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Global Impact of a Shift in Foreign Reserves to Euros

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Global Impact of a Shift in Foreign Reserves to Euros

by

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Abstract:

This paper uses QUEST III, a multi-region DSGE model, to study the macroeconomic effects of a gradual equalization of official foreign reserves between dollars and euros. We simulate a scenario of a shift in the composition of foreign reserves holdings from the present ratio of 65 percent dollars and 25 percent euros to equal 45 percent shares over a 10 years period. We assume imperfect substitutability between financial assets to allow this shift to have real effects. Our simulations point towards small real effects due to the reduction in real interest rates resulting from this shift in official holdings.

JEL Classification: C68 , F31, F32
Keywords: Globalization, Global imbalances, reserve currency, euro area, DSGE modelling.

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1 Introduction

Global imbalances have caused much concern in the economic community over the last decade[1]. First of all, the persistent current account deficit of the United States (US) remains worrying many observers. For the time being it seems as if the US is not having too much difficulty attracting enough capital inflows sufficient to finance this deficit. However, the question is how long such an imbalance is sustainable and at which point in time investors "gradually" or "suddenly" stop their investments in the US. The *International Monetary Fund (IMF)* in its World Economic Outlooks in the last years also warned repeatedly against the risks of the global economic consequences of a dollar crisis in the wake of the reorientation of international investments, away from the United States[2]. Whether a possible cease of capital inflows is a gradual process or an abrupt stop with a following dollar plunge is an open question. Most of the 2005 issue of *Brookings Papers on Economic Activity* (issue 1) addressed such questions. Krugman (2007) shows that any process of gradual dollar decline fast enough to prevent the accumulation of implausible levels of US external debt could impose considerable capital losses on investors. As a result, there will come a point at which expectations switch and the dollar drops sharply. Whether and to what extent this "dollar crisis" will produce macroeconomic problems he could not answer.

Besides the traditional financiers of the US current account deficit, Japan and Europe, other Asian countries, first of all the rising China will play an ever prominent role. Additionally, with the introduction of the euro, a real alternative to the dollar as foreign reserve has evolved. This situation increases the likelihood of a shift of foreign reserves to euros. According to IMF's COFER database, the share of the euro as a foreign reserve has increased from 18 percent in 1999 to over 25 percent in 2007. In contrast, the US dollar share has declined from its peak of 72

[1] Bracke et al. (2008) present a (statistical) framework for assessing global imbalances.

[2] In its *World Economic Outlook* of October 2007, the IMF claims that the Multilateral Consultation (MC) held by the IMF had made some progress toward developing a joint approach toward global imbalances. The MC provides a forum for discussion with key countries to strengthen mutual understanding of the issues and to reaffirm support for the International Monetary and Finance Committee (IMFC). On June 5, 2006, the IMF initiated its first ever MC - a new tool of multilateral surveillance - with a focus on addressing global current account imbalances in a manner supportive of global growth. Five countries or regions agreed to participate - China, the euro area, Japan, Saudi Arabia, and the United States. (IMF, 2007, Box 1.3: *Multilateral Consultation on Global Imbalances*). The Consultation culminated with the publication of policy plans by each participant in April 2007, which included substantive steps in all key areas of the IMFC Strategy. It is hoped that their implementation would substantially reduce global risks.

percent in 2001 to less than 65 percent in 2007. The widening of the options for currency diversification makes it less risky to switch from US dollars to euros. Other currencies play practically no role as official foreign reserves. Many commentators and also European exporters fear that a shift of foreign reserves from US dollars – currently the primary haven – to euros could deteriorate their competitiveness on US dollar markets. It is feared that if this shift would suddenly occur, a plunge in the US dollar-euro exchange rate could be the consequence.

The primary purpose of this investigation is to analyze the macroeconomic implications of a shift of foreign reserves to euros – in particular in the Asian countries (China). We apply an extended version of the QUEST III model, a multi- country Dynamic Stochastic General Equilibrium (DSGE) model. Our work is closely related to several recent model simulations to study the adjustment processes of the elimination of global current account imbalances. Lane and Milesi-Ferretti (2007) is closest to our own work. They use IMF's Global Economy Model (GEM; see Kumhof et al., 2005), a multi-country dynamic general equilibrium model, similar in design to our QUEST model, with four regions: US, the euro area, Japan, and the rest of the world. The authors simulated three scenarios: (i) a *"baseline"* scenario with no big changes to the status quo (exchange rates pegged to the dollar); (ii) a *"disruptive"* scenario with a sharp decline in other countries willingness to hold US assets and abandonment of emerging Asia's peg to the dollar; and (iii) a *"third scenario"* by the implementation of a set of policies designed to reduce imbalances and stave off the risks of a disorderly adjustment. In emerging Asia, it is assumed a shift towards a flexible exchange rate regime, with monetary policy following a Taylor rule similar to the one employed in other regions. Except for the case of the baseline scenario, the results point to abrupt exchange rate adjustments, followed by a balancing of the US current account and significant real effects, i.e., huge declines in real GDP in all regions. Obstfeld-Rogoff (2005) set up a three-region model of the world economy (US, Europe and Asia) and study the possible adjustment paths of dollar depreciations in three scenarios concerning the current account balances. (i) in the "global rebalancing scenario" where current account balances in all three regions go to zero, the model predicts a depreciation of the dollar vis à vis Europe (the euro) of 29 percent and vis à vis the Asian currencies by 35 percent. (ii) in the "Bretton Woods II" scenario where Asia's current account surplus rises to keep its exchange rate with the dollar fixed and Europe's current account absorbs all changes in the U.S. and Asian current accounts the

depreciation effect of the dollar vis à vis the euro would be 59 percent, whereas those against the Asian currencies – due to the pegging-policy – would be unchanged. (iii) the scenario of "Europe and US trade places" where Europe absorbs the entire improvement in the US current account balance while Asia's current account balance remains unchanged, the US dollar depreciates against the euro by 45 percent and against the Asian currency by 19 percent. Both types of models, the GEM and the Obstfeld-Rogoff model allow for the operation of the valuation channel, i.e. the effects of currency realignments on net external positions. Blanchard et al. (2005) also incorporate the valuation channel in a portfolio balance model that allows for imperfect substitutability of assets across countries.

The focus of our analysis is radically different to the abovementioned studies. We focus on *official foreign reserve holdings* and concentrate on the quantification of a realistic shift in these foreign reserves from US dollars to euros both in the Asian countries (China) and across the world. We study the global macroeconomic impact of an equalization of the ratio of the composition of foreign reserves of dollars and euros via numerical simulations with the QUEST III model. It is assumed that this shift happens gradually over the next 10 years increasing the share of the euro by 20 percentage points from 25 to 45 percent of total official reserves and the fall of the dollar share by 20 percentage points to 45 percent of total. The interesting result is that this portfolio switch does not result in the suspected big change in the dollar/euro exchange rate. Nevertheless, there can be a marked macro-economic impact in the euro area (an increase of real GDP) and in the United States (a decline in the overall activity) due to persistent real interest rate effects. We find that the magnitude of these effects depend crucially on the elasticity of substitution between domestic and foreign assets.

The structure of the rest of the paper is as follows. The following section discusses the evolution of foreign reserve holdings in recent years. Section 3 describes how the shift in official reserves is modeled in the QUEST III model. Section 4 then reports results from model simulations that assume the euro becomes in a period of 10 years an international reserve currency of equal importance as the US dollar. Finally, section 5 concludes.

2 International role of the euro in global foreign exchange reserves

Global foreign exchange reserve holdings have risen spectacularly in recent years, from around 1.2 trillion Special Drawing Rights (SDRs) in the late 1990s to more than 4 trillion SDRs in 2007 (see *Figure 1*). This spectacular surge in holdings of official reserves has been concentrated in Asian emerging market economies (especially China) and Eastern Europe (mainly Russia) (see *Table 1*) and came after the severe financial crises that hit many developing countries in the late 1990s. While the main motives for holding official reserves are directly related to intervention in foreign exchange markets to avoid (disorderly) exchange rate movements and building up buffers to deal more effectively with "sudden stops" of capital inflows, it has been argued that the notion of financial independence, i.e. avoiding future recourse to the IMF, and the policy conditionality attached to its loans, has also become an important motive (see de Beaufort Wijnholds and Søndergaard, 2007)[3]. The increase in reserve holdings in developing countries partly reflects higher growth in these regions and the buildup of reserves coincided with large surpluses on their current accounts and in some cases also on their capital accounts in these countries[4].

Full data on the currency breakdown of foreign reserves is unfortunately not available[5]. But on the basis of data available, it appears that, despite expectations that the euro would soon rival the US dollar as international reserve currency, so far not much diversification has taken place. The share of the US dollar has declined slightly since the euro's inception, from a peak at 72 per cent of disclosed reserves in 2001 to 65 per cent now, while the euro's share has risen from around 18 per cent in 1999 to 25 percent in 2007 (see *Figure 2*).

[3] The strong growth in official reserves has prompted the question whether there has not been excessive reserve accumulation in a number of countries (see Bird and Rajan, 2003, de Beaufort Wijnholds and Søndergaard, 2007)

[4] Note that current account surpluses will only result in reserve accumulation when combined with central bank intervention in the foreign exchange markets. The large external surpluses of many oil-exporting countries have generally led to only very small increases in official foreign exchange holdings, partly because: (1) they were channelled into special state-owned funds (like Sovereign Wealth Funds; see Beck and Fidora, 2008), where assets are generally a less liquid and, therefore not counted as part of international reserves; (2) partly because assets were placed in offshore financial centres (see de Beaufort Wijnholds and Søndergaard, 2007).

[5] The IMF's Currency Composition of Official Foreign Exchange Reserves (COFER) data are the most comprehensive at an aggregate level but they only include reserves held by central banks that actually disclose the currency composition of their reserves to the IMF. Many countries that have accumulated foreign reserves (e.g. China) are not included in COFER data. According to Masson (2007), the COFER data may underestimate the increase in the share of the euro in world reserves.

Table 1 Shares in global foreign exchange reserves (%)

	1999	2000	2001	2002	2003	2004	2005	2006	2007
A. Industrial countries	40.94	40.60	38.70	37.81	37.25	35.34	31.18	27.87	23.48
. United States	*1.81*	*1.61*	*1.41*	*1.40*	*1.31*	*1.14*	*0.91*	*0.81*	*0.72*
. Japan	*15.58*	*17.93*	*18.91*	*18.74*	*21.58*	*21.99*	*19.85*	*17.37*	*14.83*
. Euro area	*12.79*	*11.29*	*10.14*	*8.96*	*6.22*	*4.83*	*4.00*	*3.65*	*3.18*
. United Kingdom	*1.54*	*1.76*	*1.41*	*1.29*	*0.95*	*0.91*	*0.86*	*0.77*	*0.74*
. Canada	*1.37*	*1.50*	*1.49*	*1.36*	*1.04*	*0.80*	*0.73*	*0.66*	*0.61*
. Australia	*1.09*	*0.87*	*0.80*	*0.77*	*0.99*	*0.90*	*0.98*	*1.05*	*0.38*
B. Developing Asia	36.85	36.56	38.41	40.18	40.96	42.82	44.54	45.01	46.64
. China, P.R.: Mainland	*8.68*	*8.55*	*10.35*	*11.89*	*13.33*	*16.27*	*19.61*	*21.17*	*23.91*
. China, P.R.: Hong Kong	*5.40*	*5.55*	*5.42*	*4.65*	*3.91*	*3.30*	*2.98*	*2.64*	*2.39*
. Korea	*4.14*	*4.95*	*5.00*	*5.02*	*5.11*	*5.29*	*5.03*	*4.73*	*4.09*
. Singapore	*4.29*	*4.12*	*3.67*	*3.39*	*3.16*	*2.98*	*2.77*	*2.70*	*2.54*
. India	*1.80*	*1.92*	*2.21*	*2.78*	*3.23*	*3.34*	*3.14*	*3.38*	*4.17*
C. Eastern Europe and C. Asia	5.62	6.16	6.38	7.31	7.87	8.49	9.92	11.84	13.22
. Russia	*0.47*	*1.25*	*1.59*	*1.83*	*2.42*	*3.22*	*4.21*	*5.86*	*7.26*
D. Western Hemisphere	8.49	7.93	7.64	6.54	6.30	5.76	5.94	6.10	6.91
. Brazil	*1.98*	*1.67*	*1.73*	*1.54*	*1.61*	*1.40*	*1.27*	*1.69*	*2.81*
E. Middle East	5.80	5.97	5.75	5.19	4.64	4.23	4.59	4.80	5.24
. Saudi Arabia	*0.87*	*0.93*	*0.72*	*0.69*	*0.58*	*0.62*	*0.58*	*0.52*	*0.51*
F. Africa	2.31	2.78	3.13	2.97	2.98	3.36	3.84	4.39	4.51
All countries: A. – F.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: IMF, International Financial Statistics.

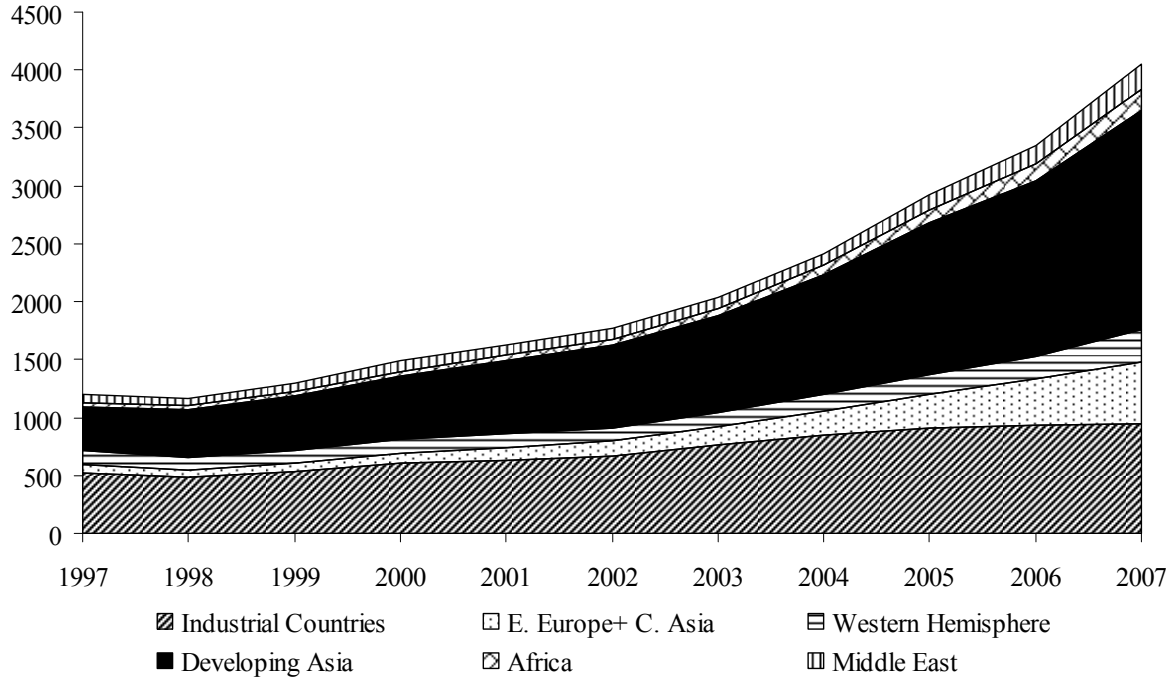

Fig. 1 Global foreign exchange reserves 1997-2007 (bln. SDRs). *Source:* IMF, International Financial Statistics.

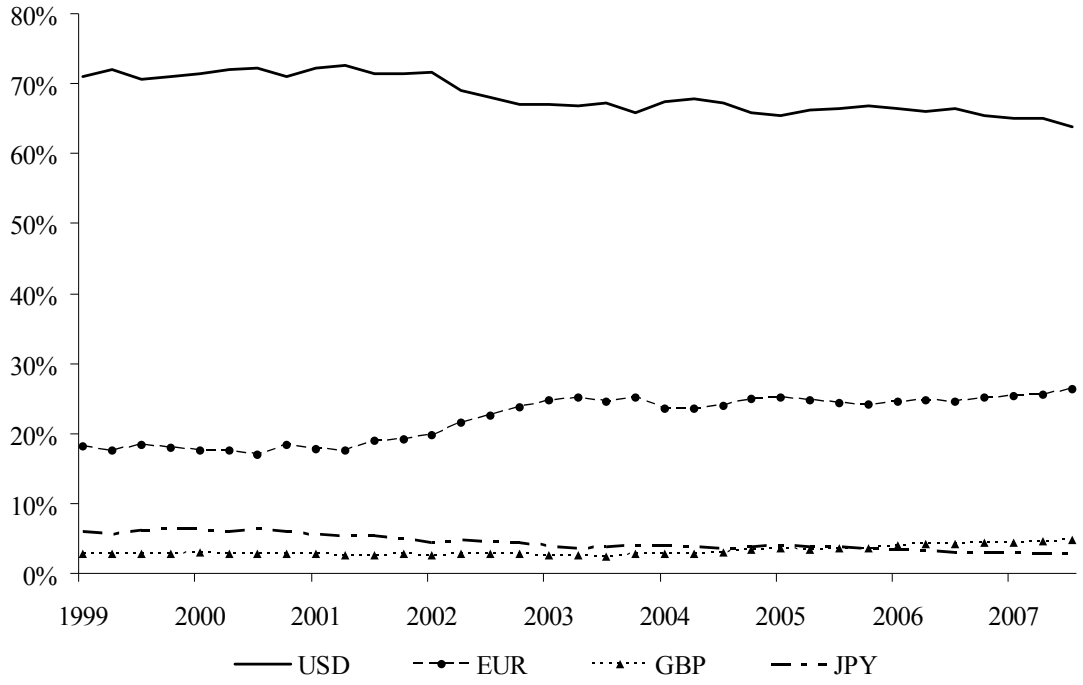

Fig. 2 Currency shares in global foreign exchange reserves (with a disclosed currency composition). *Source:* IMF COFER

The euro plays an important role as an anchor or reference currency in the managed exchange rate regimes of countries that are geographically close to the euro area (non-euro-area EU Member States, candidate countries, potential candidate countries and the countries of the CFA Franc Zone). Russia's currency is also pegged to a trade-weighted basket of currencies with a substantial weight placed on the euro. The ECB (2007) shows that in most EU neighbouring economies that disclose the currency composition of their reserves, the share of the euro ranges from 40 per cent to 85 per cent. Lim (2006) argues that the diversification into euros has been much less pronounced in Asia, and that "dollar-zone" countries diversified into euros more out of yen than out of US dollars. In relative terms, the US dollar appears more dominant in so-called "dollar-zone" countries than the euro is within its domain (Papaioannou and Portes, 2008, European Commission, 2008).

Chinn and Frankel (2008) investigate the factors that determine the suitability of a currency for international currency status. They consider factors related to output and trade, the size of the

country's financial markets, confidence in the value of the currency and network externalities. On the basis of their analysis they posit scenarios under which in the future the euro might surpass the US dollar as the world's leading international reserve currency. Depending on assumptions related to the extension of the euro area, trend currency depreciations and counting a fraction of London financial markets' forex trading to the euro area, they find that the euro can rival or even overtake the US dollar, in one of their scenarios as early as 2015. An equalization of the portfolio composition of official foreign reserves of dollars and euros is the focus of our analysis.

3 The model

We use a six region version of the European Commission's QUEST III model[6], a multi-country DSGE model, with the following regions: the euro area, the new EU member states, the other non-euro area EU member states, the US, Emerging Asia and the rest of the world. Each region of the model economy is populated by representative households and firms and there is a monetary and a fiscal authority, both committed to rules-based stabilisation policies. Firms in each region produce a continuum of differentiated goods. The goods produced in one region are imperfect substitutes for goods produced in other regions. We distinguish households which are liquidity constrained and consume their disposable income from households which have full access to financial markets. Unconstrained households make decisions on financial and real capital investments and allocate their financial wealth over both domestic and foreign assets.

For this analysis we depart from the standard assumption of perfect substitutability between domestic and foreign assets and we follow Blanchard et al. (2005), who, building on a set of previous papers by Masson (1981) and Henderson and Rogoff (1982), have revived the portfolio balance approach to the current account. Their motivation for assuming imperfect substitutability is mostly based on recent empirical results by Gourinchas and Rey (2005) which suggests that financial assets denominated in different currencies are indeed imperfect substitutes. As shown below, in order to generate real effects of a shift in the demand for international reserves by central banks it is necessary to allow for imperfect substitutability between domestic and foreign

[6] A detailed description of the QUEST III model can be found in Ratto *et al*. (2008).

assets. In this section we extend the QUEST III model[7] to include international portfolio decision. In addition, a stylised example that shows the adjustment to a shift in reserves is employed to gain intuition.

Consider a two-country case with a domestic and foreign economy indexed by *c=(d,f)*. Let B_t^c be the total stock of asset of country *c* and let ($B_t^{d,c}$, $B_t^{f,c}$), be asset holdings by households of country *c* from country *d* and *f* respectively. We assume further that the foreign central bank holds domestic assets $B_t^{CB,d,f}$. There are two asset market equilibrium conditions

$$B_t^d - B_t^{CB,d,f} = B_t^{d,d} + B_t^{d,f} \tag{1a}$$

and

$$B_t^f = B_t^{f,d} + B_t^{f,f} \tag{1b}$$

We specify the following set of asset demand equation for domestic households

$$B_t^{d,d} = (b^{d,d} + \sigma(r_t^d - r_t^{world}))W_t^d \tag{2a}$$

$$E_t\, B_t^{f,d} = (b^{f,d} + \sigma(r_t^f - \Delta e_{t+1} - r_t^{world}))W_t^d \tag{2b}$$

where *E* is the nominal exchange rate defined as units of domestic currency per unit of foreign currency. $b^{d,d}$ and $b^{f,d}$ respectively, are the portfolio shares of investment destinations (see the values in *Table 2*). r_t^c and r_t^{world} respectively, are (real) interest rates of country *c* and that of the world. σ is the elasticity of substitution between domestic and foreign assets.

Using the asset market equilibrium condition, total domestic private financial wealth (in domestic currency) is given by

$$W_t^d = B_t^{d,d} + E_t B_t^{f,d} = B_t^d + NFA_t^d\,, \tag{3}$$

[7] This extension models international portfolio decisions though an adapted uncovered interest parity condition (see below).

where the net foreign asset (*NFA*) position is defined as

$$NFA_t^d = E_t B_t^{f,d} - B_t^{CB,d,f} - B_t^{d,f} \tag{4}$$

Likewise, a set of asset demand equations are defined for foreign households as well. The asset equilibrium conditions can be rearranged to yield an interest parity condition with a risk premium which depends on the demand and supply of domestic and foreign assets[8]

$$\left(1-\left(b^{d,d}-\frac{b^{f,d}}{E_t}\right)\right)B_t^d-\left(1-\left(b^{f,f}-b^{d,f}E_t\right)\right)B_t^f-B_t^{CB,d,f}-\left[\left(b^{d,d}-\frac{b^{f,d}}{E_t}\right)-\left(b^{f,f}-b^{d,f}E_t\right)\right]NFA_t^d \tag{5}$$
$$=(r_t^d-r_t^f-\Delta e_{t+1})\sigma\left(W_t^d+W_t^f\right)$$

This interest parity conditions has a fairly simple economic interpretation. Consider for example an increase in the net foreign asset position (NFA_t^d) of country *d*, which in turn corresponds to an increase in domestic wealth. How this affects the international interest differential depends crucially on the degree of home bias in the portfolio of households. In case of a home bias ($b^{d,d} > b^{f,d}/E$) and ($b^{f,f} > b^{d,f}E$) domestic interest rates will decline, because the transfer of financial wealth from foreign to domestic households increases the demand for domestic assets. Equation (5) also shows that changes in the supply of domestic assets to the private sector also affects positively the interest differential for a finite elasticity of substitution between domestic and foreign bonds. Finally, an increase in the demand for domestic assets by the foreign central bank ($B_t^{CB,d,f}$) lowers the risk premium since it acts like a reduction of the supply of domestic bonds to domestic and foreign private investors. The standard interest parity condition arises for σ going to infinity. Combining the portfolio balance condition with the current account identity

$$NFA_t^d = (1+r_{t-1})NFA_{t-1}^d + TB(E_t) \tag{6}$$

[8] We neglect valuation effects on the rhs of the equation. Note also that because we are concerned with the reserve currency status of the dollar and euro in the rest of the world, we assume the domestic central bank (US, euro area) holds no foreign (rest of the world) assets, i.e. $B_t^{CB,f,d} = 0$.

allows us to study the dynamics of the exchange rate and net foreign assets as a response to an increase in foreign reserves ($B_t^{CB,d,f}$). For this purpose we use a phase diagram (see *Figure 3*) defined by the current account equation and the portfolio balance condition. The current account balance (*CA*), i. e. the locus of all combinations between *E* and *NFA* for which no change in *NFA* occurs, is clearly downward sloping. A high value of *E* leads to a trade surplus, and *NFA* must be sufficiently small (negative) such that interest payments to the RoW compensate for the trade surplus. The opposite holds for a low value of *E*. The locus of all combinations between *NFA* and E, for which the asset markets do not require a change in the exchange rate, as described above – which we denote as portfolio balance (*PB*), referring to the asset market equilibrium condition of equation 5 and the other conditions described above - is also downward sloping, provided there is a home bias in portfolio holdings[9]. The reasoning is as follows: suppose there is a decline in *NFA*, i.e. wealth is transferred abroad. With a home portfolio bias this implies a reduction in demand for domestic assets $B_t^{d,d}$. Equilibrium in the market for domestic asset can be re-established via a depreciation of the domestic currency. This lowers the price of domestic assets for foreigners and raises demand. The following phase diagram (*Figure 3*) shows the adjustment of *E* and *NFA* to an increase in ($B_t^{CB,d,f}$).

[9] For stability reasons, the slope of PB must exceed the slope of CA in absolute value. This condition usually holds in empirical applications since the slope of the current account balance is extremely small and is determined by the ratio of the interest rate *r* to the elasticity of the trade balance *TB* to changes in the exchange rate *E*.

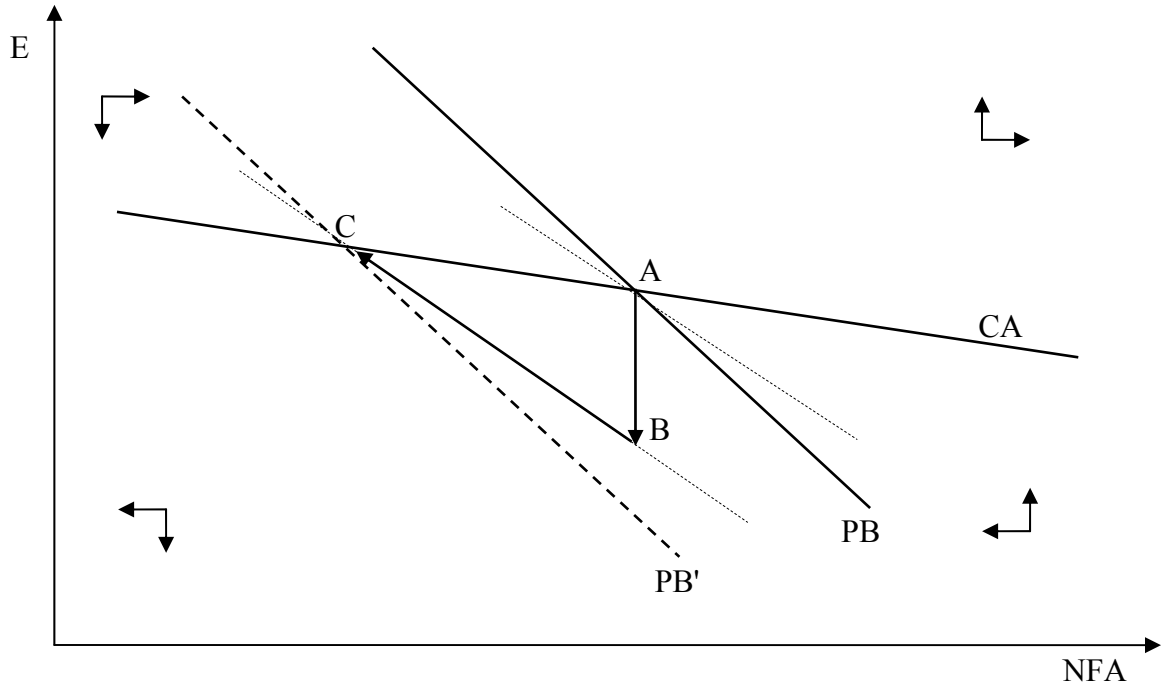

Fig. 3 Adjustment of exchange rate and net foreign assets to an increase in $B_t^{CB,d,f}$

The increase in $B_t^{d,CBf}$ reduces the supply of domestic government bonds to private households in the domestic and foreign economy. This leads to a downward shift in the portfolio balance equation. This can most easily be seen if one looks at the equilibrium condition for domestic assets and assumes a low interest elasticity (σ). In this case domestic households would not change their demand for domestic bonds, therefore a new equilibrium can only be established with an appreciation of the domestic currency which induces foreign households to reduce their demand for domestic assets. Thus, for low interest rate elasticities of asset demand, asset market equilibrium requires an immediate appreciation of the domestic currency. The appreciation (from A to B in Figure 3) leads to a loss of competitiveness and a worsening of the trade balance and as a consequence a reduction in *NFA*. The reduction of wealth of domestic households reduces the demand for domestic assets (home bias), which requires a depreciation (from B to C in Figure 3) of the domestic currency. The economy moves - along the saddle path – to a new long run equilibrium (point C in Figure 3) characterized by a depreciated currency and a reduced stock of *NFA*.

The role played by the interest elasticity in the demand for bonds can best be seen when we move to the other extreme, namely perfect substitutability, characterised by σ going to infinity. In this case a reallocation of international reserves by the central bank (CB) of a third country would be completely offset by changes in the portfolio allocation of the private sector without any change in the structure of relative asset prices or asset returns.

For the more general multi country case as considered in our simulations the interest parity condition slightly generalises to

$$\left(1-\left(\frac{b^{jj}}{E_t^{jj}}-\frac{b^{ij}}{E^{ij}}\right)\right)B_t^j-\sum_c B_t^{CB,j,c}-\left(1-\left(\frac{b^{ii}}{E_t^{ii}}-\frac{b^{ji}}{E^{ji}}\right)\right)B_t^i+\sum_c B_t^{CB,i,c}+\sum_c\left(\frac{b^{ic}}{E_t^{ic}}-\frac{b^{jc}}{E_t^{jc}}\right)B_t^c$$

$$-\left(\frac{b^{jj}}{E_t^{jj}}-\frac{b^{ij}}{E^{ij}}\right)NFA_t^j+\left(\frac{b^{ii}}{E_t^{ii}}-\frac{b^{ji}}{E^{ji}}\right)NFA_t^i+\sum_c\left(\frac{b^{ic}}{E_t^{ic}}-\frac{b^{jc}}{E_t^{jc}}\right)NFA_t^c \qquad (5')$$

$$=(r_t^j-r_t^i-\Delta e_{t+1}^{ji})\sigma\sum_c W_t^c \qquad \text{where} \quad c\in 1....N\,.$$

Now the interest rate differential between assets from country *j* and country *i* not only depend on demand and supply conditions of country *j* and *i* but also on demand and supply conditions in all other countries, unless preferences in the RoW are not completely symmetric w. r. t. asset holding from *j* and *i*. Suppose for example that country *c* prefers assets from county *j* over assets from country *i* (i.e. $b^{jc}>b^{ic}$), then a change in financial wealth of country *c* lowers the risk premium for assets of country *j* (relative to country *i*) because it increases the demand for assets from *j* (relative to country *i*). Also, as above, the relative demand of central banks for assets from country *j* (relative to *i*) affects the risk premium. If the demand for country *j* reserves from all central bank exceeds the corresponding demand for reserves from country *i*, this reduces the risk premium for country *j*.

4 Simulations of a shift in reserve holdings

What would be the macro-economic implications of a gradual shift in reserves towards the euro ? The model simulations reported here assume a gradual equalization of the portfolio composition of official foreign reserves between dollars to euros over a 10 years period. Our simulations are based on certain assumptions. First, we assume the 65-25 dollar-euro split recorded in COFER data is representative for the overall distribution of foreign reserves by the end of 2007. We then assume a gradual increase in the share of the euro in global reserve holdings such that parity with the dollar is reached after 10 years, i.e. in 2018. This gradual equalization of the portfolio composition of official foreign reserves would imply a 20 percentage point decline in the dollar share and a 20 percentage point increase in the euro share to 45 percent of total reserves each. Converted into dollars, total global foreign official reserves amounted to approximately 6.4 trillion US dollars in 2007, of which reserves in Asia accounted for roughly half (3.0 trillion dollars). Expressed in 2007 exchange rates, a 20 percentage points shift amounts to 1.28 trillion dollars (870 bln euros), or 9.3 per cent of US GDP (9.8 per cent of euro area GDP) in 2007.

For the portfolio shares of investment destinations (the b^{ij}'s) we use the shares reported in *Table 2*. These are based on calculations reported in Blanchard *et al.* (2005), adapted with our assumed shares for the other regions. Blanchard *et al.* only report portfolio shares for the US and the euro area and an additional assumption has to be made about the distribution over other destinations. We assume for both the US and the euro area proportionally equal portfolio shares for 'other' destinations. We assume a 'home-bias' for each of the other regions' portfolios of 0.6, lower than the one reported for the US, but higher than for the euro area. For Asia and the rest of the world we assume a distribution over US dollars and euros corresponding to those reported in COFER for official reserves, i.e., a 65-25 split in favour of the US (*Figure 2*), with the remainder allocated to other regions. The implicit assumption in our simulations is that at present central bank' preferences reflect private sector preferences and that private sector's preferences are not changing. Only official reserves holdings are shifting from dollars to euros. For the new member states and the rest of the EU we assume a preference bias towards the euro area.

We follow Blanchard *et al*. and show simulation results for a range of values of the parameter σ, the sensitivity of the portfolio shares to interest rate differentials. A value of 1 implies that an

increase in the rate of return on country A's assets of 100 basis points increases the desired share of that country's assets in total wealth by 1 percentage point. We show also results for a larger value of 10 and a smaller value of 0.1.

Table 2 Portfolio shares by investment destination

	Investing country					
Destination	United States	Euro area	New EU member states	Rest of EU	Asia	Rest of World
United States	0.77	0.19	0.10	0.10	0.26	0.26
Euro area	0.08	0.53	0.26	0.26	0.10	0.10
New EU member states	0.04	0.07	0.60	0.02	0.03	0.03
Rest of EU	0.04	0.07	0.02	0.60	0.03	0.03
Asia	0.04	0.07	0.02	0.02	0.60	0.03
Rest of World	0.04	0.07	0.02	0.02	0.03	0.60

Sources: Blanchard, Giavazzi and Sa (2005), own calculations.

Figures 4 to 7 show the effects of a shift in reserve holdings for GDP and the real effective exchange rates for the euro area and the US over time, under alternative assumptions related to parameter σ. *Table 3* summarises the results for the main macroeconomic variables for the euro area and the US (detailed tables are shown in the appendix). The redistribution of official reserves leads to an appreciation of the euro and depreciation of the US dollar. The loss in competitiveness of the euro area has a negative impact on exports and output. The GDP impact is negative in the first year. But the shift in reserve holdings has real benefits for the euro area economy in the medium term. The increase in demand for euros from foreign central banks reduces real interest rates in the euro area (eq. 5) and this leads to more capital accumulation. The fall in exports and rise in imports leads to a deterioration of the trade balance for the euro area and an improvement for the US. The value of parameter σ determines by how much interest rates fall or by how much the euro appreciates. For a value of σ of 1, the shift leads to an appreciation of the euro of no more than 3.5 percent relative to baseline, and 1.5 percent in real effective terms. Under this case GDP is around 0.35 percent above baseline in the medium term (*Figure 4*). The trade balance deteriorates by up to 0.4 percent of GDP. The effects for the US are the mirror image of this. The shift in official reserves by central banks in Asia and the rest of the world from US dollars to euros does not change the relative demand for their own respective assets and the macroeconomic impact for other global regions is negligible.

For a smaller value of σ of 0.1, the euro appreciation is as much as 8.5 per cent against the dollar. Note that we only assume a shift in official reserve holdings, and no change in private portfolio shares. If the latter were also assumed to change the exchange rate effects could be many times larger. However, in the case of high asset substitutability ($\sigma = 10$), the real effects as well as the exchange rate effects become small and would disappear entirely for very large values of international asset substitutability of investors. Unfortunately, as has been noted by Blanchard *et al.*, there is little empirical information about the value of σ which is the crucial parameter for pinning down the real effects of portfolio shifts.

However, there is a common dynamic adjustment pattern. The initial appreciation of the Euro leads to a deterioration in the trade balance, induced both by an exchange rate effect on the trade balance and a wealth effect on private consumption. As a consequence the net foreign asset position of the euro area declines gradually over time. In the long run, the exchange rate depreciates. However there is permanent reduction of real interest rates in the Euro area which stimulates investment and GDP.

Table 3a Macro-economic effects of shift in global reserve holdings: imperfect substitutability

σ = 1 **year**	**1**	**2**	**3**	**4**	**5**	**10**	**15**
EA							
GDP	-0.07	0.12	0.20	0.23	0.25	0.31	0.35
Consumption	0.40	0.67	0.74	0.76	0.75	0.64	0.44
Investment	1.02	1.96	2.37	2.57	2.66	2.54	2.02
Real effective exchange rate	-1.38	-1.41	-1.44	-1.43	-1.40	-0.95	-0.29
Dollar/€	-2.31	-2.70	-3.05	-3.29	-3.44	-3.34	-2.37
Real interest rate*	-0.06	-0.07	-0.07	-0.06	-0.06	-0.08	-0.07
Current account (% GDP)*	-0.25	-0.33	-0.36	-0.39	-0.41	-0.42	-0.36
NFA (% GDP)*	-0.14	-0.44	-0.79	-1.17	-1.56	-3.67	-5.59
US							
GDP	0.07	-0.03	-0.07	-0.08	-0.09	-0.12	-0.15
Consumption	-0.21	-0.35	-0.38	-0.37	-0.29	-0.64	-0.18
Investment	-0.57	-1.07	-1.28	-1.37	-1.41	-1.30	-0.99
Real effective exchange rate	1.11	1.15	1.17	1.16	1.12	0.75	0.23
Real interest rate*	0.07	0.05	0.04	0.03	0.03	0.05	0.04
Current account (% GDP)*	0.18	0.22	0.24	0.25	0.25	0.24	0.18
NFA (% GDP)*	0.10	0.32	0.55	0.79	1.04	2.31	3.35
Asia GDP	0.01	-0.00	-0.01	-0.01	-0.02	-0.02	-0.02
Rest of world GDP	0.01	-0.00	-0.01	-0.01	-0.01	-0.03	-0.04

Note: percentage (* point) difference from baseline.

Table 3b Macro-economic effects of shift in global reserve holdings: case of lower substitutability

σ = 0.1 year	1	2	3	4	5	10	15
EA							
GDP	-0.24	0.28	0.49	0.56	0.58	0.52	0.55
Consumption	0.95	1.60	1.75	1.73	1.66	0.94	0.13
Investment	3.19	6.05	7.22	7.65	7.73	5.47	2.24
Real effective exchange rate	-3.86	-3.89	-3.91	-3.82	-3.64	-1.71	0.85
Dollar/€	-5.99	-6.95	-7.75	-8.23	-8.47	-6.60	-2.12
Real interest rate*	-0.18	-0.25	-0.24	-0.22	-0.23	-0.29	-0.15
Current account (% GDP)*	-0.68	-0.89	-0.98	-1.04	-1.07	-0.96	-0.46
NFA (% GDP)*	-0.39	-1.22	-2.16	-3.17	-4.21	-9.32	-12.64
US							
GDP	0.19	-0.06	-0.15	-0.18	-0.19	-0.17	-0.22
Consumption	-0.45	-0.75	-0.80	-0.78	-0.74	-0.35	0.02
Investment	-1.53	-2.84	-3.34	-3.50	-3.50	-2.27	-0.74
Real effective exchange rate	2.73	2.78	2.77	2.68	2.53	1.10	-0.59
Real interest rate*	0.15	0.14	0.12	0.11	0.11	0.15	0.06
Current account (% GDP)*	0.43	0.53	0.55	0.56	0.56	0.40	0.13
NFA (% GDP)*	0.25	0.76	1.30	1.87	2.43	4.95	6.15
Asia GDP	0.03	-0.00	-0.02	-0.03	-0.03	-0.04	-0.05
Rest of world GDP	0.06	-0.03	-0.07	-0.09	-0.10	-0.13	-0.13

Note: percentage (* point) difference from baseline.

Table 3c Macro-economic effects of shift in global reserve holdings: case of higher substitutability

σ = 10 year	1	2	3	4	5	10	15
EA							
GDP	-0.01	0.02	0.04	0.04	0.05	0.06	0.07
Consumption	0.08	0.13	0.15	0.15	0.15	0.14	0.12
Investment	0.16	0.32	0.38	0.42	0.43	0.46	0.43
Real effective exchange rate	-0.25	-0.25	-0.26	-0.26	-0.26	-0.20	-0.11
Dollar/€	-0.44	-0.51	-0.58	-0.62	-0.66	-0.69	-0.59
Real interest rate*	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Current account (% GDP)*	-0.04	-0.06	-0.07	-0.07	-0.07	-0.08	-0.08
NFA (% GDP)*	-0.03	-0.08	-0.14	-0.21	-0.28	-0.68	-1.09
US							
GDP	0.01	-0.01	-0.01	-0.01	-0.02	-0.03	-0.04
Consumption	-0.05	-0.08	-0.08	-0.08	-0.08	-0.08	-0.06
Investment	-0.10	-0.19	-0.23	-0.25	-0.26	-0.27	-0.26
Real effective exchange rate	0.22	0.23	0.24	0.24	0.23	0.18	0.11
Real interest rate*	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Current account (% GDP)*	0.04	0.05	0.05	0.05	0.05	0.06	0.05
NFA (% GDP)*	0.02	0.06	0.11	0.16	0.22	0.50	0.77
Asia GDP	0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00
Rest of world GDP	0.00	0.00	0.00	0.00	0.00	0.00	-0.00

Note: percentage (* point) difference from baseline.

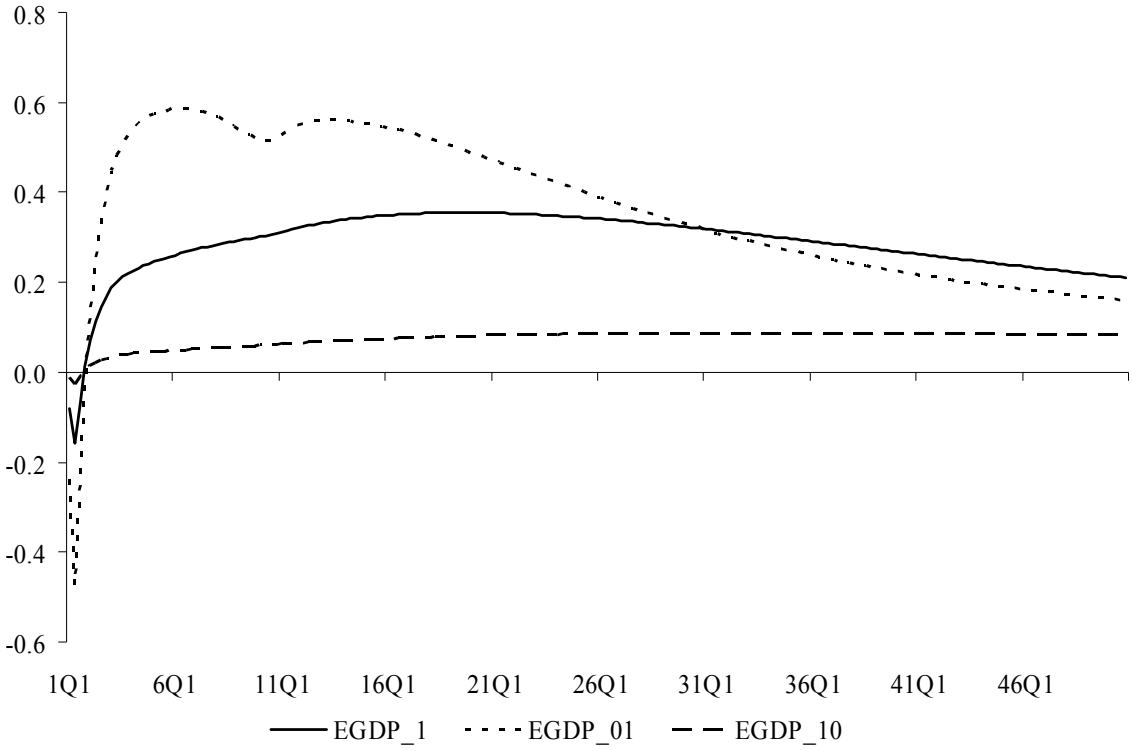

Fig. 4 GDP effects of a shift in foreign reserve: EA. Deviations from baseline (%). Bold line: $\sigma = 1$; dotted line $\sigma = 0.1$; dashed line $\sigma = 10$.

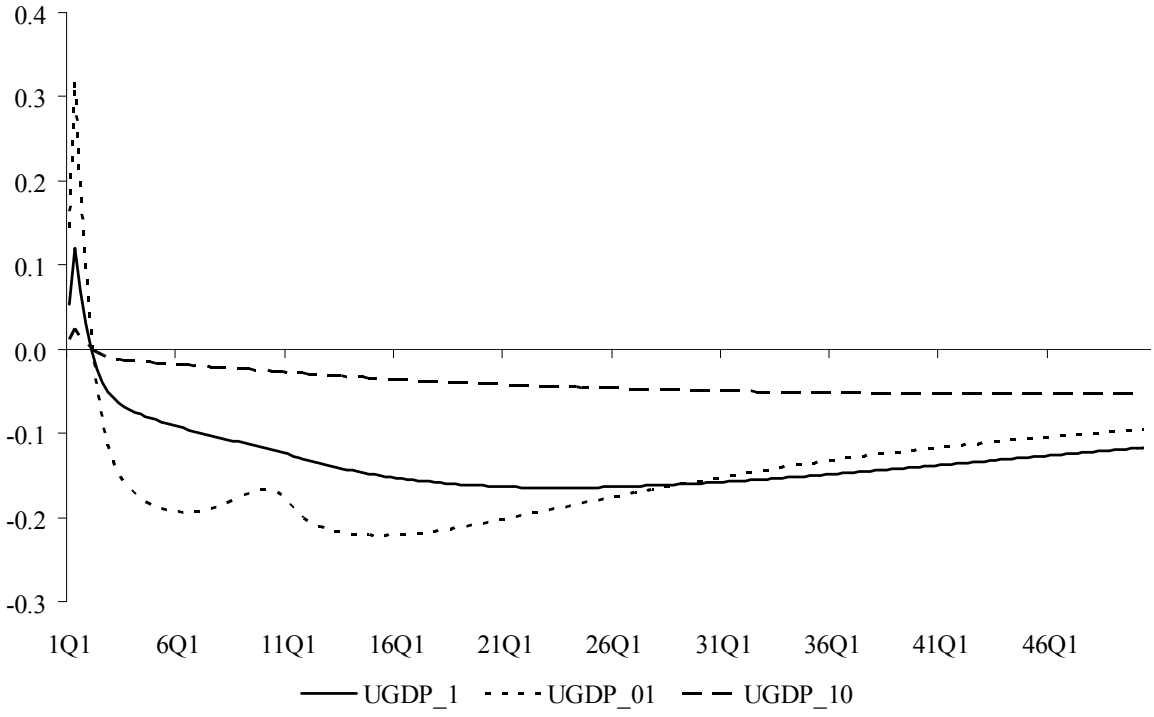

Fig. 5 GDP effects of a shift in foreign reserve: US. Deviations from baseline (%). Bold line: $\sigma = 1$; dotted line $\sigma = 0.1$; dashed line $\sigma = 10$.

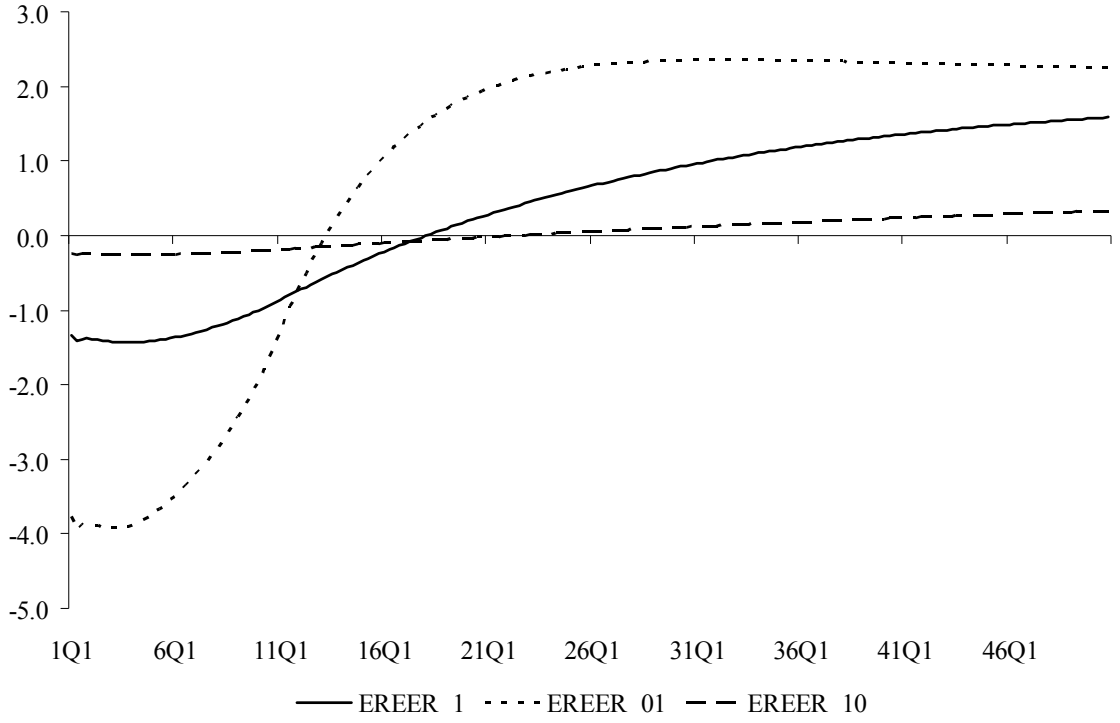

Fig. 6 Real effective exchange rate effects of a shift in foreign reserve: EA. Deviations from baseline (%).
Bold line: $\sigma = 1$; dotted line $\sigma = 0.1$; dashed line $\sigma = 10$.

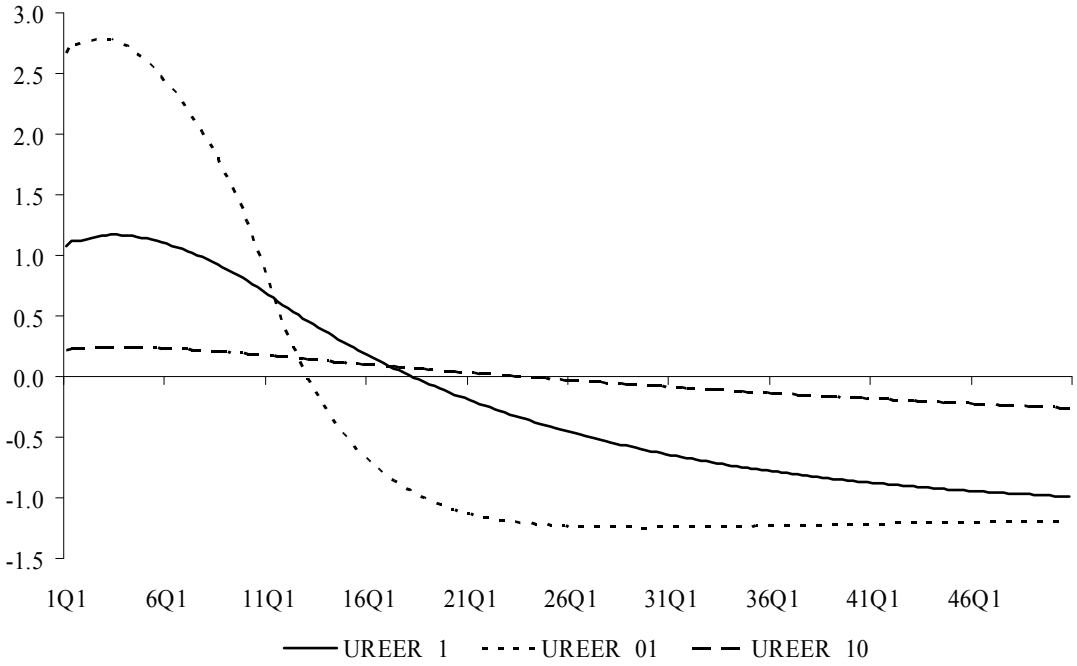

Fig. 7 Real effective exchange rate effects of a shift in foreign reserve: US. Deviations from baseline (%).
Bold line: $\sigma = 1$; dotted line $\sigma = 0.1$; dashed line $\sigma = 10$.

5 Concluding remarks

This paper considered the macroeconomic effects of a gradual equalization of the portfolio composition of official foreign reserves of US dollars to euros, from the present ratio of 65 percent dollars and 25 percent euros to equal 45 percent shares over a 10 years period. Our simulations point towards real effects of such a shift in holdings due to sizable reductions (increases) in interest rates in the euro area (United States) resulting from this shift in central banks' preferences. The shift leads initially to an appreciation of the euro and a long run depreciation. The macroeconomic effects on Emerging Asia (China) and the rest of the world are negligible.

This exercise simulated the effects of a larger role for the euro in official reserve holdings. This official use is of course only one small part of the international role of the euro. If private agents would also shift their preferences and private portfolios towards the euro, then the effects would of course be many times larger.

While the exchange rate changes from this shock predicted by the model may seem small in comparison to exchange rate movements observed in the real world, it should be recognised that exchange rate volatility is not totally explicable in the context of structural shocks to the model. Movements in exchange rates cannot be explained by fundamentals alone, but are to a large extent linked to perceptions of risks and uncertainties that are not captured in a structural model like QUEST. Model simulations instead highlight the real effects of shocks to the model. As shown here, the real benefits from the euro playing a larger role as global reserve currency can be substantial. Nevertheless, further research is needed to capture more of the hitherto unexplained exchange rate volatility.

References

de Beaufort Wijnholds J O, Søndergaard L (2007) Reserve accumulation: objective or by-product? ECB Occasional Paper Series no. 73, September.

Beck R, Fidora M. (2008) The impact of Sovereign Wealth Funds on global financial markets. ECB Occasional Paper Series no. 91, July.

Bird, G, Rajan R (2003) Too Much of a Good Thing? The Adequacy of International Reserves in the Aftermath of Crises. World Economy, Vol. 26 No 6: 873-891.

Blanchard, O, Giavazzi, F, Sa F (2005) International investors, the U.S. current account, and the dollar. Brookings Papers on Economic Activity 1: 1–49.

Bracke, Th, Bussière, M, Fidora, M, Straub, R (2008) A Framework for Assessing Global Imbalances. ECB, Occasional Paper Series No. 78, January.

Chinn M, Frankel J (2008) The Euro may over the next 15 years surpass the dollar as leading international currency. International Finance, Blackwell Publishers (forthcoming).

European Central Bank (2007) Review of the international role of the euro. Frankfurt am Main: European Central Bank, June.

European Commission (2008) EMU@10: successes and challenges after 10 years of Economic and Monetary Union. European Economy, No. 2. Economic and Financial Affairs DG

Gourinchas, P O, Rey H (2005) International Financial Adjustment. NBER Working Paper 11155.

Henderson, D, Rogoff K (1982) Negative Net Foreign Asset Positions and Stability in a World Portfolio Balance Model. Journal of International Economics 13: 85-104.

IMF (2007) World Economic Outlook: Globalization and Inequality. International Monetary Fund, Washington D.C., October.

Kumhof, M, Laxton D, Muir D (2005) The consequences of U.S. fiscal consolidation for the current account. In: United States: Selected Issues, IMF Country Report No. 05/258, International Monetary Fund, Washington DC.

Krugman, P (2007) Will there be a dollar crisis? Economic Policy, Vol. 22, Issue 51, July: 436-467.

Lane, Ph R, Milesi-Ferretti, G M (2007) Europe and global imbalances., Economic Policy, Vol. 22, Issue 51, July: 520-573.

Lim, E G (2006) The euro's challenge to the dollar: Different views from economists and evidence from COFER (Currency Composition of Foreign Exchange Reserves) and other data. IMF Working Papers, No. 06/153, June.

Masson, P R (1981) Dynamic stability of portfolio Balance Models of the Exchange Rate. Journal of International Economics 11: 467-77.

Masson, P R (2007) The growing role of the euro in emerging market finance, World Bank Policy Research Working Papers, No. 4381, November.

Obstfeld, M, Rogoff K (2005) Global current account imbalances and exchange rate adjustments. Brookings Papers on Economic Activity 1: 67–146.

Papaioannou E, Portes, R (2008) The international role of the euro: a status report. European Economy, Economic papers, no.317. European Commission, Brussels.

Ratto, M, Roeger W, in 't Veld J (2008) QUEST III: An Estimated Open-Economy DSGE Model of the Euro Area with Fiscal and Monetary Policy. Economic Modelling (forthcoming).

Appendix:

Table A1 Macro-economic effects of shift in global reserve holdings for Euro area and US (imperfect substitutability, σ =1)

EA year:	1	2	3	4	5	10	15
GDP	-0.07	0.12	0.20	0.23	0.25	0.31	0.35
VALUE ADDED (trad.)	-0.44	-0.38	-0.32	-0.29	-0.26	-0.06	0.20
VALUE ADDED (non-trad.)	0.16	0.41	0.50	0.53	0.54	0.51	0.43
CAPITAL	0.02	0.08	0.17	0.26	0.36	0.85	1.19
EMPLOYMENT	-0.04	0.14	0.21	0.21	0.19	0.10	0.05
CONSUMPTION	0.40	0.67	0.74	0.76	0.75	0.64	0.44
.CONS. (liq.const.)	-0.03	0.11	0.28	0.39	0.48	0.71	0.71
.CONS. (non-liq.const.)	0.60	0.93	0.96	0.92	0.88	0.61	0.31
INVESTMENT	1.02	1.96	2.37	2.57	2.66	2.54	2.02
EXPORTS	-1.17	-1.19	-1.20	-1.19	-1.17	-0.83	-0.31
IMPORTS	1.33	1.92	2.03	2.07	2.06	1.60	0.80
REAL WAGES	-0.28	-0.31	-0.23	-0.15	-0.08	0.14	0.27
NET REAL CONS WAGES	-0.08	-0.02	0.15	0.31	0.44	0.81	0.85
PRICE LEVEL GDP	-0.08	-0.34	-0.57	-0.76	-0.92	-1.35	-1.36
CONSUMER PRICE LEVEL	-0.27	-0.55	-0.78	-0.97	-1.13	-1.49	-1.40
REER	-1.38	-1.41	-1.44	-1.43	-1.40	-0.95	-0.29
NEER	-1.48	-1.82	-2.12	-2.34	-2.50	-2.58	-1.96
DOLLAR	-2.31	-2.70	-3.05	-3.29	-3.44	-3.34	-2.37
NOM. INT. RATE	-0.26	-0.32	-0.27	-0.23	-0.20	-0.11	-0.05
REAL INT. RATE	-0.06	-0.07	-0.07	-0.06	-0.06	-0.08	-0.07
INFLATION	-0.17	-0.26	-0.22	-0.18	-0.15	-0.04	0.02
TAX RATE LABOUR	-0.01	-0.05	-0.10	-0.15	-0.20	-0.32	-0.33
GOV. BALANCE(%GDP)	0.14	0.32	0.30	0.25	0.20	0.03	-0.07
TRADE BAL. (%GDP)	-0.24	-0.31	-0.34	-0.35	-0.35	-0.29	-0.16
CURRENT ACC.(%GDP)	-0.25	-0.33	-0.36	-0.39	-0.41	-0.42	-0.36
NFA (%GDP)	-0.14	-0.44	-0.79	-1.17	-1.56	-3.67	-5.59
US year:	1	2	3	4	5	10	15
GDP	0.07	-0.03	-0.07	-0.08	-0.09	-0.12	-0.15
VALUE ADDED (trad.)	0.30	0.27	0.24	0.23	0.21	0.07	-0.09
VALUE ADDED (non-trad.)	-0.07	-0.20	-0.24	-0.25	-0.25	-0.23	-0.18
CAPITAL	-0.01	-0.05	-0.10	-0.15	-0.21	-0.48	-0.65
EMPLOYMENT	0.06	-0.02	-0.05	-0.05	-0.04	0.00	0.01
CONSUMPTION	-0.21	-0.35	-0.38	-0.38	-0.37	-0.29	-0.18
.CONS. (liq.constr.)	0.00	-0.10	-0.18	-0.22	-0.26	-0.33	-0.32
.CONS. (non-liq.const.)	-0.31	-0.47	-0.47	-0.45	-0.43	-0.28	-0.11
INVESTMENT	-0.57	-1.07	-1.28	-1.37	-1.41	-1.30	-0.99
EXPORTS	0.80	0.80	0.80	0.79	0.77	0.51	0.15
IMPORTS	-1.22	-1.68	-1.73	-1.73	-1.70	-1.24	-0.52
REAL WAGES	0.08	0.08	0.04	0.01	-0.01	-0.10	-0.16
NET REAL CONS WAGES	-0.02	-0.08	-0.15	-0.21	-0.25	-0.37	-0.37
PRICE LEVEL GDP	0.01	0.10	0.18	0.25	0.31	0.50	0.53
CONSUMER PRICE LEVEL	0.11	0.21	0.29	0.36	0.42	0.58	0.55
REER	1.11	1.15	1.17	1.16	1.12	0.75	0.23
NEER	1.13	1.29	1.43	1.52	1.57	1.44	0.92
NOM. INT. RATE	0.12	0.14	0.11	0.10	0.09	0.06	0.03
REAL INT. RATE	0.07	0.05	0.04	0.03	0.03	0.05	0.04
INFLATION	0.04	0.09	0.08	0.07	0.06	0.02	-0.00
TAX RATE LABOUR	0.01	0.03	0.05	0.07	0.09	0.13	0.13
GOV. BALANCE (%GDP)	-0.06	-0.13	-0.12	-0.09	-0.08	-0.01	0.03
TRADE BAL. (%GDP)	0.18	0.22	0.23	0.23	0.23	0.17	0.07
CURRENT ACC. (%GDP)	0.18	0.22	0.24	0.25	0.25	0.24	0.18
NFA (%GDP)	0.10	0.32	0.55	0.79	1.04	2.31	3.35

Note: percentage(point) difference from baseline

Table A2 Macro-economic effects of shift in global reserve holdings for Euro area and US (case of lower substitutability, σ=0.1)

EA year:	1	2	3	4	5	10	15
GDP	-0.24	0.28	0.49	0.56	0.58	0.52	0.55
VALUE ADDED (trad.)	-1.23	-1.05	-0.87	-0.77	-0.67	-0.01	0.84
VALUE ADDED (non-trad.)	0.38	1.04	1.26	1.30	1.28	0.81	0.39
CAPITAL	0.08	0.31	0.62	0.96	1.30	2.74	3.15
EMPLOYMENT	-0.16	0.31	0.47	0.43	0.35	-0.13	-0.18
CONSUMPTION	0.95	1.60	1.75	1.73	1.66	0.94	0.13
.CONS. (liq.const.)	-0.13	0.23	0.65	0.95	1.16	1.44	1.05
.CONS. (non-liq.const.)	1.45	2.24	2.25	2.09	1.89	0.70	-0.29
INVESTMENT	3.19	6.05	7.22	7.65	7.73	5.47	2.24
EXPORTS	-3.21	-3.24	-3.25	-3.17	-3.02	-1.48	0.56
IMPORTS	3.80	5.45	5.68	5.66	5.48	3.02	-0.39
REAL WAGES	-0.80	-0.90	-0.65	-0.42	-0.23	0.45	0.76
NET REAL CONS WAGES	-0.25	-0.13	0.34	0.76	1.09	1.82	1.41
PRICE LEVEL GDP	-0.23	-0.93	-1.54	-2.04	-2.43	-3.08	-2.39
CONSUMER PRICE LEVEL	-0.75	-1.51	-2.11	-2.59	-2.95	-3.33	-2.27
REER	-3.86	-3.89	-3.91	-3.82	-3.64	-1.71	0.85
NEER	-4.16	-5.05	-5.81	-6.33	-6.62	-5.60	-2.31
DOLLAR	-5.99	-6.95	-7.75	-8.23	-8.47	-6.60	-2.12
NOM. INT. RATE	-0.75	-0.91	-0.78	-0.66	-0.56	-0.25	0.06
REAL INT. RATE	-0.18	-0.25	-0.24	-0.22	-0.23	-0.29	-0.15
INFLATION	-0.48	-0.70	-0.58	-0.46	-0.36	0.04	0.20
TAX RATE LABOUR	-0.02	-0.11	-0.26	-0.38	-0.49	-0.68	-0.48
GOV. BALANCE(%GDP)	0.35	0.83	0.77	0.61	0.46	-0.12	-0.35
TRADE BAL. (%GDP)	-0.67	-0.85	-0.91	-0.92	-0.90	-0.53	0.03
CURRENT ACC.(%GDP)	-0.68	-0.89	-0.98	-1.04	-1.07	-0.96	-0.46
NFA (%GDP)	-0.39	-1.22	-2.16	-3.17	-4.21	-9.32	-12.64

US year:	1	2	3	4	5	10	15
GDP	0.19	-0.06	-0.15	-0.18	-0.19	-0.17	-0.22
VALUE ADDED (trad.)	0.72	0.63	0.53	0.47	0.41	0.03	-0.42
VALUE ADDED (non-trad.)	-0.15	-0.45	-0.54	-0.54	-0.53	-0.29	-0.11
CAPITAL	-0.04	-0.16	-0.31	-0.47	-0.64	-1.30	-1.42
EMPLOYMENT	0.17	-0.04	-0.11	-0.09	-0.06	0.14	0.10
CONSUMPTION	-0.45	-0.75	-0.80	-0.78	-0.74	-0.35	0.02
.CONS. (liq.constr.)	0.07	-0.18	-0.37	-0.48	-0.55	-0.58	-0.40
.CONS. (non-liq.const.)	-0.68	-1.02	-1.00	-0.92	-0.82	-0.24	0.22
INVESTMENT	-1.53	-2.84	-3.34	-3.50	-3.50	-2.27	-0.74
EXPORTS	1.93	1.86	1.82	1.74	1.64	0.67	-0.47
IMPORTS	-2.90	-3.97	-4.05	-3.97	-3.80	-1.92	0.57
REAL WAGES	0.26	0.26	0.15	0.07	0.00	-0.24	-0.33
NET REAL CONS WAGES	0.01	-0.10	-0.29	-0.43	-0.54	-0.74	-0.52
PRICE LEVEL GDP	0.06	0.31	0.55	0.75	0.91	1.22	0.96
CONSUMER PRICE LEVEL	0.29	0.59	0.82	1.01	1.15	1.33	0.90
REER	2.73	2.78	2.77	2.68	2.53	1.10	-0.59
NEER	2.80	3.18	3.47	3.63	3.68	2.57	0.47
NOM. INT. RATE	0.32	0.39	0.33	0.28	0.25	0.14	-0.02
REAL INT. RATE	0.15	0.14	0.12	0.11	0.11	0.15	0.06
INFLATION	0.15	0.26	0.22	0.18	0.15	-0.01	-0.07
TAX RATE LABOUR	0.01	0.06	0.11	0.16	0.20	0.26	0.16
GOV. BALANCE (%GDP)	-0.14	-0.34	-0.30	-0.24	-0.18	0.05	0.14
TRADE BAL. (%GDP)	0.43	0.51	0.52	0.51	0.49	0.24	-0.08
CURRENT ACC. (%GDP)	0.43	0.53	0.55	0.56	0.56	0.40	0.13
NFA (%GDP)	0.25	0.76	1.30	1.87	2.43	4.95	6.15

Note: percentage(point) difference from baseline.

Table A3 Macro-economic effects of shift in global reserve holdings for Euro area and US (case of higher substitutability, σ=10)

EA year:	1	2	3	4	5	10	15
GDP	-0.01	0.02	0.04	0.04	0.05	0.06	0.07
VALUE ADDED (trad.)	-0.08	-0.07	-0.06	-0.05	-0.05	-0.02	0.02
VALUE ADDED (non-trad.)	0.03	0.08	0.09	0.10	0.10	0.11	0.10
CAPITAL	0.00	0.01	0.02	0.04	0.05	0.13	0.19
EMPLOYMENT	-0.01	0.03	0.04	0.04	0.04	0.03	0.02
CONSUMPTION	0.08	0.13	0.15	0.15	0.15	0.14	0.12
.CONS. (liq.const.)	-0.00	0.02	0.05	0.07	0.09	0.14	0.16
.CONS. (non-liq.const.)	0.12	0.18	0.19	0.18	0.18	0.15	0.11
INVESTMENT	0.16	0.32	0.38	0.42	0.43	0.46	0.43
EXPORTS	-0.21	-0.21	-0.22	-0.22	-0.21	-0.17	-0.10
IMPORTS	0.24	0.34	0.36	0.37	0.37	0.33	0.23
REAL WAGES	-0.05	-0.05	-0.04	-0.03	-0.02	0.02	0.04
NET REAL CONS WAGES	-0.01	-0.00	0.03	0.06	0.08	0.16	0.18
PRICE LEVEL GDP	-0.01	-0.06	-0.10	-0.13	-0.16	-0.25	-0.28
CONSUMER PRICE LEVEL	-0.05	-0.10	-0.14	-0.17	-0.20	-0.28	-0.30
REER	-0.25	-0.25	-0.26	-0.26	-0.26	-0.20	-0.11
NEER	-0.26	-0.32	-0.38	-0.42	-0.45	-0.50	-0.44
DOLLAR	-0.44	-0.51	-0.58	-0.62	-0.66	-0.69	-0.59
NOM. INT. RATE	-0.05	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01
REAL INT. RATE	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
INFLATION	-0.03	-0.05	-0.04	-0.03	-0.03	-0.01	-0.00
TAX RATE LABOUR	-0.00	-0.01	-0.02	-0.03	-0.04	-0.06	-0.07
GOV. BALANCE(%GDP)	0.03	0.06	0.05	0.05	0.04	0.01	-0.00
TRADE BAL. (%GDP)	-0.04	-0.06	-0.06	-0.06	-0.06	-0.06	-0.04
CURRENT ACC.(%GDP)	-0.04	-0.06	-0.07	-0.07	-0.07	-0.08	-0.08
NFA (%GDP)	-0.03	-0.08	-0.14	-0.21	-0.28	-0.68	-1.09
US year:	1	2	3	4	5	10	15
GDP	0.01	-0.01	-0.01	-0.01	-0.02	-0.03	-0.04
VALUE ADDED (trad.)	0.06	0.06	0.05	0.05	0.05	0.03	-0.00
VALUE ADDED (non-trad.)	-0.02	-0.04	-0.05	-0.05	-0.05	-0.05	-0.05
CAPITAL	-0.00	-0.01	-0.02	-0.02	-0.03	-0.08	-0.12
EMPLOYMENT	0.01	-0.00	-0.01	-0.01	-0.01	-0.00	-0.00
CONSUMPTION	-0.05	-0.08	-0.08	-0.08	-0.08	-0.08	-0.06
.CONS. (liq.constr.)	-0.00	-0.02	-0.04	-0.05	-0.05	-0.07	-0.08
.CONS. (non-liq.const.)	-0.07	-0.10	-0.11	-0.10	-0.10	-0.08	-0.05
INVESTMENT	-0.10	-0.19	-0.23	-0.25	-0.26	-0.27	-0.26
EXPORTS	0.16	0.17	0.17	0.17	0.17	0.13	0.08
IMPORTS	-0.25	-0.34	-0.36	-0.36	-0.36	-0.30	-0.20
REAL WAGES	0.01	0.01	0.00	-0.00	-0.00	-0.02	-0.03
NET REAL CONS_WAGES	-0.01	-0.02	-0.04	-0.05	-0.05	-0.08	-0.09
PRICE LEVEL GDP	-0.00	0.01	0.03	0.04	0.05	0.09	0.11
CONSUMER PRICE LEVEL	0.02	0.04	0.05	0.06	0.07	0.11	0.12
REER	0.22	0.23	0.24	0.24	0.23	0.18	0.11
NEER	0.23	0.26	0.28	0.30	0.31	0.32	0.26
NOM. INT. RATE	0.02	0.02	0.02	0.02	0.01	0.01	0.01
REAL INT. RATE	0.02	0.01	0.01	0.00	0.00	0.01	0.01
INFLATION	0.00	0.01	0.01	0.01	0.01	0.01	0.00
TAX RATE LABOUR	0.00	0.01	0.01	0.01	0.02	0.03	0.03
GOV. BALANCE (%GDP)	-0.01	-0.02	-0.02	-0.02	-0.01	-0.00	0.00
TRADE BAL. (%GDP)	0.04	0.05	0.05	0.05	0.05	0.04	0.03
CURRENT ACC. (%GDP)	0.04	0.05	0.05	0.05	0.05	0.06	0.05
NFA (%GDP)	0.02	0.06	0.11	0.16	0.22	0.50	0.77

Note: percentage(point) difference from baseline.