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Keskusteluaiheita - Discussion papers

No. 399

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EXCHANGE RATE UNIONS: A COMPARISON TO CURRENCY BASKET AND FLOATING RATE REGIMES - A THREE-COUNTRY MODEL*

* This is a preliminary report of an ongoing research project. I thank Kari Alho, William Brainard, Vesa Kanniainen, Jukka Lassila, Pentti Pikkarainen, Pentti Vartia and Clas Wihlborg for comments; I am, however, solely responsible for any remaining errors. Any further comments are welcome. Financial support from the Academy of Finland, the Danish Summer Research Institute and the Yrjö Jahnsson Foundation is gratefully acknowledged. I also thank John Rogers for checking the language. The study was accepted as a Licentiate's thesis at the University of Helsinki in February 1992.

ISSN 0781-6847 09.03.1992

KOTILAINEN, Markku, **EXCHANGE RATE UNIONS: A COMPARISON TO CURRENCY BASKET AND FLOATING RATE REGIMES - A THREE-COUNTRY MODEL.** Helsinki : ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1992. 120 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 399).

ABSTRACT: The paper is the third preliminary report of a project in which exchange rate unions are systematically compared to currency basket and floating rate regimes in the framework of a three-country macroeconomic model. 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 basket. The first report of the project includes the results obtained in a version of the model where prices are assumed to be fixed (ETLA Discussion Paper, No. 356). In the second report the formation of producer prices is made endogenous by adding an aggregate supply curve into the model (ETLA Discussion Paper, No. 372). The current third report reviews both of the previously mentioned model versions and provides a comprehensive evaluation of the exchange rate regimes on the basis of the results obtained in the study.

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

NON-TECHNICAL SUMMARY

In the study three exchange rate regimes - exchange rate union, currency basket exchange rate regime and floating rates - are compared in the case of a small country. An exchange rate union is a regime where a country's exchange rate is pegged to that of another country. This kind of an arrangement depicts for example pegging to the European Currency Unit (ECU). By a currency basket regime is meant in this study pegging to a trade-weighted currency index. Floating rates in turn are determined in the foreign exchange market on the basis of the equilibrium conditions of the economy. The framework used in the study is a three-country macroeconomic (IS-LM) model where there are two big countries and a small open economy.

The big country models are solved simultaneously in the case of floating exchange rates. The small country is modelled in a recursive way, i.e. the big countries affect the small country but not the other way round. The exchange rate regimes of the small country are analyzed and compared with respect to the effects of various kinds of economic shocks. The shocks considered are as follows: a goods demand shock, a monetary shock and a supply (productivity) shock, which all can occur either in the small home country or in each of the big foreign countries. Two model versions are used in the study: in the first model producer prices are fixed and output is determined on the basis of demand. In the other version there is additionally a supply curve in each country model, which makes producer prices endogenous. Exchange rate and price expectations are static in both models. The solutions of the models are shown with analytical formulae when possible; otherwise simulations with relevant parameter values with sensitivity analyses are used.

In the case of domestic shocks similar conclusions are drawn as in the traditional Mundell-Fleming models: floating exchange rates insulate the output of a small country better against goods demand shocks and fixed rates against monetary shocks. Endogenizing prices, however, makes the results less dichotomic than is obtained in the fixed price models. Fixed rates insulate the output more also in the case of productivity shocks, if the money supply remains unchanged. The effects of foreign shocks depend on both the nature and the origin of the shock. With respect to the currency union the most problematic shocks are the monetary and productivity shocks which occur in the union partner country because in these cases changes in exchange rates reinforce the effects of changing foreign demand and interest rates. The basket peg regime insulates the domestic prices the best against foreign shocks.

SUOMENKIELINEN TIIVISTELMÄ

Tutkimuksessa verrataan pienen maan tapauksessa toisiinsa kolmea valuuttakurssijärjestelmää: valuuttakurssiunionia, korivaluuttajärjestelmää ja kelluvia kursseja. Valuuttakurssiunioni on järjestelmä, jossa maan valuuttakurssi on kiinnitetty toisen maan kurssiin. Tällainen järjestely kuvaa esimerkiksi kytkentää Euroopan Rahayksikköön, ECU:un. Korijärjestelmällä tarkoitetaan tässä tutkimuksessa sidontaa ulkomaankauppaosuuksilla painotetun valuuttaindeksin suhteen. Kelluvat kurssit taas määräytyvät vapaasti kansainvälisillä valuuttamarkkinoilla. Tarkastelukehikkona on kolmen maan makroteoreettinen (IS-LM) malli, jossa on kaksi suurta maata ja yksi pieni avoin talous.

Suurten maiden mallit ratkaistaan samanaikaisesti kelluvien valuuttakurssien vallitessa. Pieni maa on mallitettu siten, että suuret maat vaikuttavat pieneen maahan, mutta ei päinvastoin. Pienen maan valuuttakurssijärjestelmiä analysoidaan ja verrataan sen suhteen, miten odottamattomat taloudelliset häiriöt vaikuttavat niissä. Tarkasteltavat häiriötyypit ovat: hyödykkeiden kysyntään, rahatalouteen ja hyödykkeiden tarjontaan liittyvät häiriöt, jotka kaikki voivat tapahtua joko pienessä kotimaassa tai jommassakummassa suuressa maassa. Tutkimuksessa käytetään kahta malliversiota: ensimmäisessä mallissa tuottajahinnat ovat kiinteät ja tuotanto määräytyy kysynnän mukaan, toisessa versiossa kunkin maan malleihin on lisätty tarjontakäyrä, jolloin tuottajahinnat muuttuvat häiriön seurauksena. Valuuttakurssi- ja hintaodotukset ovat molemmissa malleissa muuttumattomia. Mallien ratkaisut esitetään analyyttisina lausekkeina milloin tämä on mahdollista, muulloin tehdään numeerisia simulointeja ja esitetään herkkyysanalyyseja.

Kotimaisten häiriöiden osalta päädytään pohjimmiltaan samoihin johtopäätöksiin kuin aiemmissa tutkimuksissa: kelluvat kurssit eristävät pienen maan tuotannon paremmin hyödykkeiden kysyntähäiriöiltä ja kiinteät kurssit rahataloudellisilta häiriöiltä. Hintojen muutosten huomioonottaminen kuitenkin tekee tulokset vähemmän kaksijakoisiksi kuin kiinteähintaisten mallien tapauksessa. Kiinteät kurssit vakauttavat paremmin tuotantoa myös tuottavuushäiriöiden tapauksessa, mikäli rahan tarjonta säilyy muuttumattomana. Ulkomaisten häiriöiden vaikutukset riippuvat sekä häiriön luonteesta että alkuperästä. Valuuttakurssiunionin kannalta ongelmallisimpia ovat unionikumppanimaassa tapahtuvat rahataloudelliset ja tuottavuushäiriöt, koska näissä tapauksissa valuuttakurssimuutokset vahvistavat ulkomaisen kysynnän ja koron muutosten vaikutusta. Korivaluuttajärjestelmä vakauttaa parhaiten pienen maan hintatason ulkomaisilta häiriöiltä.

CONTENTS

1 INTRODUCTION

In this study exchange rate unions are systematically compared to currency basket and floating rate regimes. An exchange rate union means a more or less fixed peg of a currency's exchange rate to that of another country or an area inside which the exchange rates are fixed. The European Monetary System (EMS) or the possibly evolving European Monetary Union (EMU) are examples of exchange rate unions. The union can be based on joint interventions in defending the exchange rates, as in the case of the EMS, but also a unilateral peg of a currency to another one can be regarded as a form of an exchange rate union, even if the peg in this case is usually less credible.

A currency basket exchange rate regime is in this context a system where a currency is pegged to a trade-weighted currency basket. An essential feature of a trade-weighted basket is that it stabilizes the effective exchange rate of a country. This kind of a system was followed for example in Finland and Sweden until 1991, and in Norway until 1990; since then they have unilaterally pegged their currencies to the European Currency Unit (ECU).[1] There are, however, many other countries which still use their own, often trade-weighted, currency baskets (see appendix 1). In the floating rate regime the exchange rate is determined freely in the foreign exchange market on the basis of the equilibrium conditions of the economy.

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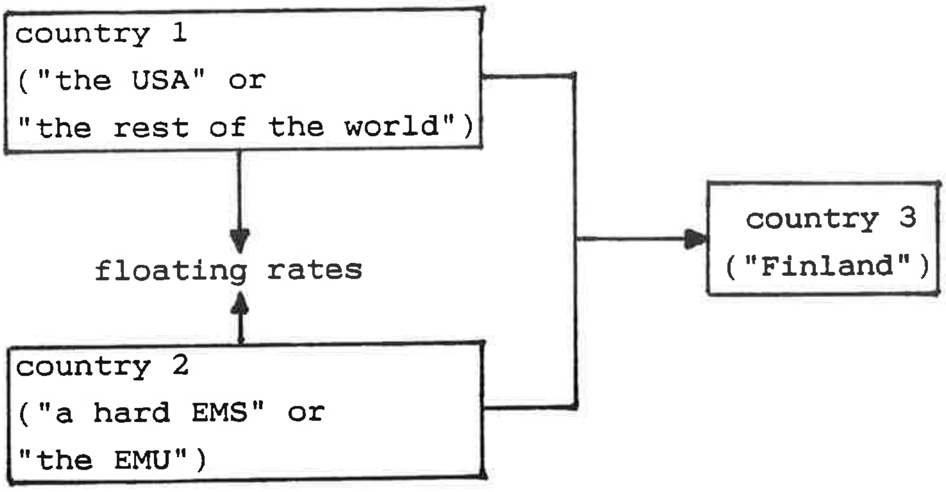
[1]The ECU is a kind of a currency basket, too, but at the moment there are rarely realignments of the currencies participating in the Exchange Rate Mechanism (ERM) of the EMS, i.e. the EMS is rather "hard". In the future the ECU is planned to be the common currency of the European Monetary Union (EMU).

In the analysis of the exchange rate union and the basket regime we confine ourselves to studying credibly fixed rates, i.e. the exchange rates are not expected to change and there is no risk of a change. This is due to the assumption of static expectations used in the models. The research thus puts the emphasis on the systemic properties of the exchange rate regimes.

The framework used is a three-country macroeconomic model, in which we have two big countries and a small open economy. The models of the big countries are solved simultaneously, whereas the small country is modelled in a recursive way - i.e. the big countries affect the small economy, but not the other way round.

The bilateral exchange rates of the big countries are determined freely in the foreign exchange market, reflecting the characteristics of the floating rate regime, which is in practice between the main currency blocks in the world of today. The big countries can thus be called "the USA" (country 1) and "the EMS" or "the EMU" (country 2). In the third country, which can be called "Finland" or some other small economy, we study three alternative exchange rate regimes: floating rates, exchange rate union with country 2, and a currency basket exchange rate regime.

Figure 1. Description of the research framework



The common practice in the literature on exchange rate regimes is to study the insulation properties of the regimes in the face of exogenous shocks. We also follow the same procedure. The shocks we study are goods demand shocks, monetary shocks and productivity shocks (in chapter 3). These shocks can occur in the home country or in either of the big countries. The total number of the shocks studied is thus nine.

The idea behind the shock approach is that stabilization of certain economic variables, especially of output and prices, against temporary shocks is desirable. This objective can be legitimized by arguing that stable economic development produces a higher level of welfare than fluctuating development. It can also be motivated by the adjustment costs which are connected to fluctuating economic development.

The models of each country are basically traditional open economy IS-LM models. The formulation of the supply curve in chapter 3 is, however, unconventional, and it makes possible an analysis of productivity shocks, which I have not seen in the literature on exchange rate regimes. The main contribution of this research is nevertheless in the widening of the IS-LM framework into a three-country context, and in the explicit comparison of the above mentioned three exchange rate regimes. This kind of a study sheds more light on different ways of fixing the exchange rate and on different types of fixity and flexibility than is possible in one- or two-country models. In a floating rate world the exchange rate of the home country is fixed in the exchange rate union with respect to the union partner, but floating with respect to the rest of the world. In the basket peg regime the trade-weighted (effective) rate is fixed. From a macroeconomic point of view the degree of fixity is higher than in the union, even if the bilateral rates can change.

When using IS-LM models instead of, for example, asset market models we want to emphasize the longer than very short-term determinants of the exchange rate, i.e. on the flow effects of both monetary and real factors. On the other hand IS-LM models are more manageable in a three-country context than asset market models, which make the recursive treatment of the small country impossible by requiring that the big countries hold the assets of the small country, too. Combining short-run asset market effects with longer-run current account effects, as for example in Kouri (1976) and in Dornbusch and Fischer (1980), would further complicate the analysis. New classical optimization models would also make the three-country analysis complex. These models are better suited for the analysis of rather specific issues in a one-country setting. For example Rudiger Dornbusch has preferred IS-LM models to the alternative ones. (For the properties of different kinds of models in analyzing exchange rate regimes, see Dornbusch, 1989 and 1986.)

Modelling the foreign countries with structural equations makes it possible to identify the source of the shock and to take into account the transmission of the foreign shocks in the international economy. This kind of a transmission occurs already within the time horizon which is relevant for short-run analyses. The shocks which the small economy faces are thus composite shocks, combinations of the effects which the exogenous disturbances have had on the big countries. This makes the shocks more realistic from the small country's point of view than by just focusing on changes in individual foreign variables.

When compared to two-country models the three-country framework makes it possible to distinguish between the exchange rate union and the currency basket regime. Analyzing the exchange rate union in a three-country setting is also fruitful as such, because the impacts of foreign shocks can be analyzed more carefully than in one- or two-country models.

The traditional approach in the macroeconomic analysis of exchange rate regimes is the so-called Mundell-Fleming model, which goes back to Mundell (1960, 1961a, 1961b, 1963, 1964; collected in 1968) and Fleming (1962). (For a survey of the development of the Mundell-Fleming model, see Frenkel and Razin, 1987.) From the insulation point of view the main conclusion of the Mundell-Fleming analysis is that fixed rates are preferable to flexible rates if domestic monetary disturbances are important since they have no impact on output under fixed rates. They only result in a change in foreign exchange reserves. On the other hand, if aggregate demand disturbances are important, flexible rates are preferable, because they eliminate the effects on output.[2]

The results of the original Mundell-Fleming model are strong and dependent on the assumptions used: (1) a small country, (2) assets are perfect substitutes, (3) perfect capital mobility, (4) exchange rate expectations are static, (5) nominal wage and price levels are fixed, (6) there are unemployed resources, (7) an exchange rate depreciation (appreciation) improves (worsens) the balance of trade (the Marshall-Lerner condition), and (8) the whole model is a static one. In spite of these limiting assumptions, the Mundell-Fleming model is still an important starting point for further analysis.

Originally the Mundell-Fleming analysis was developed in a one-country model. It has been widened, however, subsequently to a two-country context (see Mundell, 1964; Swoboda and Dornbusch, 1973; Mussa, 1979, Allen and Kenen (1980), and Dornbusch (1980). Argy and Salop (1983) developed the two-country model further by allowing wages and prices to vary and by studying the effects of monetary and fiscal policies with and without real wage indexation in the case of flexible exchange rates. They found that when real wages are fully indexed, fiscal stimulus expands output at home, but this occurs at the expense of output abroad. In the case of monetary policy they obtained the result that world output remains unchanged if wages are fully indexed. The big country model presented in chapter

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[2]From the policy effectiveness point of view the conclusion is that under the regime of fixed rates monetary policy is ineffective in influencing output, whereas fiscal policy is effective. In the floating rate regime it is the other way round.

3 of this study resembles this kind of a model. In the 1980s some researchers have developed the two-country IS-LM model in a dynamic context (see especially Buiter, 1986; see also Wohltmann, 1991).

Exchange rate unions have traditionally been analyzed with the frameworks suggested by the optimum currency area literature (for a survey see for example Ishiyama, 1975; Kotilainen and Peura, 1988; Wihlborg and Willett, 1991). The traditional optimum currency area approach tries to single out crucial economic criteria for fixing exchange rates between countries, i.e. for forming a currency area. (See especially Mundell, 1961; McKinnon, 1963; Kenen, 1969 and Vaubel, 1978.) The optimum currency area literature, even if it is rather loose and eclectic, is still an important benchmark in the research of exchange rate unions and provides a lot of working hypothesis for further theoretical and empirical studies. Some of the criteria, for example the degree of openness of the economy, have relevance for this study, too.

There are some studies in which exchange rate unions have been analyzed in a three-country setting. Marston (1985) has used a two-model approach where he has a financial market model, inside which the exchange rates are determined, and a real sector model to which the outcomes of the financial sector model are connected. Callan (1989) is a numerical dynamic three-country model for analyzing the impacts of an exchange rate union. My approach resembles these frameworks, too, even if the model I use is different. I also analyze a greater amount of shocks and the alternative regimes, too, which Marston (1985) and Callan (1989) have not done.

In macroeconomic theory currency basket exchange rate regimes have been analyzed in the so-called optimal currency basket literature (for a survey see for example Pikkarainen, 1986; Kotilainen and Peura, 1988). In these studies the aim has been to derive optimal currency baskets with respect to some target variables for a small open economy faced with stochastic shocks. In some cases the covariances of the shocks have to some extent been taken into account, but usually the international transmission of the initial shocks has been neglected. Bhandari (1985) is an exception; he uses a numerical model where, in addition to the home country, two foreign countries are modelled explicitly. Pikkarainen (1986) and Edison and Vårdal (1987) are examples of macroeconomic studies where the optimal basket approach has been used in empirical research. Sauramo (1989) has studied the strategic behaviour of countries using currency basket regimes in a game theoretic setting. Pikkarainen (1991a and b) has studied the currency basket regime from a microeconomic point of view.

The method of this research project has been to start with a simple Mundell-Fleming type of fixed price model structure. Widening of this into a three-country context already gives new insights into the traditional theory. The next step is to make producer prices endogenous by adding an aggregate supply curve into the model. Both model versions are static with static expectations.[3] Part of the analysis can be done analytically. Because of the complexity of the model, there are, however, limitations for obtaining *a priori* results. In these cases the

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[3]In forthcoming research reports the model will be widened to incorporate rational exchange rate and price expectations, and the dynamic adjustment of the small open economy under different exchange rate regimes.

analysis has been continued by the means of numerical simulations with sensitivity analyses. Even if numerical techniques are limiting as such, sensitivity analyses with relevant key parameter values give new insights both into the analysis of exchange rate regimes and into the properties of the IS-LM model, which is the most commonly used model in macroeconomics.

The rest of the research report is organized as follows. In chapter 2 the fixed price version of the model is used for analyzing the effects of domestic and foreign goods demand and monetary shocks. In the case of foreign shocks the two-country world economy model is solved first, and then the effects on the small open economy are recursively analyzed under different exchange rate regimes. The effects of domestic shocks are the same as in the traditional Mundell-Fleming model (see pages 5-6). (Chapter 2 is based on Kotilainen, 1991a.) In chapter 3 the models of each country are widened by incorporating aggregate supply equations in them, which makes the producer prices endogenous, and makes it possible to study the effects of productivity shocks. It is shown that the results obtained in the fixed price model are modified when supply reactions are taken into account. The model presented in chapter 2 is in fact a special case of the latter model, but for expository purposes, and because of the differing philosophy and analytical treatment, they are presented in separate chapters. (Chapter 3 is based on Kotilainen, 1991b.) In chapter 4 an overall evaluation of the results is presented. Chapter 5 is the summary of the report.

2 A THREE-COUNTRY MODEL WITH FIXED PRICES

2.1 The structure of the model

The models specified here for the individual economies are rather traditional IS-LM models (see for example Dornbusch, 1980, p. 199; Buiter, 1986). The models used in this chapter include 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 exchange rate expectations are static, i.e. the exchange rates are assumed to be the same tomorrow as they are today. Additionally we assume that speculators are risk-neutral. This means that interest rates are equalized internationally through perfect capital mobility. The purchasing power parity condition is not required, i.e. producer prices in common currency are not equalized internationally. Effects of inflation are excluded from the model at this stage by assuming that prices are constant. This assumption is consistent with standard Keynesian assumptions used in short-run analysis.

In spite of the simple structure of the model, it gives the basic results, which serve as a reference in more comprehensive models. Making the country models more detailed greatly complicates the three country analysis.

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

<u>Country 1 ("the USA")</u>

$$(1)\ m_1 - p_1 = k_1y_1 - \Phi_1i_1 \quad \text{(LM)}$$
$$(2)\ y_1 = -\mu_1r_1 + \sigma_{12}(e + p_2 - p_1) + \epsilon_{12}y_2 + f_1 \quad \text{(IS)}$$

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

$$(3)\quad m_2 - p_2 = k_2y_2 - \Phi_2 i_2 \qquad \text{(LM)}$$

$$(4)\quad y_2 = -\mu_2 r_2 - \sigma_{21}(e + p_2 - p_1) + \epsilon_{21}y_1 + f_2 \qquad \text{(IS)}$$

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

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 = elasticity of goods demand with respect to relative prices or the terms of trade ("competitiveness elasticity"), 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 real income, 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, relative prices ("competitiveness") 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 non-negative. We also assume that $0 < \epsilon_1, \epsilon_2, \epsilon_3 < 1$ and $0 \leq \theta \leq 1$.

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.

2.2 Domestic shocks in the small country

Because of the assumption of static expectations, the exchange rate union and the basket peg regime are identical with each other in the case of domestic shocks. They both work as fully credible fixed rate regimes. We thus confine ourselves to comparing the effects of goods demand and monetary shocks in the floating and fixed rate regimes. In the case of floating rates we use a model consisting of equations (6), (7) and (8). In the case of fixed rates we can abolish the LM curve (equation (6)) from the model. Because of perfect capital mobility, the credibly fixed exchange rate and risk neutrality of investors, money supply is now perfectly elastic at the interest rate $i_3 = i_2 = i_1$.

When there is a domestic goods demand shock in country 3, a floating exchange rate insulates the domestic output fully. The change in the trade-weighted exchange rate is $\delta e_3/\delta f_3 = -1/\sigma_3$. In the case of a positive shock there is thus an appreciation, the magnitude of which is inversely related to the elasticity of output with respect to relative prices. In the fixed rate regime output reacts fully to the exogenous change in demand (according to multiplier 1).

In the case of a domestic monetary shock (a money supply or demand shock) the output changes by $\delta y_3/\delta m_3 = 1/k_3$ and the trade-weighted exchange rate by $\delta e_3/\delta m_3 = 1/(k_3\delta_3)$. These changes are thus inversely related to the income elasticity of money demand (k_3). In the fixed rate regime a monetary shock has no effect on output.

The results presented above are consistent with the conclusions drawn in the traditional Mundell-Fleming literature (see pages 5-6).

2.3 A goods demand shock in country 1

2.3.1 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:

$$
\begin{aligned}
&(9) \quad m_1 - p_1 - k_1 y_1 + \Phi_1 i_2 = 0 \\
&(10) \quad y_1 + \mu_1 i_2 - \sigma_{12} c - \epsilon_{12} y_2 - f_1 = 0 \\
&(11) \quad m_2 - p_2 - k_2 y_2 + \Phi_2 i_2 = 0 \\
&(12) \quad y_2 + \mu_2 i_2 + \sigma_{21} c - \epsilon_{21} y_1 - f_2 = 0.
\end{aligned}
$$

Next, the effects of a change in f_1 (a goods demand shock in country 1 due to, for example, debt financed fiscal policy) are derived on the endogenous variables y_1, y_2, e or c, and i_2. We first consider the effects on y_1:

(13)

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

The sign of this expression is not determined 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):

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

This expression $\delta y_1/\delta f_1 > 0$ because we assume that $0 < \epsilon < 1$, where ϵ is the elasticity of goods demand with respect to the real income of the foreign country. Intuitively, the explanation for ϵ being smaller than 1 is that the production (income) of a country is obviously a less important demand factor 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. Under symmetry 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. whether $\Phi_1 k_2$ 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 relative prices (competitiveness) c. We again assume that countries 1 and 2 are symmetric. After taking the derivative 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 a rise in the world interest rate $i = i_1 = i_2$.

We summarize the effects of a positive goods demand shock 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 similar 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 fixed-price 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 new interest rate, too. Developments in the home country also affect the developments in the foreign country.

2.3.2 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 always the same as in countries 1 and 2).

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 a 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 1 and 2, θ and $1-\theta$, are the same in both competitiveness and export demand terms. This assumption means in the floating rate case that the relative changes of the two bilateral exchange rates of country 3 are determined according to "real" factors, i.e. the foreign trade shares of countries 1 and 2 (see equation (25) and page 19). 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 emphasized in the determination of bilateral rates, see Marston, 1985, 278.) We have only one elasticity with respect to competitiveness and foreign demand in the model (σ_3 and ϵ_3), the country specific 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 expectations of exchange rate changes are static $i_1 = i_2 = i_3$. 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:

$$(20)\ m_3 - p_3 - k_3y_3 + \Phi_3 i_2 = 0$$

$$(21)\ y_3 + \mu_3 i_2 + \sigma_3\theta c - \sigma_3 c_{32} - \epsilon_3\theta y_1 - \epsilon_3(1 - \theta)y_2 - f_3 = 0$$

We solve the model in terms of y_3 and c_{32}. The variables c and $i_2 = i$ are determined in the big country model and the small country cannot affect them.

For output we get the following expression:

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

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 producer prices are constant) between countries 2 and 3 we obtain:

$$(23)\ \frac{\delta c_{32}}{\delta f_1}=\frac{k_3\mu_3k\sigma+\theta k_3\sigma_3\phi e+\phi_3k\sigma-\theta k_3\sigma_3k\mu-\theta k_3\sigma_3\phi-k_3\phi e_3\sigma}{2\sigma\sigma_3k_3[k\mu+\phi(1-e)]}.$$

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 the currency of country 2):

$$(24)\ \theta>\frac{k_3\phi e_3\sigma-k_3\mu_3k\sigma-\phi_3k\sigma}{k_3\sigma_3\phi e-k_3\sigma_3k\mu-k_3\sigma_3\phi}.$$

If country 3 is structurally symmetrical to countries 1 and 2, expression (23) reduces 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 above, 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 $k_3\mu_3 k + \Phi_3 k > k_3\Phi\epsilon_3$, i.e. if

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

If we assume that the LM curve of country 3 is symmetrical to those of countries 1 and 2, so that $k_3 = k$ and $\Phi_3 = \Phi$, we obtain expression (29). (We can maintain asymmetry in terms of σ_3 , ϵ_3 and μ_3, the competitiveness and foreign demand elasticities and the interest rate sensitivity with respect to aggregate demand, respectively.)

$$(29)\ \frac{\delta c_3}{\delta f_1}=\frac{k\mu_3+\phi(1-\epsilon_3)}{2\sigma_3[k\mu+\phi(1-\epsilon)]}>0$$

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.

2.3.2.2 Exchange rate union

By an exchange rate union we mean pegging the small country's currency to that of country 2 ("the EMS" or "the EMU"). Because the exchange rate of country 3 is fixed with respect to a large country, 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 outcome is the same as for country 2, i.e. (31) is the same as (15). The output of country 3 in this case increases if the shock is positive.

The change in competitiveness is the fraction θ of the change in competitiveness of country 2 vis-à-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, but by less than in country 2 (if $\theta < 1$).

2.3.2.3 Currency basket exchange rate regime

Because the trade-weighted exchange rate ($e_3 = \theta e_{31} + (1 - \theta)e_{32}$) 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 remains unchanged, 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 by the expressions obtained in the big country model, we can write for the output:

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

The expression $\delta y_3/\delta f_1 > 0$ if $\epsilon_3 > \mu_3 k/\Phi$. We make the following numerical illustration. Let us assume that $\mu_3=0.2$, $k=0.67$, and $\Phi=0.46$. 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 and Lane (1990, 796), where the authors estimated money demand coefficients for the EMS countries as an aggregate. The value of μ_3 is a "guesstimate" which is obtained on the basis of econometric models of the Finnish economy and by adjusting the estimate slightly upwards when assuming that the short-run interest rate sensitivity of aggregate demand has increased after the deregulation of the financial markets (see for example Tarkka and Willman (ed.) (1985)). The magnitude, even the sign, of the interest rate sensitivity of especially consumption is, however, a debatable question (see for example Starck, 1990; The BOF4 Quarterly Model of the Finnish Economy, 1990).

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 2.)

2.3.2.4 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 cannot be determined *a priori*; it depends on the parameter values. If the LM curve of country 3 is symmetrical to those of countries 1 and 2, the currency of country 3 will depreciate, and competitiveness improves. The interest rate rises, which has a negative impact on output.

Exchange rate union ("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 cannot be determined *a priori* - except in some special cases. An increase in output is likely, but if the negative interest rate effect is large enough, it can outweigh the positive effects. Here we have a difference with respect 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 its 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:

The output effects are only due to changes in export demand and in interest rates (competitiveness does not change). If the demand shock occurring 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 the output of country 3 is not known a *priori;* it depends on the relative magnitudes of the effects.

Comparison:

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

This means that the output of country 3 is greater in the EMU-peg regime than in the basket regime after a positive demand shock occurring in country 1, assuming that the pre-shock levels are the same initially . 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 the post-shock output becomes even greater 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 rate regime to the lowest output. These differences are due to different competitiveness effects in the regimes. In the floating rate regime the 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).

With respect to output deviations from the equilibrium level two possible cases are shown in figure 2. The ranking of the regimes depends on the relative magnitudes of the individual effects. Case 1 is obviously more likely for a small open economy, but case 2 is theoretically possible, too. (See also appendix 2.)

Figure 2. Change in the output of the small country after a positive goods demand shock occurring in country 1: two possible cases

Case 1. 'Low' interest rate sensitivity of aggregate demand and 'high' elasticity with respect to foreign demand and relative prices

Case 2. 'High' interest rate sensitivity of aggregate demand and 'low' elasticity with respect to foreign demand and relative prices

2.4 A goods demand shock in country 2

2.4.1 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.

2.4.2 Impacts on the small country

2.4.2.1 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 2.3.2.1.).

2.4.2.2 Exchange rate union

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

$$(35)\quad \frac{\delta y_3}{\delta f_2}=\frac{\sigma[\epsilon_3\phi-\mu_3 k]-\theta\sigma_3[k\mu+\phi(1-\epsilon)]}{2\sigma[k\mu+\phi(1-\epsilon)]}.$$

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 thus leads 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.

2.4.2.3 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. Because of symmetry between the big countries, output of the small country changes thus also by the same amount as in the case when the shock originates in country 1 (equation (34)). We do not know the sign of the change *a priori*.

2.4.2.4 Comparison of effects in different exchange rate regimes

When comparing the output effects in the EMU-peg and the basket peg regimes (expressions (35) 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 basket peg regime by the amount $\theta\sigma_3/2\sigma$ (if the shock is positive), assuming that the pre-shock levels are the same.

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.

2.5 A monetary shock in country 1

When analysing the effects of a money supply or demand 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.

2.5.1 Impacts on the big countries

After solving the effect of a monetary shock on the output of country 1, we get the following result:

$$(36)\ \frac{\delta y_1}{\delta m_1} = \frac{2k\mu+\phi(1-\epsilon)}{2k[k\mu+\phi(1-\epsilon)]} = \frac{\mu}{2[k\mu+\phi(1-\epsilon)]} + \frac{1}{2k} > 0\ .$$

An increase in money supply, or a decrease in money demand, in country 1 thus leads to an increase in that country's output. The output of country 2 in turn decreases (given $1-\epsilon > 0$):

$$(37)\ \frac{\delta y_2}{\delta m_1}=\frac{-\phi(1-\epsilon)}{2k[k\mu+\phi(1-\epsilon)]}<0.$$

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 (38) and (39)). Export demand, as country 2's output decreases, has a negative impact on the output of country 1. The effects on c and i are as follows:

$$(38)\ \frac{\delta c}{\delta m_1}=\frac{\epsilon+1}{2k\sigma}>0$$

$$(39)\ \frac{\delta(i_2=i_1)}{\delta m_1}=-\frac{1-\epsilon}{2[k\mu+\phi(1-\epsilon)]}<0.$$

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.

2.5.2 Impacts on the small country

2.5.2.1 Floating exchange rates

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

$$(40)\ \frac{\delta y_3}{\delta m_1} = -\frac{\phi_3(1-\epsilon)}{2k_3[k\mu+\phi(1-\epsilon)]} < 0.$$

The output of the small country thus decreases, as does that of country 2, if there is an increase in the money supply (or a decrease in money demand) 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 expression (26). The competitiveness c, between countries 1 and 2, is determined in the big country model (expression (38)). The change in competitiveness of country 3 is as follows:

(41)

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

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 the money supply in country 1 increases, the currency of country 3 thus appreciates effectively, i.e. competitiveness deteriorates.

2.5.2.2 Exchange rate union

We use the same model as in section 2.3.2.2. (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 2.5.1. The output effect is as follows:

(42)

$$\frac{\delta y_3}{\delta m_1}=\frac{\sigma k\mu_3(1-\epsilon)+\epsilon_3\sigma\theta[2k\mu+\phi(1-\epsilon)]-\sigma_3\theta(\epsilon+1)[k\mu+\phi(1-\epsilon)]-\sigma\epsilon_3(1-\theta)\phi(1-\epsilon)}{2k\sigma[k\mu+\phi(1-\epsilon)]}.$$

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

$$\theta < \frac{\sigma(1-\epsilon)(\epsilon_3\phi - k\mu_3)}{[\sigma_3(\epsilon+1)-2\epsilon_3\sigma][k\mu+\phi(1-\epsilon)]}.$$

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

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

A decreasing interest rate and increasing export demand in country 1 contribute positively to the output of country 3. Worsening competitiveness (expression (43)) and decreasing export demand in country 2, in turn, contribute negatively to it.

As a numerical illustration (in the symmetrical case) we assume: $k=0.67$, $\mu=0.2$, $\Phi=0.46$, and $\epsilon=0.3$. Now the condition for positiveness of $\delta y_3/\delta m_1$ is $\theta<-0.009$, which is not possible (foreign trade shares cannot be negative). In the asymmetrical case we assume additionally: $\epsilon_3=0.6$, $\sigma_3=0.3$, $\sigma=0.1$ and $\mu_3=0.2$. 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. The values of k and Φ are adopted from Kremers and Lane (1990, 796). The rest of the parameter values are "guesstimates", although loosely based on econometric studies of the Finnish economy (see the references on page 23; Vartia (1974)). The reason for not using direct estimates is that in many cases there are not direct counterparts of the needed parameter values in the empirical literature.

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

$$(43)\quad \delta c_3/\delta m_1 = -\theta(c) = -\theta(e+1)/2k\sigma < 0.$$

If m_1 increases, the competitiveness of country 3 worsens.

2.5.2.3 Currency basket exchange rate regime

We derive the output effects of a change in m_1 by using the model presented in section 2.3.2.3 and by inserting the interest rate and export demand equations derived in section 2.5.1. into this model. Competitiveness is stabilized so that c_{32} changes to compensate for changes in c. The output effect is as follows:

$$(44)\quad \frac{\delta y_3}{\delta m_1} = \frac{2\theta\epsilon_3[k\mu+\phi(1-\epsilon)]+(k\mu_3-\epsilon_3\phi)(1-\epsilon)}{2k[k\mu+\phi(1-\epsilon)]}.$$

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 θ = 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 multiplier (44), 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).

2.5.2.4 Comparison of effects in different exchange rate regimes

Floating exchange rates:

If there is an increase in the money supply in country 1, the output of country 3 decreases (expression (40)). 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.

Exchange rate union ("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 expansionary monetary policy of country 1 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). When assuming that the initial output levels are the same, the currency basket exchange rate regime thus leads 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.

2.6 A monetary shock in country 2

2.6.1 Impacts on the big countries

A monetary shock originating in country 2 creates the same effects in country 2 as a similar shock originating in country 1 creates in country 1. 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 expressions (36)-(39).)

2.6.2 Impacts on the small country

2.6.2.1 Floating exchange rates

In the floating exchange rate regime there is no difference in output effects according to the origin of the shock. The effect of a money supply shock occurring in country 2 is thus negative by the amount presented in equation (40). 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.

2.6.2.2 Exchange rate union

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

(45)

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

We do not know the sign of the change a *priori*, but it is likely that it is positive 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:

$$\frac{\delta y_3}{\delta m_1}-\frac{\delta y_3}{\delta m_2}=\frac{(2\theta-1)e_3\sigma-\theta(e+1)\sigma_3}{k\sigma}.$$

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.

2.6.2.3 Currency basket exchange rate regime

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

$$(46)\ \frac{\delta y_3}{\delta m_2} = \frac{-2\theta e_3[k\mu+\phi(1-e)] + (k\mu_3+e_3\phi)(1-e) + 2e_3k\mu}{2k[k\mu+\phi(1-e)]}.$$

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:

$$\frac{\delta y_3}{\delta m_1} - \frac{\delta y_3}{\delta m_2} = \frac{(2\theta-1)e_3}{k}.$$

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, assuming that the pre-shock outputs are the same. The relative magnitudes of the effects depend thus on the export market shares of countries 1 and 2.

2.6.2.4 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 - when assuming that the pre-shock outputs are the same. This is due to the improving competitiveness with respect to country 1 in the former regime; in the latter one average 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 basket peg regime is also greater than that in the floating rate regime (if the shock is positive). We can thus write:

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

2.7 Evaluation of the results

In the case of <u>a goods demand shock</u> originating in country 1 (we call this case R.1.) we are 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 originates in country 2 (case R.2.), we can 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 a money supply shock originating in country 1 (denoted by M.1.) we can 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 originates in country 2 (case M.2.), we obtain:

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

We can thus give the ranking according to the post-shock output levels (assuming the same pre-shock outputs), 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 a 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 appears to be an empirical question, depending on the relative magnitudes of various effects and thus on the parameters of the model.

In the floating case we can determine the signs of the changes a *priori*. When there is a demand shock in the big countries the output effect on country 3 is positive, and in the case of a money supply shock it is negative. The effect is independent of the origin of the shock. To compare theoretically the output effects with those in the EMU-peg and basket peg regimes, we have, however, to assume symmetry of parameters between all three countries. Now we obtain the following ranking with respect to the post-shock outputs of country 3 - when assuming that the initial outputs are the same. We denote the cases as above. (The signs of the changes are presented in parenthesis.)

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

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

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

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

Floating leads thus in the symmetrical case to the greatest or to the smallest output depending on the nature of the shock. The relative effects on the output of country 3 in the EMU-peg and in the basket peg 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 with respect to absolute changes in output we assume 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 foreign real income 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 again adopted from Kremers and Lane (1990, 796), the rest of the parameter values are more or less "guesstimates". The assumed differences in the export demand and competitiveness elasticities are 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 assume $\theta = 0.3$. (For the "guesstimates" see pages 23 and 34.) (For an alternative set of parameter values see appendix 3.)

Table 1. The effects of foreign shocks on the output of the small country in different exchange rate regimes (the baseline calculation, fixed price model)

We assume the following parameter values:

$k = k_3 = 0.67$, $\Phi = \Phi_3 = 0.46$ } Kremers & Lane (1990) for the EMS

$\mu = \mu_3 = 0.2$

$\sigma = 0.1$; $\epsilon = 0.3$

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

Now we get the following absolute values for output effects in different exchange rate regimes:

$$|0.156| \qquad |0.504| \qquad |0.606|$$

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

$$|0.156| \qquad |-0.294| \qquad |0.504|$$

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

$$|0.106| \qquad |-0.527| \qquad |-0.767|$$

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

$$|0.464| \qquad |-0.527| \qquad |1.337|$$

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

Using these parameter values we get the result that in the R.1. case the currency basket regime leads to a smaller deviation of output than the EMU-peg regime (table 1). The signs of both deviations are positive.[4] The difference between the changes is $\theta\sigma_3/2\sigma = 1.5\theta$ (due to the competitiveness factor). In the R.2. case the basket peg regime again leads 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 is the same as before (competitiveness factor).

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

[4]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 result 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 2.)

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 notice that even then the currency basket exchange rate regime stabilizes the output of the small country the most against all foreign shocks studied. Floating is 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 foreign real income are lower, the basket regime stays the best according to this criterion, but the "EMU-peg regime" is now the second best in cases R.1., R.2. and M.1. Floating is the second best in case M.2. (For this alternative scenario, see appendix 3.)

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

2.8 Summary of chapter 2

In the case of domestic shocks the traditional Mundell-Fleming result was obtained: floating exchange rates insulate the output against goods demand shocks and fixed rates against monetary shocks.

In the big country model we noticed that a positive demand shock increases the output of both big countries by an equal amount independently of the origin of the shock (assuming symmetry of countries). An increase in the money supply, however, increases the output of the origin country but reduces the output of the other big country. The increase in the origin country is greater than the decrease in the other country. There is thus a net increase in the world output.

When we have a floating exchange rate in the small country, output of this country increases in the case of a positive foreign goods demand shock and decreases in the case of a corresponding monetary shock. The effect is independent of the origin of the shock.

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

Even if we do not get differences in signs for 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 is useful as such. By assuming symmetry of the parameters between all three countries we can 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 can 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 is the best in stabilizing the output of the small country against all foreign shocks considered.

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

Even if the numerical experiments conducted give more concreteness to the results of the theoretical model, they must be interpreted with caution. The parameter estimates used are rather rough. More sensitivity analysis with different parameter values is thus needed to increase the reliability of the experiments.

3 A THREE-COUNTRY MODEL WITH ENDOGENOUS PRICES

3.1 The structure of the model

The models for each country include again money market (LM) and goods market (IS) equilibrium conditions, and an interest rate parity condition, which means that nominal interest rates are equalized internationally through perfect capital mobility. Compared to the previous chapter the model differs in the way in which goods market behaviour is modelled. Previously output was demand determined and prices did not react to changes in demand; the model expressed thus the very short-term (Keynesian) behaviour of the economy. In this chapter supply reactions and changes in prices are also taken into account by adding a supply curve (equations (49), (53) and (56)) into each country model. The goods market equilibriums are now expressed with two equations: the goods demand equations ((48), (52) and (55)) and the above-mentioned supply equations.

Endogenizing prices in this model version serves to shed light on the impacts of changes in relative prices and of supply reactions. The model does not fully include the effects of inflation, because no distinction has been made between nominal and real interest rates (ex ante). The interest rate parity condition is also formulated according to static exchange rate expectations, i.e. exchange rates are assumed to be the same in the future as they are today. Equations (50) and (57) express thus a version of the real interest rate parity condition.

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

Country 1 ("the USA")

$$(47)\quad m_1 - p_1 = k_1y_1 - \Phi_1i_1$$
$$(48)\quad y_1 = -\mu_1r_1 + \sigma_{12}(e + p_2 - p_1) + \epsilon_{12}y_2 + f_1$$
$$(49)\quad p_1 = \alpha_1(e + p_2) + \beta_1y_1 - s_1$$
$$(50)\quad i = i_1 = i_2 = r_1 = r_2 \text{ (common to countries 1 and 2)}$$

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

$$(51)\quad m_2 - p_2 = k_2y_2 - \Phi_2i_2$$
$$(52)\quad y_2 = -\mu_2r_2 - \sigma_{21}(e + p_2 - p_1) + \epsilon_{21}y_1 + f_2$$
$$(53)\quad p_2 = \alpha_2(p_1 - e) + \beta_2y_2 - s_2$$

Country 3 ("Finland")

$$(54)\quad m_3 - p_3 = k_3y_3 - \Phi_3i_3$$
$$(55)\quad y_3 = -\mu_3r_3 + \sigma_3[\theta(e_{31} + p_1 - p_3) + (1 - \theta)(e_{32} + p_2 - p_3)] + \epsilon_3[\theta y_1 + (1 - \theta)y_2] + f_3$$
$$(56)\quad p_3 = \alpha_3[\theta(e_{31} + p_1) + (1 - \theta)(e_{32} + p_2)] + \beta_3y_3 - s_3$$
$$(57)\quad i = i_1 = i_2 = i_3 = r_1 = r_2 = r_3.$$

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 = elasticity of goods demand with respect to relative prices ("competitiveness elasticity"), 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 real income, α = the elasticity of domestic prices with respect to foreign prices, β = the elasticity of prices with respect to domestic output, f =

exogenous goods demand shock, s = exogenous price shock ("productivity shock"), e_{31} and e_{32} = prices of the currencies of country 1 and country 2 in terms of the currency of country 3, respectively. Additionally, relative prices ("competitiveness") 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 as defined above are non-negative. We also assume that $0 < \epsilon_1, \epsilon_2, \epsilon_3 < 1$ and $0 \leq \theta \leq 1$.

The countries are assumed to produce tradeable goods which can be somewhat different as aggregates. This difference is reflected in the values of σ:s. The purchasing power parity condition (PPP) is not required in the model. The PPP holds only if $\alpha_1 = \alpha_2 = \alpha_3 = 1$ and $\beta_1 = \beta_2 = \beta_3 = 0$. The form in which the interest rate parity condition is written implies that the assets of different countries are assumed to be perfect substitutes. It implies also that the agents are on average risk neutral.

In the big country model y_1, y_2, p_1, p_2, e and $i_1=i_2$ are endogenous variables. In the small country model y_3 and p_3 are endogenous, and in the floating exchange rate regime also 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, for example $e_{31} = e_{32} - e$. In the currency basket exchange rate regime the bilateral exchange rates change according to the trade weights so that the effective (trade-weighted) exchange rate remains constant. In the case of an exchange rate union, the exchange rate of the small country is the same as that of country 2.

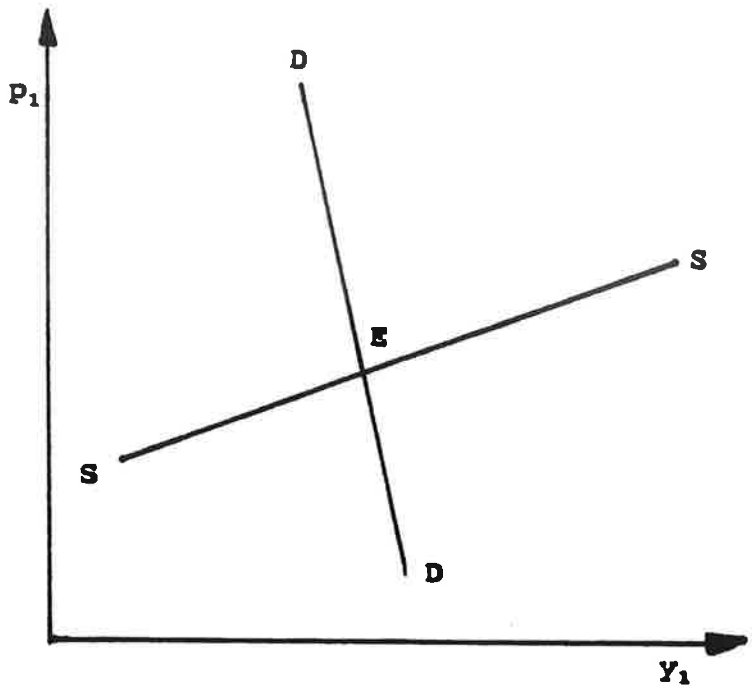
The ideas behind the money market equilibrium condition and the goods demand equation are straightforward. The supply curve might need some clarification. When solved in terms of y_1, we can write the supply curve for country 1 as follows:

$$(49)' \quad y_1 = (1/\beta_1)p_1 - (\alpha_1/\beta_1)(p_2 + e) + (1/\beta_1)s_1.$$

The supply of the domestic good thus responds positively to an increase in its own price, and negatively to an increase in the price of the foreign good, which is assumed to be used in consumption and as an input in the production process. The negative response of output to increases in foreign prices can be interpreted as a reaction to rising prices of foreign inputs and as a reaction to increasing wages due to rising consumer prices. The firms are assumed to follow a mark-up pricing practice. The response of wages and prices, and accordingly of production, is assumed to be symmetric, i.e. they react similarly to an increase and to a decrease in foreign prices. The exogenous shock s_1 is written in the equation as a positive one, which can be interpreted to be, for example, an exogenous increase in the productivity.

The goods market equilibrium is presented in the following figure for country 1 with respect to output and domestic prices. The supply curve is denoted by SS and the demand curve by DD. The equilibrium is attained at point E. An increase in domestic prices thus increases supply and decreases demand.

Figure 3. Goods market equilibrium in country 1



In the previous chapter rather clearcut results for the big countries were obtained with a model where countries were symmetric, prices were fixed and supply was assumed to be perfectly elastic. When comparing the effects of foreign shocks on the small economy in different exchange rate regimes, we already had to use numerical calculations to some extent, especially to make a distinction between the exchange rate union and the currency basket regime.

After adding a rising supply curve, we are no longer able to draw *a priori* conclusions from the changes in the endogenous variables in the big country model either - the model is too complicated. Some conclusions can, however, be obtained when we give extreme values (0 or 1) for certain key parameters. About the effects of foreign shocks on the small economy *a priori* conclusions can be drawn concerning the relative post-shock output levels assuming that the pre-shock outputs are the same in different exchange rate regimes. The signs of the changes, and so the deviations from zero, are, however, dependent on the parameter values. We must therefore rely on numerical calculations of the equilibrium values of the model. When using this kind of a solution method also sensitivity analyses with various alternative numerical values of the parameters are necessary. In the case of domestic shocks in the small country, a *priori* results can, however, be obtained.

We assume again throughout the chapter that the big countries are symmetric. We thus denote these parameters without a subscript. The smallness of the third country normally implies higher values for the elasticities with respect to foreign demand and relative prices than for the big countries.

When studying the effects of shocks originating in the big countries, we use the following numerical values for the parameters in the baseline scenario:

<u>common parameters:</u>

$k = k_1 = k_2 = k_3 = 0.67$, $\Phi = \Phi_1 = \Phi_2 = \Phi_3 = 0.46$,

$\mu = \mu_1 = \mu_2 = \mu_3 = 0.2$, $\beta = \beta_1 = \beta_3 = \beta_3 = 0.3$

<u>big country parameters:</u>

$\sigma = 0.1$, $\epsilon = 0.3$, $\alpha = 0.1$

<u>small country parameters:</u>

$\sigma_3 = 0.3$, $\epsilon_3 = 0.6$, $\alpha_3 = 0.3$, $\theta = 0.3$.

The parameters have the same values as before in chapter 2. The αs and βs are "new" parameters. The numerical values presented above are assumed to reflect rather short-term relationships between the variables. Money demand coefficients with respect to income and interest rates are adopted from Kremers and Lane (1990). These values are estimated for the EMS countries as an aggregate, but they are used as an approximation for all countries. In reality these parameter values differ between countries, but because they differ in reality also in time and because the main point in the study is comparing the systemic differences between exchange rate regimes, abstracting from the differences seems legitimate. When comparing the exchange rate union and the currency basket regime, the possibly differing money demand elasticities of the small economy are irrelevant. In these regimes the money supply is fully elastic, when capital is mobile; the LM curve of the small country can thus be omitted.

The rest of the parameter values are determined on the basis of econometric studies for the Finnish economy, for example on the basis of the econometric model of The Research Institute of the Finnish Economy (ETLA) (Vartia, 1974; see also the references on pp. 23 and 34). Because most of the parameter estimates needed do not have a direct counterpart in the studies, the values adopted must be considered more or less as "guesstimates". The values of σ, ϵ and α are between one third and a half of the small country parameters (in the EC countries about one third of foreign trade occurs with non-EC countries).

3.2 Domestic shocks in the small country

In the model framework used we cannot make a distinction between the exchange rate union and the currency basket regime in the case of domestic shocks. The regimes are both fixed exchange rate regimes. A distinction can be made, for example, in models where the regimes are assumed to differ in terms of the degree of fixity and accordingly in terms of the credibility of the peg. These aspects are neglected at this stage of the study. In the following we confine ourselves to comparing the effects of domestic shocks in the floating and fixed exchange rate regimes.

In the case of a domestic goods demand shock occurring in the small country 3 (change in f_3 in equation (55)), output, prices and exchange rates change in the floating rate regime as follows:

$$(58)\ \frac{\delta y_3}{\delta f_3}=\frac{\alpha_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3}$$

$$(59)\ \frac{\delta e_3}{\delta f_3}=\frac{-\beta_3-k_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3}$$

$$(60)\ \frac{\delta p_3}{\delta f_3}=-\frac{\alpha_3k_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3}.$$

It is obvious for relevant values of the parameters that the denominator of the above-mentioned multipliers is positive. Positiveness is guaranteed when $\alpha_3 \leq 1$, which we can take for granted. A positive domestic demand shock thus increases output, spurs an appreciation of the exchange rate and lowers prices accordingly (because of the appreciation). Output is insulated only when $\alpha_3 = 0$; this case corresponds to the result obtained in the traditional fixed-price Mundell-Fleming model (see section 2.2.).

In the fixed exchange rate regime we drop the LM curve from the small country model, because the money supply is perfectly elastic when capital is fully mobile and there is no uncertainty about the level of the exchange rate. We have now two endogenous variables, output and prices, the changes of which are as follows:

$$(61)\ \frac{\delta y_3}{\delta f_3} = \frac{1}{1+\beta_3\sigma_3}$$

$$(62)\ \frac{\delta p_3}{\delta f_3} = \frac{\beta_3}{1+\beta_3\sigma_3}.$$

In the fixed rate regime both output and prices increase after a positive real shock.

For values $\alpha_3 < 1$ it can be shown a *priori* that output changes less in the floating rate regime than in the fixed rate regime. If $\alpha_3 = 1$, i.e. domestic prices adjust fully to changes in foreign prices, there is no difference between the exchange rate regimes with respect to the output reaction. This implies the traditional result that floating insulates the output better in the short run against domestic real shocks than fixed rates, and that fiscal policy is less efficient in the floating rate regime than in the fixed rate regime. The short run means here a period during which domestic prices have not adjusted fully to changes in the exchange rate.

The results concerning the stabilization of prices are not as clearcut. Relative changes in prices depend more on the relative magnitudes of parameter values. If k_3 (the income elasticity of money demand) is high relative to β_3 (the responsiveness of prices to changes in output) fixed rates stabilize prices better than floating, and the other way round. Additionally, the less open the economy is, i.e. the smaller α_3 is, the smaller is the change in prices in the floating rate regime.

In the case of <u>a domestic monetary shock</u> (money supply or money demand shock) we obtain the following results in the floating rate regime:

$$(63)\ \frac{\delta y_3}{\delta m_3}=\frac{\sigma_3-\alpha_3\sigma_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3}$$

$$(64)\ \frac{\delta e_3}{\delta m_3}=\frac{1+\beta_3\sigma_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3}$$

$$(65)\ \frac{\delta p_3}{\delta m_3}=\frac{\alpha_3+\beta_3\sigma_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3}\ .$$

The denominator of the multipliers is the same as in the case of a demand shock, and thus positive in the relevant cases. We can now conclude that an increase in the money supply (or, correspondingly, a decrease in the demand for money) leads to an increase in the output if $\alpha_3 < 1$. If $\alpha_3 = 1$, the output remains unchanged, i.e. the neutrality-of-money result is obtained. We can also conclude for relevant values of the parameters that the exchange rate depreciates and prices increase as a result of the above-mentioned shock.

In the fixed exchange rate regime the domestic money supply or demand shocks have no effect on the output or prices. International capital flows mitigate immediately any efforts to influence the domestic output through monetary policy. This is analogous to the result obtained in the traditional fixed-price Mundell-Fleming models.

If there is a domestic productivity shock we obtain the following changes in the floating rate regime:

$$(66)\ \frac{\delta y_3}{\delta s_3}=\frac{\sigma_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3 k_3\sigma_3}$$

$$(67)\ \frac{\delta e_3}{\delta s_3}=\frac{1-k_3\sigma_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3 k_3\sigma_3}$$

$$(68)\ \frac{\delta p_3}{\delta s_3}=-\frac{k_3\sigma_3}{\alpha_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3 k_3\sigma_3}.$$

The denominator is again the same as above so we can assume that it is positive. A positive productivity shock increases output and decreases domestic prices. The exchange rate depreciates in the short run, because we can assume that $k_3\sigma_3 < 1$. The depreciation is due to the excess supply of real balances when the price level decreases.

The result obtained above is crucially dependent on the assumption of an unchanged money supply. If the money supply adjusts fully to changes in the domestic price level, the output remains unchanged. For the other endogenous variables we get the following results:

$$(69)\ \frac{\delta p_3}{\delta s_3}=\frac{\delta e_3}{\delta s_3}=\frac{\delta m_3}{\delta s_3}=\frac{1}{-1+\alpha_3}$$

Prices, exchange rates and the money supply thus change by an equal amount. This kind of a money supply rule can be followed if α_3 (the response of domestic prices to changes in the exchange rate) is rather small. If it approaches the value 1, the rule leads to an exploding path of prices and exchange rates.

In a fixed rate regime a domestic productivity shock leads to the following changes in the output and prices:

$$(70)\ \frac{\delta y_3}{\delta s_3}=\frac{\sigma_3}{1+\beta_3\sigma_3}>0$$

$$(71)\ \frac{\delta p_3}{\delta s_3}=-\frac{1}{1+\beta_3\sigma_3}<0.$$

When compared to a floating rate regime <u>with no changes in the money supply</u>, the fixed rate regime leads to a smaller change in output if $\alpha_3 < 1$ and if $k_3\sigma_3 < 1$, which obviously holds at least in the short run. If $\alpha_3 = 1$, there is no difference between the regimes in this respect. <u>When the money supply responds</u> wholly to changes in the price level, floating rates insulate the domestic output, but this kind of a policy is obviously not possible in the longer run when α_3 increases.

3.3 Goods demand shocks in the big countries

3.3.1 Shocks occurring in country 1

3.3.1.1 Effects on the big countries

In the model with fixed prices we obtained the following *a priori* results in the case of a (positive) goods demand shock occurring in country 1: (1) outputs of both countries increase by the same amount (assuming symmetry), (2) the competitiveness of country 1 deteriorates because its currency appreciates, and (3) interest rates in both countries increase (chapter 2, pp. 14-16).

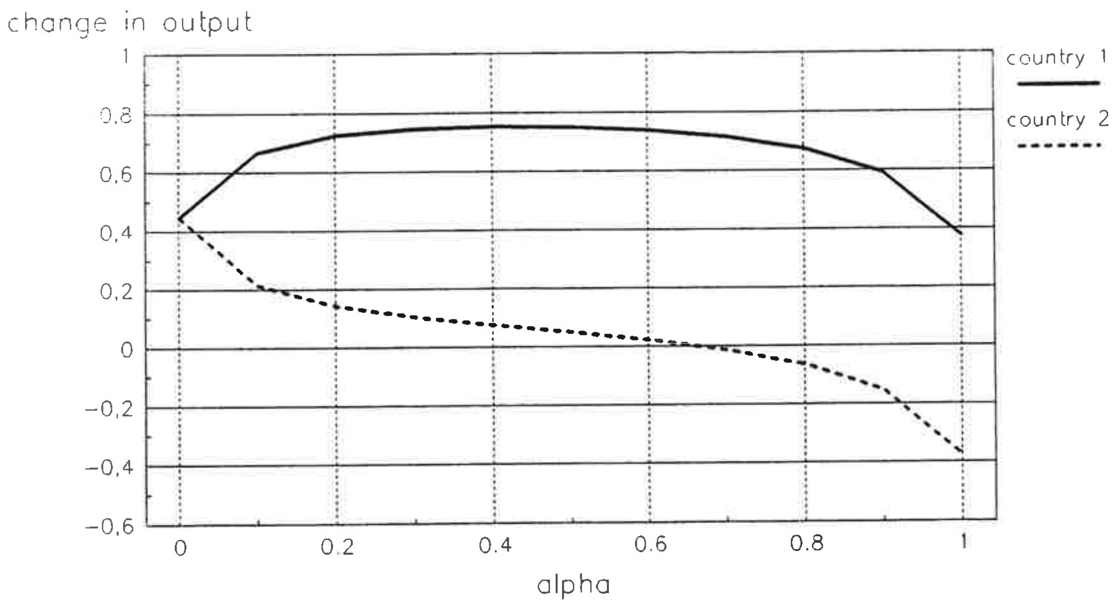
In the case of variable prices we get now the following results for the big countries when using the parameter values of the baseline scenario as described on page 56:

$$\delta y_1/\delta f_1 = 0.667, \qquad \delta y_2/\delta f_1 = 0.213$$
$$\delta e/\delta f_1 = -2.354, \qquad \delta i/\delta f_1 = 0.960$$
$$\delta p_1/\delta f_1 = -0.005, \qquad \delta p_2/\delta f_1 = 0.299.$$

A debt-financed expansive fiscal policy or some other exogenous demand shock thus increases the output of the home country more than that of the other big country, boosts the exchange rate, increases the global interest rate, and raises the price level of country 2. These kinds of price changes are due to changes in the exchange rate. In country 1 the appreciation of the exchange rate slows down the pressure on prices, so that the price level remains almost unchanged. In country 2 the depreciation reinforces the price increases.

The breakdown of the symmetry result in the case of output changes is due to the parameter α, while the response of domestic prices and output supply is due to foreign trade prices. This can be seen in the following sensitivity analysis (other parameter values except those of α are the same as in the baseline scenario) (figure 4). In a one-country model an increase in α can be presented as an upward shift of the SS curve in figure 3 (p. 55).

Figure 4. Goods demand shock in country 1: sensitivity of output reactions with respect to α in the big countries



When there is no response to foreign prices (α = 0), the symmetrical result is established, even if output supply reacts to domestic prices (β = 0.3). At the other extreme, when domestic prices are assumed to respond fully to foreign trade prices ($\alpha = 1$), the output of country 2 decreases as much as that of country 1 increases. This result can be shown *a priori*, too, for positive values of the parameters:

$$(72)\ \frac{\delta y_1}{\delta f_1} = \frac{1}{2(1+e+\beta\sigma)} \quad ,\text{when } \alpha = 1$$

$$(73)\ \frac{\delta y_2}{\delta f_1} = \frac{-1}{2(1+e+\beta\sigma)} \quad ,\ \text{when } \alpha = 1,$$

In the baseline scenario the assumption of $\alpha = 0.1$ is motivated by the import content of domestic final demand based on input-output calculations. The idea behind this assumption is that domestic producers are assumed to follow a kind of mark-up pricing. The inflationary process that possibly follows is thus not taken into account.

3.3.1.2 Effects on the small country

Even if we are not able to compare *a priori* the <u>deviations</u> of economic variables, because we do not know the signs of the effects, we can compare the post-shock <u>levels</u>, as was the case in the previous chapter, too (pp. 25-27). Assuming that the output is in all exchange rate regimes at the same level before the shock, it can be shown that the exchange rate union leads to a higher output after a positive real shock occurring in country 1 than the basket regime. The difference between the output effects is as follows:

$$\frac{\delta y_3}{\delta f_1}(EMU\text{-}peg) - \frac{\delta y_3}{\delta f_1}(basket) = \frac{(1-\alpha_3)(\beta+k+\alpha k)\sigma_3\theta}{2(\alpha+\alpha\varepsilon+\beta\sigma+k\sigma-\alpha k\sigma)(1+\beta_3\sigma_3)}.$$

It can be shown that this formula is <u>positive</u> for values $0 \le \alpha \& \alpha_3 < 1$ and $\theta > 0$. If $\alpha_3 = 1$, $\sigma_3 = 0$ or $\theta = 0$, the formula is zero and there is no difference between the output effects in the exchange rate union and in the basket peg regime. The difference between the output effects in these regimes consists of the competitiveness effect and of the price effect through the supply side. If α, α_3, β and β_3 are all zero, we are back in the fixed price case, where the above-mentioned formula reduces to the difference in the exchange rate effect. When assuming symmetry between all three economies, it can additionally be shown that floating leads to an even higher post-shock output level than the union in the case of a positive shock. It must be assumed that $0 \le \alpha < 1$ and $0 \le \theta < 1$.

We next study the effects of the shock in the baseline numerical calculation. <u>In the floating rate regime</u> the shock leads to an increase in the output of the small country, to a rise in prices, to a depreciation of the effective exchange rate and, accordingly, to an improvement in the competitive position (=relative prices):

$$\delta y_3/\delta f_1 = 0.185,\ \delta p_3/\delta f_1 = 0.318,\ \delta c_3/\delta f_1 = 0.556.$$

The international rise in interest rates tends to lower output, but increasing export demand and improving competitiveness are strong enough to compensate for that effect. The currency of the small country depreciates in relation to the currency of country 1, but appreciates slightly in relation to that of country 2.

In the case of an exchange rate union the bilateral exchange rate with respect to the currency of country 2 is fixed, but that with respect to country 1 is floating. The effective exchange rate depreciates somewhat more than in the floating rate regime. The positive competitiveness effect on output is thus stronger. The changes in the output, prices and competitiveness are as follows:

$$\delta y_3/\delta f_1 = 0.192, \ \delta p_3/\delta f_1 = 0.332, \ \delta c_3/\delta f_1 = 0.582.$$

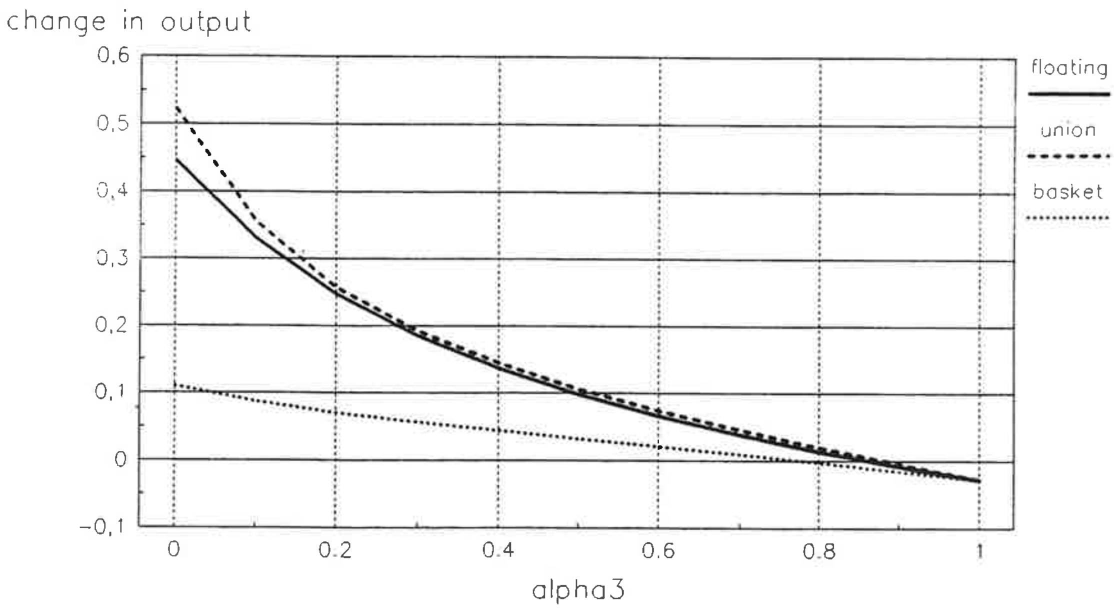
In the basket peg regime the effective (trade-weighted) exchange rate is stabilized. This leads to a rather small increase in competitiveness and domestic prices, and is also reflected in a smaller change in output than in the other exchange rate regimes considered. The multipliers are as follows:

$$\delta y_3/\delta f_1 = 0.056, \ \delta p_3/\delta f_1 = 0.079, \ \delta c_3/\delta f_1 = 0.179.$$

The conclusion that the currency basket exchange rate regime stabilizes the output more than the other two regimes holds for different values of α and α_3, too, as is seen in figure 5 on page 68. However, if $\alpha_3 = 1$, i.e. if domestic prices adjust wholly to foreign trade prices, there is no difference between the regimes in this respect. This is the same result which was obtained in the case of domestic shocks, too (page 58). The basket regime stabilizes also domestic prices better than the other regimes with the respective values of α and α_3. Floating is the second best.

The above-mentioned results apply to an economy where output is rather responsive to changes in competitiveness and foreign demand. In more closed real economies, with small values of σ, σ_3, ϵ and ϵ_3, the change in the interest rate can outweigh the effects of export demand so that a positive goods demand shock occurring in country 1 can lead to a decline of the small country's output in the currency basket regime. In this case it is possible in principle that the exchange rate union leads to a smaller change in output than the basket peg regime (appendix 6). (The situation is similar in the fixed-price case, see figure 2, p. 27 and appendix 2.)

Figure 5. Goods demand shock in country 1: sensitivity of output in the small country with respect to α and α_3 ($\alpha_3 = 3 * \alpha$)



In the case when $\alpha = \alpha_3 = 1$ the change in output in all exchange rate regimes is as follows (baseline calculation): $\delta y_3/\delta f_3 = -0.541$. The negative effect thus increases when α approaches 1. This is because the output effect of the shock on country 2 (the more important trading partner) becomes negative (see figure 4).

3.3.2 Shocks occurring in country 2

3.3.2.1 Effects on the big countries

Because of the assumption of symmetry between the big countries, the effects of a demand shock occurring in country 2 are the same as in the case when the shock originates in country 1 - the countries just change places. The results are as follows:

$\delta y_1/\delta f_2 = 0.213$, $\delta y_2/\delta f_2 = 0.667$
$\delta e/\delta f_2 = 2.354$, $\delta i/\delta f_2 = 0.960$
$\delta p_1/\delta f_2 = 0.299$, $\delta p_2/\delta f_2 = -0.005$.

A positive goods demand shock in country 2 increases the output of the home country more than that of the neighbouring country, raises the interest rate globally, and spurs an appreciation of the exchange rate of country 2. Because of the appreciation, the price level of the home country remains almost unchanged, whereas that of country 1 rises.

3.3.2.2 Effects on the small country

The difference between the post-shock output levels is the same as in the case when the shock occurs in country 1 (pages 65-66). Now, however, the basket peg regime leads to a higher output level than the exchange rate union. The deviation from zero is again dependent on the parameter values. In the case of symmetry between the economies it can be shown that floating leads to the highest post-shock output. (We must assume: $0 \leq \alpha < 1$, $0 < \epsilon < 1$ and $\theta < 1$.)

In the floating rate regime the effects of this shock are different from those of a shock occurring in country 1, because country 2 is assumed to be a more important trading partner than country 1. This result differs from that obtained with a fixed price model (chapter 2, pp. 28 and 46). The reason for this difference is that export demands from the big countries differ in this model version; in the fixed price model the outputs of both big countries change by an equal amount (see p. 14).

In the case of a shock occurring in country 2 the export demand of country 3 grows by more than when the shock occurs in country 1. According to the goods and money market equilibrium conditions the effective exchange rate of the small country depreciates also less in this case, and accordingly the domestic price level rises less. Also the improvement in competitiveness is smaller. The results of the baseline calculation are as follows:

$$\delta y_3/\delta f_2 = 0.246, \ \delta p_3/\delta f_2 = 0.277, \ \delta c_3/\delta f_2 = 0.399.$$

In the exchange rate union the effects of increasing export demand are almost completely compensated for by the increasing interest rate and the deteriorating competitiveness, which results from the appreciating effective exchange rate. The appreciation causes also a decrease in the domestic price level. The result differs from the effects occurring in country 2, in the respect that the real shock there is internal and affects demand directly. In the small country the increase in demand is indirect and smaller:

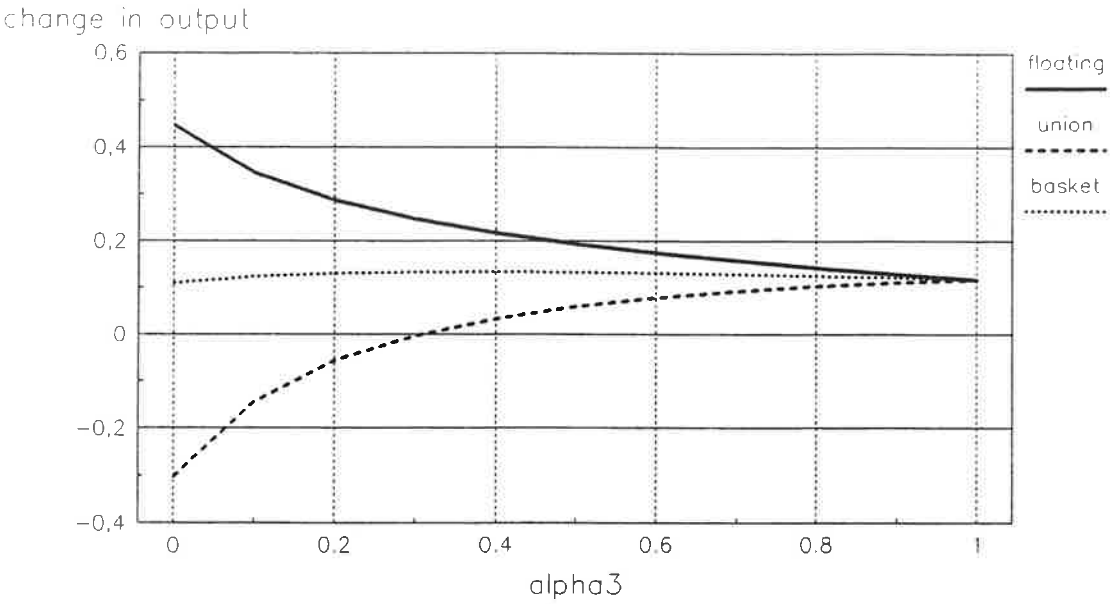
$$\delta y_3/\delta f_2 = -0.003, \ \delta p_3/\delta f_2 = -0.187, \ \delta c_3/\delta f_2 = -0.867.$$

In <u>the currency basket exchange rate regime</u> the effective exchange rate remains constant and again stabilizes prices and competitiveness better than the other regimes, but is exactly for this reason worse in stabilizing output than the exchange rate union. In the face of increasing export demand only the rising interest rate tends to offset the growth effect:

$$\delta y_3/\delta f_2 = 0.133,\ \delta p_3/\delta f_2 = 0.066,\ \delta c_3/\delta f_2 = 0.020.$$

The sensitivity of the output effects with respect to different values of α and α_3 is seen in figure 6. If the values of these parameters are very low, the currency basket regime still stabilizes the output the best. Nevertheless, as the parameter values grow, the changing import prices (due to the change in the effective exchange rate) soon make the change in output smaller in the union case. Thus, if there is a positive goods demand shock in country 2, the appreciating exchange rate in the case of the union reduces import prices and increases the output through the supply channel. The currency basket regime stabilizes the output more than the floating regime for all values of $\alpha_3 < 1$. In the case when $\alpha_3 = 1$, there is no difference between the regimes with respect to output stabilization.

Figure 6. Goods demand shock in country 2: sensitivity of output in the small country with respect to α and α_3 ($\alpha_3 = 3 * \alpha$)



In the case when $\alpha = \alpha_3 = 1$ the change in the output of country 3 is in all exchange rate regimes as follows (baseline calculation): $\delta y_3/\delta f_2 = -0.376$. The output changes thus by less than in the case when the shock occurs in country 1. This is because the dominating negative effects are now partly compensated for by the positive export demand effect due to the larger foreign trade share of country 2. When the shock occurs in country 1, the export demand effect is negative.

As expected, the currency basket regime is again the best in stabilizing domestic prices with all relevant values of α and α_3. The exchange rate union is now the second best alternative, and floating the worst in this respect.

In an alternative calculation (presented in appendix 6), where all economies respond less to changes in competitiveness and foreign demand, a real shock occurring in country 2 leads to a greater decline in output in the exchange rate union than in the baseline calculation. (The interest rate sensitivity of aggregate demand is the same in both calculations.) This result is due to the smaller positive effect of foreign demand and due to the greater negative exchange rate effect - because the exchange rate of country 2 appreciates more than in the baseline calculation. When output reacts less to changes in the exchange rate, a greater change in it is needed to restore equilibrium. In this alternative calculation, when the real sectors of the economies are rather closed, the basket regime leads to the smallest change in output.

3.4 Monetary shocks in the big countries

3.4.1 Shocks occurring in country 1

3.4.1.1 Effects on the big countries

In the case of a money supply shock, or equivalently of a money demand shock with the opposite sign, the endogenous variables change in the following way in the baseline calculation:

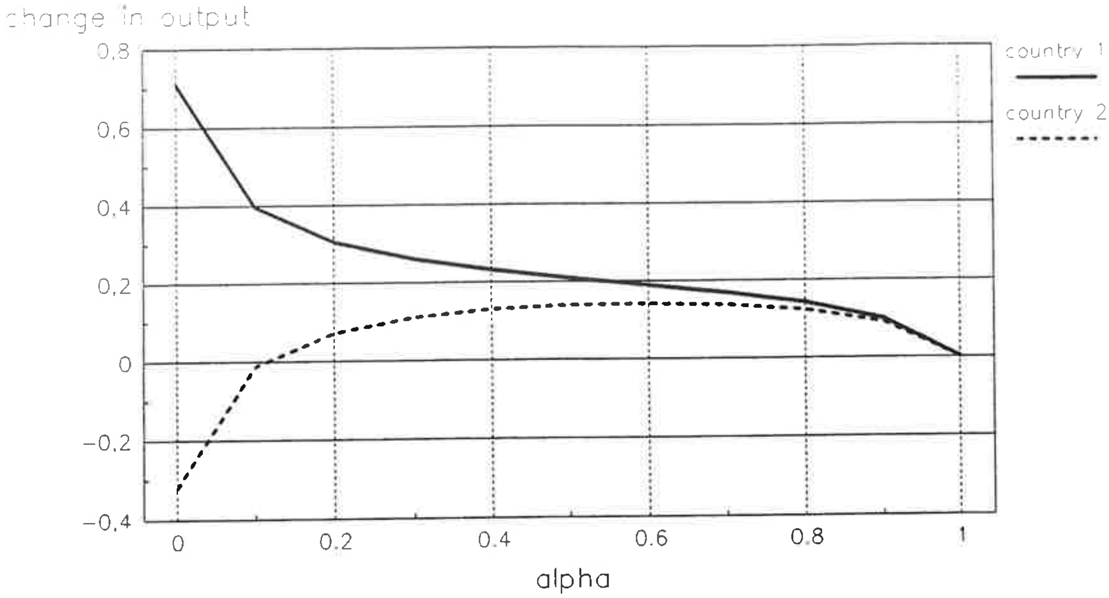
$$\delta y_1/\delta m_1 = 0.396, \qquad \delta y_2/\delta m_1 = -0.013$$
$$\delta e/\delta m_1 = 3.382, \qquad \delta i/\delta m_1 = -0.670$$
$$\delta p_1/\delta m_1 = 0.427, \qquad \delta p_2/\delta m_1 = -0.299.$$

If the monetary shock is an increase in the money supply (or equivalently a decrease in money demand) the output of country 1 increases, whereas that of country 2 remains about unchanged. The exchange rate of country 1 depreciates, and the global interest rate decreases. The depreciation and the increase in output lead to a rise in the price level of country 1. In country 2 the opposite movements of these variables lead to a decrease in prices.

When looking at the following figure 7, we notice that the beggar-thy-neighbour result is obtained when the value of α is low, but when α increases somewhat above 0.1 the output of country 2 increases, too. This is because of the supply effect of decreasing import prices in country 2. The effects of the shock on the two countries approach each other when α grows. When $\alpha = 1$ the neutrality-of-money result is established for both countries. This is a general result, which holds for all positive values of the other parameters.

Even in the case of $\alpha = 0$ (and $\beta = 0.3$), the increase in output of country 1 is greater than the decrease in the output of country 2. This is the same result that was obtained in the model with fixed prices. Monetary policy is thus not a zero-sum game worldwide in terms of output changes when $0 \leq \alpha < 1$. There is, however, a net increase in the international price level with all values of α from 0 to 1.

Figure 7. Monetary shock in country 1: sensitivity of output reactions with respect to α in the big countries



3.4.1.2 Effects on the small country

It can be shown *a priori* that the basket peg regime leads to a higher post-shock output level in the case of a positive shock if the pre-shock output level is assumed to be the same in different exchange rate regimes. The difference between the output effects is as follows:

$$\frac{\delta y_3}{\delta m_1}(EMU\text{-}peg) - \frac{\delta y_3}{\delta m_1}(basket) = \frac{(\alpha_3 - 1)(1+\alpha+\epsilon+\alpha\epsilon+2\beta\sigma)\sigma_3\theta}{2(\alpha+\alpha\epsilon+\beta\sigma+k\sigma-\alpha k\sigma)(1+\beta_3\sigma_3)}.$$

When assuming $0 \leq \alpha \& \alpha_3 < 1$ and $0 < \theta \leq 1$, the formula is negative. This formula, like that in the case of real shocks, consists of differences in the competitiveness and price effects. If $\alpha = \alpha_3 = \beta = \beta_3 = 0$, only the difference in the exchange rate effect is left, and the formula reduces to the same as that obtained in the fixed price model (chapter 2, p. 37). In the case of symmetry between all economies it can be shown that floating leads to the lowest post-shock output level when the shock is positive - assuming that the pre-shock output levels are the same in all regimes. It must be assumed that $0 \leq \theta < 1$, $\epsilon < 1$ and $0 \leq \alpha < 1$.

In the baseline calculation the change in foreign demand is rather modest, because in the most important trading partner, country 2, the change in output is small. If there is a positive money supply shock, the export demand, however, increases. The decreasing international interest rate is another factor which tends to increase the output of the small country.

In the floating rate regime the effective exchange rate of country 3 appreciates and leads to a worsening of competitiveness, but also to a fall in the price level. Even if the decreasing import prices tend to increase the domestic output, the competitiveness effect is big enough to reduce the growth of output to about zero:

$$\delta y_3/\delta m_1 = -0.009,\ \delta p_3/\delta m_1 = -0.302,\ \delta c_3/\delta m_1 = -0.758.$$

In the exchange rate union the appreciation of the effective exchange rate is somewhat greater than in the case of floating rates. This leads to decreasing import prices, but also to deteriorating competitiveness. The net effect is a bit greater decrease in output than in the floating rate regime. The change is, however, close to zero:

$$\delta y_3/\delta m_1 = -0.028,\ \delta p_3/\delta m_1 = -0.337,\ \delta c_3/\delta m_1 = -0.696.$$

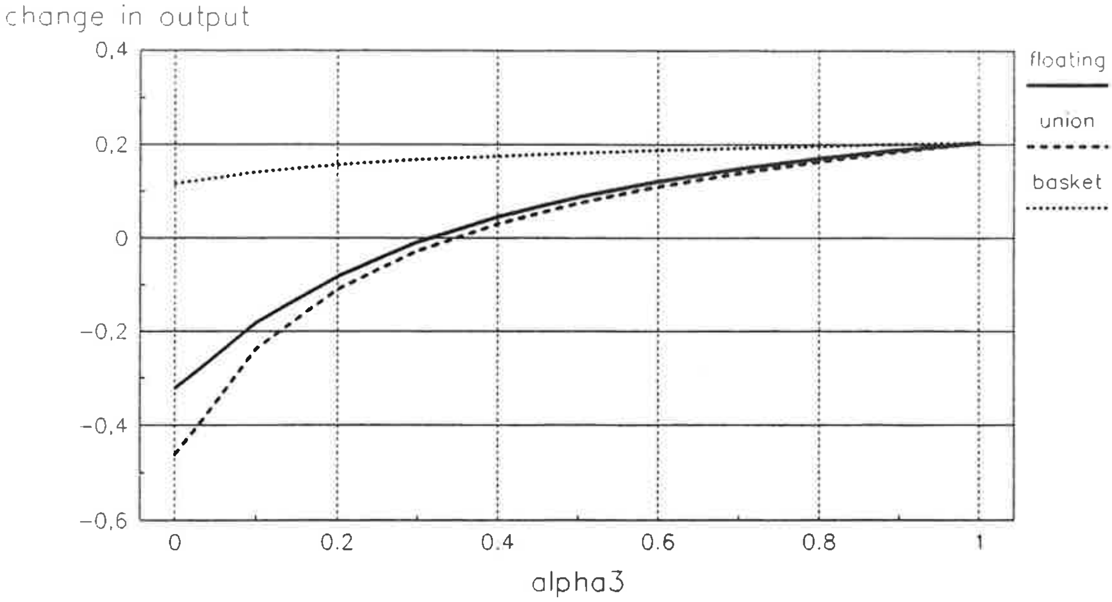
In the <u>currency basket exchange rate regime</u> the positive effects due to export demand and interest rates are only slightly compensated for by the negative change in competitiveness. Because the effective exchange rate is stabilized, the effect comes through changes in prices. The change in output is greater than in the cases of floating and the exchange rate union:

$$\delta y_3/\delta m_1 = 0.168,\ \delta p_3/\delta m_1 = 0.026,\ \delta c_3/\delta m_1 = -0.108.$$

The output reactions in the floating rate regime and in the exchange rate union are very similar with different values of α and α_3 (figure 8). Changes in output are greater in these regimes than in the basket peg regime when the values of α and α_3 are very low. Nevertheless already with modest values of these parameters the change becomes smaller. This is due to the strengthening supply effect of import prices. The basket regime again stabilizes domestic prices the best with all values of α and α_3 considered, floating is the second best in this respect and the union the worst.

In the alternative calculation, presented in appendix 6, the ranking of the regimes according to the change in output does not change. The result is thus not very sensitive to competitiveness and foreign demand elasticities.

Figure 8. Monetary shock in country 1: sensitivity of output in the small country with respect to α and α_3 ($\alpha_3 = 3 * \alpha$)



When $\alpha = \alpha_3 = 1$, there is no change in the output of country 3 in any of the regimes. This is due to the neutrality-of-money effect in the big countries.

3.4.2 Shocks occurring in country 2

3.4.2.1 Effects on the big countries

In the case of a monetary shock originating in country 2 the effects on the big countries are again the mirror image of a shock originating in country 1. The countries change places. In the baseline calculation the results are as follows:

$$\delta y_1/\delta m_2 = -0.013, \qquad \delta y_2/\delta m_2 = 0.396$$
$$\delta e/\delta m_2 = -3.382, \qquad \delta i/\delta m_2 = -0.670$$
$$\delta p_1/\delta m_2 = -0.299, \qquad \delta p_2/\delta m_2 = 0.427.$$

The output of country 2 increases, that of country 1 remains almost unchanged, the exchange rate of country 2 depreciates and the global interest rate falls. The price level of country 2 increases and that of country 1 decreases. The sensitivity analysis with respect to α is also the mirror image of that presented in figure 7.

3.4.2.2 Effects on the small country

From the small country's point of view there is a difference between the shocks originating in countries 1 and 2, because country 2 is assumed to be a more important trading partner than country 1. Export demand thus changes more when the shock occurs in country 2. The change in the interest rate is the same, because the big countries are assumed to be symmetric.

It can be shown *a priori* that the exchange rate union leads to a higher post-shock output than the basket regime after a positive shock, assuming that the pre-shock levels are the same in different exchange rate regimes. The difference is the same as in the case of a monetary shock occurring in country 1, but the ranking between the regimes is the opposite. The position of the floating rate regime cannot be shown *a priori*, not even in the case of symmetry.

In the floating rate regime the effects of changes in export demand and interest rates are compensated for by opposite effects of changes in the effective exchange rate and competitiveness. If there is a positive monetary shock in country 2, the effective exchange rate of country 3 appreciates and competitiveness deteriorates:

$$\delta y_3/\delta m_2 = 0.025,\ \delta p_3/\delta m_2 = -0.254,\ \delta c_3/\delta m_2 = -0.348.$$

In the exchange rate union the reactions of the effective exchange rate and, accordingly, of competitiveness reinforce the impacts of the shock. In the case of a positive monetary shock in country 2 increasing export demand, declining interest rates and improving competitiveness all tend to increase the output of country 3:

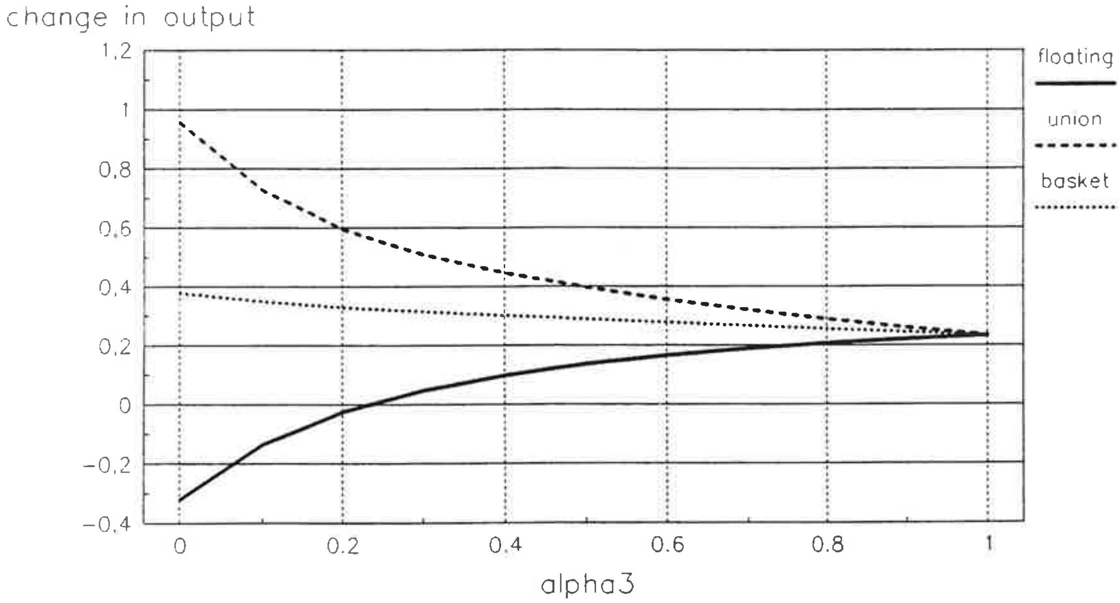
$$\delta y_3/\delta m_2 = 0.509,\ \delta p_3/\delta m_2 = 0.520,\ \delta c_3/\delta m_2 = 0.704.$$

In the currency basket exchange rate regime trade-weighted relative prices (= competitiveness) remain almost constant and the change in output is due to changes in export demand and interest rates:

$$\delta y_3/\delta m_2 = 0.313,\ \delta p_3/\delta m_2 = 0.157,\ \delta c_3/\delta m_2 = 0.052.$$

The sensitivity analysis with respect to α and α_3 is presented in figure 9. Floating stabilizes the output the most already with zero values of α and α_3. In the fixed price model of the previous chapter the basket regime is somewhat better than floating in the case of this shock, too. The output reaction with respect to domestic prices according to $\beta_3 = 0.3$ in the model of the current chapter is the reason for this difference. The currency basket regime stabilizes the ouput more than the exchange rate union with all values of $\alpha_3 = 3 * \alpha$ up to 1, where there is no difference between the regimes. The better performance of the basket peg regime is due to the "shock reinforcing" change of the exchange rate in the exchange rate union. The basket regime is again the best in stabilizing domestic prices, except when $\alpha_3 = \alpha = 0$. In this case floating is the best. The exchange union is for all values of $\alpha_3 = 3 * \alpha$ the worst in this respect. The results are not sensitive to the values of competitiveness and foreign demand elasticities (appendix 6).

Figure 9. Monetary shock in country 2: sensitivity of output in the small country with respect to α and α_3 ($\alpha_3 = 3 * \alpha$)



When $\alpha = \alpha_3 = 1$, the neutrality-of-money effect (no change in the output of country 3) holds, as in the case when the shock occurs in country 1.

3.5 Productivity shocks in the big countries

3.5.1 Shocks occurring in country 1

3.5.1.1 Effects on the big countries

We assume that there is a supply shock in country 1 due to, for example, a change in productivity. This shock is presented in the supply curve as variable s. An increase in s results from an exogenous decline in domestic costs and is reflected in declining prices and increasing supply of goods (equation (49)' on page 55). A decrease in s results in the opposite reaction. Graphically an increase in s can be presented as a downward shift of the SS curve in figure 3 on page 55.

In this version of the model a change in s does not lead to any change in monetary policy. This can be rationalized, for example, by the difficulty to notice shocks, by the sluggish reaction of monetary policy, or by the difficulties to form a realistic money supply rule. (See pages 62-63 about the effects of a money supply rule in the case of a domestic supply shock occurring in the small country.) The neglect of any money supply reaction implies that the effects must be interpreted to be short-term.

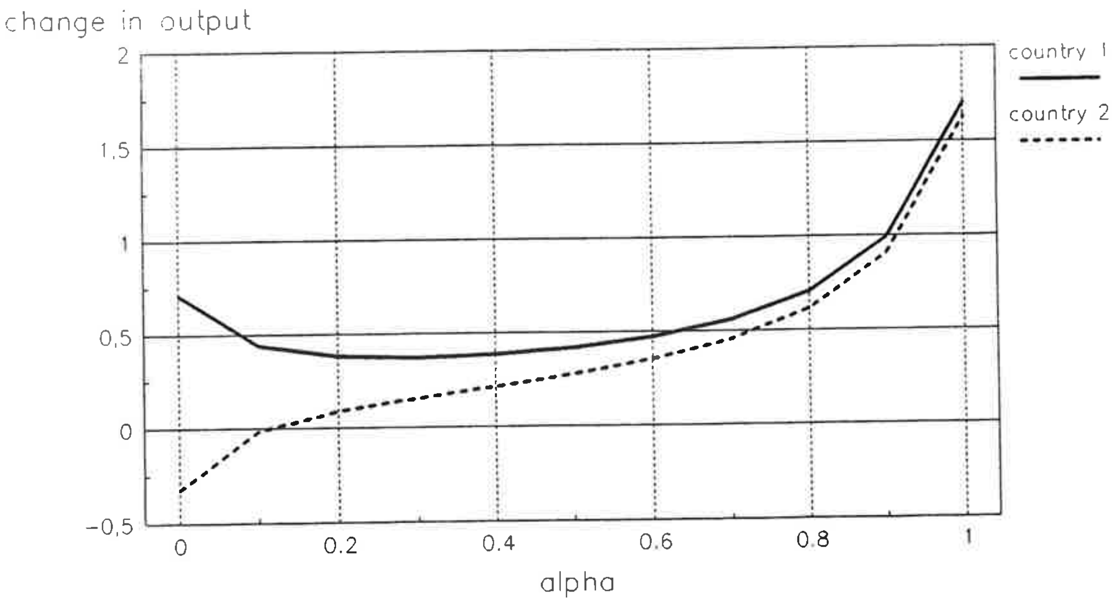
In this kind of a model an exogenous decline in domestic prices (a positive supply shock) leads in the baseline calculation to the following results:

$$\delta y_1/\delta s_1 = 0.440, \qquad \delta y_2/\delta s_1 = -0.014$$
$$\delta e/\delta s_1 = 2.646, \qquad \delta i/\delta s_1 = -0.744$$
$$\delta p_1/\delta s_1 = -0.637, \qquad \delta p_2/\delta s_1 = -0.333.$$

Output of country 1 increases after the shock and that of country 2 decreases slightly. The interest rates also decline globally. Because the money supply does not react to the change in prices, there is an excess supply of real balances, which leads to a depreciation of the currency of country 1. This reinforces the increase in output of this country. The price level falls in both countries, but more in country 1, where the shock originates.

In the case where the reaction of domestic prices to import prices (α) is small, the output of country 2 decreases. When this reaction is stronger, the output of country 2 increases, too. (Figure 10.)

Figure 10. Productivity shock in country 1: sensitivity of output reactions with respect to α in the big countries



When $\alpha = 1$, it can be shown *a priori* that the outputs of both big countries increase, with the increase in country 1 being higher than that in country 2:

$$(74)\ \frac{\delta y_1}{\delta s_1} = \frac{1+\epsilon+2\beta\sigma}{2\beta(1+\epsilon+\beta\sigma)} > 0,$$

$$(75)\ \frac{\delta y_2}{\delta s_1} = \frac{1+\epsilon}{2\beta(1+\epsilon+\beta\sigma)} > 0.$$

3.5.1.2 Effects on the small country

When the supply shock occurs in country 1, the export demand of the small country does not change very much when the value of α is low, because the output of the more important trading partner (country 2) remains almost unchanged. In the case of a positive shock declining international interest rates tend to increase the output of the small country. Basically the effects on output are very similar to those of monetary shocks. This is natural, because in both cases there is a change in real money balances in the country where the shock originates.

It can again be shown *a priori* (under the assumptions presented below) that the post-shock output is lower in the exchange rate union than in the basket regime given that the pre-shock output is at the same level. This can be seen from the following expression:

$$\frac{\delta y_3}{\delta s_1}(EMU\text{-}peg) - \frac{\delta y_3}{\delta s_1}(basket) = \frac{(\alpha_3-1)(1+\epsilon-2k\sigma)\sigma_3\theta}{2(\alpha+\alpha\epsilon+\beta\sigma+k\sigma-\alpha k\sigma)(1+\beta_3\sigma_3)},$$

which is negative if $0 \leq \alpha \& \alpha_3 < 1$, $\theta > 0$ and $\epsilon > 2k\sigma - 1$. The two first-mentioned conditions are obvious. Because σ (the "competitiveness elasticity" in the big countries) is rather small (clearly less than 0.5), the last mentioned condition holds even if $k = 1$. For floating this kind of a ranking cannot be shown - even in the case of symmetry.

In <u>the floating rate regime</u> output remains almost unchanged in the baseline calculation. The effects of export demand and interest rates are offset by the change in the effective exchange rate and thus in competitiveness. The effects of the shock are as follows:

$$\delta y_3/s_1 = -0.010, \ \delta p_3/\delta s_1 = -0.336, \ \delta c_3/\delta s_1 = -0.773.$$

In <u>the exchange rate union</u> the effects are similar to those in the floating rate regime. The change in the effective exchange rate and, accordingly, in competitiveness is somewhat greater, and the price level changes somewhat more. This difference is due to the slight opposite change in the bilateral exchange rate between countries 3 and 2 (e_{32}) in the case of floating. In the exchange rate union this exchange rate is fixed. The effects are as follows:

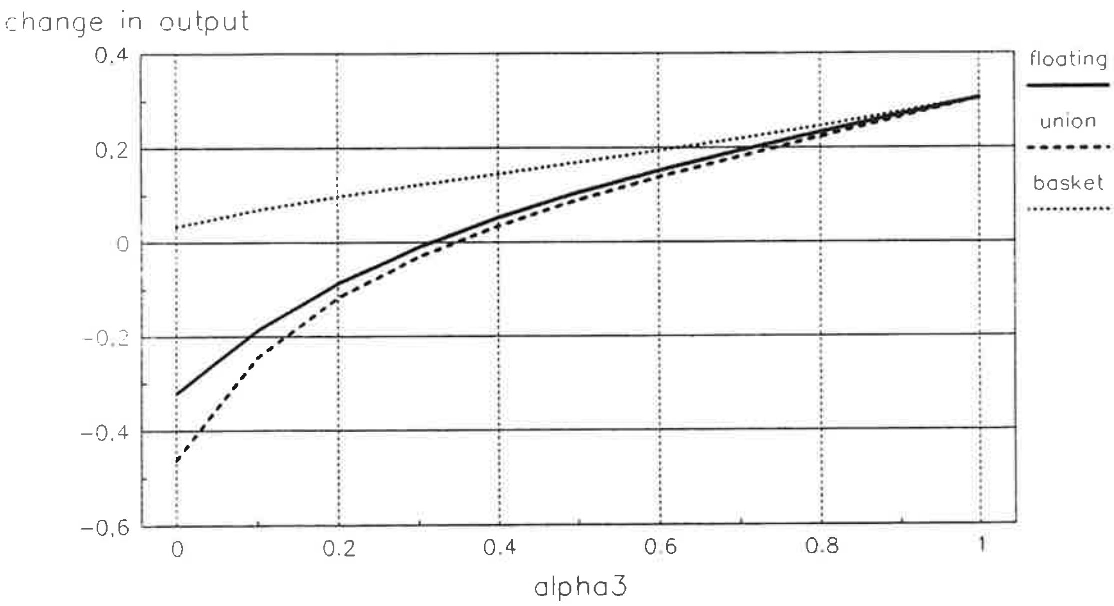
$$\delta y_3/\delta s_1 = -0.031, \ \delta p_3/\delta s_1 = -0.375, \ \delta c_3/\delta s_1 = -0.843.$$

In <u>the currency basket regime</u> competitiveness deteriorates only through the producer price channel, because the effective exchange rate is stabilized. The positive effects due to export demand and interest rates are thus offset to a smaller degree than in the previous cases. Output changes, accordingly, more:

$$\delta y_3/\delta s_1 = 0.122, \ \delta p_3/\delta s_1 = -0.091, \ \delta c_3/\delta s_1 = -0.333.$$

The sensitivity of output effects with respect to α is very much similar to the results obtained when we analysed the effects of a monetary shock occurring in country 1. The currency basket regime again stabilizes the prices the most with all relevant values of α_3(from 0 to 1), floating is the second best and the union the worst in this respect.

Figure 11. Productivity shock in country 1: sensitivity of output in the small country with respect to α and α_3 (α_3 = 3 * α)



In the case when $\alpha = \alpha_3 = 1$ the change in the output of country 3 according to the baseline calculation for all exchange rate regimes is as follows: $\delta y_3/\delta s_1 = 1.979$.

3.5.2 Shocks occurring in country 2

3.5.2.1 Effects on the big countries

Because of the assumption of symmetry between the big countries, the results are again the mirror image of those presented in the previous section.

3.5.2.2 Effects on the small country

The effects on the export demand of the small country are again bigger in this case than in the case when the shock originates in country 1. The results are similar to those of a monetary shock. The most important difference is that in the case of an exchange rate union the depreciation of the currency leads to an increase in prices, whereas in the other regimes prices decline.

Under the same assumptions as presented in the case when the shock occurs in country 1 (page 85) it can be shown that the exchange rate union leads to a higher post-shock output than the basket regime, assuming that the pre-shock output is at the same level. This result is thus the opposite of that when the shock occurs in country 1. The difference is the same as presented on page 84, but of the opposite sign.

In <u>the floating rate regime</u> the output effects due to changes in export demand and interest rates are compensated for by the opposite effects of the effective exchange rate and competitiveness. Output is rather well stabilized, and the price level falls. The effects are thus very similar to those in country 1:

$\delta y_3/\delta s_2 = 0.052, \; \delta p_3/\delta s_2 = -0.377, \; \delta c_3/\delta s_2 = -0.931.$

In the short run country 2 is thus affected the most, whereas countries 1 and 3 are almost insulated when their exchange rates are floating.

In the exchange rate union the effective exchange rate depreciates together with that of country 2, although by less. This effect on relative prices is however compensated for by the producer price development. The price level in country 3 increases contrary to the developments in the other two countries. Relative prices in a common currency (competitiveness) remains for this reason almost unchanged, so the output effect is neutral. The increase in output is thus due to the increasing export demand and the declining interest rate:

$\delta y_3/\delta s_2 = 0.351, \; \delta p_3/\delta s_2 = 0.180, \; \delta c_3/\delta s_2 = 0.068.$

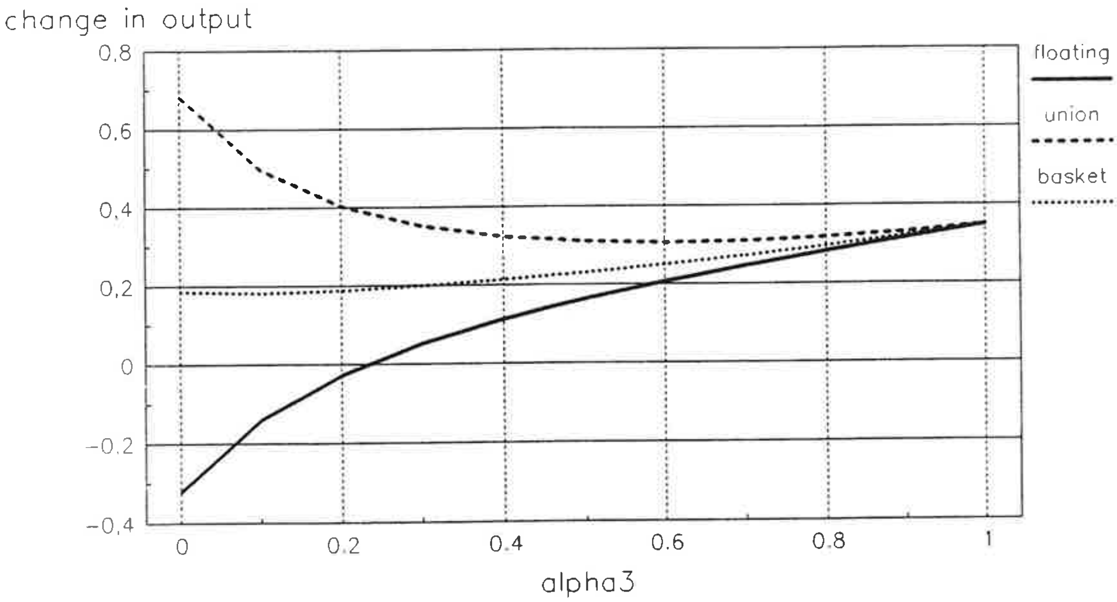
In the currency basket exchange rate regime the effective exchange rate is stabilized, but because the prices of country 3 change less than those of countries 1 and 2, the competitiveness affects in the opposite direction than export demand and interest rates, and makes the change in output smaller than in the case of the union:

$\delta y_3/\delta s_2 = 0.198, \; \delta p_3/\delta s_2 = -0.104, \; \delta c_3/\delta s_2 = -0.442.$

The sensitivity analysis presented in figure 12 shows that the basket peg regime stabilizes the output the most only for small values of $\alpha_3 = 3 * \alpha$, and for higher values floating exchange rates are the best in this respect. The basket regime is, however, better than the exchange rate union for all relevant values of α and α_3. The basket regime stabilizes prices the best for the values of α_3 from

0 to 0.3, but after that the exchange rate union alternative gives the smallest change in the domestic price level. Floating leads to the greatest changes in the price level with relevant values of $\alpha_3 = 3 * \alpha$.

Figure 12. Productivity shock in country 2: sensitivity of output in the small country with respect to α and α_3 ($\alpha_3 = 3 * \alpha$)



When $\alpha = \alpha_3 = 1$, the change in the output of country 3 according to the baseline calculation for all exchange rate regimes is as follows: $\delta y_3/\delta s_2 = 1.996$. The change is thus somewhat greater than in the case when the shock originates in country 1. This difference is due to the greater share of country 2 in the foreign trade of country 3.

3.6 Evaluation of the results

In the case of domestic shocks we found in section 3.2. that floating exchange rates stabilize the output of a small country better against goods demand shocks than fixed rates. In the case of a money supply (or money demand) shock fixed exchange rates in turn are better in stabilizing the output. When the small country faces a productivity shock, fixed rates stabilize the output better if no monetary policy response is assumed in the case of floating rates. But if the money supply adjusts fully to the change in the price level, floating rates insulate the domestic output against the effects of the shock.

In the case of foreign shocks the situation is different. From the small country's point of view a foreign real shock is not only real, and a monetary shock is not only monetary. Both shocks are composite shocks. A real shock occurring in one of the big countries changes the outputs of the big countries, but also exchange rates and interest rates. The monetary shock also has important real effects.

We could not show the ranking of the regimes with respect to the deviation of output from zero *a priori*, because we did not know the signs of the changes. We were, however, in most cases able to determine the difference between the post-shock levels, assuming that the pre-shock outputs were the same in all regimes. The magnitudes of the deviations, even their signs, depend on the values of the parameters. The output effects of the shocks in different exchange rate regimes according to the baseline calculation are presented in table 2 on page 92. (For the parameter values see page 56.) The symbols R.1. and R.2. refer to real (goods demand) shocks originating in countries 1 and 2 respectively. The symbols M.1., M.2., S.1. and S.2. refer to monetary and supply (productivity) shocks in the respective countries. For an alternative calculation, where the values of the "open economy variables" σ, σ_3, ϵ and ϵ_3 are assumed to be lower, see appendix 6.

Table 2. The effects of foreign shocks on the output of the small country in different exchange rate regimes (the baseline calculation, endogenous price model)

$$(R.1.)\quad \underset{|0.056|}{\left|\frac{\delta y_3}{\delta f_1}(basket)\right|} < \underset{|0.185|}{\left|\frac{\delta y_3}{\delta f_1}(floating)\right|} < \underset{|0.192|}{\left|\frac{\delta y_3}{\delta f_1}(EMU\text{-}peg)\right|}$$

$$(R.2)\quad \underset{|-0.003|}{\left|\frac{\delta y_3}{\delta f_2}(EMU\text{-}peg)\right|} < \underset{|0.133|}{\left|\frac{\delta y_3}{\delta f_2}(basket)\right|} < \underset{|0.246|}{\left|\frac{\delta y_3}{\delta f_2}(floating)\right|}$$

$$(M.1.)\quad \underset{|-0.009|}{\left|\frac{\delta y_3}{\delta m_1}(floating)\right|} < \underset{|-0.028|}{\left|\frac{\delta y_3}{\delta m_1}(EMU\text{-}peg)\right|} < \underset{|0.168|}{\left|\frac{\delta y_3}{\delta m_1}(basket)\right|}$$

$$(M.2.)\quad \underset{|0.025|}{\left|\frac{\delta y_3}{\delta m_2}(floating)\right|} < \underset{|0.313|}{\left|\frac{\delta y_3}{\delta m_2}(basket)\right|} < \underset{|0.509|}{\left|\frac{\delta y_3}{\delta m_2}(EMU\text{-}peg)\right|}$$

$$(S.1.)\quad \underset{|-0.010|}{\left|\frac{\delta y_3}{\delta s_1}(floating)\right|} < \underset{|-0.031|}{\left|\frac{\delta y_3}{\delta s_1}(EMU\text{-}peg)\right|} < \underset{|0.122|}{\left|\frac{\delta y_3}{\delta s_1}(basket)\right|}$$

$$(S.2.)\quad \underset{|0.052|}{\left|\frac{\delta y_3}{\delta s_2}(floating)\right|} < \underset{|0.198|}{\left|\frac{\delta y_3}{\delta s_2}(basket)\right|} < \underset{|0.351|}{\left|\frac{\delta y_3}{\delta s_2}(EMU\text{-}peg)\right|}$$

In the baseline calculation the difference between the export demand effects of the monetary and goods demand shocks on the small country is not big. Exchange rate, interest rate and price effects however differ more. A goods demand shock has a greater interest rate effect than a monetary one. The exchange rate in turn reacts more in the case of a corresponding monetary shock. The price levels of the big countries change in opposite directions in the case of both shocks, but in the case of monetary shocks the difference is greater due to the stronger exchange rate reaction. (See table 3, p. 94.)

On the basis of the interest rate reactions a goods demand shock occurring in the big countries in a floating rate world is more monetary than a corresponding monetary shock from the small country's point of view. This obviously explains partly the result obtained in the baseline calculation that floating rates are not very good in stabilizing the output of the small country against foreign goods demand shocks. The main reason for this result is, however, that floating rates reinforce the export demand effect in the case of foreign goods demand shocks and counteract them in the case of monetary shocks. If there is for example an increase in the demand for goods in country 1, the foreign demand for the products of country 3 increases, but additionally the exchange rate depreciates. In the case of a positive monetary shock, the exchange rate of the small country appreciates and partly offsets the effect of foreign demand on the domestic output.

Table 3. Some important effects of the foreign shocks (baseline calculation, endogenous price model)

effect	goods demand shock Δf_1	Δf_2	monetary shock Δm_1	Δm_2	productivity shock Δs_1	Δs_2
Δe	-2.354	2.354	3.383	-3.382	2.646	-2.646
Δi	0.960	0.960	-0.670	-0.670	-0.744	-0.744
Δ(foreign demand)	0.349	0.531	0.110	0.273	0.122	0.266
Δc_3 (floating)	0.556	0.399	-0.758	-0.348	-0.773	-0.931
Δc_3 (union)	0.582	-0.867	-0.696	0.704	-0.843	0.068
Δc_3 (basket)	0.179	0.020	-0.108	0.052	-0.333	-0.442

The crucial factor when comparing the effects of the shocks in the exchange rate union and in the basket regime is whether the change of the exchange rate, which in the union case is determined by the big countries, tends to offset the other effects or whether it will reinforce them. When there is a goods demand shock in the union partner country and when there is a monetary shock in the rest of the world, the exchange rate union stabilizes the output more than the basket regime. But when there is a goods demand shock in the rest of the world and when there is a monetary shock in the union partner country, the basket peg regime stabilizes the output better.

The effects of a foreign productivity shock (supply shock) are almost the same as those of a monetary shock if the money supply is kept unchanged. This is logical because in both cases there is a change in real balances.

The crucial feature of the basket peg regime is that it stabilizes the effective exchange rate. This implies that the basket peg regime stabilizes also the relative prices, i.e. competitiveness, and the domestic price level more against foreign shocks than the other two regimes, where the effective exchange rate changes. (For the changes in the domestic price level and competitiveness, see appendices 4 and 5.)

When evaluating the alternative exchange rate regimes the crucial question is which variable is to be stabilized. Is it output only, or should prices, competitiveness and other possible variables have some weight, too? In this respect the effects of the variability in the different variables should be analysed. We come back to this question in chapter 4.

3.7 Summary of chapter 3

In this chapter we first studied the effects of three domestic shocks: a goods demand shock, a money supply (or demand) shock, and a productivity shock (a supply shock). In the case of domestic shocks we are not able to distinguish between the exchange rate union and the basket peg regime. If no difference is made between the regimes with respect to, for example, credibility, the regimes function in the same way as fixed exchange rate regimes. The results obtained are consistent with those of traditional models. The floating rate regime is better in stabilizing the output against domestic goods demand shocks, whereas the fixed rate regime isolates the output from the effects of a domestic monetary shock. Fixed rates are better also in the case of a productivity shock, if there is no reaction of the money supply in the floating rate regime, but if the money supply responds fully to changes in prices, floating insulates the output completely.

The main focus of the chapter was on the effects of the respective foreign shocks. Because of the complicatedness of the model and its solutions we could not compare the results a *priori*. We instead had to use numerical calculations. The parameter estimates used in the baseline calculation were based on empirical studies, but because of the lack of direct counterparts, the estimates had to be adjusted ad hoc. They must thus be considered more or less as "guesstimates". To decrease the uncertainty related to this procedure and to control the results, sensitivity analyses were made.

We studied the effects of a goods demand shock, a monetary shock and of a productivity shock originating in each of the big countries. We noticed that the output effects are different in the different exchange rate regimes. The effects are dependent on both the nature of the shock and the origin of the shock. In the baseline calculation the basket peg regime stabilizes the output the best against goods demand shocks occurring in "the rest of the world", and the exchange rate union those originating in "the EMS/EMU" area. Floating is the best in stabilizing the output against monetary shocks. The exchange rate union is almost as good as floating when the monetary shock originates in "the rest of the world". This is due to the joint floating against this area. But when the monetary shock occurs in "the EMS area", an exchange rate union with it leads to the greatest change in output.

The currency basket exchange rate regime stabilizes the effective exchange rate. This property of the regime implies that it stabilizes also the relative prices (=competitiveness) and the domestic price level better than the other two regimes.

4 AN OVERALL EVALUATION OF THE EXCHANGE RATE REGIMES

Until now we have confined ourselves to studying the effects of various kinds of shocks in different exchange rate regimes. We have thus not made any effort to say something about the relative ability of the regimes to insulate the small economy against all the shocks studied.

It is clear that we are not able to conclude *a priori* which regime has the best insulation properties. The ranking of the regimes depends crucially on the nature and on the origin of the shocks, and on their relative variances. Additionally, because we are not able to obtain many *a priori* results concerning the effects of the shocks, we have to study them by using different values of the parameters of the model. The ranking between the regimes depends also on whether we include only output in the social welfare function, or whether we put emphasis on other objectives, too, especially on the variability of the domestic price level.

In this chapter we present a framework for making a synthesis of the relative ability of the regimes to insulate the small economy against the shocks studied. As a method we use quadratic loss functions (see for example Boyer, 1978; originally Theil, 1964). We first put the emphasis on the variability of output.

We write a loss function (L^o) for each exchange rate regime with respect to all output effects of the shocks considered as follows:

$$(76)\ L^{o}_{f,u,b}=\sigma^2_{f_1}\left(\frac{\delta y_3}{\delta f_1}\right)^2+\sigma^2_{f_2}\left(\frac{\delta y_3}{\delta f_2}\right)^2+\sigma^2_{m_1}\left(\frac{\delta y_3}{\delta m_1}\right)^2+\sigma^2_{m_2}\left(\frac{\delta y_3}{\delta m_2}\right)^2+\sigma^2_{s_1}\left(\frac{\delta y_3}{\delta s_1}\right)^2$$

$$+\sigma^2_{s_2}\left(\frac{\delta y_3}{\delta s_2}\right)^2+\sigma^2_{f_3}\left(\frac{\delta y_3}{\delta f_3}\right)^2+\sigma^2_{m_3}\left(\frac{\delta y_3}{m_3}\right)^2+\sigma^2_{s_3}\left(\frac{\delta y_3}{s_3}\right)^2.$$

The letters f, u and b refer to floating, the exchange rate union and the basket peg regime, respectively. The loss function is thus written for each regime. The letter o refers to output; the loss of welfare is measured with respect to the deviation of the output from a "normal" level. The first multiplicative factor in the expression refers to the variance of the respective shock: σ^2_{f1} for example is the variance of the goods demand shock occurring in country 1. The second multiplicative factor in turn refers to the quadraticized effect of each shock on the small open economy (country 3). The loss function as a whole measures the loss of welfare due to all foreign and domestic shocks studied in the previous chapters. Maximization of welfare means thus minimization of the loss due to the effects of the shocks.

If we knew the variances of the shocks and their effects on the small country under different exchange rate regimes, we could calculate numerical values for the loss functions. We have already presented the effects of the shocks under two alternative scenarios of parameter values and conducted sensitivity analyses. For the variances of the shocks it is difficult, however, to give any precise values. In principle they could be calculated empirically in the cases of the USA, the EMS countries and Finland, for example. However, in addition to the problems related to finding proper empirical counterparts and to the estimation procedures, it is questionable whether estimates based on historical data can serve as a very reliable guide in assessing the variances of the shocks at the present and in the future. The institutions and policies have changed and are changing all the time. It is also difficult to say much about the variances *a priori*.

In the following calculations we use the numerical values of the multipliers obtained in the two simulations performed. Concerning the variances of the shocks we first assume that they are the same for all shocks. The idea behind this assumption is that the expected values of the variances are the same. In addition to this, we calculate some critical values for the variances. The procedure used is limiting in generality. It is, however, at least one possible scenario. How likely it is depends on the realism of the parameter estimates used.

We first calculate the loss functions in the case of <u>the fixed price model</u> presented in chapter 2. After assuming that the variances of all the shocks are the same (σ^2_{shock}) and summing up the quadratic multipliers of the effects of the shocks, we obtain **in the baseline scenario** the following loss functions:

$$L^{\circ}_{f} = \sigma^2_{shock} * 3.291,$$
$$L^{\circ}_{u} = \sigma^2_{shock} * 3.830,$$
$$L^{\circ}_{b} = \sigma^2_{shock} * 1.275.$$

We can thus write:

$$L^{\circ}_{b} < L^{\circ}_{f} < L^{\circ}_{u}.$$

The ranking of the regimes is the same if we consider the effects of the foreign shocks only (see table 1, p. 46). In the case of domestic shocks the two fixed rate regimes insulate the economy more than the floating rate regime, because under floating a monetary shock leads to a greater change in output (= $1/k_3$) than a real shock under fixed rates (= 1). Real shocks are insulated fully in the case of floating and monetary shocks in the case of fixed rates. (See section 2.2., pp. 12-13.)

In **the alternative scenario** (in a less open economy) we obtain the following loss functions (for the parameters, see appendix 3):

$$L^{\circ}_{f} = \sigma^2_{shock} * 3.230,$$
$$L^{\circ}_{u} = \sigma^2_{shock} * 2.012,$$
$$L^{\circ}_{b} = \sigma^2_{shock} * 1.112.$$

With respect to all shocks we can thus write:

$$L^{\circ}_{b} < L^{\circ}_{u} < L^{\circ}_{f}.$$

If we consider only the effects of the foreign shocks, floating is ranked before the exchange rate union. This difference is due to the better insulation of domestic shocks in the fixed rate regime (see the baseline case).

In the endogenous price model (chapter 3) we obtain the following loss functions in **the baseline scenario:**

$$L^{\circ}_{f} = \sigma^2_{shock} * 0.894,$$
$$L^{\circ}_{u} = \sigma^2_{shock} * 1.338,$$
$$L^{\circ}_{b} = \sigma^2_{shock} * 1.118.$$

The ranking between the regimes is thus:

$$L^{\circ}_{f} < L^{\circ}_{b} < L^{\circ}_{u}.$$

In **the alternative scenario** (in a less open economy) we obtain:

$$L^{o}_{f} = \sigma^{2}_{shock} * 0.746,$$
$$L^{o}_{u} = \sigma^{2}_{shock} * 1.160,$$
$$L^{o}_{b} = \sigma^{2}_{shock} * 1.044.$$

The ranking is the same as in the baseline calculation.

If we study the effects of the foreign shocks only, the order of the regimes in both scenarios is the same as in the case of all shocks.

When studying the effects of domestic shocks, we obtain a result that floating insulates the output of the small country more than the fixed rate regimes. This result is the opposite of that obtained in the fixed price model. The difference is due to the strong effect of a goods demand shock in the fixed rate regime, whereas the effect of a monetary shock in the floating rate regime is clearly weaker in the case of endogenous prices.[5] A part of the adjustment occurs in this case through changes in the price level. (For these differences see sections 2.2. and 3.2.)

We can summarize the results of the above-mentioned examples where the variances of all shocks are assumed to be the same as follows: **In the examples based on the fixed price model the basket regime insulates the output of the small open economy on average more than the other two regimes. But in the examples based on the model where producer prices are allowed to change floating insulates the output the most on average. The exchange rate union insulates the output the worst in all examples against the foreign shocks studied. This is especially due to the**

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[5]If $\alpha_3 = 1$, the output is fully insulated against domestic monetary shocks in the floating rate regime (see expression (63), p. 60).

vulnerability of the exchange rate union in the case of monetary and productivity shocks occurring in the union partner country. In the case of domestic shocks fixed rate regimes insulate the output more than floating in the fixed price model. This is why the exchange rate union is ranked above floating with respect to all shocks in the case of the less open economy (alternative scenario). When producer prices are allowed to change, floating, however, insulates the output more than the two fixed exchange rate regimes against domestic shocks.

Above we assumed that the variances of all the shocks studied are the same. Next we assume that the variances of different kinds of shocks are the same inside countries, but that shock-proneness differs between countries. We thus write:

$$\sigma^2_{1shock} = \sigma^2_{f1} = \sigma^2_{m1} = \sigma^2_{s1},$$
$$\sigma^2_{2shock} = \sigma^2_{f2} = \sigma^2_{m2} = \sigma^2_{s2},$$
$$\sigma^2_{3shock} = \sigma^2_{f3} = \sigma^2_{m3} = \sigma^2_{s3}.$$

From now on we confine ourselves only to the model with endogenous prices. **In the baseline scenario** we obtain the following values for the loss functions:

$$L^{\circ}_f = \sigma^2_{1shock}*0.034 + \sigma^2_{2shock}*0.064 + \sigma^2_{3shock}*0.796,$$
$$L^{\circ}_u = \sigma^2_{1shock}*0.039 + \sigma^2_{2shock}*0.382 + \sigma^2_{3shock}*0.917,$$
$$L^{\circ}_b = \sigma^2_{1shock}*0.046 + \sigma^2_{2shock}*0.155 + \sigma^2_{3shock}*0.917.$$

We see above that:

(1) floating insulates the output the best against the shocks of all countries, and accordingly the best on average irrespective of the values of the country specific variances, and

(2) the exchange rate union insulates the output clearly the least when the shocks originate in the union partner country (due to monetary and productivity shocks, see table 2 on page 92).

Next we compare the exchange rate union and the basket peg regime. By subtracting L°_{b} from L°_{u} from the above equations we obtain:

$$L^{\circ}_{u} - L^{\circ}_{b} = - \sigma^{2}_{1shock}*0.076 + \sigma^{2}_{2shock}*0.227.$$

$L^{\circ}_{u} - L^{\circ}_{b} < 0$, if the relative variance $\sigma^{2}_{1shock}/\sigma^{2}_{2shock} > 2.979$. The exchange rate union thus insulates the output more than the basket peg regime if country 1 is more than three times as shock-prone as country 2.[6]

Now we widen our loss function approach by taking into account the variability of domestic producer prices, in addition to the variability of output. This procedure can be rationalized by the argument that stability of the producer prices makes the working environment of the firms, and indirectly of consumers, more predictable. The variability of producer prices deserves for this reason <u>some</u> weight in the social welfare (loss) function; although including the price target is to some extent contradictory, because variability of competitiveness, and accordingly of prices, is one of the channels through which output variations are reduced in the case of some shocks. In the baseline calculation it is assumed that producer prices are affected by foreign trade prices

[6] In principle we could do a similar analysis for the relative variances according to the <u>nature of the shock</u>, by assuming that similar shocks have the same variances in all countries. This is not, however, very useful, because domestic and foreign shocks have basically very different impacts on the small economy.

according to the input-output relationships of the economies. The difference between the producer and consumer prices is thus not very great.

We write the aggregate loss function in the case of floating as follows:

$$L_f = a\ L^p_f + (1-a)\ L^o_f,$$

where L_f refers to the total loss of welfare under floating, and L^p_f and L^o_f to the losses with respect to variability of prices and output, respectively. The weight of the price target is denoted by a ($0 \leq a \leq 1$). The loss functions for the other exchange rate regimes are formulated analogously.

We consider next **the baseline scenario** of <u>the endogenous price model</u>. (In the fixed price model minimization of output variation is the only target.) The variances of all the shocks are again assumed to be the same, irrespective of the nature or the origin of the shock. We can now write:

$$L_f = a\sigma^2_{shock}*1.320 + (1-a)\sigma^2_{shock}*0.894,$$
$$L_u = a\sigma^2_{shock}*1.620 + (1-a)\sigma^2_{shock}*1.338,$$
$$L_b = a\sigma^2_{shock}*0.972 + (1-a)\sigma^2_{shock}*1.118.$$

According to the price target the ranking of the loss functions of the regimes is as follows:

$$L^p_b < L^p_f < L^p_u.$$

With respect to the output target we can write:

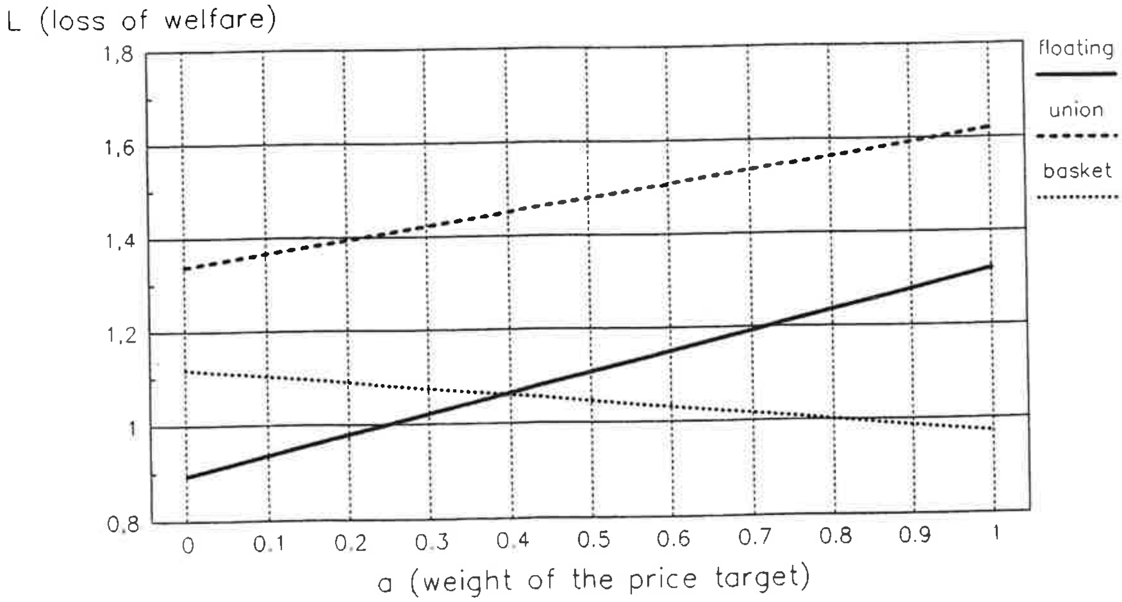
$$L^o_f < L^o_b < L^o_u.$$

Because the exchange rate union leads in the baseline calculation to the highest value of the loss function with respect to both targets we can conclude:

$$(L_b \ \& \ L_f) < L_u, \text{ for all } 0 \leq a \leq 1.$$

The ranking between floating and the basket peg regime depends on the relative weights of the output and price targets. A high weight for the output target favours floating, and a high weight for the price target favours the basket peg regime. If a < 0.392, floating is preferred, and vice versa. We illustrate the situation with figure 13, where the values of the loss functions, calculated in the baseline case for different exchange rate regimes, are presented for different values of the price target a ($0 \leq a \leq 1$).

Figure 13. The values of the aggregate loss functions for different exchange rate regimes in the baseline calculation: sensitivity with respect to the weight of the price target a ($0 \leq a \leq 1$) (standardization: $\sigma^2_{shock} = 1$)



Basically the same conclusions are obtained **in the alternative scenario** (in a less open economy), too. The exchange rate union leads to the greatest loss of welfare with all values of a. When comparing floating and the basket peg regime, the critical value of a is now somewhat lower. If a > 0.309, the basket peg regime is preferred to floating.

The poor performance of the exchange rate union in the examples studied is especially due to the great output effects in the cases of monetary and productivity shocks occurring in the union partner country (see table 2 on page 92). If the variances of these shocks could be assumed to be small, the attractiveness of the exchange rate union would increase. The insulation properties of the exchange rate union with respect to prices are also clearly worse than those of especially the basket peg regime (see appendix 4). This is due to the "half-float nature" of the exchange rate union in a floating rate world. Domestic producer prices react thus to the changes in the exchange rate between the big economies.

The comparison of the exchange rate regimes presented above does not attempt to be general; it is rather an example of the use of the model. The model itself and the method used have, however, more generality.

The limitations and reservations of the conclusions drawn above can be divided into two categories: (1) those related to the use of the model, and (2) those related to the model itself. The former set of limitations includes for example reservations related to the numerical values of the parameters used, to the shocks studied and to the assumptions concerning the variances of the shocks. These assumptions can easily be changed according to new information and according to countries studied. The latter set of limitations includes the general philosophy and structure of the model and the various specifications. Other kinds of models or specifications, and criteria used, can lead to different kinds of rankings between the regimes.

The floating exchange rate regime was, for example, modelled in a way that reflects the importance of economic fundamentals in the determination of the exchange rate. This is a kind of an "ideal" floating. Allowing the exchange rate to be affected more by factors related to the functioning of the foreign exchange market (speculative bubbles etc.) can change the conclusions. In the model specifications used we did not yet take into account the effects of expectations.[7] The possibilities for limited flexibility within the exchange rate union and the currency basket regime were neglected, as well as the implications of differing degrees of credibility of the exchange rate in different regimes. We have also assumed that the values of the parameters are the same in all exchange rate regimes. This assumption may be realistic in the short run, when we can assume that there is no learning process. In the longer run, and when expectations are added into the model, this assumption does not necessarily hold.

Some of the aspects mentioned above can (and will) be incorporated into the model. Many aspects relevant for the choice of an exchange rate regime must, however, be analyzed outside the model, and with the help of other kinds of models.

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[7]This extension will be made in a forthcoming report.

5 SUMMARY

In this study exchange rate unions were compared to currency basket and floating rate regimes in the framework of a three-country macroeconomic (IS-LM) model. In the model we had two big countries and a small open economy. The two-country model was solved simultaneously, whereas the small country was modelled in a recursive way, i.e. the small economy was affected by the big countries but not the other way round. The alternative regimes were analyzed in the case of the small open economy. The exchange rate between the big economies was determined freely in the foreign exchange market.

The study was done with two versions of the model. In the first version (chapter 2) producer prices were fixed, the model was thus a Keynesian short-term (Mundell-Fleming) model. In the second version (chapter 3) an aggregate supply equation was added into each country model, whereby the determination of producer prices was made endogenous. Both models were static with static exchange rate and price expectations.

Floating rates were modelled in a way where "economic fundamentals" determine the exchange rate through the money and goods market equilibrium conditions in the presence of free capital mobility and perfect asset substitutability. In the cases of the exchange rate union and in the currency basket regime, we studied only cases where the exchange rate is credibly fixed.

The approach used in the comparison of the regimes was a traditional one: to study how exogenous domestic and foreign shocks affect the small open economy, and in which regime the effects are minimized. This approach is legitimized by the costs related to short-term variations in economic variables. The shocks studied are a goods demand shock, a monetary shock and a productivity shock, which all can occur in the home country or in either of the big countries.

In the cases of domestic goods demand and monetary shocks the general conclusions of the traditional Mundell-Fleming research were confirmed in both models: floating rates are preferred in the case of goods demand shocks and fixed rates in the case of monetary shocks. Endogenizing prices, however, modifies the conclusions: insulation properties are not as dichotomic as in the fixed price model, but more a matter of degree. In the case of productivity shocks it was shown that a fixed exchange rate insulates the output more than floating if the money supply remains unchanged.

The main contribution of the study is in the widening of the IS-LM framework into a three-country model, and in a systematic comparison of the three exchange rate regimes in the face of various foreign shocks. In the fixed price model a *priori* results concerning the signs of the changes were obtained in the big country model and for floating rates in the case of the small country. When comparing the exchange rate union and the basket peg regime we noticed, however, that few a *priori* conclusions can be drawn about the variations of economic variables. The conclusions depend on the relative size of the various effects, and thus on the parameters of the model. In the case of endogenous prices it was even more difficult to obtain a *priori* results already in the big country model.

In addition to some discussion about the net effects with different combinations of the values of the parameters, we calculated two numerical simulations of the model and conducted sensitivity analyses. The parameter estimates used were partly based on empirical studies, but because of difficulties in finding direct empirical counterparts, the parameter values used must be considered more as "guesstimates" than estimates. In the baseline scenario we had a rather open economy concerning the elasticities with respect to relative prices and foreign demand. In an alternative scenario we had a more closed real economy.

In the numerical simulations conducted, the basket peg regime stabilizes the output of the small country more than the alternative regimes if producer prices are fixed. A stable effective exchange rate thus leads in this case to the most stable output. Floating generates the second best outcome in three of the four cases in the open economy (baseline) scenario, and the exchange rate union correspondingly in three cases in the alternative (less open economy) scenario. The exchange rate union stabilizes the output the worst in both scenarios when there is a monetary shock in the union partner country.

In the simulations with the endogenous price model we noticed that a stable effective exchange rate does not necessarily lead to the most stable development of the output. A change in the exchange rate and accordingly in competitiveness reduces in some cases the effect of the other factors, having a stabilizing effect on output. But in some other cases changes in competitiveness reinforce the other effects. The result depends crucially on the nature and on the origin of the shock. In the main simulations conducted it was assumed that domestic prices respond to changes in foreign prices according to input-output relations of the economy, and on the basis of the mark-up pricing practice of the firms.

It was found in the simulations that the basket peg regime tends to stabilize the output more than the alternative regimes if there is a goods demand shock in "the rest of the world". If a similar shock occurs in the potential union partner country, the exchange rate union and the basket peg regime stabilize the output the best, the relative performance depending on the parameter values. Flexible exchange rates are not good stabilizers against foreign goods demand shocks in a floating rate world, because the exchange rate tends to reinforce the effect of the changing export demand. The same conclusion applies to the exchange rate union, if the shock occurs in "the rest of the world".

In the case of foreign monetary shocks floating tends to reduce the effects due to changes in the interest rate and in the foreign demand. An exchange rate union has a similar effect if the shock occurs in "the rest of the world", but if it occurs in the union partner country, the other effects are essentially reinforced. In the simulations conducted the basket peg regime stabilizes the output less than the other regimes when a monetary shock occurs in "the rest of the world". When the shock occurs in the potential union partner country, it takes an intermediate position.

In the case of productivity shocks when the money supply is kept unchanged, the results are very similar to those obtained in the case of monetary shocks. This is due to similar changes in real money balances.

At the end of the report we presented a method for analyzing the stabilizing properties of the exchange rate regimes against a combination of all the shocks studied. We presented a quadratic loss function for each regime, first with respect to deviations in output only, and after that a loss function where deviations in prices were also taken into account.

In order to be able to calculate the values of the loss functions, we need the multipliers of the effects of the shocks and the variances of the shocks. The multipliers we had calculated already in the numerical simulations. As for the variances it is difficult to present any *a priori* judgements, neither did we have any empirical estimates. We therefore calculated the values of the loss functions when assuming that the variances of the shocks are the same, i.e. that their expected values are the same. We also calculated some critical variances.

In the experiment with the same variances for all shocks, we obtained the greatest value of the aggregate loss function (the lowest welfare) for the exchange rate union. The weak performance of the union is due to the poor stabilization properties in the cases of monetary and productivity shocks occurring in the union partner country. If the variances of these shocks were small, the attractiveness of the exchange rate union would increase. The ranking between floating and the basket peg regime depends on the weight of the price target in the aggregate loss function. Because the basket peg regime stabilizes producer prices the best against all foreign shocks, increasing the weight of the price target makes the basket peg regime preferable to floating. But with low weights for the price target floating leads to the lowest value of the loss function, and thus to the highest welfare.

The limitations and reservations of the conclusions drawn can be divided into two parts: (1) those related to the use of the model, and (2) those related to the model itself. The former limitations can be reduced by using new information concerning the values of the parameters, when empirical knowledge accumulates, and by conducting further sensitivity analysis. The latter limitations are a problem of all economic models. In this respect evaluations done outside the model and with other kinds of models are needed in the research and discussion on exchange rate regimes.

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Exchange Rate Arrangements

(As of June 30, 1991)[1]

Currency pegged to					Flexibility Limited in terms of a Single Currency or Group of Currencies		More Flexible		
US Dollar	French Franc	Other currency	SDR	Other composite[2]	Single currency[3]	Cooperative arrangements[4]	Adjusted according to a set of indicators[5]	Other managed floating	Independently floating
Afghanistan Angola Antigua & Barbuda Argentina Bahamas, The Barbados Belize Djibouti Dominica Ethiopia Grenada Haiti Iraq Liberia Mongolia Nicaragua Oman Panama St. Kitts & Nevis St. Lucia St. Vincent and the Grenadines Sudan Suriname Syrian Arab Rep Trinidad and Tobago Yemen, Republic of	Benin Burkina Faso Cameroon C. African Rep. Chad Comoros Congo Côte d'Ivoire Equatorial Guinea Gabon Mali Niger Senegal Togo	Bhutan (Indian Rupee) Kiribati (Australian Dollar) Lesotho (South African Rand) Swaziland (South African Rand) Yugoslavia (deutsche mark)	Burundi Iran, I. R. of Libya Myanmar Rwanda Seychelles	Algeria Austria Bangladesh Botswana Cape Verde Cyprus Czechoslovakia Fiji Finland Hungary Iceland Israel Jordan Kenya Kuwait Malawi Malaysia Malta Mauritius Morocco Nepal Norway Papua New Guinea Poland Sao Tome & Principe Solomon Islands Sweden Tanzania Thailand Tonga Uganda Vanuatu Western Samoa Zimbabwe	Bahrain Qatar Saudi Arabia United Arab Emirates	Belgium Denmark France Germany Ireland Italy Luxembourg Netherlands Spain United Kingdom	Chile Colombia Madagascar Mozambique Zambia	China, P.R. Costa Rica Ecuador Egypt Greece Guinea Guinea-Bissau Honduras India Indonesia Korea Lao P.D. Rep Mauritania Mexico Pakistan Portugal Singapore Somalia Sri Lanka Tunisia Turkey Viet Nam	Australia Bolivia Brazil Bulgaria Canada Dominican Rep. El Salvador Gambia, The Ghana Guatemala Guyana Jamaica Japan Lebanon Maldives Namibia New Zealand Nigeria Paraguay Peru Philippines Romania Sierra Leone South Africa United States Uruguay Venezuela Zaire

Classification Status[1]	End of Period														
				1988		1989				1990				1991	
	1985	1986	1987	QIII	QIV	QI	QII	QIII	QIV	QI	QII	QIII	QIV	QI	QII
Currency pegged to															
US Dollar	31	32	38	38	36	31	32	32	32	30	28	25	25	27	26
French Franc	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Other Currency	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
of which: Pound Sterling	(1)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
SDR	12	10	8	7	8	8	7	7	7	7	7	7	6	6	6
Other currency composite	32	30	27	31	31	31	32	32	34	34	35	37	35	34	34
Flexibility limited vis-à-vis a single currency	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4
Cooperative arrangements	8	8	8	8	8	8	9	9	9	9	9	9	10	10	10
Adjusted according to a set of indicators	5	6	5	5	5	5	5	5	5	4	4	3	5	5	5
Managed floating	21	21	23	21	22	25	24	25	21	23	21	23	23	22	22
Independently floating	15	19	18	17	17	19	18	18	20	21	23	26	25	27	28
Total[6]	149	151	151	151	151	151	151	152	152	152	151	154	154	155	155

[1] Excluding the currency of Cambodia, for which no current information is available. For members with dual or multiple exchange markets, the arrangement shown is that in the major market.

[2] Comprises currencies which are pegged to various "baskets" of currencies of the members' own choice, as distinct from the SDR basket.

[3] Exchange rates of all currencies have shown limited flexibility in terms of the U.S. dollar.

[4] Refers to the cooperative arrangement maintained under the European Monetary System.

[5] Includes exchange arrangements under which the exchange rate is adjusted at relatively frequent intervals, on the basis of indicators determined by the respective member countries.

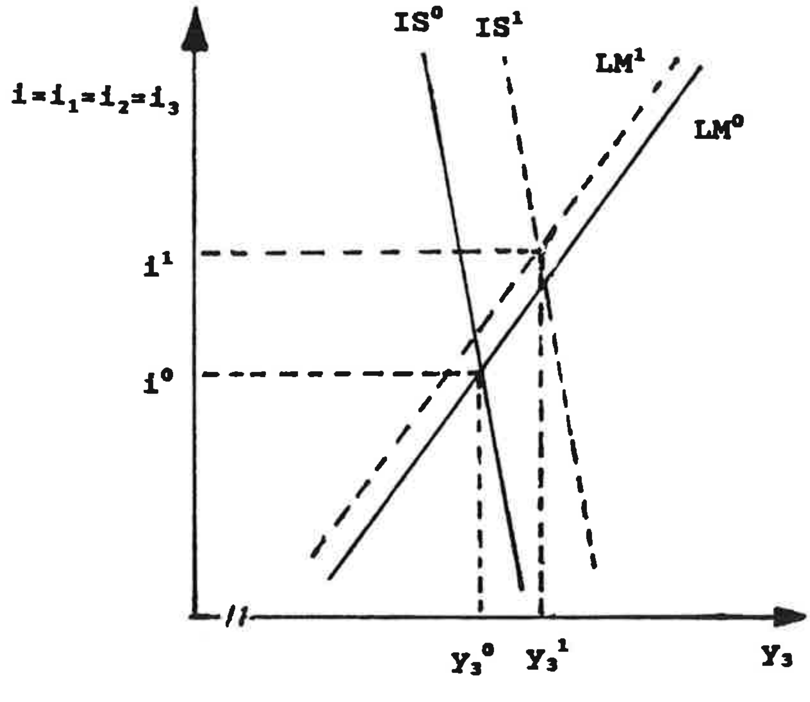
[6] Including the currency of Cambodia and, effective February 14, 1991, of Mongolia. Effective May 22, 1990, the Yemen Arab Republic and the People's Democratic Republic of Yemen merged as the Republic of Yemen.

Source: International Financial Statistics, October 1991.

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

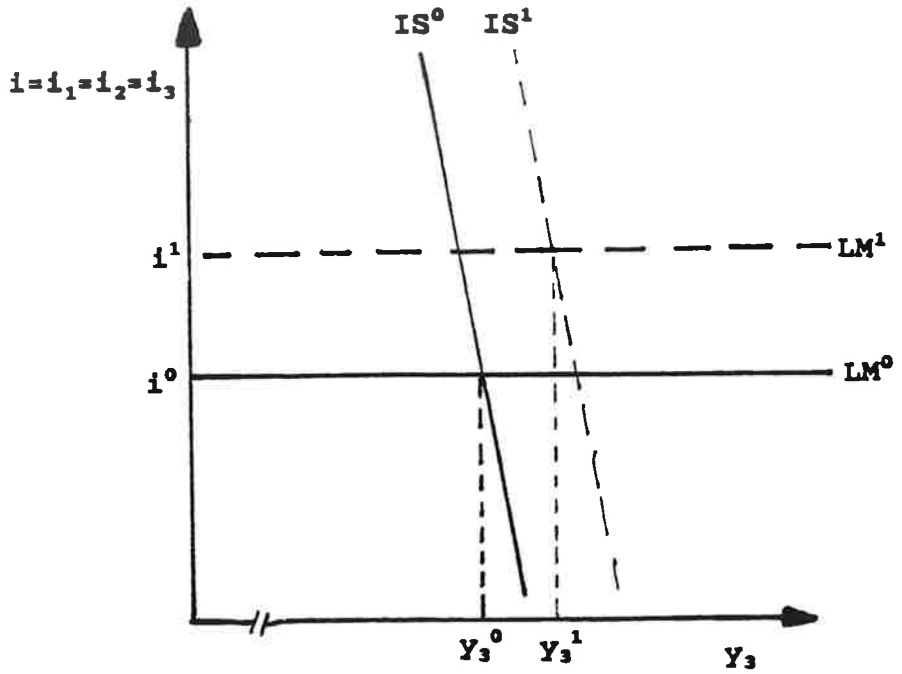
We assume in all cases that the demand shock is positive and that the large countries are symmetrical, i.e. that y_1 and y_2 increase by an equal amount. The figures are drawn according to the parameter values given in table 1 on page 46.

Floating exchange rates:



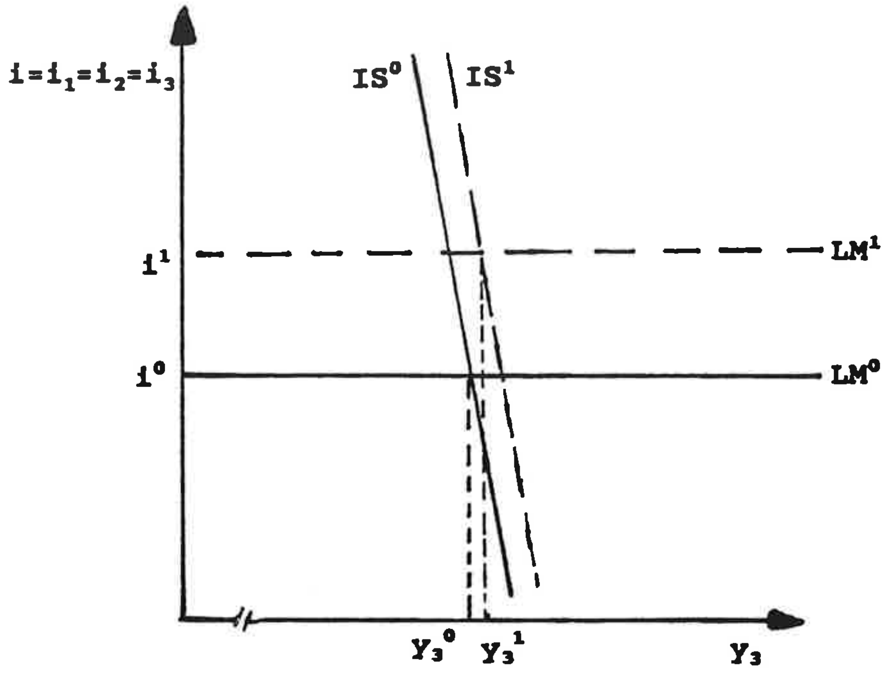
Export demand of country 3 increases and competitiveness improves at least in the symmetrical case (we do not know this *a priori* in the asymmetrical case). The net effect is nonetheless positive, so that the IS curve shifts to the right. The interest rate increases from i^0 to i^1 (the LM-curve shifts 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 the output (the IS curve shifts to the right). The net effect on the output of country 3 is likely to be positive. 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 IS 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".

Fixed price model: The effects of foreign shocks on the output of the small country (alternative calculation)

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 absolute values for output effects in different exchange rate regimes:

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

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

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

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

<u>Endogenous price model</u>: The effects of foreign shocks on the price level of the small country in different exchange rate regimes (the baseline calculation)

$$\begin{array}{cccccc} & |0.079| & & |0.318| & & |0.332| \\ (R.1.) & \left|\frac{\delta p_3}{\delta f_1}(basket)\right| & < & \left|\frac{\delta p_3}{\delta f_1}(floating)\right| & < & \left|\frac{\delta p_3}{\delta f_1}(EMU\text{-}peg)\right| \end{array}$$

$$\begin{array}{cccccc} & |0.066| & & |-0.187| & & |0.277| \\ (R.2.) & \left|\frac{\delta p_3}{\delta f_2}(basket)\right| & < & \left|\frac{\delta p_3}{\delta f_2}(EMU\text{-}peg)\right| & < & \left|\frac{\delta p_3}{\delta f_2}(floating)\right| \end{array}$$

$$\begin{array}{cccccc} & |0.026| & & |-0.302| & & |-0.337| \\ (M.1.) & \left|\frac{\delta p_3}{\delta m_1}(basket)\right| & < & \left|\frac{\delta p_3}{\delta m_1}(floating)\right| & < & \left|\frac{\delta p_3}{\delta m_1}(EMU\text{-}peg)\right| \end{array}$$

$$\begin{array}{cccccc} & |0.157| & & |-0.254| & & |0.520| \\ (M.2.) & \left|\frac{\delta p_3}{\delta m_2}(basket)\right| & < & \left|\frac{\delta p_3}{\delta m_2}(floating)\right| & < & \left|\frac{\delta p_3}{\delta m_2}(EMU\text{-}peg)\right| \end{array}$$

$$\begin{array}{cccccc} & |-0.091| & & |-0.335| & & |-0.375| \\ (S.1.) & \left|\frac{\delta p_3}{\delta s_1}(basket)\right| & < & \left|\frac{\delta p_3}{\delta s_1}(floating)\right| & < & \left|\frac{\delta p_3}{\delta s_1}(EMU\text{-}peg)\right| \end{array}$$

$$\begin{array}{cccccc} & |-0.104| & & |0.180| & & |-0.377| \\ (S.2.) & \left|\frac{\delta p_3}{\delta s_2}(basket)\right| & < & \left|\frac{\delta p_3}{\delta s_2}(EMU\text{-}peg)\right| & < & \left|\frac{\delta p_3}{\delta s_2}(floating)\right| \end{array}$$

Endogenous price model: The effects of the foreign shocks on the competitiveness of the small country in different exchange rate regimes (baseline calculation)

$$|0.179| \qquad |0.556| \qquad |0.582|$$

$$(R.1.)\ \left|\frac{\delta c_3}{\delta f_1}(basket)\right| < \left|\frac{\delta c_3}{\delta f_1}(floating)\right| < \left|\frac{\delta c_3}{\delta f_1}(EMU\text{-}peg)\right|$$

$$|0.020| \qquad |0.399| \qquad |-0.687|$$

$$(R.2.)\ \left|\frac{\delta c_3}{\delta f_2}(basket)\right| < \left|\frac{\delta c_3}{\delta f_2}(floating)\right| < \left|\frac{\delta c_3}{\delta f_2}(EMU\text{-}peg)\right|$$

$$|-0.108| \qquad |-0.758| \qquad |-0.696|$$

$$(M.1.)\ \left|\frac{\delta c_3}{\delta m_1}(basket)\right| < \left|\frac{\delta c_3}{\delta m_1}(floating)\right| < \left|\frac{\delta c_3}{\delta m_1}(EMU\text{-}peg)\right|$$

$$|0.052| \qquad |-0.348| \qquad |0.704|$$

$$(M.2.)\ \left|\frac{\delta c_3}{\delta m_2}(basket)\right| < \left|\frac{\delta c_3}{\delta m_2}(floating)\right| < \left|\frac{\delta c_3}{\delta m_2}(EMU\text{-}peg)\right|$$

$$|-0.333| \qquad |-0.773| \qquad |-0.843|$$

$$(S.1.)\ \left|\frac{\delta c_3}{\delta s_1}(basket)\right| < \left|\frac{\delta c_3}{\delta s_1}(floating)\right| < \left|\frac{\delta c_3}{\delta s_1}(EMU\text{-}peg)\right|$$

$$|0.068| \qquad |-0.442| \qquad |-0.931|$$

$$(S.2.)\ \left|\frac{\delta c_3}{\delta s_2}(EMU\text{-}peg)\right| < \left|\frac{\delta c_3}{\delta s_2}(basket)\right| < \left|\frac{\delta c_3}{\delta s_2}(floating)\right|$$

Endogenous price model: The effects of foreign shocks on the output of the small country in different exchange rate regimes in the alternative calculation (the case of low "open economy parameter" values)

We assume the following values for the parameters:

$k = k_3 = 0.67, \quad \Phi = \Phi_3 = 0.46, \quad \mu = \mu_3 = 0.2, \quad \beta = \beta_3 = 0.3$

$\sigma = 0.07, \quad \epsilon = 0.15, \quad \alpha = 0.1$

$\sigma_3 = 0.2, \quad \epsilon_3 = 0.3, \quad \alpha_3 = 0.3, \quad \theta = 0.3$

Now we get the following absolute values for the output effects in different exchange rate regimes:

$$\begin{array}{cccc} & |-0.055| & |0.061| & |0.063| \\ (R.1.) & \left|\frac{\delta y_3}{\delta f_1}(basket)\right| < & \left|\frac{\delta y_3}{\delta f_1}(EMU\text{-}peg)\right| < & \left|\frac{\delta y_3}{\delta f_1}(floating)\right| \end{array}$$

$$\begin{array}{cccc} & |-0.011| & |0.108| & |-0.126| \\ (R.2.) & \left|\frac{\delta y_3}{\delta f_2}(basket)\right| < & \left|\frac{\delta y_3}{\delta f_2}(floating)\right| < & \left|\frac{\delta y_3}{\delta f_2}(EMU\text{-}peg)\right| \end{array}$$

$$\begin{array}{cccc} & |0.005| & |0.013| & |0.151| \\ (M.1.) & \left|\frac{\delta y_3}{\delta m_1}(EMU\text{-}peg)\right| < & \left|\frac{\delta y_3}{\delta m_1}(floating)\right| < & \left|\frac{\delta y_3}{\delta m_1}(basket)\right| \end{array}$$

$$\begin{array}{cccc} & |0.041| & |0.231| & |0.376| \\ (M.2.) & \left|\frac{\delta y_3}{\delta m_2}(floating)\right| < & \left|\frac{\delta y_3}{\delta m_2}(basket)\right| < & \left|\frac{\delta y_3}{\delta m_2}(EMU\text{-}peg)\right| \end{array}$$

$$|0.006| \qquad |0.014| \qquad |0.123|$$

$$(S.1.)\ \left|\frac{\delta y_3}{\delta s_1}(EMU\text{-}peg)\right| < \left|\frac{\delta y_3}{\delta s_1}(floating)\right| < \left|\frac{\delta y_3}{\delta s_1}(basket)\right|$$

$$|0.045| \qquad |0.154| \qquad |0.271|$$

$$(S.2.)\ \left|\frac{\delta y_3}{\delta s_2}(floating)\right| < \left|\frac{\delta y_3}{\delta s_2}(basket)\right| < \left|\frac{\delta y_3}{\delta s_2}(EMU\text{-}peg)\right|$$

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