International Monetary Coordination and Macroeconomic Stabilization

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Abstract

The paper puts forward an explanation of the policy-mix overshots that is based on the coordination failures between independent monetary and fiscal policies. It shows that international monetary cooperation may reduce the magnitude of stabilization policies and strengthen their efficiency. We consider the usual cooperative solution and the one based on current-account targets à la Williamson. The corresponding monetary rule involves temporary divergence of interest rates in front of asymmetric supply shocks, and if need be, when the current-account targets are revised. That implies temporary deviations of the (cooperative) equilibrium exchange rates.

*JEL classification*: E42; E52; E58; E61; E63; F33; F41; F42

*Keywords*: Fundamental Equilibrium Exchange Rate; International Monetary System; Monetary Policies Coordination; Stabilization Policies

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1 Introduction

The floating of the main currencies modified noticeably the macroeconomic policy-making in the seventies: free from the obligation to defend their exchange rate, policies were more sought, but also more inflationary, causing public deficits, and finally they were less efficient against unemployment\(^1\). That supported the idea that markets work better without macroeconomic policies, and encouraged academic researches that postulated the efficiency of competitive mechanisms and delivered therefore a negative vision of macroeconomic policies: either they were useless, or they were inflation-biased because of the temptation to monetize deficits or get extra output. That literature gave rise to new standards for macroeconomic governance, like monetary policy "conservatism", and public deficit limitations.

Yet the deterioration of the United States public finances since the beginning of the present decade, as well as the trials of the European stability pact, shows that it is difficult to hold the line of conduct. We suggest an explanation that is not based on the inflationist bias hypothesis, but rather on the coordination failures between independent monetary and fiscal policies.

\(^1\)"The collapse of Bretton Woods [...] removed the traditional anchor for monetary and fiscal policies. In the absence of an adequate nominal anchor and a coherent operating strategy for policy, the 1970s became a decade of big budget deficits and high inflation, as policy was cut loose from its moorings. And with the failure of policy makers to articulate an alternative monetary anchor and an adequate framework for macroeconomic policy generally, that policy grew increasingly ineffectual". Eichengreen & Sussman (2000, p 36).
etary regime has important effects on the efficiency of stabilization policies (McKibbin & Sachs [1988], Muet [1998], Sterdyniak & Villa [1993], Capoen, Sterdyniak & Villa [1994], McKibbin & Bok [1998])². As McKibbin & Sachs (1988) pointed out, "the cross-country transmission of fiscal policy is affected in crucial quantitative ways according to the global monetary arrangement in which the fiscal expansion takes place". In a more recent study of the monetary cooperation issues between Europe and the United States, Eichengreen and Ghironi [2002] noticed "When the Fed and the ECB cooperate, [...] they move jointly their instrument less aggressively. In turns, this causes governments to be less active".

We extend these results in the following directions. First, we show from a positive point of view that, if the governments and the central banks adjust their instrument independently of each other, the monetary and fiscal responses to a shock may be very excessive because of instruments redundancy and negative externalities. We show then from a normative perspective that coordinating monetary reactions solves the instrument redundancy problem and leads to complementary interactions between monetary and fiscal instruments, at both national and international levels. We consider the usual cooperative solution and the one based on current-account targets à la Williamson & Miller [1987].

The corresponding monetary rule involves temporary divergence of interest rates

²See also Bordo & Schwartz [1997] and Ghosh & al. [1996] for an historical assessment of the link between exchange rate regimes and macroeconomic performances. Laskar [2001, 2003] provides a complementary discussion concerning the need for fiscal coordination in monetary unions compared with flexible exchange rate regimes.
in front of asymmetric supply shocks, and if need be, when current-account targets are revised. That entails temporary deviations of the equilibrium exchange rates, or, when the cooperative objectives are current-account targets, temporary deviations of the "fundamental equilibrium exchange rate".

In section 2 we present a simplified two-country model and discuss the issues of non cooperative monetary and fiscal responses for a decentralized international monetary system. Section 3 studies the consequences of monetary cooperation with respect to the magnitude and efficiency of stabilization policies. Section 4 focuses on the current-account target solution. Section 5 concludes.

2 Stabilization and instability in a decentralized monetary system

Strategic interactions between stabilization policies may be studied in a two-country framework with an exogenous "rest of the world". This approach proves to be helpful as a first approximation of interaction between relatively small economies, because their fluctuations have a negligible impact at the world level. By contrast, as long as large economies are considered, the assumption that the "rest of the world" absorbs externalities without reacting is quite problematic. A solution may be found through modelling the "rest of the world" reactions, but it would be too much caricatural, besides it would weigh algebra.

It seems to be better to think about the two countries interactions as if there

\[^{3}\text{See Levin [1984], De Grauwe [1990], De Bonis [1994], Muet [1995].}\]
were no "rest of the world", because this enforce them to manage their own externalities\textsuperscript{4}.

Thus, we consider a symmetric two-country model\textsuperscript{5}, where all parameters are positive and identical across countries, and where output prices and exchange rate are normalized to one. We take the logarithm of the variables, except interest rates and the expected rate of inflation.

\begin{align}
\forall i & = 1,2 \\
q_i & = \eta g_i + \eta a_i - \kappa (p_i - s_{ij} - p_j) + \lambda q_j - \sigma (r_i - p_i), j \neq i \quad (1) \\
p_i & = v q_i + w_i - v_i \quad (2) \\
w_i & = \theta p_{e_i}^\alpha + \psi q_i \quad (3) \\
p_{e_i} & = \gamma_i p_i + (1 - \gamma_i) (s_{ij} + p_j) \quad (4) \\
r_i & = r_2 + s_{12}^\alpha - s_{12} \quad (5)
\end{align}

The first equation describes the equality between aggregate output \((q_i)\) and aggregate demand, which depends on the relative price of output \((p_i)\) represents the price of output in country \(i\), \(s_{ij}\) is the exchange rate), foreign demand \((q_j)\), the real interest rate \((r_i - p_i)\), and the government expenditures \((g_i)\); \(a_i\) is a demand shock.

The price equation (2) results from the supply of goods: \(q_i = \frac{1}{\theta} (p_i - w_i + v_i)\),

\textsuperscript{4}Eichengreen and Ghironi [2002] consider a three-country model (the USA and the core and periphery of the European economy), without "rest of the world".

\textsuperscript{5}The main features are similar to those of Laskar [2001, 2003] and, except we abstract from fiscal-distortion effects, to those of Eichengreen and Ghironi [2002].
which is a function of the real cost of labour \((w_i - p_i)\); \(v_i\) represents a supply shock. Equations (3) and (4) give the nominal wage \((w_i)\), and the consumer price index \((p_{c_i})\).

The balance of payments requires the current account to be offset by net capital flows:

\[
bc_1 = f (r_2 + s_{12}^* - s_{12} - r_1)
\]

where \(bc_1\) is the current account of country 1 \((bc_2 = -bc_1)\). Assuming perfect capital mobility \((f \to \infty)\), we get equation (5).

We consider the temporary effects of stochastic shocks on a stationary system (so that \(p_{i, t}^o = s_{12}^o = 0\) without inflationary trend \((p_i = 0)\). Hence, wages react to output deviations, but not to the current changes of price indexes.

Substituting equations (3) into equations (2) yields a system with seven equations that represent the temporary deviations of national outputs, price indexes, consumer price indexes, and the deviation of the exchange rate, as functions of the shocks and policy instruments.

In front of a shock, authorities of each country move their respective instruments \((g_i\) and \(r_i)\). We assume these adjustments to minimize the following loss functions:

\[
L_i = \frac{1}{2} (q_i^2 + \beta p_{c_i}^2) , \ i = 1, 2
\]

The economic-policy game has fundamentally two objectives (to minimize \(L_1\) and \(L_2\)), though there are four targets. Since four instruments are available, redundancy of instrument may arise when authorities respond independently of
each other. The problem varies according to the type of the shock.

Proposition 1

If authorities respond to a demand shock independently of each other, the number of solutions such as both countries minimize simultaneously the losses given by equations (6) is infinite.

Proof

To minimize equations (6) only requires two instruments. For example, a demand shock could be perfectly countered through fiscal policies \( g_1 = -a_1, g_2 = -a_2 \), as equations (1) let see. However, monetary responses complicate the stabilization problem\(^6\). Notice first that the fiscal best responses: \( g_1^* (a_1, r_1, r_2), \)
\( g_2^* (a_2, r_1, r_2) \), which minimize (6) for given values of \( r_1 \) and \( r_2 \), lead to:

\[
\begin{align*}
i & = 1, 2, \ j \neq i, \ \mu = \vartheta + \upsilon \\
q_i & = \mu \beta (1 - \gamma) \frac{\mu \kappa + (\gamma + (1 - \gamma) \lambda)(r_i - r_j)}{\mu^2 \beta (2\gamma - 1)(((1 - \gamma) \lambda + \gamma) + \mu \kappa) + 1 + \kappa \mu} \\
p_i & = \mu^2 \beta (1 - \gamma) \frac{\mu \kappa + (\gamma + (1 - \gamma) \lambda)(r_i - r_j)}{\mu^2 \beta (2\gamma - 1)(((1 - \gamma) \lambda + \gamma) + \mu \kappa) + 1 + \kappa \mu} \\
s_{12} & = r_2 - r_1
\end{align*}
\]

As we can see, any monetary policy combination that verify the condition \( r_1 = r_2 \) get the zero-loss ideal outcome. Since fiscal policies \( (g_1^*, g_2^*) \) become in this case: \( g_i^* = -a_i + \frac{\sigma}{\eta} r_1, \ i = 1, 2 \), there is as much Nash equilibria as possible values of \( r \).

\[^6\text{This does not arise in Eichengreen and Ghironi (2002) because they suppose implicitly that monetary and fiscal authorities coordinate their reaction within each country. This issue is discussed below.}\]
Proposition 2

If authorities respond to a supply shock independently of each other, there is no solution such as both countries minimize simultaneously the losses given by equations (6).

Proof

The fiscal responses which minimize equations (6) in front of a supply shock have the form: $g_1(v_1, v_2, r_1, r_2)$, $g_2(v_1, v_2, r_1, r_2)$. Substituting into equations (1) to (5) and using (6) yields monetary reaction functions of the form: $r_i = r_j + f(v_i, v_j)$, $i = 1, 2$, $i \neq j$. These inconsistent reactions make the system unstable, since there is no equilibrium solution$^7$.

However, because we have assumed that, within a specific country, each authority employs fully its instrument without taking into account the fact that the other does the same thing, the game above is a quite unrealistic representation of the national policy mix. It would suppose a total lack of coordination. In practice, we can expect that, because they have entrusted an objective to their central bank (to minimise the social loss function, denoted $L_{r_i}$ below), the governments actually restrain their own response (in order to save deficit for example). Such a restriction may be modelled by introducing the fiscal instrument into the governments loss functions ($L_{g_i}$):

$^7$In a model with a passive "rest of the world", this inconsistency would vanish because externalities would be exported without any conflict.
\[ L_{g_i} = \frac{1}{2} \left( (1 - \varphi) \left( \frac{q_i^2}{\varphi} + \beta p_{c_i}^2 \right) + \varphi g_i^2 \right), \quad 0 < \varphi \leq 1 \quad (7) \]
\[ L_{r_i} = \frac{1}{2} \left( \frac{q_i^2}{\varphi} + \beta p_{c_i}^2 \right), \quad (8) \]

The fiscal and monetary reactions derived from (7) and (8) become as less redundant as \( \varphi \) go to one. In the extreme case (\( \varphi = 1 \)), fiscal policies are disabled (\( g_1 = g_2 = 0 \)), and there remain only two active instruments and two national objectives.

We have simulated the reactions of the model to demand and supply shocks\(^8\). Note that the monetary-reaction coefficient \( \left( \frac{\partial r^*_j}{\partial r^*_i} \right) \) increases as the fiscal-restraint coefficient decreases \( \left( \frac{\partial r^*_j}{\partial r^*_i} \rightarrow 1 \text{ as } \varphi \rightarrow 0 \right) \).

![Monetary-reaction coefficient \( \left( \frac{\partial r^*_j}{\partial r^*_i} \right) \)](image)

**figure 1**

Since the monetary-reaction functions become consistent with each other for any strictly positive value of \( \varphi \), calculations yields a unique solution, even in

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\(^8\)We set \( \beta = 0.4 \) and \( \gamma = 0.9 \). Other parameters are derived from Ghironi & Giavazzi (1997) : \( \kappa = 2.9; \lambda = 0.3; \sigma = 1.3; \eta = 3.2; \mu = 0.34 \).
front of supply shocks (fig. 2), but the instruments may respond violently if the fiscal-restriction coefficient is too low (that depends on the numerical values of the other parameters).

Supply shock \((v_1 > 0)\)

Monetary and fiscal equilibrium responses

Monetary-response coefficient \(\frac{\partial r^*_1}{\partial v_1}\)    Monetary-response coefficient \(\frac{\partial r^*_2}{\partial v_1}\)

Fiscal-response coefficient \(\frac{\partial g^*_1}{\partial v_1}\)    Fiscal-response coefficient \(\frac{\partial g^*_2}{\partial v_1}\)
Demand shock ($a_1 > 0$)

Monetary and fiscal equilibrium responses

Monetary-response coefficient ($\frac{\partial r_1^*}{\partial a_1}$)

Fiscal-response coefficient ($\frac{\partial g_1^*}{\partial a_1}$)

Monetary-response coefficient ($\frac{\partial r_2^*}{\partial a_1}$)

Fiscal-response coefficient ($\frac{\partial g_2^*}{\partial a_1}$)

The responses to a shock on $v_2$ and $a_2$ follows by symmetry: $\frac{\partial r_2^*}{\partial v_2} = \frac{\partial r_1^*}{\partial v_1}$, $\frac{\partial g_2^*}{\partial v_2} = \frac{\partial g_1^*}{\partial v_1}$, $\frac{\partial r_2^*}{\partial a_2} = \frac{\partial r_1^*}{\partial a_1}$, $\frac{\partial g_2^*}{\partial a_2} = \frac{\partial g_1^*}{\partial a_1}$.

Restraining instruments thus prove to be stabilizing, in the sense that it avoids non-existence or multiple equilibria problems, even when the restriction
is partial ($\varphi < 1$). Nonetheless, if the restraint is too weak, fiscal and monetary responses may be extremely violent, especially in front of supply shocks.\textsuperscript{9,10}

The following section discusses how cooperative monetary policies influence the responses magnitude.

### 3 International monetary cooperation

Assume now that central banks adjust jointly their instrument $r_1$ and $r_2$ so as to minimize the average loss function:

$$L_{r_1,r_2} = \frac{1}{2} \left( \frac{1}{2} (q_1^2 + \beta p_c^2) + \frac{1}{2} (q_2^2 + \beta p_c^2) \right)$$

(9)

while fiscal instruments minimize (7).

The simulations suggests that, especially when the fiscal-restraint coefficient is small, responses are less violent than in the previous case.

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\textsuperscript{9}Since fiscal policies work through the same channels that demand shocks, they tend to cancel their effects in both countries (perfect stabilization is nonetheless not possible when instruments are restrained). That is why the reactions to demand shocks are not disproportionate, even when instruments are weakly restrained.

\textsuperscript{10}In any case, monetary reactions are bounded since interest rates can not be negative, despite the model does not take it into account.
Supply shock \((v_1 > 0)^*\)

Monetary and fiscal equilibrium responses

(International monetary cooperation)

Monetary-response coefficient \(\frac{\partial r^*_1}{\partial v_1}\) coop
Monetary-response coefficient \(\frac{\partial r^*_2}{\partial v_1}\) coop

Fiscal-response coefficient \(\frac{\partial g^*_1}{\partial v_1}\) coop
Fiscal-response coefficient \(\frac{\partial g^*_2}{\partial v_1}\) coop
**Figure 3**

This result comes from the complementarities that monetary cooperation produces: when monetary reactions jointly minimize the collective loss (equation 9), they implicitly fight the inefficiencies that fiscal policies may produce through minimizing independently their national loss (equation 7). Monetary
cooperation works against fiscal negative externalities. Therefore, at equilibrium, fiscal and monetary responses prove to be less disproportionate. They are also more efficient, in the sense that the average loss (which represents the expected loss as long as shocks are equally distributed across countries) is lower when monetary policies cooperate (fig. 4)\textsuperscript{11}.

Supply shock ($v_1 > 0$)

Gain from international monetary cooperation* measured from (6)

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{diagram}
\caption{Graph of Supply Shock ($v_1 > 0$) and Gain from International Monetary Cooperation (from (6))}
\end{figure}

\textsuperscript{11}As regards demand shocks, the simulations (not reproduced) reveal extremely weak gains in comparison.
measured from (7)

Country 1

Country 2

Country 1 + Country 2

figure 4

*The (relative) gain has been measured as \( \frac{L_i - L_{icoop}}{L_i} \). The average gain is \( \frac{1}{2} \left( L_1 + L_2 \right) - \frac{1}{2} \left( L_{1coop} + L_{2coop} \right) \); it differs from the average of the relative national gains because the gain in country 2 is low in comparison to those of country 1 (which is hit by the shock \( v_1 \)).

The gain from monetary cooperation, which is especially strong when the fiscal-restraint coefficient is small, may be interestingly linked to the discussion about the redundancy of instruments. Equation (9) introduced a third objective
function into the game, besides the national objectives. Since interest rates responses are now coordinated, there are three independent instruments. Thus, even if the governments do not restrain their response, we can expect to find a solution of the game in front of supply shocks.

Proposition 3

If fiscal policies minimize their national loss function without restraining their instrument (equations 6) and monetary policies cooperate in order to minimize (9), the number of possible Nash equilibria is infinite whatever the shocks, but cooperation permits to select one of them.

Proof

Let us consider the solutions \( g_1^*(a_1, v_1, v_2, r_1, r_2) \) and \( g_2^*(a_2, v_1, v_2, r_1, r_2) \) that minimize equations (6), taking equations (1) to (5) into account. Two interest rates are available for the common objective given by equation (9), with the result that whatever the value of \( r_j \), a value of \( r_i^* \) which minimizes (9) can be found:

\[
 r_i^* = r_j + \frac{1}{2} \frac{1 - 2\gamma}{1 - \gamma} (v_i - v_j), \quad i = 1, 2, j = 1, 2, j \neq i \quad (10)
\]

Substituting \( r_i^* \) into fiscal responses then yields \( g_1^*(a_1, v_1, v_2, r_j) \) and \( g_2^*(a_2, v_1, v_2, r_j) \).

There are thus as many solutions as possible values of \( r_j \), but since monetary authorities jointly adjust the interest rates, they can select \( r_j = r_j^* \) so as to anchor the system\(^\text{12}\). Monetary cooperation take then the form of a simple monetary

\(^\text{12}\)They can for example select \( r_j^* \) so as the deviation of each interest rate (given equation 10) has the same magnitude: \( r_j^* = -\frac{1}{4} \frac{1 - 2\gamma}{1 - \gamma} (v_i - v_j) \Rightarrow r_i^* = \frac{1}{4} \frac{1 - 2\gamma}{1 - \gamma} (v_i - v_j) \), which
rule (equation 10), which implies that interest rates temporarily diverge in front of supply shocks\textsuperscript{13}.

Remarks

i) Monetary cooperation works as if it wanted to prevent national divergences in front of asymmetric shocks. It can be shown that the monetary rule of equation (10) applies, for any given value of $r_j^*$, when $r_i^*$ is set so as $q_1 - q_2 = 0$, or when it is set so as $p_{c1} - p_{c2} = 0$.

ii) If monetary policies cooperate in order to stabilize the exchange rate ($s_{12} = 0$), they do not apply the interest rate rule of equation (10), but rather $r_i^* = r_j^*$ (from equation 5), with the result that asymmetric shocks produce temporary divergences of national outputs and consumer price indexes. Since these policies do not minimize the collective loss function (equation 9), fixed pegs prove to be unsatisfactory forms of monetary cooperation from the stabilization point of view.

\textsuperscript{13} When the governments do not restrain their instrument, they perfectly can cancel the demand shocks as long as monetary policies are disabled (see footnote n\textsuperscript{9}). If monetary instruments respond, perfect stabilization is possible provided that monetary authorities anchor the system, which implies $r_i^* = r_j^*$ according to equation (10). In this case, the governments respond to interest rates deviation, besides the shocks (see equation 1).
4 International monetary cooperation and current-account targets

Solving the system of equations (1) to (5), (7) and (9) gives the equilibrium (cooperative) real exchange rate:

\[ p_{c_1} - s_{12} - p_{c_2} = \frac{1}{2} (1 - 2\gamma) \frac{v_1 - v_2}{1 - \gamma} \]

which deviates along with asymmetric supply shocks. These shocks hence influence the national current accounts, and therefore concern the international financial equilibrium. This topic is related with the literature on fundamental equilibrium exchange rates (FEER). That literature aims to design a set of consistent current-account targets (and therefore a set of FEER), which would organize a consensual distribution of international capital resources when markets forces fail to do it. From this cooperative point of view, monetary policies could be designed so as to adjust, if need be, the current accounts to their target.

Proposition 4

If fiscal responses minimize the national loss functions without restraint (equation 6) and monetary policies agree about the current-account target, the number of possible Nash equilibria is infinite whatever the shocks, but cooperation permits to select one of them.

Proof

The demonstration is similar to those of proposition 3, but the objective of monetary policies must be replaced by the condition \( b_{c_1} = \overline{bc}_1 \), where \( \overline{bc}_1 = -\overline{bc}_2 \)

\(^{14}\)Williamson (1994) provides a theoretical and empirical overview on FEER.
is the deviation of the common current-account target. Modelling the current-account deviation as: $bc_1 = \zeta(q_2 - q_1) - \rho(p_1 - s_{12} - p_2)$, then leads to the cooperative monetary rule:

$$r^*_1 = r^*_2 - \Upsilon bc_1 + \Gamma (v_1 - v_2) \quad (11)$$

where $\Upsilon$ and $\Gamma$ depend on the parameters of the model.

Solving for the (fundamental) exchange rate deviation yields

$$s^*_{12} = \zeta \overline{bc}_1 + \xi (v_2 - v_1) \quad (12)$$

where $\zeta$ and $\xi$ depend on the parameters of the model. Note that despite the current-account target only vary in the long run, the fundamental exchange rate may vary in the short run (in front of asymmetric supply shocks).

Remark

Following Williamson, exchange rates reach the fundamental values when national outputs ensure full employment (internal balances) and current accounts coincide with the targeted values (external balances). It can be shown that if $\beta \to 0$ (i.e. fiscal policies only focus on output stabilization), then $\zeta \to \frac{1}{\rho}$ and $\xi \to 1$ (and $\Upsilon \to \frac{1}{\rho}, \Gamma \to 1$).

5 Conclusion

According to our discussion, the magnitude of monetary and fiscal responses to shocks, especially supply shocks, depends on the way the instruments are
managed. When authorities aim to minimize their loss independently of each other, instruments may mutually hamper, with the result that responses may be very excessive (this problem goes unnoticed in models where externalities are passively absorbed by the "rest of the world").

A first way to strengthen the efficiency of stabilization policies is to coordinate monetary and fiscal policies within the countries (internal cooperation), but it seems difficult to do as far as central banks decide independently how to use their instrument for stabilization purposes. In practice however, most governments assign objectives to their central banks, and therefore probably restrain their fiscal response in order to avoid a redundant use of instruments. We showed that such restraints can solve part of the problem, although reactions may be violent if it is not strong enough.

A second way can be found through international cooperation. We found that monetary cooperation simultaneously solves the problem of redundancy and weaken the collective impact of fiscal negatives externalities. Since monetary responses become complementary (not only to each other, but also to those of the governments), reactions at equilibrium are weaker and losses are lower, especially when fiscal responses are weakly restrained. In this sense, monetary cooperation strengthens the stability and efficiency of macroeconomic policies. This result contrasts sharply with the conclusion of Pappa (2004): ". . . the ECB has little to gain by coordinating with the Fed." The reason probably hangs on the attention we have paid to the interactions between monetary and fiscal policies, in addition to monetary interactions, which reveals an important
aspect of the potential benefits of international monetary cooperation.

The cooperative solutions we have considered work as if they aimed to prevent consumer price indexes and national outputs to diverge across countries. They lead to a simple monetary rule, which involves temporary divergence of interest rates in front of asymmetric supply shocks, and if need be, when the current-account targets are revised. International monetary cooperation therefore entails temporary deviations of the equilibrium exchange rates (the fundamental ones in Williamson’s meaning). However, notwithstanding the simplicity of the rule, the crucial problem of the anchorage remains. As we have seen, there is potentially an infinite choice of cooperative equilibria. This raises the question of the interest rates levels at which the cooperative relation between interest rates hold; an old and always central topic for research on international monetary systems.

6 References


McKibbin W.J. and Sachs J., (1988), "Coordination of Monetary and Fis-


