The advantages of introducing an exchange rate target within the statutes of the European Central Bank

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Abstract

With the help of a Keynesian dynamic macro-economic model in an open economy, this paper aims at studying the possible consequences of introducing an exchange rate target within the statutes of the European Central Bank. Even if we assume zero cooperation between the ECB and the various budgetary authorities, it appears that such a target would have only slight implications for the stabilization of demand or for the mitigation of external supply shocks. But in case of internal negative supply shocks, this scheme could limit the conflict of goals between the monetary and budgetary authorities, a conflict that could lead to excessive economic policies, while it would at the same time reduce the slowdown in economic activity. Finally, in the case of positive shocks on interest rates in the rest of the world, an exchange rate target could have advantages which are different from those implied by a goal of limiting the variation in interest rates. Such a scheme could increase the role of the central bank in the control of restrictive policies designed to stabilize these shocks. The paper then concludes that such an exchange rate target could limit variations in economic activity triggered in the monetary union by foreign shocks.

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1 Introduction

Many economic studies have tried to estimate the consequences of the creation of a monetary union on the international volatility of exchange rates, and to compare the potential volatility of the exchange rate of a unique currency with the volatility of ancient national currencies after a monetary unification [for example: Bartolini and Bodnar (1996), Benassy, Mojon and Pisani-Ferry (1997), Benassy and Pisani-Ferry (1998), Creel and Sterdyniak (1998), Fitoussi and *alii* (1999), Van Oorschot, Vijselaar and Voormeulen (2000)]. Some studies have thus tried to estimate the potential volatility of the unique European currency, the euro, and to analyze in which proportion the creation of the Economic and Monetary Union (EMU) could be a factor of increase in the volatility or of stabilization of exchange rates. But the results of these studies are generally divided.

Indeed, Fitoussi and *alii* (1999) underline that many phenomenons act in opposite directions regarding the volatility of the common currency, in a monetary union. A little country must be worried about stabilizing its exchange rate, in order to avoid large inflationary (in case of a depreciation in its exchange rate) or commercial (in case of an appreciation) shocks. But this is not the case of the European monetary zone, whose degree of openness is only slightly above 10% of GDP, and that represents then a "big relatively closed country". Because of the reduced openness of Europe, the European Central Bank (ECB) should then be less worried about the exchange rate of the euro [Artus (1997), Cohen (1997), Benassy, Mojon and Pisani-Ferry (1997)]. The Euro-zone could use its interest rates in order to stabilize its activity or its inflation without much worrying about fluctuations in the exchange rate, and in these circumstances, the volatility of the euro could be relatively high. Afterwards, in case of a conflict of goals between the monetary and budgetary authorities for the stabilization of the negative and recessive supply shocks, a bad management of the European "policy-mix" could imply an overly restrictive monetary policy and excessive increases in interest rates. This risk of rough increases in the interest rates and of an appreciation in the common currency could also increase the instability of the euro. Finally, Creel and Sterdyniak (1998) mention that the paralysis of the budgetary policies in Europe due to the Stability and Growth Pact could also increase the monetary activism, and consequently the volatility of the euro.

Nevertheless, Martin (1997) estimates on the contrary that in the context of the EMU, the big countries are less incited to use the exchange rate in a strategic way in order to stabilize the real economy, thus limiting the volatility of the euro. Indeed, the monetary policy of the ECB now reacts to an average of the conjuncture conditions of the European countries. Its utilization is then more limited than if the monetary policies were differentiated in all the countries, and its efficiency is also less than that of an independent central bank. Indeed, the variation in the common interest rate now responds to an "average" conjuncture, and it is therefore less efficient to address the situation of a specific country. If the monetary policy and the interest rates fluctuate less, this could then contribute to a stabilization of the euro's exchange rate.

Let's now take some examples of the theoretical studies made to estimate the volatility of the euro. Masson and Turtelboom (1997) or Alogoskoufis and Portes (1997) show that the European monetary unification should increase the variability

of the dollar in relation to the euro, in comparison with its volatility with the ancient national currencies. Benassy and Pisani-Ferry (1998) also find the same consequence of European monetary unification in comparison with a fully flexible exchange rate system. Nevertheless, in comparison with the asymmetrical fixed exchange rate system in place before 1999 in Europe (the EMS), their result is more ambiguous. In the same way, Creel and Sterdyniak (1998) show that a surplus of volatility of the euro should only appear for the demand shocks or the external supply shocks, whereas on the contrary, in case of internal supply shocks, the monetary unification should imply a clear reduction in the volatility of the exchange rates. Nevertheless, these results could be reversed in the case of a large sensibility of the intra-European commerce to relative prices.

The results concerning the potential volatility of the euro are then quiet divided. Nevertheless, the EMU is a monetary zone that is more closed than each of the member countries taken individually. In these conditions, the variations in the global commercial position of the European monetary zone, and the inflationary consequences of the variations in the euros's exchange rate, could lose some importance in the eyes of the European political decision-makers. Moreover, whereas the mistaken variations in the dollar in relation to the European currencies could be at the origin of tensions in the EMS framework, this is no longer the case in the context of the EMU where a unique European currency does exist. The ECB could then be tempted to neglect the fluctuations in the euros's exchange rate.

But beyond these interrogations on the potential volatility of the euro, we can also ask ourselves the following question. What could be the consequences if the ECB fully neglects fluctuations in the value of the common currency? Institutionally, the main objective of the ECB is to preserve the price stability, and its statutes do not mention any exchange rate target. Indeed, the hypothesis that the ECB could target the exchange rate has been studied however rejected by the European Monetary Institute in 1997. More precisely, article 109 of the Maastricht Treaty (article 111 of the Treaty of Amsterdam) gives the ECOFIN Council the power to formulate general orientations of exchange policy, and eventually to conclude formal agreements in relation to third currencies, as long as the external policy does not affect the main goal of price stability of the ECB. Nevertheless, this article specifies that the ECB remains the only institution responsible for the development of monetary policy, and then for the daily management of the parity of the euro through its influence on interest rates. Moreover, the exchange rate is one of the structural indicators comprised in the "second pillar" of the ECB's monetary strategy, which allows the evaluation of potential future levels of the inflation. The distribution of the tasks for the determination of the euro's exchange rate implies then a certain institutional haze on the respective responsibilities of the ECB and of the governments of the member states of the EMU.

In these conditions, even if the statutes of the ECB do not give it any explicit objective of exchange, the euro's exchange rate is considered as a question of common interest, which the European authorities must jointly take into account. Indeed, in the context of a simple Taylor rule, a central bank modifies its interest rates only according to the differential between the effective and desired inflation rates and to the differential between the effective and potential levels of production. But afterwards, some rare studies have also analyzed, in the context of an increased Taylor rule, the

empirical reactivity of the interest rates to a variation in the effective exchange rate in relation to the target rate. And in this paper, from a quite different theoretical point of view, we mainly want to determine if it is necessary to give a non negligible weight to the exchange rate target in the loss function of the central bank of a unified monetary zone. Indeed, fluctuations in the exchange rate are partially taken into account in the traditional loss function of a central bank, by the way of their consequences on the level of economic activity and on the inflation. Nevertheless, we can wonder if it would not be useful, and even desirable, that when fixing the level of its interest rates, the ECB explicitly takes into account a supplementary exchange rate objective.

At first, we can wonder what are the traditionally advanced arguments that plead for an action of the central bank aiming at limiting the fluctuations of exchanges. Some studies have insisted on the dangers of a misalignment of the euro's exchange rate. Starting from a theory giving the exchange rate of equilibrium of the European currency, they have tried to compare this rate with its current parity. Nevertheless, this method has some limits. Indeed, does the differential found reflect a real misalignment, or is it appropriated given the specific cyclical factors or the internal economic policy objectives of a country? Does it reflect an economic policy ill-adapted to the economic situation, or a bad perception of this policy? It is exceedingly difficult to be able to draw clear conclusions from the differential found between an exchange rate and its supposed equilibrium level. But in any case, without any reference to a possible exchange rate of equilibrium that is always difficult to determine, what would be the dangers of huge and accentuated fluctuations of the unique European currency?

At the beginning of the existence of the euro, it was greatly depreciated, going from 1.18 dollars in January 1999 to 0.823 dollars in October 2000. And such a depreciation in the European currency includes many risks. First, an important depreciation in the euro can be harmful to the construction of the credibility of the new ECB, as it increases the risks of an imported inflation that endangers its main goal of price stability. Then, it can discourage the capital investment in Europe, as happened in 2000 for example. However, after March 2002, the euro has greatly appreciated, reaching its highest historical value at 1.36 dollars in December 2004. And such an appreciation in the European currency includes other drawbacks. Mainly, it is harmful to the competitiveness of the European export enterprises or to the ones that have subsidiaries in the rest of the world. Despite these risks traditionally mentioned that are associated with important fluctuations in the exchange rate of the European currency, the ECB seemed to neglect any exchange rate target at the beginning of its existence. Indeed, in 1999 as well as in 2000, the variations in interest rates responded more to inflationary risks and to the internal economic situation than to the necessity to stabilize the euro's exchange rate[1]. Nevertheless, during the autumn of 2000, the ECB finally reacted to the continuous depreciation of the euro since its introduction. Then, on September 14th and 22nd and on November 3rd, it intervened on the exchange markets to sustain the euro's exchange rate. But the essential motivation of these interventions remained that this depreciation began to endanger price stability, because of the imported inflation that it implied in a context

[1]See: European Commission (2000), for an analysis of the monetary policy of the ECB determinants in 1999 and 2000.

of increased oil prices.

Indeed, we can underline here that it is difficult for the ECB to take into account an exchange rate target, as the non-sterilized interventions on the exchange markets in order to stabilize the euro directly put into question and are in competition with its internal main objective of price stability. More precisely, it is often not possible to simultaneously attain the internal and external objectives with only one instrument: the interest rate and the monetary policy. Nevertheless, the ECB knows that the euro's exchange rate influences its main goal of price stability, and that the value of the euro determines the price competitiveness and the growth perspectives of the whole Euro-zone[2]. The exchange rate is an important indicator of the inflationary anticipations (through its impact on the import prices), and then of the monetary policy. Afterwards, if the ECB does not at all consider the external goal, the fluctuations in the euro's exchange rate could create distortions in economic activity, be harmful to the efficient allocation of financial resources, and put into question the efficiency and stability of the European financial system[3]. Finally, the instability of the exchange rate could have a prejudicial psychological impact on the perception of the new currency, and be harmful to the credibility of the ECB, even if the latter perfectly plays its legal mandate of preserving price stability.

Beyond these arguments traditionally mentioned to justify an action of the ECB in order to limit the fluctuations in the exchange rate of the European currency, we have chosen in this paper to take interest in another argument that could justify the inclusion of an exchange rate target in the determinants guiding the formation of the European monetary policy. The second section will then present a dynamic Keynesian macroeconomic model able to make clear the risks associated with a negligence of the exchange rate by the ECB that is less often underlined, related to the inefficiency in a non coordinated formation of the European policy-mix. Afterwards, the third section will study the consequences of an absence of exchange rate target for the global economic policies led by the authorities with more precision. The fourth section will then analyze the implications of these policies on the well-being of the economic agents. Finally, the fifth section will conclude by looking at potential advantages, for the European policy-mix, of giving an explicit exchange rate target to the ECB.

2 The model

An abundant economic literature has sought to analyze the interest of integrating an exchange rate target in monetary policy, with the framework of models which integrate the microeconomic foundations of the economic agents' behaviors, so-called from the New International Macro-economy. In this way, Engel (2002) underlines that it is not necessary for monetary policy to target the exchange rate in a PCP (Producer-Currency Pricing) context but that, optimally, it must stabilize the nominal exchange rates in a LCP (Local-Currency Pricing) context, if the markets are segmented. In the same way, Clarida, Gali and Gertler (2001) show that in the framework of a small open economy with nominal rigidities of prices, the central bank can be satisfied with targeting the national inflation and can authorize the exchange rate to fluctuate only if there is a perfect integration of the exchange rate variations in imported goods'

[2]See for example: Buti and Sapir (1998), p.75.

[3]See for example: Van Oorschot, Vijselaar and Voormeulen (2000), p.221.

prices (perfect exchange rate pass through). Finally, Svensson (2000) shows that a flexible inflation targeting, which includes the stabilization of the out-put gap in the goals of the central bank, allows to limit not only the variations in inflation, but also those in economic activity and in the real exchange rate. But all these papers introduce micro-foundations in the models at the cost of greater complexity. That is why we have chosen to use a more simplified macroeconomic model, in the tradition of Ball (1998).

Let's consider a Keynesian log-linear model with two countries: the home (h) and the foreign (f) countries, forming a monetary union. The nominal wages are supposed to be rigid, the production is determined by the demand, but the prices are flexible. We also suppose that the mobility of capital is perfect between the two countries of the monetary union, but imperfect with the rest of the world. And we make the hypothesis that there exists a single financial asset that continuously yields the current interest rate, and that the countries are completely identical (with the same size, same behaviors, and same loss functions).

Let's mention that the quantity of money in circulation is absent of our model[4]. Indeed, it seems to us preferable to consider that today, the European Central Bank acts via its interest rates for main refinancing operations on the level of the interest rates in the economy in order to control inflation, more than it stabilizes the quantity of money in circulation. We will also suppose that monetary policy fixes nominal interest rates at each period, and we will interpret the independence of the central bank based on its power to fix interest rates according to its own goals. Concurrently, the government of each country tries to satisfy its goals with the help of its national budgetary policy. Finally, in our model, we will suppose that in a monetary union, the interest rates are the same in the two countries, without any particular risk premium associated with the budgetary situation (particularly in terms of public debt) of one of the member countries.

2.1 The basic equations of the model

In this model, all the variables are expressed in logarithms, except the interest rates, which are expressed in percentages. All the variables are expressed in relative gaps to their long run equilibrium values. In order to determine the importance of the exchange rate target for the central bank, we have chosen to use a dynamic model, like Ball (1998) or Svensson (1997), and contrary to Capoen and *alii* (1994) for example.

Let's take the following equations for the home country (h):

$$\begin{aligned} y_{h,t} = {} & \lambda y_{h,t-1} + \eta g_{h,t} - \sigma(i_{t-1} - \pi_{h,t-1}) + \beta(\pi_{f,t} - \pi_{h,t}) + \varsigma(e_t + \pi_t^e - \pi_{h,t}) \\ & + \tau y_{f,t} + \rho y_t^e - d_{h,t} \end{aligned} \tag{1}$$

The change in economic activity is firstly a function of the lagged variation in economic activity. Then, it depends on the change in the public expenditures of the country. The private demand is also a decreasing function of the lagged real interest

[4]On the contrary, Bensaïd and Gravel (1993) suppose that the aim of the central bank is to stabilize the global supply of money, and they introduce a demand of money. In the same way, Muet (1995) uses a function of money demand in his model. Let's also mention that Svensson (1997) studies the case of money growth targeting in comparison with direct inflation targeting.

rate. Svensson (2000) and Ball (1998) also mention that monetary policy influences the activity by the aggregated demand channel, but with a lag of one period.

As regards to the net exports of a country, they are an increasing function of its price competitiveness. The higher the inflation is in the other country of the monetary union (f) or in the rest of the world in comparison with the inflation in the home country, the higher the net exports are. The national exports are also an increasing function of the economic activity abroad, which encourages foreign imports. Finally, the change in economic activity is a decreasing function of a negative specific demand shock.

As we are interested in the regulation of the conjuncture, our model supposes that it is the demand of goods that determines the production.

$$\pi_{h,t} = \pi_{h,t-1} + vy_{h,t-1} + \phi\pi_{f,t-1} + \varphi(e_{t-1} + \pi^e_{t-1}) + s_{h,t} \tag{2}$$

Change in inflation is an increasing function of the lagged inflation and of the lag of output, as demand is a manifestation of tensions on the use of production capacities. Monetary policy needs then two periods to influence the inflation by the way of the aggregated demand channel: a period to modify the economic activity, and another period for this to modify the prices, as in Ball (1998) or Svensson (2000). Nevertheless, the monetary authority can also influence the exchange rate by the mean of its interest rates (see equation (3)). And as a variation in the exchange rate implies a change in inflation only one period latter, this is the quickest channel. More precisely, the inflation is an increasing function of the lagged inflation abroad, in the other country of the monetary union or in the rest of the world, by the mean of the prices of the imported intermediate goods. Finally, the inflation is also an increasing function of a negative specific supply shock.

$$e_t = \chi(i^e_t - i_t) \tag{3}$$

If the nominal interest rate exterior to (i^e) is superior to the interest rate in the monetary union (i), the better return of the assets in the rest of the world implies instantaneously out-goings of short run capital from the monetary union, and a depreciation in the exchange rate (which corresponds to an increase in e).

$$E_t[e_{t+1}] = \chi\left(i_t - i^e_t\right) \tag{4}$$

But according to the Uncovered Interest Rate Parity (UIRP) condition, if the nominal interest rate in the rest of the world (i^e) is superior to the one applied in the monetary union (i), the economic agents anticipate a future appreciation in the common currency (a decrease in e) in order to recover the equilibrium and to stabilize the movements of capitals. That is to say that the exchange rate will automatically come back to its natural level of equilibrium.

Finally, $E_t[e_{t+1}] + e_t = 0$, and the anticipated global variation in the exchange rate after two periods is null. The exchange rate will finally return to its long-run level, which is here normalized to zero. So, the global variation in the nominal interest rates in the monetary union must be equal to the global variation in those rates in the rest of the world, in order to stabilize the exchange rate. We therefore have:

$$E_{t-1}[i_t^e] + i_{t-1}^e = E_{t-1}[i_t] + i_{t-1} \tag{5}$$

Within period t: (i_t): nominal interest rate in the monetary union; (e_t): nominal exchange rate of the common currency [1 unity of foreign currency = e units of the common currency]; (π_t^e): inflation in the rest of the world; (y_t^e): real economic activity in the rest of the world; (i_t^e): nominal interest rate in the rest of the world.

And for the home country h (the variables are the same for the foreign country f): ($y_{h,t}$): real economic activity; ($g_{h,t}$): public expenditures; ($\pi_{h,t}$): inflation; ($d_{h,t}$): negative demand shock (white noise); ($s_{h,t}$): negative supply shock (white noise).

And where $E_t[.]$ is the operator of anticipation in the period t of a given economic value.

We will also suppose that all the parameters are positive but smaller than one.

Monetary policy then acts with a delay of one period on the economic activity (demand channel) and of two periods on the inflation (see Annex A). However it also acts through the exchange rate channel, which is the quickest. The effect is then immediate on the exchange rate and on the level of economic activity, but it is canceled as soon as the following period because of the UIRP condition. Nevertheless, there remains a small expansive effect of the former increase in interest rates in the monetary union, for example, because the temporary appreciation in the exchange rate of the common currency has better limited the spiral of increases in prices in the countries of the monetary union. More precisely, the temporary better price competitiveness of these countries during the past period will tend to be self maintained, to limit their inflation and to sustain durably their net exports and their economic growth.

On the contrary, the national or foreign budgetary policies immediately affect the economic activity through the demand channel. An expansionary budgetary policy also implies an increase in inflation the following year, so with a delay of one period.

2.2 Definition of the objective functions

With the preceding equations, we can then determine the effect of a supply or demand shock, internal or external to the monetary union, or the effect of policies led on the economic variables, which are the objectives of the authorities. Indeed, by combining the previous equations (1), (2) and (3), we can obtain the values of the economic activity and of the inflation in the monetary union (see Annex A).

Afterwards, we must introduce some quadratic loss functions, which penalize the weighted sum of the squared deviations of each objective from its equilibrium value.

The loss function of the central bank is:

$$L^M = \sum_{s=t}^{t+n} \delta^{s-t} \left[\omega^M e_s^2 + \alpha^M \pi_s^2 + \gamma^M (y_s - y^*)^2 + \xi^M \left(i_s - i_{s-1} \right)^2 \right] \tag{6}$$

where n is the horizon of action of the central bank, and where y* is the economic activity which corresponds to a kind of natural employment rate, in order to minimize the output-gap (y-y*). The implicit targets of inflation (goal of price stability) and of exchange rate (see equations (3) and (4)) are null.

Let's mention that in Europe, the central bank is mainly concerned with maintaining the price stability, by the control of the inflation, because it is the main goal

given to the monetary authority. It can also take care of the exchange rate of the common currency, which contributes to the confidence in the euro, and therefore indirectly to the stability of the financial system. The central bank can also have a long run growth objective in the monetary zone, even if ω^M and γ^M are relatively weak in comparison with the weight α^M given to price stability. Finally, we will suppose that the central bank wants to limit the variations in its instrument: the interest rate. Indeed, it does not know necessarily the effects of a modification in the interest rate, whereas its fluctuations always introduce some uncertainty for the private agents, and they can then be harmful.

The loss function of the country h is:

$$L_h^G = \alpha^G \pi_{h,t}^2 + \gamma^G (y_{h,t} - y^*)^2 + \xi^G (g_{h,t} - g^*)^2 \tag{7}$$

We will then suppose that the government of each country has mostly an immediate horizon, and tries to limit the current fluctuations in the economic variables. The governments are mainly looking to ameliorate the immediate living conditions of the economic agents, and to sustain the present level of economic activity (γ^G high). However, they also try to limit the variations in prices, the inflation having to be sufficient to sustain the employment but not too high in order not to discourage the sparing and the financial investment. Finally, we will suppose that the governments want to limit the variations in their public expenditures around a given target g*, as today their budgetary policies are hardly constrained in Europe by the Stability and Growth Pact, which limits the authorized public deficits to 3% of GDP[5].

with: ω: weight given to the objective of stabilizing the exchange rate
α: weight given to the objective of price stability
γ: weight given to the objective of sustaining the economic activity
ξ: weight given to the objective of limiting the variations in the instrument.

So, to simplify, we have supposed here that the preferences of the governments are the same. Moreover, the conflict of goals which can appear between the governments and the central bank is only due to the heterogeneity between their preferences, as their long run targets of activity and inflation are the same. Finally, we have chosen to limit ourselves exclusively to the study of the non cooperative equilibrium between three players, a central bank and two governments, each of them acting according to their own interests. Indeed, the statutes of the European Central Bank make it largely independent, in the context of the EMU. Moreover, the ECOFIN Council and the Euro-group have only introduced a very limited cooperation between the ECB and the European governments. The cooperative equilibrium therefore seemed to be hardly compatible with the institutional context of the Economic and Monetary Union.

3 Determination of the economic policies

Let's first determine the Nash equilibrium of our model, that is to say the non cooperative appropriate answer of each of the economic authorities to an internal or

[5]We suppose that the governments try to limit the variations in their public expenditures around a target g*, falling because of the political necessity to maintain the supply of a certain level of public goods and services, and rising because of the necessity to avoid aggravating the public deficits.

external supply or demand shock, or to a shock on the interest rate in the rest of the world. Our results could then have the originality to propose, in a relatively standard but dynamic framework, an explicit analysis of the consequences of a variation in the weight given by the central bank to the stabilization of the exchange rate (ω^M) on the efficiency of the economic equilibrium.

3.1 Reaction functions of the economic authorities

Minimizing its loss function, the government of the country (h) fixes its public expenditures at the level ($g_{h,t}$) which verifies[6]:

$$\left[\eta^2\gamma^G + \xi^G(1-\tau^2)^2\right] g_{h,t} = -\tau\eta^2\gamma^G g_{f,t} + \xi^G\left(1-\tau^2\right)^2 g^* + \eta\gamma^G\left(1-\tau^2\right) y^* + \eta\gamma^G(1+\tau)\left[(\sigma-\varsigma\chi\varphi)\, i_{t-1} - \varsigma e_t - B_{h,t}\right] \quad . \quad (12)$$

with the expression of $B_{h,t}$ mentioned in (10) in Annex A.

The home government (h) then conducts a budgetary policy that is contrary to the policy led by the foreign government (f) of the monetary union. And its budgetary policy is also rather substitutable and opposite to the monetary policy of the common central bank [as $-e_t = \chi(i_t - i_t^e)$]. Indeed, the budgetary policy of a given country is all the more expansive (respectively: restrictive) as the common monetary policy is restrictive (respectively: expansive) and as the interest rates are high in the monetary union, in order to compensate for the recessive effect of the monetary policy.

Regarding the central bank, its horizon of decision can be more ambiguous. More precisely, in Europe, the Executive Board members of the ECB are elected for longer mandates (a non-renewable term of eight years) than the leaders of the national governments. The main goal of this central bank, to preserve the price stability, is an objective that is more often apprehended with a long term horizon than the goals of the governments. Indeed, the necessity to sustain the level of economic activity and to decrease the unemployment rate appear as more immediate and instantaneous goals.

At first, if we suppose that the central bank has a very short term horizon (n=0), the minimization of its loss function would imply[7]:

$$i_t = \frac{\omega^M\chi^2}{\left(\omega^M\chi^2 + \xi^M\right)} i_t^e + \frac{\xi^M}{\left(\omega^M\chi^2 + \xi^M\right)} i_{t-1} \quad (13)$$

So, in this case, the only two important goals for the central bank would be to stabilize the exchange rate of the common currency and to limit the fluctuations in

[6] Using (8) and (10), the government of each country h chooses the public expenditures $g_{h,t}$ that verify, as $\frac{d\pi_{h,t}}{dg_{h,t}} = 0$: $\frac{dL_h^G}{dg_{h,t}} = 2\gamma^G \frac{dy_{h,t}}{dg_{h,t}}\left(y_{h,t} - y^*\right) + 2\xi^G\left(g_{h,t} - g^*\right) = 0 \Leftrightarrow \frac{\eta\gamma^G}{\left(1-\tau^2\right)^2}\left[\left(1-\tau^2\right) y_{h,t} - \left(1-\tau^2\right) y^*\right] + \xi^G\left(g_{h,t} - g^*\right) = 0.$

[7] Using (3), (9) and (11), the central bank chooses the interest rate i_t that verifies:
$\frac{dL^M}{di_t} = 2\omega^M \frac{de_t}{di_t} e_t + 2\xi^M\left(i_t - i_{t-1}\right) = 0 \Leftrightarrow -\omega^M\chi^2\left(i_t^e - i_t\right) + \xi^M\left(i_t - i_{t-1}\right) = 0$
as $\frac{d\pi_t}{di_t} = \frac{dy_t}{di_t} = 0$.

its interest rates, whatever the inflation and the level of economic activity. Therefore, because of the UIRP condition, the interest rates in the monetary union would be a weighted function of past interest rates in the monetary zone and of current interest rates in the rest of the world, according to the respective weights given to the two goals mentioned above. More precisely, the central bank would follow the fluctuations in the interest rates in the rest of the world, but less than proportionally ($di_t/di_t^e<1$) in order to limit the fluctuations in the interest rates in the monetary union (because of ξ^M). It would all the more replicate the variations in the interest rates in the rest of the world as the stabilization of the exchange rate is an important goal (ϖ^M is high). Indeed, the higher the weight given to this goal, the more the central bank would look to avoid any differential in interest rates with the rest of the world, in order to avoid massive movements of capital which would destabilize the capital balance of the monetary union and the exchange rate of the common currency. However, on the contrary, in case of "benign neglect" of the exchange rate target ($\varpi^M=0$), the central bank would only replicate from period to period the past interest rates ($i_t = i_{t-1}$) in order to limit only the fluctuations in its instrument.

Nevertheless, it is certainly more interesting to suppose that the central bank has a longer term horizon of at least one period (n=1). We could have studied the results of our model in the framework of a horizon of two periods, but this would have greatly complicated our formal calculations. Moreover, many results would then have been less well defined and would have remained undetermined without strong hypotheses on the values of our parameters and on the respective preferences of the economic authorities. Therefore, if we are content with a horizon of one period, Annex B gives the reaction function of the central bank. By combining this reaction function with the one of the governments, we can therefore determine the economic policies formed by the economic authorities.

3.2 Monetary policy

Let's first determine the monetary policy led by the common central bank, assuming zero cooperation between the monetary authority and the governments (Nash equilibrium). If the central bank has a horizon of one period (n=1), we obtain (see Annex B):

$$\begin{aligned}
D^{MG} i_t = {} & \delta\alpha^M\varphi\chi\Omega^G\left\{\eta^2\gamma^G(1+\phi)+\xi^G\left(1-\tau^2\right)\left[(1-\tau)(1+\phi)-v\varsigma\right]\right\}s_t \\
& +\delta\gamma^M\xi^G(1+\tau)\Psi\left\{\Omega^G\left[\sigma-\varsigma(1+\phi)\right]-\xi^G\varsigma\left(1-\tau^2\right)(\lambda-v\varsigma)\right\}s_t \\
& +\delta\Omega^{G2}\left\{\alpha^M\varphi^2\chi\pi_t^e+2\xi^M E_t\left[i_{t+1}^e\right]\right\} \\
& +\delta\gamma^M\xi^G(1+\tau)\Psi\Omega^G\left\{E_t\left[\varsigma\pi_{t+1}^e+\rho y_{t+1}^e\right]-\varsigma\varphi\pi_t^e\right\} \\
& +\delta\xi^G\left(1-\tau^2\right)\left\{\alpha^M v\varphi\chi\Omega^G+\gamma^M\xi^G(1+\tau)\Psi(\lambda-v\varsigma)\right\}\left[\varsigma\pi_t^e+\rho y_t^e-d_t\right] \\
& +\left[D^{MG}-\Omega^{G2}\xi^M(1+2\delta)-\delta\gamma^M\xi^G(1+\tau)\Psi\sigma\Omega^G\right]i_t^e \\
& +OBS_{t-1}+f(g^*,y^*) \qquad (15)
\end{aligned}$$

with: $\Omega^G=\left[\eta^2\gamma^G+\xi^G(1+\tau)(1-\tau)^2\right]\succ 0$, $\Psi=\left[\sigma-\varsigma\chi(1+\varphi)\right]$

and $D^{MG} = \delta\alpha^M\Omega^G\varphi\chi^2\left[\Omega^G\varphi + v\varsigma\xi^G(1-\tau^2)\right] + \Omega^{G2}\left[\omega^M\chi^2(1+\delta) + \xi^M(1+4\delta)\right]$
$+\delta\gamma^M\xi^G(1+\tau)\Psi\left[\xi^G(1-\tau^2)\varsigma\chi(\lambda - v\varsigma) + \Omega^G\Psi\right]$

where (OBS_{t-1}) designs some functions of the past economic variables, f(g*,y*) designs some functions of the public expenditures and activity targets, and by noting the average values of the monetary union without any country index.

The central bank therefore reacts by conducting a restrictive monetary policy fighting against the inflation (increase in the interest rates) in case of an inflationary negative supply shock, internal (s_t) or external (π_t^e) to the monetary union, present or anticipated for the following period (π_{t+1}^e), if we look at the numerical calibration of our parameters[8]. This is right at least when the weight accorded by the central bank to the economic activity goal (γ^M) is sufficiently negligible in comparison with its main goal to preserve the price stability (α^M). We also note that following these negative supply shocks, the monetary policy is all the more restrictive as it tends to neglect the exchange rate goal ($\omega^M \to 0$). The bigger the weight accorded to the limitation of the variations in its instrument (ξ^M) or in the exchange rate (ω^M) by the central bank, the less active the monetary policy is in order to fight against the inflation. Indeed, an important increase in the interest rates in the monetary union would then imply an excessive appreciation in the exchange rate of the common currency, even if it is necessary to avoid price increases.

In the same way, a positive demand shock that is anticipated (y_{t+1}^e) or present in the rest of the world (y_t^e) or in one country of the monetary union (-d_t) implies a more restrictive monetary policy, according to the numerical calibration of our parameters[9]. This is true as soon as the variations in their public expenditures are not without cost for the governments (ξ^G>0), and if they are reluctant to compensate fully by themselves with the appropriate contra-cyclical budgetary policies these demand shocks. Nevertheless, taking into account the exchange rate goal (ω^M) or limiting the variations in the interest rates (ξ^M) allows the monetary policy to be less active and restrictive, because the central bank then seeks to avoid a large temporary appreciation in the exchange rate or a vast increase in the interest rates. On the contrary, if the weights accorded to the goals above are low, the monetary policy is very restrictive, as the positive demand shocks sustain the level of the demand and risk to impose an increase in inflation.

Therefore, in the preceding configurations, the exchange rate goal (ω^M) and the limitation of the variations in the instrument (ξ^M) have the same role of limitation of the monetary activism. But contrary to the former shocks, in case of a shock on the interest rates in the rest of the world (i_t^e), these goals are mostly contradictory and opposite. Indeed, the central bank is incited to follow the variations in foreign interest rates in order to limit the fluctuations in the exchange rate. Nevertheless, the variations in the interest rates in the monetary union are less than proportional (di_t/di_t^e<1) to the variations in these rates in the rest of the world, in order to limit the variations in this instrument (ξ^M) and to limit the slowdown in economic activity (γ^M). More precisely, according to the UIRP condition, the exchange rate must return after two periods to its equilibrium level; the variations in the interest rates in the

[8] $[(1-\tau)(1+\phi) - v\varsigma] = 0,6 \succ 0$; $[\sigma - \varsigma(1+\phi)] = 0,07 \succ 0$; $\Psi = [\sigma - \varsigma\chi(1+\varphi)] = 0,07 \succ 0$; $(\lambda - v\varsigma) = 0,74 \succ 0$ according to the numerical calibration of our parameters in Annex C.

[9] See the numerical calibration mentioned in the previous footnote.

monetary union and in the rest of the world after two periods must be the same. The action of the central bank to return to this equilibrium level is then only slower as ξ^M and γ^M increase. The weight accorded by the central bank to the exchange rate goal (ω^M) here is of no importance on the degree of monetary activism, as the UIRP condition always assures a return of the exchange rate to its equilibrium level.

Finally, we will also mention that in order to limit the variations in its instrument (ξ^M), the central bank begins as soon as the present period to increase its interest rates when it anticipates a future increase in the interest rates in the rest of the world during the following period (i^e_{t+1}).

3.3 Budgetary policies

Let's now study the budgetary policies led by the governments. The equations (11) and (14) respectively in Annexes A and B and the equation (3) imply :

$$\begin{aligned}\Omega^G g_t = {} & \xi^G (1-\tau)^2 (1+\tau) g^* + \eta\gamma^G (1-\tau) y^* + \eta\gamma^G \varsigma\chi i_t \\ & -\eta\gamma^G \left\{ \begin{array}{c} (\lambda - v\varsigma) y_{t-1} + [\sigma - \varsigma(1+\phi)] \pi_{t-1} - \varsigma\varphi\pi^e_{t-1} - \varsigma\chi\varphi i^e_{t-1} \\ -(\sigma - \varsigma\chi\varphi) i_{t-1} + \varsigma\pi^e_t + \rho y^e_t + \varsigma\chi i^e_t - d_t - \varsigma s_t \end{array} \right\}\end{aligned}$$

Therefore, by using this equation and the expression (15) above for i_t, we can obtain:

$$\begin{aligned}D^{MG} g_t = {} & \varsigma\eta\gamma^G\Omega^G \left[\delta\alpha^M\varphi\chi^2(1+\phi+\varphi) + \omega^M\chi^2(1+\delta) + \xi^M(1+4\delta)\right] s_t \\ & +\delta\gamma^M\xi^G\gamma^G\eta\varsigma(1+\tau)\Psi[\sigma(1+\chi) - \varsigma\chi(2+\phi+\varphi)] s_t \\ & +\delta\gamma^G\eta\varsigma\chi\left\{2\xi^M\Omega^G E_t\left[i^e_{t+1}\right] + \gamma^M\xi^G(1+\tau)\Psi E_t\left[\varsigma\pi^e_{t+1} + \rho y^e_{t+1}\right]\right\} \\ & -\gamma^G\eta\varsigma\left\{\Omega^G\left[\omega^M\chi^2(1+\delta) + \xi^M(1+4\delta)\right] + \delta\gamma^M\xi^G(1+\tau)\Psi(\sigma - \varsigma\chi)\right\}\pi^e_t \\ & -\left\{\Omega^G\left[\delta\alpha^M(\varphi\chi)^2 + \omega^M\chi^2(1+\delta) + \xi^M(1+4\delta)\right] + \delta\gamma^M\xi^G(1+\tau)\Psi^2\right\} \\ & \quad \eta\gamma^G[\rho y^e_t - d_t] \\ & -\gamma^G\eta\varsigma\chi\left[\Omega^G\xi^M(1+2\delta) + \delta\sigma\gamma^M\xi^G(1+\tau)\Psi\right] i^e_t \\ & +OBS_{t-1} + f(g^*, y^*) \qquad (16)\end{aligned}$$

So, the global budgetary policy is all the more restrictive as there is an inflationary shock in the rest of the world (π^e_t) that already sustains the price competitiveness of the countries of the monetary union, or a positive demand shock in the rest of the world (y^e_t), which also contributes to increase the net exports of these countries. The budgetary policies are also all the more restrictive as there is a positive demand shock in one country of the monetary union (-d_t). The economic policies are then always complementary in order to stabilize these shocks. Moreover, the preference given by the central bank to the price stability (α^M) can reduce the necessity of restrictive budgetary policies. On the contrary, the weight accorded to the exchange rate goal (ω^M) by the central bank can make the budgetary policies still more restrictive in

order to stabilize the demand or external shocks, as the monetary policy is then less active. Indeed, if γ^M is negligible, we obtain:

$$\frac{dg_t}{d(\rho y_t^e)} = \frac{dg_t}{d(-d_t)} = \frac{-\eta\gamma^G}{\left[\eta^2\gamma^G + \xi^G(1+\tau)(1-\tau)^2\right]} + \frac{\delta\alpha^M\varphi\chi^2\varsigma\eta\gamma^G v\xi^G(1-\tau^2)}{D^{MG}} \quad (17)$$

$$\frac{dg_t}{d(\pi_t^e)} = \frac{-\eta\varsigma\gamma^G}{\left[\eta^2\gamma^G + \xi^G(1+\tau)(1-\tau)^2\right]} + \frac{\delta\alpha^M\varphi\chi^2\varsigma\eta\gamma^G\left[\Omega^G\varphi + v\varsigma\xi^G(1-\tau^2)\right]}{D^{MG}} \quad (18)$$

On the contrary, if a shock on the interest rates in the rest of the world (i_{t+1}^e) or a positive external supply (π_{t+1}^e) or demand (y_{t+1}^e) shock is anticipated for the following period, the budgetary policies become more expansive during the present period, in order to compensate for the recessive effect of the temporary appreciation in the exchange rate of the common currency due to the immediate increase in the interest rates in the monetary union. The economic policies are then opposite and conflicting in order to stabilize these future anticipated shocks. Nevertheless, giving more weight to the exchange rate goal (ω^M) can contribute to reduce this conflict of goals between the economic authorities (only the denominator D^{MG} increases).

In the same way, the global budgetary policy becomes more expansive in case of a negative supply shock (s_t), in order to compensate for the decrease in the price competitiveness and in the exports of the monetary union and to compensate for the more restrictive monetary policy. The global budgetary policy is then opposite to the monetary policy, and contrary to the demand shocks, the internal supply shocks can lead to a conflict of goals between the economic authorities. Indeed, if γ^M is negligible, we obtain[10]:

$$\frac{dg_t}{ds_t} = \frac{\eta\varsigma\gamma^G}{\Omega^G} + \frac{\delta\alpha^M\varphi\chi^2\varsigma\eta\gamma^G\left[\Omega^G(1+\phi) - v\varsigma\xi^G(1-\tau^2)\right]}{D^{MG}} \quad . \quad (19)$$

More precisely, in the case of negative supply shocks, monetary policy is all the more restrictive, and the global budgetary policy on the contrary all the more expansive, as the central bank accords a bigger weight to the price stability (α^M) and the governments a bigger weight to the opposite goal of sustaining the level of economic activity (γ^G). We can then find again the result of Capoen and *alii* (1994) or Creel and Sterdyniak (1998) for example, who show the excessive utilization of the instruments of economic policy without cooperation between the economic authorities and in case of conflicting goals between them in a monetary union. Indeed, the interest rates and the public expenditures and deficits are then excessive, and the well-being of the economic agents decreases. Nevertheless, the weight accorded by the central bank to the exchange rate goal (ω^M) or to the limitation of the variations in its instrument (ξ^M) tends mainly to limit the utilization of the monetary and consequently of the budgetary policies. On the contrary, the "benign neglect" of the exchange rate accentuates the conflict of goals between the economic authorities, even if this objective has, here, a redundant role compared to the limitation of the variations in the interest rates. Taking into account an exchange rate goal can then contribute limiting the formation of excessive economic policies in the case of negative supply shocks.

[10] $\sigma(1+\chi) - \varsigma\chi(2+\phi+\varphi) = 0,14 > 0$ and $(1+\phi)(1-\tau) - v\varsigma = 0,6 > 0$ according to the numerical calibration of our parameters in Annex C.

The global budgetary policy becomes also more restrictive after a positive shock on the interest rates in the rest of the world (i_t^e). Indeed, such a shock implies a temporary depreciation of the common currency beneficial to the exports of the monetary union; budgetary as well as monetary policies become more restrictive then in order to compensate for this shock. More precisely, the increase in the interest rates in the monetary union is not fully proportional to their increase in the rest of the world, because the monetary authority wants to limit the variations in its interest rates (ξ^M) and eventually also to sustain the level of economic activity (γ^M). Therefore, the governments also have to create restrictive budgetary policies in order to compensate for this lack of monetary activism, and for the increase in the net exports of the monetary union. Nevertheless, we can underline here that, like the weight given to the price stability (α^M), the weight accorded by the central bank to the exchange rate goal (ω^M) can contribute increasing the role of the central bank and decreasing that of the governments in the stabilization of these shocks on the foreign interest rates.

Finally, we can also mention that the differential in the public expenditures as well as in the main economic variables between the two countries of the monetary union are fully independent from the preferences of the central bank, and from the weight that it accords to the exchange rate goal (ω^M). Indeed, the equation (12) implies[11]:

$$\begin{aligned}\left[\eta^2\gamma^G + \xi^G(1-\tau)\left(1+\tau\right)^2\right](g_{h,t} - g_{f,t}) = &-\eta\gamma^G\left[\lambda - v\left(2\beta+\varsigma\right)\right](y_{h,t-1} - y_{f,t-1}) \\ &+\eta\gamma^G\left[(1-\phi)\left(2\beta+\varsigma\right) - \sigma\right](\pi_{h,t-1} - \pi_{f,t-1}) \\ &+\eta\gamma^G\left[(d_{h,t} - d_{f,t}) + \left(2\beta+\varsigma\right)(s_{h,t} - s_{f,t})\right] \quad (20)\end{aligned}$$

The budgetary policy is then more expansive in the country that is the most affected by an asymmetric negative demand shock ($d_{h,t}$), in order to sustain the level of its economic activity. It is also more expansive in the country that is the most affected by an asymmetric negative supply shock ($s_{h,t}$), in order to compensate for the recessive effect of the shock. Indeed, the inflationary shock that is more important in a country (h) tends to reduce the price-competitiveness and the net exports of this country, which must then increase its public expenditures more than its partner in order to compensate. But naturally, the differential in the budgetary policies between the two countries of the monetary union is all the more reduced as the variation in the public expenditures is costly for the governments (ξ^G>0).

Nevertheless, we can also note here that the differential in budgetary policies does not depend on the preferences of the central bank, and on the importance for the monetary authority to limit the fluctuations in the exchange rate (ω^M). Indeed, for fully identical countries, the respective preferences of the economic authorities determine their possible conflict of goals and the global budgetary and monetary policies. But the differential in the budgetary policies must afterwards represent the discrepancies between the shocks of conjuncture undergone by the countries, for given monetary and global budgetary policies. This differential then only depends on the relative preferences of the governments.

[11] (12) implies : $\left[(1-\tau)\,\eta^2\gamma^G + \xi^G\left(1-\tau^2\right)^2\right](g_{h,t} - g_{f,t}) = -\eta\gamma^G\left(1+\tau\right)(B_{h,t} - B_{f,t})$, with $B_{h,t}$ mentioned in (10) in Annex A

4 Effect on economic variables and on the well-being of the agents

After studying how the consideration of an exchange rate target by the central bank can modify the economic policies led by the monetary and budgetary authorities, let's now analyze how it acts on the economic results, on the level of economic activity and on the inflation. This final step in our study will then allow us to conclude on the consequences of a possible exchange rate target for the well-being of the economic agents.

According to Ball (1998), in the context of a closed economy, a central bank can be satisfied with targeting the inflation and the economic activity, following a kind of Taylor rule. However, on the contrary, in the framework of an open economy, it must also consider the exchange rate. Indeed, failing to take into account this variable would not be too damageable for the demand and supply shocks, but it would be highly inefficient for the shocks on the foreign interest rates for example[12]. Nevertheless, our model can lead to more precise results regarding the consequences of the neglecting of the exchange rate by the central bank. These results are at the same time diverse and specific to the shocks concerned.

Let's first mention that, in conformity to the differential in the public expenditures, the differentials in the economic variables between the two countries of the monetary union are fully independent from the preferences of the central bank, and from the weight that it accords to the exchange rate goal (ω^M). Indeed, the equations (8) and (10) in Annex A and (12) imply[13]:

$$\begin{aligned}\left[\eta^2\gamma^G + \xi^G(1-\tau)(1+\tau)^2\right](y_{h,t} - y_{f,t}) = \xi^G(1-\tau^2)\left[\lambda - v(2\beta+\varsigma)\right](y_{h,t-1} - y_{f,t-1}) \\ - \xi^G(1-\tau^2)\left[(1-\phi)(2\beta+\varsigma) - \sigma\right](\pi_{h,t-1} - \pi_{f,t-1}) \\ - \xi^G(1-\tau^2)(d_{h,t} - d_{f,t}) - \xi^G(1-\tau^2)(2\beta+\varsigma)(s_{h,t} - s_{f,t}) \quad (21)\end{aligned}$$

$$(\pi_{h,t} - \pi_{f,t}) = v(y_{h,t-1} - y_{f,t-1}) + (1-\phi)(\pi_{h,t-1} - \pi_{f,t-1}) + (s_{h,t} - s_{f,t}) \quad (22)$$

So, the slowdown in economic activity is always more accentuated in the country that is the most affected by an asymmetric negative demand ($d_{h,t}$) or supply ($s_{h,t}$) shock. In the same way, the inflation is always higher in the country that is the most affected by an asymmetric negative supply shock. Nevertheless, these asymmetric shocks only influence the differential in the economic variables between the two countries. But in case of symmetric shocks, what then are the specific consequences on the average variables of the monetary union of the weight accorded to the exchange rate goal by the central bank (ω^M)?

[12] According to the author, the best would be for the central bank to target a "long run inflation rate", adjusted from the temporary effects of the variations in the exchange rate.

[13] $\left[\eta^2\gamma^G + \xi^G(1-\tau)(1+\tau)^2\right](y_{h,t} - y_{f,t}) = \xi^G(1+\tau)^2(B_{h,t} - B_{f,t})$, with $B_{h,t}$ mentioned in (10) in Annex A.

4.1 Economic activity

The level of economic activity can be a relatively good index of the well-being of the economic agents, as their consumption and their standard of living depend mainly on the economic growth. After having defined the effects of a possible exchange rate target for the central bank on the policies conducted by the economic authorities, what are its consequences on the level of economic activity in a monetary union, within the framework of our model?

According to equations (11) and (14) respectively in Annexes A and B and to equation (3), the average economic activity in the monetary union verifies:

$$\begin{aligned}\Omega^G y_t = {} & \eta\xi^G\left(1-\tau^2\right)g^* + \eta^2\gamma^G y^* - \xi^G\left(1-\tau^2\right)\varsigma\chi i_t \\ & + \xi^G\left(1-\tau^2\right)\left\{\begin{array}{c}(\lambda - v\varsigma)\, y_{t-1} + [\sigma - \varsigma\,(1+\phi)]\,\pi_{t-1} - \varsigma\varphi\pi^e_{t-1} - \varsigma\chi\varphi i^e_{t-1} \\ -(\sigma - \varsigma\chi\varphi)\, i_{t-1} + \varsigma\pi^e_t + \rho y^e_t + \varsigma\chi i^e_t - d_t - \varsigma s_t\end{array}\right\}\end{aligned}$$

With the expression (15) for i_t, we can then obtain:

$$\begin{aligned}D^{MG} y_t = {} & -\xi^G\left(1-\tau^2\right)\varsigma\Omega^G\left[\delta\alpha^M\varphi\chi^2\,(1+\phi+\varphi) + \omega^M\chi^2\,(1+\delta) + \xi^M\,(1+4\delta)\right]s_t \\ & -\xi^{G2}\gamma^M\,(1-\tau)\,(1+\tau)^2\,\delta\varsigma\Psi\,[\sigma\,(1+\chi) - \varsigma\chi\,(2+\phi+\varphi)]\,s_t \\ & -\xi^G\left(1-\tau^2\right)\varsigma\chi\delta\left\{2\xi^M\Omega^G E_t\left[i^e_{t+1}\right] + \gamma^M\xi^G\,(1+\tau)\,\Psi E_t\left[\varsigma\pi^e_{t+1} + \rho y^e_{t+1}\right]\right\} \\ & +\xi^G\left(1-\tau^2\right)\varsigma\left\{\left[\omega^M\chi^2\,(1+\delta) + \xi^M\,(1+4\delta)\right]\Omega^G + \delta\gamma^M\xi^G\,(1+\tau)\,\Psi\,(\sigma - \varsigma\chi)\right\}\pi^e_t \\ & +\left\{\Omega^G\left[\delta\alpha^M\,(\varphi\chi)^2 + \omega^M\chi^2\,(1+\delta) + \xi^M\,(1+4\delta)\right] + \delta\gamma^M\xi^G\,(1+\tau)\,\Psi^2\right\} \\ & \quad \xi^G\left(1-\tau^2\right)[\rho y^e_t - d_t] \\ & +\xi^G\left(1-\tau^2\right)\varsigma\chi\left[\Omega^G\xi^M\,(1+2\delta) + \delta\sigma\gamma^M\xi^G\,(1+\tau)\,\Psi\right]i^e_t \\ & +OBS_{t-1} + f(g^*, y^*)\end{aligned} \tag{23}$$

So, if the variations in their public expenditures were without costs for the governments, the latter could then perfectly stabilize and cancel the consequences of all kinds of shocks on the level of economic activity. But if these variations are costly (ξ^G>0), in terms of public deficits and of accumulation of public debt in particular, the shocks have different consequences on the activity and on the well-being of the economic agents.

First, the average economic activity increases all the more as there is an inflationary negative supply shock in the rest of the world (π^e_t) or a positive demand shock in the monetary union (-d_t) or in the rest of the world (y^e_t). Indeed, in these cases, the expansive consequences of the shocks are not fully compensated by the more restrictive monetary and global budgetary policies. In fact, the budgetary authorities are then reluctant to modify their public expenditures in proportion to the shocks, because of the cost of the variations in these expenditures (ξ^G>0). Moreover, regarding these external or demand shocks, the weight accorded by the central bank to the exchange rate goal (ω^M) can reduce the restrictive character of the monetary policy; the growth in economic activity can then be accentuated. Indeed, if γ^M is negligible,

we obtain:

$$\frac{dy_t}{d(\rho y_t^e)} = \frac{dy_t}{d(-d_t)} = \frac{\xi^G (1+\tau)(1-\tau)}{\left[\eta^2\gamma^G + \xi^G (1+\tau)(1-\tau)^2\right]} - \frac{\delta\alpha^M\varphi\chi^2 v\varsigma\xi^{G2}(1-\tau^2)^2}{D^{MG}} \quad . \tag{24}$$

$$\frac{dy_t}{d(\pi_t^e)} = \frac{\xi^G\varsigma (1+\tau)(1-\tau)}{\left[\eta^2\gamma^G + \xi^G (1+\tau)(1-\tau)^2\right]} - \frac{\delta\alpha^M\varphi\chi^2\varsigma\xi^G(1-\tau^2)\left[\Omega^G\varphi + v\varsigma\xi^G(1-\tau^2)\right]}{D^{MG}} \tag{25}$$

Afterwards, if a shock on the interest rates in the rest of the world (i_{t+1}^e) or a positive external supply (π_{t+1}^e) or demand (y_{t+1}^e) shock is anticipated for the following period, despite the currently more expansive budgetary policies, the economic activity decreases. Indeed, the immediate increase in the interest rates and the appreciation in the exchange rate of the common currency imply a decrease in the net exports of the monetary union. However, giving more weight to the exchange rate target (ω^M) can contribute to reduce the variations in monetary policy in order to compensate for anticipated variations in foreign economic variables as well as to limit the slowdown in economic activity.

In the same way, the negative supply shocks (s_t) are recessive by themselves; moreover, they provoke a more restrictive monetary policy in order to fight against the inflation. So, despite the more expansive budgetary policies, the increase in the public expenditures remains insufficient to avoid the slowdown in economic activity. Indeed, the governments have to limit their budgetary activism because of their budgetary constraints ($\xi^G>0$). Nevertheless, the increase in the interest rates is all the more limited as the central bank grants a non-negligible weight to the exchange rate goal or to the limitation of the variations in its instrument. The importance given to these two goals can therefore contribute to attenuate the conflict of goals between the authorities and the slowdown in economic activity. More precisely, if γ^M is negligible, we obtain:

$$\frac{dy_t}{ds_t} = \frac{-\varsigma\xi^G(1-\tau^2)}{\Omega^G} - \frac{\delta\alpha^M\varphi\chi^2\varsigma\xi^G(1-\tau^2)\left[\Omega^G(1+\phi) - v\varsigma\xi^G(1-\tau^2)\right]}{D^{MG}} \quad . \tag{26}$$

Nevertheless, we can mention that the weights given by the central bank to the limitation of the variations in the exchange rate of the common currency (ω^M) or in the interest rates in the monetary union (ξ^M) are relatively interchangeable in case of demand or supply shocks. Increasing one of these weights has exactly the same effect on the policies conducted and on the level of economic activity in the monetary union. Therefore, it is mostly in the case of a shock on the interest rates in the rest of the world (i_t^e) that the weight given by the central bank to the exchange rate goal has a truly specific importance. More precisely, following such a shock, the central bank must follow after two periods the variation in the interest rates in the rest of the world in order to stabilize the exchange rate, in conformity with the UIRP condition. Nevertheless, the adaptation to these external conditions is not perfect (as $di_t/di_t^e < 1$), and it is slower as the weight accorded by the central bank to the limitation of the variations in its instrument (ξ^M) or to the sustain of economic activity (γ^M) increases. That is why the higher interest rates in the rest of the world imply outgoings of capital because of the better return of the assets abroad, and a temporary

depreciation in the exchange rate of the common currency which increases the exports of the monetary union. Despite restrictive economic policies, the economic activity then increases in the monetary union.

In fact, there are then two different configurations according to the preferences of the central bank. If the latter accords a large weight to the exchange rate goal (ω^M), the interest rates in the monetary union closely follow the variations in the interest rates in the rest of the world (i_t^e). The temporary expansive effect of the depreciation in the exchange rate is then very limited. There is only a moderate growth in economic activity, and budgetary policies can be less restrictive. On the contrary, if the central bank accords a large weight to the limitation of the variations in its instrument (ξ^M), it smooths the adaptation to the foreign values. The temporary depreciation in the exchange rate is then more accentuated. So, budgetary policies have to be more restrictive and to stabilize a bigger part of the shock, but nevertheless, the economic activity increases more.

4.2 Inflation and the question of "inflation targeting"

The level of economic activity is certainly one of the best indexes of the well-being of the economic agents. However, in order to complete our study, we can also quickly mention in which way the preferences of the central bank can act on the average inflation in the monetary union. Equation (9) in Annex A implies:

$$\pi_t = s_t + v y_{t-1} + (1+\phi)\,\pi_{t-1} + \varphi\chi i_{t-1}^e + \varphi\pi_{t-1}^e - \varphi\chi i_{t-1} \tag{27}$$

So, except the past economic variables that can be observed in the present period, the negative supply shocks (s_t) are the only present shocks which can influence the actual level of inflation. These supply shocks are, naturally, highly inflationary despite the more restrictive monetary policy. Moreover, this is right whatever the preferences of the central bank, and the weight that it gives to the stability of the exchange rate of the common currency. Otherwise, all the shocks coming from the rest of the world (π_t^e, y_t^e, i_t^e) or the demand shocks (d_t) will only affect future inflation.

Afterwards, we can also mention that in the dynamic framework of our model, the inflationary consequences of the negative supply shocks could not be stabilized even in the case of a strict inflation targeting ($\omega^M = \xi^M = \gamma^M = 0$) from the part of the central bank, because these white noise shocks could not be anticipated by the monetary authority. Nevertheless, the monetary policy would then be more active and restrictive in order to stabilize these shocks and to preserve the price stability. And the temporary appreciation in the common currency would also be more accentuated. So, as mentioned by Ball (1998), a strict inflation targeting could imply huge fluctuations in economic activity in order to eliminate the inflationary or deflationary consequences of the supply shocks during each period. This can be perfectly verified in the framework of our model. If the central bank chooses to target only the inflation rate, equation (23) implies:

$$\begin{aligned}\left[\Omega^G\varphi + v\varsigma\xi^G\left(1-\tau^2\right)\right] y_t = &-\xi^G\left(1-\tau^2\right)\varsigma\,(1+\phi+\varphi)\,s_t \\ &+\varphi\xi^G\left(1-\tau^2\right)(\rho y_t^e - d_t) + OBS_{t-1} + f(g^*, y^*)\end{aligned} \tag{28}$$

So, a strict inflation targeting can allow the economic policies to suppress any consequence on the level of economic activity of a shock on the interest rates (i_t^e), of a supply shock (π_t^e), or of a future anticipated shock in the rest of the world. Moreover, in case of external (y_t^e) or internal (-d_t) positive demand shocks, the growth in economic activity could be reduced if the central bank chooses a strict inflation targeting. Nevertheless, after internal negative supply shocks (s_t), neglecting any other objective than price stability is a monetary policy that can accentuate the slowdown in economic activity[14]. That is why according to Svensson (1997) for example, the best loss function for the central bank consists in targeting the future inflation rate, anticipated for two periods later, but to return only gradually to this long run inflation target if the monetary authority looks for limiting the fluctuations in economic activity.

5 Conclusion

Should the European Central Bank take the fluctuations in the euro more into account, and should it eventually consider in a more explicit way an exchange rate target, complementing its main goal of preserving the price stability? Our study has shown that targeting the exchange rate could have different advantages according to the shocks which are considered.

First, the positive demand shocks, internal or external to the monetary union, or the negative supply shocks in the rest of the world imply a more restrictive monetary policy in the monetary union, complementary to the more restrictive budgetary policies. Nevertheless, we have seen that introducing an exchange rate target for the central bank could make the monetary policy less restrictive and accentuate the role of the governments in the stabilization of these shocks. The growth in economic activity implied by the shocks would then be more accentuated than in the absence of an exchange rate target.

Regarding the internal negative supply shocks and also the positive shocks anticipated for the following period in the rest of the world (on the inflation, the economic activity or the interest rates), the main advantage of an exchange rate goal is to avoid the formation of inefficient economic policies in the context of conflicting goals between the economic authorities. It limits the danger of the appearance of a harmful out-biding of increases in interest rates and in public expenditures, when the central bank mostly seeks to fight against the inflation, whereas the governments want to avoid the deterioration in the level of their economic activity. Indeed, in case of opposite preferences between the economic authorities, if the central bank neglects the fluctuations in the exchange rate of the common currency, this accentuates the problem related to an excessive utilization of the instruments of economic policy. Moreover, an exchange rate goal can also diminish the slowdown in economic activity

[14] If γ^M is negligible, a policy of strict inflation targeting implies:
$\frac{dy_t}{ds_t} = \frac{-\varsigma\xi^G\left(1-\tau^2\right)}{\Omega^G} - \frac{\delta\alpha^M\varphi\chi^2\varsigma\xi^G\left(1-\tau^2\right)\left[\Omega^G\left(1+\phi\right)-v\varsigma\xi^G\left(1-\tau^2\right)\right]}{\delta\alpha^M\varphi\chi^2\Omega^G\left[\Omega^G\varphi+v\varsigma\xi^G\left(1-\tau^2\right)\right]}$
and $\frac{dy_t}{d(\rho y_t^e)} = \frac{dy_t}{d(-d_t)} = \frac{\xi^G\left(1+\tau\right)\left(1-\tau\right)}{\left[\eta^2\gamma^G+\xi^G\left(1+\tau\right)\left(1-\tau\right)^2\right]} - \frac{\delta\alpha^M\varphi\chi^2 v\varsigma\xi^{G2}\left(1-\tau^2\right)^2}{\delta\alpha^M\varphi\chi^2\Omega^G\left[\Omega^G\varphi+v\varsigma\xi^G\left(1-\tau^2\right)\right]}$
which are lower than their respective expressions in (24) and (26) as:
$\delta\alpha^M\varphi\chi^2\Omega^G\left[\Omega^G\varphi+v\varsigma\xi^G\left(1-\tau^2\right)\right] < D^{MG}$.

following these shocks, even if it leaves the present inflation unchanged in the case of negative supply shocks.

Finally, it is only in the case of shocks on interest rates in the rest of the world that the weight given by the central bank to the goal of stabilizing the exchange rate of the common currency can have different and opposite effects from the goal of limiting the variations in interest rates. Indeed, after a positive shock on the foreign interest rates, the monetary policy is similarly restrictive in the monetary union and the budgetary policies are complementary. Nevertheless, if the central bank gives a larger weight to the exchange rate goal and a smaller weight to the stabilization of its interest rates, the monetary policy is more suddenly restrictive as the central bank closely follows the variations in the foreign interest rates, and the global budgetary policy is more passive. On the contrary, neglecting the exchange rate goal and according a large weight to the stabilization of the variations in interest rates decreases the role of the central bank and increases the one of the governments in the stabilization of the shocks on the foreign interest rates. In this last case, the economic activity then increases more because of the temporary depreciation in the exchange rate of the common currency.

In conclusion, the weight that the central bank should give to the exchange rate goal depends on many parameters. First, naturally, it depends on the shocks which mainly affect the countries of the monetary union. Therefore, neglecting the variations in the exchange rate is mainly beneficial in case of demand shocks. However, in the case of supply shocks, it can accentuate the conflict of goals between the economic authorities as well as the slowdown in economic activity. An exchange rate goal could also increase the role of the central bank in comparison with the one of the governments in the stabilization of the shocks on the foreign interest rates, and reduce the variations in the level of economic activity. Moreover, in this last case, an exchange rate goal has very specific advantages and it is not interchangeable with the goal of limiting the variations in the interest rates for the central bank. But the weight that the central bank should give to the exchange rate goal also depends on the preferences of the economic authorities. Indeed, if the central bank neglects this goal, this is all the more inefficient for the well-being of the economic agents as the preferences of the central bank are distant and differ from those of the governments in the case of negative supply shocks.

There are studies which have underlined that the ECB should be preoccupied with maintaining the euro's exchange rate (in relation to the dollar in particular) in a zone of equilibrium considered as "good" for economic activity and for economic growth in Europe. The arguments generally advanced are then that on over-evaluation of the euro would be harmful to European exports, whereas an under-evaluation of the common currency would discourage the Foreign Direct Investments and the arriving of foreign assets. Beyond these arguments, our model shows that giving an exchange rate target to the ECB would sometimes also allow for the creation of a much more efficient policy-mix in Europe, which would be beneficial to the well-being of the economic agents throughout the monetary union.

Annex A: inflation rate and economic activity in the mone-

tary union

By combining equations (2) and (3), we obtain:

$$\pi_{h,t+1} = vy_{h,t} + \pi_{h,t} + \phi\pi_{f,t} + \varphi\chi\left(i_t^e - i_t\right) + \varphi\pi_t^e + s_{h,t+1} \tag{8}$$

$$\pi_{t+1} = A_{t+1} - \varphi\chi i_t \qquad \text{with } A_{t+1} = vy_t + (1+\phi)\,\pi_t + \varphi\chi i_t^e + \varphi\pi_t^e + s_{t+1} \tag{9}$$

By using the former equation and equations (1) and (3), we obtain:

$$\left(1-\tau^2\right) y_{h,t+1} = \eta g_{h,t+1} + \tau\eta g_{f,t+1} + (1+\tau)\left[\varsigma e_{t+1} - (\sigma - \varsigma\chi\varphi)\, i_t + B_{h,t+1}\right] \tag{10}$$

$$\begin{aligned}\text{with } (1+\tau)\, B_{h,t+1} = {} & -\varsigma\chi\varphi\,(1+\tau)\, i_t^e - \varsigma\varphi\,(1+\tau)\,\pi_t^e + \rho\,(1+\tau)\, y_{t+1}^e + \varsigma\,(1+\tau)\,\pi_{t+1}^e \\ & + \left[\lambda - v\left(\beta + \varsigma - \beta\tau\right)\right] y_{h,t} + \left[\lambda\tau + v\left(\beta - \varsigma\tau - \beta\tau\right)\right] y_{f,t} \\ & + \left[\sigma + \phi\left(\beta - \varsigma\tau - \beta\tau\right) - \left(\beta + \varsigma - \beta\tau\right)\right] \pi_{h,t} \\ & + \left[\sigma\tau - \phi\left(\beta + \varsigma - \beta\tau\right) + \left(\beta - \varsigma\tau - \beta\tau\right)\right] \pi_{f,t} \\ & - d_{h,t+1} - \tau d_{f,t+1} - \left(\beta + \varsigma - \beta\tau\right) s_{h,t+1} + \left(\beta - \varsigma\tau - \beta\tau\right) s_{f,t+1}\end{aligned}$$

$$(1-\tau)\, y_{t+1} = \eta g_{t+1} + \varsigma e_{t+1} - (\sigma - \varsigma\chi\varphi)\, i_t + B_{t+1} \tag{11}$$

$$\begin{aligned}\text{with } B_{t+1} = {} & -\varsigma\chi\varphi i_t^e - \varsigma\varphi\pi_t^e + \rho y_{t+1}^e + \varsigma\pi_{t+1}^e + (\lambda - v\varsigma)\, y_t \\ & + \left[\sigma - \varsigma\left(1+\phi\right)\right] \pi_t - d_{t+1} - \varsigma s_{t+1}\end{aligned}$$

Where the average values of the monetary union are noted without any country index

Annex B: reaction function and monetary policy led by the central bank

If the central bank has a horizon of one period (n=1), we obtain:

$$\begin{aligned}&\frac{dL^M}{di_t} = 2\varpi^M e_t \frac{de_t}{di_t} + 2\delta\varpi^M E_t\left[e_{t+1}\right] \frac{dE_t\left[e_{t+1}\right]}{di_t} + 2\delta\alpha^M E_t\left[\pi_{t+1}\right] \frac{dE_t\left[\pi_{t+1}\right]}{di_t} \\ &+2\delta\gamma^M\left(E_t\left[y_{t+1}\right] - y^*\right) \frac{dE_t\left[y_{t+1}\right]}{di_t} + 2\xi^M(i_t - i_{t-1}) - 4\delta\xi^M(E_t\left[i_{t+1}^e\right] + i_t^e - 2i_t) = 0.\end{aligned}$$

Indeed, $\dfrac{d\pi_t}{di_t} = \dfrac{dy_t}{di_t} = 0$ and equation (5) implies:

$$E_t\left[i_{t+1}\right] - i_t = E_t\left[i_{t+1}^e\right] + i_t^e - 2i_t.$$

With equations (3), (4), (9) and (11), this implies then:

$$\begin{aligned}&\left\{\left[\delta\alpha^M(\varphi\chi)^2 + \omega^M\chi^2\,(1+\delta) + \xi^M\,(1+4\delta)\right](1-\tau)^2 + \delta\gamma^M\left[\sigma - \varsigma\chi\,(1+\varphi)\right]^2\right\} i_t \\ &= \delta\alpha^M\varphi\chi(1-\tau)^2 E_t[A_{t+1}] + \delta\gamma^M\left[\sigma - \varsigma\chi\,(1+\varphi)\right] E_t[B_{t+1} + \eta g_{t+1} - \varsigma\chi i_t^e - (1-\tau)y^*] \\ &\quad + \left[\omega^M\chi^2\,(1+\delta) + 2\delta\xi^M\right](1-\tau)^2 i_t^e + \xi^M(1-\tau)^2 i_{t-1} + 2\delta\xi^M(1-\tau)^2 E_t[i_{t+1}^e]\end{aligned}$$

Moreover, equation (12) implies:

$$\begin{aligned}\left[\eta^2\gamma^G + \xi^G\,(1+\tau)\,(1-\tau)^2\right] g_{t+1} = {} & \xi^G\,(1-\tau)^2\,(1+\tau)\, g^* + \eta\gamma^G\,(1-\tau)\, y^* \\ & + \eta\gamma^G\,(\sigma - \varsigma\chi\varphi)\, i_t - \eta\gamma^G\varsigma e_{t+1} - \eta\gamma^G B_{t+1}\end{aligned} \tag{14}$$

Then, by replacing A_{t+1} by its expression in (9), B_{t+1}, y_t and B_t by their expressions in (11), and g_{t+1} and g_t by their expressions in the former equation (14), given $E_t[d_{t+1}] = E_t[s_{t+1}] = 0$,we obtain:

$$\begin{aligned}
&\left\{\begin{array}{c}\delta\alpha^M\Omega^G\varphi\chi^2\left[\Omega^G\varphi+\upsilon\varsigma\xi^G(1-\tau^2)\right]+\Omega^{G2}\left[\omega^M\chi^2(1+\delta)+\xi^M(1+4\delta)\right]\\ +\delta\gamma^M\xi^G(1+\tau)\Psi\left[\Omega^G\Psi+\varsigma\chi\xi^G(1-\tau^2)(\lambda-\upsilon\varsigma)\right]\end{array}\right\}i_t\\
&=\delta\alpha^M\varphi\chi\Omega^{G2}\left[(1+\phi)\pi_t+\varphi\pi_t^e\right]+\Omega^{G2}\xi^M\left\{i_{t-1}+2\delta E_t\left[i_{t+1}^e\right]\right\}\\
&+\delta\gamma^M\xi^G(1+\tau)\Psi\Omega^G\left\{\left[\sigma-\varsigma(1+\phi)\right]\pi_t-\varsigma\varphi\pi_t^e+E_t\left[\varsigma\pi_{t+1}^e+\rho y_{t+1}^e\right]\right\}\\
&+\delta\xi^G\left(1-\tau^2\right)\left\{\alpha^M\upsilon\varphi\chi\Omega^G+\gamma^M\xi^G(1+\tau)\Psi(\lambda-\upsilon\varsigma)\right\}\\
&\quad\left\{(\lambda-\upsilon\varsigma)y_{t-1}+\left[\sigma-\varsigma(1+\phi)\right]\pi_{t-1}-\varsigma\varphi\pi_{t-1}^e-\varsigma\chi\varphi i_{t-1}^e-(\sigma-\varsigma\chi\varphi)i_{t-1}\right\}\\
&+\delta\xi^G\left(1-\tau^2\right)\left\{\alpha^M\upsilon\varphi\chi\Omega^G+\gamma^M\xi^G(1+\tau)\Psi(\lambda-\upsilon\varsigma)\right\}\left\{\varsigma\pi_t^e+\rho y_t^e-d_t-\varsigma s_t\right\}\\
&+\left\{\begin{array}{c}\delta\alpha^M\Omega^G\varphi\chi^2\left[\Omega^G\varphi+\upsilon\varsigma\xi^G(1-\tau^2)\right]+\Omega^{G2}\left[\omega^M\chi^2(1+\delta)+2\delta\xi^M\right]\\ +\delta\gamma^M\xi^G(1+\tau)\Psi\varsigma\chi\left[\xi^G(1-\tau^2)(\lambda-\upsilon\varsigma)-\Omega^G(1+\varphi)\right]\end{array}\right\}i_t^e\\
&+\delta\xi^G(1+\tau)\eta\left\{\alpha^M\upsilon\varphi\chi(1-\tau)\Omega^G+\gamma^M\Psi\left[\Omega^G+\xi^G\left(1-\tau^2\right)(\lambda-\upsilon\varsigma)\right]\right\}g^*\\
&+\delta\left\{\alpha^M\upsilon\varphi\chi\eta^2\gamma^G\Omega^G+\gamma^M\xi^G(1+\tau)\Psi\left[\eta^2\gamma^G(\lambda-\upsilon\varsigma)-\Omega^G(1-\tau)\right]\right\}y^*
\end{aligned}$$

with: $\Omega^G = \left[\eta^2\gamma^G+\xi^G(1+\tau)(1-\tau)^2\right] \succ 0$, and $\Psi = [\sigma-\varsigma\chi(1+\varphi)]$

Annex C: numerical calibration of our parameters

-Persistence of the shock on the level of economic activity (λ):

According to Ball (1998), this persistence is quite large, and can be set equal to λ=0.8 according to some econometric studies.

-Sensibility of the demand to the public expenditures (η):

A study by the European Commission (2001) gives the fiscal multipliers of expenditures in the short run, estimated by the model QUEST. The effect of an increase of 1% of GDP in the public expenditures on the demand would be: 0.4 in Germany or Ireland, 0.5 in most of the European countries, and 0.7 in Portugal. We can then retain the value of: η=0.5.

-Sensibility of the demand to the interest rate (σ):

A study by the ECB [Van Els and *alii* (2001)] gives the following results, for the negative effect during the second year of a monetary policy shock on real GDP:

Greece: σ=0.78 ; Italy: σ=0.60 ; Portugal: σ=0.54 ; Ireland: σ=0.48 ;

Austria: σ=0.47 ; Spain: σ=0.43 ; Germany: σ=0.33 ; France: σ=0.28 ;

Netherlands: σ=0.27 ; Finland: σ=0.24 ; Belgium: σ=0.20.

We can then retain the following average value: σ=0.4.

-Sensibility of the demand to the differential in inflation in comparison with abroad (β and ς):

Like Creel and Sterdyniak (1998) for example, we can retain the following specification for the value of the commercial balance: x_i =n(y_j-y_i) +1.5n(p_j-p_i), where n is the opening rate of the concerned economy. And the European Commission gives us

the integration of the goods market (value of the exports and of the imports of goods and services divided by twice the GDP, multiplied by 100) for the European countries in 2004[15]. So these values are highly dissimilar between the European countries, ranging from only 0.378 for Greece up to 1.232 for Belgium. But the average value for the European Union (25 countries) is about 0.530.

Moreover, we can suppose that the elasticity of the demand of exports is two times higher when it comes from the European Union than when it comes from the rest of the world. We can then retain as average values for the sensibility of the inner activity to the differential in inflation with abroad: in the monetary zone: β=0.6, and towards the rest of the world: ς=0.3.

-Sensibility of economic activity to foreign demand (τ and ρ):

According to the specification retained above, we can consider that the sensibility of the demand to the differential in economic activity with abroad is equal, for a country, to its opening rate. We then use, as above, the data supplied by the European Commission for the European countries in 2004. The values are then spread between 0.252 for Greece and 0.821 for Belgium. But the average value for the European Union (25 countries) is about 0.353. Moreover, we have mentioned above that we can retain a ratio of one to two between the commercial elasticities in the European Union and those in relation with the rest of the world. We can then retain as average values for the sensibility of the inner activity to the foreign demand: in the monetary zone: τ=0.4, and towards the rest of the world: ρ=0.2.

-Sensibility of the inflation to the supply production (v):

According to Rogers (2001), the sensibility to the GDP growth in 1999 of the Harmonized Index of Consumer Prices (HICP) during the 4^{th} trimester of the year 2000 is 0.24 in Europe. Penot, Pollin and Seltz (2000) also estimate the sensibility of inflation to the level of economic activity, during a period extending from 1981 (Netherlands) or 1991 (Germany, Italy) to 1999. They then find the following values, nevertheless with differences between the countries in the delays after which the growth influences the inflation:

Portugal: v=0.19 ; Germany: v = 0.15 ; Italy: v = 0.14 ; France: v = 0.12 ;
Belgium: v=0.09 ; Finland: v=0.09 ; Spain: v = 0.08 ; Netherlands: v = 0.07.
We can then retain the value: v=0.2.

-Sensibility of inner inflation to foreign inflation (ϕ and φ):

Gagnon and Ihrig (2002) estimate the sensibility of the domestic prices to a variation in the exchange rate and in the foreign prices, between the second half of the 1980's and the end of 2000, therefore after the break of the disinflation due to the EMS. They find that this sensibility is still equal to 0.36 in Greece, to 0.12 in Germany, but that it is now inferior to 0.1 in the other countries. We will then retain the average values: ϕ=0.1 ; φ=0.1.

-Sensibility of the exchange rate to the differential in interest rates (χ):

The condition of Uncovered Interest Rate Parity (UIRP), which corresponds to a perfect mobility of assets at the world level, is generally retained by most of the models. It is the one used, for example, by the Multimod Mark II model [Masson and *alii* (1990), p.16]. We will then retain the value: χ=1.

[15]These data come from the Eurostat data base of the European Commission.

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