Correcting US Imbalances

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Abstract. The US current account deficit is in excess of 6 per cent of GDP, and is leading to an accumulation of debts. We use NiGEM to evaluate the causes of the decline, and suggest that domestic absorption in the US has increased markedly. Nominal realignments and monetary expansions elsewhere are shown to be only short term palliatives. A sustained change in the current account must come either from a real realignment associated with a rise in risk premia on US assets or from a change in domestic absorption in the US and elsewhere. Any adjustment must be associated with a significant change in the US real exchange rate to induce expenditure switching as well.

Keywords. Current account imbalances, realignments, risk premia, policy coordination.

JEL Classification. F32, F42, F47

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**Introduction**

The US is now running a current account deficit of 6 per cent of GDP, and can be expected to do so for some time unless the US economy slows rapidly. Although some of this may be due to ‘misaligned’ real exchange rates, some may also be due to ‘inappropriate’ domestic absorption. The greater the ‘appropriate’ level of domestic absorption, the higher is the ‘correctly aligned’ real exchange rate. Without an analysis of equilibrium capital flows and national savings underlying them it is difficult to judge what might be inappropriate or misaligned. Our intention in this note is to look at changes in domestic absorption and the real exchange rate using our model NiGEM, which is outlined in an annex.

Figure 1 US Net Asset Ratio

The set of global current account deficit and surpluses we see may be sustainable, and may be the result of private sector investment choices reflecting risk adjusted real rates of return, but it does involve a deterioration of the US foreign asset position, as we can see from figure 1. The US was a net creditor until 1990, but cumulating deficits since then have led to a negative asset position of 20 per cent of GDP. As global financial markets have liberalised it is not surprising to see countries’ asset positions change, and chart may just reflect the preferences of portfolio holders worldwide. If the deficit were to stay at around 6 per cent of GDP and the US were to experience nominal growth of 6 per cent per annum then the net asset ratio would settle at around 100 per cent of GDP, and this may of course be sustainable. Depending on the rates of return on assets and liabilities, the trade balance would have to improve from its current level, and if the net return on the stock of liabilities were four percent, and revaluations continued to add to that as they have in the last decade, then the trade balance would have to improve by more than 3 per cent of GDP to accommodate the new equilibrium. It is not clear how the trade balance might adjust, nor that debts of 100 per cent of GDP are sustainable.
We look at the factors that have caused the deterioration of the US current account and hence at the sustainability of the US asset position in the medium term. We discuss what determines the exchange rate in a world with forward looking expectations and limited controls on the mobility of capita. We analyse both recent developments and possible future scenarios including both an adjustment through risk premium induced exchange rate changes and a shared demand managed adjustment.

We first produce counterfactual histories involving the oil price not rising in 2003 and the exchange rate not falling since that time. We then look at the effects of monetary and fiscal policy on imbalances under various assumptions about the world. The change in US fiscal policy and the fall in private sector saving have both had an impact on domestic absorption, and they have clearly contributed to the worsening of the current account. The scale of surpluses in Japan and China, and especially the increase in the latter, may also be the result of patterns of domestic absorption affected by perception of risk and by government strategies towards private sector consumption.

We use a version of our model that has many forward looking elements and also a version where all agents look forward to approximate the results obtained with modern DSGE models. After looking at the demand related factors behind imbalances we look at the role of the exchange rate in changing them. A realignment of the renminbi is shown to have only a transitory effect on the Chinese (and hence US) current account because it does not address the structural factors behind the Chinese surplus. The effects of a devaluation of the dollar are also investigated, and we explain why that thought experiment is not internally consistent. We then look at an exchange rate driven orderly adjustment, where US imbalances are gradually corrected by a sequence of exchange rate movements driven by changes in risk premia. If neither US consumers nor the US fiscal authorities change their behaviour and spend less of their incomes this as an extremely likely scenario. We finally look at a concerted attempt by other countries, and the US, to address imbalances.

We would conclude from these experiments that nominal realignments are not the solution to the imbalances we see in the world economy. Adjustment could come from an orderly and gradual change in real exchange rates and domestic absorption brought about by a rising risk premium in the US. It could also come through a change in domestic absorption in the rest of the world and in the US, and these changes would be associated with changes in nominal and real exchange rates that could speed and support the change in absorption that are needed.

**The Recent Past**

Between 1997 and 2005 the US current account deteriorated by $650 billion or about 4½ per cent of GDP, and the deterioration was widespread across countries, as we can see from figure 2, which plots the contributions of changes in bilateral balances to the overall deterioration in the balance over this period. Although the largest component on this chart is the deterioration of the bilateral balance with China, the contributions from NAFTA,
the EU and OPEC are all large. The US trade balance has deteriorated in a similar way to the US balance, both overall and in terms of its country composition.

Fig 2 US Trade by Country; Sources of deterioration since 1997

Source Bureau of Economic Analysis and NIESR

The US current account may have deteriorated because asset preferences have increased the sustainable real exchange rate in order to accommodate capital inflows related to low levels of risk. In the late 1990s, this was at least partly the case, as Al Eyd Barrell and Pomerantz (2005) argue. However, they also suggest that domestic imbalances have been partly responsible for the deterioration in the current account, with low levels of domestic saving and increased government deficits contributing to excess domestic absorption and hence current account deficits. In addition, since 2002 the oil price has risen by 200 per cent, and as the US is a large net oil importer this has led to a significant deterioration in the current account.

It is usual to presume that agents in the foreign exchange markets look forward, and form expectation about interest rates and other events that may affect the evolution of the currency. In most of our analysis we adopt this standard approach. The arbitrage equation for the bilateral exchange rate exchange $e_t$ rate may be written as

$$e_t = e_{t+1}((1 + r_{f})/(1 + r_h))(1 + r_p)$$ (1)

where $r_h$ is the interest rate at home, $r_{f}$ is the interest rate in the partner country and $r_p$ is a risk premium. Exchange rates change because one of these factors changes. A rise in
domestic interest rates (now or expected in the future) will cause the exchange rate to strengthen, whilst the same change abroad will cause it to weaken. Interest rates may be expected to change because of fiscal and monetary policy developments, or because of changes in the private sector. There may also be impacts from the risk premium on assets. Al Eyd, Barrell and Holland (2006) present evidence of an asset related risk premium on the US exchange rate, and as debts build up then risk premia should rise.

Counterfactual histories: the impact of recent exchange rate changes
The current exchange rate should fully discount the future path of asset holdings and hence the exchange rate we observe may be sustainable even with growing debts. However, if ‘news’ arrives that suggests that the nation’s debt will rise, then the perceived risk premium could increase and hence the exchange rate would jump down now. It is possible to use this description to decompose history. The US effective exchange rate fell by around 15 per cent between the first quarter of 2003 and the first quarter of 2005, and the fall has come in a number of steps. Each time it fell we might expect an initial worsening of the current account for a year as prices change in advance of quantities (the J curve effect of the first year textbook). Hence we might have expected no sustained improvement until at least a year after the last downward step toward the end of 2004.

Fig 3 Counterfactual histories for the US exchange rate

We can model this history by taking off each of the major steps down in the currency, starting with the last, and evaluating what would have happened if the fall had not taken place. The new ‘history with a higher exchange rate is then used as the baseline against

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1 The appreciation of the dollar was a relative recent phenomenon in 2002, and the 15 per cent increase over the previous 4 years may not have had much impact on the US current account.
which we remove another fall in the exchange rate. As we can see from Figure 3 we repeat these steps until we have an approximately constant exchange rate from 2003.

Of course there has to be an explanation for the changes in the exchange rate before we can draw conclusions. Our exchange rate changes are assumed to be driven by small changes in the risk premium, and as we discuss below this has real effects in the longer term, as it causes a wedge to develop between real interest rates in the US and those elsewhere, and hence changes relative domestic absorption. We can see the impacts on the current account in Figure 4. Our experiments suggest that if the exchange rate had not fallen by 15 per cent the US current account would have been approximately 2 per cent of GDP worse than it now is. Over that period domestic absorption was autonomously rising by enough to offset the fall in the exchange rate.

![Fig 4 Counterfactual US Current balances (as % GDP)](image)

Counterfactual history: the role of the oil price
The US is a major importer of oil and other forms of energy, although the share of energy in imports fell consistently from 35 per cent in 1980 to 9 per cent in 1997, partly as oil prices fell in real terms, but also because volumes of other imports rose rapidly. Between 1997 and 2005 the oil price, in US dollars, rose approximately threefold, and energy imports as a share of the total rose from 9 per cent in 1997 to 18 per cent in 2005. Most US energy imports originate from OPEC, NAFTA and the rest of the Western Hemisphere, and this has been a major factor in the deterioration of balances with these regions. The overall decline in the energy balance, which was mainly driven by prices, contributed around a third of the deterioration in the US trade balance since 1997 and 60 per cent of the deterioration since 2002. The decline will have come from the effects of the change in price and the relative decline in sourcing oil from the US. We look at the
effects of the change in price in this section, assuming production is constant, and that consumption changes ‘mirror’ GDP changes.

The current account effects of a rise in the oil price are interesting, as they may not be obvious. If a the owner of an exhaustible resource receives a windfall gain in revenue of K for one year, then they will spend rK in that year, where r is the rate of return, and use the remainder of the revenue to invest in non-exhaustible assets. Hence the balance of payments of the resource producer improves by (1-r)K in that year and the balance of payments of the rest of the world worsens by the same amount. Over the last 5 years we have seen the price of an exhaustible resource rise noticeably. Even if the price rise is permanent, the resource producers should invest much of the revenue in foreign assets. If the price rise is perceived as temporary then more will be saved. Oil producers such as Norway have for some time had oil funds that accumulate foreign assets, and such funds are becoming more common, for instance in Russia. All oil producers should have been accumulating assets and running current account surpluses in the last few years, and they have been doing so. The rest of the world must run a structural current account deficit for the same period. It is not surprising that much of this structural deficit might turn up in the US (and the UK) as these are perhaps the economies where it is easiest to allocate assets. Hence we might say that the effects of the oil price rise on the US current account deficit has been greater than one per cent of GDP, but it would be hard to quantify this effect.

Fig 6 Counterfactual oil prices

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2 This is Hartwick’s rule. See Sefton and Weale (1996), Journal of Public Economics for a relevant discussion.
We undertake a sequence of simulation that remove the increase in the oil price we have seen, as detailed in figure 6, which shows that we look only at the major increases in the last 5 years, not at every gyration in the price. We run the model in our standard forward mode each time and use the resulting baseline that we construct as the starting point for the next shock in the stack. These stacked simulations allow expectations to emerge so that individuals in 2002 are not aware that the oil price will rise by $40 per barrel. The effects of this counterfactual analysis on the US current balance can be seen in figure 7 which shows the path the US current account would have otherwise have taken, given that policy reactions would have been in place and that oil producers, who receive less revenue would have spent less. Overall we can say that the rise in the oil price we have seen since 2002 has worsened the US current account by around 1 per cent of GDP.

Fig 7 Counterfactual histories for the US Current Account with different oil prices

**Monetary Policy and Chinese realignments**

We can address the role of monetary policy in inducing a change in the current account, either through its effects on domestic demand or on the exchange rate, and that is the issue we discuss here. A US current account deficit can be the result of too much absorption in the US or too little absorption elsewhere. Monetary expansion outside the US, for instance in the Euro Area, Japan or China might be expected to shift the US current account. In order to evaluate this possibility we can look at the impacts of a monetary policy expansion and Chinese exchange rate realignment using on our model NiGEM. This requires that we set our monetary policy framework and explain how it affects current accounts amongst other things. These effects vary depending upon the

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3 Financial and labour markets are assumed to be forward looking, as is price setting and the investment decision. Although consumers observe and react to ‘jumps’ in their wealth they are no assumed to change their perception of their permanent incomes.
assumptions made about the world we live in. NiGEM can be operated in various ways, from an old fashioned ‘backward looking’ model in which devaluations are possible, to one where all agents are forward looking and equilibrium is achieved quickly.

Monetary policy is set by using rules on the model that describe the responses of the monetary authorities to events. The rules we use are not derived from estimated equations, but rather may come from standard presentations in the literature or from the publications of Centrals Banks. The parameters of the policy rules are either the standard ones, those published by the banks (whether in use or not) or are calibrated to be ‘optimal’ in response to shocks on the model (see Barrell and Dury 2000 and Barrell Dury and Hurst 2001 and references therein). The default rules on the model involve nominal GDP targeting described in equation 2, whilst alternative rules use versions of the Taylor rule in equation 3 and 4. Equation three is the default or industry standard Taylor rule whilst 4 is the version used in the Bank of England Quarterly Model. These rules feed back on a nominal aggregate (NOM) as compared to target (NOMT), on the output gap (OG) and on the deviation of inflation (INF) from target (INFT) (see Barrell, Hall and Hurst 2006).

\[ r_t = \phi(NOM / NOMT) + \phi(INF - INFT) \]  
\[ r_t = r_s + 0.5(OG) + 1.5(INF - INFT) \]  
\[ r_t = 0.65 \times r_{t-1} + (1 - 0.65) \times (r_s + 0.125(OG) + 1.5(INF - INFT)) \]

In the nominal targeting regime (2), which we may call an ECB two pillar strategy, we do not need to specify the equilibrium or steady state real interest rate \( r_s \) in the economy, but this is essential in the Taylor style rules (3) and (4). We can describe a change in policy as a change in a target variable. If interest rates are changed for a period independently of the target then we have to specify what happens afterward. If a nominal target is left in place then the rule will drive nominal GDP back to where it would otherwise have been, whilst with a Taylor rule the long run impact of a target change will depend on its duration, the parameters of the rule and the parameters and structure of the model.

The parameters and structure of NiGEM can be changed with ease. We present monetary policy experiments that are designed to change the US current balance under three sets of assumptions

**Backward.** All agents in the economy are myopic and form expectations of the future based only on past information. This backward looking world of IS-LM analysis with production functions and labour markets is commonly used.

**New Keynesian** Financial markets are forward looking as are bargainers in the labour market, and investment decision are made in relation to forward looking variables. Exchange rates, long term interest rates and equity prices ‘jump’.

**Fully forward looking models of maximising agents.** If all agents look forward and maximise profits or welfare then we might be said to have a Dynamic Stochastic General Equilibrium (DSGE) model.
The specification of the interactions between the exchange rate and monetary policy is central to the issues we are addressing. Once the foreign exchange markets are forward looking monetary policy has major impacts through its effects on the exchange rate as well as directly on demand. However, a change in the monetary stance is unlikely to lead to any changes in current account or the real equilibrium of the economy in the long run, whilst a change in risk premia will induce real changes in both. The same can be said for the impacts of a re-pegging of the Chinese exchange rate, which changes nothing real in the long run. For a period China would be less competitive, and the current account would worsen, but how long this might be sustained would depend on how quickly prices reacted in China and elsewhere.

*A Chinese realignment*

As China has been following the dollar closely, it is possible to conceive of a change in the peg. We shift it by 10 percent, with the rest of the world following their existing policies. As the rest of the world has forward looking financial markets, exchange rates elsewhere adjust in a minor way, and inflation stays around target in other countries, but with higher nominal Chinese export prices in the short run. We use a small estimated (new Keynesian) model of China within our world model and the estimated parameters for price setting must reflect behaviour in the estimation period. This includes the period of deflation after the appreciation of the currency during the Asian crisis in 1997 and 1998. It is therefore not surprising that our simulation produces a sharp fall in Chinese inflation, a decline in growth and a decline of the current account surplus that is temporary. We would suggest that the policy driven structural factors that have given China a current account surplus are largely independent of the exchange rate regime.

Figure 8 The impacts of a Chinese realignment

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**Current Balance (% GDP)**

- **GDP % diff from baseline**
- **Inflation % points diff from baseline**
New Keynesian models: Monetary experiments with rational financial markets

If we assume we are in a world where financial markets are rational with forward looking expectations and labour markets and firms investment decisions are affected by the same expectations of the future, then we can undertake more sophisticated monetary experiments. We undertake these one at a time

1. We shift the inflation target by 1.0 percentage points for six years in Japan and assume that policy rule (3) is in place. We use this rule because there are clear elements of inflation targeting in what the Bank does.

2. We shift the inflation target by 1.0 percentage points for six years in the UK and assume that policy rule (4) is in place. We use this rule because it can be found in the Bank’s model manual.

3. We shift the nominal target in rule (2) in the Euro Area by an amount sufficient to raise the price level by an amount similar to the changes in Japan and the UK. We use this rule because it represents what the Bank says it does.

Fig 9 Impacts of monetary expansions in Europe and Japan on the US current account

We can see from Figure 9 that a monetary expansion in each of these countries will cause the US current account to improve for around two years and it will then worsen before eventually it will return to baseline. Hence there are no long run impacts of these monetary expansions. The price level will rise in each of the countries involved by approximately 6 to 8 per cent, depending on the parameters of the rules and the speed of response in the economies. In each experiment the exchange rate will ‘jump’ down as equation 1 requires that it should do, and demand will expand because the real exchanges rates and real interest rates are initially lower in the expanding economies. However, the lower real exchange rate will quickly offset the demand effects, and inflation will remove the competitiveness advantage gained after a few years.
The effects on the economies undertaking monetary expansions are similar, and we plot only that for the Euro Area in Figure 10. The monetary expansion induces a real depreciation of over five percent as interest rates in the Euro Area fall relative to those elsewhere. GDP growth is boosted by almost one per cent in the first two years as real interest rates are lower than base, as is the real exchange rate. However, inflation increases by around a percentage point a year for six to eight years, and after that period the competitiveness advantage has disappeared. Output, inflation and the real exchange rate all end up back where they would otherwise have been. The US has gained temporary respite on its current account for two years, and the Euro Area has higher growth and higher inflation for a period. Although some people in Europe may want to see such an outcome, it is very unlikely to materialise, as the ECB sets its own inflation target and it would be exceeding that target by one per cent a year for (a further) six years. It would only be prepared to do this (and the same goes for the UK and Japan) if the monetary authorities thought a temporary respite for the US was essential for the health of the global financial system and if they could see no other way of achieving it. They are very unlikely to take this position.

**Figure 10 Impacts of Monetary Expansion on the Euro Area**

![Figure 10](image)

**Fiscal Policy in the US**

US government borrowing has recently been high, with the Bush administration moving from the surplus it inherited in 2000 to a deficit of almost 5 per cent of GDP within four years. This appears to have raised the level of absorption in the US economy. Over the past five years the US current account deficit and the level of US government borrowing have moved closely together, as we can see from figure 11, but over the longer term the association is less obvious. The recent association of the government deficit and the
current account is much as we would expect if we were to simulate a permanent increase of government spending with bond financing with myopic consumers. However, the deterioration in the current account in the last few years has not only been associated with fiscal policy. Private sector net saving has also been declining, and the recent improvement in the fiscal position has not been reflected in the current account.

Figure 11 The US Current Account and Government balances

Using our model NiGEM, we have undertaken a simulation of an increase in spending financed by borrowing. We plot (figure 12) the impacts of a 1 per cent of GDP increase in government spending and borrowing. We assume that financial markets (exchange rates, long-term interest rates and equity prices) are fully forward looking and anticipate the effects of the shock, but that consumers are myopic and consume in relation to their current wealth and real personal disposable income. As the fiscal increase involves permanently higher deficits, it has a sustained impact on GDP, raising it to higher levels than we would have otherwise seen for eight years. Financial markets react to the anticipated decline in national (and given the size of the US, in world) net savings, and real long-term interest rates rise by 0.5 percentage points. This reduces the equilibrium capital stock in the longer run and output settles 0.2 per cent below its initial supply determined baseline after twelve years or so.

As we can see from Figure 12 the current account permanently deteriorates by around 0.5 per cent of GDP. Our results suggest that the 5 per cent of GDP increase in government borrowing between 2000 and 2004 would have caused a deterioration in the current account of 2–2.5 per cent of GDP. This suggests that the reversal of the current account deficit would be aided by a marked fiscal contraction.
If consumers are forward looking and are aware that their future tax liabilities will be higher, then they may adjust their consumption now in response to higher government spending. Of course some consumers may be liquidity constrained (our estimate is that 15 per cent of US consumers must face such constraints) and they will not be able to react to the impacts of higher future taxes. In addition changes in demand may have temporary affects as changes in equity prices and house prices may be difficult to interpret, with longer-term trends affecting consumption after some years. Hence an increase in government spending should raise GDP somewhat in the short run even when consumers take account of the net present value of their future real income streams.

We can take account of forward consumers using a version of NiGEM that approximates the modern DSGE models and see what they add to the debate. Financial liberalisation over the last two decades have made this approach much more realistic than it would have been in the 1980s, and it gives us some extra useful insights, especially into problems that affect the supply side of the economy. We assume consumers in the UK, the US and the Euro Area are forward looking. It is not clear that Japan has become more financially liberalised over the last 15 years and so we do not make the assumption there.

The results of a simulation with forward looking consumers are plotted in figure 13. A 1 per cent of GDP permanent fiscal expansion raises GDP by 0.5 per cent in the first year (70 per cent of the increase with backward looking consumers), but after one year output

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Barrell and Davis (2007) suggest that Japanese consumers have become more liquidity constrained over the last 15 years in response to the problems the banking sector has faced. The US, The US, Canada and France have clear signs of declining liquidity constraints, whereas Germany does not.
is only marginally above base, as consumption begins to fall to offset the increase in government spending. In the longer term, after seven years or so, the fall in consumption matches the increase in spending and national saving is unchanged. Hence real interest rates are ‘on base’, the capital stock is the same as it would have been and output is on base as well. The current account would have deteriorated initially but is essentially on base from the second year of our simulation.

Fig 13 Forward looking consumers and a permanent US fiscal expansion (1% of GDP)

If consumers are fully forward looking then increased government spending cannot explain the deterioration in the US current account, nor can it explain the decline in national saving that is documented in Al-Eyd, Barrell and Pomerantz (2005). In the past decade it is difficult to justify the claim that the deficit is associated with productive investment inflows, as between 1997 and 2005 private sector investment rose by 1.7 per cent of GDP whilst the current account deteriorated by 4.6 per cent of GDP.

Orderly adjustment through Risk Premia

The decline in the US current account since 1997 seems to have been associated with a decline in private sector, and especially household, saving. This conclusion is independent of the impacts of government spending on consumption, and it may reflect the willingness of the rest of the world to lend to US consumers, albeit through banking sector intermediaries. This situation may also be sustainable, but it could also give rise to a rising risk premium and a fall in the US real exchange rate to correct the imbalance. If the US does not adjust then risk premia will rise. It is unlikely that this will take place suddenly and all at once. The risk premia would reflect the increasing exposure of lenders to US borrowers, and the fact that as there portfolios became overburdened with US debt
they would become reluctant to take on more without a greater mark up over standard market rates. As debts rise then the premium would rise, and we can assume that every time it did so markets would then expect the US to adjust its overall savings. If this did not happen in a reasonable amount of time then the premium would rise again.

We can look at an orderly adjustment by imposing a shift in the risk premium every 6 months for 3 years, producing a cumulative downward movement in the nominal exchange rate of around 15 per cent. We can get some idea of the scale of impacts from Barrell and Holland (2006), and the sequence we discuss below is consistent with their results. Each time the risk premia rise then the exchange rate would jump down, as we can see in Figure 14 and real interest rates would rise in the US and fall elsewhere. This would reduce absorption in the US, raise it elsewhere, and also cause expenditure switching for a sustained period as real exchanges rates would have changed. All these forces would help more the US current balance in the right direction.

**Figure 14 Risk premium induced movements in the US effective exchange rate**

*Dates are the start of each unanticipated shift, using the last run as a baseline*

The rise in the risk premium would increase US real interest rates by over one percentage point by 2010, as compared to baseline, and if no other changes took place, they would be two percentage points higher by 2015 than they were in 2006. The fall in the exchange rate would not boost output in the US as its effects would be offset by the rise in real interest rates and US growth would slow by more than half a point to around 2 per cent a year for some years before reverting to its technology and labour supply driven trend. US inflation would rise to around four per cent or so for a sustained period. However, the real exchange rate would be enough, with the change in growth rate, to induce a change in the
current account as we can see from Figure 15, which plots an orderly sequence of current balance improvements. In the early quarters of each sequential shift in the premium there is a small deterioration in the current account as compared to the last element in the stack. However, within a short period there is a sustained improvement, and within 3 years a sustained improvement in the current account is under way. As a consequence of these changes the current account deficit would approach 3 per cent of GDP by 2015, which may be regarded as acceptable.

Figure 15 The impacts of a sequence of risk premium induced realignments on the US current account

*Dates are the start of each unanticipated shift, using the last run as a baseline*

A risk premium adjustment of this sort is both orderly and conceivable. Unless domestic demand changes elsewhere, raising absorption, or in the US reducing it, we see that this is the most likely outcome. It involves neither a collapse of the US, nor a currency crisis and, as Barrell and Holland (2006) show, it quite quickly boosts output in the rest of the world as they benefit from the fall of one to one and a half percentage points in their real interest rates between 2010 and 2015. Each of these shifts in the US effective exchange rate is associated with a change in the dollar exchange rate vis a vis the US. The adjustment is particularly large in Japan and the European countries, but in the full scenario there are realignments in East Asia as well. The real interest differential between the US and the Euro Area would then be as large in 2012 as we saw in 1981, and the four year average around 2012 could be larger that the differential we saw between 1981 and 1984. We have floating rates in all countries, but Sweden follows the euro If the adjustment is to be focused Japan and China then there has to be an autonomous change in absorption there in addition to the induced change that comes from higher real rates.
Devaluing the dollar in a backward world

If we operate our model in backward mode we can avoid the question on the causes of a change in the dollar. In this section we present the impacts of a 30 per cent change in the dollar against all other currencies. We may still need to have a monetary reaction available and where necessary we assume that policy makers follow and industry standard Taylor rule. Running in backward mode means that we do not have to run the model until it reaches a steady state, and we present results for the first five years of a run (starting in 2007q1). Figure 16 shows that a devaluation of this magnitude will improve the US current account by 2.5 per cent of GDP after five years, and that the ‘J’ curve effect lasts for 4 to 6 quarters, depending on the monetary response. This looks like a successful policy. However, a fall in the exchange rate of this magnitude is bound to impact on the inflation rate.

Figure 16 The effects of a 30 per cent devaluation on the US current account

In the long run a fall in the US nominal exchange rate of this magnitude must feed into prices somewhere, either as a rise in prices in the US or as a fall in prices (relative to baseline) in the economies that have appreciated. If the US were able to target its price level then all the adjustment would have to take place in other countries. We have assumed that Taylor rules are being used, and hence the adjustment must be shared. The impacts of the devaluation on US inflation are plotted in Figure 17. The impacts of the devaluation on US inflation is inevitable large, and follows only from the assumption that domestic prices are statically homogenous in their determinants. The extensive literature on the pass through puzzle does not throw light on macro economic issues such as the effects of a change in the exchange rate on prices. The counterfactual theory based experiment, what happens when the exchange rate changes, cannot be answered by
reduced form regressions of structural relationships. The real exchange rate is the relative price of domestic goods compared to foreign goods. If half the shocks to nominal prices are domestic and half are foreign, for a given equilibrium real exchange rate, half of the changes in the nominal exchange rate will reflect domestic shocks and half will reflect foreign shocks, and hence the observed correlation will be about a half.

The policy framework we have in place is of course problematic as in all backward runs, in that interest rates are allowed to change, but financial markets do not react and shift the exchange rate. This assumption of myopia limits the use to which these thought experiments can be put. However, we gain two insights from the experiment. A thirty per cent devaluation might be associated with a 2.5 per cent of GDP improvement in the current account over five years. If there are no real causes of the realignment and no real changes in absorption then there will be no lasting effect on the current account. If we allow the model to run on beyond 2011, the results presented are not changed, but the shock does not change anything real and the model reaches the pre shock real equilibrium in the long run. In particular this means that the US real exchange rate, the level of US output and the US current account as a per cent of GDP go back to where they were on our baseline. Devaluations without reasons are not long run solutions to global current account imbalances.

Figure 17 The Effects of a US Devaluation on US Inflation

A Demand induced Adjustment (the Williamson scenario)
John Williamson, in his preparatory note for the Washington conference, suggests three different scenarios for adjustment, with an even adjustment, a cap to surpluses and a set of adjustments that are designed to take account of some oil producers needs to
accumulate reserves to spread their consumption optimally. The possible scenarios are set out in Figure 18. As we can see, adjustment is to take place in all surplus countries, with China, Japan, east Asia (fe), Sweden (sd), Switzerland Norway and Russia all bearing a share of the change. Apart from the scale of the change to China, the major difference between scenarios is that OPEC has to take up some slack in the even share. WE choose, as a counterpart to the risk premium adjustment discussed above, to allow domestic absorption alone to achieve the targets and then look at the consequences for the value of the dollar. We address the combination of these two scenarios in the IIE publication associated with the conference.

Figure 18 Target Changes in current accounts

We implement something approximating to the welfare change scenario. We do not have OPEC changing, but shifts of these magnitudes require significant changes in some structural elements in the model. We build up the simulations with adjustment outside the US taking place as requested, and then look at the effects on the US. As not all countries adjust, not all of the worsening elsewhere will be reflected in an improvement in the US. In particular we find that the Euro Area current account surplus ‘bulges out, not surprisingly given the adjustment on its borders, and we undertake a demand expansion to remove this. We detail each stage of the change sin current accounts below, along with the accompanying change in the exchange rate. Once we have hit a sensible set of targets, including the Euro Area, we then reduce demand in the US by enough to hit our target by 2015 or thereabouts.

5 We do not try to hit each target, and it would be unwise to try to do so. It is relatively easy to ‘fix’ one country account target using and instrument such as government spending and then allow the rest of the model to solve. Type 2 fixes, as they are known, change the way Gauss Seidel and Newtonian methods work, and if we attempted to implement a large number, as here, the ‘fixing’ will prevent all algorithms we are aware of from finding as structural solution. Many will stop, but they will not have found a solution.
Nominal exchange rate changes on their own without an explanation cannot be considered as reasonable tools for this analysis, and in each case we induce a change in domestic demand with a floating exchange rate. We raise domestic demand by six per cent or more for a sustained period in China, Hong Kong, Taiwan, Russia and Switzerland, and by three per cent in Sweden. Elsewhere approximately two per cent is sufficient to achieve the targets. It is easy to induce changes of this magnitude on a model, especially where we have a government sector and myopic consumers. It is not clear that it is possible to do this in the world. We constructed the simulation by first inducing a demand change in each country one at a time in order to get a change in the current account of the desired magnitude. We then put the shocks together, but the outcome is clearly not just a sum of the individual countries, because there are spillovers from one country to another, and only China, Japan and Canada maintain their initial targets. The European countries are very dependent on each other, and the impacts are hence reduced.

Figure 19 The current account impacts of demand expansions in the surplus countries

As we operate the model with monetary feedbacks in place and with forward looking financial markets the demand increases induce a rise in the nominal exchange rate. Even if the monetary authority were willing to be initially more moderate in their response we have seen above that monetary responses only allow short term palliatives, and not changes in structure. Hence delayed monetary responses may mean interest rates are lower, but exchange rates may move by more. We plot the medium term (six years after the shock) current account outcomes from stage 1 in Figure 19. We do not try to

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6 In the first group 2 per cent extra growth in demand on average for three years or more, in Sweden one percent a year on average for 3 years, and elsewhere one per cent a year for two years.
recalibrate shocks at this stage, as there is a clear need for a change in the Euro Area if there is to be an improvement in the US current account.

Figure 20 Current account impacts of sustained demand increases outside the US (including the Euro Area)

Figure 21 Current account impacts of sustained demand increases outside the US and a demand decrease in the US
We took the baseline constructed by our first set of scenarios and expanded demand in the Euro Area for a sustained period by 2 per cent of GDP. We did this by increasing government spending by 2 per cent of GDP and increasing borrowing by 2 per cent as well. Given the existence of the Stability and Growth Pact floor of 3 per cent borrowing, it is hard to see that governments would adopt this strategy. We could have alternatively raised consumption in each country by enough to induce the same change, and if we had assumed consumers were forward looking this would have been our only alternative. It is as hard to imagine why Euro Area consumers should increase their spending as it is to assume governments would increase theirs, so they are equally acceptable.

We plot the impacts on current accounts after six years in Figure 20. The Euro Area expansion clearly spills over to other countries in the region, and deficits that had emerged now disappear. It is clear that the external adjustments we have implemented have moved the US current account only half of the way toward sustainability.

As the demand induced adjustment outside the US is only sufficient to remove around half of the US imbalance, we need to adjust the US as well. As we know a reduction in domestic demand induced by the government reduces the current account if consumers are myopic, we use that scenario. We reduce US domestic demand with a three per cent of GDP fiscal contraction. This is as artificial as the expansions elsewhere, but allows us to reach our target, as we can see from Figure 22. These changes are the result of uncoordinated expansions and contractions of demand.

Figure 23 The exchange rate path of the dollar when demand adjusts everywhere
The exchange rate consequences are broadly clear. Fiscal tightening in the US includes lower interest rates and the dollar weakens, fiscal loosening elsewhere raises interest rates there and induces an exchange rate increase. Hence the dollar falls, as we can see from Figure 23, and other countries appreciate. The scale of the appreciation depends on the reactions of the authorities to the change in demand, and we have floated currencies that are currently fixed. If monetary policy were to react less in the short run, more action would be needed later, and the appreciation would be largely unchanged, unless inflation targets were changed in a significant way which is not likely. US growth would have to slow more markedly in the overall scenario, and would drop to around 1 per cent a year for a year of so before reverting to its technology and labour supply driven trend. However, the cumulated output adjustment is, unsurprisingly similar to that in our emerging risk premium case. US inflation, would however, rise less with the demand based adjustment outside the US.

Conclusion
Current account imbalances are difficult to change and if they are sustainable they do not need to do so. The US has a large deficit, and unless something structural changes, it is difficult to see how we might see adjustment. Our analysis suggest that the deficit has been affected by rising oil prices, which may have increased it by one per cent of GDP, whilst the fall in the dollar since 2003 has prevented a further worsening of 2 per cent of GDP. Although China has seen the largest increase over the last 10 years in its overall surplus and in its bilateral surplus with the US, it is not clear that a nominal realignment would be anything other than a short term palliative.

We need to explain why exchange rates change before we can assess whether such changes will affect imbalances other than in a transitory way as the reasons for the change affect the outcomes. A devaluation of the dollar induced by monetary expansions elsewhere would have a much more transitory impact on the US current account than the same fall induced by a rise in the risk premium on US assets, or by one driven by a US domestic contraction that resulted from a decline in domestic demand and output that was accompanied by a cut in interest rates by the Federal Reserve in response to lower inflation and the increase in the output gap.

If the US current account is not sustainable then it is possible that there could be an orderly market driven adjustment, and we look at such a scenario. The forward looking arbitrage condition that we utilize involves a risk premium, reflecting portfolio decision on assets. A gradual rise in the risk premium on US assets as debts to foreigners increased would induce both a permanent change in the real exchange rate and a reduction in domestic absorption. We analyse a sequence of risk premium induced declines the dollar that would involve a gradual 17 per cent depreciation and would leave the current account 3 per cent of GDP higher than on our baseline. This benign adjustment scenario is a distinct possibility The likelihood of a currency crisis is low, and the impacts of the adjustment we envisage, which is gradual, would be widely spread and not catastrophic.
References to NiGEM work of relevance to the paper

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Appendix  Overview of NiGEM

NiGEM is an estimated model, which uses a ‘New-Keynesian’ framework in that agents are presumed to be forward-looking but nominal rigidities slow the process of adjustment to external events. Most countries in the OECD are modeled separately, including Mexico and South Korea, as are China, Hong Kong, Taiwan and Brazil. The rest of the world is modeled through regional blocks: Latin America, Africa, East Asia, Developing Europe, OPEC and a Miscellaneous group mainly in West Asia. All models contain the determinants of domestic demand, export and import volumes, prices, current accounts and net assets, and the OECD countries are more complex than those of the non-OECD countries.

Spillages and linkages in NiGEM take place through trade and competitiveness, interacting financial markets and international stocks of assets. The model is homogeneous in exchange rates, and exports demand equals imports across the world. Competitiveness acts as an important stabilising feedback on the model, as shifts in the domestic price level or exchange rate feed into relative trade prices, allowing net trade to offset shifts in domestic demand. There are also links between countries in their financial markets as the model describes the structure and composition of wealth, emphasizing the role and origin of foreign assets and liabilities as well as the distinction between equity, bond and bank based assets, all of which are covered.

Most of the models of the OECD countries are more detailed than the other country and regional models. The core of each of these country models consists of a production function determining output in the long term; a wage-price block; a description of the government sector; consumption, personal income and wealth; international trade; and financial markets. We use a dynamic error-correction structure on the estimated equations, which allows the model to adjust gradually towards equilibrium in response to a shock. In some cases the speed of adjustment will depend on expectations as well as distance from equilibrium.

The NiGEM model allows forward-looking expectations in wages, consumption, exchange rates and equity prices. We assume forward-looking behaviour by default in most cases, except in the case of consumption where the evidence of forward-looking behaviour is less clear. Bond prices affect wealth and depend on long-term interest rates, which are the forward convolution of short-term interest rates. A solution method is, therefore, needed that allows us to solve for their current and future values. We use the Extended Path Method of Fair and Taylor to obtain values for the future and current expectations and iterate along solution paths. Expectations are repeatedly recalculated until convergence is achieved. The model is solved far enough into the future so that the results are not affected by the terminal date, and terminal conditions are standard.

In order for the model to be theoretically coherent, there must not be any financial ‘black holes’ to absorb imbalances. Every export must be matched by an import, all liabilities must be matched by assets, all income flows from assets matched by outflows on liabilities and current accounts must add up across the world (to the normal degree of discrepancy). The model should be approaching an asset equilibrium by the terminal date. This in turn requires that the stock of government debt does not explode, and this is ensured by the no Ponzi games condition we discuss below.
The structure of the trade block ensures overall global consistency of trade volumes by imposing that the growth of import volumes is equal to the growth of export volumes at the global level. Trade volumes and prices are linked by Armington (1969) matrices that depend on trade shares. Price weights for export competitors vary over time as the pattern of trade changes. The demand indicator in the export volume equation is based on 2000 trade patterns, and hence our multipliers and spillovers will depend on current or recent trade patterns and the average of the last thirty years. The export demand variable is constructed as a weighted average of other countries’ imports, which ensures approximate balance, and any discrepancy is allocated to exports in proportion to the country’s share of world trade. Import prices depend on a weighted average of global export prices, and this ensures that the ratio of the value of exports to the value of imports remains at around its historical level. World flows of property income balance because all assets are matched by liabilities, revaluations of liabilities match those of assets and income flows match payments.

For a macroeconometric model to be useful for policy analyses, particular attention must be paid to its long-term equilibrium properties. At the same time, we need to ensure that short-term dynamic properties and underlying estimated properties are consistent with data and well-determined. As far as possible the same theoretical structure has been adopted for each of the major industrial countries, except where clear institutional or other factors prevent this. As a result, variations in the properties of each country model reflect genuine differences in data ratios and estimated parameters, rather than different theoretical approaches. The behavioural equations have been mostly estimated individually, although key equations have been estimated in a panel framework.

Production and price setting

The major country models rely on an underlying constant-returns-to-scale CES production function with labour-augmenting technical progress.

$$Q = \gamma \left[ s(K)^{\rho} + (1-s)(Le^{\lambda t})^{-\rho} \right]^{1/\rho}$$

(1)

where $Q$ is real output, $K$ is the total capital stock, $L$ is total hours worked and $t$ is an index of labour-augmenting technical progress. This constitutes the theoretical background for the specifications of the factor demand equations, forms the basis for unit total costs and provides a measure of capacity utilization, which then feed into the price system.

Demand for labour and capital is determined by profit maximisation of firms, implying that the long-run labour-output ratio depends on real wage costs and technical progress, while the long-run capital output ratio depends on the real user cost of capital:

$$Ln(L) = [c \ln(\beta (1-s))] - (1-c)\ln(\gamma) + \ln(Q) - (1-c)\lambda t - c \ln(w/p)$$

(2)

$$Ln(K) = [c \ln(\beta s) - (1-c)\ln(\gamma)] + \ln(Q) - c \ln(c/p)$$

(3)
where $w/p$ is the real wage and $c/p$ is the real user cost of capital. The user cost of capital is influenced by the forward-looking real long-run interest rate, as well as by corporate taxes and depreciation. The user cost of capital variable is calculated from data for the past, but individual firms take account of risk on their investments when undertaking projects. Business investment is determined through the identity relationship of investment, depreciation and the capital stock. Housing investment depends on real disposable income and real interest rates.

Prices are determined as a constant mark-up over marginal costs in the long term. Our core price equations related the producer price to the unit total cost function implied by our production function. Import prices also feed into producer prices, while consumer prices are determined by producer prices, import prices and unit labour costs. The price equations are all statically homogenous. Capacity utilisation is determined by the production function in simulation mode, and if output is above capacity producer prices rise more rapidly.

*Labour market*

We assume that employers have a right to manage, and hence the bargain in the labour market is over the real wage. Real wages, therefore, depend on the level of trend labour productivity as well as the rate of unemployment. We assume that labour markets embody rational expectations and that wage bargainers use model consistent expectations. The dynamics of the wage market depend upon the error correction term in the equation and on the split between lagged inflation and forward inflation as well as on the impact of unemployment on the wage bargain.

There is no explicit equation for sustainable employment in the model, but as the wage and price system is complete the model delivers equilibrium levels of employment and unemployment. An estimate of the NAIRU can be obtained by substituting the mark-up adjusted unit total cost equation into the wage equation and solving for the unemployment rate\(^7\). The labour supply is determined by demographics and an exogenous participation rate.

*Consumption, personal income and wealth*

Consumption decisions are presumed to depend on real disposable income and real wealth in the long run, and follow the pattern discussed in Barrell and Davis (2007). Total wealth is composed of both financial wealth and tangible (housing) wealth where the latter data are available.

\[
\ln(C) = \alpha + \beta \ln(RPDI) + (1 - \beta) \ln(RFN + RTW) \quad (4)
\]

where $C$ is real consumption, $RPDI$ is real personal disposable income, $RFN$ is real net financial wealth and $RTW$ is real tangible wealth. If we switch the model to forward-looking consumer behaviour, then we need to find a proxy for unobservable permanent

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\(^7\) The labour market in NiGEM is discussed in more detail in Barrell and Dury (2003) and Barrell, Becker and Gottschalk (2004)
income (the income stream from the net present value of human wealth). We assume that RPDI is a good indicator of permanent income in our long run estimation (although measured with error) and in our simulations we replace it with the variable for which it was a proxy. If incomes or interest rates change in the future in these specific simulations then the proxy variable will change and consumers will react to their permanent incomes\(^8\). Financial wealth depends on foreign and domestic equity and bond prices and on the accumulation of assets.

Where housing wealth is absent house prices play a separate role. The dynamics of adjustment to the long run, which are central to a forecast, are data based, and differ between countries to take account of differences in the relative importance of types of wealth and of liquidity constraints. Personal incomes are also forecast in each country building up from components. Employment income comes from the labour market models. Taxes and transfers come from the public sector models. Rents, dividends and interest incomes are flows on the accumulated stocks of assets.

The evolution of gross financial assets and liabilities are modeled in the wealth blocks of the model. We assume that the personal sector has ultimate ownership of all domestically held financial assets. Each country on the model has a stock of foreign assets and a stock of liabilities. These are linked to the stock of domestic financial assets and the stock of domestic private sector and public sector liabilities. A proportion of government debt is owned abroad, as are proportions of the national stock of equities and the stock of banking assets. Some national financial wealth is held in foreign equities and bonds as well as banks. Income flows from asset stocks are allocated in relation to ownership, and hence net property income from abroad depends on income receipts and payments on bonds, equity holdings and bank. The wealth and accumulation system allows for flows of saving onto wealth and for revaluations of existing stocks of assets in line with their prices determined as above. When foreign equity and bond prices change, domestically held assets change in value.

**Financial markets**

We generally assume that exchange rates are forward looking, and ‘jump’ when there is news. The size of the jump depends on the expected future path of interest rates and risk premia, solving an uncovered interest parity condition, and these, in turn, are determined by policy rules adopted by monetary authorities\(^9\):  

\[ RX(t) = RX(t+1)((1 + rh)/(1 + ra))(1 + rprx) \]  

where \( RX \) is the exchange rate, \( rh \) is the home interest rate, \( ra \) is the interest rate abroad and \( rprx \) is the risk premium. For the purposes of this paper it is assumed that the monetary authorities adopt a feedback rule the interest rate, \( r \), of the form

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\(^8\) This is of course an experimental convenience adopted to undertake one or two ‘what if’ experiments.

\(^9\) See Barrell and Dury (2000) for a discussion of monetary and fiscal policy rules in NiGEM.
\[ r_t = \varphi_1(NOM_t/NOMT_t) + \varphi_2(INF_t-INFT_t) \]  \hspace{1cm} (6)

where NOM is nominal GDP, NOMT is its target, INF is the inflation rate and INFT is the target. We use this rule because the ECB says that this is what it does. We assume that bond and equity markets are also forward looking, and long-term interest rates are a forward convolution of expected short-term interest rates. Forward looking equity prices are determined by the discounted present value of expected profits. The discount factor is made up of the nominal interest rate and the risk premium on equity holding decisions.

**Public sector**

Each country has a set of equations for the public sector. Both direct and indirect taxes depend upon their respective tax bases and on the tax rate. Government spending on current goods and services and investment spending depend in part on current plans, and by default rise with trend output. Transfer payments depend upon unemployment and the dependency ratio as well as on policy. Government interest payments are determined by a perpetual inventory model based on the flow deficit and the stock of debt, with the appropriate structure of short and long-term interest payments on the debt stock.

Budget deficits are kept within bounds in the longer term through a targeted adjustment on income tax rates.

\[ Tax(t) = Tax(t-1) + [GBR(t)* - GBR(t)] \]  \hspace{1cm} (7)

Where Tax is the direct income tax rate and GBR is the general government deficit as a share of nominal GDP and * denotes the targeted ratio. This simple feedback rule is important in ensuring the long run stability of the model. Another important feedback is related to the financing of the government deficit (BUD), which can be financed through either money (M) or bond finance (DEBT).

\[ DEBT(t) = DEBT(t-1) - BUD(t) - M(t) \]  \hspace{1cm} (8)

The debt stock affects interest payments and forms part of private sector wealth. Without a solvency rule or a no Ponzi games assumption there is no necessary solution to a forward-looking model.