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EXCHANGE RATE UNIONS: A COMPARISON WITH CURRENCY BASKET AND FLOATING RATE REGIMES - A CASE OF TEMPORARY SHOCKS*

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ABSTRACT: The paper is part of an ongoing project in which exchange rate unions are systematically compared with 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 previous results of the study are collected in ETLA Discussion Paper no. 399. In that paper exchange rate and price expectations were static and the shocks studied were permanent. In the current paper we study a case where the shocks are assumed to be reversed during the next period. Exchange rate and price expectations are in this respect rational. The results concerning the insulation properties of different regimes are not changed drastically. As regards the exchange rate union the most problematic shocks are again monetary and productivity shocks occurring in the union partner country. At the end of the paper we study the insulation properties of the exchange rate regimes with respect to two criteria for optimum currency areas: the degree of integration and the diversification of foreign trade. We do not get general support for the hypotheses. We notice that the criteria lead to different conclusions depending on the nature and the origin of the shock.

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

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 uskottavaa kytkentää Euroopan Rahayksikköön, ECUun tai jäsenyyttä Euroopan talous- ja rahaliitossa. 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.

Tutkimus on osa tekijän laajempaa projektia. Tässä tutkimuksessa käytetään malliversiota, jossa taloudenpitäjät olettavat kuluvan periodin häiriöiden vaikutusten valuuttakursseihin ja inflaatioon muuttuvan seuraavalla periodilla vastakkaismerkkisiksi, jolloin häiriöiden pitkän ajan vaikutus eliminoituu. Taloudenpitäjillä on tällä tavoin määriteltynä rationaaliset odotukset valuuttakurssien ja inflaation suhteen.

Mallissa tuottajahinnat ovat yhdessä ääripäässä kiinteät ja tuotanto määräytyy kysynnän mukaan, toisessa ääripäässä kotimaiset tuottajahinnat reagoivat täysimääräisesti ulkomaisten hintojen muutokseen. Malli sisältää tarjontakäyrän, jonka kautta tuottajahinnat muuttuvat häiriön seurauksena. 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. Tällä mallilla saadut tulokset eivät poikkea kovin paljon aiemmin käytetyllä staattisten odotusten mallilla saaduista (ETLA Discussion Paper no. 399). Valuuttakurssiunionin kannalta ongelmallisimpia ovat unionikumppanimaassa tapahtuvat rahataloudelliset ja tuottavuushäiriöt, koska näissä tapauksissa valuuttakurssimuutokset vahvistavat ulkomaisen kysynnän ja koron muutosten vaikutusta. Kelluvat kurssit vakauttavat käytetyssä perusskenaariossa parhaiten pienen maan hintatason ulkomaisilta häiriöiltä. Aiemmassa tutkimuksessa käytetyssä staattisten odotusten mallissa korijärjestelmä vakautti parhaiten hintatason.

Tutkimuksen lopussa tarkastellaan eri valuuttakurssijärjestelmien kykyä suojata pienen maan kansantalous häiriöiltä kahden optimivaluutta-alueen kriteerin, integraation asteen ja ulkomaankaupan diversifikaation, suhteen. Tutkimuksessa ei saada yleistä tukea hypoteeseille, että suurempi ulkomaankaupan integraatio jonkin maa-alueen kanssa tai suuri ulkomaankaupan diversifikaatio lisäisivät valuuttaunion toivottavuutta. Kriteerit johtavat erilaisiin johtopäätöksiin häiriön luonteesta ja alkuperästä riippuen.

CONTENTS

1. INTRODUCTION

This paper is the fourth report of a project, where exchange rate unions are compared with currency basket and floating rate regimes in the framework of a three-country macroeconomic model. The previous reports are Kotilainen (1991a, 1991b and 1992). The last-mentioned report incorporates the analysis of the two first-mentioned ones and extends the scope.

The comparison of the exchange rate regimes takes place with respect to the effects of different kinds of shocks. Recent developments in the international economy remind us that the shocks are still there and can crucially affect the economies and welfare of individuals. It is thus important to study how different kinds of shocks are transmitted in different exchange rate regimes.

The shocks studied are goods demand, monetary and productivity (supply) shocks. These three shocks can occur in the small home country or in either of the two big countries. The exchange rate between the big countries is floating. The comparison of the regimes takes place in the case of the small country. The basic idea in using a three-country model is that in the case of foreign shocks the mechanisms of the three regimes differ depending on in which of the big countries the shock originates. (For more about the model and the alternative approaches, see Kotilainen 1992.)

The model tries to shed light on the options of a small European country like Finland or the other Nordic countries in the face of European monetary integration. The big countries can denote "the USA" or "the rest of the world" (country 1) and "the EMU" or "a hard EMS" (country 2). The small country is modelled in a recursive way, i.e.

the big countries affect the small one but not the other way round.

The exchange rate union alternative for the small country means a credible fixed exchange rate with respect to country 2. In the currency basket exchange rate regime the trade-weighted exchange rate is kept constant. Also in this case the peg is assumed to be credible. In forthcoming versions of the model this assumption is to be released. The floating rate regime is modelled in a way where the exchange rate is determined on the basis of the fundamentals. Foreign exchange market imperfections are thus not assumed to exist.

The models used in the studies are IS-LM models of the Dornbusch type. The first version was a fixed price model with traditional Mundell-Fleming implications in the cases of domestic goods demand and monetary shocks. The inclusion of the foreign shocks was, however, a new element. The second version included a supply curve whereby the supply of goods was affected by prices. This addition made possible the analysis of supply shocks. Both of the previous model versions were static with static exchange rate expectations.

The current model version is structurally similar to the previous ones, but the exchange rate and price expectations are now rational, which allows the interest rates to differ between countries. The shocks are now temporary so that the exchange rate and price changes occurring this period are assumed to be reversed next period.[1]

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[1]In a forthcoming report (Kotilainen, 1993) a continuous time dynamic three-country model with rational expectations is built. Therein the adjustment paths of

The solutions of the models are presented analytically, when possible. In the case of foreign shocks it is, however, very difficult to obtain *a priori* results, because even a rather simple model for a single country becomes complicated, when it is solved simultaneously with models for two other countries. In these cases the results are obtained through numerical simulations with sensitivity analyses.

In the next section the structure of the model is presented. After that in section 3 the effects of domestic goods demand, monetary and supply shocks are analyzed in the cases of floating and fixed exchange rates. The exchange rate union and the basket peg do not differ in this respect. In sections 4-6 the effects of the three shocks occurring in both of the big countries are analyzed. In each section we study first the effects on the big countries and after that the effects on the small country in the cases of the three exchange rate regimes. In section 7 the exchange rate regimes are compared on the basis of the results obtained. In section 8 the effects of the shocks are studied with reference to two important criteria for optimum currency areas: the degree of foreign trade integration and the diversification of foreign trade. The summary and conclusions are presented in section 9.

2. STRUCTURE OF THE MODEL

The model used here belongs to the IS-LM (Mundell-Fleming) model family. The way of presenting the open economy aspects of the economy is similar to that used by Rudiger Dornbusch. These types of models are often called

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economic variables are investigated in different regimes.

Dornbusch type models. Three-country models of this type are very rare. There are, however, some two-country models which resemble those used here. (See Dornbusch 1980, p. 199; Argy and Salop 1983; Buiter 1986; Wohltmann 1991.) There are nevertheless some three-country models (of a different type) which have similarities to the model used here. (For simulation models see Callan 1989.) Among the models which have influenced my approach it is also necessary to mention Marston (1985), where exchange rate unions were analyzed in the framework of a two-country model. The traditional theories of optimum currency areas have connections to my approach, too. Some parameters of the model can be interpreted to present criteria for optimum currency areas (see section 8.)

Each country model of the three-country system used in this study consists of the money market equilibrium (LM) condition, goods demand and supply equations and the uncovered interest rate parity condition. Goods are assumed to be imperfect substitutes. Capital mobility is free between countries and speculators are assumed to be risk-neutral. This implies that assets of different countries are perfect substitutes.

The LM curve is traditional so it needs no clarification. The goods demand equation consists of the real expected interest rate, competitiveness and foreign demand terms. The domestic supply of goods is affected by foreign and domestic prices. The equation is written for changes in domestic prices which are determined on the basis of foreign prices and domestic output.

In this model version we study the effects of temporary shocks. Rationality of exchange rate and price expectations means here that the agents expect the changes in these variables to be reversed in the next period. In this respect the model resembles that of Aizenman (1985).

The exchange rate between the big economies is floating and it is determined when solving the two big country models simultaneously. To simplify the analysis and to put emphasis on the effects of the exchange rate regimes the big countries are assumed to be symmetrical. In the small country the exchange rate regimes are modelled through the competitiveness term in the goods demand equation and through the uncovered interest rate arbitrage condition.

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

<u>Country 1 ("the USA" or "the rest of the world":</u>

(1) $m_1 - p_1 = ky_1 - \Phi i_1$

(2) $y_1 = -\mu(i_1 - \Delta p_1^e) + \sigma(e + p_2 - p_1) + \epsilon y_2 + f_1$

(3) $\Delta p_1 = \alpha(\Delta e + \Delta p_2) + \beta y_1 - s_1$

(4) $i_1 = i_2 + \Delta e^e$

(5) $\Delta p_1^e = p_{1\ (+1)}^e - p_1$

(6) $\Delta p_1 = p_1 - p_{1(-1)}$

(7) $\Delta e^e = e^e_{(+1)} - e$

(8) $\Delta e = e - e_{(-1)}$

(9) $c = e + p_2 - p_1$.

When assuming that the shocks are <u>temporary</u>, we can write:

(10) $\Delta p_1^e = -\Delta p_1$

(11) $\Delta e^e = -\Delta e$

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

$$(12)\ m_2 - p_2 = ky_2 - \Phi i_2$$
$$(13)\ y_2 = -\mu(i_2 - \Delta p_2^e) - \sigma(e + p_2 - p_1) + \epsilon y_1 + f_2$$
$$(14)\ \Delta p_2 = \alpha(\Delta p_1 - \Delta e) + \beta y_2 - s_2$$
$$(15)\ \Delta p_2^e = p_{2\ (+1)}^e - p_2$$
$$(16)\ \Delta p_2 = p_2 - p_{2(-1)}.$$

When the shocks are temporary, we write:

$$(17)\ \Delta p_2^e = -\Delta p_2.$$

Country 3 ("Finland"):

$$(18)\ m_3 - p_3 = k_3 y_3 - \Phi_3 i_3$$
$$(19)\ y_3 = -\mu_3(i_3 - \Delta p_3^e) + \sigma_3[\theta(e_{31} + p_1 - p_3) + (1 - \theta)(e_{32} + p_2 - p_3)] + \epsilon_3[\theta y_1 + (1 - \theta)\ y_2] + f_3$$
$$(20)\ \Delta p_3 = \alpha_3[\theta(\Delta e_{31} + \Delta p_1) + (1 - \theta)(\Delta e_{32} + \Delta p_2)] + \beta_3 y_3 - s_3$$
$$(21)\ \Delta p_3^e = p_{3\ (+1)}^e - p_3$$
$$(22)\ \Delta p_3 = p_3 - p_{3(-1)}$$
$$(23)\ \Delta e_{32}{}^e = e_{32(+1)}{}^e - e_{32} \quad \text{(floating)}$$
$$(24)\ c_3 = \theta(e_{31} + p_1 - p_3) + (1 - \theta)(e_{32} + p_2 - p_3)$$
$$(25)'\ i_3 = i_2 + \Delta e_{32}{}^e \ \text{(floating)}$$
$$(25)''\ i_3 = i_2 \ \text{(EMU-peg, credible rate)}$$
$$(25)'''\ i_3 = \theta i_1 + (1 - \theta) i_2 \ \text{(basket peg, credible rate).}$$

When the shocks are temporary, we write:

$$(26)\ \Delta p_3^e = -\Delta p_3$$
$$(27)\ \Delta e_{32}{}^e = -\Delta e_{32}.$$

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. "Competitiveness" c is defined as a trade-weighted average of the bilateral relative prices.

All coefficients of the model as defined above are non-negative. We also assume that $0 < \epsilon_1, \epsilon_2, \epsilon_3 < 1$ (the demand of a country cannot be more important for a foreign country than it is for the home country) and $0 \leq \theta \leq 1$. The superscript e refers to expectations, the subscripts (+1) and (-1) to the next and the previous periods, respectively and Δ means a change in the variable.

The countries are assumed to produce tradeable goods which can be somewhat different. This difference is reflected in the values of σ:s. The purchasing power parity condition (PPP) is not required in the model. The absolute PPP holds if $\alpha_1 = \alpha_2 = \alpha_3 = 1$ and $\beta_1 = \beta_2 = \beta_3 = 0$.

After replacing the expected variables by the values of the next period (reversed shocks) and changes (Δe:s and Δp:s) by the differences, we obtain a model which we solve with respect to the shocks. The (symmetric) big country models are solved simultaneously. The small country model is solved recursively for each exchange rate regime.

In the big country model y_1, y_2, p_1, p_2, e, c, i_1 and i_2 are now endogenous variables. In the small country model y_3, p_3 and c_3 are endogenous in all regimes. The interest rate is endogenous in the floating rate and in the basket peg regimes. The uncovered interest parity condition for the basket peg regime (equation (25)''') is obtained by solving Δe_{31}^e and Δe_{32}^e from the bilateral interest rate parity conditions $i_3 = i_1 + \Delta e_{31}^e$ and $i_3 = i_2 + \Delta e_{32}^e$ and by inserting the results into the trade-weighted currency index $\theta\Delta e_{31}^e + (1 - \theta)\Delta e_{32}^e = 0$. It is assumed that the index is known by the economic agents. In the exchange rate union the interest rate is the same as in country 2 as shown in equation (25)''.

In the floating exchange rate regime also one of the bilateral exchange rates, e_{31} or e_{32}, is determined endogenously. 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 solutions are presented with analytical formulas as far as it is possible. In addition, numerical simulations with sensitivity analyses are presented.

3. DOMESTIC SHOCKS

The effects of domestic shocks are analyzed by solving the small country model with respect to goods demand, monetary and supply shocks. Because we do not assume any differences between the EMU and basket peg regimes with respect to credibility, the regimes do not differ in the case of domestic shocks. They both are fixed exchange rate regimes.

In the case of domestic **goods demand shocks** we obtain for floating rates the following results:

$$(28)\ \frac{\delta y_3}{\delta f_3}=\frac{\alpha_3+\phi_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}>0,$$

$$(29)\ \frac{\delta p_3}{\delta f_3}=\frac{-\alpha_3k_3+\beta_3\phi_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3},$$

$$(30)\ \frac{\delta e_{32}}{\delta f_3}=\frac{-\beta_3-k_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}<0,$$

$$(31)\ \frac{\delta c_3}{\delta f_3}=\frac{-\beta_3-k_3+\alpha_3k_3-\beta_3\phi_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}<0.$$

$$(32)\ \frac{\delta i_3}{\delta f_3}=\frac{\beta_3+k_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}>0.$$

The denominator of the above expressions is positive for the values $\alpha_3 \leq 1$, which we can assume to hold, i.e. changes in the foreign price level change domestic prices by a smaller or by an equal amount. We can thus show a *priori* that the output of the small country increases when there is a positive goods demand shock, for example due to unexpectedly increased foreign demand or due to an uncompensated expansive fiscal policy.

The output effect is positive if α_3 or Φ_3 > 0. In the previous model version with static expectations (permanent shocks), output was insulated when $\alpha_3 = 0$ (Kotilainen 1992, 58). The positive demand effect is not compensated for by the deteriorating competitiveness (due to the appreciating exchange rate) and by the rising interest rate. The direction in the change of prices is not known a *priori*. The increasing demand tends to rise prises, but the appreciating exchange rate tends to decrease them.

In <u>the fixed exchange rate regimes</u> output and prices increase in response to a positive goods demand shock. The effect is smaller than in the previous model with static expectations (permanent shocks) (Kotilainen 1992, 59). Competitiveness deteriorates due to rising domestic prices. The interest rate is not affected, because we assume that the peg is credible. We obtain the following results:

$$(33)\ \frac{\delta y_3}{\delta f_3}=\frac{1}{1+\beta_3\mu_3+\beta_3\sigma_3}>0,$$

$$(34)\ \frac{\delta p_3}{\delta f_3}=\frac{\beta_3}{1+\beta_3\mu_3+\beta_3\sigma_3}>0,$$

$$(35)\ \frac{\delta c_3}{\delta f_3}=\frac{-\beta_3}{1+\beta_3\mu_3+\beta_3\sigma_3}<0.$$

It can be shown a *priori* that the output effect is greater in the fixed than in the floating rate regime when $\alpha_3 < 1$. When $\alpha_3 = 1$, there is no difference between the regimes with respect to output reactions.

In the case of **monetary shocks** we obtain for <u>floating rates</u> the following results:

$$(36)\ \frac{\delta y_3}{\delta m_3}=\frac{\mu_3-\alpha_3\mu_3+\sigma_3-\alpha_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3},$$

$$(37)\ \frac{\delta p_3}{\delta m_3}=\frac{\alpha_3+\beta_3\mu_3+\beta_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}>0,$$

$$(38)\ \frac{\delta e_{32}}{\delta m_3}=\frac{1+\beta_3\mu_3+\beta_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}>0,$$

$$(39)\ \frac{\delta c_3}{\delta m_3}=\frac{1-\alpha_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3},$$

$$(40)\ \frac{\delta i_3}{\delta m_3}=-\frac{1+\beta_3\mu_3+\beta_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}<0.$$

If the monetary shock is an increase in the money supply or a decrease in money demand, output increases assuming $\alpha_3 < 1$. If $\alpha_3 = 1$, the neutrality of the money result is obtained. This is due to the competitiveness reaction. If $\alpha_3 = 1$, there is no change in competitiveness in the current model, because the increase in prices eliminates the positive effects of the depreciation of the currency and the decline of the interest rate.

In the <u>fixed exchange rate regime</u> the neutrality of the money result holds always. There is no change in output, prices, competitiveness or the interest rate. International capital flows mitigate immediately any effects of the changes in money sypply or demand. This is analogous to the results obtained in the fixed price Mundell-Fleming models.

In the case of a domestic **supply (productivity) shock** we obtain the following results for floating exchange rates:

$$(41)\ \frac{\delta y_3}{\delta s_3}=\frac{\mu_3+\mu_3\phi_3+\sigma_3+\phi_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}>0,$$

$$(42)\ \frac{\delta p_3}{\delta s_3}=-\frac{k_3\mu_3+\phi_3+k_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}<0,$$

$$(43)\ \frac{\delta e_{32}}{\delta s_3}=\frac{1-k_3\mu_3-k_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3},$$

$$(44)\ \frac{\delta c_3}{\delta s_3}=\frac{1+\phi_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}>0,$$

$$(45)\ \frac{\delta i_3}{\delta s_3}=\frac{-1+k_3\mu_3+k_3\sigma_3}{\alpha_3+\beta_3\mu_3+k_3\mu_3-\alpha_3k_3\mu_3+\phi_3+\beta_3\mu_3\phi_3+\beta_3\sigma_3+k_3\sigma_3-\alpha_3k_3\sigma_3+\beta_3\phi_3\sigma_3}.$$

When analysing the effects of a productivity shock, we assume that the supply of money remains unchanged. Therefore there is an increase in the real money balances in the case of a productivity shock as well as in the case of a monetary shock.

A rise in the productivity of the small country leads to an increase in output. Domestic producer prices decline and competitiveness improves. The sign of the exchange and interest rate reactions cannot be shown a *priori*. These effects are linked to each other. If one increases, the other decreases by the same amount.

In the fixed exchange rate regimes output increases because of the decline in prices. Because there is no change in the exchange rate, competitiveness improves correspondingly. The interest rate is determined at the international level. We obtain the following results:

$$(46)\ \frac{\delta y_3}{\delta s_3}=\frac{\mu_3+\sigma_3}{1+\beta_3\mu_3+\beta_3\sigma_3}>0,$$

$$(47)\ \frac{\delta p_3}{\delta s_3}=-\frac{1}{1+\beta_3\mu_3+\beta_3\sigma_3}<0,$$

$$(48)\ \frac{\delta c_3}{\delta s_3}=\frac{1}{1+\beta_3\mu_3+\beta_3\sigma_3}>0.$$

When $\alpha_3 = 1$ there is again no difference between the exchange rate regimes with respect to output reactions. When $\alpha_3 < 1$, output changes more in the floating rate regime if $k_3(\mu_3 + \sigma_3) < 1$, which holds for relevant values of the parameters.[1]

[1]The sum of the interest rate semielasticity of money demand and of the "competitiveness elasticity" of goods demand can be assumed to be less than one. The income elasticity of money demand can also be assumed to be usually less than or equal to 1.

With respect to the insulation properties of the exchange rate regimes we can conclude that floating rates insulate the output better against domestic goods demand shocks than fixed exchange rates. Fixed rates, however, insulate the output better against monetary shocks. For relevant parameter values it can also be shown that fixed rates insulate the output more also against domestic productivity shocks. In the long run, illustrated as a situation when domestic prices respond fully to changes in the exchange rate, there is no difference between the exchange rate regimes.

The ranking of the regimes with respect to the insulation properties as presented above is consistent with the results obtained in the previous models. There are, however, differences in the magnitudes of the effects.

4. GOODS DEMAND SHOCKS IN THE BIG COUNTRIES

4.1 Shocks occurring in country 1

4.1.1 Effects on the big countries

We assume that there is a goods demand shock in country 1 ("the USA") due to, for example, an expansionary fiscal policy, which is unexpected to be followed in this period but which is assumed to be reversed in the next period so that the exchange rate and prices return to the "normal" level. We study now the effects of this shock on "the USA" and on "the EMU" (country 2) in a two-country model.

The general a *priori* results are too complicated to be presented. We can, however, present a *priori* results for two extreme cases: (1) for the fixed price case ($\alpha = \beta = 0$) and (2) for the flexible price case ($\alpha = 1$). For the intermediate values of these variables we present a numerical analysis based on relevant values of the parameters and make sensitivity analyses.

In the fixed price case the output reactions are as follows:

$$(49)\ \frac{\delta y_1}{\delta f_1}=\frac{\phi(k\mu+\phi+k\sigma)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)}>0,$$

$$(50)\ \frac{\delta y_2}{\delta f_1}=\frac{\phi(\epsilon\phi+k\sigma)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)}>0.$$

The outputs of both big countries increase if the shock is positive. The denominator of the above expressions is positive, because we can assume that $0 < \epsilon < 1$. The change in output is greater in "the USA", where the shock originates. The exchange rate of "the USA" appreciates. Interest rates of both countries increase, that of "the USA" by more than that of "the EMU". The above result is different from that obtained in the model with static expectations (permanent shocks), where the outputs of both countries increase by an equal amount.

In the flexible price case a beggar-thy-neighbour result is obtained. In country 1 the output increases if the shock is positive, but in country 2 it declines by the same amount:

$$(51)\ \frac{\delta y_1}{\delta f_1}=\frac{1}{2+2\epsilon+\beta\mu+2\beta\sigma}>0,$$

$$(52)\ \frac{\delta y_2}{\delta f_1} = -\frac{1}{2+2\epsilon+\beta\mu+2\beta\sigma} < 0,$$

The exchange rate of country 1 appreciates. Interest rates in both countries increase, in country 1 by more. Prices rise in country 2. The rise of prices in country 1 is not clear a *priori*, but it is very probable.

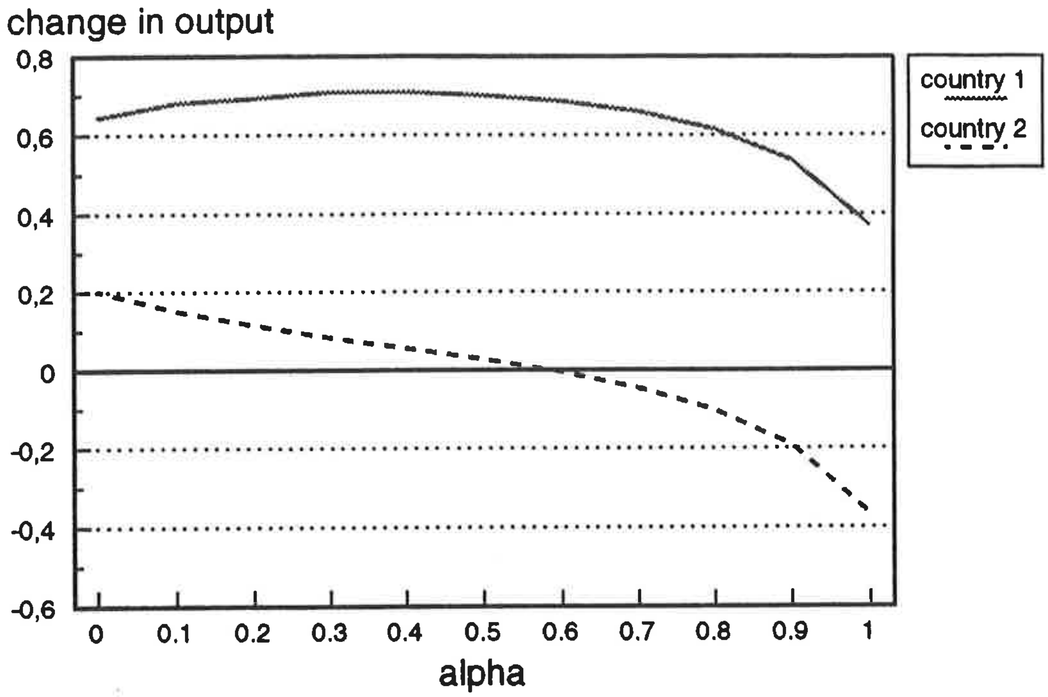
We now present numerically a scenario which is between the two extremes. The numerical values of the parameters are partly based on econometric studies and partly "guesstimates". The values of the parameters of this baseline scenario and their motivations are presented in appendix 1. For the parameter α we have chosen the value of 0.1, which is motivated by the direct and indirect import content of the demand in big economic areas like the USA and the EC.

The numerical results in the baseline scenario are as follows:

$\delta y_1/\delta f_1 = 0.680$, $\delta y_2/\delta f_1 = 0.151$
$\delta p_1/\delta f_1 = 0.140$, $\delta p_2/\delta f_1 = 0.137$
$\delta e/\delta f_1 = -0.777$, $\delta c/\delta f_1 = -0.780$
$\delta i_1/\delta f_1 = 1.295$, $\delta i_2/\delta f_1 = 0.518$.

A sensitivity analysis with respect to different values of the parameter α between 0 and 1 is presented in figure 1. The values of the other parameters are as in the baseline scenario.

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



4.1.2 Effects on the small country

In the analysis of the effects of foreign shocks on the small economy we insert the results of the big country model into the small country model, which we then solve with respect to the shocks studied. The large economies thus have an impact on the small one but not the other way round. For the small country it is even more difficult to obtain *a priori* results than for the large ones.

In the case of flexible prices ($\alpha = \alpha_3 = 1$) we obtain the following result for the output of the small country in all exchange rate regimes studied:

$$(53)\ \frac{\delta y_3}{\delta f_1}=\frac{-\epsilon_3\mu-\mu_3-\epsilon\mu_3-\beta\mu_3\sigma+2\epsilon_3\mu\theta-\beta\mu\mu_3\theta}{\mu(2+2\epsilon+\beta\mu+2\beta\sigma)(1+\beta_3\mu_3+\beta_3\sigma_3)}.$$

In this case we cannot say *a priori* whether the output of the small country increases or decreases. We can say for sure that the expression is negative if there is no trade with the growing economy ("the USA"), i.e. $\theta = 0$.

The "neutrality of the exchange rate regime" result is the same as obtained in the model with static expectations (permanent shocks) as well as in the case of domestic shocks with the current model. The differences between the regimes thus exist only when there is some rigidity in prices.

In the <u>floating exchange rate regime</u> the output of the small country increases after a positive goods demand shock occurring in country 1 if prices are fully fixed ($\alpha = \alpha_3 = \beta = \beta_3 = 0$). In this case we obtain:

$$(54)\ \frac{\delta y_3}{\delta f_1}=\frac{-(\phi_3(\epsilon_3\phi+k\sigma_3)(-\epsilon\phi-k\sigma-k\mu\theta-\phi\theta+\epsilon\phi\theta)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)(k_3\mu_3+\phi_3+k_3\sigma_3)}>0.$$

The above expression is positive, because we assume that $\epsilon < 1$. The positiveness is due to the positive export demand effect (see expressions (49) and (50)) and due to the obviously improving competitiveness. The increasing interest rate has a negative effect.

In the baseline scenario it is assumed that $\alpha = 0.1$ and $\alpha_3 = 0.3$. The small country is thus more open and correspondingly more affected by the exchange rate and international prices than the large ones. The share of country 2 ("the EMU") in the foreign trade of the small economy is assumed to be 0.7. (About the motivations of the assumption see appendix 1.)

In the baseline scenario we obtain:

$\delta y_3/\delta f_1 = 0.123$ $\qquad$ $\delta p_3/\delta f_1 = 0.151$
$\delta e_{32}/\delta f_1 = 0.010$ $\qquad$ $\delta c_3/\delta f_1 = 0.230$
$\delta i_3/\delta f_1 = 0.508.$

The exchange rate changes only slightly with respect to "the EMU", but it depreciates substantially with respect to "the USA".

In the <u>exchange rate union</u> with country 2 ("the EMU") the output effect is probably positive in the case of fully fixed prices, because the negative terms are relatively small (obs: ϵ and $\epsilon_3 < 1$), but this cannot be shown for certain:

$$(55)\ \frac{\delta y_3}{\delta f_1} = \frac{-(\epsilon k\mu_3\phi - \epsilon\epsilon_3\phi^2 + k^2\mu_3\sigma - \epsilon_3 k\phi\sigma - \epsilon_3 k\mu\phi\theta - \epsilon_3\phi^2\theta + \epsilon\epsilon_3\phi^2\theta - k^2\mu\sigma_3\theta - k\phi\sigma_3\theta + \epsilon k\phi\sigma_3\theta)}{(k\mu + \phi - \epsilon\phi)(k\mu + \phi + \epsilon\phi + 2k\sigma)}.$$

In the baseline scenario (with somewhat changing prices) we obtain:

$\delta y_3/\delta f_1 = 0.120,$ $\qquad$ $\delta p_3/\delta f_1 = 0.147$
$\delta c_3/\delta f_1 = 0.224.$ $\qquad$ $\delta i_2/\delta f_1 = 0.518.$

The output increases due to rising export demand (see page 16) and improving competitiveness. The rise in the interest rate (of the same magnitude as in country 2) affects the output negatively.

In the <u>currency basket exchange rate regime</u> we obtain for the output in the case of fixed prices as follows:

$$(56)\ \frac{\sigma y_3}{\sigma f_1} = \frac{-(k\mu_3 - \epsilon_3\phi)\,(\epsilon\phi + k\sigma + k\mu\theta + \phi\theta - \epsilon\phi\theta)}{(k\mu + \phi - \epsilon\phi)\,(k\mu + \phi + \epsilon\phi + 2k\sigma)}\ .$$

The sign of this expression is not clear a *priori* either. It is positive if $\epsilon_3\Phi < k\ \mu_3$, i.e. it depends positively on the domestic income elasticity with respect to foreign demand and negatively on the domestic interest rate semielasticity of goods demand. The result depends also on the magnitudes of the foreign money demand parameters.

In the baseline scenario we obtain:

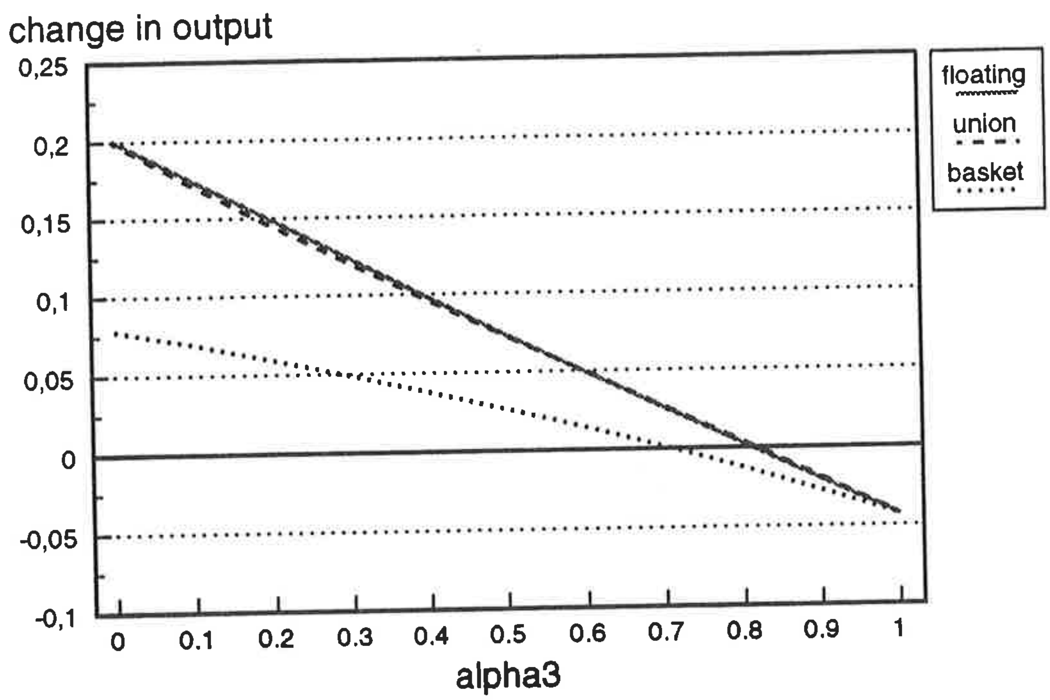
$\delta y_3/\delta f_1 = 0.049$, $\delta p_3/\delta f_1 = 0.056$

$\delta c_3/\delta f_1 = 0.082$. $\delta i_3/\delta f_1 = 0.751$.

The output changes only slightly. Because the effective exchange rate is stabilized, competitiveness remains rather stable. The positive effect due to foreign demand is largely offset by the increase in the interest rate.

In figure 2 a sensitivity analysis for different values of the elasticity of domestic prices with respect to foreign prices is presented. We assume $\alpha_3 = 3 * \alpha$, while for other parameters the baseline scenario is used. It is shown that in this case the basket beg regime insulates the domestic output more than the other regimes in the case of rather rigid prices. When flexibility of prices increases, differences become smaller. Floating and the exchange rate union do not differ essentially with respect to the insulation properties. These results are analogous to those obtained in the model with static expectations and permanent shocks (Kotilainen 1992, 68). Output changes now, however, less in all regimes, and the (absolute) differences between the regimes are smaller.

Figure 2. Goods demand shock in country 1: sensitivity of output in the small country with respect to α and α_3 ($\alpha_3 = 3 * \alpha$)



Prices are also stabilized more in the basket peg regime than in the two other ones. This is due to the fixed trade-weighted exchange rate in this regime. The interest rate increases more in the basket peg regime than in the other two, because country one's interest rate affects more in this regime (see equation (25)'''on page 6). The increasing interest rate has, however, a stabilizing effect on the economy.

4.2 Shocks occurring in country 2

4.2.1 Effects on the big countries

Because the big countries are assumed to be symmetric, the shock occurring in country 2 has the same effects as that occurring in country 1. The countries just change places. In the baseline scenario the results are as follows:

$$\delta y_1/\delta f_2 = 0.151, \qquad \delta y_2/\delta f_2 = 0.680$$
$$\delta p_1/\delta f_2 = 0.137, \qquad \delta p_2/\delta f_2 = 0.140$$
$$\delta e/\delta f_2 = 0.777, \qquad \delta c/\delta f_2 = 0.780$$
$$\delta i_1/\delta f_2 = 0.518, \qquad \delta i_2/\delta f_2 = 1.295.$$

The output of country 2 ("the EMU"), which is the more important trading partner for the small country grows now more. Its exchange rate appreciates and its interest rate increases substantially.

4.2.2 Effects on the small country

In the case of flexible prices ($\alpha = \alpha_3 = 1$) we obtain the following result for the output of the small country in all exchange rate regimes:

$$(57)\ \frac{\delta y_3}{\delta f_2} = \frac{-(-\epsilon_3\mu+\mu_3+\epsilon\mu_3+\beta\mu\mu_3+\beta\mu_3\sigma+2\epsilon_3\mu\theta-\beta\mu\mu_3\theta)}{\mu(2+2\epsilon+\beta\mu+2\beta\sigma)(1+\beta_3\mu_3+\beta_3\sigma_3)}.$$

We do not know *a priori* whether the expression is positive or negative. If there is no trade with the growing economy ("the EMU") ($\theta = 1$), we can show for sure that the effect is negative.

In the floating exchange rate regime the output of the small country increases when prices are rigid, i.e. $\alpha = \alpha_3 = \beta = \beta_3 = 0$. In this case we obtain:

$$(58)\ \frac{\delta y_3}{\delta f_2} = \frac{-\phi_3(\epsilon_3\phi+k\sigma_3)(-k\mu+k\mu\theta-\phi+\phi\theta-k\sigma-\epsilon\phi\theta)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)(k_3\mu_3+\phi_3+k_3\sigma_3)} > 0.$$

The expression is positive, because $\theta \leq 1$. The growing foreign demand and the probably improving competitiveness contribute to this. The rising interest rate has a negative impact on output.

In the baseline scenario we have the following numerical results:

$\delta y_3/\delta f_2 = 0.205$ $\delta p_3/\delta f_2 = 0.201$

$\delta e_{32}/\delta f_2 = 0.560$ $\delta c_3/\delta f_2 = 0.264$

$\delta i_3/\delta f_2 = 0.736.$

In the exchange rate union with "the EMU" competitiveness and the interest rate go along with those of the union partner. These variables have a negative impact on output. In the fixed price case the foreign demand affects the output clearly positively. The net effect is not, however, known a *priori*.

In the baseline scenario we obtain.

$\delta y_3/\delta f_2 = 0.035,$ $\delta p_3/\delta f_2 = -0.018$
$\delta c_3/\delta f_2 = -0.076,$ $\delta i_2/\delta f_2 = 1.295.$

The interest rate and competitiveness impacts eliminate the effect due to foreign demand, and output remains almost unchanged.

In the <u>currency basket exchange rate regime</u> the effect of the shock on output in the case of rigid prices is not known a *priori* either:

$$(59)\ \frac{\delta y_3}{\delta f_2} = \frac{(k\mu_3-\epsilon_3\phi)(-k\mu-\phi-k\sigma+k\mu\theta+\phi\theta-\epsilon\phi\theta)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)}.$$

The effect is positive if the goods demand elasticity with respect to foreign demand (ϵ_3) is large compared to the interest rate semielasticity (μ_3). The result depends also on the foreign money demand parameters.

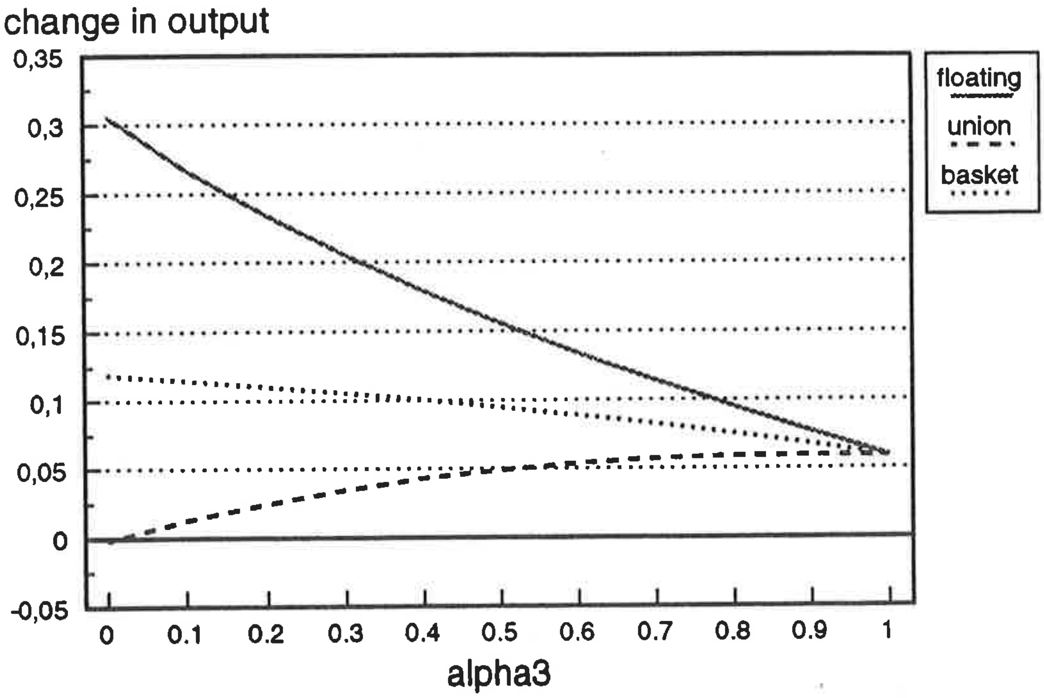
In the baseline scenario we obtain:

$\delta y_3/\delta f_2 = 0.106,$ $\delta p_3/\delta f_2 = 0.073$
$\delta c_3/\delta f_2 = 0.066,$ $\delta i_3/\delta f_2 = 1.062.$

The interest rate increases, which has a negative impact on output. The foreign demand increases, however, enough to compensate for this negative effect. Competitiveness and prices remain almost unchanged.

In the sensitivity analysis presented in figure 3 we notice that in the baseline scenario output changes the least in the exchange rate union except for very high values of α and α_3. Differences are eliminated when $\alpha_3 = 1$. The currency basket regime leads to the second lowest change. In the floating rate regime the change is the largest. This is due to the fact that foreign demand and competitiveness affect in the same direction.

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



Prices are stabilized in the exchange rate union rather well for all values of α_3. Also in the currency basket regime producer prices change only a little when the value of α_3 is low, because the effect of foreign prices is small. In the case of floating the exchange rate affects prices. The interest rate changes the least in the floating rate regime, and the most in the exchange rate union, where the increasing interest rate of "the EMU" area is directly taken.

5. MONETARY SHOCKS IN THE BIG COUNTRIES

5.1 Shocks occurring in country 1

5.1.1 Effects on the big countries

The general *a priori* results are again too complicated to be presented here. The effects in the fixed price case ($\alpha = \beta = 0$) and in the flexible price case are, however, simple enough. For <u>fixed prices</u> we obtain:

$$(69)\ \frac{\delta y_1}{\delta m_1}=\frac{k\mu^2+\mu\phi+2k\mu\sigma+\phi\sigma-\epsilon\phi\sigma}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)}>0,$$

$$(70)\ \frac{\delta y_2}{\delta m_1}=\frac{\phi(\epsilon\mu-(1-\epsilon)\sigma)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)}.$$

The effect of, for example, an unexpected expansionary monetary policy in country 1 is positive on the home country. The effect on country 2 is not clear, however. The effect is positive if $\epsilon > \sigma/(\mu + \sigma)$, i.e. the greater the foreign demand elasticity and interest rate semielasticity are in relation to the competitiveness elasticity.

Competitiveness of country 1 improves and that of country 2 worsens. The interest rate of country 1 declines, the sign of the change in country 2 depends on the same condition as the output effect. The effect on country 2 differs from that obtained in the model with static expectations and permanent shocks, where the output effect was clearly negative.

In the <u>flexible price</u> case the neutrality-of-money result is obtained. The outputs of both country 1 and 2 are insulated. Prices in country 1 and the exchange rate are changed by $1/(1 + \Phi)$. The interest rate in "the USA" changes by $- 1/(1 + \Phi)$. Competitiveness as well as prices and interest rates in country 2 remain unchanged.

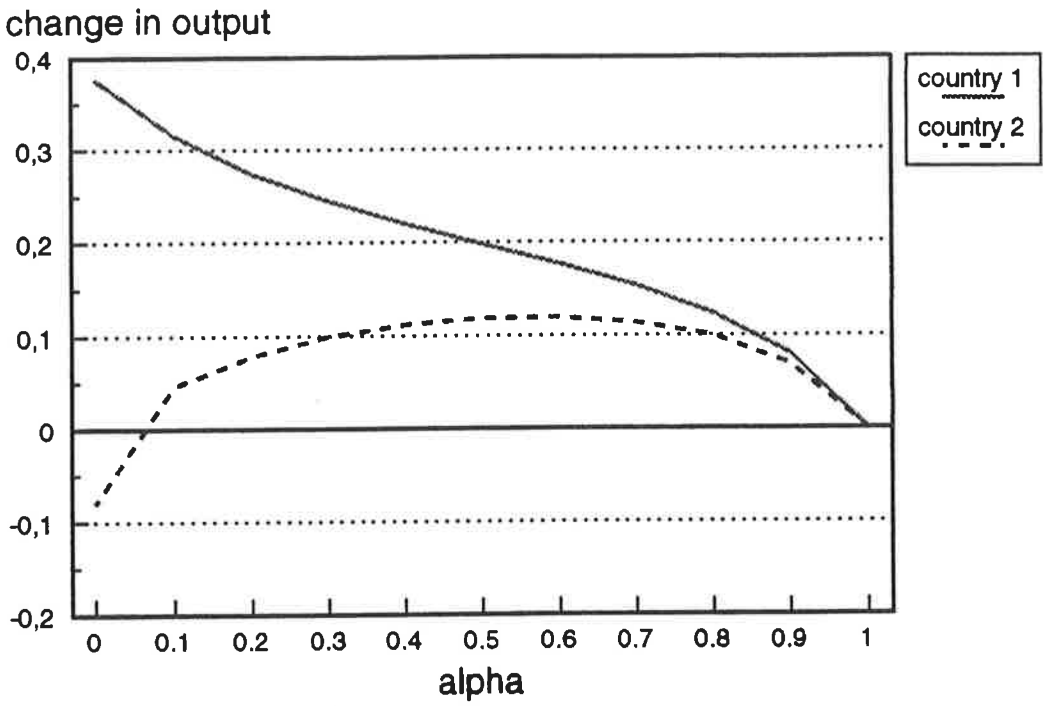
In the baseline scenario we obtain:

$$\delta y_1/\delta m_1 = 0.316, \qquad \delta y_2/\delta m_1 = 0.046$$
$$\delta p_1/\delta m_1 = 0.203, \qquad \delta p_2/\delta m_1 = - 0.082$$
$$\delta e/\delta m_1 = 1.162, \qquad \delta c/\delta m_1 = 0.877$$
$$\delta i_1/\delta m_1 = - 1.274, \qquad \delta i_2/\delta m_1 = - 0.112.$$

With a low value of $\alpha = 0.1$ the effects on country 2 are small. For country 1 the effects on output are rather big.

In figure 4 sensitivity of the effects on the outputs with respect to different values of α are presented. The effect on country 1 is big with low values of α, but gradually fades away when α grows. For country 2 the effect is small with low values of α, but it rises with intermediate values. With fully flexible prices ($\alpha = 1$) the neutrality-of-money result is obtained.

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



The greater α is, the more producer prices increase in country 1. In country 2 the decline in prices is the greatest with intermediate values of α. When α = 1, prices are insulated in country 2. Interest rates decrease in country 1 the more the lower α is. In country 2 the interest rate reactions are similar to those of prices.

5.1.2 Effects on the small country

In the flexible price case (α_3 = 1) the neutrality-of-money result with respect to output is obtained in all regimes. In the case of fixed prices no a *priori* conclusions can be drawn in any of the regimes.

In the floating exchange rate regime the baseline scenario gives the following results:

$$\delta y_3/\delta m_1 = 0.044 \qquad \delta p_3/\delta m_1 = -\ 0.087$$
$$\delta e_{32}/\delta m_1 = 0.012 \qquad \delta c_3/\delta m_1 = -\ 0.246$$
$$\delta i_3/\delta m_1 = -\ 0.124.$$

The change in output is largely eliminated by the change in competitiveness, which affects in the opposite direction compared to the foreign demand and interest rate. The exchange rate appreciates with respect to country one's currency.

In the exchange rate union with country 2 the situation is largely similar to that of floating. The exchange rate floats jointly against the currency of country 1 and affects in the opposite direction compared to foreign demand and interest rates. In the baseline scenario the results are as follows:

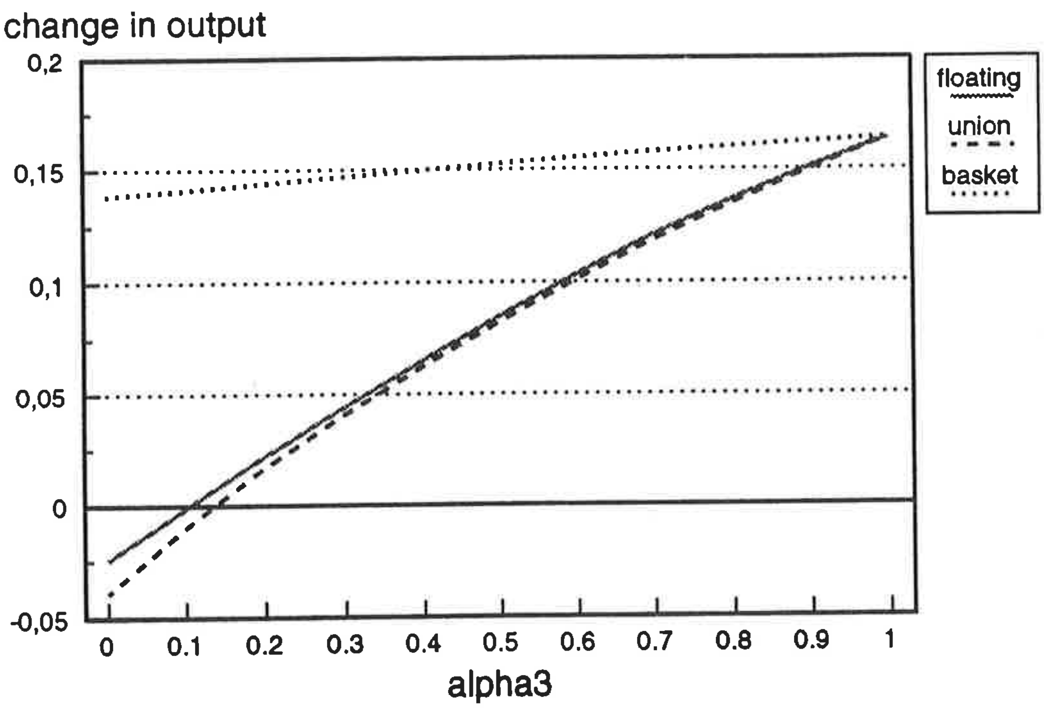
$$\delta y_3/\delta m_1 = 0.041 \qquad \delta p_3/\delta m_1 = -\ 0.091$$
$$\delta e_{31}/\delta m_1 = -1.162 \qquad \delta c_3/\delta m_1 = -\ 0.254$$
$$\delta i_2/\delta m_1 = -\ 0.112.$$

In the currency basket exchange rate regime the effective exchange rate is stabilized and competitiveness changes only slightly due to changes in prices. The foreign demand and the interest rate affect in the same direction and thus reinforce each other's effects. The interest rate changes more than in the previous regimes. The baseline scenario is as follows:

$$\delta y_3/\delta m_1 = 0.147 \qquad \delta p_3/\delta m_1 = 0.045$$
$$\delta c_3/\delta m_1 = -\ 0.042 \qquad \delta i_3/\delta m_1 = -\ 0.460.$$

Sensitivity analysis regarding the elasticity of domestic prices with respect to foreign prices is presented in figure 5. Output reactions in the floating rate regime and in the exchange rate union are very similar with all values of α and α_3. The basket peg regime insulates the output the least against this shock.

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



Competitiveness and prices, however, are insulated the most in the basket peg regime, whereas floating and the exchange rate union lead to greater changes. Interest rates change the most in the basket peg regime, because the change in country 1 has the greatest effect in this respect.

5.2 Shocks occurring in country 2

5.2.1 Effects on the big countries

Because of the symmetry assumption, the effects of a shock occurring in country 2 are mirror images of those in the case of a shock in country 1. The countries just change places:

$$\delta y_2/\delta m_2 = 0.316, \qquad \delta y_1/\delta m_2 = 0.046$$
$$\delta p_2/\delta m_2 = 0.203, \qquad \delta p_1/\delta m_2 = -\ 0.082$$
$$\delta e/\delta m_2 = -\ 1.162, \qquad \delta c/\delta m_2 = -\ 0.877$$
$$\delta i_2/\delta m_2 = -\ 1.274, \qquad \delta i_1/\delta m_2 = -\ 0.112.$$

Because we assume that country 2 is the more important trading partner for country 3, the export demand effects occurring after the shock are greater than in the case of the previous shock.

5.2.2 Effects on the small country

In the case of flexible prices ($\alpha = \alpha_3 = 1$) the neutrality-of-money with respect to output is again obtained in all regimes. Exchange rate, price and interest rate reactions differ, but competitiveness remains unchanged in all regimes. In the case of fixed prices it is not possible to obtain *a priori* results. In the following we again present the results in the baseline scenario.

In the <u>floating rate regime</u> the exchange rate and, accordingly, competitiveness change in a way which affects the output in the opposite direction than changes in export demand and interest rates. This tends to stabilize the output. In the baseline scenario we obtain:

$\delta y_3/\delta m_2 = 0.082$ $\delta p_3/\delta m_2 = -\ 0.154$

$\delta e_{32}/\delta m_2 = -\ 1.060$ $\delta c_3/\delta m_2 = -\ 0.440$

$\delta i_3/\delta m_2 = -\ 0.214.$

In the <u>exchange rate union</u> the change in the exchange rate and hence in competitiveness affect the output in the same direction as export demand and interest rates. The result is thus a great change in output. The same result was obtained also in the case of static expectations and permanent shocks. The outcome is as follows:

$\delta y_3/\delta m_2 = 0.405$ $\delta p_3/\delta m_2 = 0.261$

$\delta e_{31}/\delta m_2 = 1.162$ $\delta c_3/\delta m_2 = 0.205$

$\delta i_2/\delta m_2 = -\ 1.274.$

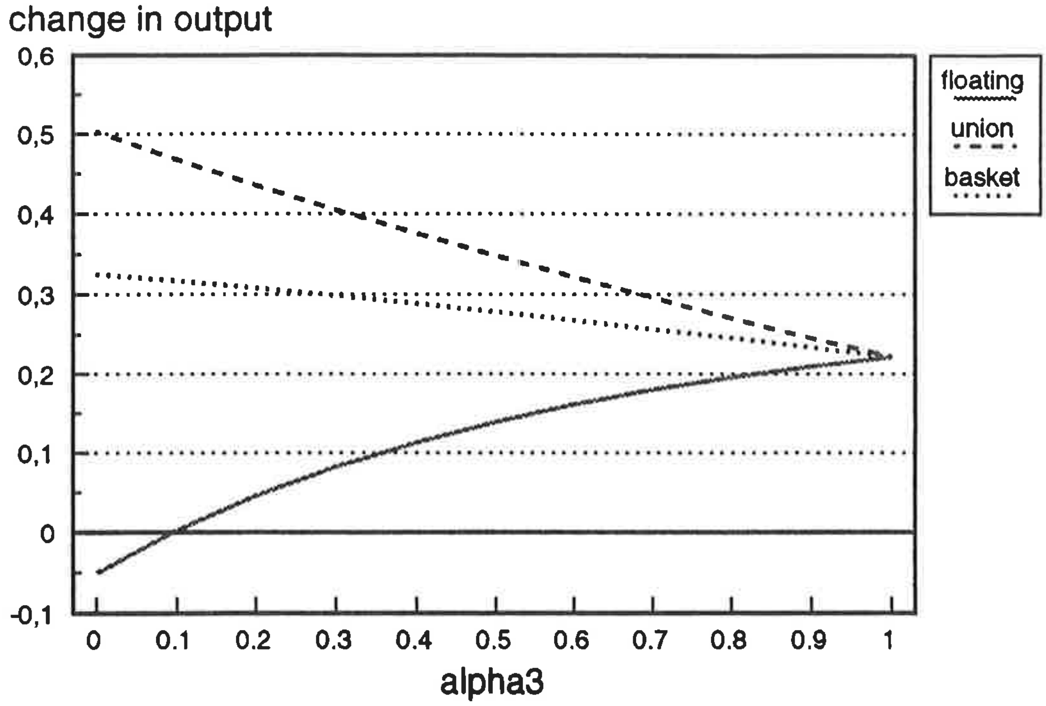
In the <u>currency basket exchange rate regime</u> competitiveness is almost stabilized. Export demand and interest rates, however, change the output in the same direction. Output changes in the baseline scenario less than in the exchange rate union but more than in the floating rate regime:

$\delta y_3/\delta m_1 = 0.299$ $\delta p_3/\delta m_1 = 0.125$

$\delta c_3/\delta m_1 = -\ 0.008$ $\delta i_3/\delta m_1 = -\ 0.925.$

The ranking of the regimes with respect to output stabilization remains the same as in the baseline scenario for all values of $\alpha_3 < 1$ (figure 6).

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



Producer prices change the most in the exchange rate union for all relevant values of α and α_3. Floating stabilizes prices the most for very small values of α:s, but then the basket peg produces the smallest deviation. The interest rate changes the most in the exchange rate union (in a pro-cyclical way), while the change is the smallest in the case of floating.

6. PRODUCTIVITY SHOCKS IN THE BIG COUNTRIES

6.1 Shocks occurring in country 1

6.1.1 Effects on the big countries

A priori results in the general case cannot be presented. In the extreme cases of the fixed and flexible prices they can, however, be obtained. When producer prices are fully fixed ($\alpha = \beta = 0$), we obtain for the outputs of the big countries:

$$(71)\ \frac{\delta y_1}{\delta s_1} = \frac{(1+\phi)(k\mu^2+\mu\phi+2k\mu\sigma+\phi-\epsilon\phi\sigma)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)} > 0,$$

$$(72)\ \frac{\delta y_2}{\delta s_1} = \frac{\phi(1+\phi)(\epsilon\mu-(1-\epsilon)\sigma)}{(k\mu+\phi-\epsilon\phi)(k\mu+\phi+\epsilon\phi+2k\sigma)}.$$

These results are very similar to those obtained in the case of a monetary shock occurring in country 1 (see p. 26). Now we have an exogenous change in the price level instead of a change through the money supply or demand. Expressions (71) and (72) are $(1 + \Phi)$ times those for the monetary shocks, where Φ is the interest rate semielasticity of the demand for money.

The price level changes in country 1 but remains unchanged in country 2. The competitiveness of country 1 improves, but the interest rate increases. The sign of the change in the interest rate in country 2 is not known *a priori*.

In the case of <u>flexible prices</u> it can be shown *a priori* that the output of country 1 increases if the shock is positive (i.e. productivity improves). The output of country 2 increases if the elasticity with respect to foreign demand and the interest rate semielasticity of money demand are great in relation to the competitiveness elasticity. The expressions are as follows:

$$(73)\ \frac{\delta y_1}{\delta s_1}=\frac{1+\epsilon+\beta\mu+2\beta\sigma}{\beta(2+2\epsilon+\beta\mu+2\beta\sigma)}>0,$$

$$(74)\ \frac{\delta y_2}{\delta s_1}=\frac{1+\epsilon}{\beta(2+2\epsilon+\beta\mu+2\beta\sigma)}>0.$$

Competitiveness in country 1 improves due to the decrease in producer prices. The exchange rate reaction is not, however, clear *a priori*, neither is the sign of the change in the producer prices in country 2. The signs of the changes in the interest rates are not clear *a priori* either.

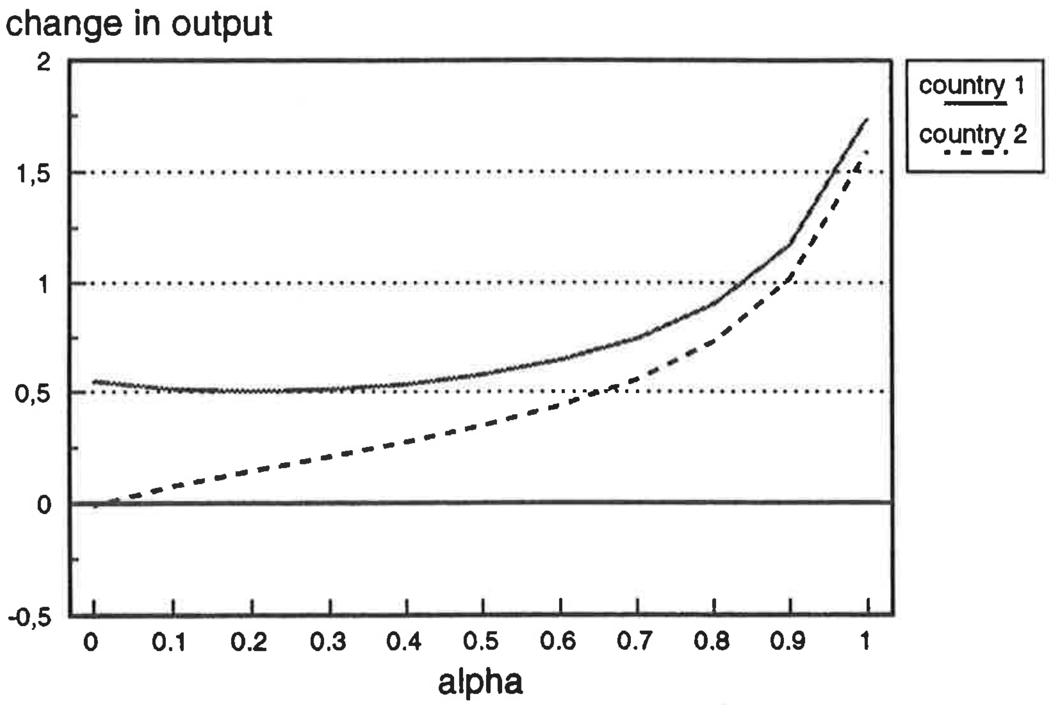
In the baseline scenario with somewhat flexible prices we obtain the following results:

$\delta y_1/\delta s_1 = 0.512$, $\delta y_2/\delta s_1 = 0.074$
$\delta p_1/\delta s_1 = -0.782$, $\delta p_2/\delta s_1 = -0.133$
$\delta e/\delta s_1 = 0.773$, $\delta c/\delta s_1 = 1.422$
$\delta i_1/\delta s_1 = -0.955$, $\delta i_2/\delta s_1 = -0.182$.

Outputs increase and prices as well as interest rates decrease in both countries. The changes are greater in country 1. The exchange rate of country 1 depreciates, somewhat paradoxically, because the fall in prices increases the real money supply. The nominal money supply is assumed to remain constant.

In figure 7 the sensitivity of the output reactions in the baseline scenario with respect to the parameter α is presented. The output of country 2 grows the more (in relation to that of country 1) the greater is the responsiveness of domestic prices to changes in the foreign prices (α).

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



Also in the producer prices there is covergence between the countries when α grows, prices of country 1 decrease, however, more even when $\alpha = 1$. The same holds for interest rate reactions in these countries.

6.1.2 Effects on the small country

In the case of flexible prices ($\alpha = \alpha_3 = 1$) the output of the small country changes as follows in all exchange rate regimes:

$$(75)\ \frac{\delta y_3}{\delta s_1} = \frac{\epsilon_3\mu + \epsilon\epsilon_3\mu + \mu_3 - \epsilon^2\mu_3 - \beta\epsilon\mu\mu_3 + \beta\mu_3\sigma - \beta\epsilon\mu_3\sigma + \beta\epsilon_3\mu^2\theta + \beta\mu\mu_3\theta + \beta\epsilon\mu\mu_3\theta + 2\beta\epsilon_3\mu\sigma\theta}{\beta\mu(2+2\epsilon+\beta\mu+2\beta\sigma)(1+\beta_3\mu_3+\beta_3\sigma_3)}.$$

The expression is obviously positive, because the negative terms are very small ($\epsilon < 1$), but we cannot show it *a priori*. It is definitely positive if there is trade only with country 1 ($\theta = 1$), a sufficient condition for positiveness is also that $\theta > \epsilon$.

With less than flexible prices in country 3 the results differ between exchange rate regimes. The signs of the changes in output cannot be known *a priori* in any of the regimes, not even in the case of fully fixed prices.

In the <u>flexible exchange rate regime</u> a productivity shock occurring in country 1 leads to the following changes in the baseline scenario:

$\delta y_3/\delta s_1 = 0.072$ $\quad$ $\delta p_3/\delta s_1 = -\ 0.141$

$\delta e_{32}/\delta s_1 = 0.020$ $\quad$ $\delta c_3/\delta s_1 = -\ 0.400$

$\delta i_3/\delta s_1 = -\ 0.201.$

The output of the small country is almost insulated. The increase in export demand and the decrease in the interest rate tend to increase the output, but the worsening of competitiveness due to the foreign price and exchange rate development is so big that the positive effect remains small. The exchange rate with respect to country 1 appreciates, because no change in monetary policy is assumed in country 1 after the shock.

In the <u>exchange rate union</u> the output is also stabilized to a large extent. The export demand and interest rate effects are positive, but competitiveness worsens for the same reasons as before. The results are as follows:

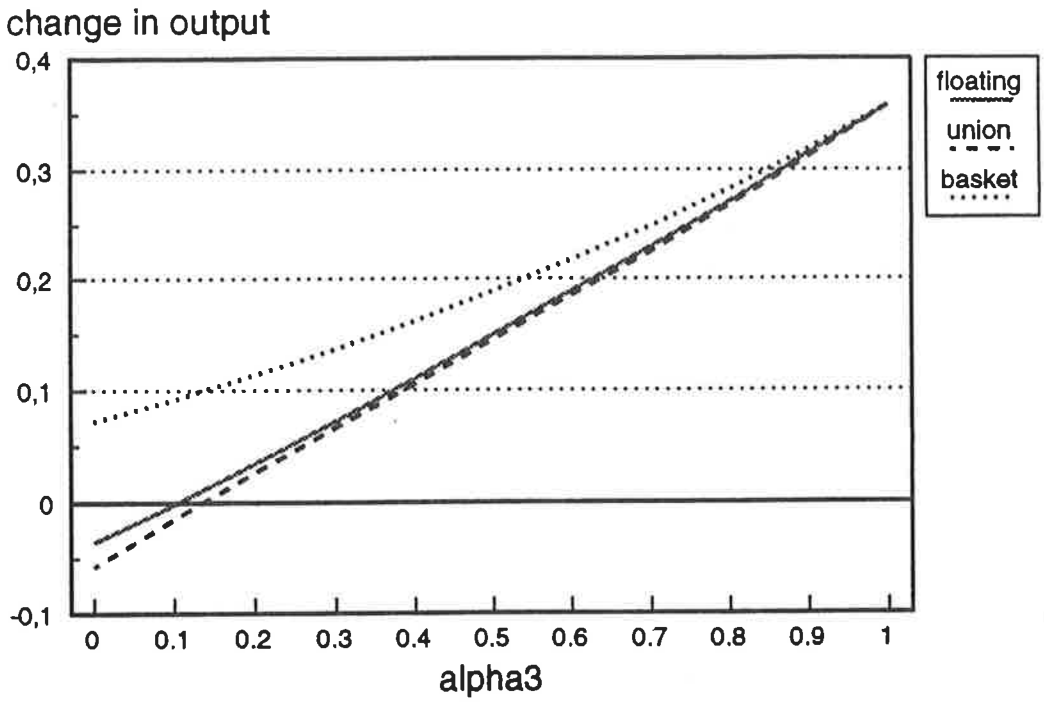
$\delta y_3/\delta s_1 = 0.066$ $\quad$ $\delta p_3/\delta s_1 = -\ 0.148$
$\delta e_{31}/\delta s_1 = -\ 0.773$ $\quad$ $\delta c_3/\delta s_1 = -\ 0.412$
$\delta i_2/\delta s_1 = -\ 0.182.$

In the <u>currency basket exchange rate regime</u> export demand contributes positively to the output and the interest rate decreases even more than in the previous regimes (see equation (25)''' on page 6). The counteracting effect due to competitiveness is, however, weaker. The output changes accordingly more than in the previous regimes:

$\delta y_3/\delta s_1 = 0.136$ $\quad$ $\delta p_3/\delta s_1 = -\ 0.057$
$\delta c_3/\delta s_1 = -\ 0.271$ $\quad$ $\delta i_3/\delta s_1 = -\ 0.414.$

The sensitivity of the output reactions in different exchange rate regimes with respect to parameters α and α_3 is again presented in figure 8.

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



Floating and the exchange rate union do not differ much with respect to the insulation of output with any degree of flexibility of prices. In the basket peg regime the change in output is the largest with all values of $\alpha_3 < 1$, but the difference becomes small with rather high values of α_3. Producer prices are again stabilized the most in the basket peg regime. The interest rate, however, changes the most in this regime.

6.2 Shocks occurring in country 2

6.2.1 Effects on the big countries

Because of symmetry between countries 1 and 2, the impacts of shocks are similar independent of the origin country of the shock. The effects are thus similar to those presented on pages 34-36. The countries just change places. In the baseline scenario we obtain the following results:

$$\delta y_2/\delta s_2 = 0.512, \qquad \delta y_1/\delta s_2 = 0.074$$
$$\delta p_2/\delta s_2 = -\ 0.782, \qquad \delta p_1/\delta s_2 = -\ 0.133$$
$$\delta e/\delta s_2 = -\ 0.773, \qquad \delta c/\delta s_2 = -\ 1.422$$
$$\delta i_2/\delta s_2 = -\ 0.955, \qquad \delta i_1/\delta s_2 = -\ 0.182.$$

Because country 2 is assumed to be the more important trading partner for country 3, export demand changes more, when the shock occurs in country 2 than when it occurs in country 1.

6.2.2 Effects on the small country

The signs of the output effects cannot be shown a *priori*. We confine ourselves to presenting the results in the baseline scenario.

In the floating exchange rate regime output increases if the shock is positive. This is due to the growing foreign demand and declining interest rate. Competitiveness, however, worsens. The results are as follows:

$$\delta y_3/\delta s_2 = 0.133 \qquad \delta p_3/\delta s_2 = -\ 0.249$$
$$\delta e_{32}/\delta s_2 = -\ 0.608 \qquad \delta c_3/\delta s_2 = -\ 0.714$$
$$\delta i_3/\delta s_2 = -\ 0.347.$$

In <u>exchange rate union</u> output changes by more than in the floating rate regime. Competitiveness worsens by less, because the exchange rate with respect to the currency of country 2 is fixed. There is a depreciation of the currency with respect to that of country 1, which tends to increase prices. This leads to almost complete elimination of the decrease in prices, which occurs in the case of floating. The interest rate declines significantly as in country 2.

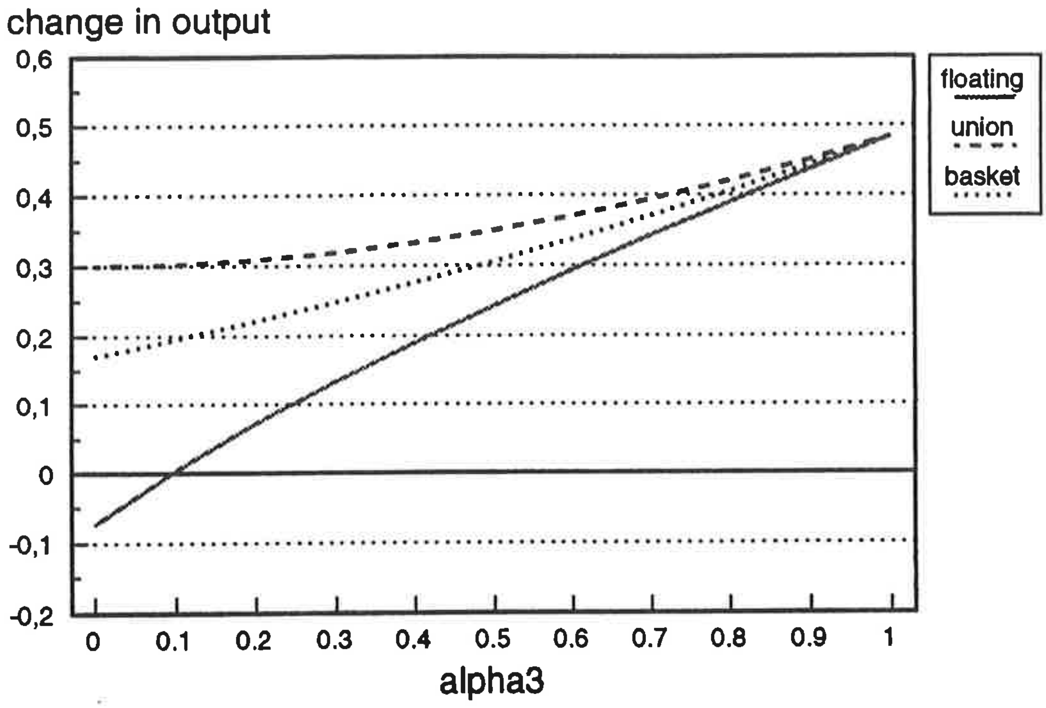
$$\delta y_3/\delta s_2 = 0.318 \qquad \delta p_3/\delta s_2 = -0.011$$
$$\delta e_{31}/\delta s_2 = 0.773 \qquad \delta c_3/\delta s_2 = -0.344$$
$$\delta i_2/\delta s_2 = -0.995.$$

In the <u>currency basket exchange rate regime</u> the change in output is smaller than in the exchange union but higher than in the case of floating. Because of the stabilization of the effective trade-weighted exchange rate, the change in competitiveness is due to price developments. Competitiveness worsens now more than in the exchange rate union. Also the decrease in the interest rate is smaller.

$$\delta y_3/\delta s_2 = 0.248 \qquad \delta p_3/\delta s_2 = -0.102$$
$$\delta c_3/\delta s_2 = -0.486 \qquad \delta i_3/\delta s_2 = -0.723.$$

In figure 9 a sensitivity analysis with respect to the degree of flexibility in prices (α and α_3) is presented. We notice that floating insulates the output the most for all values of α and α_3 studied. The basket peg ranks second in this respect, and the exchange rate union leads to the greatest deviation of output.

Figure 8. Productivity shock in country 2: sensitivity of output in the small country with respect to α and α_3 ($\alpha_3 = 3 * \alpha$)



Prices are now stabilized the most in the exchange rate union, where depreciation of the currency together with that of country 2 (with money supply unchanged there) eliminates a part of the decline. Producer prices change now the most in the floating rate regime. The interest rate declines the most in the exchange rate union and the least in floating.

7. EVALUATION OF THE REGIMES IN THE CASES OF DIFFERENT SHOCKS

In the case of **domestic shocks** it was shown *a priori* that floating exchange rates insulate the output more against goods demand shocks than fixed exchange rates if there is some rigidity in prices. If producer prices are fully flexible, there is no difference between the regimes.

If the shock is positive, the exchange rate appreciates in the floating rate regime, which leads to a worsening of competitiveness. The interest rate rises. These effects tend to stabilize the output. In the fixed rate regime the exchange rate and the interest rate remain unchanged. Competitiveness, however, deteriorates as a result of a rise in prices.

In the case of monetary shocks fixed exchange rates in turn insulate the output fully. This result is analogous to that obtained in the fixed price Mundell-Fleming model. In the floating rate regime there is an increase in output if the shock is positive, assuming that there is some rigidity in producer prices. The exchange rate depreciates and competitiveness improves accordingly. Also the interest rate declines. Producer prices increase.

It was shown in section 3, that both floating and fixed rates lead to a change in output if there is a domestic productivity shock. For relevant parameter values it could also be shown that the change is greater in the floating rate regime, assuming that there is no change in monetary policy.

When comparing the exchange rate regimes in the cases of **foreign shocks** we use the baseline scenarios calculated for each regime. Changes in the most important variables after each shock are presented in table 1.

Table 1. Some important effects of the foreign shocks (baseline calculation)

effect	goods demand shock Δf_1	Δf_2	monetary shock Δm_1	Δm_2	productivity shock Δs_1	Δs_2
Δe	-0.777	0.777	1.162	-1.162	0.773	-0.773
Δi_1	1.295	0.518	-1.274	-0.112	-0.955	-0.955
Δi_2	0.518	1.295	-0.112	-1.274	-0.182	-0.182
Δ(foreign demand)	0.310	0.521	0.127	0.235	0.206	0.381
Δc_3 (floating)	0.230	0.264	-0.246	-0.440	-0.400	-0.714
Δc_3 (union)	0.224	-0.076	-0.254	0.205	-0.412	-0.344
Δc_3 (basket)	0.082	0.066	-0.042	-0.008	-0.271	-0.486
Δi_3 (floating)	0.508	0.736	-0.124	-0.214	-0.201	-0.347
Δi_3 (union)	0.518	1.295	-0.112	-1.274	-0.182	-0.995
Δi_3 (basket)	0.751	1.062	-0.460	-0.925	-0.414	-0.723
Δy_3 (floating)	0.123	0.205	0.044	0.082	0.072	0.133
Δy_3 (union)	0.120	0.035	0.041	0.405	0.066	0.318
Δy_3 (basket)	0.049	0.106	0.147	0.299	0.136	0.248

It is seen in the table that the exchange rate union insulates the output clearly more than the other regimes in the case of a goods demand shock occurring in country 2 ("the EMU"). This is due to the competitiveness and interest rate reactions, which tend to decrease the impact of the export demand. The insulation is also good, about as good as in the floating rate regime, against monetary and productivity shocks occurring in "the USA".

The problematic shocks in the exchange rate union are especially monetary and productivity shocks occurring in "the EMU". This is due to the competitiveness (exchange rate) and interest rate reactions, which reinforce the effect of the change in export demand. The exchange rate union does not insulate the output well against a goods demand shock occurring in "the USA", either.

Floating performs well with respect to insulation of output in the cases of foreign monetary shocks independent of the origin of the shock, and in the case of a productivity shock occurring in "the USA". This is especially due to the "counter-cyclical" change in competitiveness. The interest rate reaction reinforces the export demand effect relatively little, too. The insulation properties of floating are, however, not good against goods demand shocks.

The currency basket exchange rate regime performs the best in the case of a goods demand shock occurring in "the USA". The unchanged effective exchange rate is better from the stabilization point of view than the "pro-cyclical" reactions in the floating rate regime and in the exchange rate union. The interest rate reaction is also more stabilizing than in the two other regimes. When there is a monetary shock in "the USA" and a productivity shock in "the EMU", the basket peg stabilizes the output the least of the regimes studied. In the rest of the shocks this regime ranks in the middle of the extremes.

When compared to the results obtained in the model with static expectations and permanent shocks the ranking of the regimes does not change in any of the shocks (see table 2, appendix 2). The absolute differences between the output changes are, however, usually smaller. Competitiveness changes in the current model less than in the previous one, because a part of the adjustment occurs now through changes in the interest rate.

We have noticed that the insulation properties of the exchange rate regimes depend crucially on the nature and on the origin of the shock. Therefore, in order to make a general evaluation of the insulation properties of the regimes we should know the variances of the different shocks.

We can write the following quadratic loss function for each exchange rate regime, where each quadratic effect of the shock is weighted by the variance of the respective shock, σ^2_{f1} for example refers to the variance of a goods demand shock occurring in country 1.

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

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

The letters f, u and b refer to floating, the exchange rate union and the basket peg regime, respectively. The letter o refers to output; the loss of welfare is measured with respect to the deviation of the output from a "normal" level.

If we knew all the variances we could calculate the values for the loss functions. Empirical studies about the shocks could in principle give some starting points for the calculation. This would, however, not be a very reliable guide because there are continuous changes in institutions and in policy in the home country as well as abroad.

In the following we assume that the variance of each shock is the same. The idea behind this assumption is that the expected values of the variances are the same in an uncertain and continuously changing world. This procedure was used in the previous study, too (Kotilainen 1992, 100). We now obtain the following loss functions for each exchange rate regime <u>in the baseline scenario</u>:

$$L^{o}_{f} = \sigma^{2}_{shock} * 0.926$$
$$L^{o}_{u} = \sigma^{2}_{shock} * 1.232$$
$$L^{o}_{b} = \sigma^{2}_{shock} * 1.150.$$

The ranking of the regimes is thus:

$$L^{o}_{f} < L^{o}_{b} < L^{o}_{u}.$$

This result is similar to that obtained in the model with static expectations and permanent shocks (Kotilainen 1992, 101).

We can write the same kind of a loss function with respect to the stabilization of prices:

$$L^{P}_{f} = \sigma^{2}_{shock} * 0.746$$
$$L^{P}_{u} = \sigma^{2}_{shock} * 0.945$$
$$L^{P}_{b} = \sigma^{2}_{shock} * 0.863.$$

The ranking of the regimes is:

$$L^{P}_{f} < L^{P}_{b} < L^{o}_{u}.$$

The ranking according to the price target differs from that obtained in the model with static expectations and permanent shocks. In that model the basket peg regime insulates prices more than floating. This difference is due to the poorer stabilization of prices in the case of a domestic productivity shock in the current model. The basket peg regime insulates the producer price level the most against foreign shocks also in this model.

We now widen our loss function approach to take into account as well the output as the price target. We write the loss function for floating as a weighted average 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 loss 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 regimes are formulated analogously.

In the baseline scenario we can write the aggregate loss functions for each regime as follows:

$$L_f = a\ \sigma^2_{shock}*0.926 + (1 - a)\sigma^2_{shock}*0.746$$
$$L_u = a\ \sigma^2_{shock}*1.232 + (1 - a)\sigma^2_{shock}*0.945$$
$$L_b = a\ \sigma^2_{shock}*1.150 + (1 - a)\sigma^2_{shock}*0.863.$$

Because the ranking in the baseline scenario is the same according to the output and price targets, we obtain:

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

The above result is naturally dependent on the values chosen for the parameters. In the case of the previous model an alternative scenario for a less open and a more diversified economy was calculated. In that case the general conclusion did not differ from that obtained in the baseline scenario. It is therefore not probable that there would be a big difference in the current model either. Further sensitivity analyses will, however, be done later.

The result is also dependent on the assumption of the same variance of all shocks. The ranking of the exchange rate union becomes low especially because of the poor insulation properties of this regime against monetary and productivity shocks occurring in the "EMU area".

8. TWO CRITERIA FOR OPTIMUM CURRENCY AREAS

In addition to the "insulation against shocks" criterion, an important approach in the study of exchange rate unions is the so-called theory of optimum currency areas. The approaches are related to each other, because in the theory of optimum currency areas the idea behind the criteria often entails how they contribute to the stability of the economy in different exchange rate regimes.

In the theory of optimum currency areas the following characteristics of an economy are thought to increase the need for exchange rate fixity within an area: (1) high mobility of factors of production (Mundell 1961), (2) high share of tradeables in production (openness criterium) (income and price stabilization by fixing) (McKinnon 1963), (3) a high degree of product diversification (Kenen

1969a), (4) a high degree of financial integration within an area (especially concerning long-term securities) (Ingram 1969), (5) similarity in rates of inflation (Haberler 1970; Fleming 1971), (6) no need for real exchange rate changes (Vaubel 1978) and (7) a high degree of policy integration (for example Tower and Willett 1970). (For surveys, see Ishiyama 1975; Kotilainen and Peura 1988.)

In the following we study the sensitivity of the results presented in the previous sections with respect to two of the criteria for optimum currency areas: the degree of integration with an area and the diversification of foreign trade. We thus research, for example, whether, the degree of integration with country 2 ("the EMU") or the degree of diversification of foreign trade have any impact on the desirability of an exchange rate union from the stabilization point of view.

8.1 The degree of integration

The measure of the degree of integration with the potential exchange rate union partner is in the current model the parameter θ, the share of country 1 ("the USA") in the foreign trade. The smaller θ is, the more integrated the small country is with "the EMU".

The parameter θ affects in the model through two channels: (1) the export demand factor and (2) the competitiveness factor. The export demand changes in all regimes in the same direction. A change in the country composition of foreign trade increases or decreases the output effect depending on whether the trade partner concerned is the faster or the slower growing economy.

The effect through the competitiveness factor and especially through the effective exchange rate changes differently in different regimes. This gives a possibility to compare the regimes. We make this comparison in the baseline scenario. The sensitivity analyses in the cases of different shocks are presented in appendices 3-5. In the following we present the results briefly and explain the factors behind the results.[3]

When there is a **goods demand shock in country 1**, a high degree of integration with "the EMU" makes the exchange rate union more attractive compared to the other regimes. This is due to the "pro-cyclical" effect of the exchange rate with respect to country 1, i.e. the exchange rate depreciates (jointly with that of "the EMU") when there is a positive goods demand shock in "the USA".

In the case of a **goods demand shock in country 2** a medium degree of integration with the potential union partner makes the change in output the smallest compared to the other regimes. With a high degree of integration the union leads to a smaller deviation in output than floating, but is only as good as the basket peg regime.

A medium degree of integration leads to the smallest deviation in output in the exchange rate union, because the export demand and competitiveness effects compensate for each other the most in this case. With high integration the export demand effect is big and the negative competitiveness effect small. With low integration with "the EMU" in turn the export demand

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[3]When $\theta = 0$, i.e. when there is trade only with "the EMU", the output effects in the exchange rate union and in the basket peg regime are identical in the cases of all shocks.

effect is low, but the negative competitiveness effect is high.

In the case of foreign **monetary shocks** the output is not sensitive to changes in the degree of integration in the exchange rate union. This is due to foreign demand and competitiveness effects, which change so that the changes compensate for each other. The ranking of the regimes changes, however, because the other two regimes are sensitive to changes in the degree of integration.

If there is a **monetary shock in country 1** the exchange rate union and floating both lead to small deviations of output. Because the deviation of output increases in the floating and basket peg regimes when the degree of integration becomes smaller, the relative performance of the exchange rate union is the best when the degree of integration is low. This result is explained by the fact that the effect due to the growing export demand (in the case of a positive shock) is not offset by a change in the effective exchange rate - in the basket peg regime at all, and in the floating rate regime to a smaller degree. The "pro-cyclical" interest rate reaction becomes also stronger in the floating and basket peg regimes when θ grows.

When there is **a monetary shock in country 2** the exchange rate union leads to the greatest deviation of output with all values of θ. Its relative performance with this respect is, however, the best when the degree of integration with "the EMU" is high. With high values of θ (a low degree of integration) the floating and basket peg regimes lead to a very small change in output, because the export demand effect becomes smaller, and there is no compensating competitiveness effect as in the exchange rate union.

In the case of foreign **productivity shocks** the output effect is not sensitive to the values of θ, either. The relative performance of this regime must therefore be measured through the other two regimes.

When there is a productivity shock in country 1 the exchange rate union insulates the output well with all values of θ. This regime's relative performance is the best with high values of θ, i.e. a low degree of integration with "the EMU". This is again due to the stronger compensating exchange rate effect when θ is high, and due to the weaker "pro-cyclical" interest rate effect than in the other two regimes.

In the case **of a productivity shock in country 2** the exchange rate union leads to the highest deviation of output irrespective of the degree of integration. The relative performance of the regime is, however, the best with a high degree of integration with country 2, because in the other two regimes the diminishing effect of foreign demand is in this case not offset by an opposite competitiveness effect.

The results presented above are contradictory concerning the "degree of integration" criterion measured as the relative trade share of the potential exchange rate union partner. We obtained in only three of the six cases a confirming result for the hypothesis that a high degree of integration with the potential union partner increases the attractiveness of the exchange rate union. There are, however, reasons to conclude that an exchange rate union is a more attractive alternative when the degree of integration is high rather than low, because

1. the union is always as good as the basket peg regime, when $\theta = 0$,

2. in cases where the union insulates the output better than the other regimes with a low degree of integration, the deviations of output are in these cases small in absolute terms, and they are not sensitive to the degree of integration.

8.2 Diversification of foreign trade

In the following we measure the diversification of foreign trade with the "competitiveness elasticity" σ_3. A low value for this variable reflects a high diversification of foreign trade. Trade is in this case so diversified and based on "real competitiveness" that changes in relative prices do not substantially affect the output. The parameter σ_3 reflects partly also the degree of openness of the economy. Highly sheltered economies have a low value of σ_3. The study presented here is thus a joint, but partial, test for both of these criteria. (For a discussion of the meaning of the criteria, see McKinnon (1969), Kenen (1969b) and Ishiyama (1975).)[4]

The relevant values of σ_3 range from 0 to perhaps 0.5. Values higher than this are no longer relevant, because in no country is the share of foreign trade so great and the sensitivity of output with respect to relative prices so

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[4]This study catches only some (macro) aspects of the criteria. Kenen (1969a) motivated the diversification criterium originally on the grounds of microeconomic demand disturbances. Openness of the economy is in turn reflected also in parameters α_3 and ϵ_3.

high that the output would change for example by one percent when relative prices change by one percent (the situation when $\sigma_3 = 1$).

With respect to the "diversification of foreign trade" criterion we can compare the insulation properties of the floating and the fixed rate regimes also in the case of **domestic shocks.**

When there is **a goods demand shock in the home country**, a high degree of diversification of foreign trade (and production) (a low σ_3) leads to the highest deviation of output in the floating as well as in the fixed rate regime (see expressions (28) and (33) on pages 9-10). Competitiveness worsens in both regimes the more the higher σ_3 is (if the shock is positive). The deviation is always greater in the fixed rate regime, but the difference between the outcomes is smaller when the diversification of foreign trade is high. These results can be shown *a priori*.

In the case of a **monetary shock in the home country** the output remains in the fixed rate regime unchanged with all values of σ_3. In the floating rate regime the deviation increases in the baseline scenario when diversification declines. We cannot, however, show this *a priori* (see expression (36) on page 11). In relative terms the insulation properties of the fixed rate regime are better in the baseline scenario with a low degree of diversification, but in absolute terms there is no difference in the fixed rate regime.

When there is **a domestic productivity shock**, the higher the diversification of foreign trade is, the smaller the deviation in output in the baseline scenario in both regimes (the smaller σ_3 is). We cannot, however, show this *a priori* (see expressions (41) and (46)). In relative terms the fixed rate regime insulates the output in the baseline scenario more than the floating rate regime when the diversification of foreign trade is high.

In the case of **foreign shocks** we make the sensitivity analysis in the baseline scenario. Obtaining *a priori* results is not possible. (The sensitivity analyses in the baseline scenario are presented in appendices 6-10.)

When there is a **goods demand shock in country 1** the deviation of output is the smallest in all regimes with small values of σ_3 (a high degree of diversification). In the basket peg regime the output is rather insensitive to changes in the level of diversification, because the effective exchange rate is unchanged and because changes in the price level are small. In the exchange rate union and in the floating rate regime the deviation becomes greater when σ_3 grows, because the "pro-cyclical" change in competitiveness has a greater effect. We can conclude that the exchange rate union performs the better the higher is the diversification of foreign trade (the lower σ_3 is).

In the case of a **goods demand shock in country 2**, the exchange rate union insulates the output rather well with all values of σ_3, because the negative competitiveness effect compensates for the positive export demand effect. The "best" value of σ_3 is an emprical question depending on the relative magnitudes of the above effects.

In the baseline scenario a rather low degree of diversification leads to the smallest deviation of output, but the sensitivity is not high. In the floating and basket peg regimes the deviation in output is the greater the lower the diversification. In relative terms we can thus conclude that the exchange rate union is the more attractive the lower the degree of diversification.

When there is a monetary shock in country 1 the exchange rate union and floating rates insulate the output rather well. The insulation is in the baseline scenario the best with a low degree of diversification (high values of σ_3). This is again due to the two "competing" effects: the export demand and competitiveness effects.

In the case of a monetary shock in country 2 the exchange rate union leads to the greatest deviation in output irrespective of the degree of diversification of trade. In the baseline scenario the difference is, however, the smallest when the degree of diversification is high. When the diversification decreases, the competitiveness effect becomes stronger. In the case of the exchange rate union this effect is "pro-cyclical" and in the other regimes "counter-cyclical".

In the case of a productivity shock in country 1 a low degree of diversification minimizes the deviation in output in the exchange rate union as well as in the floating rate regime. This is again due to the competing export demand and competitiveness effects.

When there is a productivity shock in country 2, the competitiveness effect tends to offset the strong foreign demand effect. Accordingly, the change in output becomes smaller when the diversification of foreign trade decreases. The same occurs in the other regimes , too. Therefore, no clear conclusions can be drawn.

The conclusion of the "diversification of foreign trade" criterion is not clearcut. We obtained in four cases out of nine a result that the insulation properties of the exchange rate union are the better the higher the degree of diversification of foreign trade. In the rest of the cases we either could not make a conclusion or the relative attractiveness of the exchange rate union improved when the degree of diversification decreased.

9. SUMMARY

In this paper exchange rate unions were compared with currency basket and floating rate regimes in the context of a three-country macroeconomic (IS-LM) model. In the model we had two large countries and a small economy. In the large countries the exchange rate was floating. The comparison of the regimes was made in the case of the small country.

This research constellation depicts the choice situation of a small European country in the face of the European monetary integration in a world of floating exchange rates between the economic blocks. The exchange rate union describes membership in the European Monetary Union (EMU) or in a "hard" EMS. The currency basket exchange rate regime in turn represents the characteristics of the regimes used previously, for example, in Finland, Norway and Sweden. In this regime the exchange rate is in normal circumstances (with no devaluations or revaluations) the most fixed. In the exchange rate union the currency is floating against the rest of the world.

The criterion in the comparison was the ability of the regimes to insulate the economy against domestic and foreign shocks. The insulation was studied in the cases of goods demand, monetary and supply (productivity) shocks, which occurred in the small home country or in either of the large economies. The shocks studied in this paper were assumed to be temporary so that the changes in exchange rates and prices were reversed in the next period. Exchange rate and price expectations were rational. In the previous versions of the model the shocks were permanent and the expectations were static (Kotilainen 1992).

When compared to the results obtained in the case of permanent shocks, the main conclusions concerning the ranking of the regimes in insulating the output against the shocks studied were not changed. There were, however, smaller differences in the magnitudes of the effects. The output effects were now usually smaller in all regimes.

It was shown *a priori* that a floating exchange rate insulates the output more against a **domestic** goods demand shock than a fixed rate. In the case of a domestic monetary shock a fixed exchange rate, in turn, insulates the output fully, whereas floating leads to a change in it.

It could also be shown for relevant parameters of the model that a fixed exchange rate insulates the output against domestic productivity shocks more than a floating one. In the study of productivity shocks it was assumed that the money supply remains unchanged, which means that changes in the price level lead to changes in the real money balances as in the case of monetary shocks.

In the cases of foreign shocks the ranking of the regimes could not be shown *a priori*. To overcome this problem we solved the models numerically using relevant parameter estimates and conducted sensitivity analyses.

Concerning the exchange rate union the main result of the analysis was that this regime is the most problematic in the cases of monetary and productivity shocks occurring in the potential union partner country. This is due to the "pro-cyclical" exchange rate and interest rate effects. The exchange rate effect reinforces the export demand effect also when there is a goods demand shock in "the USA" or "the rest of the world". When the monetary and productivity shocks occur in "the USA" the exchange rate union insulates the output well.

In the floating rate regime the insulation was the worst in the cases of foreign goods demand shocks. This is due to the "pro-cyclical" exchange rate effect. Floating performs well in the cases of monetary shocks and when the productivity shock occurs in "the USA". The exchange rate effect now tends to decrease the effect due to foreign demand.

The currency basket exchange rate regime is often in the middle in the ranking. It stabilizes the output well against goods demand shocks occurring in "the USA". This is due to the neutral competitiveness effect in this regime. The insulation performance of this regime is the worst, when compared to the other regimes, in the cases of monetary and productivity shocks occurring in "the USA". This is due to the stronger "pro-cyclical" interest rate effect and due to the weaker "counter-cyclical" competitiveness effect than in the other two regimes.

Assuming that the variances of all shocks are the same, a loss function was calculated for each regime with respect to variation in output and prices. In the baseline scenario we noticed that floating insulates the output as well as prices more than the other regimes. The exchange rate union performs the worst with both measures. The basket peg regime ranks in the middle. The poor performance of the exchange rate union is due to the monetary and productivity shocks occurring in the union partner country.

In the end of the paper the insulation properties of the exchange rate regimes were studied with respect to two criteria for optimum currency areas: the degree of integration and the diversification of trade.

The hypothesis that a high degree of integration with the union partner country makes the exchange rate union more attractive got support in some cases, while in some cases the criterion was not important or could also be interpreted to be against the hypothesis. In the case of the diversification of trade criterion, the hypothesis that a high degree of diversification would make the exchange rate union more preferable gained no support.

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THE NUMERICAL VALUES OF THE PARAMETERS USED IN THE BASELINE SCENARIO

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

common parameters:

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

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

big country parameters:

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

small country parameters:

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

The description of the symbols is presented on pages 6-7. We assume throughout the study 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.

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) and the Bank of Finland Quarterly Econometric Model (BOF) (Tarkka and Willman (ed.) (1985). 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).

Table 2. Some important effects of the foreign shocks (the model with static expectations and permanent shocks, baseline calculation)

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
Δy_3 (floating)	0.185	0.246	-0.009	0.025	-0.010	0.052
Δy_3 (union)	0.192	-0.003	-0.028	0.509	-0.031	0.351
Δy_3 (basket)	0.056	0.133	0.168	0.313	0.122	0.198

Source: Kotilainen (1992).

Figure 8. Goods demand shock in country 1: output reaction in the small country for various levels of foreign trade integration with country 2 (the lower theta is, the higher the degree of integration)

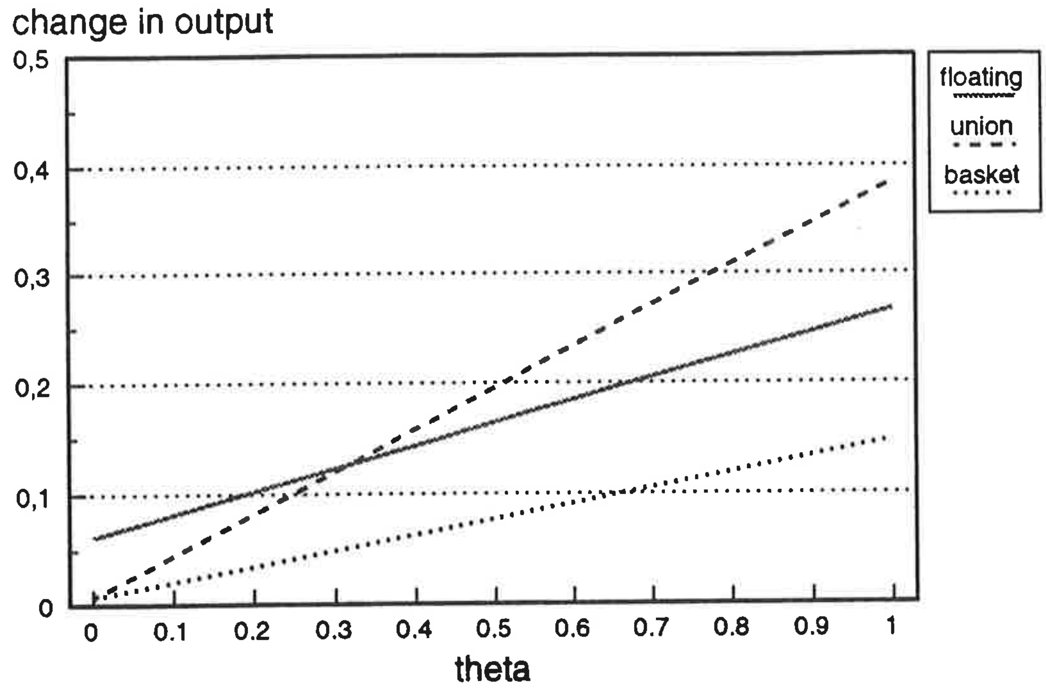
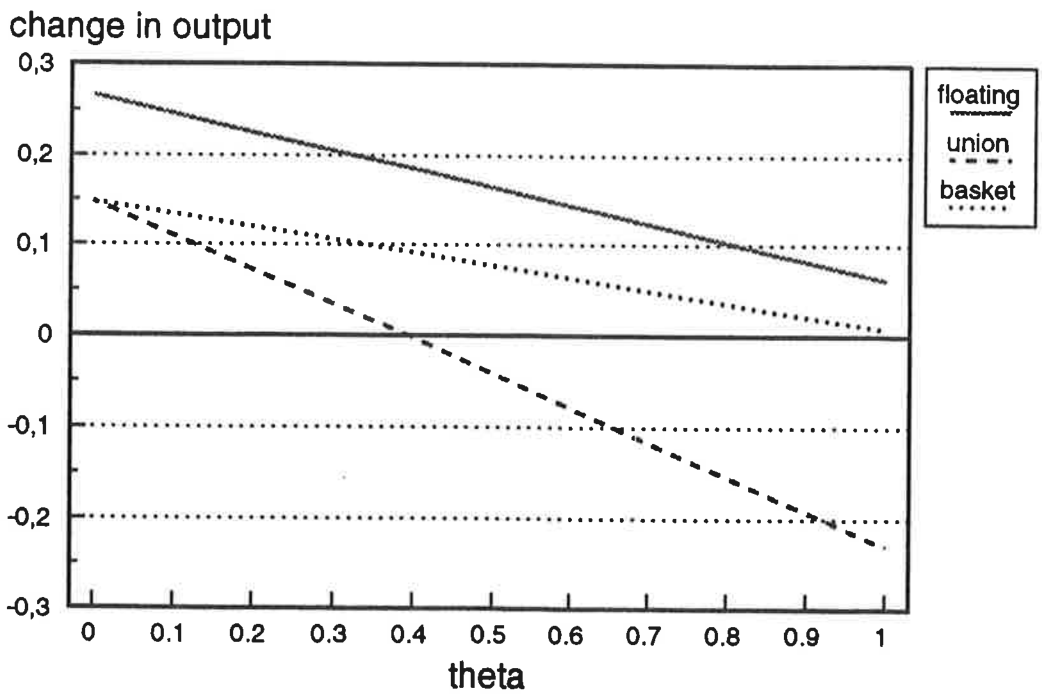
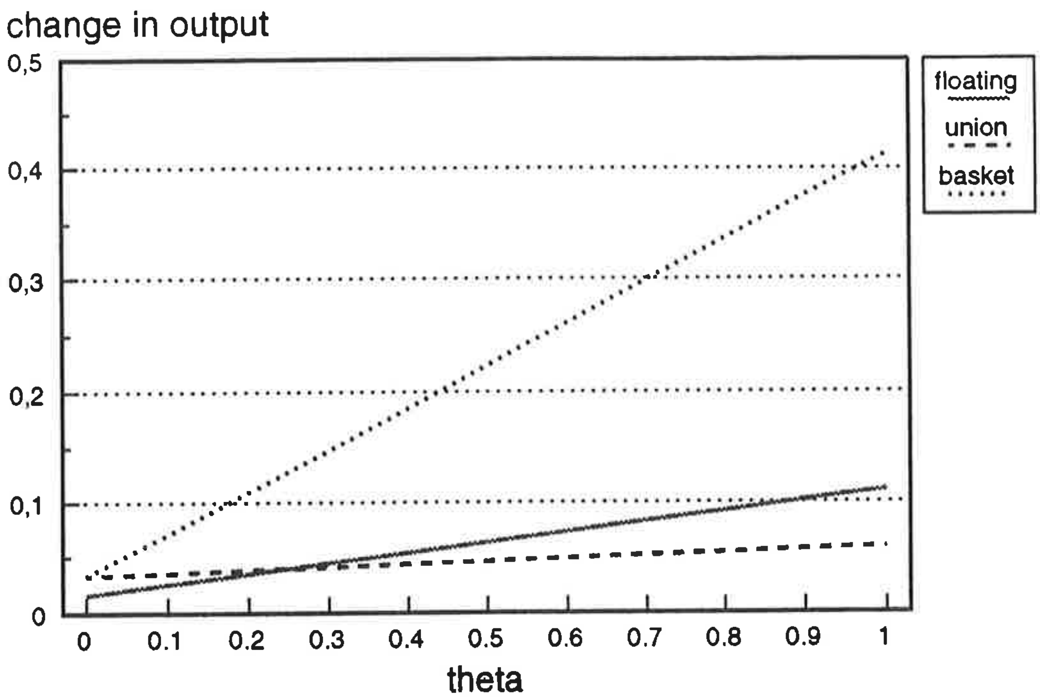


Figure 9. Goods demand shock in country 2: output reaction in the small country for various levels of foreign trade integration with country 2 (the lower theta is, the higher the degree of integration)



<u>Figure 10</u>. Monetary shock in country 1: output reaction in the small country for various levels of foreign trade integration with country 2 (the lower theta is, the higher the degree of integration)



<u>Figure 11</u>. Monetary shock in country 2: output reaction in the small country for various levels of foreign trade integration with country 2 (the lower theta is, the higher the degree of integration)

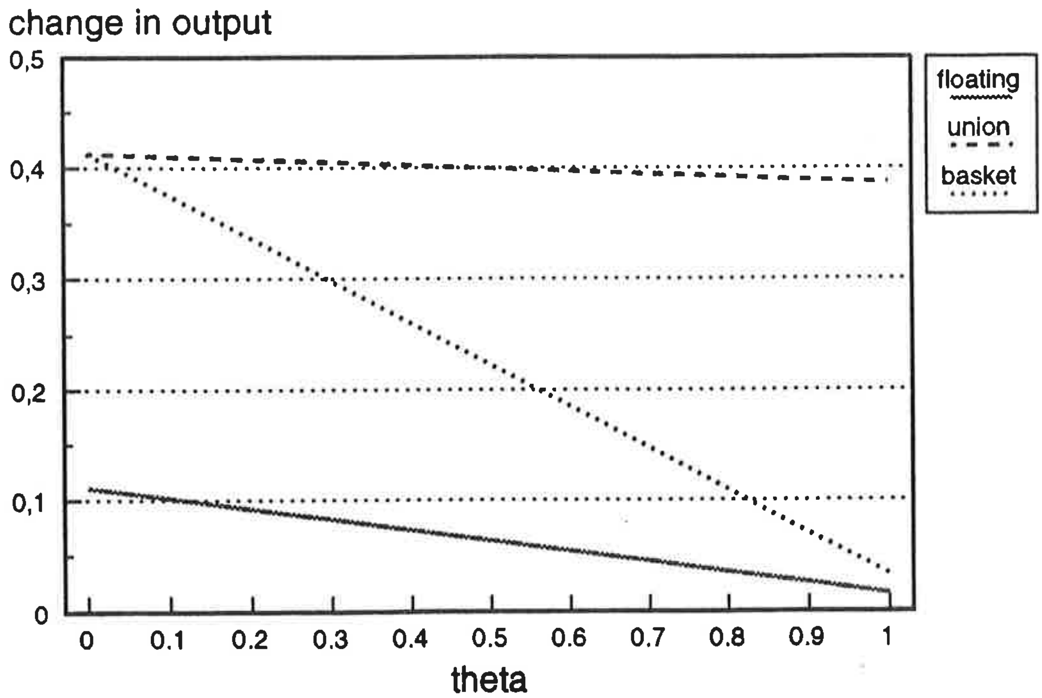


Figure 12. Supply shock in country 1: output reaction in the small country for various levels of foreign trade integration with country 2 (the lower theta is, the higher the degree of integration)

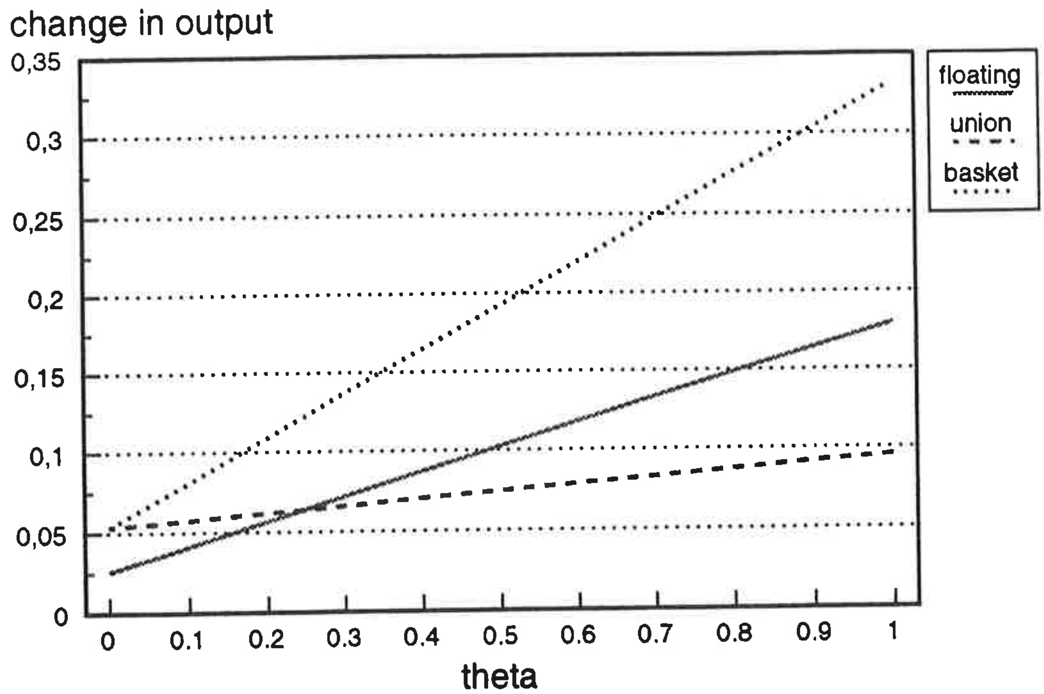


Figure 13. Supply shock in country 2: output reaction in the small country for various levels of foreign trade integration with country 2 (the lower theta is, the higher the degree of integration)

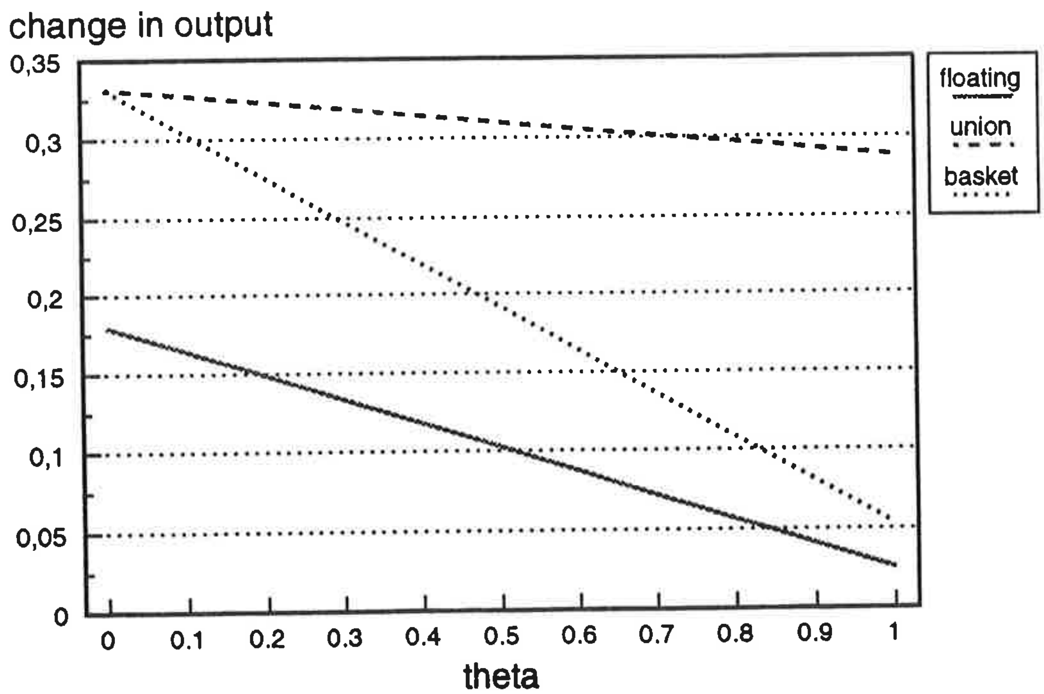


Figure 14. Goods demand shock in the home country: output reaction for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

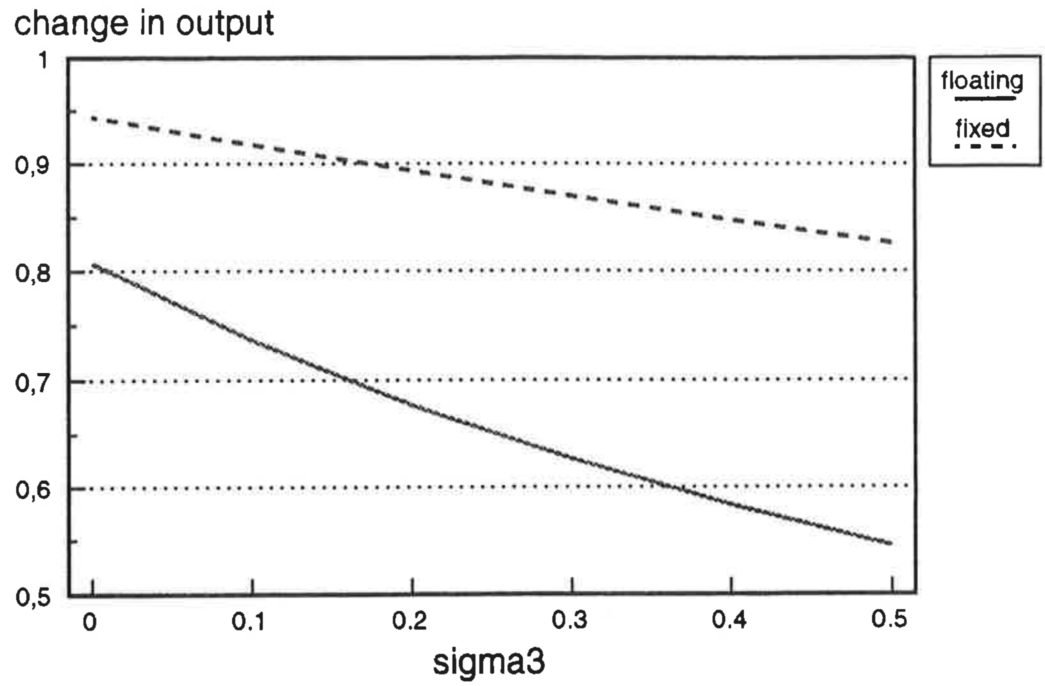


Figure 15. Monetary shock in the home country: output reaction for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

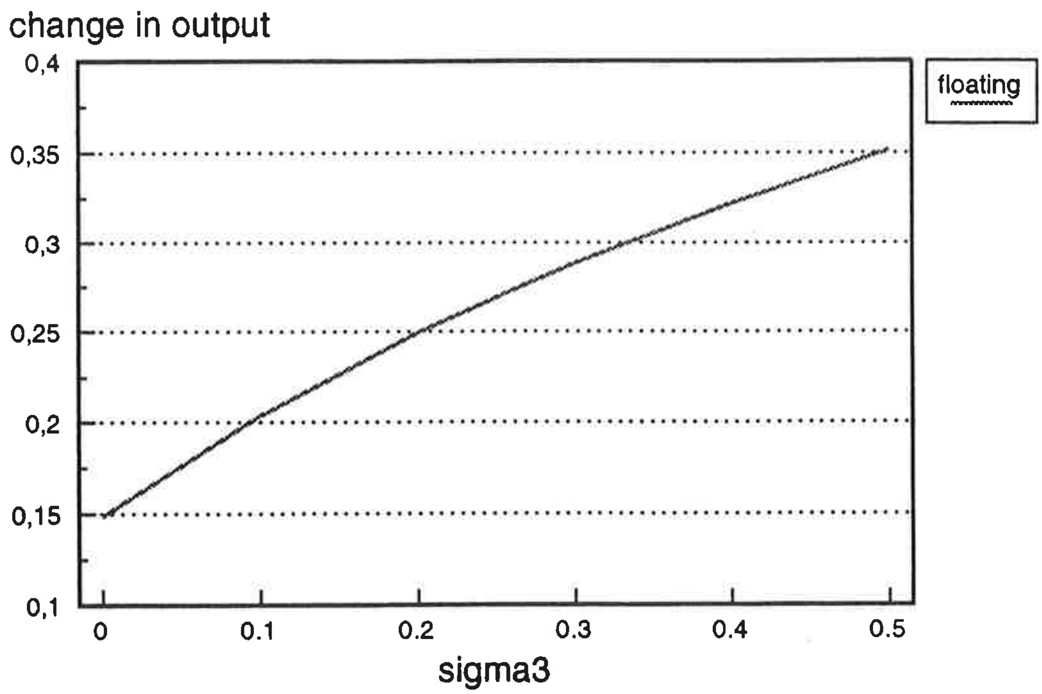


Figure 17. Supply shock in the home country: output reaction for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

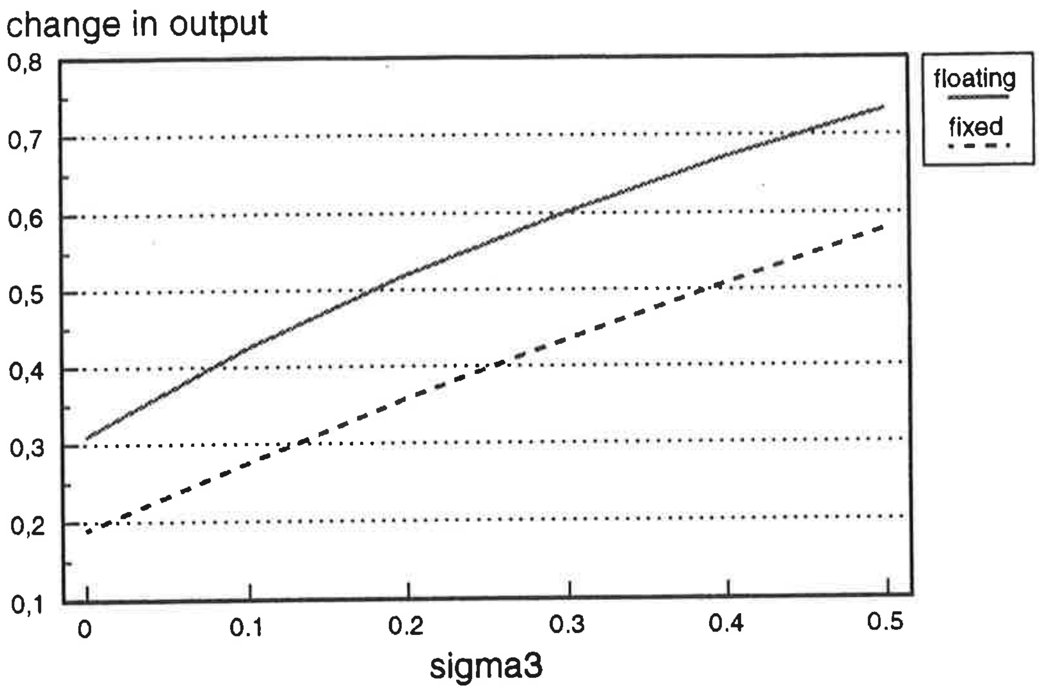


Figure 17. Goods demand shock in country 1: output reaction in the small country for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

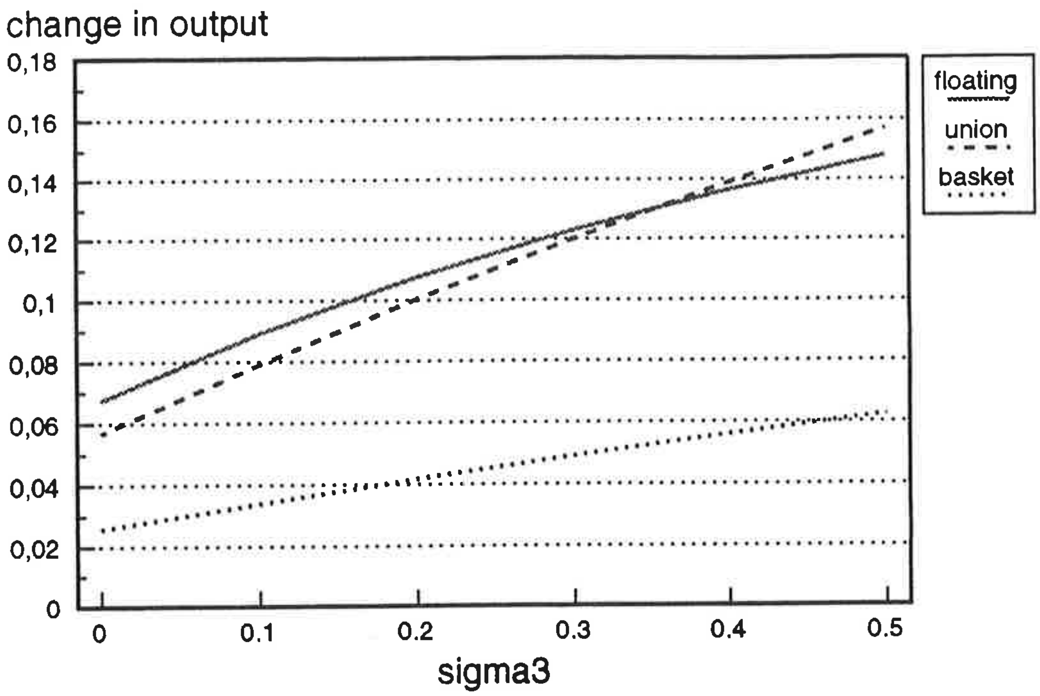


Figure 18. Goods demand shock in country 2: output reaction in the small country for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

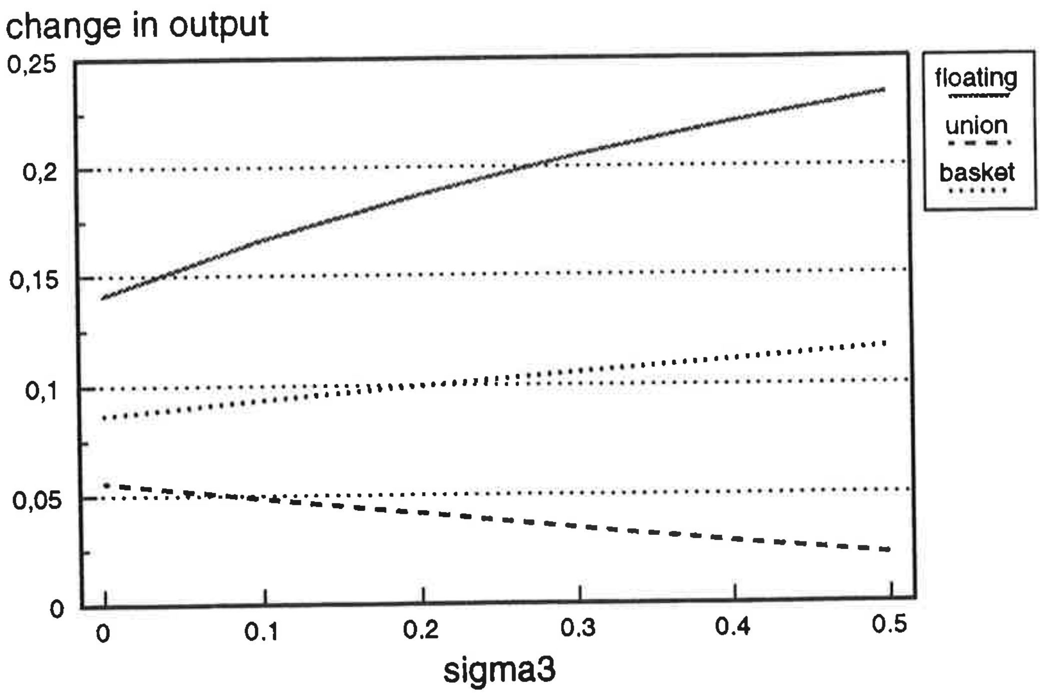


Figure 19. Monetary shock in country 1: output reaction in the small country for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

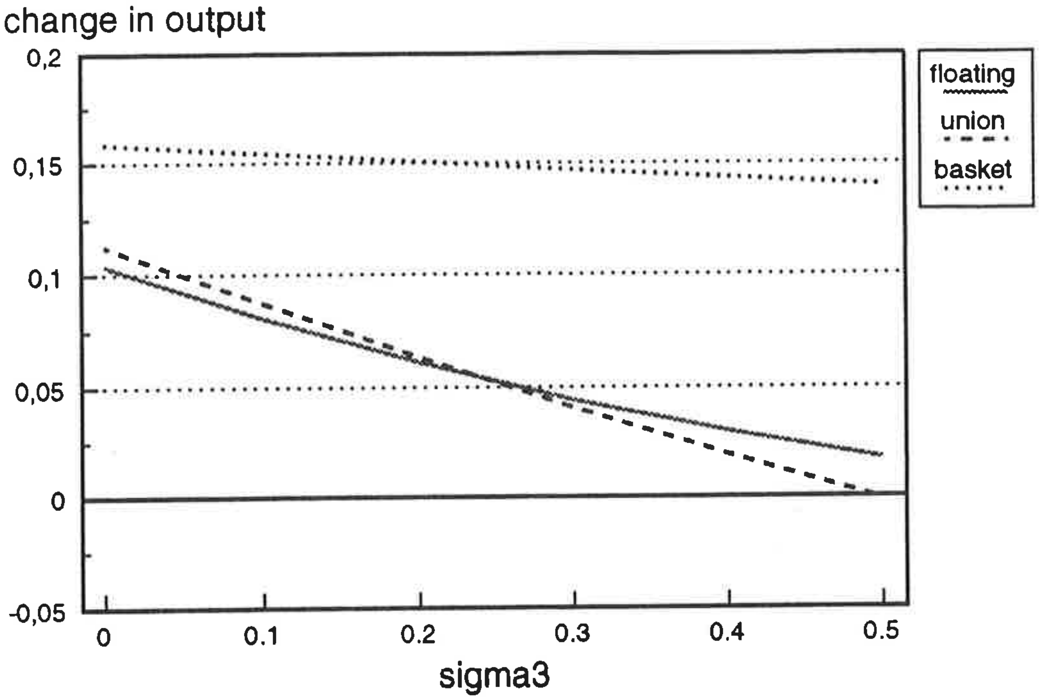


Figure 20. Monetary shock in country 2: output reaction in the small country for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

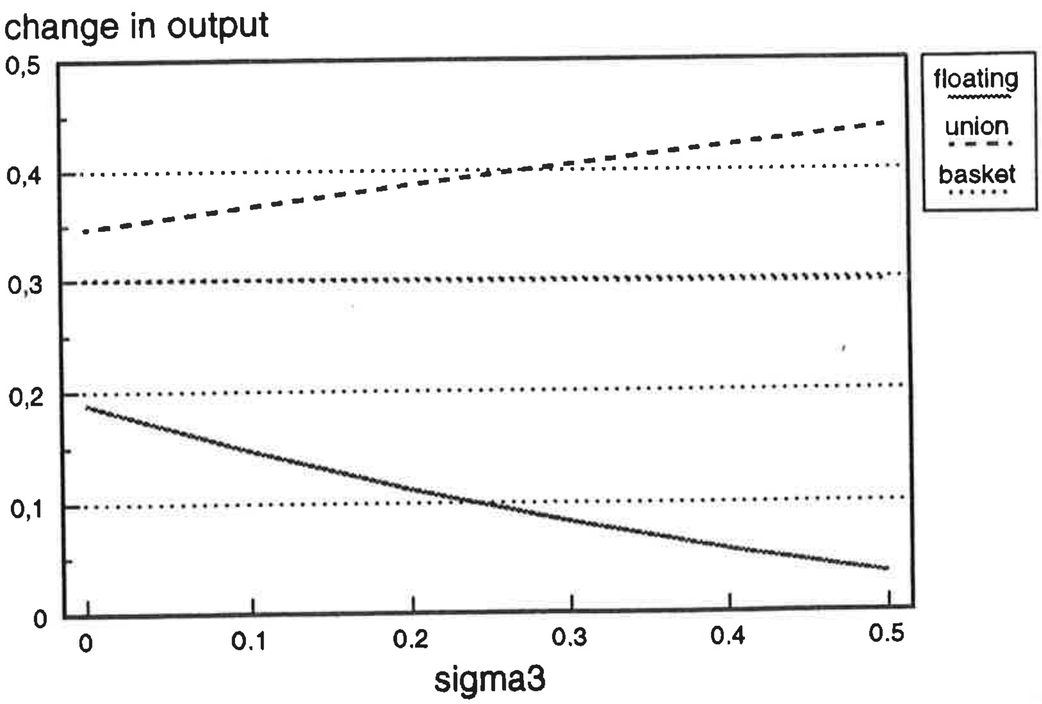


Figure 21. Supply shock in country 1: output reaction in the small country for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)

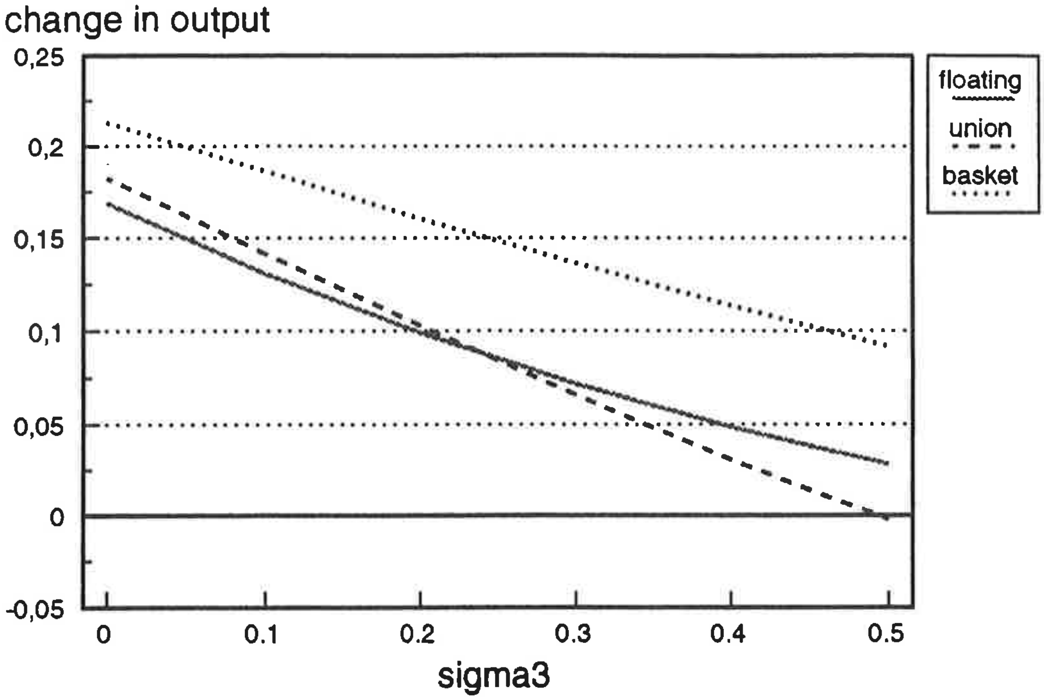
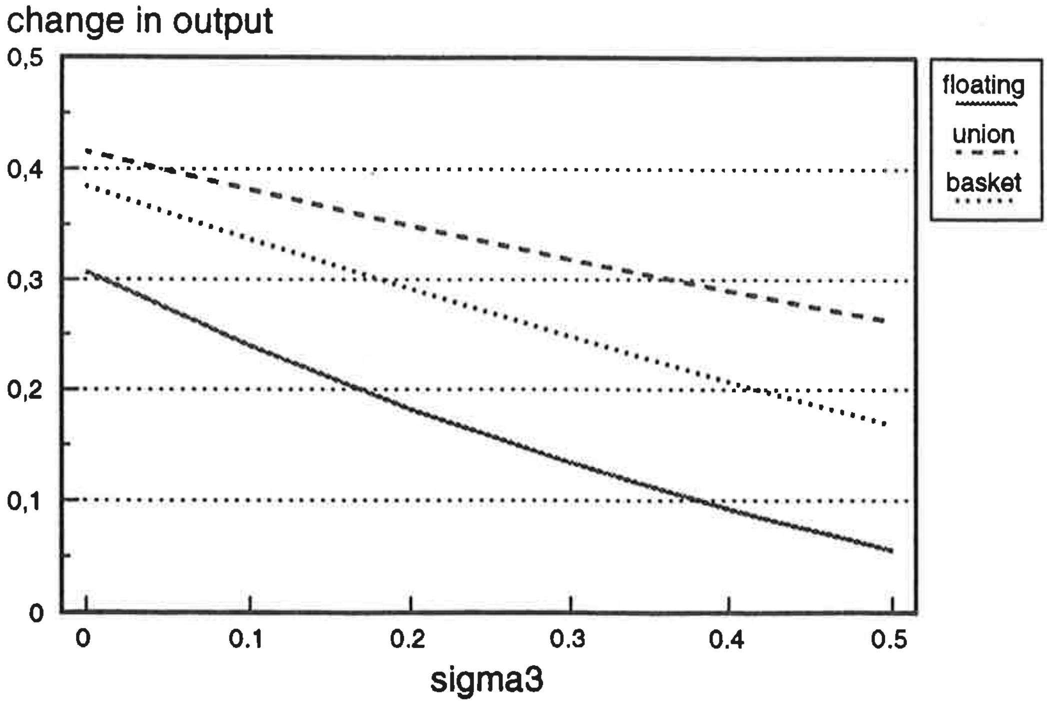


Figure 22. Supply shock in country 2: output reaction in the small country for various levels of diversification of foreign trade (the lower sigma3 is, the higher the degree of diversification)



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