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EXCHANGE RATES AND INFLATION TARGETING IN THE CONTEXT OF INTERNATIONAL MACROECONOMIC COORDINATION

Анотація *У статті розглянуто питання міжнародної макроекономічної координації та стабілізації в рамках програмної теми конференції: Фінансові аспекти досягнення глобальної економічної рівноваги. Проведено порівняльний аналіз правил вибору оптимальної монетарної політики для трьох видів рівноваги: макроекономічної координації, рівноваги Неша та Штакельберга, використовуючи параметри, що відображають відносні показники розміру та відкритості економіки. Розкрито переваги політики макроекономічної координації та важливість її подальших досліджень.*

Annotation *This paper deals with international macroeconomic coordination and its stabilization within a conference framework: Financial Aspects of Rebalancing the Global Economy. The optimal monetary policy rule for three types of equilibria: macroeconomic coordination, Nash and Stackelberg, using parameters that reflect the relative size and degree of openness of the economies, have been compared. This paper confirms that macroeconomic coordination policy is better than non-coordination rules, and it is a starting point for a promising research agenda.*

Key words Macroeconomic coordination, open economy, inflation targeting, Nash equilibrium, Stackelberg equilibrium, monetary policy rules.

The Mundell–Fleming model (the IS-LM-BP model) shows that macroeconomic policies are not independent from foreign developments and interdependence reduces effectiveness of policy. Visa versus, international policy coordination minimizes negative side-effects of domestic policy and increases power of policy interventions.

Though, a political problem of revealing interdependence appears. Thus at the global level, systematic coordination has never lasted long, but nonrecurring initiatives have taken place. Worth mentioning are the coordinated reflation engineered at the Bonn Summit in 1978, the Plaza agreement of G5 members to amplify the depreciation of the dollar in October 1985, the January 1987 Louvre agreements to stabilize exchange rates, when G6 members temporarily agreed on a system of exchange-rate target zones, i.e., fluctuation bands for bilateral nominal exchange rates which would be protected by central bank intervention at the margin of the bands, and the "Framework for strong, sustainable and balanced growth" initiated in 2009 by the G20 to address global current account imbalances.

The purpose of this paper is to compare the optimal monetary policy rule for three types of equilibriums: macroeconomic coordination, Nash and Stackelberg, using parameters that reflect the relative size and degree of openness of the economies.

The literature on macro coordination is considerable and started with the paper of K.

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Hamada [10] and followed by M.B. Canzoneri and J.A. Gray [3], K. Rogoff [15], P. Kehoe [12], M.B. Canzoneri and D.W. Henderson [4]. One of the first papers about economic coordination among countries was by J. Robinson. It involves a trade game among countries and the strategies and retaliations among partners in response to adverse situations. The main policy instruments are: depreciation of the exchange rate, wage reduction, exports subsidies and tariffs retaliations [14]. This started an extensive research agenda focusing on trade policy cooperation among nations.

K. Hamada analyzed the monetary policy and exchange regimes, using a box called the Hamada diagram, where the potential gains from macro coordination became more visible. Using the diagram, it was possible to show that Nash and Stackelberg equilibriums were inferior solutions than coordination (which were located on the Pareto contract curve) (Figures 1.1, 1.2, 2.1, 2.2) [10; 11].

Foreign / Home	Somewhat restrictive	Very restrictive
Somewhat restrictive	$\Delta\pi^* = -1\%$ $\Delta U^* = 1\%$ $\Delta\pi = -1\%$ $\Delta U = 1\%$	$\Delta\pi^* = -2\%$ $\Delta U^* = 1{,}75\%$ $\Delta\pi = 0\%$ $\Delta U = 0{,}5\%$
Very restrictive	$\Delta\pi^* = 0\%$ $\Delta U^* = 0{,}5\%$ $\Delta\pi = -2\%$ $\Delta U = 1{,}75\%$	$\Delta\pi^* = -1{,}25\%$ $\Delta U^* = 1{,}5\%$ $\Delta\pi = -1{,}25\%$ $\Delta U = 1{,}5\%$

Figure 1.1. INTERNATIONAL POLICY COORDINATION FAILURS
Hypothetical Effects of Different Monetary Policy Combinations on Inflation and Unemployment

Nash Equilibrium
Pareto-optimal Equilibrium

Foreign / Home	Somewhat restrictive	Very restrictive
Somewhat restrictive		8/7 0
Very restrictive	0 8/7	

Figure 1.2. PRISONER’S DILEMMA
Payoff Matrix for Different Monetary Policy Moves

Another example of showing superiority of cooperation is the paper by M.B. Canzoneri and

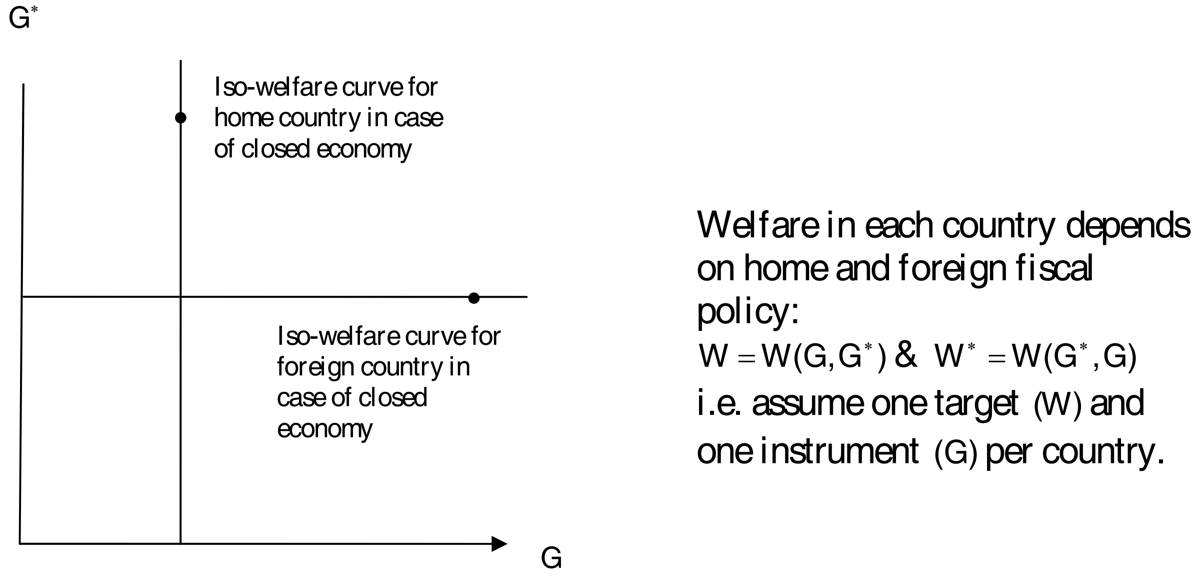

Figure 2.1. HAMADA DIAGRAM

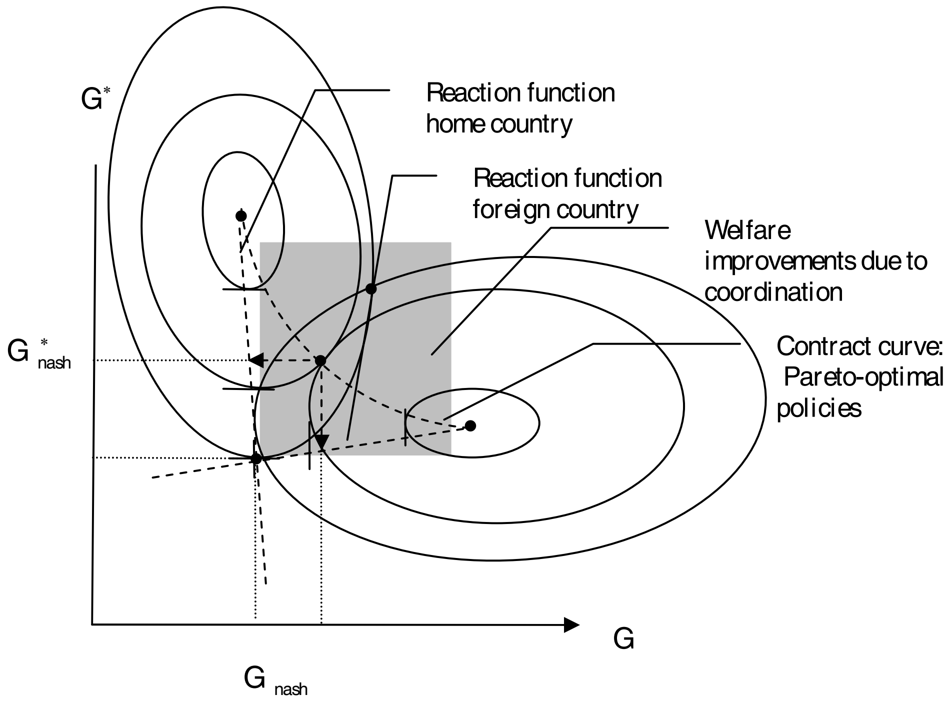

Figure 2.2.

J.A. Gray. They analyzed the result of the same exogenous shock (for example, an oil shock) on two blocks (in the case, the US and the rest of the world (ROW)). The analysis involved three types of externalities of the macro policy decision:

a) externality with a negative symmetry (beggar-thy-neighbor effect), where an expansionary policy in one country exports unemployment to the other;

b) externality with a positive effect (locomotive effect), where an expansionary policy in one country raises the GDP in the other;

c) externality with asymmetry, where the expansion in the US increases the product in ROW, but the expansion in ROW decreases the product in the US.

The authors clearly pointed out that for regimes with positive or negative externalities there is room for coordination, giving superior results than the Nash or Stackelberg equilibria. But for the case of the asymmetry externality, there is not a clear result [3].

K. Hamada [10; 11], C.E. Walsh [19], M.B. Canzoneri and J.A. Gray [3] reached similar conclusions with different models. These models emphasize that coordination is desirable from an economic point of view. The major drawbacks of the mentioned models are: they are static and the policy instruments to control are not clearly defined. All the policy decisions are taken at the same time and do not consider the delay effect of policy transmission. Understanding the macro coordination becomes more difficult when the policy decisions are not synchronized and when they are gradual.

K. Rogoff, using a monetary model, shows that a cooperative solution may be inferior to the non-cooperation, when the authorities do not take into account the reaction of the private sector. When the authorities for both countries try to boost the employment level, the private sector may become afraid of exchange rate depreciation and may adjust the wage and price level, increasing inflation. K. Rogoff claims that coordination involves credibility issues about the commitment of the authorities to fighting inflation [15].

P. Kehoe rejected K. Rogoff's point of view presenting a counter example where a government can maximize the welfare of the economy bringing about better results with macrocoordination than with Nash equilibrium. When there is a common strategy by the private agents and the government, these models raise questions about credibility and intertemporal inconsistency [12; 15].

All the quoted papers are two-country models. When more than two countries are involved the following cases are presented:

a) all the countries work in coordination;

b) there is no coordination among them;

c) only a sub-set of those countries are willing to coordinate their policy.

Partial coordination is only sustainable when no inside country (insiders) or nor outside country (outsiders) is willing to change the status quo. These questions of insiders and outsiders and others related to incentives (free-riding) are addressed by M. Espinosa-Vega and C.K. Yip [6].

In the 90's, there were some papers considering how monetary policy should be conducted. Among them the inflation-targeting approach is the major theoretical and practical reference as a monetary rule and this framework has been adopted in many countries. The inflation-targeting framework allows the researches to treat the interaction among the major variables in a simple manner than that of the big econometric models.

This paper uses the inflation-targeting framework in a two-country model, presented by M.K. Muinhos, E.U. Chang, J.R. Teixeira [13], allowing us to consider macroeconomic stabilization and coordination between two nations and it is an extension of L. Ball research «Policy Rules for Open Economies» [1]. The parameters are set in a way to characterize the difference in size and degree of openness of the two representative countries.

Three optimal monetary rules are used:

a) macroeconomic coordination equilibrium,

b) Nash equilibrium,

c) Stackelberg equilibrium.

The reaction function depends on the output of the two economies, inflation, an exchange rate shock, the lagged exchange rate and in some specific rules on the inflation of the other country, the optimal rules can be found using a linear quadratic model. Several simulations are performed in order to calculate the variances on the inflation, output and interest rates when economies are under demand, cost and/or exchange shocks.

The model shows us that the output and inflation stabilization is more efficient when the coordination rule is used. The greater is the welfare gains the more dependent and open the country is. If macro coordination is impossible, in the case of one country having all the relevant information of the other one, and if it assumes a leader position, there would bring about stabilization welfare gains.

Without coordination, monetary rules with more weight on inflation turned out to get less stabilization on inflation and output than other policies rules. Hence, the more dependent and open is the country, the less weight should be placed on inflation, to avoid an increase in the output and inflation volatilities. The relevance of this kind of model that allows the interaction of two economies is increasing lately, as we move to a more global and integrated world.

Two-Country Model: the core of the two-country model, proposed by M.K. Muinhos, E.U.Chang, J.R. Teixeira [13], is based on L. Ball research, adding up the externalities of the other economy output [1]. The model has five equations: the domestic and foreign country demand, the domestic and foreign supply and the fifth equation that connects both economies by the exchange rate.

The model specification is:

$$y_t = a_1 p_{t-1} - a_2 r_{t-1} + a_3 y_{t-1} + a_4 y^*_{t-1} + u_t \quad (1)$$

$$y^*_t = -a^*_1 p_{t-1} - a^*_2 r^*_{t-1} + a^*_3 y^*_{t-1} + a^*_4 y_{t-1} + u^*_t \quad (2)$$

$$\pi_t = \pi_{t-1} + b_1 y_{t-1} + b_2(\rho_{t-1} - \rho_{t-2}) + e_t \quad (3)$$

$$\pi^*_t = \pi^*_{t-1} + b^*_1 y^*_{t-1} - b^*_2(\rho_{t-1} - \rho_{t-2}) + e^*_t \quad (4)$$

$$p_t = \theta(r^*_t - r_t) + \nu_t \quad (5)$$

where

y_t - the log of the output gap (real output minus the potential one),

r - the real interest rate,

p - is the real exchange rate – an increase means exchange rate depreciation in the domestic economy –

- is the inflation rate,

πu - is the demand shock,

e - is the cost-push shock and v is the exchange rate shock;

a_i and b_i are the structural parameters of the economy.

The asterisks mean external variables and parameters.

Phillips Curves: equations (3) and (4) present the Phillips curves. Each one relates inflation with its lagged value, lagged output gap, changes in the exchange rate and the contemporaneous cost shock. A change in the exchange rate affects inflation due to imported prices. The equation merges the imported and domestic inflation.

The specification for the domestic inflation is:

$$\pi^d_t = \pi_{t-1} + by_{t-1} + e'_t \quad (6)$$

Equation (6) is similar to a Phillips curve for a closed economy. Imported inflation is given for the total inflation of the previous period added to a proportion of the lagged output gap.

Imported prices follow a purchase power parity, so this inflation is given by:

$$\pi^i_t = \pi_{t-1} + (\rho_{t-1} + \rho_{t-2}) \quad (7)$$

where imported inflation is a result of the total inflation of the last period plus any change in the exchange rate in the last period. In the other hand, inflation in the present period, given by equation (3), is a weighted average of domestic inflation and imported one, taking the share of imported goods as ϕ. The following identities hold: $b_1 = (1-\phi)b$, $b_2 = \phi$ e $e_t = (1-\phi)e'_t$.

Real Exchange Rate: equation (5) connects the two economies by the real exchange rate, which relates it to the interest rate differential. This relationship captures the financial market behavior: an increase in the real interest rate turns the domestic asset more attractive and so causes exchange rate appreciation. Other things that affect the exchange rate are the shocks in the exchange rate, which capture the expectations and the confidence of the private agents.

The balance of payments equation has the current account expression and the capital equations . The current account is positively related to the real exchange rate and the capital equation is positively related to the real interest rate differential. Hence:

$$TC(\rho_t) + MCA(r_t - r_t^* + \rho_t - E_t\rho_{t+1}) = 0$$

The linear approximation of the equation (8) brings us to the equation (5), unless the exchange rate shock. In the absence of the bubbles and under rational expectations give us that $E_t\rho_{t+1} = 0$.

There are other theories about the exchange rate behavior. Some of them are focused on variables as wealth and debt; others consider purchase power parity and the uncovered interest rate. This paper emphasizes the role for the trade balance and the interest rate differential and no attention to the role of the wealth and the debt stocks.

Parameters of the model: the purpose of M.K. Muinhos et al. paper was not the estimation of the parameters of the structural model for a particular economy, so that the calibration was based on results found in the literature. Some parameters are set to capture the difference in the degree of openness and in the relative size of the economies [13].

Table 1 presents the results of the calibration for an open economy.

L. Ball shows the results for American economy [1]; A.G. Haldane and N. Batini for the UK [9]; M.A. Bonomo and R.D. Brito [2]; P.S. Freitas and M.K. Muinhos for Brazil [8]. C.E. Walsh uses data based on other M.K. Muinhos et al. papers and with the exception of this research and L. Ball all the others results are for quarterly models [19].

Table 1.
Parameters of the Structural Model

	L. Ball (1998)	H&B (1998)	B&B (2001)	F&M (2001)	Walsh (1998)
a_3	0,8	0,8	0,91	0,73	0,8
a_2	0,6	0,5	0,51	0,39	0,35
a_1	0,2	0,2	0,08	-	0,04
b_1	0,4	0,4	0,32	0,31	-
b_2	0,2	0,4	0,1	0,2	0,2

where:
a_3 – demand elasticity for the exchange rate,
a_2 – demand elasticity for the real interest rate,
a_1 – auto-regressive parameter,
b_1 – inflation elasticity in relation to the demand,
b_2 – inflation elasticity in relation to the exchange (pass-through).

Table 1, comparing all the parameters used in the small-scale structural model, points out the consistency in the magnitude and the sign of the parameters used by those authors. The IS curve and the Phillips curve in the models by L. Ball [1] and by P.S. Freitas and M.K. Muinhos

[8] are backward-looking. A.G. Haldane and N. Batini model has a backward-looking IS curve and the Phillips curve is a weighted average of backward-looking and forward-looking terms with a small weight in the last term [9]. The exchange rate parameter in the IS curve and in the Phillips curve from M.A. Bonomo and R.D. Brito is rather small, showing how closed is the Brazilian economy compared with the US and the UK [2].

Table 2 shows the parameters used in the simulations that are based on those presented in Table 1.

Table 2.
Parameters for the Two Economies

Domestic	Foreign
$a_1 = 0{,}1$	$a_1^* = 0{,}2$
$a_2 = a_2^* = 0{,}45$	$a_2 = a_2^* = 0{,}45$
$a_3 = a_3^* = 0{,}8$	$a_3 = a_3^* = 0{,}8$
$a_4 = 0{,}1$	$a_4^* = 0{,}2$
$b_1 = 0{,}3$	$b_1^* = 0{,}4$
$b_2 = 0{,}2$	$b_2^8 = 0{,}4$

Those parameters are meant to represent two facts: that the domestic economy is more closed, with a smaller pass-through from exchange rate to inflation, $b_2 < b_2^*$; and it is less dependent on the foreign country's output, meaning that the demand of the other economy will affect less the domestic economy than vice-versa, . $a_4 < a_4^*$.

Optimal Equilibrium Rule: in the optimal dynamic solution (about how to obtain the optimal equilibrium rule) of the two-country model M.K. Muinhos at el. used the algorithm of linear quadratic method (based on J. Diaz-Gimenez paper [5]). This method is extensively used in Real Business Cycle Theory (RBC), where the return function is maximized. In case of M.K. Muinhos et al. model, it is a loss function which is minimized [13].

Further details on how M.K. Muinhos et al. implemented the algorithm of obtaining three types of solutions: macroeconomic coordination equilibrium, Nash equilibrium and Stackelberg equilibrium, will be given [13].

Macroeconomic Coordination Equilibrium: two countries obtain macroeconomic coordination when they minimize a joint objective function with same weight on the output gap, under the control of their respective monetary instruments, *r* e *r**. That is:

$$\min_{r_t r_t^8} \sum_{i=0}^{\infty} \beta^i E_t \{ \frac{1}{2}(\pi_{t+i+1}^2 + \lambda y_{t+i+1}^2) + \frac{1}{2}[(\pi_{t+i+1}^*)^2 + \lambda (y_{t+i+1}^*)^2] \} \quad (9)$$

subject to

$$y_{t+1} = -(a_1\theta + a_2) r_t + a_1\theta r_t^* + a_1 \nu_t + a_3 y_t + a_4 y_t^* + u_{t+1} \quad (10)$$

$$y_{t+1}^* = -(a_1^*\theta + a_2^*) r_t^* + a_1^*\theta r_t^* - a_1^* \nu_t + a_3^* y_t + u_{t+1}^* \quad (11)$$

$$\pi_{t+1} = \pi_t + b_1 y_t - b_2 \rho_{t-1} + b_2 \nu_t - b_2 \theta r_t + b_2 \theta r_t^* + e_{t+1} \quad (12)$$

$$\pi_{t+1}^* = \pi_t^* + b_1^* y - b_2^* \rho_{t-1} + b_2^* \nu_t - b_2^* \theta r_t + b_2^* \theta r_t^* + e_{t+1}^* \quad (13)$$

Each restriction equation can be separated in three parts:

a) state variables at time *t*;

b) control variables at time *t*;

c) shocks at time *t* + *1*. Defining the state variables by s_1, where *i*=1, 2, 3 or 4. Then:

$$s_{1t} = a_1\nu_t + a_3 y_t + a_4 y_t^*$$
$$s_{2t} = -a_1^*\nu_t + a_3^* y_t^* + a_4^* y_t$$
$$s_{3t} = \pi_t + b_1 y_t - b_2\rho_{t-1} + b_2\nu_t$$
$$s_{4t} = \pi_t^* + b_1^* y_t^* - b_2^*\rho_{t-1} - b_2^*\nu_t$$

The optimal monetary policy rules with coordination are obtained by simulation using the value function of macroeconomic coordination and the return function with parameters given by Table 2. These rules are function of six arguments $(y, y^*, \pi, \pi^*, \rho_{-1}, \nu)$, shown by expressions below. The coefficients of these arguments are taken for the specific case with $\lambda = 1$, the weight attributed to the output gap in the loss function. Therefore:

$$r_t = 1{,}6005 y_t + 0{,}6806 y_t^* + 1{,}2027\pi_t + 0{,}2063\pi_t^* + 0{,}1843\nu_t - 0{,}1580\rho_{t-1} \qquad (14)$$

$$r_t^* = 1{,}1734 y_t + 1{,}2225 y_t^* + 0{,}7177\pi_t + 0{,}8072\pi_t^* - 0{,}2860\nu_t + 0{,}1793\rho_{t-1} \qquad (15)$$

The signals of the coefficients of above reactions functions are all coherent with that point out by literature. The interest rate reacts positively to the output gap and inflation rate to both economies. Recalling that a higher interest rate means less demand and appreciation of real exchange rate, which brings about a reduction in inflation.

M.K. Muinhos et al. generated many samples to output, inflation and interest rate under optimal rules and taking the demands, the supplies and the exchange rate shocks. After that, the variances of inflation and output were calculated [13].

Nash Equilibrium: the Nash equilibrium is a non-coordinated policy. The authorities choose interest rate to minimize loss, taking as given the interest rate of the other country. Each country decides their policy, taking into account that the other nation has already decided and would not change it during this period. The Nash equilibrium treatment in this section is similar that is taken by C.E. Walsh [19].

The home country loss function is:

$$\min_{r_t} \sum_{i=0}^{\infty} \beta^i E_t \frac{1}{2}(\pi_{t+i+1}^2 + \lambda y_{t+i+1}^2) \qquad (16)$$

and foreign country loss function is:

$$\min_{r_t^*} \sum_{i=0}^{\infty} \beta^i E_t \frac{1}{2}[(\pi_{t+i+1}^*)^2 + \lambda (y_{t+i+1}^*)^2] \qquad (17)$$

The equilibrium treatment is similar to both countries. M.K. Muinhos et al. took home country to focus, taking the aggregate demand and Phillips curve expression at time *t + 1*, they have got [13]:

$$y_{t+1} = -(a_1\theta + a_2) r_t + a_1\theta r_t^* + a_1\nu_t + a_3 y_t + a_4 y_t^* + u_{t+1} \qquad (18)$$

$$\pi_{t+1} = \pi_t + b_1 y_t - b_2\rho_{t-1} + b_2\nu_t - b_2\theta r_t + b_2\theta r_t^* + e_{t+1} \qquad (19)$$

Following the same treatment given to coordinated solution, each restriction equation can be separated in three parts:

a) state variables at time *t*;
b) control variables at time *t*;
c) shocks at time *t + 1*. The two state variables s_1 and s_2 are defined as:

$$s_{1t} = a_1\nu_t + a_3 y_t + a_4 y_t^* \qquad (20)$$

$$s_{3t} = \pi_t + b_1 y_t - b_2\rho_{t-1} + b_2\nu_t \qquad (21)$$

The optimal monetary policy rules to home country, *r*, is a function of five arguments $(y, y^*, \pi, \rho_{-1}, \nu)$ while foreigner country has $(y, y^*, \pi^*, \rho_{-1}, \nu)$ as its rule, r^*. The coefficients of these arguments are taken for the specific case with $\lambda = 1$, the weight attributed to the output gap in the loss function. Therefore:

$$r_t = 1{,}28619y_t + 0{,}11871y_t^* + 1{,}12117\pi_t + 0{,}34305\nu_t - 0{,}22434\rho_{t-1} \quad (22)$$

$$r_t^* = 0{,}6642y_t^* + 0{,}0414y_t + 0{,}7191\pi_t^* - 0{,}38178\nu_t + 0{,}28764\rho_{t-1} \quad (23)$$

Stackelberg Equilibrium: Stackelberg equilibrium, also known as leader-follower equilibrium, is another example of uncoordinated policy. The authorities choose the interest rate to minimize loss, taking into account how the other policy authority will respond to the leader's choice of interest rate. M.K. Muinhos et al. took home country as leader. The external reaction function is given by Nash equilibrium, $r_t^* = j_1 s_{2t} + j_2 s_{4t}$, where j_1 and j_2 are the coefficients that depend on weight attributed to output gap variance in loss function [13].

The optimal monetary policy rules to home country, r, is a function of six arguments $f(y, y^*, \pi, \pi^*, \rho_{-1}, \nu)$ while foreigner country has $f(y, y^*, \pi^*, \rho_{-1}, \nu)$ as its rule, r^*. The coefficients of these arguments are taken for the specific case with $\lambda = 1$, the weight attributed to the output gap variance in the loss function. Thus:

$$r_t = 1{,}3458y_t + 0{,}4272y_t^* + 1{,}1036\pi_t + 0{,}3029\nu_t + 0{,}1744\nu_t - 0{,}0996\rho_{t-1} \quad (24)$$

$$r_t^* = 0{,}0940y_t^* + 0{,}6638y_t + 0{,}7191\pi_t^* - 0{,}3817\nu_t + 0{,}2876\rho_{t-1} \quad (25)$$

The leader reaction function has the output gap and inflation rate of foreign country as its arguments while the follower takes only leader's output gap on its optimal reaction function.

Results: volatilities of inflation and output are used to measure the performance of different monetary policy rules following J.B. Taylor, L. Ball [1], L.E.O. Svensson [16; 17]. The policy rule that conducts to less inflation and output volatilities is considered the best one.

M.K. Muinhos et al. made a simulation to obtain the inflation rate, the output gap and the interest rate volatilities as shown in Table 3. Each optimal rule is obtained with parameter values given by Table 2 and taking the same weight attributed to the inflation rate and output gap in the loss function [13].

Table 3.
Volatilities of Inflation rate, Output Gap and Interest rate

	Home country			**Foreign country**		
Equilibrium type	Var (π)	Var (y)	Var (r)	Var (π^*)	Var (y^*)	Var (r^*)
Coordination	3,11	2,57	4,71	2,39	2,46	4,38
Nash	3,25	2,86	3,61	4,43	4,27	2,4
Leader (home)	2,98	2,76	3,98	4,46	4,9	2,61
Leader (foreign)	3,11	3,02	3,72	2,51	2,59	3,8

Table 3 shows that under macroeconomic coordination policy, both countries have less inflation and output gap volatilities than any other types of policy. Nash equilibrium has clearly worse inflation and output gap volatilities than other rules for both countries. But comparing Nash equilibrium with Stackelberg equilibrium, the leader has better performance.

In short, two-country inflation target framework pointed out that macroeconomic coordination is desirable. This result is in agreement with models like the works of M.B. Canzoneri and J.A. Gray [3], D. Fielding and P. Mizen [7], C.E. Walsh [19].

J.B. Taylor brings us a remark about volatility of policy instrument in his analyses of different monetary policy rules [18]. Table 3 shows that the volatility of interest rate is higher in the case of coordination equilibrium. The less volatilities of output gap and inflation rate in coordination equilibrium come from an aggressive policy response to the external shocks. Briefly, the coordination equilibrium conducts to less inflation rate and output gap volatilities but not to interest rate and exchange rate volatilities.

These figures show the efficient frontier of the inflation rate and output gap volatilities under the optimal rules. Each simulation consists of two steps:

1) optimal rules of home and foreign countries are obtained to each type of equilibrium and;

2) using these rules and considering all types of external shocks many sample of variables and then its variances are generated.

The figures also show the increasing volatilities of the inflation rate and output gap while assigning more weight to inflation stabilization (except to macroeconomic coordination policy). This fact occurs when the optimal rule does not consider the reaction of the other country. The simultaneous increasing volatilities of inflation and output do not occur under macroeconomic coordination rule because both countries agree in their objective.

Model's equations point out that the stabilization of output gap and inflation rate occurs in two channels: the interest rate and the exchange rate. Expect coordination rule equilibrium, the lower weight in output (meaning higher commitment with lower inflation) conducts to greater volatilities of inflation and output. In the other hand, higher output gap stabilization does not result in inflation rate destabilization.

Under Nash equilibrium rule, while assigning more weight to inflation stabilization in loss function, the increasing volatilities of inflation rate and output gap are more evident to the foreign country. In other words, a country with "greater" openness and "more" dependent can conduct to the increasing volatilities of the inflation rate and also to the output gap without macroeconomic coordination. For this type of country it is not recommended a strict inflation goal but a flexible target.

The optimal rules coefficients depend on the structural parameters of the model and the weight given to output gap in the loss function. The model points out two structural parameters: the degree of openness and relative size of the country. The simulation takes the parameters as given in Table 2. Needless to say, $a_4 < a_4^*$ characterizes that the home country is less dependent than the foreign country and $b_2 < b_2^*$ means that domestic country is less open compared to foreign country.

Another simulation is made taking the greater degree of openness and greater relative size of two countries than before. The coefficients of these simulations are consistent with the signals and magnitudes of the previous one.

Table 4 shows the coefficients using original parameters and Table 5, using new parameters values.

Table 4.
Nash Equilibrium with $a_4 = 0{,}1 < a_4^* = 0{,}2$ and $b_2 = 0{,}2 < b_2^* = 0{,}4$

	y	y^*	π	π^*	?	ρ_{-1}
R	1,28619	0,11871	1,1217	0	0,34305	-0,22434
r^*	0,09414	0,6642	0	0,7191	-0,38178	0,28764

Table 5.
Nash Equilibrium with $a_4 = 0{,}05 < a_4^* = 0{,}3$ and $b_2 = 0{,}1 < b_2^* = 0{,}5$

	y	y^*	π	π^*	?	ρ_{-1}
r	1,51657	0,071425	1,2459	0	0,26744	-0,12459
r^*	0,11538	0,57524	0	0,6689	-0,41137	0,33445

The more closed is the economy, the less important are the other country's variables, the exchange rate shock, and lagged exchange rate variables. This means that the greater is the degree of openness and dependence of other economy, the smaller is the monetary policy reaction through the interest rate, in response to the inflation rate and the output gap.

The following main conclusions of this paper can be pointed:

1. The macro coordination equilibrium brings about less volatile output and inflation than Nash and Stackelberg equilibrium;
2. The gains of stabilization are greater for more dependent and more open economy;
3. The country which has more information and adopts a leader position presents a more stable economy;
4. In the absence of coordination, a more strict anti-inflation policy results in a greater output volatility, being worse in a more dependent and open economy;
5. A more dependent and open economy responds more aggressively to an exchange rate shock.

Summing up, it became possible to illustrate some questions and derive some conclusions about different aspects of the monetary policy. However, it is worth to stress that some important aspects such as fiscal policy and the structural features of the economy are not taken into account in this paper, but the author believes it to be a starting point for a promising research agenda.

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