreasing in relation with the already installed subsidiaries of TNCs. In this case, the country i has no interest in sharing 50% of the total FDI with country j, as the expected payoff of the **T** strategy, aimed at capturing all FDI can be higher than the **R** = $[t_i W_i - G^1_i]/2$ payoff of the cooperative strategy. Obviously, the same thing applies to the j country, so **T>R** and the non-cooperative, Pareto-inferior outcome becomes the norm.[11] Political cycle may also alter the balance between the costs and benefits of cooperation as perceived by the decision makers. Attracting as much investment –and new job opportunities– as possible on the eve of elections may shift the **T** and **R** balance in favour of the former in the short term.

Hence, it is not easy to attain spontaneously a cooperative equilibrium. Unless there is a credible commitment on the part of the players, or coordination by an external referee, it will remain elusive, even in a case where players are allowed to communicate in advance. The problem is compounded when there are more than two players since there is always a possibility that one or more players will defect and behave as free riders. And if we include the time dimension (games are repeated many times), the problem of credibility becomes central (Gibbons, 1992).

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[10] Another condition, applying to repeated games, is that the players cannot get out of their dilemma by taking turns randomly exploiting each other. This means that R>(T+S)/2 (Axelrod, 1984).

[11] This hypothesis of increasing returns implies that the relative disadvantage faced by least developed economies may persist –or worsen– when they access the international market. If a country has even a small comparative advantage over another one before opening its borders, externalities will generate a technological advantage that will be accumulated through time. History matters even in the long run and non convexities in the production function (i.e., decreasing marginal cost) preserve and reinforce the pattern of specialization. Thus, initial advantages will tend to be cumulative, and polarization will be the rule rather than an exception. These theoretical concepts have very important practical implications for the smaller developing countries, either for their national development and export diversification policies or their regional and international integration strategies, see Escaith (2001).

d. Regional Integration and Fiscal Cooperation

In this section the above-mentioned concepts are applied in the analysis of tax and subsidy competition to attract foreign direct investment in the Latin American and Caribbean context.

The policy of export diversification in that region has used fiscal incentives to subsidise inward investments for both tactical and structural reasons (see Escaith and Inoue, 2001). This practice is also widely used by other developing and industrialised countries. It is justified in a traditional framework by the expectations that (i) for the public finance, the subsidy on the initial investment will be compensated by future taxes; (ii) for the community, the cost will be compensated by employment opportunities, imports of technology and know-how, exports diversification, etc.; (iii) for the economy in general, incentives will reduce the wedge between the private and social rates of return for FDI projects that create positive spillovers. However, since all countries have an incentive to follow this policy, the investors have an incentive to play one country against others in order to extract the highest net subsidy. This is a clear example of a direct application of game theory to macroeconomic policy. (See box 1)

Box 1
GLOBALIZATION AND SMALLER STATES' EXPORT DIVERSIFICATION STRATEGIES

Openness and trade are the traditional ingredients of the recipe for the smaller developing economies, characterised by a tiny internal market, to attain high and sustainable growth and catch-up with the more industrialised countries. However, recent developments in both trade and growth theories have shed doubts on these conclusions. Because there are positive externalities generated by the technology used in the industrial sector, investment decisions in manufacturing activities – those more likely to promote industrialisation and growth– are not made principally on the basis of traditional comparative advantages in factor costs. Instead, there is an inherent advantage to specialization and concentration: the more developed country attracts investment in high value added activities and gets richer in a situation where the poorer is stuck in a regressive specialization pattern. Instead of promoting convergence, trade among asymmetric countries could well

lead to an increase in their income gap. One possible conclusion is that public authorities in developing countries must adopt an active development policy to counteract these trends. In the simple game represented in table 1 above, horizontal type of public development policies are comparable to investing in physical infrastructure and in human capital to increase I_i. Unfortunately, these strategies are not always feasible in smaller Latin American and Caribbean countries due to fiscal constraints faced by these countries. To make investing in the country an attractive opportunity, a Government has to adopt a long run strategy that is costly in the short term (G_i) while future revenues ($t_i W_i$) are uncertain. As reported by Escaith and Inoue (2001), to diversify their exports, smaller countries in Central America and the Caribbean have used, instead, the second-best strategy of competing through reduced or zero-rate of taxation of export oriented activities (tourism and the so-called "maquiladora" activities). The cost in foregone revenue $t_i W_i$ is real, but contingent to the materialisation of the investment. The initial cost (G_i) has been kept to a minimum by focalising public investment in specific places (Export Processing Zones, tourist areas).

Finally, the third best strategy is to lower the labour cost W_i, through a policy of competitive devaluation. In a regional context characterised by strong intra-regional interdependence, this beggar-thy-neighbour strategy may lead to negative-sum games. This was the case in Europe before the creation of the common monetary system, and has been the case recently in South America (for the latter, see CEPAL, 2002).

UNCTAD (1996) distinguishes among three types of incentives for FDI. Fiscal incentives' objective is to reduce the tax burden for foreign investors, and include a wide variety of measures. Among them are reductions of corporate-income tax rate, tax holidays, accelerated depreciation, reductions in social security contributions, exemptions from import duties, preferential tax treatment of income from exports, duty drawbacks, and so on. Financial incentives consist of providing funds directly to foreign investors in the form of government grants, subsidised credit, government equity participation and insurance at preferential rates. The third type of incentives are those that cannot be easily classified, and are devised to increase the profitability of FDI projects

by non-financial means. According to that study, financial incentives are more common in developed countries while less-developed ones use fiscal incentives more often.

As mentioned earlier, the competition among countries to attract investment produces what is commonly known as the "race to the bottom". Countries competing to attract FDI offer ever more generous incentives to investors, which results in a reduction of benefits from the investment. Thus, "the race to the bottom" may deprive public budgets of affected countries of all direct expected benefits of the investment, as the authorities have incentive to extend subsidy up to the point where costs of subsidising equals total benefits (direct and indirect). The outcome can be not only costly for individual countries' public finances, but globally inefficient in terms of resources allocation: on the premises that the high cost countries (high wage economies) also have "deeper pockets", they can outbid the low-wage ones and increase their share of investment. If that happens, the investment would flow to countries that have a lower marginal return to capital. In a neo-classical framework this will interfere with the process of convergence. In the context of the endogenous growth theory, it will reinforce the existing drive towards polarisation due to positive externalities and non-convexities in the production function.

The recent downward trend of corporate tax rates, especially in developed countries, supports the claim that more developed countries could outbid the less developed ones. In the OECD countries, for example, the average corporate tax rates have fallen from 39% in 1996 to 34.1% in 2000.[12] As a result, the difference between the rates in the developed world and the less developed countries are narrowing. The above-mentioned UNCTAD study also concludes that the competition among countries to attract FDI is intensifying, given that the number of countries that have liberalised their FDI frameworks has been growing steadily in the past twenty years.

Studies done in Latin America and the Caribbean also show that the competition for FDI is intensifying. Fitzgerald (2002) estimate that, as a result of competition to attract FDI, the effective tax rate on the revenues of U.S. corporations in Argentina, Brazil, Mexico and Venezuela has gone from an average of 50% in 1983-1986 to 25% in 1993-1997. Mortimore and Peres (1998) find that competition for FDI is not only pervasive but is also intensifying in the Caribbean region, the main focus of their study. They also find that there exists a process of homogenisation of incentives through competition, and that incentives-based and rules-based competition can easily become a bidding war when no international standards set a lower limit to those rules.

However, Latin American and Caribbean countries have disadvantages when compared to other regions. According to Bird and Chen (2000), these countries tend to impose non-profit-related taxes such as turnover tax, and gross- or net-assets-based taxes that increase the effective tax burden. In addition, payroll taxes are higher than in most Asian countries. Finally, most tax incentives are sectoral, meaning that they are used more as instruments of industrial policy than as of growth-oriented development policy. Thus, in spite of the intense competition for FDI, Latin American and Caribbean countries are on average less attractive than most East-Asian countries.

While a solution of the problem regarding the "race to the bottom" at the international level demands an international code on investment, sub-regional integration entities have a direct interest and a direct possibility to increase their welfare by entering into self-restraint pacts in order to harmonise and integrate their tax policies. Oman (2000) finds that most incentives-based competition involves governments of neighbouring countries. That means that most competition for FDI among countries involves competition of investment sites within a particular region. Foreign investors decide to invest in that particular region and afterwards they search for a location in a specific country within that region.

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[12]   KPMG 2000.

The nature of competition for FDI within a region could be best understood using the tools of game theory. In particular, countries competing for FDI within a region are faced with what is commonly referred to in the literature as a "prisoner's dilemma". Building on our previous development of fiscal policy games, we now present an example with values, not symbols.

Suppose that we have two neighbouring countries, Mahiti and Sahiti, competing for FDI. The level of subsidies they offer could be high or low. If they offer low subsidies, they get more net benefits from the FDI than in the opposite case. We also assume that they are not competing for one big FDI project, but for several smaller ones. This means that the game is not of the zero-sum type, hence one country will not get the entire FDI at the expense of the other. Finally, we assume that other important elements for deciding where to invest (for example, macroeconomic fundamentals, human capital, the rule of law, etc.) are similar in both countries. The payoffs are presented below.

Table 4

PRISONER'S DILEMMA NATURE OF COMPETITION FOR FDI

Mahiti \Sahiti	High subsidies	Low subsidies
High subsidies	5M, 5M	20M, 1M
Low subsidies	1M, 20M	15M,15M

If Mahiti chooses low subsidies, the payoff it gets depends on the decision of Sahiti. If Sahiti also opts for low subsidies, they attract about the same amount of FDI and get a payoff of 15M each. However, if Sahiti opts for high subsidies, it gets the bulk of the FDI and that increases its payoff to 20M. In that case, Mahiti gets only 1M. Thus, Sahiti has an incentive to offer high subsidies to attract as much FDI as possible. The same reasoning applies to Mahiti, as well. Individually, each country has an incentive to offer high subsidies to get as much FDI as possible, and that leads to the high/high outcome in the northwestern quadrant. Both countries offer high subsidies and they share the amount of FDI equally. The result is a reduction of net benefits to them, and transfer of those benefits to foreign investors.

The prisoner's dilemma nature of incentives-based competition for FDI has been widely recognised.[13] Game theory has proposed a general solution to the prisoner's dilemma that is well established by now, and it consists of cooperation between players. If they cooperate, they could get to a cooperative equilibrium that is also Pareto-optimal. In our case, it is a situation where both countries offer low subsidies. Hence, the problem is how to achieve cooperation between countries. Fernandez-Arias, Hausmann and Stein (2001) suggest that countries would do better by delegating authority to determine subsidies to a supra-national government. UNCTAD (1996) suggests regional integration efforts should adopt rules for attracting FDI among its members. In other words, the cooperation should be secured via formal agreements.

The experience of the European Union in limiting the competition for FDI is instructive in that case. The regulatory framework adopted provides some measure of autonomy for governments that wish to offer incentives, but it also provides some autonomy for the supervisory body of the European Union and establishes procedures for enforcement and sanctions (Oman 2000, p.123.). In our region there are examples of cooperation in that respect, too. Already in 1973, CARICOM enacted a Scheme for the Harmonisation of Fiscal Incentives to Industry. The purpose was to limit rivalry among member states for the location of industrial activities, to assist in rationalising the criteria for granting incentives, and to reduce regional economic inequalities by creating preferential incentives for the less developed countries of the region. However, the effectiveness of

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[13]   For example, UNCTAD (1996), Oman (2000).

the scheme has been reduced because of the inadequacy of monitoring and follow-up mechanisms.[14]

To sum up, the application of game theory to fiscal incentives aimed to attract FDI shows there are static gains that could be reaped. This win-win situation for all host countries stems from the fact that competition for FDI usually involves neighbouring countries, once a decision to invest in that part of the world has already been made. In the absence of cooperation, the "race to the bottom" among countries of the region benefits only foreign investors. Cooperation, in turn, makes possible attainment of the Pareto-efficient equilibrium where net benefits of FDI to host countries are not appropriated by foreign investors.

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[14]   UNCTAD (1996), p.68.

III. Dynamic gains and cooperation: concepts and application to macroeconomic coordination

a. Facing the prisoner's dilemma

As we have seen, some games do not have dominant strategies that coincide with social optimum. In the so-called Prisoner's Dilemma, each player has an incentive to play the non-cooperative way, and there is a divergence between individual and collective rationality. When generalised to more than two players, this becomes a version of the so called Tragedy of the Commons (Hardin, 1968). Decisions that are rational from the point of view of each individual become defective from the point of view of all.

For this reason, Prisoner's Dilemma has attracted a great deal of attention from researchers and practitioners in economic, social and political sciences. Clearly, this has a particular relevance for nations, in both their internal and external affairs. As Zagare (1984) says, internally –in the space of national community– Prisoner's Dilemma is one of the main justifications for the existence of the State; externally –in the space of international relations– if nations are unable to cooperate, we are condemned to live in a world where conflict is the norm. One way out of the dilemma is to consider that in the real life our players have other options. One of them is to build agreements through communication. It is clear that if the parties are able to negotiate a binding agreement, the dilemma disappears. Penalties may be built in to punish uncooperative behaviour, so that for each player, **R>T>P>S** (see table 3 for reference).

Obviously, in the case of sovereign countries, which are the actors to be considered in the macroeconomic coordination game, international agreements-cum-penalties are not always legally enforceable, and could be subject to abrogation if one party considers that its "superior" state interest is at stake. Thus, communication by itself does not solve the dilemma, because with the passing of time, the incentive to defect does not disappear.

Stating from a different approach than the traditional game theory, the modern literature on credibility in macroeconomics (which often refers to Kydland and Prescott,1977, as the starting point), has developed a comparable concept of time consistency of policies. A policy is credible if it is time consistent, i.e., there is no incentive to change it in the next period. The problem of governments is to make credible commitments, and this typical macro-policy problem could also be studied from the game-theoretic point of view.

b. Dynamic Games and Time Consistency

Without a formal binding contract, it is still possible to reach a cooperative outcome when games are considered in a dynamic perspective. Axelrod (1984) shows that time is an important factor is resolving cooperation deficits. The fact that players have to meet again and again pave the way for "nice" strategies to develop, even when players are selfish: cooperation is based upon self interest without the aid of central or supra-national authorities. Two key requisites for cooperation to thrive in this context are that the cooperation be based on reciprocity, and that the shadow of future is important enough to make this reciprocity stable.

Players in the real life, be they individuals, firms, or countries, do not play the game just once, but the game is repeated over and over again. Thus, each player can develop reputations and credibility[15] about his/her behaviour, and learn about other players' conduct. Players not only learn about each other's behaviour, but also they become capable of rewarding cooperative conducts (C strategy) or punish uncooperative ones (D). If the other party plays the D strategy, there is time to counter attack with one's own D strategy and avoid the disastrous CD or DC outcomes.

This strategy is called the tit-for-tat strategy: I start out cooperating, and continue to do so as long as the other player cooperates. As soon as the other player tries to extract a higher personal gain by cheating, I follow suit and act also in a non-cooperative manner. This will decrease my opponent's gain not only below the non-cooperative move if I had continued to stick to the previous course of action, but also below the cooperative outcome. If the other player later decides to cooperate, I'll immediately do so again. Since all parties know that the logical outcome of unilateral defection is a DD result, the reasonable outcome of a repeated game is mutual cooperation (CC), which is also the Pareto-optimal solution.

This tit-for-tat strategy is the best alternative when games are infinitely repeated or repeated with sufficient number of iteration and compatible set of rewards and punishments (provided certain conditions are met, see footnote 17 below), even against more sophisticated strategies (Axelrod, 1984). When this is not the case, however, there is a high probability in a finite game that the other (perfectly rational) player will use the selfish and uncooperative strategy in the last occurrence of the game. Since this is the last occurrence, I will not have the possibility to retaliate. Thus my optimal action in this case is to choose the uncooperative strategy, whatever the other player chooses, and the last occurrence of a finite game will be non-cooperative. Because of the same reasoning there shall be no cooperation at the next-to-last occurrence, and so on. Thus, for a finite game, the tit-for-tat strategy does not seem to offer a way out of the Prisoner's Dilemma when

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[15] The concepts of reputation and credibility in game theory are very complex and require assumptions about the degree of rationality of players, asymmetric information, different characterization of players, and many other ingredients. Since our purpose is to present basic concepts of game theory, we try to make it as simple as possible.

players are fully rational and selfish. As nothing lasts forever in the real life, the pessimistic theoretical outcome of a finite game (namely, that strictly competitive strategies would prevail) seems the most probable.

However, cooperation may prevail, because in the real life the hypothesis of pure rationality and selfishness is not always representative of the actual behaviour of players. Following Brams and Wittman,[16] if all players are *nonmyopic* and are able to anticipate the consequences of their strategic choices, the nonmyopic equilibrium is the Pareto-optimal CC outcome. In this context, there is a non-zero probability that the other player will play the cooperative tit-for-tat strategy. Hence, it is rational in terms of expected value (and if the time horizon of the game is long enough) to use the cooperative strategy, even in a finite game.

The rationale behind this optimistic expected result is that, as the game is repeated many times, if one party is fooled by its partner it can always shift to the most secure non-cooperative strategy, at the cost of only one period loss. This cost is minor compared to the potential benefit in the case where both parties choose to cooperate. Thus, in a finite repeated game, the Prisoner's Dilemma can have a cooperative outcome if they are played over a long and uncertain period of time, and players have reason to doubt that other players will choose the myopic (albeit perfectly rationale) uncooperative strategy.

As stated by Axelrod (1984), cooperation can emerge even in a world of unconditional defection, if at least some of the players are willing to initiate the game using a cooperative ("nice") strategy. The development cannot take place if it is tried only by scattered players who have virtually no chance to interact with each other. However, cooperation can evolve from small clusters of individuals who base their cooperation on reciprocity and have even a small proportion of their interaction with each other. In the author's words "The most promising finding is that, if the facts of Cooperation Theory are known by the participants with foresight, the evolution of cooperation can be speed-up." (p.24)

The probability of cooperation in this particular framework is enhanced when there are fewer players, when each player's discounting of the future payoffs is sufficiently low (i.e., if players are farsighted[17]), when they are interacting frequently and when the benefits and costs associated with each strategy are well known. In this case, the outcome of the iterated Prisoner's Dilemma game will result in the repeated selection of CC on every repetition of the game. On the other hand, the cooperation breaks down or never begins when there are too many parties, when players are short-sighted or when benefit conditions are rapidly shifting (Pindyck and Rubinfeld, 1992).

Translating these theoretical conclusions into practical regional economics, it means that countries that have commercial and financial relations, that interact frequently and cannot escape from the consequences their decisions have on their partners, have a strong probability of entering into a cooperative dynamic which will be beneficial for all cooperative participants and will be stable, at least within the original cluster. This definition fits almost perfectly the definition of regional integration, as it is understood in Latin America and the Caribbean.

Yet, for cooperation to develop, someone has to start being cooperative, irrespective of the decision taken by the others (at least in the short run). In other words, if it does not start by mutual consensus, the cooperation needs a leader that will show the way. One of the interesting games for us in this aspect is the so-called *Stackelberg* game, where the situation of players is no more symmetric, as it is the case in the standard games. It was first developed in the theory of imperfect

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[16] Brams S.J and D. Wittman (1981) "Nonmyopic equilibria in 2x2 games" Conflict Management and Peace Science 6: 39-62, cited in Zagare (1984).

[17] As shown by Axelrod (1984), a simple TIT FOR TAT strategy to achieve cooperation is collectively stable if and only if the weight of future outcome in today's decisions (w) is large enough. This critical value of w is a function of the four payoff parameters T,R,P and S. Critical value for w is the maximum of (T-R)/(T-P) and (T-R)/(R-S). If w is less than this critical value, it pays to defect.

competition where two firms compete in an oligopolistic market. The basic idea is that one firm is a leader and chooses output or price before the other firm. Thus, in this two-stage game the roles of the players are asymmetric. The leader acts independently, while the follower reacts to his/her choice, reaching a Nash equilibrium relative to the leader's strategy. [18]

The *Stackelberg* game is one of the possible devices to reach a mutually rewarding commitment. A commitment of the first player (the leader) to a given sequence of actions may alter the play of other players. The outcome is paradoxical since the first player reduces the number of strategies he or she could play, and by doing so attains a higher payoff.[19]

This type of game is also useful in macroeconomics and regional integration to solve the time-consistency problem. Studying an internal coordination problem, Velasco (1987) shows that the government, by assuming a role of the leader can speed up disinflation by "sacrificing" on potential –but highly hypothetical– gain on growth. In the European integration context, the inflation record of the German central bank (Bundesbank) was much better than that of the rest of the central banks in the European Community. For that reason, the Bundesbank was chosen as a leader in setting the communitarian monetary policy, while the rest were followers. In the Latin American context, it is difficult to imagine today which country would be able to play the asymmetric role of the Bundesbank. Looking for a benevolent leader outside the region is quite hypothetical and is one of the arguments against dollarization of the Latin American and Caribbean countries (Escaith, Ghymers and Studart, 2002). Although it is out of the scope of the paper to discuss the theoretical and practical aspects of trade and macroeconomic integration among asymmetric countries, we presume cooperation in Latin America will probably result from a concerted initiative of symmetric partners, rather than out of the asymmetric example of a credible and benevolent leader. The following section will look into some of the potential obstacles facing this outcome and look for possible solutions.

c. Uncertainty and the costs and benefits of regional cooperation

Avoiding the above-analysed difficulties and initiating a programme of policy coordination is just part of the story, as many other challenges remain. Indeed, a cooperation among regional partners who decide to implement a common strategy faces several obstacles, as uncertainty with regard to sovereign state's cooperation in a real life situation has several dimensions.

The first of them, obviously, is about the net outcome per se (balance of costs and benefits of cooperation), but probably the second most important one is the uncertainty concerning the behaviour of other players. As we mentioned earlier, the latter, which is prejudicial to a cooperative outcome in a finite game, can be controlled and reduced by the possibility of committing players, through an enforceable agreement, to adopt a cooperative strategy. This is particularly relevant in the present case of treaties regulating international relations between countries, but underlines the difficulty of enforcing contracts (i.e., devising penalties) among sovereign states.

National authorities may also be induced to choose the non-myopic cooperative strategy if their own national institutions limit the possibility of using short-sighted discretionary strategies. Among such institutional characteristic that restrain from using short sighted strategies, the most common in the region is the independence of the Central Bank, which defines its monetary policies in relation to preannounced goals on inflation. A more recent trend towards fiscal responsibility laws also reduces the possibility of implementing discretionary policies (such as the limit on fiscal deficit set in the "Maastrich" treaty). Explicit and transparent national regulations as those

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[18] In the presence of more than one Nash equilibrium, it is necessary to have a commitment device that augments the credibility of players for the Pareto equilibrium to be attained.

[19] Fudenberg and Tirole (1998).

described give more credibility to regional coordination commitments taken on by the respective governments, at least as long as the coordinated policy measures are consistent with the domestic rules.[20]

From this narrative, one deducts that, in the presence of Prisoner's Dilemma, several key points have to be clarified in order to advance the case for a regional cooperation on macroeconomic policy in a finite repeated game:

- – The first set of critical factors relates to the nature of costs and benefits. Cooperation should not only be beneficial for all participants, but these benefits must be sufficiently larger than in the case of an alternative, non-cooperative outcome. At the same time, they must be easily identifiable and not too uncertain in order to define a clear incentive to cooperate.

- – Second, it must be ensured that there are not too many players, and that they can be induced to accept reasonably binding commitments to cooperate. Building an appropriate institutional framework is a key element in this point.

These two criteria by themselves open some new questions, which, although can not be fully answered here, should not be underestimated. The question about the nature and size of the benefits from cooperation has been studied from two distinct approaches in the literature. One is illustrated by the well-known work by Mundell (1961) and the traditional literature on the OCA criteria, and can be summarised from a point of view of the theory of cooperative games by the discussion on the optimality of a currency area and the optimality of its size. Traditional literature stresses that the benefit of cooperation via currency area rises with openness and symmetry of shocks. Factor mobility, a condition that is commonly added to the criteria, is a parameter that reduces the costs of asymmetric shocks: these costs are absorbed through the existence of free factor mobility across national boundaries. Fiscal integration plays more or less the same role as factor mobility: a confederate fiscal policy can serve as an alternative method to smooth out transitory asymmetric shocks, or contribute to level out the structural ones.[21]

In their review, Demopoulos and Yannacopoulos (2001) emphasise the weakness of this traditional literature. The costs and benefits of a currency area should also be treated as a function of its size. As a currency area expands, the benefits from adopting a single currency increase, but not as fast as the difficulties of agreeing on a common set of policies as new countries, with macroeconomic problems of their own, join the area. As transaction costs increase faster than benefits, the marginalist approach seeks to determine the optimum size from the point of view of a single country. A sufficient condition is that the characteristic function must exhibit non-decreasing returns with respect to the size of the currency area (otherwise, a subset of participating countries would be better off and would improve their position by withdrawing from it).

Parameter uncertainty and disagreement among coalition partners about the right economic model pose another challenge for a cooperative economic policy. Policymakers may have different beliefs about how an economy actually works. Disagreement is not an obstacle to cooperation, but because of the uncertainty about the "true model", negotiations may lead to a wrong model and result in a lower welfare than non-cooperation.

Hughes Hallet (1995) illustrates the problem of decision strategies when both policies and models are subject to choice. Policy makers have four options: (i) They make neither an attempt to agree on the appropriate model, nor to coordinate their policies; (ii) they may exchange information

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[20] Obviously, such national mechanisms reduce the set of regionally acceptable macroeconomic policy measures, in the same way that the existing bilateral commitments with a third party (e.g., the IMF) may reduce the scope for policy coordination if they represent a binding constraint for the government.

[21] See, for example, the use of structural funds in Europe.

or bargain over the model, but make no attempt to choose jointly their policies; (iii) they may not discuss which model should be used, but they coordinate their policy choices explicitly (they do not discuss the justification of their policies); lastly, (iv) they agree both on the choice of the model and to coordinate their policies. The paper shows that disagreement over the model in the presence of uncertainty can still be beneficial for the policy makers if it causes the exchange of information, reducing the risk of serious losses.

Because the application of the economic theory to real life situations is not unambiguous, there is always a probability of error when adopting a particular model specification. In practice, countries that enter into an active process of macroeconomic coordination do so after an extensive period of dialogue, exchange of information, mutual monitoring and convergence. The European Union is perhaps the best example of this process of uncertainty reduction through sharing of information and mutual monitoring. In the Latin American region, there are several examples of similar processes, and in all sub-regional integration groups, national decision-makers are actively engaged in a dialogue to reduce uncertainty concerning the key parameters of their respective economies.

Usually, the first step is to establish convergence criteria for key indicators (as in the GMM in Mercosur, the Caribbean or the Central American Common Market).[22] The Andean Group, as part of its work programme on macroeconomic convergence, has been studying the real impact of key economic variables in the five member economies. This process of defining common concept for the monitoring of the respective economies from a regional perspective is an important step in promoting a regional dialogue on key variables, defining transparent criteria and building mutual trust among regional partners, all points whose importance cannot be underestimated.

These processes are still at an initial stage, and more efforts should be made to define in a more precise way the models underlying the national economies and their interactions. This implies specifying the key parameters of each national economy constituting the subregional group, and modelling the interdependence between them. In addition, unlike the countries of the European Union, those constituting the Latin American and Caribbean regions are developing economies, i.e., economies where the key parameters and the systemic response to impulses are prone to rapid and substantial change. Thus, it is even more important in the Latin American context than in the European Union to maintain a close monitoring of the key indicators and foster a common programme of analysis of reaction functions to external and policy impulses.

d. Dynamic gains from regional cooperation in the realm of monetary and exchange rate policies

The technical discussion about the optimality of regionally coordinated exchange rate policies is usually based on the Optimal Currency Areas criteria (OCA). Countries considering whether to adopt the currency of a third country (e.g., dollarisation) or to join a currency union (e.g., the European Economic and Monetary Union) weigh the potential benefits against the expected costs. Since Mundell (1961) developed the concept of OCA, the criteria are defined in terms of (1) trade relationship and (2) symmetry or asymmetry of external shocks, the greater the linkage, the more desirable an union; to compensate for imperfection to the first two criteria, two additional ones are considered: (3) degree of labour mobility and/or (4) system of fiscal transfer.[23]

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[22]   See Chapter V in CEPAL (2002) Panorama de la inserción internacional de América Latina y el Caribe 2000-2001, March.

[23]   The advantages of adopting a common currency depend positively on both trade integration and business cycle correlation. Correlation of business cycles across countries depends, inter alia, on trade structure and trade integration. Those countries that are highly integrated in terms of trade in goods and services and tend to be exposed to similar external shocks and follow the same pattern of "ups and downs" in their economic activity, are more likely to form a common currency area.

Recent developments in the positive theory of OCA and the European experience show that the optimality criteria are in fact endogenous, and full OCA observance is no more a necessity. As stated by Frankel and Rose (1996), and illustrated in the case of the European Union, the suitability of OCA criteria cannot be judged on the basis of historical data, since the structure of the national economies –in particular trade structure– will be affected by the creation of a currency area and is likely to change. In the authors' words, the OCA criteria are *jointly endogenous:*

"Countries are likely deliberately to link their currencies to those of some of their most important trading partners, in order to capture gains associated with greater exchange rate stability. In doing so, they lose the ability to set monetary policy independently of those neighbors. The fact that their monetary policy will be closely tied to that of their neighbors could result in an observed positive association between trade link and income links. In other words, the association could be the *result* of countries' application to the OCA criterion, rather than an aspect of economic structure that is invariant to the exchange rate regimes." (p. 15).

As a consequence, the authors state in their conclusion (p. 22) that "some countries may appear, on the basis of historical data, to be poor candidates for EMU entry. But EMU entry *per se,* for whatever reason, may provide a substantial impetus for trade expansion; this in turn may result in more highly correlated business cycles. That is, a country is more likely to satisfy the criteria for entry into a currency union *ex post* than *ex ante*".

In this endogenous framework, monetary and exchange rate regional coordination can be represented by a new kind of a non-zero sum game, where the positive outcome increases when the game is repeated: the more you play, the more you gain. Because of objective reasons, linked to the OCA criteria (weaknesses of trade and financial integration, asymmetry of business cycles), and to subjective weaknesses (reduced credibility of the regional commitments and weak institutional enforcement procedures), initial gains from consensuating regional policy response to external shocks and coordinating exchange rate fluctuations may be low. But because of the endogenous nature of the OCA criteria, as time goes by and the more countries interact, the higher is the welfare gain obtained from coordination and the lower the temptation to defect.

Figure 1
GAME TREE REPRESENTATION
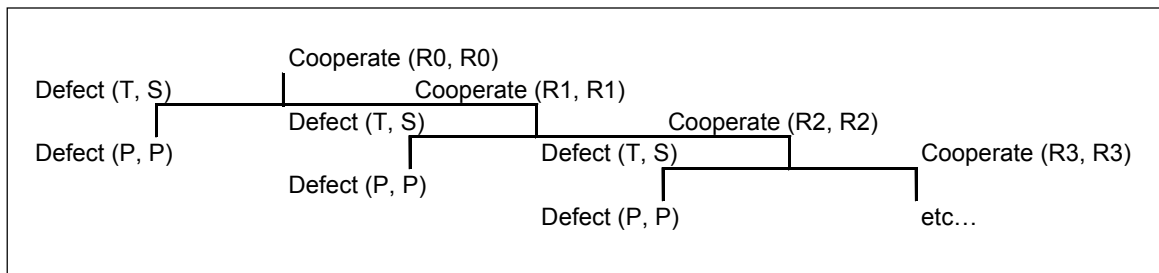
If we go back to the formal representation of the Prisoner's Dilemma, as in Table 3, the gain from cooperation **R** depends positively on the number of time the game is repeated (t). Figure 1 gives a tree representation of this game. The first letter in parentheses denotes the strategy of A, while the second is the strategy of B. For simplicity, let's assume that B applies a tit-for-tat strategy. Both countries cooperate in the initial round and gain R_0.

- If A defects in the first iteration, it gains **T** and B suffers the **S** outcome, but both gain only **P** in the second round, once B applies the tit-for-tat countermove.

- If A cooperates, both countries gain R_1, with $R_1 > R_0$.

The same reasoning applies to subsequent moves, with $R_t > R_{(t-1)}$.

Remember that a Prisoner's Dilemma exists only when, for both players, **T>R>P>S** and the dominant strategy dictates that each player should defect and follow a non-cooperative strategy. Thanks to the endogenous and incremental nature of R_t in this class of games, the gains from cooperation should increase with time such as to reach the situation when $R_{(t*)}>T$ and defecting is no more a dominant strategy. Obviously, the initial stages of the cooperation game are critical for its success, when R_t is lower than **T** or too close to it, such as making the net gain from cooperation too uncertain. (see figure 2).

Figure 2
DYNAMIC GAINS AND PRISONER'S DILEMMA
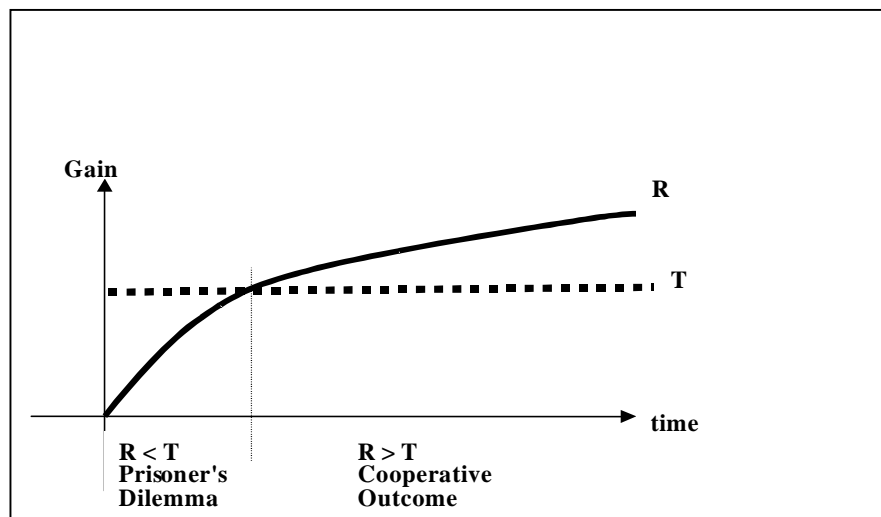
In addition to the arguments of Frankel and Rose (1996), one could add that with the passing of time and the building-up of regional institutions, regional integration and policy coordination gain credibility with national and international agents, a factor that is the key in exchange rate determination. This "subjective" aspect of welfare enhancing cooperative games is closely related to the political economy side of macroeconomics, when a decision in the current period depend on the expectations of policies in all future period and policymakers may have an incentive to "surprise" the agents *ex post* with a discretionary change and depart from the announced policy. Obviously, foul play is far from being the monopoly of policymakers. Strengthening the institutional framework with a regional component can also be useful when national institutions have to enforce economic regulation and are facing powerful private lobbies.

As noted earlier, political economy considerations are taking an increasing role in the analysis of macroeconomic policymaking. The Persson and Tabellini (1990) monograph is representative of both normative and positive examination of modern political economy and game theory applications to monetary and fiscal policies, closely related to the Principal-Agent discussion. From a positive point of view, the analysis describes the policy maker's behaviour under alternative incentive constraints. From a normative point of view, by disclosing the incentives for the policy maker to surprise the private sector, this approach allows to identify the appropriate institutional reforms needed to embed desirable incentives in the existing political and economic institutions. The same trend can be observed in applied development economics, where research brings together the work of economists and political scientists to focus on the interaction of economic and political factors in the making of the actual policy. This field is especially interesting in the case of regional integration, where trade policy and exchange rate regime alternatives can be analysed in terms of distributional and welfare effects. With regards to exchange rate regimes, the principal tradeoffs

are between price stability and monetary flexibility, competitiveness versus purchasing power, controlling inflation or smoothing out the transitory shocks.[24]

As often occurs when competing objectives cannot be reached simultaneously with the actual set of policy instruments (a situation typical of many developing countries), policymakers are constrained to second-best solutions. In such a situation, competing objectives must be reached sequentially, and short-term deviation from pre-announced policies should not be mistaken for an abandonment of initial goals. This means that the long-term commitments announced by the policy makers must be credible. When national situation is less than favourable in that respect, policy-takers may be tempted to interpret short-term deviations from pre-announced targets as discretional shifts in policy, and hedge against this risk (for example by reducing their demand of national currency). Bringing in the supra-national dimension can help avoiding this outcome. Person and Tabellini (1990) state that the decision to join a supra-national exchange rate arrangement, either regional like the EMS, or international like the Bretton Woods agreements, provides a *commitment technology* that makes it costly for the policymakers to reverse their initial decision and surprise the "decision takers".

This institutional *commitment technology* needed to increase the credibility of the decision agreed upon is the key to understanding the importance of a proper institutional setting in the design of a sub-regional coordination mechanism. This arrangement should include the appropriate monitoring and endorsement/disqualification capacities, and calls for the existence of a formal institutional arrangement at supra-national level. [25] Such institutional mechanism for sub-regional macroeconomic coordination, as one presented in Escaith, Ghymers and Studart (2002), should offer national governments a set of positive and negative incentives to cooperate, as well as a well designed negotiation, monitoring and reporting system that creates an effective system of checks and balances.

Also, this institutional commitment must be workable and credible, which means that the conditions and criteria stated earlier regarding the optimal size of a Monetary Area apply also to these aspects. Because the initial benefits R_t may be low and uncertain as long as t<t*, a strategy of defection of one of the players due to the Prisoner's Dilemma situation is a real possibility, so a proper formal institutional setting will be central for a cooperative game to be sustained. The institutional setting can also incorporate penalties for non-cooperative behaviour, in order to lower **T** and the temptation to defect.[26] Once the game has been repeated a sufficient number of times, so that credibility has been established and welfare gains have become clear to all players, agents (governments) and principals (private sector) will have the incentive to continue, even when transitory conditions provide incentive to defect.[27]

e. Regional monetary policy and optimal exchange rate regime in Latin America and the Caribbean

In this section, the above mentioned conflicts are illustrated from a monetary and exchange rate policy perspective. In the second half of the 1990s, a heated debate sparked between defenders of flexible exchange rate and advocates of hard pegs. After the Mexican and the Asian/Russian crises, the revocable pegs, fixed or crawling, that had been preferred by many policymakers in inflation-prone developing countries, appeared indefensible in a world of high and volatile capital mobility.

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[24] See Frieden and Stein (2001) for a recent review of the political economy of exchange rate policy in Latin America.

[25] As recently exemplified by the European case, regional commitments to reduce fiscal deficit may be counterbalanced by short-term national considerations, be they electoral or others. Nevertheless, member countries, even the largest ones as in cases of France and Germany, take the political consequences of a regional sanction very seriously.

[26] As in the European case.

[27] Many observers believe that if Mercosur had a proper Secretariat, the "Grupo de monitoreo macroeconómico" (GMM) initiative would have survived the Argentinian-Brasilian tensions and would have played a role in resolving the crisis.

The new conventional wisdom that emerged in LAC countries (or at least in academic circles) was quite non-Aristotelian, as it advocated the law of the excluded middle, promoting instead corner solutions for the exchange rate strategy: hard peg (currency boards or full dollarisation) or fully flexible exchange rates. The response to the LAC monetary authorities' lack of credibility was either to suppress its possibility to interfere with money (as done in a currency board or a full-fledged dollarisation) or, on the other extreme, not to make any commitment to the future value of the currency (free float). But recent experience is not promising (see box 2).

Box 2
PROBLEMS WITH CORNER SOLUTIONS

Recent regional experience with corner solutions is not promising. Hardening the peg through a legally binding currency board eventually failed in Argentina (albeit currency boards and dollarisation have been working in the smaller economies of the eastern Caribbean and in Panama). The free-floating experiment in Ecuador during 1999 led to a rapid collapse of the currency and was followed by a full dollarization. This move was able to slow-down inflation considerably, but has not been able so far to provide the foundation for a stronger macroeconomic framework. The Brazilian, Chilean and Colombian experiments with floating were more successful. Thus, if the question is ultimately an empirical one, in the end it seems that corner solutions are not a magic potion curing all monetary sickness and providing sustainability either through strength (currency board) or flexibility (floating).

As shown by Escaith, Studart and Ghymers (2002), the argument in favour of currency boards is flawed in the sense that it removes only part of the problem. Fixed exchange rate sustainability (leaving aside technical arguments about optimal currency areas and nominal flexibility of domestic prices) depends also on the capacity to control fiscal and financial sectors. Nothing guarantees that a country unable to manage its monetary policy would be able to do the financial and fiscal part. Of all structural reforms, fiscal and institutional reforms are perhaps the most difficult to implement in terms of political economy, as they affect not only the policytakers (like most other reforms), but also the policymakers. Thus, the political economy argument for hard pegs is internally inconsistent: if political factors prevent an economy from managing prudently its monetary policy, then the same critique should be applied to its fiscal and financial policies.

Conversely, flexible exchange rate under inflation targeting arrangements call for an alternative nominal anchoring in both fiscal and financial policies. Otherwise, unchecked perturbations in the most fragile part of the system could put in jeopardy the whole arrangement. When credibility is weak, a small perturbation at the frontier of an admissible set of parameters may create a disproportionate outcome if it changes agents' expectations about future outcomes.

After reviewing the pros and cons of both propositions, Velasco (2000) concludes that the debate between partisans of dollarisation and defenders of discretionary monetary policy in developing countries boils down to one about credibility and political economy. The key issue, therefore, is to find the set of policies and institutional arrangements that bring both flexibility and credibility into the system. However, a discussion of technical conditions of inflation targeting, which basically rest upon the predictability of the inflation target and the stability of the various monetary instruments used in the policy mix, is out of the scope of this paper.

Fulfilling the institutional conditions is even more difficult. Some authors want to replicate in the fiscal sphere the successful experience of central bank autonomy in the monetary one, promoting an independent fiscal authority (Eichengreen, Hausmann and von Hagen, 1996). The idea is that if instability is built in the original politico-administrative system, then this adverse situation calls for a neutral anchor to guide the system back to equilibrium. But this national solution is not easy to implement for political reasons (from the powerful vested interests lobbying

against a proper "checks and balances" system, to the civil society's different perceptions about the appropriate balance between rule and discretion in policy making).

Building a national consensus on the "correct" set of policies is therefore a long process of political negotiations plagued by the well known "prisoner's dilemma". Implementing pure national solutions might also prove unworkable when external shocks are very large or simply inefficient when the source of perturbations is regional and could be better confronted by a cooperative effort. In the context where the internal decision-making process based on purely national solutions is prone to stall, a regional approach via the coordination of macroeconomic policies, including exchange rate, monetary and fiscal policies, is potentially a better solution.

Obviously, applying regional peer pressure in Latin America and the Caribbean helps resolving the internal conflicts of vested interests that lock the national policies into "prisoner's dilemma". Contrary to exogenous rules that are perceived as forced upon the national governments by international markets or the multilateral organisations, regionally negotiated rules provide also a firmer ground for promoting national "ownership" of policies. On a more technical basis, regional cooperation is also the adequate forum when the regional partners' economic policies are themselves source of externalities, as is the case when instability and lack of credibility in one country cause contagion of neighbouring economies. Thus, providing the regional system is well behaved,[28] regional co-operative solutions are at least comparable --if not superior-- to individual national solutions on both technical and institutional grounds. From a larger perspective, regional cooperation in the face of large external financial shocks is the most appropriate step to face the asymmetries build in the new international financial system, where purely national answers are notably insufficient. (Ocampo, 2001)

At first glance, initial conditions for developing coordination at the regional level are not promising. As showed in Escaith, Ghymers and Studart (2002), on a strict examination of the standard OCA criteria, LAC countries do not pass the test, and are not yet ready to adopt a third currency (dollar) or to form a monetary union, despite some encouraging results in the later part of the 1990s. Nevertheless, more promising results appear when looking at the subregional level. Intraregional trade has been rapidly increasing during the past decade, and countries have tended to share the same financial shocks, leading to financial interdependency. Even if we consider business cycles, LAC countries have "tended to cluster around common subregional patterns" (p.26).

Obviously, there is still a large gap between the reality and the OCA criteria, even at the subregional level. But the above mentioned developments in the positive theory of endogenous OCA indicate that full OCA observance is not a necessity to initiate mutually beneficial coordination. If the dynamic of the cooperative game is well behaved (see note page 2), then the iteration of the cooperative game should naturally guide the countries out of the prisoner's dilemma. In absence of a leader country, cooperation must initiate by a (minimum) consensus of the participating countries, a process that calls for a preliminary phase of confidence building based on dialogue and exchange of information, and culminates in a regional agreement. That agreement should provide the necessary commitment technology to initiate and maintain the cooperative game at least in the first phase of implementation, when benefits are still diffuse and temptation to defect is strong. This commitment technology should therefore include features that increase the immediate benefits for cooperation (such as the structural funds in the EU) and increase the cost of defection (peer pressure from within the region, loss of reputation with international markets).

The *commitment technology* provided by a regional agreement is not only useful in an advanced regional agreement such as monetary union, but may also be applied to looser regional integration

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[28] Obviously a big "if" that calls for a proper institutional setting, see Escaith, Ghymers and Studart (2002).

schemes where a convergence of national policy objectives, such as inflation targeting, is the aim. As in exchange rate regimes, the credibility aspect of pre-announced targets is the key to success of policies based on inflation targeting. In particular, the shift from rules-based monetary and exchange policy (especially nominal exchange rate anchors and monetary aggregate objectives that were instrumental in controlling inflation in Latin America in the 1990s), was made possible thanks to the greater credibility of the national monetary authorities to control inflation. Albeit no substitute for national reputation in monetary and fiscal policies, promoting a sub-regional monitoring and reporting of national inflation targets would accelerate the building of credibility of the monetary policy of the participating nations. This is the key factor in the face of random external shocks, because the target would eventually be fulfilled despite transitory deviations as long as the private agents believe that the national authorities will stick to their commitment. By providing an external auditing of the macroeconomic situation, regional monitoring and analysis will also help discriminating between exogenous and endogenous policy shocks when actual inflation deviates from the pre-established target. Provided that regional institutions are sufficiently isolated from national pressures, they would be instrumental in consolidating the credibility of the national institutions when deviations between ex ante objectives and ex post realisations are unintended and due to external factors.

IV. Conclusions

Significant changes in macroeconomic policies and structural reforms in Latin America and the Caribbean that occurred during the 1990s, led to a convergence in macroeconomic policies, objectives and instruments, as well as to a clear increase in interdependencies of these national economies in both trade and financial realms. In particular, as a result of financial globalisation, economic policies or economic events in one country may have direct impacts on financial spreads in the whole region. These transformations have been creating a fertile ground for deepening the cooperation among LAC countries. Recent developments in monetary and exchange rate policies in Latin America and the Caribbean, specifically the move out of pre-established rules to adopt inflation targeting and floating exchange rates, provide another positive outcome that favour the incorporation of coordinated regional objectives and policies as complement to national strategies.

Given that interdependency among Latin American countries has risen substantially in the last fifteen years, standard textbook approach is no more adequate for analysing macroeconomic interactions in the region, especially when considering the sub-regional level. Instead, we argue that the game-theoretic approach is more suitable in this case, since it takes into account strategic behaviour of players and the interactions between them. More specifically, the fact that decisions of one player affect future decisions of other players, and may even lead to a contagion in extreme cases, renders the traditional approach inoperable. The inner logic of the actual interdependence leads such isolated and non-cooperative approaches to inferior outcomes.

Incorporating the regional dimension in the macro-economic decision making process, by coordinating national policies in response to common challenges allows cooperating countries to end up with the highest payoff possible. For example, regional cooperation allows avoiding the damaging outcome of a fiscal "race to the bottom" when courting foreign direct investments.

When political economy factors are incorporated into the analysis, two dimensions become important to avoid the so-called "Prisoner's Dilemma" outcome of non-cooperation: credibility and sustainability. Since credibility is the key feature of stabilization-cum-flexibility policies at national level, regional cooperation provides the much needed commitment technology and enhances the gains that can be expected from flexible monetary and exchange rate policies.

The welfare gains to be expected at the regional level from cooperation in monetary and exchange rate policies depend crucially on the OCA criteria. The European experience shows that fulfilling all these criteria are not a necessary condition, to be satisfied before negotiating and implementing a cooperative agreement on exchange rate policy. Indeed, it works both ways and the benefits from the cooperative agreement reinforce the initial case for entering the agreement. Thanks to trade creation and convergence of business cycles, regional cooperation endogenously creates optimal conditions for an OCA as time goes by. This conclusion applies to the Latin America and the Caribbean integration schemes, for the reasons mentioned earlier.

By the mere fact of cooperating, even from a less than an ideal initial position, the players' interaction produces a convergence to this ideal situation and in the process improves the welfare gains. By endogenously increasing the rewards from cooperation with the passing of time, it was shown in the paper that the Prisoner's Dilemma can be avoided, even in the case of finite games.

Nevertheless, cooperation is not always a stable outcome in the case of macroeconomic policy coordination, especially at the initial stage of the process. When the benefits from cooperation are uncertain, it is not clear whether a break in the cooperation will result in a loss of welfare. This uncertainty increases with the number of countries involved. This lead to two positive conclusions: first, that coordination in Latin America and the Caribbean should take place at the sub-regional level, where there are a reduced number of countries, with reasonably homogeneous characteristics that do not deviate too much from the OCA criteria. Second, that a formal institutional setting is indispensable, not only to initiate and coordinate the cooperative process but also to keep it running, at least in the initial stages when the positive results from cooperation are still uncertain.

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