Exchange Rate Policy: The euro area, the US, and Asia

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Abstract

This paper uses a three-country model of the US, the euro area and Asia, to analyze alternative policy responses in the euro area to a currency appreciation. The initial shock is an exogenous depreciation of the US dollar, following which the Asian authorities try to maintain their parities with the dollar, while the monetary authority in the euro area can either choose to keep its monetary policy unchanged or try to stabilize its exchange rate. We analyze the conditions under which one option is more attractive than the other by carrying out simulations. We find that in many cases it is not optimal for the ECB to try to offset euro appreciation. It all depends on the degree of substitutability between US, euro area, and Asian goods, and the degree of competition within each market.

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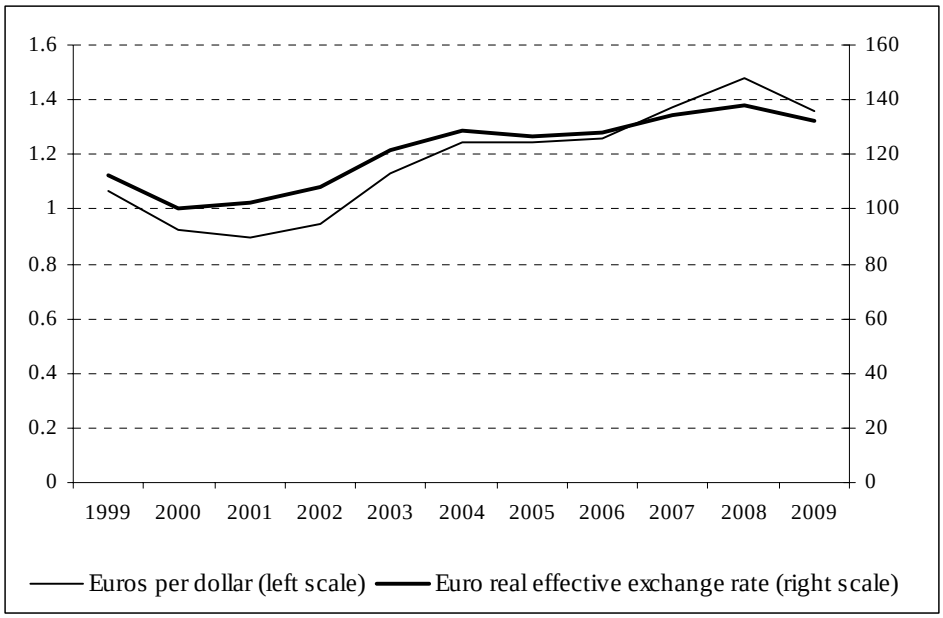
1. Introduction

The significant depreciation of the US dollar between 2002 and 2008, and the reluctance of Asian countries to allow their currencies to float freely, coupled with the increasing role of Asia in the world economy, have stirred the debate among policymakers about whether the ECB should pursue policies to stabilize and curtail a rise in the euro. From 2002 to 2008 the euro steadily gained in value against the US dollar in both nominal and real terms (see Figure 1). While most economists defended this as a necessary adjustment in the face of the large US current account deficit, which reached about 6 percent of US gross domestic product in 2008 (see for instance, Obstfeld and Rogoff, 2005, Devereux and Genberg, 2007, Lane and Milesi-Ferretti, 2007, Mussa, 2007, Clarida, 2007, and references therein), policymakers and public opinion in general expressed concern that these developments were detrimental to Europe, and should be avoided in the future, especially since the main counterpart of the US deficit has not been in the EU but in Asia.

Figure 1: Euro-dollar exchange rate 1999-2009



Source: European Commission, AMECO database. The values for 2009 are February 2009's forecasts for the year.

This issue has particular importance, because episodes of concerted political pressure on

the ECB could threaten the ECB's independence. In 2007, for example, the ECB was under strong political pressure (albeit not concerted) to curtail the euro rise (see Financial Times, 2007, for instance). But is an appreciation of the euro really detrimental to the euro area, and do Asian policies inflict a larger burden on the euro area? This paper uses a simple tractable model to analyze conditions under which conditions a depreciation of the US dollar, given the Asian peg, can be detrimental to the euro area.

In the traditional framework of international economics, the Mundell-Fleming-Dornsbush (MFD) framework, the answer to the question of whether the depreciation of the dollar is detrimental to the euro area would most probably be yes. In the traditional analysis depreciation in one country is beggar-thy-neighbour because it lowers the price of home goods relative to foreign goods and, therefore, shifts trade away from foreign goods into home goods. More recently, a "new open economy macroeconomics" (NOEM), based on microfoundations and using the consumers' welfare function as the basis for policy evaluation, has progressively been replacing the MDF model in the analysis of the effects of alternative macroeconomic policies (Obstfeld and Rogoff, 1995 and Woodford and Rotemberg, 1997, were two influential contributions towards this trend). Within the new framework many competing effects are balanced in order for judgment to be made of the overall impact of macroeconomic policy. In particular, in the case of a depreciation of the home currency it is still true that the prices of goods produced by the home country become more competitive in the world market (if goods are priced in the producer's currency), but to the extent that the depreciation corresponds to a loosening of monetary policy in the home country, and an increase in world demand, it can still be beneficial to the foreign country. In addition, the terms of trade improve in the foreign country, increasing the purchasing power of foreign consumers. Overall, the structural parameters of the model will determine which effect dominates.[2]

This research is more closely related to the work of Lane and Milesi-Ferretti (2007), who undertake simulations using the IMF's Global Economic Model (GEM), to analyze the

[2] Bergin (2006) discusses how well NOEM models fit the data in terms of exchange rate and current account dynamics, concluding that these models perform reasonably well, even though certain extensions may be warranted.

impact of the adjustments needed to bring the US current account back into balance, under different adjustment scenarios: (i) a scenario where adjustment takes place gradually through an increase in the US private savings rate (the benign scenario); (ii) a scenario where there is a sharp reversal of preferences for US dollar assets, abandonment of the Asian peg, and protectionist measures worldwide (the disruptive scenario); and (iii) a scenario where increased exchange rate flexibility is combined with measures to boost consumption in Asia, structural reforms in the euro area and Japan, leading to faster growth in these countries, and higher investment in oil exporting countries (the policies scenario). They conclude that structural policies in Europe can help mitigate the impact of the adjustment, and that flexible exchange rates in Asia do imply a smaller real exchange rate appreciation in the euro area. In our analysis we focus on a different issue, however. Here, we intend to highlight the trade-off between competitiveness and the terms of trade effect, in an analytically tractable model, and analyze different policy options for the euro area, taking the policies of other countries as given.

In this analysis we use a three-country NOEM model to analyze alternative policy responses of the monetary authority in the euro area to a depreciation of the US dollar, assuming that the Asian authorities peg their currencies to the dollar. For simplicity, the model bundles the US and the euro area into an area called the West, so that most of the analysis resembles a two-country set up. In addition, it assumes monopolistic competition and price rigidity, which are the standard assumptions in NOEM.[3] The shock that will be considered is an exogenous depreciation of the US dollar, accommodated by a US monetary expansion. The Asian authorities try to maintain their parities with the dollar, while the monetary authority in the euro area, the European Central Bank (ECB), can follow one of two possible policy alternatives: “benign neglect”; or try to intervene to stabilize its exchange rate. Our model follows closely the Centre-Periphery model of Corsetti et al. (2000), but is used to analyze a different question, and relaxes some of their restrictions (Corsetti et al., 2000, analyze the conditions under which one trading partner would have incentives to abandon a peg in response to another trading partner’s devaluation).

[3] The model will be closely related to the model of Corsetti et al. (2000).

Applying the model to the case of three monetary areas, the euro area, the US, and Asia, which we will define as regions, we can observe that a US dollar depreciation (accommodated by a US monetary expansion), has an ambiguous effect on the euro area's welfare: first, it improves the euro area's terms of trade; second, it shifts overall trade away from Asian goods into Western goods (US and euro area products); third, within Western goods it shifts trade away from euro area goods into US goods. The first two effects are positive, while the third effect is negative. In addition, a monetary expansion by the ECB to curtail euro appreciation also has an ambiguous effect on the euro area economy: it worsens the euro area's terms-of-trade relative to the other currency blocks (negative effect), it shifts demand from Asian goods to Western goods (positive effect) and, within the West (the euro area and the US), it shifts demand away from US goods into euro area goods (positive effect). Only the Asian expansion has an unambiguously positive effect on the euro area's welfare, provided that the degree of competition within regions is higher than the degree of competition across regions (an assumption that is plausible). The strength of the Asian response, however, will depend on the ECB's policy response, since the exchange rate of Asian currencies against the US depends on euro area monetary policy. The degree of Asian expansion will be larger when the ECB intervenes if there is more competition between US and European goods than between Asian and Western goods. This occurs because in that case a monetary expansion by the euro area puts pressure on the Asian currencies to appreciate; hence, the Asian authorities need a stronger response in order to defend their exchange rate.

In order to analyze the choices of the ECB we simulate the welfare results for different values of the parameters of interest. The simulations show that when the degree of competition is high within the region, relative to the degree of competition it faces abroad, the terms of trade effects dominate and the impact of a euro appreciation on the euro area's welfare is positive. In addition, the simulations confirm that the Asian peg always has a positive impact on welfare in the euro area, if competition within regions is stronger than across regions. Although the peg offsets the shift from Asian goods towards Western goods, it expands world consumption and improves the euro area's terms of trade with Asia. The latter effects are always more important than the first when the degree of competition within the euro area is relatively large compared to the degree of

competition between euro area and Asia. The gains from the Asian peg increase, the larger Asia's share in the world economy. Finally, the results show that, for relatively low degrees of substitution between goods produced in different countries the impact of a monetary expansion by the ECB (and depreciation of the euro) will be negative, but producing a depreciation becomes more attractive for the ECB the larger the substitutability between euro area and foreign goods.

2. The model

The model used for the simulations follows Corsetti et al. (2000). We assume that the world economy is formed of three monetary areas which will be called regions: the US, the euro area (or EMU), and Asia.[4] For simplicity, each region specializes in the production of one type of good, but there is a certain degree of substitutability between these goods. In addition, each region produces a continuum of brands for its good, imperfectly substitutable between each other. Households in each region decide how much to consume and work, and the quantity of money balances to hold, by maximizing an intertemporal utility function subject to an intertemporal budget constraint. The government collects lump-sum taxes from households and redistributes those in the form of transfers. Seignorage revenues obtained by the central bank are also rebated to the public. The details of the model are shown in the Appendix.

For simplicity we assume that the population share of each region in the world economy is constant, and we bundle the US and the euro area into an area called the West. This allows the reduction of most of the analysis to a two-country case. We define γ_{West} as the share of the population in the West (the euro area and the US), while the population share of Asia is $(1-\gamma_{West})$. The West's share can be split between the US (γ_{US}) and the euro area $(1-\gamma_{US})$. Hence, the population share of the US in the world is given by $\gamma_{West}\gamma_{US}$, while the European share is $\gamma_{West}(1-\gamma_{US})$. In addition, the elasticity of substitution between the goods produced in the West and Asian goods will be equal to ρ, while the elasticity of substitution between Western goods will be referred to as ψ.

[44] The regions will be treated in the same way as individual countries throughout the analysis.

The elasticity of substitution across brands in any region will be equal to θ.

The household maximization problem yields the following equilibrium relationships: (1) an Euler equation; a money demand equation (2); and a consumption-effort trade-off equation (3):

$$\frac{C_{t+1}^{i}}{C_{t}^{i}} = \beta\left(1+i_{t+1}\right)\frac{P_{t}^{C}}{P_{t+1}^{C}} \tag{1}$$

$$\frac{M_{t}^{i}}{P_{t}^{i}} = \chi C_{t}^{i}\frac{\left(1+i_{t+1}\right)E_{t+1}^{i}}{\left(1+i_{t+1}\right)E_{t+1}^{i}-E_{t}^{i}} \tag{2}$$

$$\frac{P_{i,t}^{i}}{P_{t}^{i}} = \frac{\theta k}{\theta-1}C_{t}^{i}Y_{t}^{i} \tag{3}$$

where C^i is the consumption basket, Y^i is the output of the good produced by household i, M^i denotes money holdings denominated in the currency of region i, P^i is the unit price of the consumption basket in currency i, ($1+ i_{t+1}$) is the gross nominal interest rate from period t to t+1, and E^i denotes the price of dollars in terms of the currency of country i ($E^{US}=1$). A rise in E^i denotes a depreciation of currency i and an appreciation of the US dollar.

It is assumed that prices take one period to adjust. At the time of a shock (the short run) producers are willing to accommodate increases in demand at given prices (assuming prices remain above marginal costs), so that condition (3) only holds in the long run (when prices fully adjust to their equilibrium level). Prices are assumed to be pre-determined in terms of the seller's currency.

In this model, country i 's current account equation will be given by equation (4), which simply states that the country's net claims from the rest of the world (left hand side) must equal domestic income minus absorption (the right side):

$$E_{t}^{i}\left(B_{t+1}^{i}-B_{t}^{i}\right) = i_{t}E_{t}^{i}B_{t}^{i}+P_{i,t}^{i}Y_{t}^{i}-P_{t}^{i}C_{t}^{i} \tag{4}$$

The model can then be linearized around a symmetric steady state, where

$B^{US} = B^{EMU} = B^{West} = B^{Asia} = 0$ and agents do not expect any change in monetary policy.[5] We assume a balanced-budget steady state for simplicity, and we therefore ignore valuation effects, however, in the case of the euro area these valuation effects are likely to be insignificant, since, as mentioned earlier, the largest counterpart of the US current account deficit is in Asia (see Lane and Milesi-Ferretti, 2007).[6] Starting from such equilibrium we then characterize the impact of permanent unanticipated depreciation of the US dollar, when the Asian countries defend the value of their currencies against the dollar.

3. US dollar depreciation and the Asian peg

The shock we will analyze with this model will be a depreciation of the US dollar, accommodated by the US money supply, such that $\bar{m}^{US} = \bar{\mu}$. Asian authorities will be assumed to target the US dollar; hence the response of the Asian authorities to US dollar depreciation will be to defend their exchange rate through an expansionary monetary policy. How much Asia has to devalue, however, will depend on the response of the euro area, due to third currency effects. To see this, notice that in this model the Asian currency's exchange rate against the dollar can be written as follows (see the calculations in the Appendix):

$$\bar{e}^{Asia} = -\Omega(\gamma_{US}, \rho, \psi)\bar{m}^{US} - \Gamma(\gamma_{US}, \rho, \psi)\bar{m}^{EMU} + \Pi(\rho)\bar{m}^{Asia} \qquad (5)$$

where $\Omega(\gamma_{US}, \rho, \psi)$ and $\Pi(\rho)$ are always positive, and declining with the degree of substitutability between Asian and Western goods (ρ), and US and European goods (ψ) in the case of Ω. $\Gamma(\gamma_{US}, \rho, \psi)$ on the other hand is positive if $\psi > \rho$, but negative otherwise. A monetary expansion in the euro area, and hence a depreciation of the euro,

[5] Subscripts and superscripts EMU are used to denote euro area variables.
[6] Valuation effects also mean that the US dollar may not need to devalue much further to correct the current account imbalance, since the appreciation of the euro translates into capital gains on euro denominated assets held in the US, which automatically improve the current account (see Gourinchas and Rey, 2005, 2007), but Obstfeld and Rogoff (2005) show that even taking into account valuation effects there is a need for substantial depreciation of the US dollar to close even just half of the current imbalance.

has two effects of opposite direction on the Asian exchange rate against the dollar in this model. Through intra-West trade a monetary expansion in the euro area causes pressure on the dollar to appreciate and, indirectly, the Asian exchange rate against the dollar should depreciate. On the other hand, through Asian-West trade, a monetary expansion in the euro area puts pressure on the Asian exchange rate to appreciate.

According to equation (5), in order to preserve the value of their currency the Asian authorities will have to follow the following monetary rule:

$$\bar{m}^{Asia} = \frac{\Omega(\rho, \gamma_{US}, \psi)}{\Pi(\rho)} \bar{m}^{US} + \frac{\Gamma(\rho, \gamma_{US}, \psi)}{\Pi(\rho)} \bar{m}^{EMU} \qquad (6)$$

It is clear now that the size of the Asian expansion will depend on the response by the euro area authorities.

4. Alternative responses by the euro area

4.1 Welfare

To guide the discussion, this section explains the welfare implications of the model. Because prices take one period to adjust, the steady state takes one period to be reached, and the model is reduced to a two-period model: the short run, and the long run. Solving the model in terms of monetary expansions will give the following results for welfare (in present value terms) in the West:

$$u^{West} = \frac{1}{\theta}\left[\left(\gamma_{West} - (1-\gamma_{West})\Lambda(\rho)\,(\theta-\rho)\right)\bar{m}^{West} + (1-\gamma_{West})\left(1+\Lambda(\rho)(\theta-\rho)\right)\bar{m}^{Asia}\right] \qquad (7)$$

where $\Lambda(\rho)$ is a positive but declining function of the degree of competition between Asia and the West (ρ). According to equation (7), when competition within regions is higher than between Asian and Western goods ($\theta > \rho$), a monetary expansion in Asia is

always welfare improving for the West as a whole, but the effect of a monetary expansion in the West on West's welfare is uncertain. If the elasticity of substitution between varieties (θ) is very large, for instance, so that the economy is already close to the competitive equilibrium, the effect of a domestic monetary expansion is likely to be negative; the negative terms of the trade effect will dominate.[7] The same negative effect can occur if the elasticity of substitution between Western and Asian (ρ) goods is small. It is also possible to use the model to calculate the impact of monetary expansions on the euro area's welfare, by unbundling the West. This is given by equation (8):

$$\theta u^{EMU} = \alpha_1^{EMU} \overline{m}^{US} + \alpha_2^{EMU} \overline{m}^{EMU} + \alpha_3^{EMU} \overline{m}^{Asia} \qquad (8)$$

where

$$\begin{aligned}
\alpha_1^{EMU} &= \gamma_{US}\left(\left(\gamma_{West} - \left(1-\gamma_{West}\right)\Lambda\left(\rho\right)\left(\theta-\rho\right)\right) + \Lambda\left(\psi\right)\left(\theta-\psi\right)\right) \\
\alpha_2^{EMU} &= \left(1-\gamma_{US}\right)\left(\gamma_{West} - \left(1-\gamma_{West}\right)\Lambda(\rho)\left(\theta-\rho\right)\right) - \gamma_{US}\Lambda\left(\psi\right)\left(\theta-\psi\right) \\
\alpha_3^{EMU} &= \left(1-\gamma_{West}\right)\left(1+\Lambda\left(\rho\right)\left(\theta-\rho\right)\right)
\end{aligned}$$

and $\Lambda(\psi)$ is a positive but declining function of the degree of competition between the euro area and the US (ψ). The sign of the parameter α_3^{EMU} is always positive when $\theta > \rho$, that is, when the degree of competition within regions is stronger than the degree of competition between Asia and the West. In this case, an Asian monetary expansion has an unambiguously positive effect on the euro area's welfare. The signs of the parameters α_1^{EMU} and α_2^{EMU} depend on the values of the structural parameters, that is, a monetary expansion either by the US or by the ECB have both positive and negative effects on welfare in the euro area and a priori it is difficult to say which effect dominates. The positive effects of a US expansion are the increase in world demand, the improvement of the euro area's terms of trade, and the shifting of overall trade away from Asian goods into Western goods. In this model the euro area's terms of trade improve following a depreciation of the US dollar because goods are priced in the currency of the producer. Obstfeld and Rogoff (2000) show that there is significant empirical evidence of a positive

[7] See also Tille (2001) on the role of consumption substitutability in the international transmission of monetary shock.

relationship between a country's terms-of-trade (measured as the ratio of the price of exports to the price of imports) and the value of its currency. The negative effect of the US expansion is the shifting of trade away from euro area goods into US goods. Similarly, the positive effects of a monetary expansion in the euro area are an increase in world demand, and the shifting of trade away from Asian goods into Western goods and, within Western trade, away from US goods into euro area goods. The negative effect is a deterioration of the euro area's terms of trade.

4.2 "Benign Neglect" in the euro area

In this policy scenario the ECB chooses not to respond to exchange rate developments, therefore $\bar{m}_{BN}^{EMU} = 0$. It follows from equation (6) that the response in Asia will be given by:

$$\bar{m}_{BN}^{Asia} = \frac{\gamma_{US}\Pi(\rho) + (1-\gamma_{US})\Pi(\psi)}{\Pi(\rho)}\bar{\mu} \qquad (9)$$

where $\Pi(\psi)$ is a positive but declining function of the elasticity of substitution between euro area and US goods (ψ), equivalent to $\Pi(\rho)$ when we substitute ρ by ψ. Hence $\psi > \pi$ implies that $\Pi(\rho) > \Pi(\psi)$ and vice versa (see the Appendix for details).

Substituting equation (9) into the welfare function (8) yields:

$$\theta u_{BN}^{EMU} = \left[\alpha_1^{EMU}\bar{\mu} + \alpha_3^{EMU}\frac{\gamma_{US}\Pi(\rho) + (1-\gamma_{US})\Pi(\psi)}{\Pi(\rho)}\bar{\mu}\right] \qquad (10)$$

In this case there are only two effects on the euro area's welfare: the effect from the US expansion (ambiguous) and the impact from the Asian monetary expansion.

4.3 Intervention to stabilize the exchange rate

Under this scenario, the ECB intervenes to stabilize the euro exchange rate, such that $\bar{e}^{EMU} = 0$. For that a monetary expansion is required, such that:

$$\overline{m}_{EST}^{EMU} = \overline{\mu}$$

Substituting this into equation (9) gives the response of Asia under this regime:

$$\overline{m}_{EST}^{Asia} = \frac{\gamma_{US}\Pi(\rho)+(1-\gamma_{US})\Pi(\psi)}{\Pi(\rho)}\overline{\mu} + (1-\gamma_{US})\frac{\Pi(\rho)-\Pi(\psi)}{\Pi(\rho)}\overline{\mu} = \overline{\mu} \qquad (11)$$

Notice that when $\psi > \rho$, the response of Asia is stronger when the euro area stabilizes its exchange rate, since as mentioned above, in this case *Π(ρ)>Π(ψ).* This occurs because when $\psi > \rho$ a monetary expansion by the euro area puts pressure on the Asian currencies to appreciate, hence the Asian authorities need a stronger response in order to defend their exchange rate. Under this scenario the welfare effects are given by:

$$\theta u_{EST}^{EMU} = \left(\alpha_1^{EMU} + \alpha_2^{EMU} + \alpha_3^{EMU}\right)\overline{\mu} \qquad (12)$$

In this scenario there are three effects on welfare, resulting from an expansion in each of the three monetary policy areas.

4.4 Comparing the two policy scenarios

The policy option of exchange rate stabilization will be preferred to a policy of benign neglect when $u_{EST}^{EMU} - u_{BN}^{EMU} > 0$. Analyzing equation (13) below, it is possible to see that the second term is always positive when the degree of intra-region competition (θ) is high (so that α_3 is positive), and the degree of competition between euro area and the US (ψ) is higher than the degree of competition between the West and Asia (ρ), such that $\Pi(\rho)>\Pi(\psi)$. The reason for this is that, when the degree of intra-West competition (ψ) is higher than the degree of competition between the West and Asia (ρ), Asia is forced to expand by more under the alternative of exchange rate stabilization. Hence, this scenario becomes more attractive for the euro area when the effects of an Asian expansion are positive $(\theta > \rho)$.

$$\theta\left(u_{EST}^{EMU} - u_{MST}^{EMU}\right) = \alpha_2^{EMU}\overline{\mu} + \alpha_3^{EMU}(1-\gamma_{US})\frac{\Pi(\rho)-\Pi(\psi)}{\Pi(\rho)}\overline{\mu} \qquad (13)$$

The impact of the euro area expansion $\left(\alpha_2^{EMU}\right)$, however, can be either positive or negative. If it is negative, this means that a monetary expansion by the euro area is beggar-thyself, implying, therefore, a trade-off associated with the scenario of exchange rate stabilization: on the one hand, under this scenario, the Asian expansion is stronger with a positive impact on euro area's welfare but, on the other hand, the euro area's own monetary expansion has a negative impact on welfare. Under these circumstances, this scenario will be preferred only if the first effect is stronger than the second.

In order to analyze under what conditions this may occur, we simulate the welfare results for alternative values of the structural parameters. The results are shown in Table 1. The superscripts EMU are omitted because the table only analyses the welfare gains/losses in the euro area. For each alternative, *BN* and *EST*, the table shows the contribution of the US dollar depreciation to euro area welfare $\left(u\left(\bar{m}^{US}\right)\right)$, the contribution of the euro area monetary policy $\left(u\left(\bar{m}^{EMU}\right)\right)$ to euro area welfare, and the contribution of the Asian peg to euro area welfare $\left(u\left(\bar{m}^{Asia}\right)\right)$, all multiplied by θ. It also summarizes the overall welfare gains under each scenario (θu) and the difference between the welfare gain under the policy alternatives of exchange rate stabilization and benign neglect ($\theta\left(u_{EST}-u_{BN}\right)$).

Table 1: Comparison between policy choices for the euro area, $\bar{\mu}$ = 1

	(1)		*(2)*		*(3)*		*(4)*	
γ_{west}	0.67		0.67		0.67		0.67	
γ_{US}	0.5		0.5		0.5		0.5	
θ	3.0		8.0		8.0		8.0	
ψ	7.0		7.0		7.5		7.0	
ρ	6.0		6.0		7.0		7.5	
β	0.99		0.99		0.99		0.99	
μ	1		1		1		1	
	BN	EST	BN	EST	BN	EST	BN	EST
$\theta u(m_{us})$	-0.4929	-0.4929	0.4246	0.4246	0.3807	0.3807	0.5671	0.5671
$\theta u(m_{euro\ area})$	0.0000	1.7263	0.0000	-0.1302	0.0000	0.1063	0.0000	0.0123
$\theta u(m_{asia})$	-0.2328	-0.2334	0.7039	0.7056	0.5124	0.5131	0.4211	0.4206
θu	-0.7257	1.0000	1.1284	1.0000	0.8931	1.0000	0.9882	1.0000
$\theta(u_{EST}-u_{BN})$	1.73		-0.13		0.11		0.01	

Recall that the US dollar depreciation (accommodated by the monetary expansion) has basically the following effects in the euro area: it expands world demand, it improves the euro area's terms of trade, it shifts overall trade away from Asian goods into Western goods, and within Western goods it shifts trade away from euro area goods into US goods. The first three effects are positive. The third effect in particular depends on the size of the Asian economy and on the elasticity of substitution between Asian and Western goods (ρ). The last effect is negative and depends on the relative size of the West and on the degree of substitution between euro area and US goods (ψ).

In column (1) we simulate a situation in which the level of intra-region competition (θ) is lower than the level of external competition (ψ,ρ).[8] In this case we see that the substitution effect of foreign currency depreciation dominates. Both the US and Asian expansions, which drive up the value of the euro, have a negative impact on euro area welfare. Under these parameters, it is optimal for the ECB to stabilize the euro exchange rate.

In column (2) we increase the degree of intra-region competition (θ), to where it is higher than the degree of competition across region (ψ,ρ). In this case we see that the positive effects of foreign currency depreciation on world demand and on domestic terms-of-trade dominate. In fact an expansion by the euro area will be beggar-thyself because it reduces welfare relative to the benign neglect situation. In the third column of the table we can see that the beggar-thyself effect is reduced when the degree of substitutability between regions increases, and stabilizing the exchange rate becomes more attractive.

In columns (1)-(3) we have assumed that the elasticity of substitution between US and euro area goods is higher than the elasticity of substitution between Asian and Western goods (Western goods being US and euro area goods). This is consistent with a scenario where the US and the euro area produce more similar goods (less labour-intensive), while Asia produces goods that are less similar to the goods produced by the West (more

[8] In this case the intra-region demand schedules are relatively inelastic; hence an increase in demand is associated with a relatively sharp drop in prices.

labour-intensive).[9] In column (4) we relax this assumption by switching the value of the elasticity of substitution between the euro area and the US (ψ) with the value of the elasticity of substitution between Asian and Western goods (ρ). The results show that in this case Asian expansion still has a positive effect on the euro area albeit smaller.

This table shows that the optimal exchange rate policy in the euro area crucially depends on the characteristics of trade flows between the US, the euro area, and Asia, and the level of competition between and within these markets. Further research aiming at quantifying these relative degrees of substitution is essential for understanding the consequences of euro appreciation on the euro area.

5. Conclusions

This paper applies a three-country model to three regions, the US, the euro area, and Asia, to analyze the alternative policy responses of the monetary authorities in the euro area to a depreciation of the US dollar, assuming that the Asian authorities peg their currencies to the dollar. The model assumes monopolistic competition and price rigidity, which are standard assumptions in the NOEM literature.

A depreciation of the US dollar is found to have multiple effects in the euro area: (i) it increases world demand; (ii) it improves the euro area's terms of trade; (iii) it shifts overall trade away from Asian goods into Western goods; and (iii) it shifts trade away from euro area goods into US goods, within the trade in Western goods. The first three effects are positive, while the fourth is negative. The relative importance of these effects crucially depends on the levels of competition within and across regions.

We assumed that in response to the dollar depreciation, Asian monetary authorities expand to maintain the fixed value of their currencies against the dollar. This response

[9] We consider the assumptions regarding cross-country elasticities of substitution plausible, given the similarities between the US and the euro area economies, which are mature economies, in contrast with developing Asian economies, especially China. Although empirical evidence is needed to validate these assumptions, we do not know of any study that has investigated this issue to date, and we leave it to further research.

also has multiple effects on euro area: on the positive side, it expands world demand and improves euro area terms-of-trade, but on the negative side it shifts trade away from Western goods into Asian goods. The positive effects dominate if the degree of intra-country competition is higher than the competition between Asia and the West.

Does the euro area have an incentive to curtail the appreciation of the euro? It depends. If the degree of intra region competition is very low, the standard Mundel-Flemming substitution effects of foreign currency depreciation dominate, and euro area has an incentive to stabilize the exchange rate to re-capture world trade and improve its welfare. On the other hand, if intra-region competition is stronger than competition between regions, a monetary expansion by euro area to stabilize the value of the euro may be beggar-thyself. Stabilization in this case will only be worthwhile if the degree of competition between regions is relatively close to the degree of competition within regions.

One limitation of the model is that the economies are linearized around a symmetric steady state where current accounts are all balanced. As shown in Lane and Milesi-Ferretti (2001, 2006), when current accounts are initially imbalanced, valuation effects become important. Thoenissen (2005) has also shown that the impact of the exchange rate on the current account may change depending on whether a country is initially a net borrower or a net debtor. As mentioned earlier, however, valuation effects are not likely to be as important for the euro area as they are for Asia (where most of the counterpart to the large US current account deficit is), but they could affect the incentives for Asia to abandon the peg.

Another limitation of the analysis is that it considers prices to remain constant for one period. A more realistic assumption would be to consider Calvo-type contracts, in which in every period a certain fraction of firms is allowed to change prices. This would allow the introduction of heterogeneity in the level of price rigidity across countries. The model can also be further extended to allow for alternative policy instruments and shocks, but at the expense of analytical tractability. We leave these extensions for future research.

REFERENCES

Bergin, P. R. (2006). "How well can the New Open Economy Macroeconomics explain the exchange rate and current account?". Journal of International Money and Finance 25 (5), 675-701.

Clarida, R. (2007). G7 Current Account Imbalances: Sustainability and Adjustment. Chicago, University of Chicago Press for NBER.

Corsetti, G., Peseti, P., Roubini, N. and Tille, C. (2000). "Competitive Devaluations: Towards a Welfare Based Approach". Jounal of International Economics, 51 (2000), 217-241.

Devereux, M. B., and Genberg, H. (2007). "Currency Appreciation and Current Account Adjustment ". Journal of International Money and Finance 26 (4), 570-586.

Financial Times (2007). "Calls grow for ECB intervention to stem the relentless rise of the euro", October 2.

Gourinchas, P., and Rey, H. (2005). "International Financial Adjustment". NBER Working Paper No. 11155 (August).

Gourinchas, P., and Rey (2007). "From World Banker to World Venture Capitalist: US External Adjustment and the Exorbitant Privilege ". In G7 Current Account Imbalances: Sustainability and Adjustment, edited by Clarida, R. Chicago, University of Chicago Press for NBER.

Lane, P. R., and Milesi-Ferretti, G. M. (2007). "Europe and Global Imbalances". IMF Working Paper No. 07/144, June.

Lane, P. R., and Milesi-Ferretti, G. M. (2006). The External Wealth of Nations Mark II, IMF Working Paper No. 06/169, March (forthcoming, Journal of International Economics).

Lane, Philip R., and Milesi-Ferretti, G. M. (2001). The External Wealth of Nations: Measures of Foreign Assets and Liabilities for Industrial and Developing Countries. Journal of International Economics 55, 263--94.

Mussa, M. (2007). "The dollar and the current account deficit: How much should we worry?". Journal of Policy Modeling 29 (5), 691-696.

Obstfeld, M., and Rogoff, K. (2005). "Global Current Account Imbalances and Exchange Rate Adjustment". Brookings Papers on Economic Activity (1), 67-146.

Obstfeld, M., and Rogoff, K. (2000). "New Directions for Stochastic Open Economy Models", Journal of International Economics 50 (2000), 117-153.

Obstfeld, M., and Rogoff, K. (1995). "Exchange Rate Dynamics Redux ", Journal of

Political Economy 103, 640-60.

Tille, C. (2001). "The Role of Consumption Substitutability in the International Transmission of Monetary Shocks". Journal of International Economics, 53, April, 421-444.

Thoenissen, C. (2005). "Current account and exchange rate dynamics and the net foreign asset position". In Exchange Rates, Capital Flows and Policy. edited by Driver, Sinclair, and Thoenissen. Routledge, London.

Woodford, M.,and Rotemberg, J. (1997). "An Optimization-Based Econometric Model for the Evaluation of Monetary Policy". NBER Macroeconomics Annual 12: 297-346.

Appendix

A. The Model

The model is based on Corsetti et al. (2000)'s Centre-Periphery model. The representative household living in region *i* (*i=US, EMU, Asia*) is assumed to maximize the following objective function at time t :

$$U_t^i = E_t \sum_{s=0}^{\infty} \beta^s \left\{ \ln C_{t+s}^i - \frac{k}{2}\left(Y_{t+s}^i\right)^2 + \chi \ln\left(\frac{M_{t+s}^i}{P_{t+s}^i}\right)\right\} \tag{A1}$$

with all variables as defined in the main text. EMU is used to denote euro area variables. The utility maximization is subject to the standard budget constraint (with T denoting net taxes, and B denoting a nominal bond denominated in US dollars in zero-net supply worldwide):

$$\frac{E_t^i B_{t+1}^i}{P_t^i} + \frac{M_t^i}{P_t^i} + C_t^i = \left(1+i_t\right)\frac{E_t^i B_t^i}{P_t^i} + \frac{M_{t-1}^i}{P_t^i} + \frac{P_{i,t}^i Y_t^i}{P_t^i} - T_t^i \tag{A2}$$

Given the definitions in the main text, the consumption baskets of the representative household of country i can be defined as follows:

$$C^i = \left[\gamma_{West}^{\frac{1}{\rho}}\left(C_{West}^i\right)^{\frac{\rho-1}{\rho}} + \left(1-\gamma_{West}\right)^{\frac{1}{\rho}}\left(C_{Asia}^i\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}} \tag{A3}$$

$$C_{West}^i = \left[\gamma_{US}^{\frac{1}{\psi}}\left(C_{US}^i\right)^{\frac{\psi-1}{\psi}} + \left(1-\gamma_{US}\right)^{\frac{1}{\psi}}\left(C_{EMU}^i\right)^{\frac{\psi-1}{\psi}}\right]^{\frac{\psi}{\psi-1}}$$

We should also define the following consumption sub-indexes:

$$\begin{aligned} C_{US}^i &= \left[\left(\gamma_{US}\gamma_{West}\right)^{-\frac{1}{\theta}}\int_0^{\gamma_{US}\gamma_{WEST}}\left(C_{US}^i(z)\right)^{\frac{\theta-1}{\theta}}dz\right]^{\frac{\theta}{\theta-1}} \\ C_{EMU}^i &= \left[\left(\left(1-\gamma_{US}\right)\gamma_{West}\right)^{-\frac{1}{\theta}}\int_{\gamma_{US}\gamma_{WEST}}^{\gamma_{WEST}}\left(C_{EMU}^i(z)\right)^{\frac{\theta-1}{\theta}}dz\right]^{\frac{\theta}{\theta-1}} \\ C_{Asia}^i &= \left[\left(1-\gamma_{West}\right)^{-\frac{1}{\theta}}\int_{\gamma_{WEST}}^{1}\left(C_{Asia}^i(z)\right)^{\frac{\theta-1}{\theta}}dz\right]^{\frac{\theta}{\theta-1}} \end{aligned} \tag{A4}$$

Finally we describe the utility-based price indexes, defined as the minimum expenditure required to buy one unit of a consumption basket:

$$\begin{aligned} P_{US}^i &= \left[\frac{1}{\gamma_{US}\gamma_{West}}\int_0^{\gamma_{US}\gamma_{WEST}}\left(P_{US}^i(z)\right)^{1-\theta}dz\right]^{\frac{1}{1-\theta}} \\ P_{EMU}^i &= \left[\frac{1}{\left(1-\gamma_{US}\right)\gamma_{West}}\int_{\gamma_{US}\gamma_{WEST}}^{\gamma_{WEST}}\left(P_{EMU}^i(z)\right)^{1-\theta}dz\right]^{\frac{1}{1-\theta}} \\ P_{Asia}^i &= \left[\frac{1}{1-\gamma_{West}}\int_{\gamma_{WEST}}^{1}\left(P_{Asia}^i(z)\right)^{1-\theta}dz\right]^{\frac{1}{1-\theta}} \end{aligned} \tag{A5}$$

$$P^i_{West} = \left[\gamma_{US}\left(P^i_{US}\right)^{1-\psi} + \left(1-\gamma_{US}\right)\left(P^i_{EMU}\right)^{1-\psi}\right]^{\frac{1}{1-\psi}}$$
$$P^i = \left[\gamma_{West}\left(P^i_{West}\right)^{1-\rho} + \left(1-\gamma_{West}\right)\left(P^i_{Asia}\right)^{1-\rho}\right]^{\frac{1}{1-\rho}}$$

Maximizing (A1) subject to (A2) with respect to holdings of bonds and money yields the Euler equation (1) and the money demand equation (2) in the main text; while optimization with respect to output yields the consumption effort trade-off equation (3).

B. Solution

The solution strategy follows Corsetti et al. (2000). We consider only small shocks and log-linearize the model around a steady state in which $B^i=0$. We also follow the strategy of decomposing the model into differences and world averages.

B.1. Long-run equilibrium

Log-linearizing the price indexes around the steady state equilibrium and using $e^{West} = \left(1-\gamma_{US}\right)e^{EMU}$ it is possible to write:

$$\begin{aligned}
&\bar{p}^{West}_{West} = \gamma_{US}\,\bar{p}^{West}_{US} + \left(1-\gamma_{US}\right)\bar{p}^{West}_{EMU} = \gamma_{US}\,\bar{p}^{US}_{US} + \left(1-\gamma_{US}\right)\bar{p}^{EMU}_{EMU} \\
&\bar{p}^{West}_{Asia} = \gamma_{US}\,\bar{p}^{US}_{Asia} + \left(1-\gamma_{US}\right)\bar{p}^{EMU}_{Asia} = \bar{p}^{Asia}_{Asia} - \left(e^{Asia} - \left(1-\gamma_{US}\right)e^{EMU}\right) \\
&\bar{p}^{US}_{West} = \gamma_{US}\,\bar{p}^{US}_{US} + \left(1-\gamma_{US}\right)\left(\bar{p}^{EMU}_{EMU} - e^{EMU}\right) = \bar{p}^{West}_{West} - \left(1-\gamma_{US}\right)e^{EMU} \\
&\bar{p}^{West} = \gamma_{West}\left(\bar{p}^{West}_{West}\right) + \left(1-\gamma_{West}\right)\left(\bar{p}^{Asia}_{Asia} - \left(e^{Asia} - e^{West}\right)\right) \\
&\bar{p}^{Asia} = \gamma_{West}\left(\bar{p}^{West}_{West} + \left(e^{Asia} - e^{West}\right)\right) + \left(1-\gamma_{West}\right)\bar{p}^{Asia}_{Asia}
\end{aligned} \tag{B1}$$

Log-linearizing the Euler equations, the money marker equilibrium conditions, and the long-run consumption-effort trade-off, yields respectively:

$$\beta\left(1+\bar{i}\right) = 1 \tag{B2}$$
$$\bar{m}^{i} - \bar{p}^{i} = \bar{c}^{i} \tag{B3}$$
$$\bar{p}^{i}_{i} - \bar{p}^{i} = \bar{c}^{i} + \bar{y}^{i} \tag{B4}$$

Aggregating output demand:

$$\begin{aligned}
\bar{y}^{US} &= -\psi\left(\bar{p}^{US}_{US} - \bar{p}^{US}_{West}\right) + \bar{y}^{West} \\
\bar{y}^{EMU} &= -\psi\left(\bar{p}^{EMU}_{EMU} - \bar{p}^{EMU}_{West}\right) + \bar{y}^{West} \\
\bar{y}^{West} &= -\rho\left(\bar{p}^{West}_{West} - \bar{p}^{West}\right) + \bar{c}^{w} \\
\bar{y}^{Asia} &= -\rho\left(\bar{p}^{Asia}_{Asia} - \bar{p}^{Asia}\right) + \bar{c}^{w}
\end{aligned} \tag{B5}$$

Log-linearizing the long-run current account equations yields:

$$0 = \frac{1-\beta}{\beta}\bar{b}^{i} - \bar{c}^{i} + \bar{p}^{i}_{i} - \bar{p}^{i} + \bar{y}^{i} \tag{B6}$$

where $b^i = dB^i / \left(C^i P^{US}\right)$, for *i = US, euro area, West, and Asia*. In equilibrium:

$$0 = \gamma_{US}\gamma_{West}\bar{b}^{US} + \gamma_{EMU}\gamma_{West}\bar{b}^{EMU} + \gamma_{Asia}\bar{b}^{Asia} = \gamma_{West}\bar{b}^{West} + \gamma_{Asia}\bar{b}^{Asia}$$

Notice in addition that the long-run money demand equations and price indexes imply¨:

$$\begin{aligned} \bar{m}^{West} - \bar{m}^{Asia} - \left(\bar{e}^{West} - \bar{e}^{Asia}\right) &= \left(\bar{c}^{West} - \bar{c}^{Asia}\right) \\ \bar{m}^{Asia} - \bar{m}^{US} - \bar{e}^{Asia} &= \left(\bar{c}^{Asia} - \bar{c}^{US}\right) \\ \bar{m}^{EMU} - \bar{m}^{US} - \bar{e}^{EMU} &= \left(\bar{c}^{EMU} - \bar{c}^{US}\right) \end{aligned} \qquad \text{(B7)}$$

B.1.1. East versus West

From the demand equations (B5) and the price indexes (B1) it is possible to obtain:

$$\bar{y}^{West} - \bar{y}^{Asia} = -\rho\left(\bar{p}_P^{West} - \bar{p}_{Asia}^{Asia} + \left(e^{Asia} - e^{West}\right)\right) \qquad \text{(B8)}$$

Using instead the consumption-leisure trade-off (B6) and the demand equations (B5) it also possible to write:

$$\bar{p}_{West}^{West} - \bar{p}_{Asia}^{Asia} + \left(e^{Asia} - e^{West}\right) = \frac{1}{1+\rho}\left(\bar{c}^{West} - \bar{c}^{Asia}\right) \qquad \text{(B9)}$$

Substituting this result in the difference between the West and Asian current account equations yields long-run consumption differences in terms if net foreign assets:

$$\bar{c}^{West} - \bar{c}^{Asia} = \frac{1+\rho}{2\rho}\frac{1-\beta}{\beta}\frac{1}{1-\gamma_{West}}\bar{b}^{West} \qquad \text{(B10)}$$

Substituting (B10) into results (B8) and (B9) gives the long-run differences in prices and output as a function of long-run net foreign assets:

$$\bar{p}_{West}^{West} - \bar{p}_{Asia}^{Asia} - \left(e^{West} - e^{Asia}\right) = \frac{1}{2\rho}\frac{1-\beta}{\beta}\frac{1}{1-\gamma_{West}}\bar{b}^{West} \qquad \text{(B11)}$$

$$\bar{y}^{West} - \bar{y}^{Asia} = -\frac{1}{2}\frac{1-\beta}{\beta}\frac{1}{1-\gamma_{West}}\bar{b}^{West} \qquad \text{(B12)}$$

To calculate the world aggregates we take instead the averages of the equilibrium relations, and we conclude that $\bar{y}^w = \bar{c}^w$. It follows that $\bar{c}^w = \bar{y}^w = 0$.

B.1.2. Intra-West

The same procedure is followed to obtain the intra-West long-run solution, which are given by:

$$\bar{c}^{US} - \bar{c}^{EMU} = \frac{1+\psi}{2\psi}\frac{1-\beta}{\beta}\left(\bar{b}^{US} - \bar{b}^{EMU}\right) \qquad \text{(B13)}$$

$$\bar{p}_{US}^{US} - \bar{p}_{EMU}^{EMU} + \bar{e}^{EMU} = \frac{1}{2\psi}\frac{1-\beta}{\beta}\left(\bar{b}^{US} - \bar{b}^{EMU}\right) \qquad \text{(B14)}$$

$$\bar{y}^{US} - \bar{y}^{EMU} = -\frac{1}{2}\frac{1-\beta}{\beta}\left(\bar{b}^{US} - \bar{b}^{EMU}\right) \qquad \text{(B15)}$$

B.2. Short-run Equilibrium

To obtain the short-run equilibrium, notice that prices do not adjust during the short-run, that is $p_i^i = 0$. From the Euler equation $\bar{c}^i = c_t^i + (1-\beta)\bar{r}$ it is possible to write:

$$\begin{aligned} \bar{c}^{US} - \bar{c}^{EMU} &= c^{US} - c^{EMU} \\ \bar{c}^{West} - \bar{c}^{Asia} &= c^{West} - c^{Asia} \end{aligned} \tag{B16}$$

Log-linearizing the money demand equations for the short run, and taking differences yields:

$$\begin{aligned} m^{Asia} - m^{US} - e^{Asia} &= \left(c^{Asia} - c^{US}\right) - \frac{1}{\delta}\left(\bar{e}^{Asia} - e^{Asia}\right) \\ m^{EMU} - m^{US} - e^{EMU} &= \left(c^{EMU} - c^{US}\right) - \frac{1}{\delta}\left(\bar{e}^{EMU} - e^{EMU}\right) \end{aligned} \tag{B17}$$

where $\delta \equiv \frac{1-\beta}{\beta}$. If we assume a permanent monetary expansion: $m^i = \bar{m}^i$, equations (B17) together with the long-run money market equilibrium conditions (B7) and the Euler equations (B16), imply that the exchange rate jumps immediately to its new long-run equilibrium, such that $e^{Asia} = \bar{e}^{Asia}$, and $e^{EMU} = \bar{e}^{EMU}$, and it follows that:

$$\begin{aligned} c^{Asia} - c^{US} &= \bar{m}^{Asia} - \bar{m}^{US} - e^{Asia} \\ c^{EMU} - c^{US} &= \bar{m}^{EMU} - \bar{m}^{US} - e^{EMU} \\ c^{West} - c^{Asia} &= \bar{m}^{West} - \bar{m}^{Asia} - \left(e^{West} - e^{Asia}\right) \end{aligned} \tag{B18}$$

Log-linearizing the current account equilibrium conditions yields:

$$\begin{aligned} \bar{b}^{US} + c^{US} &= y^{US} - p^{US} \\ \bar{b}^{EMU} + c^{EMU} &= y^{EMU} - p^{EMU} \\ \bar{b}^{West} + c^{West} &= y^{West} - p^{West} \\ \bar{b}^{Asia} + c^{Asia} &= y^{Asia} - p^{Asia} \end{aligned} \tag{B19}$$

In equilibrium $\gamma_{West}\bar{b}^{West} + \gamma_{Asia}\bar{b}^{Asia} = 0$.

B.2.1. East versus West

Taking the difference between the West and Asian long-run current account conditions makes it possible to obtain:

$$\bar{b}^{West} = (1-\gamma_{West})\left[\left(y^{West} - y^{Asia}\right) - \left(c^{West} - c^{Asia}\right) - \left(e^{West} - e^{Asia}\right)\right] \tag{B20}$$

Taking also the differences between the short run analog of the goods market equilibrium conditions (B5) yields:

$$\left(y^{West} - y^{Asia}\right) = \rho\left(e^{West} - e^{Asia}\right) \tag{B21}$$

Using (B20) and (B21), together with the long-run relationship between net foreign assets and consumption (B19) and the second Euler equation in (B16) it is possible to write:

$$\frac{2\rho}{1+\rho}\frac{\beta}{1-\beta}\left(c^{West}-c^{Asia}\right)=(\rho-1)\left(e^{West}-e^{Asia}\right)-\left(c^{West}-c^{Asia}\right) \tag{B22}$$

Using the last equation in (B18) to substitute for consumption and rearranging yields:

$$\left(e^{West}-e^{Asia}\right)=\left(\bar{e}^{West}-\bar{e}^{Asia}\right)=\Pi(\rho)\left(\bar{m}^{West}-\bar{m}^{Asia}\right) \tag{B23}$$

where $\Pi(\rho)\equiv\frac{1}{\rho}\frac{(1-\beta)+\rho(1+\beta)}{(1+\beta)+\rho(1-\beta)}$, and is declining in ρ. Substituting (B23) into (B21) and (B18) makes it possible to obtain the results for relative output, relative consumption:

.

$$y^{West}-y^{Asia}=\frac{(1-\beta)+\rho(1+\beta)}{(1+\beta)+\rho(1-\beta)}\left(\bar{m}^{West}-\bar{m}^{Asia}\right) \tag{B24}$$

$$c^{West}-c^{Asia}=\bar{c}^{West}-\bar{c}^{Asia}=\frac{(\rho-1)}{\rho}\frac{(\rho+1)(1-\beta)}{(1+\beta)+\rho(1-\beta)}\left(\bar{m}^{West}-\bar{m}^{Asia}\right) \tag{B25}$$

Substituting (B23), (B21), and (B19) into the current account equation (B20) gives the current account balance as a function of the monetary shock.

$$\frac{\bar{b}^{West}}{1-\gamma_{West}}=\frac{2\beta(\rho-1)}{(1+\beta)+\rho(1-\beta)}\left(\bar{m}^{West}-\bar{m}^{Asia}\right) \tag{B26}$$

The world aggregates can be obtained by calculating the weighted sums of the equilibrium equations: $\bar{m}^{w}=c^{w}=y^{w}$.

B.2.2. Intra-West

Following the same strategy it is possible to obtain the following results for the intra-West variables:

$$e^{EMU}=\bar{e}^{EMU}=\Pi(\psi)\left(\bar{m}^{EMU}-\bar{m}^{US}\right)$$

where $\Pi(\psi)\equiv\frac{1}{\psi}\frac{(1-\beta)+\psi(1+\beta)}{(1+\beta)+\psi(1-\beta)}$, and is declining in ψ . Using this result in an analogous way as above we can write:

$$y^{US}-y^{EMU}=\frac{(1-\beta)+\psi(1+\beta)}{(1+\beta)+\psi(1-\beta)}\left(\bar{m}^{US}-\bar{m}^{EMU}\right) \tag{B27}$$

$$c^{US}-c^{EMU}=\bar{c}^{US}-\bar{c}^{EMU}=\frac{(\psi-1)}{\psi}\frac{(\psi+1)(1-\beta)}{(1+\beta)+\psi(1-\beta)}\left(\bar{m}^{US}-\bar{m}^{EMU}\right) \tag{B29}$$

$$\frac{\bar{b}^{US}-\bar{b}^{West}}{1-\gamma_{US}}=\frac{2\beta(\psi-1)}{(1+\beta)+\psi(1-\beta)}\left(\bar{m}^{US}-\bar{m}^{EMU}\right) \tag{B30}$$

B.3. Overall Effects

The overall effects are calculated as the net present value of the log-changes of each variable x , such that $x_{npv}=x+\frac{\beta}{1-\beta}\bar{x}$. Using the results above we can write:

$$
\begin{aligned}
y_{npv}^{West} - y_{npv}^{Asia} &= \frac{\rho(1+\rho)}{(1-\beta)+\rho(1+\beta)}\Pi(\rho)\left(\bar{m}^{West} - \bar{m}^{Asia}\right) \\
y_{npv}^{US} - y_{npv}^{EMU} &= \frac{\psi(1+\psi)}{(1-\beta)+\psi(1+\beta)}\Pi(\psi)\left(\bar{m}^{US} - \bar{m}^{EMU}\right) \\
c_{npv}^{West} - c_{npv}^{Asia} &= \frac{\rho-1}{\rho}\left(y_{npv}^{West} - y_{npv}^{Asia}\right) \\
c_{npv}^{US} - c_{npv}^{EMU} &= \frac{\psi-1}{\psi}\left(y_{npv}^{US} - y_{npv}^{EMU}\right)
\end{aligned}
\tag{B32}
$$

It follows also that the world aggregates are given by:

$$
c_{npv}^{w} = y_{npv}^{w} = \bar{m}^{w} \tag{B33}
$$

B.4. Welfare Effects

The welfare effects are calculated using the log-linearized utility function excluding utility from liquidity services, such that:

$$
u^{i} = c_{npv}^{i} - \frac{\theta-1}{\theta} y_{npv}^{i} \tag{B34}
$$

Notice that as for other variables, each country/ region's utility can be decomposed as the sum of world utility and relative utilities. It follows from (B32), (B33, and (B34) that:

$$
\begin{aligned}
u^{w} &= \frac{1}{\theta}\bar{m}^{w} \\
u^{West} - u^{Asia} &= \frac{\rho-\theta}{\rho\theta}\left(y_{npv}^{West} - y_{npv}^{Asia}\right) = \frac{1}{\theta}\frac{(\rho-\theta)(1+\rho)}{(1-\beta)+\rho(1+\beta)}\Pi(\rho)\left(\bar{m}^{West} - \bar{m}^{Asia}\right) \\
u^{US} - u^{EMU} &= \frac{\psi-\theta}{\psi\theta}\left(y_{npv}^{US} - y_{npv}^{EMU}\right) = \frac{1}{\theta}\frac{(\psi-\theta)(1+\psi)}{(1-\beta)+\psi(1+\beta)}\Pi(\psi)\left(\bar{m}^{US} - \bar{m}^{EMU}\right)
\end{aligned}
$$

Substituting for $\left(u^{West} - u^{Asia}\right)$ into $u^{West} = u^{w} + (1-\gamma_{West})\left(u^{West} - u^{Asia}\right)$, allows to write:

$$
u^{West} = \frac{1}{\theta}\left[\left(\gamma_{West} + \frac{(1-\gamma_{West})(\rho-\theta)(1+\rho)\Pi(\rho)}{(1-\beta)+\rho(1+\beta)}\right)\bar{m}^{West} + (1-\gamma_{West})\left(1 - \frac{(\rho-\theta)(1+\rho)\Pi(\rho)}{(1-\beta)+\rho(1+\beta)}\right)\bar{m}^{Asia}\right]
$$

This expression is equivalent to equation (7) in the main text, when we substitute for *Π(ρ)* and define *Λ(ρ)* as:

$$
\Lambda(\rho) \equiv \frac{1}{\rho}\frac{(1+\rho)}{(1+\beta)+\rho(1-\beta)}
$$

Substituting for $\left(u^{US} - u^{EMU}\right)$ into $u^{EMU} = u^{West} - \gamma_{US}\left(u^{US} - u^{EMU}\right)$ and replacing for u^{West} gives equation (8) in the main text, when we substitute for *Π(ψ)* and define *Λ(ψ)* as:

$$
\Lambda(\psi) \equiv \frac{1}{\psi}\frac{(1+\psi)}{(1+\beta)+\psi(1-\beta)}
$$

B.5. Policy Responses

Recall that the model solutions for the changes in the dollar exchange rates are given by:

$$\bar{e}^{Asia} = (1-\gamma_{US})\bar{e}^{EMU} - \Pi(\rho)\left(\bar{m}^{West} - \bar{m}^{Asia}\right) \quad \text{(B1)}$$

$$\bar{e}^{EMU} = \Pi(\psi)\left(\bar{m}^{EMU} - \bar{m}^{US}\right) \quad \text{(B2)}$$

Substituting (B2) into (B1), gives:

$$\bar{e}^{Asia} = (1-\gamma_{US})\Pi(\psi)\left(\bar{m}^{EMU} - \bar{m}^{US}\right) - \Pi(\rho)\left(\gamma_{US}\bar{m}^{US} + (1-\gamma_{US})\bar{m}^{EMU} - \bar{m}^{Asia}\right)$$

It is useful to rearrange the equation as follows:

$$\bar{e}^{Asia} = -\left(\gamma_{US}\Pi(\rho) + (1-\gamma_{US})\Pi(\psi)\right)\bar{m}^{US} - (1-\gamma_{US})\left(\Pi(\rho) - \Pi(\psi)\right)\bar{m}^{EMU} + \Pi(\rho)\bar{m}^{Asia}$$

Or $$\bar{e}^{Asia} = -\Omega(\gamma_{US},\rho,\psi)\bar{m}^{US} - \Gamma(\gamma_{US},\rho,\psi)\bar{m}^{EMU} + \Pi(\rho)\bar{m}^{Asia}$$

where $$\Omega(\gamma_{US},\rho,\psi) = \left(\gamma_{US}\Pi(\rho) + (1-\gamma_{US})\Pi(\psi)\right)$$
$$\Gamma(\gamma_{US},\rho,\psi) = (1-\gamma_{US})\left(\Pi(\rho) - \Pi(\psi)\right)$$

and $\Pi(\rho)$ and $\Pi(\psi)$ are defined as before

This expression is equal to zero when:

$$\bar{m}^{Asia} = \frac{\gamma_{US}\Pi(\rho) + (1-\gamma_{US})\Pi(\psi)}{\Pi(\rho)}\bar{m}^{US} + (1-\gamma_{US})\frac{\Pi(\rho) - \Pi(\psi)}{\Pi(\rho)}\bar{m}^{EMU}$$