Foreign Trade Pricing and Stability of a Monetary Union

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Abstract

This study, examine the price-setting behaviour of Europe exporters relying on the analytical framework of exchange rate pass-through. Strong differences as regards the price determination of exports can be seen in the euro zone. Some countries use local pricing: they set their selling price in the purchaser's currency, so local-currency export prices are then very sensitive to exchange-rate fluctuations. Others on the contrary find it easier to impose their price in local currency. We try to modelize this heterogeneity within a simple framework: we figure out a two-country monetary union, one of them is price-taker for its exports and the other is price-maker. We then examine the consequences of an exchange shock against the rest of the world. As far as reactions to this shock are asymmetric, the Central Bank, having as its objective the average inflation of the union, might strengthen the negative impact of such a shock, at least in one of the two countries.

1 Introduction

The theory of optimal monetary areas focused excessively on the incidence of asymmetric shocks. Some writers have tried hard to explain that a monetary union is desirable only if the economies which compose it are subjected to disturbances which are not too different, or if they have adjustment mechanisms(mobility of factors, price and wage flexibility, budgetary transfers,...) able to absorb these shocks. Today the problem is posed in slightly different terms. What matters is less the asymmetric character of the shocks which affect the partner countries of a monetary union, than the differences in their reactions to the disturbances which

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affect the partner countries of a monetary union, than the differences in their reactions to the disturbances which affect them collectively. That is to say the heterogeneity of the macroeconomic behaviour of the member countries of a monetary area is the problem and makes it much more costly to submit to a single monetary policy and to give up their exchange rate adjustments.

This heterogeneity has numerous sources. In particular the variety of financing structures (the respective place of markets and intermediation, the term structure of financing...) can be at the origin of a different impact of monetary impulses depending on the countries. Similarly, the type of wage bargaining determines different sensitivities of wages and of employment levels to inflationary shocks or situation gaps[1]. All this is likely to put into question the relevance or viability of a monetary union between countries whose institutional structures or productive and financial systems are too dissimilar.

In this contribution we want to emphasize a specific characteristic (and a source of asymmetry) of economies: export pricing. This issue directly concerns the optimality of a monetary area, since the question is to know if partner countries are in the same way going to pass through an exchange rate fluctuation of their common currency with the currencies of the rest of the world. If the economies of the zone have no homogeneous behaviour from this point of view, distortions in the evolution of prices (or price connections) may follow and they are likely to question the coherence of the monetary union.

Depending on the cases considered, the role of monetary policy may be widely modified. Since if, in a given economy, exporting companies have the ability to set their prices in their local currency, without any loss of sales as a consequence, then their margins are perfectly sheltered from exchange rate fluctuations. That is to say they completely pass through exchange rate fluctuations in their foreign currency prices. In these conditions, the monetary policy itself is indifferent to exchange rate fluctuations and can concentrate on domestic equilibrium... On the other hand, if exporters have to invoice in the market prices which prevail in the target country (or run the risk of losing an important part of their sales), then exchange rate fluctuations have a direct impact on the margins of companies. This means that they are unable to pass through the exchange rate fluctuations. So, monetary policy cannot be indifferent to it.

Now, for some time, a plentiful literature has questioned the relevance of the "Law of one price" which was one of the usual ingredients of macroeconomic models in an open economy[2]

[1]Many researchers tried to list heterogeneity factors in the euro area, and their consequences on the monetary policy. See for example R. Dornbusch, C. Favero et F. Giavazzi: Immediate challenges for the European Central Bank, Economic Policy, 1998, pp.15-52.

[2]Obsfeld considers that this questioning of the law of one price assumption is one of the stylised facts which account for a rephrasing of the traditional models of international macroeconomics. See International macroeconomics: beyond the Mundell-Fleming model

In particular, those models are unable to reproduce the observed volatility of real exchange rates, nor their high correlation with nominal exchange rates. Those observations are easier to understand if we admit the possibility of discrimination in prices, which implies some durable spreads between selling prices of the same product on the local market and in other countries[3]. In this case, the pass-through of exchange rate variations is incomplete and obviously, the law of one price doesn't apply anymore. This hypothesis refutes the all too often supposed perfect integration of international economy. It has been validated by a number of empirical works. For example, R. Feenstra and J. Kendall show that partial pass-through of exchange rate fluctuations is able to explain the deviations from purchasing power parity of four currencies (dollar, sterling, mark and yen) between 1974 and 1994[4].

P. Goldberg and M. Knetter [1997] show that the 1994-95 rise of the yen (over 30%), hardly passed through on prices, so that Japanese exports were not hit[5]. From a microeconomic point of view, several papers made clear that the "Law of one-price" doesn' t apply to specific markets or products[6]. At last C. Engle and J. Rogers in observing deviations from PPP in 55 big European cities show the presence of a boarder effect: the real exchange rate between two cities is all the more variable since they belong to different countries[7]. The authors explain this result by the heterogeneity of marketing and distribution systems.

This type of behaviour has different explanations, which have to do with the existence of market imperfections. The choice of keeping unchanged the local currency prices of the importing country (or of not passing through the exchange rate fluctuations totally) implies an action on margins which requires both a segmentation of national markets and market power. As a consequence the intensity of the phenomenon depends on the nature of exported goods. On low-differentiated goods, subjected to international competition, there are naturally few possibilities of discrimination. Their price is set in foreign currency and is imposed to all producers. On the other hand,

[3]This is precisely the idea of C. Betts and M. Devereux: in the theoretical framework of Obsfeld and Rogoff they include the pricing-to-market hypothesis to generate exchange rate volatility. See Betts et Devereux, "Exchange rate dynamics in a model of pricing to market", European Economic Review, 1996, pp. 1007-1021.

[4]See "Pass-through of exchange rates and purchasing power parity", Journal of International Economics, pp. 237-261.

[5]This article is an excellent survey of research led on international trade pricing and more specifically on exchange-rate pass-through at micro and macroeconomic levels. See P. Goldberg and M. Knetter, "Good Prices and Exchange Rates: What Have We Learned?", Journal of Economic Literature, September 1997, pp. 1243-1272

[6]See,for example J. Le Cacheux and L. Reichlin, "Taux de change et prix des importations: le cas des automobiles en Europe", Observations et diagnostics économiques, avril 1999, pp. 133-155.

[7]See "Deviations from purchasing power parity: causes and welfare costs", Board of Governors of the Federal Reserve System, International Finance Discussion Papers, no 666, may 2000.

on specific goods, exporters have more freedom to set prices, so they can set them in their local currency, i.e. they fully pass through the exchange-rate fluctuations.

From then on, we understand that according to their specializations, the various economies do not react to exchange rate fluctuations in the same way. Countries which produce standard goods have to reduce prices (in local currency) as well as the volume of their exports, in case of a rise in their currency. In the meantime, countries producing "up-market" goods will, in the same circum-stances, be able to afford to leave their export prices unchanged. And it is clear that gathering in the same monetary area, countries with too dissimilar a sensitivity to exchange-rate fluctuations can raise a problem.

The first part of this article proposes a summary assessment of these differences in sensitivities, in the case of several economies of the euro zone. The variety we observe is the justification of the exercise we put forward below. We first write a model in which two economies forming a monetary union and characterized by contradictory practices of their export pricing are affected by avariation in the parity of their common currency (compared to the rest of the world). We then determine the long-run equilibrium of the system. And finally we study the short-run dynamics to analyze the performance of these two economies, subjected to the same monetary policy.

2 Empirical Evidence

Here we wonder about possible differences in the practices of foreign trade pricing of several euro-zone countries. For that purpose we examine the export pricing of five major member countries of the euro zone: Germany, Spain, France, Italy and the Netherlands. If the exporters of a country try to stabilize their prices in the purchaser's currency, as is the case in so-called local-pricing practices, then domestic currency export prices should react strongly to exchange rate fluctuations. Conversely, the latter should not vary following an exchange rate variation, when the selling country sets most of its prices in its own currency. It must be possible to put the existence of divergent practices on this point to the test from values taken for various countries by coefficient of the following econometric relation:

$$log\left(\frac{P_{X,t}}{P_{p,t}}\right) = \beta_0 + \beta_1(log(Ereal_t)) + \mu_t$$

with P_x the export price index for the country of interest, P_p the output price index (available in monthly data for Germany, Italy and Spain [8]) or if the series is not available, the GDP price index (quarterly for France and the Netherlands), and Ereal, the average real exchange rate of the country. Marked discrepancies in the value taken by the estimates of coefficient

[8] All series come from the DATASTREAM database

disclose different practices of foreign trade pricing. However as we show in annex 1, this parameter doesn't provide a direct measure of the bearing of local pricing on exports (denoted as) since its value is also affected by the share of exports in production. More precisely, the relation between both parameters is

$$\alpha = \frac{\beta_1}{1 - \gamma + \gamma\beta_1}$$

To compute γ, we divide exports by the GDP of each country. The mean of this series is used to extrapolate the α parameter presented in the tables[9]. As regards real exchange rate, we shall resort to two indicators here. We can first of all use series of real effective exchange rates calculated by the IMF in its international financial statistics. This data source has a shortcoming: it refers to the consumer price indexes of the various countries (which include the prices of products imported in every country), while in our approach, it would be necessary to work from production prices. Furthermore, the weight system used by the IMF to construct its indicator is not optimal for our work. The weight of each currency should depend not only on the weight of the importing country in total exports but also on the proportion of these exports subject to local pricing. The IMF weight system could be convenient if the "rate of pricing to market" was identical in all importing countries. The second measure of the real exchange rate is more restrictive: it simply is the real exchange rate of the dollar worked out from output price indexes[10] according to:

$$Ereal = E_{usd}.P_p^{us}/P_p$$

with E_{usd} the nominal exchange rate of the dollar (that is the number of monetary units of j needed to buy a US dollar[11]). Since the variables are integrated of order one and not co-integrated[12], we ran the test in first differences according to the relation:

[9]GDP and exports series are quarterly observations from 1991 to 2001. They are computed at current prices and seasonally adjusted. For table 1, the mean is computed over 1991-2001, for table 2, it is calculated with data from 1995 to 2001. These calculations are presented in annex 2

[10]Identical estimates in which the real exchange rate is worked out from consumer prices gave very close results to those reported here. This leads us to think that the shortcoming related to the use of the IMF real effective exchange rate can be set aside empirically

[11]This measure is not perfect. It overlooks a potentially important part of the potential pricerelations determinants. Moreover, different estimated values for β could stem not only from varying pricing practices, but also more simply from differences in the dollar influence on exports. However, if the estimated values for the coefficient vary, this will prove that in the wake of a dollar shock, price reactions in the said countries will be different, which is at the core of our concerns.

[12]Of course, this result is problematic and probably indicates an instability of the coefficient we are interested in.

Table 1. Measure of the export price reaction to local prices.1980-2001 period

	Real effective E.R			Real E.R of the US dollar	
	Obs	β_1	α	β_1	α
Germany	261	8.89% (0.000)	11.86%	2.86% (0.000)	3.90%
Spain	261	11.25% (0.344)	14.08%	13.45% (0.011)	16.73%
France*	86	32.40% (0.000)	38.70%	11.53% (0.000)	14.65%
Italy	247	23.86% (0.000)	29.57%	13.24% (0.000)	16.97%
The Netherlands*	85	75.52% (0.000)	88.17%	19.31% (0.000)	36.63%

*For France and the Netherlands, data are quarterly, they are monthly for the other countries. Under estimated coefficients, between brackets, we indicated the significance level of the null hypothesis of the coefficient. Coefficients significant at 5% level are in bold characters

$$\Delta log\left(\frac{P_{x,t}}{P_{p,t}}\right) = \beta_0^{'} + \beta_1\left(\Delta log\left(Ereal_t\right)\right) + \mu_t$$

Where, $\Delta x_t = x_t - x_{t-1}$.

The table below summarizes the results of econometric estimates of the above relation for the two chosen measures, over a period going from the beginning of 1980 to the end of year 2001. On a global level and with regard to the dollar only, we see wide differences in the reaction coefficient of the relation of prices to the real exchange rate.

For the real effective exchange rate, except for the case of Spain where the coefficient is not significantly different from zero, we observe a one-to-seven proportion between parameter α in Germany and in the Netherlands. The latter, due to their specialisation, have to stabilise the prices for their products in their buyers' currency as much as possible. In contrast, Germany seems close to being able to pass through its whole exchange fluctuations on its selling prices. These results are confirmed when we examine results relating to the real exchange rate of the dollar. This time we have a one-to-nine proportion. Besides, the implementation of the euro probably changed things a little. indeed, the share of real exchange movements due to nominal exchange variations inside the zone disappeared.

Besides, the convergence movements observed during the 90s between the countries of Europe, could have reached their pricing practices which interest us here. Table 2 presents the results of estimates over a shorter period (first quarter of 1995 for France and the Netherlands, January 1996 for the others). We notice a reduction in the range of values taken by coefficients β and α.

Table 2. Measure of export-price reaction to local prices.1995/96-2001 Period

	Real effective E.R			Real E.R of the US dollar	
	Obs	β_1	α	β_1	α
Germany	261	12.28% (0.000)	16.53%	3.92% (0.000)	4.44%
Spain	261	49.21% (0.348)	56.92%	15.87% (0.269)	29.99%
France*	26	18.86% (0.008)	23.83%	5.32% (0.011)	6.65%
Italy	68	39.77% (0.042)	47.3%	14.95% (0.044)	22.59%
The Netherlands*	26	56.00% (0.000)	77.02%	17.17% (0.001)	32.03%

*For France and the Netherlands, data are quarterly, they are monthly for the other countries. Under estimated coefficients, between brackets, we indicated the significance level of the null hypothesis of the coefficient. Coefficients significant at 5 % level are in bold characters

The proportion between coefficients for the Netherlands and Germany is slightly over 4 in the real effective exchange rate case, and is seven times higher in the Netherlands for the real exchange rate of dollar.

So, although there actually was a partial convergence, strong disparities remain in export pricing between euro-zone countries. We are then led to wonder about the behaviour of these economies faced with exchange rate shocks with the rest of the world, and about the consequences of their submission to a common monetary policy. The following model aims to shed light on this question.

3 The Model

This model brings in three countries. Countries A and B share a single currency. By hypothesis, most parameters (sensitivity, indexing, etc.) are supposed to be identical in these two countries. They differ by their foreign-trade pricing practices. Country B is supposed to have a "*traditional*" pricing: it sets sale prices in its own currency. The buyers of these products are going to bear the consequences of any variation in their exchange rate. From this, required volumes should react to a variation of the real exchange rate. However, this reaction must be moderate; otherwise country B could not afford such a practice. Country A, on the contrary, resorts by hypothesis to so-called local pricing: it sets its price in the purchaser's currency. This behaviour probably means that, contrary to country B, the demand for its products is very price sensitive. An exchange-rate variation is then going to pass through on selling price, and on the profits of exporting firms, the

demand for exported goods remaining unchanged.

Country C represents the rest of the world, it is supposed to be big enough not to be affected by monetary union variables, and its foreign-trade pricing practice is identical to that of country B. We are not interested here in the influence of this country's main domestic variables on the countries of the union. Therefore income and general price level in C are set to one, so they are null in logarithm. In fact, country C intervenes in the model only by means of its exchange rate: we will note e the logarithm of the number of monetary units of the zone necessary to acquire a monetary unit of the rest of the world. The shock considered here is a depreciation of the monetary area currency compared to the rest of the world [13]. Finally, in the model all variables are expressed in equilibrium-gap, and in logarithm. All parameters are positive.

3.1 Supply in country A

A: *Prices and wages*

In country A entrepreneurs use local pricing. so we can suppose that this country sells its products to the other two by keeping its prices expressed in their respective currencies, and by following the local price variations if need be. The average price (in logarithm) of domestic production is thus written:

$$P_p^A = \gamma_1^A P^A + \gamma_2^A e + \gamma_3^A P^B \qquad (A1)$$

where, $\gamma_1^A + \gamma_2^A + \gamma_3^A = 1$

P^A is the logarithm of domestic good prices sold in country A and P^B the logarithm of goods produced and consumed in country B. They will be called "'domestic" prices to both countries. Their growth rate symbolizes the underlying inflation in each country. Parameter γ_2^A indicates the share of national output whose price is set following the exchange rate fluctuations with country C. As country A resorts to full local pricing it represents in fact the part of A $'s$ output exported in C. Similarly γ_3^A represents the share of A 's national output following price fluctuations in B, and thus the share of this output which is exported in B. In addition we suppose that wages evolve according to consumer prices following the rule below where θ is the indexing coefficient:

$$W^A = \theta P_C^A \qquad (A2)$$

Finally consumer prices depend on domestic prices and on the exchange rate with C and the price in B. By hypothesis these two countries *don't* use local pricing:

[13] Of course, the effects of a rise in prices are perfectly symmetrical.

$$P_A^C = \mu_1^A P^A + \mu_2^A e + \mu_3^A P^B \qquad (A3)$$

where μ_2^A et μ_3^A are the respective shares of imports from C and B[14] in the consumption of domestic goods.

B: *The long-term supply function*

In a very traditional way, the supply evolves positively depending on the gap between national output price and wage.

$$Y_s^A = \beta\left(P_P^A - W^A\right) \qquad (A4)$$

The set of these hypotheses concerning the economy supply is summed up in the following relation:

$$Y_s^A = \beta[\left(\gamma_1^A - \theta\mu_1^A\right) P^A + \left(\gamma_2^A - \theta\mu_2^A\right) e + \left(\gamma_3^A - \theta\mu_3^A\right) P^B] \quad (A5)$$

We see in particular that a depreciation of the union currency can boost supply as far as it entails an increase in the selling price of products sold in this currency. This supply function may appear very simple. There is no reference to other inputs except wages but in fact, it is possible to complexify the equation without modifying the basic principle of the framework. The coefficient of indexation captures the potentially durable effect of relative price variations (in this case, real wages). We could also interpret it as the measure of an irreversible impact (when $\theta < 1$) of a transitory alteration of relative prices on production capacity: for example a transitory improvement of relative output price increases durably investment and therefore potential supply.

C: *Demand in country A*

It takes the following shape:

$$Y_d^A = \alpha_y Y^B + \alpha_z\left(e - P^A\right) + \alpha_z\left(P^B - P^A\right) - \alpha_r(r) \quad (A6)\,.$$

We first suppose that domestic income is sensitive to country B's income, through the traditional channel of exports from A to B[16]. Furthermore, the demand for domestic goods depends on the real exchange rate between A and C (this rate is given $e - P^A$ by here) and on the real exchange rate between

[14] In all these parameters should depend on the real exchange rate with from C and B[15]. But we choose to ignore it in order to avoid non linearity

[16] Obviously the same relation also exists with the rest of the world, but here we suppose that variables there are stable.

the two union members $(P^B - P^A)$. These effects come at play only through imports. As we pointed out, the pricing behaviour of A exporters offsets any price-competitiveness impact on export volumes. However, because imports come from the two countries supposed to set prices in their own currency, the demand for them should be sensitive to real exchange rates. Parameter α_Z measures these supposedly identical sensitivities.

Besides, as usual, demand is negatively related to interest rate. In theory, we should take real long interest rate here. But as there is no price dynamics in the short term version of this model, shocks will have highly transitory effects on prices. Consequently, long-term expected inflation, is equal to zero and thus we can write demand as a function of nominal interest rate[17].

3.2 Supply in country B

A: *Prices and wages*

As in country B, entrepreneurs set their prices in local currency for their exports, so the average price of domestic goods P_p^B is equal to domestic prices in B. It is influenced neither by the exchange rate of the rest of the world, nor by prices in A. This means imposing the following set of parameters on (A1): $\gamma_1^B = 1$, $\gamma_2^B = 0$, $\gamma_3^B = 0$:

$$P_p^B = P^B \qquad (B1)$$

As in A, wages are indexed at a θ rate to the consumer price index:

$$W^B = \theta P_C^B \qquad (B2)$$

with

$$P_C^B = \mu_1^B P^B + \left(1 - \mu_1^B\right) e \qquad (B3)$$

$where \mu_1^B$ represents the share of products sold at domestic price (here the part of the consumed products which comes from the monetary union, since in this case, As price products follow the prices of goods produced in B) and $1 - \mu_1^B$ is the share of consumption in B of goods imported from C.

B: *The long-term supply function*

Finally the form of the supply function is the same as in A:

$$Y_s^B = \beta\left(P^B - W^P\right) \qquad (B4)$$

[17] Moreover, it is a way to avoid the hypothesis about expectations' formation. Lastly, if demand depends on variation of past prices, it could generate instable dynamics in some configurations.

The set of these hypotheses concerning the economy supply is summarized in the following relation:

$$Y_s^B = \beta[\Big(1-\theta\mu^B)P^B - \theta(1-\mu_1^B)e] \quad (B5)$$

We see in particular that currency depreciation will be able to hinder supply if wages are indexed: the increase in import prices increases real wage expressed in terms of output prices.

D: *Demand in country B*

We also suppose that domestic income is sensitive to income in A, through the traditional channel of exports from B to A. The influence of the real exchange rate within the union ($P^A - P^B$) comes at play only through exports from B to A, the B imports of A products are priced by B, as we saw earlier. The influence of the exchange rate with the rest of the world ($e - P^B$) affects both imports and exports.

$$Y_d^B = \alpha_Y Y^A + \alpha_{ZX}(e - P^B) + \alpha_x(P^A - P^{B)} - \alpha_r(r) \quad (B6)$$

Finally, nominal interest rates affect demand negatively.

3.3 Long-Run Equilibrium

We suppose an economy at a long-run equilibrium since domestic prices equalize supply and demand in every country. The shock under scrutiny is a depreciation of the union currency to the dollar. For the time being, we shall suppose that the interest rate of the zone is at its equilibrium value i.e r= 0. The behaviour of the Central Bank will be described further on. The analytical solution is made complex by interactions between the two union countries, yet we can examine an intermediate solution which does not refer to real interest rate.

With $c_i = \gamma_i^A - \theta\mu_i^A$, the equilibrium long term prices are:

$$P^{A*} = \frac{\alpha_y}{\beta c_1 + 2\alpha_z}\, Y^{B*} + \frac{\alpha_z - \beta c_2}{\beta c_1 + 2\alpha_z}\, e + \frac{\alpha_z - \beta c_3}{\beta c_1 + 2\alpha_z}\, P^{B*} \quad (1)$$

$$P^{B*} = \frac{\alpha_y}{\beta(1-\theta\mu_1^B) + \alpha_{zx} + \alpha_x}\, Y^{A*} + \frac{\alpha_{zx\ +\beta\theta\mu_2^B}}{\beta(1-\theta\mu_1^B)\ +\ \alpha_{zx}\ +\alpha_x}\, e$$

$$+ \frac{\alpha_y}{\beta(1-\theta\mu_1^B)\ +\ \alpha_{zx} + \alpha_x}\, P^{A*} \quad (2)$$

$$Y^{A*} = \frac{\alpha_y}{1\ (2\alpha_{z/\beta c_1})}\, Y^{B*} + \frac{c_1\ +\ 2c_2}{2/\beta\ +\ c_1/\alpha_z}\, e\ +\ \frac{c_1 + 2c_3}{2/\beta\ +\ c_1/\alpha_z}\, P^{B*} \quad (3)$$

$$Y^{B*} = \frac{\alpha_y(1-\theta\mu_1^B)}{\beta(1-\theta\mu_1^B)+(\alpha_x+\alpha_{zx})/\beta}\ Y^{A*} \ + \ \frac{(1-\theta)\alpha_{zx}-\alpha_x\theta(1-\mu_1^B)}{(1-\theta\mu_1^B))+(\alpha_z+\alpha_{zx})/\beta}$$

$$+\frac{\alpha_x(1-\theta\mu_1^B)}{(1-\theta\mu_1^B))+(\alpha_z+\alpha_{zx})/\beta}\ P^{A*} \quad (4)$$

From these equations, we are simply going to describe the main effects of an exchange rate fluctuation. It is necessary to understand interest-variable reactions, to distinguish several configurations on the value of wage indexation rate which plays a key role here.

A: *Null indexation*

In B, demand is boosted by the depreciation of real exchange rate towards the rest of the world, which transits through both exports and imports with the rest of the world. In A, this effect is less marked because it occurs only through imports from C. Besides, the influence of import propensity is going to strengthen this positive impulse because, in the studied configuration, the income increases in A as it does in B. Finally the improvement of the price-competitiveness of A compared to B - we shall see further that domestic prices move upwards in B and downwards in A - should hinder A imports from B, and thus increase the demand for A products to the disadvantage of demand for B products.

When wages are not indexed on prices, supply in B is not affected by exchange rate fluctuation. In country A, the increase in national output price, due to the rise in export price set in local currency, incites companies to produce more. The price increase in B, which affects the average selling price of companies in A, acts in the same way.

The graph[18] below reproduces the set of reactions of the supply and demand functions following an exchange rate depreciation compared to the rest of the world.

Here we observe that, in A as in B, the output and income level was boosted by the exchange rate depreciation. In contrast domestic, price levels react differently: on the rise in B and downward in A.

B: *With perfect indexation*

Initial effects on demand are unchanged. Supply in B is strongly reduced because of the growing costs. This effect, faced with the increase in

[18] see figure 1 in Annex 1

demand, entails a domestic price increase proportional to that of exchange rate. Furthermore, depreciation does not hit income.

In A the direct consequences of exchange rate fluctuation are unclear. However, through the offsetting between coefficients γ_i^A on the one hand, and coefficients μ_i^A on the other hand, by cumulating the direct effect (from the exchange rate) and the indirect one (through P^B) domestic prices will rise proportionally to the exchange rate[19]. Finally, the shock has no impact either on real income. The figure[20] above represents all these moves, identical in A and B

C:*Partial indexation*

For intermediate values of theta, variables react as described in the case of a low theta, with a few qualifications. Direct effects on demand are obviously identical, the indexation parameter acts only on supply. In B, supply is going to decrease all the more as indexation is strong. As a consequence the output cost for companies is greater. Things are not so simple in A. On the one hand, the increase in the average price of national output due to the rise in export selling prices incites companies to produce more. But this could be offset by a possible increase in wages and thus in costs.

Direct effect on supply is positive if $\gamma_2^A > \theta\mu_2^A$. This condition is verified even for fairly high values of θ[21] . It is the same story for the retroaction of the price rise in B, things depend on the relation between γ_3^A and $\theta\mu_3^A$. In any case, it should generally play in favour of supply. So, in A, prices will rather tend to decrease if the supply rise is superior to that of demand. This is verified except for values of theta very close to one2. We will also get a rise in the equilibrium level of income. Figure 3 [22] below illustrates this case in a schematic way.

4 SHORT-TERM DYNAMICS

A: *Dynamic of adjustment*

At this stage, we integrate in our model a very simple dynamic which only specifies a gradual adjustment of the supply to its long-term position.

[19]If we notice that $\sum$ c$_i$ = 1- θ $so = 0 when \theta = 1$, then it is possible to verify from the equation that the sum of coefficients multiplying e and P^{B^*} is equal to one This also verifies for e and P^{A^*} coefficients in the equation (2). It should be pointed out that, still in the case of total indexation, the sum of coefficients associated with e and P^{B^*}(resp.P^{A^*})in equation (3) (resp. (4)) is null.

[20]See Figure 2 Annex 1

[21]Indeed, if we suppose that exports have the same bearing on investment and on consumption, we can demonstrate that if the trade balance is even on the whole and if each of its geographical components (with B and C) is as well, then we must get $\gamma_i^A = \mu_i^A, \vee i$

[22]See Figure 3 in Annex 1

We suppose that the adaptation of production capacity takes more time than price adjustments. Inside each period so defined, we suppose that prices are perfectly flexible. Therefore, we give up studying the effect of short-term price rigidity in order to simplify the solving of the system. In this way, the dynamic is characterized by the following equations:

$$Y^A_{s,t} = \pi Y^A_{s,t-1} + (1-\pi)\beta(P^A - W^A)$$

So

$$Y^A_{s,t} = \pi\, Y^A_{s,t-1} + (1-\pi)\,\beta\,[(\gamma^A_1 - \theta\mu^A_1)P^A + (\gamma^A_2 - \theta\mu^A_2)\,e + (\gamma^A_3 - \theta\mu^A_3)\,P^B]\;(A5')$$

$$Y^B_{s,t} = \pi Y^A_{s,t-1} + (1-\pi)\beta(P^B - W^B) \quad (B5)$$

$$Y^B_{s,t} = \pi\, Y^B_{s,t-1} + (1-\pi)\,\beta\,[(1-\theta\mu^B_1)\,P^B - \theta(1-\mu^B_1)\,e](B5')$$

B: ***The Central Bank***

Moreover, to consider the impact of monetary policy on short-term behaviour of the system, we write the reaction function of the Central Bank. It sets its interest rate (in equilibrium-gap) according to the average underlying inflation in consumer prices inside the zone[23]. We suppose that countries A and B are of the same economic weight.

$$r = \varphi\frac{(\pi_A \;+\; \pi_B)}{2} = \varphi\frac{(P^A_{C,t} \;-\; P^A_{C,t-1}) \;+\; (P^B_{C,t} - P^B_{C,t-1})}{2} \quad (9)$$

We shall be able to put coefficient φ to zero to examine the equilibrium without Central Bank intervention, or give it a higher value to analyze the effects of such a policy. Intuitively, we already perceive the difficulty to handle such a rule since the shock has different impacts on prices in the two countries of the union.

5 Simulations

A: ***Simulation conditions***

[23] In a previous version of this work, we used a more restricted objective: the average core inflation. The reason was that the intervention rate has a weak and uncertain effect on the exchange rate which is part of total inflation. However, we think that the objective has to be global inflation if we are concerned with consumers' welfare

The equation system (A5'), (A6), (A7), (B5'), (B6), (B7) and (9) was solved by MATHEMATICA and simulations were run using RATS. The values chosen to fine-tune the model for simulation purposes aim at mirroring the strong interweaving of economies in the monetary area. This is taken into account in the values granted to parameters α_y, γ_3^A, μ_3^A which try to represent the fact that a quarter of A's output is sold in B and a quarter of A's consumption comes from B. Parameter γ_1^A takes a slightly higher value than μ_1^A in order to keep an increasing supply function when $\theta = 1$. Moreover, the parameters of income sensitivity to real exchange rates were set at a low level. The countries with no local pricing (B and C) can afford to set their prices because demand for their products is not very sensitive to real exchange rates. The supply parameter β implies a marginal productivity of work equal to 0.33. Finally, the other parameters take on values which are thought to be reasonable - other values of these parameters have obviously been tested and they don't change the meaning of our results. On the contrary, we vary the values of θ, the wage-indexation coefficient, whose influence on results is very strong.

Supply parameters:

$$\gamma_1^A = 0.61,\ \gamma_1^A = 0,14,\ \gamma_1^A = 0,25$$

$$\mu_1^A = 0.60,\ \mu_2^A = 0.15,\ \mu_3^A = 0.25$$

$$\beta = 2$$

$$\gamma_1^B = 1, \gamma_2^B = \gamma_3^B = 0$$

$$\mu_1^B = 0.85,\ \mu_2^B = 0.15,\ \mu_3^B = 0$$

Demand parameters:

$$\alpha_Y = 0.25$$

$$\alpha_Z = 0.01,\ \alpha_{xz} = 0.02,\ \alpha_x = 0.01$$
$$\alpha_r = 0.25$$

Supply adjustment:

$$\pi = 0.3$$

Monetary policy rule:

$$\varphi = 3$$

B: ***Results***

Here we wonder about the consistency of a "global" monetary policy. The Central Bank will have to face a complex situation since the exchange shock has asymmetric effects on prices in both countries. We chose to compare the effects of this single monetary policy with a situation "without a monetary policy"[24]. This situation is formalized in setting the reaction coefficient of the Central Bank φ to zero, which entails the nullity of the nominal interest rate in the model.

Low indexation. We have already underlined that, when θ is lower than unity, countries A and B have heterogeneous reactions to an exchange rate shock. In those cases the reaction scheme with or without monetary policy is identical, with an amplification when θ increases. Indeed, when indexation is high the average inflation of the area is higher, and the monetary policy becomes more restrictive.

The income level in both countries will react to this tightness, since instead of having a growth period due to currency depreciation in the area, income will decrease as illustrated in figures 4 and 5 below. In that way, monetary policy has a destabilizing impact on equilibrium income. Regarding inflation, consequences are positive in B where inflation resulting from the shock is smoothed over time by the monetary policy. But the reaction of the Central Bank is too strong for A. In this country, price variations in absolute value are higher than those observed without monetary policy. Those reactions are illustrated by figures 4 and 5 in the configurations θ= 0, and θ= 0.75[25]

High indexation. Lastly, in case of perfect wage indexation, both countries react in the same way without monetary policy and monetary policy satisfies its objective in each country: inflation is reduced in absolute value. Logically, this is obtained at the expense of growth, which remains durably negative in both countries. The restrictive effect is stronger in B because of its loss in competitiveness relative to A.

[24] Another solution consists in comparing the impact of the same shock when countries A and B are in flexible exchange, each with its own monetary policy. We must then make a hypothesis on the setting of exchange rate and their anticipations. Our attempts towards this (in which domestic exchange rate is Dornbush modelized) show a better efficiency of the two Central Banks' intervention. But this choice is not fair on the single currency: for the comparison to be fair, we should also integrate exchange shocks on the intra-zone parity in this flexible exchange model.

[25] The scale of inflation's graphics increases with θ.

Figure 4: Compared reactions after an exchange rate shock with or without monetary policy

Theta = 0.0
With - - - or without ___ Monetary Politicy

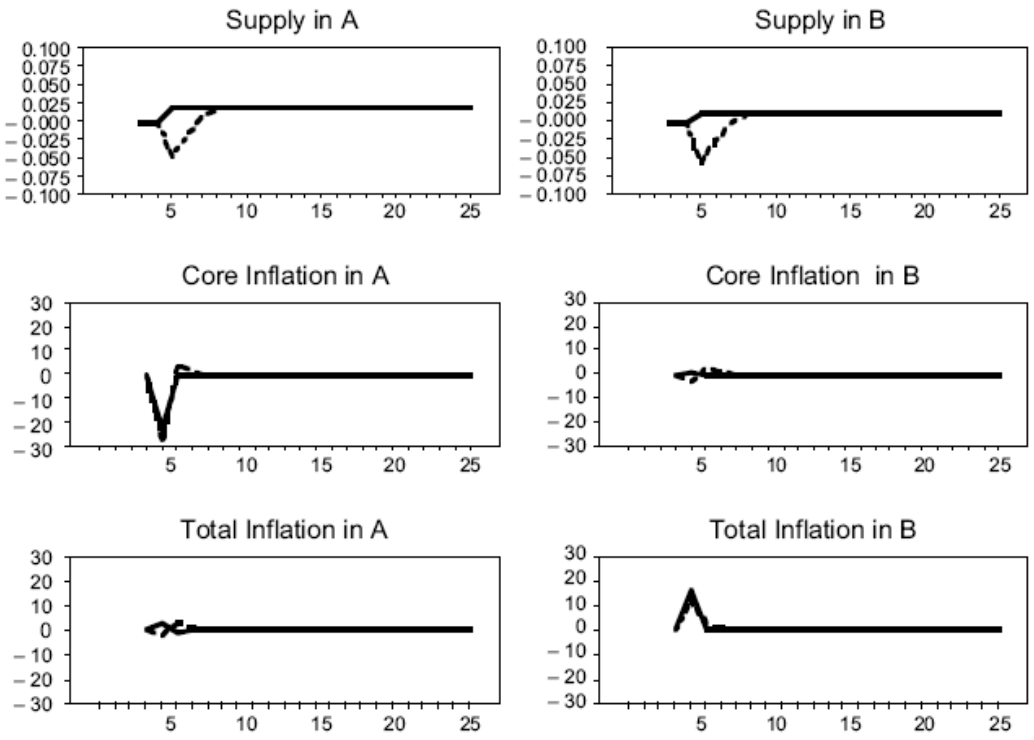


Figure 5: Compared reactions after an exchange rate shock with or without monetary policy

Theta = 0.75
With - - - or without ___ Monetary Politicy

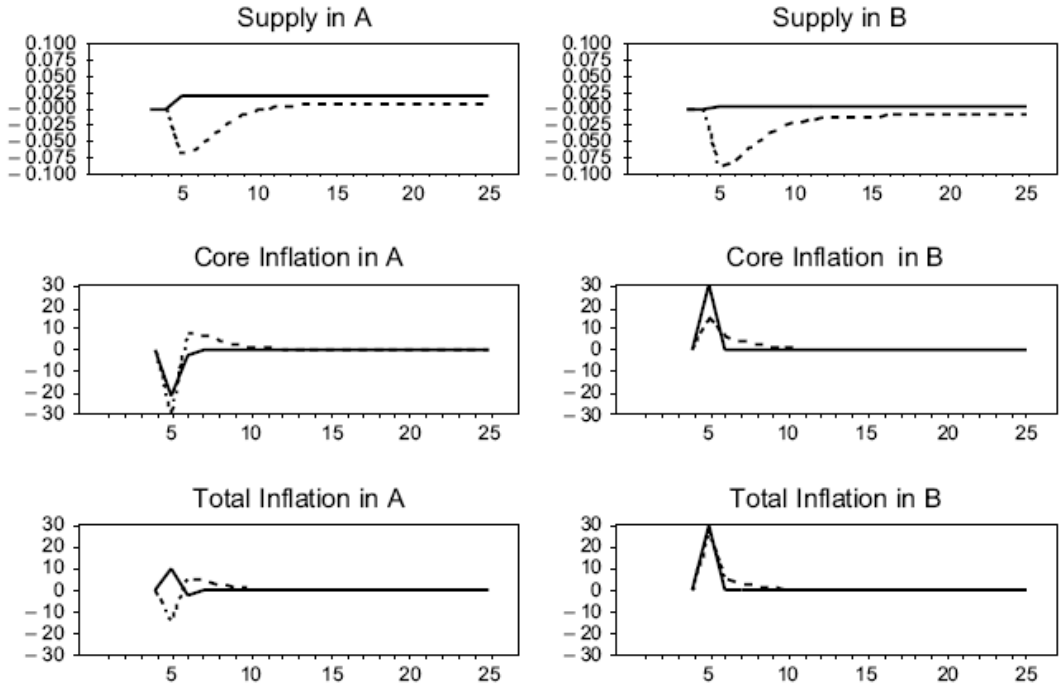
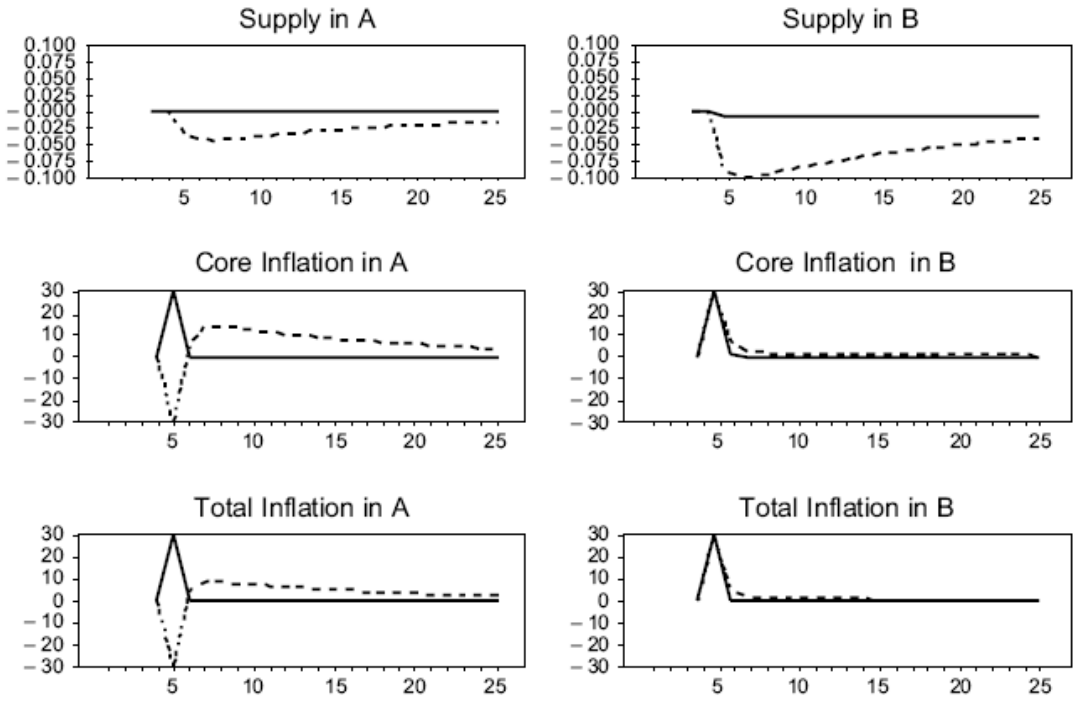


Figure 6: Compared reactions after an exchange rate shock with or without monetary policy

Theta = 0.75
With - - - or without ___ Monetary Politicy



1 CONCLUSION

Our modelization enabled us to give more ground to our first intuition : exchange shocks can affect the consistency of a monetary union, when the union members have different practices of foreign-trade pricing. In these conditions the exchange-rate fluctuations of the unionŠs currency entail distortions in performances which the common monetary policy is likely to widen. We saw that in all configurations, monetary policy always entails at least one negative effect, in emphasizing the reactions of income or in strengthening price variability in the country which uses local pricing. This is particularly true when wage indexation on prices is strong. In that case, the monetary policy is split between two contradictory preoccupations : it has to react to the aggregated imbalance of the whole zone, but it can be paralyzed by the consideration of the gap between national economic situations.

Naturally it is impossible to say if the effects we highlighted can explain inflation and growth differentials (lasting and important if not increasing) recorded between economies within the euro zone. Yet between 1999 and 2001, the euro depreciation went with moves in export prices which differed widely from one country to the other. Indeed, export prices went up by almost 10 % in Italy, Spain and the Netherlands, compared to 6 % in Germany and only 2 % in France. These evolutions certainly contributed to the difficulties faced by the single monetary policy, torn between contradictory signals[1].

However, our results do not enable to assert that in the circumstances we analyze, a monetary union is preferable or not. For we did not modelize the situation in which two economies give up the monetary union and find in the autonomy of their monetary policy, as well as their exchange rate freedom. This would have required the writing of equilibrium parity between the two currencies and the taking into consideration of unpredictable shocks on this parity. Besides, our model does not allow to examine some aspects of the optimality of a monetary union. For one of the essential limits lies in the shortcoming of its microeconomic foundations, which prevents from endogenizing some behaviours according to the chosen monetary system. We are well aware of the need to clarify pricing practices within the framework of an equilibrium model of the firm. The shape of the demand function addressed to exporters logically conditions pricing decisions. Therefore export pricing is not independent (as we assumed) from the sensitivity of foreign demand to practiced prices. Similarly, wage indexation should be derived within the framework of a game, if not from a general equilibrium of the economy. On all these points the current shortcomings of our model are justified only by the difficulty of the alternative exercise. In theory, there is a correlated determination of the exchange-rate regime and of the foreign trade pricing

[1]However, it should be pointed out that obviously these contradictions do not stem only from exchange variations, but also from economic discrepancies and catching-up phenomena leading to higher inflation rates in the least developed countries in the zone.

conditions. We reasoned as if these conditions were given and we tried to appreciate their consequences on the consistency of a monetary union. But the choice of the monetary union may affect pricing practices and

confer them the consistency or optimality which they did not have a priori[2]. More simply the constitution of the monetary union may contribute to evolve behaviours which were incompatible at first with the consistency of a monetary area.

[2]This idea is developed in two recent articles by G. Corsetti and P. Pesenti, "International Dimensions of optimal Monetary Policy", NBER Working Paper, nř 8230, in April 2001, and "Self Validating Optimum Currency Areas", NBER Working Paper, nř 8783, in February 2002.

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ANNEX 1

Figure 1: ***Stylized impacts of an exchange rate depreciation when θ is null***

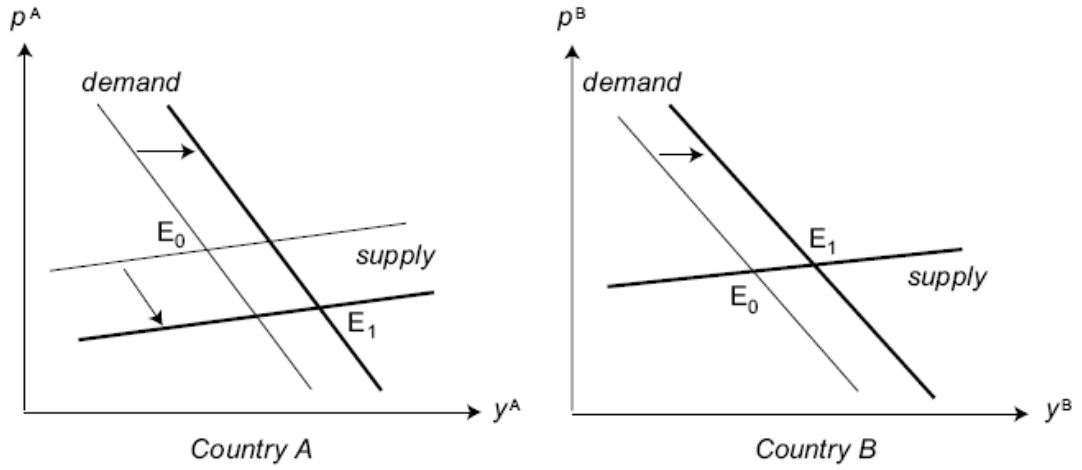
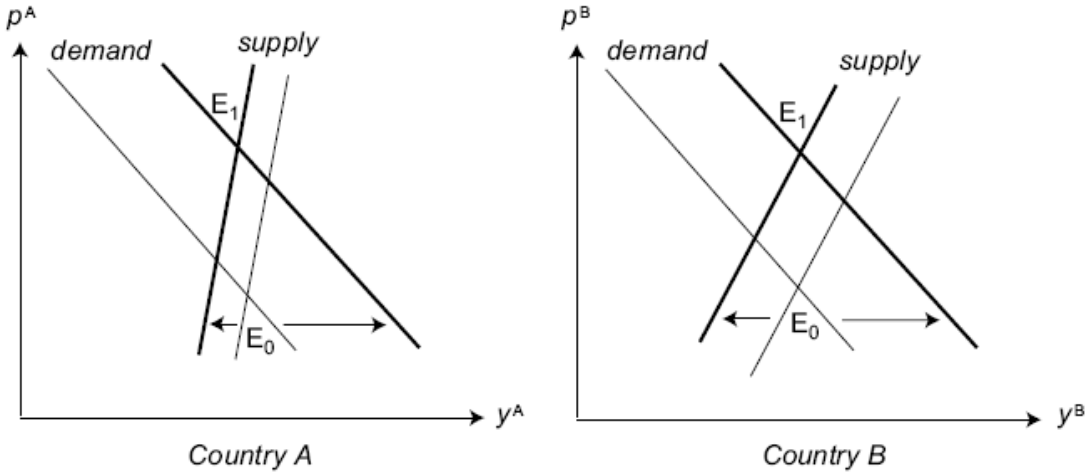


Figure 2: Stylized impacts of an exchange rate depreciation in case of total Indexation



ANNEX 2

LINK BETWEEN THE ESTIMATED β_1 PARAMETER AND LOCAL PRICING RATE α

Here we try to measure the part of exports which is locally priced. Let's suppose that a country exports its production towards another, called "the rest of the word" in which the average price level is noted P^*. The exchange rate E is computed as one unit of rest of- the-world currency expressed in domestic currency. P and P_x^* are respectively the domestic price level and the average export prices. If the country resorts to local pricing in a proportion a we have.

$$P_x = P^{1-\alpha}(EP^*)^{\alpha} \ (I)$$

If the country exports a part g of its production, the average level of the domestic production prices is :

$$P_P = P^{1-\gamma}P_x^{\gamma} \ (II)$$

Since we dont have a direct measure of domestic price level[1] P, we substitue it in (i) by its value in (II) :

$$P = P_P^{1/(1-\gamma)} \ P_x^{-(\gamma/(1-\gamma))}$$

The equation (I) become :

$$P_X^{1+((1-\alpha)\gamma/(1-\gamma))} = P_P^{(1-\alpha)/(1-\gamma)}(EP^*)^{\alpha} = P_P^{(1-\alpha)/(1-\gamma)+\alpha}\left(\frac{EP^*}{P_P^{\alpha}}\right)$$

$\left(\frac{P_x}{P_P}\right)^{\frac{1-\alpha\gamma}{1-\gamma}} = \left(\frac{EP^*}{P_P}\right)^{\alpha}$
so

$\left(\frac{P_x}{P_P}\right) = \left(\frac{EP^*}{P_P}\right)^{\frac{\alpha(1-\gamma)}{1-\alpha\gamma}}$

This implies, expressed in logarithms :

$$log\left(\frac{P_x}{P_P}\right) = \frac{\alpha(1-\gamma)}{1-\alpha\gamma} \ log\left(\frac{EP^*}{P_P}\right)$$

We now see that regression coefficient β_1 depends not only on the paramater α a we are interested in but also on the export' part in the production : γ

Then, after estimating β_1 , we can compute an estimation of α :

$$\alpha = \frac{\beta_1}{1-\gamma+\gamma\beta_1}$$

SHARE OF EXPORTS IN PRODUCTION : PARAMETER γ

[1] Price series available in each country always include an external component : production prices include export prices and consumer prices include import prices.

	Germany	Spain	France	Italy	The Netherlands
1991 -2001	0.2749	0.2264	0.2409	0.2537	0.5859
1995 - 2001	0.2931	0.2661	0.2570	0.2666	0.6202

Parameters are computed like the export/GDP ratio. GDP and exports series are computed quarterly at current prices and seasonally adjusted over 1991-2001.