ETLA ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 601322 Telefax 601753

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Markku Kotilainen

EXCHANGE RATE UNIONS: A COMPARISON TO CURRENCY BASKET AND FLOATING RATE REGIMES*

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ABSTRACT: In the paper the effects of foreign shocks on a small open economy are analysed in three alternative exchange rate regimes: membership in an exchange rate union, floating exchange rates, and currency basket exchange rate regime. The framework used is a three country macroeconomic model, where a model of two large countries is solved separately assuming that the third small country does not affect the large economies. The solution of the big country model is then inserted into the small country model in a recursive way. Membership in an exchange rate union can be interpreted to characterize pegging to the European Currency Unit (ECU), or membership in the European Monetary System or Union (EMS or EMU). The currency basket exchange rate regime in this study is a system, where the domestic exchange rate is pegged to a trade-weighted currency basket, as is currently used in Finland.

KEY WORDS: exchange rate regimes, European monetary integration, exchange rate unions, currency basket exchange rate regime, floating exchange rates

CONTENTS

1. Introduction

In this paper a short-run three country macroeconomic model is presented. In the model there are two large economies and a small open economy. The model for the two large countries is solved separately assuming that the small economy does not affect the large economies. The solution of the big country model is then inserted into the small country model in a recursive way.

The model is used for analysing the effects of economic shocks under alternative exchange rate regimes. In this paper we present the impacts of two kinds of shocks occurring in each of the big countries: (1) a goods demand shock (or fiscal policy), and (2) a money supply shock (or monetary policy).

The bilateral exchange rate of the large economies is assumed to be determined freely in the market (a floating rate). In the small country we, however, analyse the effects of shocks under three alternative exchange rate regimes: (1) floating, (2) membership in an exchange rate union (pegging to the currency of one of the big countries), and (3) currency basket exchange rate regime.

Alternative (2) can be interpreted as characterizing pegging to the European Currency Unit (ECU), or membership in the European Monetary Union or in the EMS. Alternative (3) in turn characterizes the principles of the currency basket regimes, which are in practice in Finland and Sweden, formerly also in Norway. Country 1 can be called "the USA" (or "the rest of the world"), country 2 can be interpreted to represent "the EMU" or a "hard" EMS where exchange rates are fixed. Country 3 in turn is any small open economy, for example Finland.

The model structure chosen is prompted by the fact that at least three countries are needed in a model, where the effects of a monetary union, or those of pegging to several foreign currencies, are analyzed. Compared to one-country models with exogenous foreign shocks, the model structure of this paper, where foreign countries are explicitly modelled, has the advantage that the impacts of foreign shocks in the respective countries can be traced. The shocks faced by the small open economy are thus more realistic than by just assuming changes in the individual foreign variables of the small country model.

The paper is organized as follows. In section 2 we present the basic structure of the model. In section 3 we analyze the impacts of a demand shock occurring in country 1, in section 4 the impacts of a money supply shock, also occurring in country 1, and in section 5 we summarize the effects of shocks originating in country 1 . In sections 6, 7 and 8 we analyze the corresponding shocks occurring in country 2. The summary is presented in section 9.

2. Description of the model

The model for each economy to be analysed is a traditional (Dornbusch) type of model (see Dornbusch, 1980, p. 199). For example Buiter (1986) has used a similar, however a more complicated model, in a two country framework. Bhandari (1985), Marston (1985) and Callan (1989) are examples of studies, where a three country framework, but different kinds of models are used in analysing exchange rate regimes. For other kinds of approaches in studying exchange rate regimes, see for example Kotilainen-Peura (1988).

The model used in this paper includes only money market (LM) and goods market (IS) equilibrium conditions for each country. In addition to these equations we have an interest parity condition, where expectations of changes in exchange rates are zero, i.e. the exchange rates are assumed to be the same tomorrow as they are today. This means that interest rates are equalized internationally through perfect capital mobility. Effects of inflation are at this stage excluded from the model by assuming that prices are constant. This assumption is consistent with standard Keynesian assumptions used in short-run analyses.

In spite of the simple structure of the model, it can shed some light on the differences of short-run impacts of economic shocks under alternative exchange rate regimes. Making the country models more detailed greatly complicates the three country analysis. This project will be enhanced at a later date by adding various complications into the basic model.

The basic model is presented in natural logarithms (except interest rates) as follows:

Country 1 ("the USA")

(1) $m_1 - p_1 = k_1y_1 - \Phi_1i_1$ (LM)

(2) $y_1 = -\mu_1r_1 + \sigma_{12}(e + p_2 - p_1) + \epsilon_{12}y_2 + f_1$ (IS)

Country 2 ("the EMU" or "a hard EMS")

(3) $m_2 - p_2 = k_2y_2 - \Phi_2i_2$ (LM)

(4) $y_2 = -\mu_2r_2 - \sigma_{21}(e + p_2 - p_1) + \epsilon_{12}y_1 + f_2$ (IS)

(5) $i_1 = i_2 = r_1 = r_2$

Country 3 ("Finland")

$$(6)\quad m_3 - p_3 = k_3y_3 - \Phi_3 i_3 \qquad \text{(LM)}$$

$$(7)\quad y_3 = -\mu_3 r_3 + \sigma_3[\theta(e_{31} + p_1 - p_3) + (1 - \theta)(e_{32} + p_2 - p_3)] + \epsilon_3[\theta y_1 + (1 - \theta)y_2] + f_3 \qquad \text{(IS)}$$

$$(8)\quad i_1 = i_2 = i_3 = r_1 = r_2 = r_3$$

The symbols are as follows: m = nominal money stock, p = price level (GDP deflator), k = income elasticity of money demand, i = nominal interest rate, Φ = interest rate semielasticity of money demand, y = real output, μ = real interest rate semielasticity of goods demand, r = real interest rate, σ = competitiveness elasticity of goods demand, e = the price of the currency of country 2 in terms of the currency of country 1, ϵ = elasticity of goods demand with respect to foreign output, f = exogenous goods demand shock, θ = share of country 1 in the foreign trade of country 3 (assumed to be the same in exports and imports), e_{31} and e_{32} = prices of country 1 and country 2 currencies in terms of the currency of country 3, respectively. Additionally, the competitiveness variables are defined as follows: $c = e + p_2 - p_1$, $c_{31} = e_{31} + p_1 - p_3$, and $c_{32} = e_{32} + p_2 - p_3$. All coefficients of the model are positive.

In the big country model y_1, y_2, e and $i_1=i_2$ are endogenous variables. In the small country model endogenous are y_3 and one of the bilateral exchange rates, e_{31} or e_{32}; we can write the other one with the help of e, according to the triangular arbitrage.

3. A goods demand shock in country 1

3.1. Impacts on the big countries

After replacing i_1, r_1 and r_2 by i_2, we get the following model for the big countries:

$$(9)\quad m_1 - p_1 - k_1 y_1 + \Phi_1 i_2 = 0$$

$$(10)\quad y_1 + \mu_1 i_2 - \sigma_{12} c - \epsilon_{12} y_2 - f_1 = 0$$

$$(11)\quad m_2 - p_2 - k_2 y_2 + \Phi i_2 = 0$$

$$(12)\quad y_2 + \mu_2 i_2 + \sigma_{21} c - \epsilon_{21} y_1 - f_2 = 0.$$

Next, the effects of a change in f_1 (demand shock for country 1 products) are derived on the endogenous variables y_1, y_2, e or c, and i_2. We first consider the effects on y_1. After derivation we get equation (13):

(13)

$$\frac{\delta y_1}{\delta f_1} = \frac{\phi_1 k_2 \sigma_{21}}{-k_1 \epsilon_{12} \phi_2 \sigma_{21} + k_1 \sigma_{21} k_2 \mu_2 - \phi_1 \sigma_{12} \epsilon_{21} k_2 + k_1 \mu_1 k_2 \sigma_{21} + k_1 \sigma_{12} \phi_2 + \phi_1 k_2 \sigma_{21}}$$

We do not know the sign of this equation on the basis of the signs specified above, although it is very probable that it is positive because the effect of the negative terms in the denominator is small compared to the other terms. We can, however, simplify the multiplier by assuming that countries 1 and 2 are symmetrical, i.e. that the parameters in (9) and (11), and in (10) and (12) are the same, respectively. Now we get (the symmetrical parameters are denoted without subscripts):

$$(14)\ \frac{\delta y_1}{\delta f_1} = \frac{\phi}{2[k\mu + \phi(1-\epsilon)]} > 0.$$

$\delta y_1/\delta f_1 > 0$ if we assume that $0 < \epsilon < 1$, where ϵ is the elasticity of goods demand with respect to the output of the foreign country. Intuitively, the explanation for ϵ being smaller than 1 is that the production of a country is obviously less important for the neighbouring country than for the home country. An increase in the demand for goods in country 1 thus increases the output of that country. The impact is the greater the greater ϵ is, and the smaller $k\mu$ is.

Next, we consider the impact of a demand shock occurring in country 1 on the output of country 2. The equation system (9)-(12) gives the result

$$(15)\ \frac{\delta y_2}{\delta f_1} = \frac{\phi}{2\,[k\mu + \phi(1-\epsilon)]} > 0.$$

A change in f_1 changes thus the output of country 2 by the same amount as that of country 1. If the countries are not symmetric, the difference in output effects of countries 1 and 2 depends on whether the numerator in the country 1 case $\Phi_1 k_2 \sigma_{21}$ is greater, equal or less than the numerator in the country 2 case $\Phi_2 k_1 \sigma_{21}$, i.e. $\Phi_1 k_2$ is greater, equal or smaller than $\Phi_2 k_1$ (the denominator is the same in both cases). The relative magnitudes of the output effects depend thus positively on the domestic interest rate semielasticity of money demand and on the foreign income elasticity of money demand.

Now we turn to the effects of a change in f_1 on the exchange rate e, and because prices are assumed to be constant, on competitiveness c. We again assume that countries 1 and 2 are symmetric. After derivation we get

$$(16)\ \frac{\delta c}{\delta f_1} = -\frac{1}{2\sigma} < 0.$$

The sign of the multiplier is negative, i.e. an increase in f_1 leads to appreciation of the currency of country 1. The size of the appreciation depends inversely on the competitiveness elasticity σ.

Derivation of the above-mentioned equation system for $\delta i_2/\delta f_1$ leads to the following expression:

$$(17)\ \frac{\delta i_2}{\delta f_1} = \frac{k}{2[k\mu+\phi(1-\epsilon)]} > 0.$$

An increase in the demand for goods in country 1 leads to an increase in the interest rates $i_1 = i_2$.

We summarize <u>the effects of a positive goods demand shock</u> originating in country 1 (an increase in f_1) as follows:

(1) outputs of both countries increase, and by the same amount if countries are symmetric,

(2) competitiveness of country 1 deteriorates because its currency appreciates (the currency of country 2 depreciates correspondingly by the same amount),

(3) interest rates in both countries rise.

The above results differ from the results obtained in a model with only one small country. In the latter case an exogenous change in the foreign output, for example because of a fiscal shock, leads to a change in the domestic exchange rate and thus in competitiveness, which in turn compensates for the effects of the changing foreign demand. The domestic output remains thus unchanged in standard one-country models. When comparing the results obtained in different kinds of models it has, however, to be remembered that the shocks are different from the home country's point of view. In a two-country model the home country faces, in addition to the changing foreign demand and changing competitiveness, a changing interest rate, too. Developments in the home country also affect the developments in the foreign country.

3.2. Impacts on the small country

We next study the effects of a demand shock occurring in country 1 on the small open economy under three alternative exchange rate regimes in the determination of the exchange rate of country 3:

(1) floating exchange rates,
(2) pegging to the currency of country 2 (or membership in the EMU/EMS), and

(3) currency basket exchange rate regime.

In considering the small economy we assume throughout the study that the big economies are symmetric. We insert the results of the big country model into the small country model under the above mentioned exchange rate regime specifications, and solve these models in terms of output and competitiveness (the interest rate is the same as in countries 1 and 2).

3.2.1. Floating exchange rates

The small country model is as follows:

$$(18)\ m_3 - p_3 = k_3 y_3 - \Phi_3 i_3$$

$$(19)\ y_3 = -\mu_3 i_3 + \sigma_3[\theta(e_{31} + p_1 - p_3) + (1 - \theta)(e_{32} + p_2 - p_3)] + \epsilon_3[\theta y_1 + (1-\theta)y_2] + f_3.$$

According to the triangular arbitrage we can write: $e_{31} = e_{32} - e$. One of the bilateral exchange rates between the home currency and foreign currency can thus be calculated through the other bilateral exchange rate and the cross rate between the two foreign currencies.

We assume that the weights of the big countries, θ and 1-θ, are the same in both competitiveness and export demand terms. This assumption means in the floating rate case that the relation between the two bilateral exchange rates of country 3 is determined according to "real " factors, i.e. the foreign trade shares of countries 1 and 2 (see equation 25 and page 13). The overall level of the exchange rate is, however, determined by both the goods and money market equilibrium conditions. (As an example of a model where the role of different degrees of financial market integration are emphasised in the determination of bilateral rates, see Marston, 1985, p. 278.). We have only one elasticity with respect to competitiveness and foreign demand in the model (σ_3 and ϵ_3), the country spesific elasticities are obtained by weighting the overall elasticities by the respective trade shares.

Because prices are kept constant in the model $i_3 = r_3$, and because we have no expectations of exchange rate changes $i_1 = i_2 = i_3$. After inserting these definitions into the model and after replacing $e + p_2 - p_1$ by c, and $e_{32} + p_2 - p_3$ by c_{32}, we can write the model as follows:

$$(20)\quad m_3 - p_3 - k_3y_3 + \Phi_3i_3 = 0$$

$$(21)\quad y_3 + \mu_3i_2 + \sigma_3\theta c - \sigma_3c_{32} - \epsilon_3\theta y_1 - \epsilon_3(1 - \theta)y_2 - f_3 = 0$$

We solve the model in terms of y_2 and c_{32} The variables c and i_2 are determined in the big country model and the small country cannot affect them.

For output we get the following equation:

$$(22)\ \frac{\delta y_3}{\delta f_1} = \frac{\phi_3 k}{2k_3[k\mu+\phi(1-\epsilon)]} > 0.$$

The positiveness of the above expression is assured because $0 < \epsilon < 1$ by assumption. A positive demand shock in country 1 increases thus the output of country 3. If we assume that $\Phi_3 = \Phi$ and $k_3 = k$, the output effect is the same as in countries 1 and 2.

For the change in the bilateral exchange rate (=bilateral competitiveness when prices are constant) between countries 2 and 3 we get:

$$(23)\ \frac{\delta c_{32}}{\delta f_1} = \frac{k_3\mu_3 k\sigma + \theta k_3\sigma_3\phi\epsilon + \phi_3 k\sigma - \theta k_3\sigma_3 k\mu - \theta k_3\sigma_3\phi - k_3\phi\epsilon_3\sigma}{2\sigma\sigma_3 k_3[k\mu+\phi(1-\epsilon)]}.$$

The denominator is always positive, but due to both positive and negative factors in the numerator, we do not know the sign of the above expression a priori. In terms of θ (the foreign trade share of country 1) we can write the condition for the positiveness of (23) as follows (if f_1 increases, then the currency of country 3 depreciates in terms of currency of country 2):

$$(24)\ \theta > \frac{k_3\phi e_3\sigma - k_3\mu_3 k\sigma - \phi_3 k\sigma}{k_3\sigma_3\phi e - k_3\sigma_3 k\mu - k_3\sigma_3\phi}.$$

If country 3 is structurally symmetrical to countries 1 and 2, the expression (23) is reduced to:

$$(25)\ \frac{\delta c_{32}}{\delta f_1} = \frac{1-\theta}{2\sigma} > 0,$$

i.e. the currency of country 3 depreciates with respect to the currency of country 2. If the share of country 2 in the foreign trade of country 3 is zero, i.e. $\theta = 1$, there will be no change in the bilateral exchange rate between these countries.

The effective exchange rate behaves as follows:

$$(26)\ \frac{\delta c_3}{\delta f_1} = \theta\frac{\delta c_{31}}{\delta f_1} + (1-\theta)\ \frac{\delta c_{32}}{\delta f_1} = \frac{\delta c_{32}}{\delta f_1} - \theta\frac{\delta c}{\delta f_1}.$$

After replacing $\delta c_{32}/\delta f_1$ and $\delta c/\delta f_1$ by the expressions derived before, we obtain in the general case the following:

$$(27)\ \frac{\delta c_3}{\delta f_1} = \frac{k_3\mu_3 k - k_3\phi\epsilon_3 + \phi_3 k}{2\sigma_3 k_3 [k\mu + \phi(1-\epsilon)]}.$$

We get the result that (27) is positive if $k_3\mu_3 k + \Phi 3k > k_3\Phi\epsilon_3$, i.e. if

$$(28)\ \epsilon_3 < \frac{k(k_3\mu_3 + \phi_3)}{k_3\phi}.$$

If we assume that country 3 is symmetrical to countries 1 and 2, so that $k_3 = k$, $\epsilon_3 = \epsilon$, $\mu_3 = \mu$, and $\Phi_3 = \Phi$ (we can maintain asymmetry in terms of σ, the competitiveness elasticity), we get:

$$(29)\ \frac{\delta c_3}{\delta f_1} = \frac{k\mu + \phi(1-\epsilon)}{2\sigma_3 [k\mu + \phi(1-\epsilon)]} = \frac{1}{2\sigma_3} > 0$$

Assuming the above-mentioned symmetries we thus get the result that an exogenous increase in the demand for goods in country 1 leads to a depreciation of the currency of country 3. The magnitude of the depreciation depends inversely on the magnitude of σ_3, the competitiveness elasticity of country 3.

3.2.2. Pegging to the currency of country 2

Because the exchange rate of country 3 is fixed, we can drop the LM equation from the above-presented small country model; the money supply is now perfectly elastic at the interest rate $i_3=i_2$. We can also drop the bilateral competitiveness c_{32} from the IS equation. Now we have the following IS equation:

$$(30)\quad y_3 = -\mu_3 i_2 - \sigma_3\theta c + \epsilon_3\theta y_1 + \epsilon_3(1-\theta)y_2 + f_3.$$

After replacing i_2, c, y_2 and y_1 by the expressions derived in the big country model, we obtain:

$$(31)\quad \frac{\delta y_3}{\delta f_1}=\frac{\theta\sigma_3[\phi(1-\epsilon)+k\mu]-\sigma[\mu_3 k-\epsilon_3\phi]}{2\sigma[k\mu+\phi(1-\epsilon)]}.$$

This expression is positive if

$$\theta>\frac{\sigma[\mu_3 k-\epsilon_3\phi]}{\sigma_3[\phi(1-\epsilon)+k\mu]}.$$

If $\theta = 1$ and countries 2 and 3 are symmetrical the result is the same as for country 2, i.e. (13) is the same as (15).

The change in competitiveness is the fraction θ of the change in competitiveness of country 2 vis-á-vis country 1:

$$(32)\ \frac{\delta c_3}{\delta f_1}=\theta(-c)=\frac{\theta}{2\sigma}>0.$$

In the face of a positive demand shock in country 1 the effective exchange rate of country 3 thus depreciates, and competitiveness improves.

3.2.3. Currency basket exchange rate regime

Because the exchange rate is fixed, we can again drop the LM equation for the same reason as in the previous section. In this case the effective exchange rate is fixed, so that competitiveness is stabilized; c_{32} changes so that it compensates for the effects due to a change in c. The currency of the third country depreciates with respect to the currency of country 1, and appreciates with respect to the currency of country 2. We can thus also drop the competitiveness term from the IS equation. The IS equation is now as follows:

$$(33)\ y_3 = -\mu_3 i_2 + \epsilon_3\theta y_1 + \epsilon_3(1-\theta)y_2 + f_3.$$

After derivation and replacing i_2, y_1, and y_2 (competitiveness does not change) by the expressions obtained in the big country model, we can write for the output:

$$(34)\ \frac{\delta y_3}{\delta f_1}=\frac{-\mu_3 k+\epsilon_3\phi}{2[k\mu+\phi(1-\epsilon)]}.$$

$\delta y_3/\delta f_1 > 0$ if $\epsilon_3 > \mu_3 k/\Phi$. We make the following numerical illustration. Let us assume that μ_3=0.2, k=0.67, and Φ=0.46. We now have the following condition for the positivity of $\delta y_3/\delta f_1$: it must hold that $\epsilon_3 > 0.291$. (The values for k and Φ are adopted from Kremers-Lane, 1990, p. 796.)

If we assume that there is a positive demand shock in country 1, the increasing export demand tends to increase the output of country 3, as also y_2 expands. The increasing interest rate in turn tends to lower it. The net effect depends on the values of the parameters. (For a diagrammatic presentation of the effects on the small country in different exchange rate regimes, see appendix 1.)

3.2.4. Comparison of effects in different exchange rate regimes

Floating exchange rate:

There is a positive relation between a demand shock occurring in country 1 and output in country 3, i.e. when the demand for goods increases in country 1 output increases in country 3, and the other way round. This positive impact is due to, at least, the increasing export demand. The change in competitiveness is not known a priori, it depends on parameter values. If country 3 is symmetrical to countries 1 and 2, the currency of country 3 will depreciate, and competitiveness increases. The interest rate increases, which has a negative impact on output.

Pegging to the currency of country 2 ("EMU-peg regime"):

In the case of a positive demand shock in country 1, improving competitiveness and increasing demand in countries 1 and 2 have a positive impact on the output of country 3. The increasing interest rate, on the other hand, works in the opposite direction.

The sign of the change in output is not known a priori. Here we have a difference to country 2, where output always increases. This difference is due to a smaller improvement in competitiveness in country 3 than in country 2. Country 1 is the only export market for the products of country 2 in this model, and it's exchange rate depreciates with respect to that country. Country 3 in turn has two markets, while maintaining a stable exchange rate with country 2 and a depreciating exchange rate with country 1.

Currency basket exchange rate regime:

Competitiveness is stabilized in this exchange rate regime, the output effects are thus due to changes in export demand and in interest rates. If the demand shock occuring in country 1 is a positive one, the export demand of country 3 is increasing, which tends to increase the output. The rising interest rate in turn has a negative effect on output. The sign of the change in output of country 3 is not known a priori; it depends on parameter values.

Comparison:

When comparing output effects in "the EMU-peg regime" to "the basket regime" (equations (31) and (34)), we see that in the former case there is an additional positive factor $\theta\sigma_3 / 2\sigma$ when compared to the latter one, because of improving competitiveness in the EMU regime.

This means that the output of country 3 is higher in the EMU-peg regime than in the basket regime after a positive demand shock occurring in country 1. The effects are the same in both regimes if the share of country 1 in the exports of country 3 is zero ($\theta = 0$). We can thus tell the relative magnitudes of the effects in these regimes, but **we are not, however, able to tell, on theoretical grounds, which one of the regimes leads to a greater <u>deviation</u> from zero, because we do not know the signs of the changes** (one **can be positive and the other negative, or both positive or negative).**

If we assume symmetry in parameters between countries 1, 2 and 3, we see that output becomes even higher in the floating rate regime than in the EMU peg regime. The difference $\delta y_3/\delta f_1$ (floating) - $\delta y_3/\delta f_1$ (EMU peg) = $(1 - \theta)/2$ (the expression is positive or zero because $0 \leq \theta \leq 1$).

In the symmetrical case we can write:

$$\frac{\delta y_3}{\delta f_1}(floating) > \frac{\delta y_3}{\delta f_1}(EMU\text{-}peg) > \frac{\delta y_3}{\delta f_1}(basket) .$$

Floating leads thus to the greatest output in the face of a positive real shock occurring in country 1, and the currency basket exchange regime to the lowest one. These differences are due to different competitiveness effects in the regimes. In the floating rate regime competitiveness of country 3 improves as much as that of country 2. In the EMU-peg regime competitiveness improves only with respect to country 1, but is unchanged with respect to country 2. In the currency basket regime competitiveness is stabilized (constant).

4. A money supply shock in country 1

When analysing the effects of a money supply shock originating in country 1, we again solve the effects occurring in the big countries first, and then insert these results into the small country model. We assume that the small country does not affect the solution of the big country model; we also assume symmetry between the big economies.

4.1. Impacts on the big countries

After solving the effect of a money supply shock on country 1's output, we get the following result:

$$(35)\ \frac{\delta y_1}{\delta m_1}=\frac{2k\mu+\phi(1-\epsilon)}{2k[k\mu+\phi(1-\epsilon)]}=\frac{\mu}{2[k\mu+\phi(1-\epsilon)]}+\frac{1}{2k}>0.$$

An increase in money supply in country 1 leads thus to an increase in that country's output. Country 2's output in turn decreases:

$$(36)\ \frac{\delta y_2}{\delta m_1}=\frac{-\phi(1-\epsilon)}{2k[k\mu+\phi(1-\epsilon)]}<0.$$

The above result is the so-called beggar-thy-neighbour result, where an expansive policy in one country leads to a positive impact in the home country but to a negative impact in the neighbouring country. Expansive monetary policy is not, however, a zero-sum game worldwide, because the output of country 2 decreases less than that of country 1 increases. There will be a positive net effect of the magnitude $\mu/[k\mu + \Phi(1-\epsilon)]$.

The positive impact on country 1's output is due to improving competitiveness and a decreasing interest rate (equations 37 and 38). Export demand, as country 2's output decreases, has a negative impact on the output of country 1.

$$(37)\ \frac{\delta c}{\delta m_1}=\frac{\epsilon+1}{2k\sigma}>0$$

$$(38)\ \frac{\delta(i_2=i_1)}{\delta m_1}=-\frac{1-\epsilon}{2[k\mu+\phi(1-\epsilon)]}<0$$

The decreasing interest rate has a positive impact on the output of country 2 also, but the worsening competitiveness is enough to compensate for this positive effect like the positive effect due to increasing export demand.

4.2. Impacts on the small country

4.2.1. Floating exchange rates

Solving the model gives the following expression for the change in the output of country 3:

$$(39)\ \frac{\delta y_3}{\delta m_1} = -\frac{\phi_3(1-\epsilon)}{2k_3[k\mu+\phi(1-\epsilon)]} < 0.$$

The output of the small country thus decreases, as that of country 2, if there is an increase in money supply in country 1. If $\Phi_3 = \Phi$ and $k_3 = k$, the effect is the same as in country 2. The negative impact on the output of country 3 is due to the net effect of changes in competitiveness and export demand. The worldwide decrease of interest rates has a positive impact on the output of country 3. The effect of the export demand depends on the relative export shares of countries 1 and 2. If θ is great, export demand has a positive impact. If θ is small, the impact is negative.

To determine the change in competitiveness we first derive the change in c_{32}, the bilateral competitiveness between countries 3 and 2. After that we calculate the change in the effective exchange rate/competitiveness by using equation 26. The competitiveness c, between countries 1 and 2, is determined in the big country model (equation 37). The change in competitiveness of country 3 is as follows:

(40)

$$\frac{\delta c_3}{\delta m_1}=\frac{-k_3\mu_3 k(1-\epsilon)-k_3\epsilon_3\theta[2k\mu+\phi(1-\epsilon)]+k_3\epsilon_3(1-\theta)\phi(1-\epsilon)-\phi_3 k(1-\epsilon)}{2kk_3\sigma_3[k\mu+\phi(1-\epsilon)]}$$

The above expression is likely to be negative, because the numerator is evidently negative (the only positive term is small compared to the other terms), and the denominator is always positive. If there is symmetry between economies 1, 2 and 3 (in parameters) the numerator is always negative, and the whole expression is negative (we assume $\epsilon<1$). When money supply in country 1 increases, the currency of country 3 thus appreciates effectively, i.e. competitiveness deteriorates.

4.2.2. Pegging to the currency of country 2

We use the same model as in section 3.2.2. (we do not need the LM equation, for the same reason as above). We solve now the IS equation in terms of a change in the money supply of country 1. Exogenous variables are derived from the big country model presented in section 4.1. The output effect is as follows:

(41)

$$\frac{\delta y_3}{\delta m_1}=\frac{\sigma k\mu_3(1-e)+e_3\sigma\theta[2k\mu+\phi(1-e)]-\sigma_3\theta(e+1)[k\mu+\phi(1-e)]-\sigma e_3(1-\theta)\Phi(1-\epsilon)}{2k\sigma[k\mu+\phi(1-e)]}$$

We do not know the sign of this change a priori. It is positive if

$$\theta<\frac{\sigma(1-e)(e_3\phi-k\mu_3)}{[\sigma_3(e+1)-2e_3\sigma][k\mu+\phi(1-e)]}.$$

If country 3 is symmetrical to countries 1 and 2, the above condition is as follows:

$$\theta<\frac{k\mu-\phi e}{k\mu+\phi(1-e)}.$$

A decreasing interest rate and increasing export demand in country 1 contribute positively to the output of country 3. Worsening competitiveness (equation 42) and decreasing export demand in country 2, in turn, contribute negatively to it.

As a numerical illustration (in the symmetrical case) we assume: k=0.67, μ=0.2, Φ=0.46, and ϵ=0.3. Now the condition for positiveness of $\delta y_3/\delta m_1$ is θ<-0.009, which is not possible (foreign trade shares cannot be negative). In the asymmetrical case we assume additionally: ϵ_3=0.6, σ_3=0.3, σ=0.1 and μ_3=0.2. Now the condition for positiveness of $\delta y_3/\delta m_1$ is $\theta < -0.081$, which is not possible either. In these examples the effect of an increase in the money supply in country 1 on the output of country 3 is thus negative.

Change in competitiveness is a fraction θ of that of country 2, i.e.

$$(42)\ \delta c_3/\delta m_1 = -\theta(c) = -\theta(e+1)/2k\sigma < 0.$$

If m_1 increases, competitiveness of country 3 worsens.

4.2.3. Currency basket exchange rate regime

We derive the output effects of a change in m_1 by using the model presented in section 3.2.3 and by inserting the interest rate and export demand equations derived in section 4.1. into that model. Competitiveness is stabilized so that c_{32} changes to compensate for changes in c. The output effect is as follows:

$$(43)\quad \frac{\delta y_3}{\delta m_1}=\frac{2\theta\epsilon_3[k\mu+\phi(1-\epsilon)]+(k\mu_3-\epsilon_3\phi)(1-\epsilon)}{2k[k\mu+\phi(1-\epsilon)]}.$$

Again, we do not know the sign of the change a priori. It is positive if

$$\theta>\frac{(\epsilon_3\phi-k\mu_3)(1-\epsilon)}{2\epsilon_3[k\mu+\phi(1-\epsilon)]}.$$

If $\theta = 0$, we have:

$$\frac{\delta y_3}{\delta m_1}=\frac{(k\mu_3-\epsilon_3\phi)(1-\epsilon)}{2k[k\mu+\phi(1-\epsilon)]}.$$

If $\theta = 1$, we have, in turn:

$$\frac{\delta y_3}{\delta m_1}=\frac{\mu_3 k(1-\epsilon)+\epsilon_3[2k\mu+\phi(1-\epsilon)]}{2k[k\mu+\phi(1-\epsilon)]}>0.$$

Thus, if there is trade with only country 2, output <u>can</u> increase when m_1 increases, which requires that $k\mu_3 > \epsilon_3\Phi$. But when there is trade with only country 1, output doubtlessly increases.

When we look at the output equation (43), we see that a positive impact of an increase in the money supply of country 1 is rather probable (there is only one negative factor in the numerator and it is obviously small compared to the joint effect of the other factors).

4.2.4. Comparison of effects in different exchange rate regimes

Floating exchange rates:

If there is an increase in money supply in country 1, the output of country 3 decreases. This is due to the decreasing export demand from country 2, and, at least in the symmetrical case, due to the worsening competitiveness (appreciating exchange rate). Decreasing interest rate and increasing export demand from country 1 contribute positively to the output of country 3, but these effects are too small to compensate for the negative impacts.

Pegging to the currency of country 2 ("EMU-peg regime"):

We do not know the sign of the change in output when there is a money supply shock in country 1. A decreasing interest rate and increasing export demand in country 1 contribute positively to output. But worsening competitiveness and decreasing export demand in country 2 contribute negatively to it.

Currency basket exchange rate regime:

The sign of the change in output is not known a priori in this case either. Because of the small negative components in the output multiplier, it is, however, rather probable that the output effect is a positive one.

Comparison:

In the currency basket exchange rate regime the negative impacts of an expansive monetary policy of country on the output of country 3 are weaker than in "the EMU-peg case", where competitiveness weakens. The interest rate and export demand effects are the same in both cases (assuming no behavioral differences between regimes). The currency basket exchange rate regime leads thus to a greater post-shock output than pegging to the EMU area:

$$\frac{\delta y_3}{\delta m_1}(basket)-\frac{\delta y_3}{\delta m_1}(EMU\text{-}peg)=\frac{\theta\sigma_3(1+\epsilon)}{2k\sigma}>0.$$

Assuming symmetry of parameters in countries 1, 2 and 3, we get:

$$\frac{\delta y_3}{\delta m_1}(basket) - \frac{\delta y_3}{\delta m_1}(floating) = \frac{\epsilon(2\theta-1)+1}{2k} > 0,$$

which is greater than the difference between the output effects in the basket and EMU regimes. In the symmetrical case we can thus write:

$$\frac{\delta y_3}{\delta m_1}(basket) > \frac{\delta y_3}{\delta m_1}(EMU\text{-}peg) > \frac{\delta y_3}{\delta m_1}(floating).$$

This ranking is again due to differences in exchange rate (competitiveness) effects. If the money supply increases in country 1, floating leads to the greatest appreciation of the exchange rate of country 3, whereas in the currency basket regime the effective exchange rate is kept unchanged, and competitiveness is thereby stabilized. In the EMU-peg regime competitiveness deteriorates in relation to country 1, but is constant in relation to country 2.

5. Summary of the effects of shocks originating in country 1

In the big country model framework we noticed that a positive demand shock occurring in country 1 increased the output of both countries by an equal amount (assuming symmetry of countries). An increase in money supply, however, increased the output of country 1 but reduced the output of country 2. The increase in country 1 was greater than the decrease in country 2. There was thus a net increase in the world output.

When we had a floating exchange rate in the small country, output increased in the case of a positive demand shock (originating in country 1), and decreased in the case of a money supply increase.

When the currency of country 3 was pegged to the currency of country 2 ("membership in the EMU"), and in the currency basket exchange rate regime, we did not know the sign of the output change a priori, but it was dependent on the parameter values of the model. In the case of a positive demand shock originating in country 1 the EMU-peg regime led to a greater output of country 3 than the currency basket exchange rate regime. In the case of a corresponding monetary shock, the basket regime, in turn, led to a greater output than the EMU-peg regime. These differences were due to different developments in the effective exchange rate/competitiveness of country 3.

Additionally, assuming symmetry of parameters between countries 1, 2 and 3, it could be shown that floating produced the highest output in country 3, and the currency basket exchange rate regime the lowest output when the shock was real by nature. When the shock was monetary, the ranking was the other way round. Pegging to the currency of country 2 thus produced the intermediate ranking position in the face of both kinds of shocks. This development was again due to different reactions of the effective exchange rate of country 3 in different regimes.

Even if a ranking of output effects can be presented in a theoretical model, the magnitudes of **deviations from zero** cannot be compared, because we do not know the signs of changes in the EMU-peg and currency basket regimes. For that purpose we should have estimates for the parameters of the model.

6. A goods demand shock in country 2

6.1. Impacts on the big countries

If we assume again that countries 1 and 2 are symmetrical, a demand shock occurring in country 2 leads to the same output effects as a corresponding shock occurring in country 1. Interest rate reactions are also the same. But competitiveness changes in the opposite direction, by an equal amount, depending on the origin of the shock. If the demand shock occurring in country 2 is a positive one, the exchange rate of country 2 appreciates, and competitiveness thus deteriorates.

6.2. Impacts on the small country

6.2.1. Floating exchange rates

In a floating rate regime there is no difference according to the origin of the shock. All factors affecting the output of country 3, interest rate, competitiveness and export demand, develop as in the case when the shock originates in country 1. Output thus increases by the same amount in both cases if the shock is positive (see section 3.2.1.).

6.2.2. Pegging to the currency of country 2

After solving the model with respect to the output of country 3 we get:

$$(44)\ \frac{\delta y_3}{\delta f_2}=\frac{\sigma[e_3\phi-\mu_3 k]-\theta\sigma_3[k\mu+\phi(1-e)]}{2\sigma[k\mu+\phi(1-e)]}.$$

We do not know the sign of the multiplier a priori. As a comparison to the effect of a corresponding shock originating in country 1, we get:

$$\frac{\delta y_3}{\delta f_1}-\frac{\delta y_3}{\delta f_2}=\frac{\theta\sigma_3}{\sigma}>0.$$

A positive real shock originating in country 1 leads thus to greater output than a corresponding shock originating in country 2. This is due to the competitiveness factor. If the positive demand shock occurs in country 1, the effective exchange rate of country 3 depreciates by the fraction θ of the depreciation occurring in country 2. If the same shock occurs in country 2, there will be an appreciation of the same magnitude. Interest rate and export demand effects are the same irrespective of the origin of the shock.

6.2.3. Currency basket exchange rate regime

Interest rate and export demand affect the output of country 3 in the same way as regards both origins of the demand shock, and competitiveness remains unchanged in both regimes. Output changes thus also by the same amount as in the case when the shock originates in country 1 (equation 33). We do not know the sign of the change a priori.

6.2.4. Comparison of effects in different exchange rate regimes

When comparing the output effects in the EMU-peg and the currency basket regimes (equations 44 and 34, the latter after replacing δf_1 by δf_2 in the denominator), we see that the post-shock output is greater in the currency basket regime by the amount $\theta\sigma_3/2\sigma$ (if the shock is positive).

After assuming symmetry of parameters between countries 1, 2 and 3, we see that $\delta y_3/\delta f_2$ (floating) - $\delta y_3/\delta f_2$ (basket) = 1/2 . We can thus write in the symmetrical case:

$$\frac{\delta y_3}{\delta f_2}(floating) > \frac{\delta y_3}{\delta f_2}(basket) > \frac{\delta y_3}{\delta f_2}(EMU\text{-}peg)\ .$$

These differences are again due to differences in changes in competitiveness. In the symmetrical case floating leads to a depreciation of the currency of country 3 if the shock originating in country 2 is a positive one. In the currency basket regime there is no change in competitiveness, and in the EMU-peg the competitiveness of country 3 worsens.

7. A money supply shock in country 2

7.1. Impacts on the big countries

A money supply shock originating in country 2 creates the same effects in country 2 as a similar shock originating in country 1 creates in that country. The same reasoning applies to the effects on country 1. An expansive monetary policy in country 2 depreciates its exchange rate, reduces the interest rate, and leads thus to an increase in the output of country 2. The output of country 1 declines, but by less than the output of country 2 increases. (About the magnitudes of the effects, see equations 35-38.)

7.2. Impacts on the small country

7.2.1. Floating exchange rates

In the floating exchange rate regime there is no difference in output effects according the origin of the shock. The effect of a money supply shock occurring in country 2 is thus negative by the amount presented in formula (39). The differences in export demand changes are compensated for by corresponding differences in competitiveness. Technically this is due to the same country weights in the export demand and competitiveness terms. Differences in output effects arise if the weights are assumed to be different. In the symmetrical case it can be shown that the currency of country 3 effectively appreciates.

7.2.2. Pegging to the currency of country 2

We get for the change in the output of country 3 the following:

(45)

$$\frac{\delta y_3}{\delta m_2} = \frac{\sigma k \mu_3 (1-e) + e_3 \sigma (1-\theta) [2k\mu + \phi(1-e)] + \sigma_3 \theta (e+1) [k\mu + \phi(1-e)] - \sigma \epsilon_3 \theta \Phi (1-\epsilon)}{2k\sigma [k\mu + \phi(1-e)]}$$

We do not know the sign of the change a priori, but the probability that it is positive is large because there is only one, and a rather small, negative term in the numerator. All other factors, except the export demand of country 1, contribute positively to the output. By assuming symmetry of parameters between countries 1, 2 and 3, we can conclusively show positiveness.

When comparing the effects of a money supply shock originating in country 1 to the corresponding effects of a shock originating in country 2, we get:

$$\frac{\delta y_3}{\delta m_1}-\frac{\delta y_3}{\delta m_2}=\frac{(2\theta-1)\epsilon_3\sigma-\theta(\epsilon+1)\sigma_3}{k\sigma}.$$

We do not know the sign of this difference in the general case, but by assuming, again, symmetry of parameters in countries 1,2 and 3, we get:

$$\frac{\delta y_3}{\delta m_2}>\frac{\delta y_3}{\delta m_1}.$$

When assuming symmetry an increase in the money supply leads thus to a greater output of country 3, when it occurs in country 2 than in country 1. This is due to the depreciating effective exchange rate in the former case and the appreciating effective exchange rate in the latter case.

7.2.3. Currency basket exchange rate regime

For the change in the output of country 3 we get the following expression:

$$(46)\ \frac{\delta y_3}{\delta m_2} = \frac{-2\theta\epsilon_3\,[k\mu+\phi(1-\epsilon)] + (k\mu_3+\epsilon_3\phi)(1-\epsilon) + 2\epsilon_3 k\mu}{2k[k\mu+\phi(1-\epsilon)]}.$$

We are not able to tell the sign of the change a priori, it is not possible in the symmetrical case, either, but it depends essentially on the magnitude of the export demand weights. Export demand with respect to country 2 increases, but with respect to country 1 decreases. If $\theta = 0$, the effect is positive. If $\theta = 1$, positiveness is still possible, due to the positive impact of the decreasing interest rate.

We do not know the relative effects of the shocks originating in countries 1 and 2 a priori, either:

$$\frac{\delta y_3}{\delta m_1}-\frac{\delta y_3}{\delta m_2}=\frac{(2\theta-1)\epsilon_3}{k}.$$

If $\theta < 1/2$, an expansive monetary policy of country 2 leads to greater post-shock output in country 3 than a similar policy pursued by country 1. The relative magnitudes of the effects depend thus on the export market shares of countries 1 and 2.

7.2.4. Comparison of effects in different exchange rate regimes

In the general case it can be shown that the post-shock output is greater in the EMS/EMU-peg regime than in the currency basket regime by the amount $\theta\sigma_3(1+\epsilon)$ / $2k\sigma$ if the money supply of country 2 increases. This is due to the improving competitiveness with respect to country 1 in the former regime; in the latter one competitiveness is unchanged.

Assuming symmetry of parameters between countries 1, 2 and 3 it can, additionally, be shown that the post-shock output in the EMU regime is also greater than that in the floating rate regime (if the shock is positive). We can thus write:

$$\frac{\delta y_3}{\delta m_2}(EMU\text{-}peg) > \frac{\delta y_3}{\delta m_2}(basket) > \frac{\delta y_3}{\delta m_2}(floating) .$$

8. Overall comparison of output effects on country 3 in different exchange rate regimes

In the case of <u>a goods demand shock</u> originating in country 1 (we call this case R.1.) we were able to show for the change of output in country 3 (assuming symmetry between the big countries):

$$(R.1.)\ \frac{\delta y_3}{\delta f_1}(EMU\text{-}peg) > \frac{\delta y_3}{\delta f_1}(basket) .$$

In the case when the corresponding shock originated in country 2 (case R.2.), we could show:

$$(R.2.)\ \frac{\delta y_3}{\delta f_2}\,(basket) > \frac{\delta y_3}{\delta f_2}\,(EMU\text{-}peg)\ .$$

In the case of <u>a money supply shock</u> originating in country 1 (we call it by M.1.) we could show:

$$(M.1.)\ \frac{\delta y_3}{\delta m_1}\,(basket) > \frac{\delta y_3}{\delta m_2}\,(EMU\text{-}peg)\ .$$

And when a corresponding shock originated in country 2 (case M.2.), we obtained:

$$(M.2.)\ \frac{\delta y_3}{\delta m_2}\,(EMU\text{-}peg) > \frac{\delta y_3}{\delta m_2}\,(basket)\ .$$

We could thus give the ranking according to the magnitudes of the effects of shocks, but we do not know a priori the signs of the shocks, and thus not the ranking of the regimes according to the deviation from zero. This kind of ranking is useful when evaluating the performance of different exchange rate regimes in stabilizing the economy against random foreign shocks. In this respect the relative performance of the currency basket exchange rate regime and the EMU-peg regime appeared to be an empirical question, depending on the magnitudes of the parameters of the model.

In the case of floating we could determine the signs of the changes a priori. When there was a demand shock in the big countries the output effect on country 3 was positive, and in the case of a money supply shock it was negative. The effect was independent of the origin of the shock. To compare theoretically the output effects with those in the EMU-peg and basket regimes, we had, however, to assume symmetry of parameters between all three countries. Now we obtain the following ranking according to the magnitudes of the output effects on country 3. We denote the cases as before. (The signs of the changes are presented in parenthesis.)

$$(R.1.)\quad \underset{(+)}{\frac{\delta y_3}{\delta f_1}(floating)} > \underset{(?)}{\frac{\delta y_3}{\delta f_1}(EMU\text{-}peg)} > \underset{(?)}{\frac{\delta y_3}{\delta f_1}(basket)},$$

$$(R.2.)\quad \overset{(+)}{\frac{\delta y_3}{\delta f_2}(floating)} > \overset{(?)}{\frac{\delta y_3}{\delta f_2}(basket)} > \overset{(?)}{\frac{\delta y_3}{\delta f_2}(EMU\text{-}peg)},$$

$$(M.1.)\quad \overset{(?)}{\frac{\delta y_3}{\delta m_1}(basket)} > \overset{(?)}{\frac{\delta y_3}{\delta m_1}(EMU\text{-}peg)} > \overset{(-)}{\frac{\delta y_3}{\delta m_1}(floating)},$$

$$(M.2.)\quad \overset{(?)}{\frac{\delta y_3}{\delta m_2}(EMU\text{-}peg)} > \overset{(?)}{\frac{\delta y_3}{\delta m_2}(basket)} > \overset{(-)}{\frac{\delta y_3}{\delta m_2}(floating)}.$$

Floating leads thus in the symmetrical case to the greatest or to the smallest change depending on the nature of the shock. The relative effects on the output of country 3 in the EMU-peg and in the basket regimes depend also on the origin of the shock. The stabilizing effects of the regimes are dependent on the magnitudes of the parameters of the model.

To get a feel for the differences between the regimes we <u>assumed</u> values for the important parameters as follows: interest rate semielasticity of goods demand $\mu_1=\mu_2=\mu_3=0.2$; interest rate semielasticity of money demand $\Phi_1=\Phi_2=\Phi_3=0.46$; income elasticity of money demand $k_1=k_2=k_3=0.67$;

competitiveness elasticity in the large countries $\sigma_1=\sigma_2=0.1$, and in the small country $\sigma_3=0.3$; elasticity with respect to the foreign output in the large countries $\epsilon_1=\epsilon_2=0.3$, and in the small country $\epsilon_3=0.6$. The values for k and Φ are adopted from Kremers-Lane (1990, p. 796), the rest of the parameter values are more or less "guestimates". The assumed differences in the export demand and competitiveness elasticities were due to the differences in the openness of the economy and in market power, the small country being more open and having less market power and thus exports depending more on competitiveness. Additionally, we assumed θ =0.3.

Using these parameter values we got the result that in the R.1. case the currency basket regime led to a smaller deviation of output than the EMU-peg regime. The signs of both deviations were positive.[1] The difference between the changes was $\theta\sigma_3/2\sigma = 1.5\theta$ (due to the competitiveness

[1]This result is sensitive to the values of θ, ϵ_3, σ_3 and μ_3. If the values of the first three variables are low (the IS curve shifts only slightly to the right) and the value of μ_3 is high (the IS curve is rather flat), the conclusion changes. For example if $\epsilon_3=0.2$, $\epsilon=0.1$ and $\sigma_3=0.2$, the condition that the "EMU-peg regime" stabilizes the output of country 3 better than the basket regime is: $0 < \theta < 0.073$ (ceteris paribus). This case is thus relevant for a country, which pursues almost all of its trade with the union country and whose trade is not sensitive to changes in competitiveness and export demand. If however the IS curve is steep (the value of μ_3 is low), the "EMU-peg regime" is only slightly better in stabilizing the output than the basket regime. (For a graphical analysis, see appendix 4.)

factor). In the R.2. case the basket regime again led to the same rather small positive change as in the R.1. case, and the EMU-peg regime to a greater negative change in absolute terms. The difference between the post-shock outputs was the same as before (competitiveness factor).

Also in the case of a money supply shock occurring in country 1 the basket regime led to a smaller deviation than "the EMU-peg regime". In the former case the effect was positive and in the latter case negative. When the money supply shock occurred in country 2 both regimes led to a positive change in the output of country 3. In absolute terms the change was again smaller in the basket regime. The difference was $\theta\sigma_3(1+\epsilon)/2k\sigma$ = 2.91θ. This was greater than in the case of real shocks. This result is rather probable according to the theoretical model already. By subtracting the difference between output effects in the goods demand shock case from those in the money supply shock case we get: $\theta\sigma_3(1+\epsilon-k)/2k\sigma$. The expression is positive, if $(1+\epsilon) > k$.

After calculating the corresponding output effects also in the floating rate regime, we noticed that even then the currency basket exchange rate regime stabilized the output of the small country the best against all foreign shocks studied. Floating was the second best in cases R.1., M.1.

and M.2., and the "EMU-peg regime" in case R.2. In another experiment, where the competitiveness elasticity and the elasticity with respect to the foreign output were lower, the basket regime stayed the best according to this criterion, but the "EMU-peg regime" was now the second best in cases R.1., R.2. and M.1. Floating was the second best in case M.2. (For the experiments, see appendices 2 and 3; for the differences between Finland's trade-weighted currency index and the ECU-index, see appendix 4.)

The "EMU-peg regime" was thus the worst in both experiments in the face of a monetary shock occurring in country 2 ("EMU"). On the other hand it was the second best (better than floating) in both experiments, when there was a demand for goods shock originating in country 2.

9. Summary

In this paper a short-run three country macroeconomic model was presented, where we had two large economies and a small open economy. We analysed the effects of a goods demand shock and a money supply shock originating in the big countries. The bilateral exchange rate between the big countries was assumed to be floating. In the small economy we, however, had three alternative exchange rate regimes: (1) floating rates, (2) pegging to the currency of country 2 ("EMU"), and (3) a currency basket exchange rate regime. In the big country model we noticed that a positive demand shock increased the output of both countries by an equal amount independently of the origin of the shock (assuming symmetry of countries). An increase in the money supply, however, increased the output of the origin country but reduced the output of the other big country. The increase in the origin country was greater than the decrease in the other country. There was thus a net increase in the world output.

When we had a floating exchange rate in the small country, output of this country increased in the case of a positive demand shock and decreased in the case of a money supply shock. The effect was independent of the origin of the shock.

When the currency of country 2 was pegged to the currency of country 3 ("the EMU") and in the currency basket exchange rate regime, we did not know the sign of the output effect a priori, but it was dependent on the parameter values of the model. In the case of a money supply shock the sign was not known a priori, either. We could, however, compare the relative magnitudes of the output effects in these regimes. The ranking between these regimes appeared to depend on both the nature of the shock and the origin of the shock.

Even if we did not get differences in signs of the effects in the EMU-peg and currency basket exchange rate regimes a priori, the possibility to compare the magnitudes of the effects on the basis of the multipliers was useful as such. By assuming symmetry of the parameters between all three countries we could compare the magnitudes of the effects in all three exchange rate regimes. The differences due to competitiveness changes also shed some light on the changes in the composition of the demand in each country.

In addition to the theoretical study we could also illustrate the differences between exchange rate regimes by using numerical examples. In both of the two experiments conducted the currency basket exchange rate regime was the best in stabilizing the output of the small country against all foreign shocks considered.

The second best position was more sensitive to changes in the values of competitiveness elasticity and of the elasticity with respect to foreign output. Floating was the second best regime in the face of three of the four shocks considered, when the values of these elasticities were rather high, and the "EMU-peg regime" when they were low. "The EMU-peg regime" was the worst in both experiments, when there was a money supply shock in country 2 ("EMU"), and floating when there was a demand for goods shock in country 2.

Even if the numerical experiments gave more concreteness to the results of the theoretical model they must be interpreted with caution. The parameter estimates used are very rough and uncertain. More sensitivity analysis with different parameter values is also needed to increase the reliability of the experiments.

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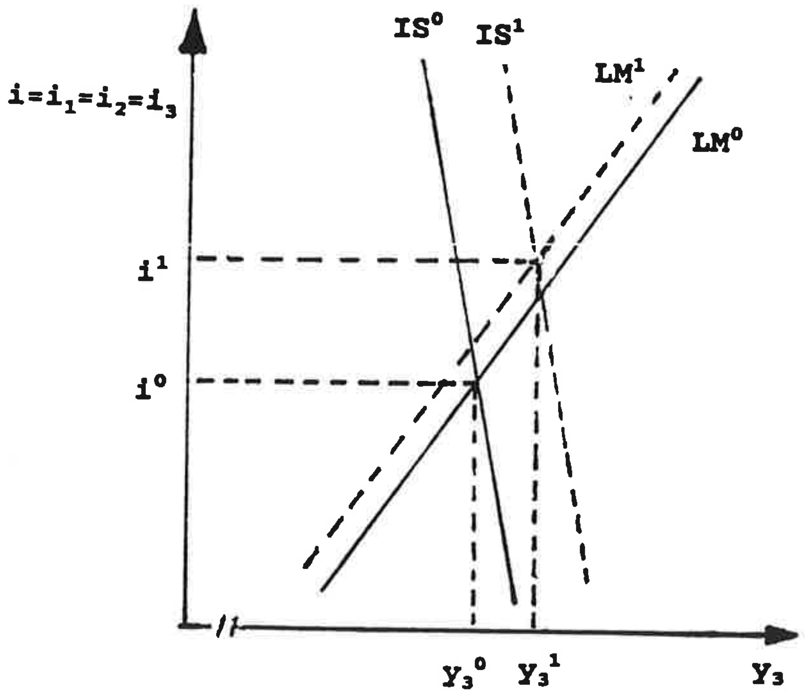
APPENDIX 1

A GOODS DEMAND SHOCK IN COUNTRY 1, EFFECTS ON THE OUTPUT OF COUNTRY 3: A GRAPHICAL ANALYSIS

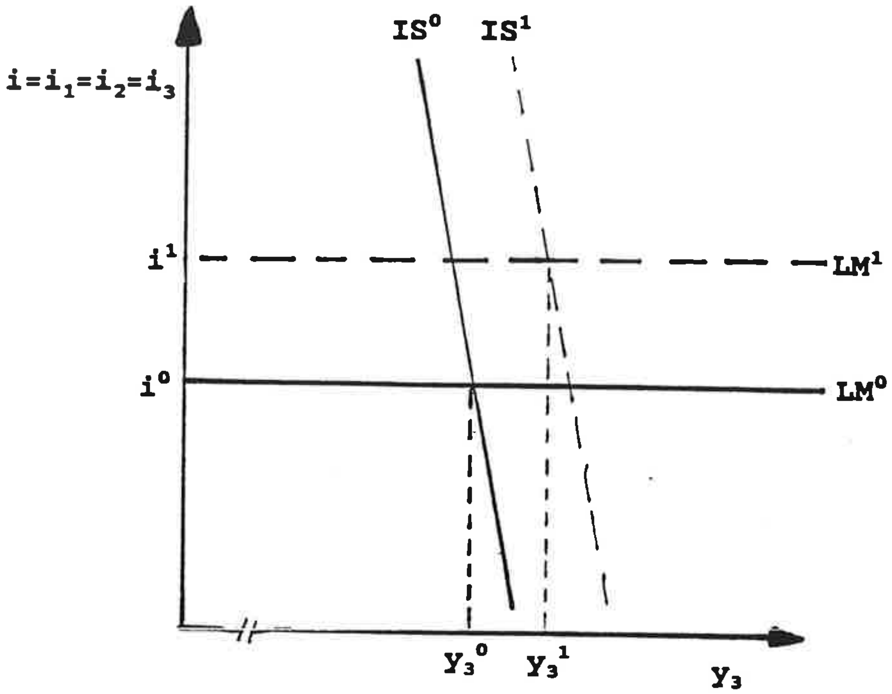
We assume in all cases that the demand shock is positive and that the large countries are symmetrical, i.e. that y_1 and y_2 increase by an equal amount. The figures are drawn according to the parameter values given in appendix 2.

Floating exchange rates:



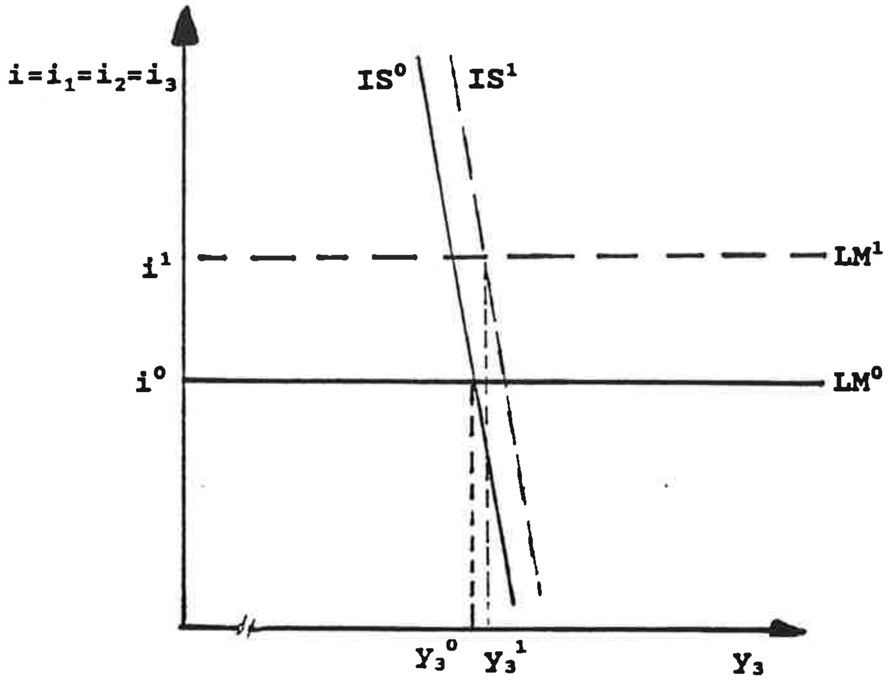
Export demand of country 3 increases and competitiveness improves at least in the symmetrical case (we do not know this a priori in the asymmetrical case). The net effect is nonetheless positive, so that the IS curve shifts to the right. The interest rate increases from i^0 to i^1 (the LM-curve shifts to the left), but this effect is small enough not to mitigate the positive output effect. It can thus be proven a priori that the output of country 3 increases from y_3^0 to y_3^1 after a positive demand shock occurring in country 1.

Pegging to the currency of country 2 (membership in an exchange rate union):



In the case of a fixed exchange rate the LM curve is vertical, i.e. the money supply is perfectly elastic at the internationally given interest rate. After a positive demand shock in country 1 the interest rate increases as above; this effect tends to decrease the output of country 3. Increasing export demand and improving competitiveness, however, tend to increase it (the IS curve shifts to the right). The output of country 3 is likely to increase. A negative output effect is theoretically possible, if domestic output is inelastic with respect to changes in foreign demand and competitiveness (the IS curve shifts only slightly to the right) and if the IS curve is flat. This case is evidently not relevant in the case of a small open economy which trades with non-union countries, too.

Currency basket exchange rate regime:



Compared to the previous case the situation differs now with respect to competitiveness, which remains unchanged in this case. The IS curve now shifts less to the right. A negative output effect is again possible theoretically if the domestic output is inelastic with respect to foreign output and if the LM curve is flat (demand for goods is very sensitive to changes in the interest rate). A positive output effect may, however, be more likely. If this is the case, the currency basket exchange rate regime stabilizes the output more than the "EMU-peg regime". The post-shock output of country 3 is smaller by factor $\theta\sigma_3/2\sigma$ than in the "EMU-peg regime".

EMPIRICAL EXPERIMENT 1

We assume the following parameter values:

$k = 0.67$, $\Phi = 0.46$ } Kremers & Lane (1990) for the EMS; $\mu = 0.2$; $\sigma = 0.1$; $\epsilon = 0.3$

$\epsilon_3 = 0.6$; $\sigma_3 = 0.3$; $\theta = 0.3$

Now we get the following values for output effects in different exchange rate regimes (marked above the effect):

$$\begin{array}{cccccc} & |0.156| & & |0.504| & & |0.606| \\ (R.1.) & \left|\frac{\delta y_3}{\delta f_1}(basket)\right| & < & \left|\frac{\delta y_3}{\delta f_1}(floating)\right| & < & \left|\frac{\delta y_3}{\delta f_1}(EMU\text{-}peg)\right| \end{array}$$

$$\begin{array}{cccccc} & |0.156| & & |-0.294| & & |0.504| \\ (R.2.) & \left|\frac{\delta y_3}{\delta f_2}(basket)\right| & < & \left|\frac{\delta y_3}{\delta f_2}(EMU\text{-}peg)\right| & < & \left|\frac{\delta y_3}{\delta f_2}(floating)\right| \end{array}$$

$$\begin{array}{cccccc} & |0.106| & & |-0.527| & & |-0.767| \\ (M.1.) & \left|\frac{\delta y_3}{\delta m_1}(basket)\right| & < & \left|\frac{\delta y_3}{\delta m_1}(floating)\right| & < & \left|\frac{\delta y_3}{\delta m_1}(EMU\text{-}peg)\right| \end{array}$$

$$\begin{array}{cccccc} & |0.454| & & |-0.527| & & |1.337| \\ (M.2.) & \left|\frac{\delta y_3}{\delta m_2}(basket)\right| & < & \left|\frac{\delta y_3}{\delta m_2}(floating)\right| & < & \left|\frac{\delta y_3}{\delta m_2}(EMU\text{-}peg)\right| \end{array}$$

APPENDIX 3

EMPIRICAL EXPERIMENT 2

We assume the following parameter values:

$k = 0.67$, $\Phi = 0.46$ } Kremers & Lane (1990) for the EMS; $\mu = 0.2$; $\sigma = 0.1$; $\epsilon = 0.15$

$\epsilon_3 = 0.3$; $\sigma_3 = 0.2$; $\theta = 0.3$

Now we get the following values for output effects in different exchange rate regimes (marked above the effect):

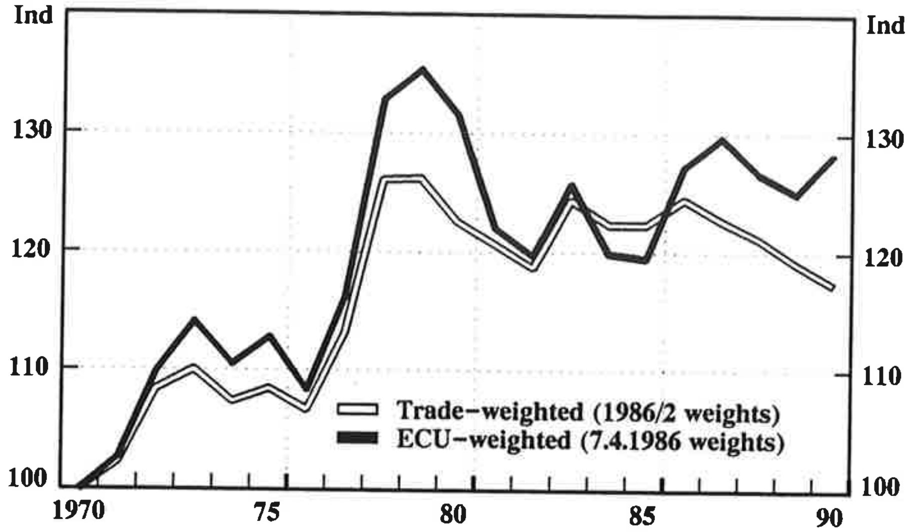
$$(R.1.)\ \left|\overset{|0|}{\frac{\delta y_3}{\delta f_1}(basket)}\right| < \left|\overset{|0.304|}{\frac{\delta y_3}{\delta f_1}(EMU\text{-}peg)}\right| < \left|\overset{|0.438|}{\frac{\delta y_3}{\delta f_1}(floating)}\right|$$

$$(R.2.)\ \left|\overset{|0|}{\frac{\delta y_3}{\delta f_2}(basket)}\right| < \left|\overset{|-0.304|}{\frac{\delta y_3}{\delta f_2}(EMU\text{-}peg)}\right| < \left|\overset{|0.438|}{\frac{\delta y_3}{\delta f_2}(floating)}\right|$$

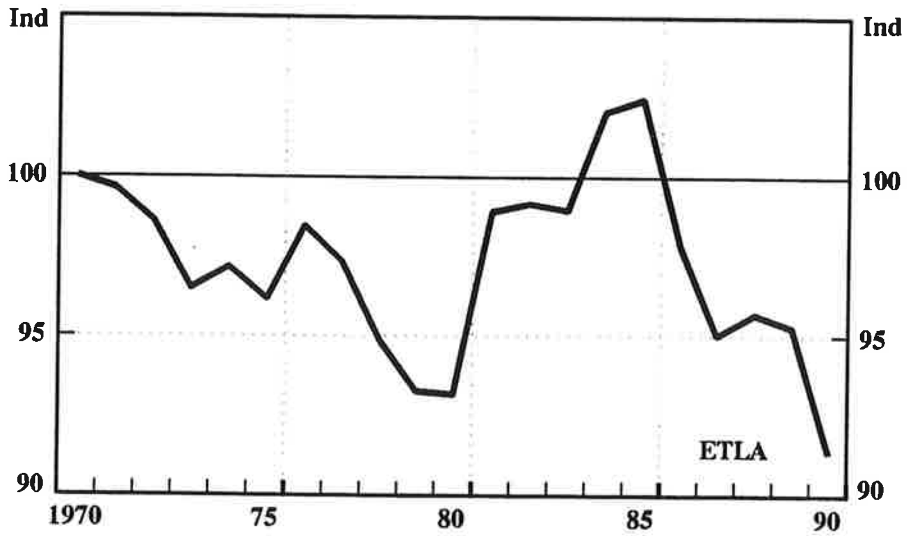
$$(M.1.)\ \left|\overset{|0.129|}{\frac{\delta y_3}{\delta m_1}(basket)}\right| < \left|\overset{|-0.385|}{\frac{\delta y_3}{\delta m_1}(EMU\text{-}peg)}\right| < \left|\overset{|-0.556|}{\frac{\delta y_3}{\delta m_1}(floating)}\right|$$

$$(M.2.)\ \left|\overset{|0.309|}{\frac{\delta y_3}{\delta m_2}(basket)}\right| < \left|\overset{|-0.556|}{\frac{\delta y_3}{\delta m_2}(floating)}\right| < \left|\overset{|0.824|}{\frac{\delta y_3}{\delta m_2}(EMU\text{-}peg)}\right|$$

Trade- and ECU-weighted exchange rate indices for Finland



The trade-weighted index relative to the ECU-weighted index 1)



1) When the curve is below 100, this means that the ECU-index has depreciated more than the trade-weighted index since 1970. Thus, if the ECU index were fixed, the trade-weighted index would be revalued more, ceteris paribus (assuming the same devaluations and revaluations), and vice versa. If for example the FIM were pegged to an ECU basket in 1970, the trade-weighted basket would have been 8.5 % stronger in 1990 than when pegging to the trade-weighted basket. If the peg were realized in 1979 or in 1985 the corresponding figures were 2 % and 11 %, (more revaluation).

ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, SF-00120 HELSINKI

Puh./Tel. (90) 601 322 Telefax (90) 601 753
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