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Global rebalancing: the macroeconomic impact on the United Kingdom

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Alex Haberis,[1] Bojan Markovic,[2] Karen Mayhew[3] and Pawel Zabczyk[4]

Abstract

This paper considers the implications for the United States, the United Kingdom and the rest of the world (ROW) of shocks that may contribute to a further reduction in global current account imbalances using a dynamic stochastic general equilibrium (DSGE) model. We consider a shock that increases domestic demand in the ROW; a shock that reduces domestic demand in the United States; and a supply shock that raises US productivity relative to other countries. The impact on UK output and inflation depends on the nature of the shock that drives global rebalancing. An increase in domestic demand in the ROW would raise UK exports and output, but would also contribute to increased inflationary pressure in the United Kingdom. Further weakness in US domestic demand is likely to weigh on UK output and inflation. Productivity gains in the United States relative to other countries would worsen the United Kingdom's current account position, pushing down on output, but would lead to reduced inflationary pressure in the United Kingdom.

Key words: Global imbalances, current account, DSGE models.

JEL classification: F41, F47, D58.

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Summary

Global current account imbalances widened sharply in the years preceding the financial crisis of 2007-08. And, although since the onset of the crisis global imbalances have narrowed somewhat, they remain substantial. The implications of an unwinding in global imbalances are of great interest to policy makers and academics and further global rebalancing is widely thought to be desirable for the world economy.

This paper considers the implications for the United States, the United Kingdom and the rest of the world (ROW) of shocks that may contribute to a further reduction in global current account imbalances using a dynamic stochastic general equilibrium (DSGE) model. These models are a standard tool for analysing macroeconomic relationships. The phrase 'dynamic general equilibrium' indicates that they allow for interrelationships between the different parts of the economy (and, in this case, between countries) that take time to unfold; the word 'stochastic' that random shocks arrive to disturb the equilibrium.

We consider a positive demand shock in the ROW, which is interpreted as representing countries with current account surpluses. This is calibrated to be consistent with features of past surplus reversals as studied by the IMF. A similarly sized negative demand shock in the United States (and the United Kingdom) is also considered. Finally, we consider the effects of a supply shock that raises US productivity growth relative to other countries, which is calibrated to match the United States' productivity advantage over its trade rivals in the recent past. We consider the effects of these shocks under the assumptions that nominal exchange rates are flexible and also when the ROW pegs to the dollar.

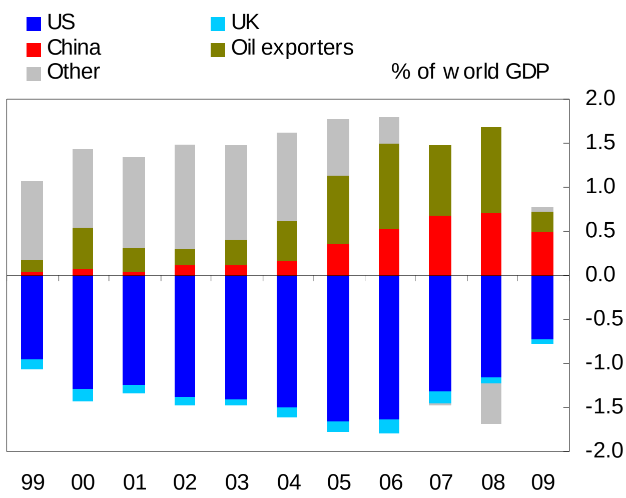
We find that the demand shocks, calibrated as above, in either the ROW or the United States would lead the US current account position to close from its end-2009 level. The supply shock we consider would not be sufficient to close the deficit. The quantitative differences to the simulation results under the different assumptions about the ROW's exchange rate regime are small. This is because, in our model, inflation in the ROW and the United States adjusts to deliver the real exchange rate movements, and associated expenditure switching. This may, of course, not accurately reflect what happens in practice.

The implications for UK output and inflation and the sterling real effective exchange rate depend on the nature of the shock that drives global rebalancing. A rebalancing of surplus countries' demand towards consumption would boost UK demand, pushing up on firms' real marginal costs, thereby raising inflationary pressures in the United Kingdom. This shock would be associated with a depreciation of the sterling real effective exchange rate. Further weakness in domestic demand in the United States would contribute to weaker output and inflation in the United Kingdom, and a real appreciation of sterling. Productivity gains in the United States would lead the United Kingdom to import more US goods, weighing down on UK output. Inflationary pressures would also be reduced in this scenario, and there would be a real depreciation.

1 Introduction

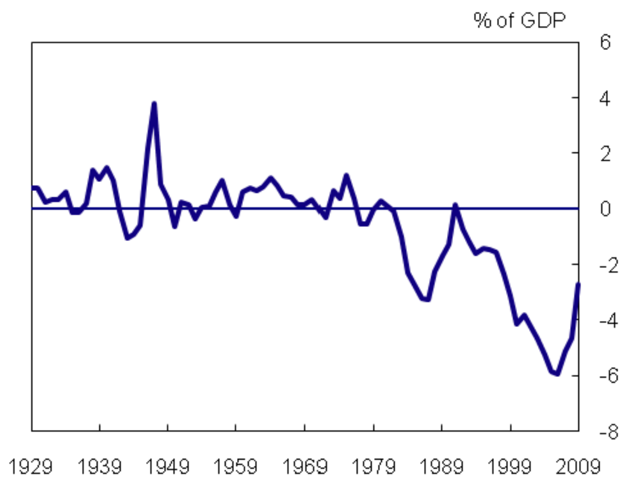
Global current account imbalances widened sharply in the years preceding the financial crisis of 2007-08. And, although global imbalances have narrowed somewhat since the onset of the crisis, they remain substantial. The United States and the United Kingdom have run persistent current account deficits (Chart 1). As a counterpart to this, China, oil exporting countries, and Japan, among others, have been in surplus. The largest share of global deficit positions is accounted for by the United States, where the deficit throughout the 2000s has been greater as a proportion of GDP than at any time in the previous 70 years – peaking at around 6% of GDP in 2006 (Chart 2). Against this, the widening in global surplus positions was largely the result of greater surpluses in China and oil exporters. By 2009, the US current account deficit had fallen to around half its 2006 level as a share of GDP. Over this period, there has been a real depreciation in the dollar effective exchange rate of around 5%.

Chart 1: World current account balance



Source: Authors' calculations based on the IMF's April 2010 *World Economic Outlook* database.

Chart 2: US current account



Source: Bureau of Economic Analysis.

The implications of an unwinding in global imbalances are of great interest to policymakers[1] and academics. It has been argued that global imbalances contributed to the origins of the crisis, and that one of the effects of the 'Great Recession' has been the narrowing in imbalances that has been observed since then (see, for instance, Astley *et al* (2009) and Blanchard and Milesi-Ferretti (2009)). Furthermore, it has been suggested that further global rebalancing would be desirable for the world economy (for instance, see the IMF's April 2010 *World Economic Outlook*). Work by Obstfeld and Rogoff (2000, 2004, 2005, 2007) has highlighted the effects of the US current account reversal on the dollar exchange rate. But relatively little work has been done on the wider macroeconomic effects, particularly for economies outside the United States. Moreover, most of the analysis that has been done has concentrated on purely domestically driven shocks that might unwind the US current account deficit. Given that the current account deficit reflects imbalances elsewhere in the world, then any analysis should also consider the possibility of events happening outside the United States.

[1] See, for example King (2005, 2010) or Bernanke (2005).

In this paper, we investigate the macroeconomic implications for the United Kingdom, the United States and the rest of the world (ROW) of various shocks that improve global imbalances using a three-country calibrated dynamic stochastic general equilibrium (DSGE) model. Under our three-country categorisation, the United States and the United Kingdom are deficit countries while the ROW is in surplus. Given the small contribution of the UK current account deficit to global imbalances overall, global rebalancing is equivalent to an improvement in the US current account position. Therefore, we focus on shocks that lead the US deficit to narrow. In particular, we consider a positive demand shock in the ROW that is calibrated to be consistent with features of past surplus reversals as studied by the IMF (April 2010 *WEO*). A similarly sized negative demand shock in the United States (and the United Kingdom) is also considered. Finally, we consider the effects of a supply shock that raises US productivity growth relative to other countries. This is calibrated to match the faster productivity growth the United Kingdom enjoyed relative to its trade partners in the mid-to-late 1990s. We consider the effects of these shocks under the assumptions that nominal exchange rates are flexible and also when the ROW pegs to the dollar.

This exercise is related to earlier work by Spange and Zabczyk (2006), which also uses the three-country setting that is necessary to analyse the macroeconomic implications of global rebalancing for the United Kingdom. But, in this paper, by using a fully specified DSGE model, we extend that work by allowing output, the real exchange rate and the current account all to respond endogenously to shocks. This gives a fuller description of the macroeconomic consequences of rebalancing and, by allowing quantities to adjust also, it reduces the extent to which rebalancing must come through movements in the real exchange rate alone.

Our simulation results suggest that demand shocks of the size that we consider, in either the ROW or the United States, would lead the US current account position to close from its end-2009 level. The supply shock we consider would not be sufficient to close the deficit. The quantitative differences to the simulation results under the different assumptions about the ROW's exchange rate regime are small. This is because, in our model, inflation in the ROW and United States adjusts to deliver the real exchange rate movements, and associated expenditure switching (albeit in a way that may not accurately reflect what happens in practice).

The implications for UK output and inflation and the sterling real effective exchange rate depend on the type of the shock that unwinds imbalances. When rebalancing is driven by an increase in surplus economies' domestic demand, UK output is increased. This pushes up on UK firms' real marginal costs, raising inflationary pressures in the United Kingdom. By contrast, a decline in domestic demand in the United States would contribute to weaker output and inflation in the United Kingdom. A positive supply shock in the United States would lead the United Kingdom to import more US goods, weighing down on UK output. Inflationary pressures in the United Kingdom would also be reduced and the real exchange rate would depreciate.

The remainder of this paper is structured as follows: Section 2 presents the model and calibration; Section 3 presents the results; Section 4 reviews previous work in this area and discusses how our results compare to other estimates in the literature; and Section 5 concludes.

2 The model

Our analysis is conducted in a new open economy dynamic stochastic general equilibrium model,[2] which consists of three countries: the United Kingdom, the United States and the rest of the world. There are three types of agent in our model: households, firms and government.[3] [4]

2.1 Households

Representative risk-averse households in each country *j* consume goods and supply labour to firms. The lifetime expected utility of households is:

$$U_0^j = E_t \sum_{t=0}^{\infty} \beta^t \left[\omega_t^j \frac{\left(C_t^j\right)^{1-\xi_C}}{1-\xi_C} + \frac{\chi}{1-\xi_M}\left(\frac{M_t^j}{P_t^j}\right)^{1-\xi_M} + \varphi \frac{\left(1-H_t^j\right)^{1-\xi_H}}{1-\xi_H} \right] \tag{1}$$

where $\beta<1$ is the discount factor, C_t is consumption, $1\text{-}H_t$ is leisure, and M_t/P_t are real money balances. Following Neiss and Nelson (2003), we model the demand shock, ω_t, as a shock to consumption preferences. Parameters ξ_C, ξ_M, ξ_H, and χ represent elasticities of substitution. They are all positive and calibrated separately for each country. Labour supply, H_t, is perfectly mobile between the traded (T) and non-traded (N) sectors within each country j:

$$H_t^j = H_{T,t}^j + H_{N,t}^j \tag{2}$$

where $H_T^j = \int_{S_T^j} H_T^j\left(z_T^j\right) dz_T^j$ and $H_N^j = \int_{S_N^j} H_N^j\left(z_N^j\right) dz_N^j$ are aggregates across firms in each sector.

Consumption in country j consists of a bundle of traded, C_T, and non-traded, C_N, goods:

$$C_t^j = \left[\left(\alpha^j\right)^{\frac{1}{\mu}} \left(C_{T,t}^j\right)^{\frac{\mu-1}{\mu}} + \left(1-\alpha^j\right)^{\frac{1}{\mu}} \left(C_{N,t}^j\right)^{\frac{\mu-1}{\mu}} \right]^{\frac{\mu}{\mu-1}} \tag{3}$$

where α represents the share of traded, and $1\text{-}\alpha$ the share of non-traded goods in the consumption basket. The substitutability between traded and non-traded goods is given by the parameter μ. We further divide the consumption of traded goods into consumption of the ROW's goods and the consumption bundle of 'periphery' goods (P), which consists of UK and US traded goods.

$$C_{T,t}^j = \left\{ \left(\gamma_P\right)^{\frac{1}{\rho}} \left(C_{P,T,t}^j\right)^{\frac{\rho-1}{\rho}} + \left[\left(1-\gamma_P\right) h^{ROW}\right]^{\frac{1}{\rho}} \left(C_{ROW,T,t}^j\right)^{\frac{\rho-1}{\rho}} \right\}^{\frac{\rho}{\rho-1}} \quad \text{for } j = UK, US:\ h^{ROW} = 1 \tag{4}$$

[2] The model is a modification of the one developed in the Bank of England and used in Markovic and Povoledo (2007).

[3] Predominantly for the sake of parsimony, the model we use does not contain capital and by extension also investment. While this might imply that it cannot replicate some episodes (eg high investment was typically linked with the US current account deficit up to 2000/01) it allows us to focus on the most relevant aspect of the current situation – ie low US saving rates.

[4] In addition, oil production and consumption are not explicitly modelled. Lipińska and Millard (2010) consider the effects of technology shocks in a three-country model with two oil-importing countries and one oil-exporting country.

$$C_{P,T,t}^{j} = \left\{ \left[(\gamma_{UK}) h^{UK} \right]^{\frac{1}{\psi}} \left(C_{UK,T,t}^{j} \right)^{\frac{\psi-1}{\psi}} + \left[(1-\gamma_{UK}) h^{US} \right]^{\frac{1}{\psi}} \left(C_{US,T,t}^{j} \right)^{\frac{\psi-1}{\psi}} \right\}^{\frac{\psi}{\psi-1}} \qquad \textbf{(5)}$$

for $j = US, ROW$: $h^{UK} = 1$. For $j = UK, ROW$: $h^{US} = 1$

Therefore, the size of the United Kingdom's goods in the traded consumption basket is $\gamma_{UK}\gamma_P$, the size of the United States' goods γ_P-$\gamma_{UK}\gamma_P$, and the size of the ROW's goods 1-γ_P. The parameter ρ is the elasticity of substitution between *ROW* and *P* traded goods, and ψ is the elasticity of substitution between *UK* and *US* traded goods. Each individual consumption good, whether traded or non-traded, is further differentiated as a constant elasticity of substitution basket of all varieties produced by the firms. The elasticity of substitution between individual varieties is given by parameter θ. The parameters h^{UK}, h^{US}, and h^{ROW} represent home bias in consumption. They are calibrated separately for each country.

Households in country *j* maximise their expected utility in each period *t* subject to the budget constraint, which is given in real terms as:

$$\begin{aligned}
&\frac{B_{US,t}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{US}} + \frac{B_{UK,t}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{UK}} + \frac{B_{ROW,t}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{ROW}} + \frac{M_t^j}{P_t^j} + C_t^j - \frac{T_t^j}{P_t^j} + \\
&\frac{\eta^{US}}{2}\left(\frac{B_{US,t}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{US}}\right)^2 + \frac{\eta^{UK}}{2}\left(\frac{B_{UK,t}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{UK}}\right)^2 + \frac{\eta^{ROW}}{2}\left(\frac{B_{ROW,t}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{ROW}}\right)^2 = \qquad \textbf{(6)} \\
&\left(1+i_{t-1}^{US}\right)\frac{B_{US,t-1}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{US}} + \left(1+i_{t-1}^{UK}\right)\frac{B_{UK,t-1}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{UK}} + \left(1+i_{t-1}^{ROW}\right)\frac{B_{ROW,t-1}^{j}}{P_t^j}\frac{\varepsilon_t^j}{\varepsilon_t^{ROW}} + \\
&\frac{M_{t-1}^j}{P_t^j} + H_t^j W_t^j + \Pi_{T,t}^j + \Pi_{N,t}^j + R_t^j
\end{aligned}$$

The budget constraint describes households' resources, which consist of their wage income, W_t, gross initial bond holdings, B_t (denominated in the issuer's currency), the profits from the ownership of firms in the traded and non-traded sectors, $\Pi_{T,t}$ and $\Pi_{N,t}$, lump-sum government transfers, T_t, as well as lump-sum rebates from the government, R_t. At the beginning of each period *t* households allocate their resources between consumption, real money balances, and nominal bond holdings that pay a risk-free interest rate, i_t. The exchange rate, ε^j, is defined as the price of country *j's* currency in terms of *ROW's* currency. The parameter $\eta>0$ is a small cost of holding bonds, which ensures the stationarity of the model.[5]

2.2 Firms

Traded, z_T, and non-traded, z_N, firms in any country operate under conditions of monopolistic competition. Each period, firms in, say, the United Kingdom's traded sector maximise the present value of their expected profits:

[5] See Schmitt-Grohe and Uribe (2003) and Ghironi and Melitz (2005) for further details.

$$E_t \sum_{i=0}^{\infty} \beta^i \frac{\omega_{t+i}^{UK}\left(C_{t+i}^{UK}\right)^{-\xi_C} / P_{t+i}^{UK}}{\omega_t^{UK}\left(C_t^{UK}\right)^{-\xi_C} / P_t^{UK}} \left[SR_{T,t+i}^{UK}\left(z_T^{UK}\right) - H_{T,t+i}^{UK}\left(z_T^{UK}\right) W_{t+i}^{UK} P_{t+i}^{UK}\right] \quad \textbf{(7)}$$

$$SR_{T,t}^{UK}\left(z_T^{UK}\right) = \left[1 - \Gamma_{T,t}^{UK}\left(z_T^{UK}\right)\right] P_{UK,T,t}^{UK}\left(z_T^{UK}\right) \widetilde{Y}_{T,t}^{UK}\left(z_T^{UK}\right) \quad \textbf{(8)}$$

which consists of their sales revenues, SR_t, less the cost of production. In order to change prices, firms have to pay a non-linear cost, Γ_t. This cost introduces Rotemberg-type nominal rigidities into the model. Following Ireland (2001), it is modelled as a deviation of inflation from its steady-state level:

$$\Gamma_{T,t}^{UK}\left(z_T^{UK}\right) = \frac{\phi}{2}\left(\frac{P_{UK,T,t}^{UK}\left(z_T^{UK}\right)}{\bar{\pi}^{UK} P_{UK,T,t-1}^{UK}\left(z_T^{UK}\right)} - 1\right)^2 \quad \textbf{(9)}$$

The expected profit is maximised subject to the downward-sloping demand for firms' products:

$$\widetilde{Y}_{T,t}^{UK}\left(z_T^{UK}\right) = \frac{1}{\alpha^{UK}\gamma_{UK}\gamma_P}\left(\frac{P_{UK,T,t}^{UK}\left(z_T^{UK}\right)}{P_{UK,T,t}^{UK}}\right)^{-\theta} \left[\gamma_{UK}\gamma_P C_{UK,T,t}^{UK} + \left(\gamma_P - \gamma_{UK}\gamma_P\right) C_{UK,T,t}^{US} + \left(1-\gamma_P\right) C_{UK,T,t}^{ROW}\right] \quad \textbf{(10)}$$

The demand for the individual firm's traded goods comes from all three countries in our model. Each firm in both sectors produces goods employing labour supplied by households as its only input. The technology of production is given as:

$$\widetilde{Y}_{T,t}^{j}\left(z_T^{j}\right) = A_{T,t}^{j}\left[H_{T,t}^{j}\left(z_T^{j}\right)\right]^{\zeta} \quad \textbf{(11)}$$

$$\widetilde{Y}_{N,t}^{j}\left(z_N^{j}\right) = A_{N,t}^{j}\left[H_{N,t}^{j}\left(z_N^{j}\right)\right]^{\zeta} \quad \textbf{(12)}$$

where A_T and A_N represent sector-specific supply (productivity) shocks, and ζ is the elasticity of output with respect to labour.

2.3 Government

As there is no public spending, the government uses seignorage revenues to finance transfers to households. The public budget constraint is balanced in each period and simply given as:

$$M_t^j - M_{t-1}^j = T_t^j \quad \textbf{(13)}$$

In this model, the government also represents the monetary authority. As such, it follows an interest rate feedback rule, targeting only the inflation rate. In the log-linearised form this rule can be expressed as:

$$\hat{i}_t^j = \rho_i \hat{i}_{t-1}^j + \left(1-\rho_i\right)\rho_\pi\left(\hat{\pi}_t^j - \pi_{tar}^j\right) \quad \textbf{(14)}$$

Where ρ_i and ρ_π are non-negative parameters, i_t is the deviation of the nominal interest rate from its steady-state level, and π_t is the consumer price inflation rate.

2.4 *The uncovered interest rate parity condition*

The uncovered interest rate parity (UIP) condition in the model is modified to take into account the difference in bond holding costs between bonds of different issuer countries.[6] In the log-linearised form, the UIP condition between the United States and the United Kingdom takes the following form:

$$E_t\,\hat{\varepsilon}_{t+1}^{US} - \hat{\varepsilon}_t^{US} = \beta\left(i_t^{US} - i_t^{UK}\right) - \eta^{US}\,\frac{B_{US,t}^{j}}{P_t^{j}}\frac{\varepsilon_t^{j}}{\varepsilon_t^{US}} + \eta^{UK}\,\frac{B_{UK,t}^{j}}{P_t^{j}}\frac{\varepsilon_t^{j}}{\varepsilon_t^{UK}} + e_t^{uip} \quad \textbf{(15)}$$

2.5 *Calibration*

The model is calibrated to match key structural features of the United Kingdom, the United States and the ROW economies. The parameters, reported in Table A, are taken from other relevant literature, our calculations and historical data.

We set the quarterly discount factor, β, at 0.99 in order to approximate the annual equilibrium real interest rate of 4%. The intertemporal elasticity of substitution in consumption, ξ^C, is taken from Chari, Kehoe, and McGrattan (2002). We calibrate the weight of leisure in the utility function, φ, in order to match the steady-state fraction of time households spend working to a third.[7] The elasticity of labour in the production function, ς, is calibrated to match the ratio of wages to output of 0.7, as in Harrison *et al* (2005) for the United Kingdom, and Rotemberg and Woodford (1999) for the United States and the rest of the world. The values for the elasticities of substitution between various consumption bundles – parameters μ, ψ, and ρ – are all taken from Obstfeld and Rogoff (2005). The elasticity of substitution between individual goods, θ, is taken from Rotemberg and Woodford (1999) for the United States and the ROW, and Benigno and Thoenissen (2003) for the United Kingdom.[8]

The values for the preference bias parameters – country size, γ_j, and home bias, h_j – are set to match empirically observed trade shares. The model implied ratios of imports to GDP for the United Kingdom, United States and the ROW match those in the data – 28%, 12.5% and 4.5%, respectively. The calibration also ensures that the shares of UK, US and ROW imports coming from their respective trading partners matches those observed in the data. The share of traded goods, α, is taken from Spange and Zabczyk (2006) for the United Kingdom, and the International Monetary Fund (2005)[9] for the United States and the ROW.

We set the cost of holding bonds, η, at a very small value, following Ghironi and Melitz (2005). The cost of price adjustment, ϕ_j, which governs the nominal rigidities in the model, is based on the calibration in Harrison *et al* (2005).

[6] See Benigno (2001) for further details.
[7] This yields the Frisch elasticity of labour supply equal to 0.23, which falls within the range of estimates found in Gali, Gertler and Lopez-Salido (2005).
[8] Our choice of θ implies a steady-state mark-up of prices over marginal costs of approximately 14%, which is the value calibrated in Markovic and Povoledo (2007).
[9] See 'Globalization and external imbalances', Chapter 3, *World Economic Outlook*, April 2005.

Table A: Parameters in the model

PARAMETER		VALUE		
		UK	US	ROW
β	Discount factor	0.99	0.99	0.99
ξ^{c}	Intertemporal elasticity of consumption	5	5	5
ξ^{h}	Intertemporal elasticity of leisure	10	10	10
ς	Elasticity of labour supply in the production function	0.8	0.8	0.8
θ	Elasticity of substitution	6.67	7.88	7.88
ϕ^{1}	Nominal rigidity	250	250	250
ψ	Elasticity of substitution between UK and US goods	3	3	3
ρ	Elasticity of substitution between ROW and US and UK	2	2	2
μ	Elasticity of substitution between traded & non-traded	1	1	1
φ	Weight on leisure in the utility function 1(a)	2.51	3.03	0.32
γ_i	Country size	0.05	0.29	0.66
α	Share of traded in total goods	0.45	0.32	0.45
h	Home bias parameters	18.33	2.68	4.64
η^{a}	Cost of holding bonds parameter	0.0025	0.0025	0.0025
ρ^{i}	AR coefficient in policy rule	0.5	0.5	0.5
ρ^{π}	Coefficient on inflation in policy rule	1.5	1.5	1.5

(a) As noted in the text the value of this coefficient is set so as to ensure that hours worked in each country in the steady state equal a third. The large cross-country differences reflect different steady-state levels of consumption and wages which are magnified by the relatively high value of the intertemporal elasticity of substitution.

3 Results

In this section we analyse the macroeconomic implications of three shocks that in theory could contribute to an unwinding of the US current account deficit. These are an increase in domestic demand in the rest of the world; a fall in domestic demand in deficit countries; and a supply shock that gives rise to relatively high growth in US productivity compared to other countries.

In what follows, we discuss the calibration for each shock and highlight the channels through which each shock propagates – focusing in particular on the response of UK variables.
The main findings we present are for the simulations under the assumption that the three countries operate flexible exchange rate regimes. We also consider the responses to the same shocks when the rest of the world pegs its nominal exchange rate to the US dollar. A full set of charts for each shock (under flexible exchange rates) is given at the end of the paper.

3.1 A positive demand shock in the rest of the world

An unwinding of the US current account deficit may be brought about by a shock that leads to an increase in domestic demand in the ROW. In the April 2010 *WEO*, the IMF highlights that an increase in domestic demand in surplus countries would be needed to offset declines in domestic demand in deficit countries such as the United States and the United Kingdom for a sustained recovery in the world economy. Given the absence of investment and government spending in our set-up, we model this increase in domestic demand as a positive consumption preference shock, which leads to a rise in ROW consumption (ie domestic demand) and output.

To calibrate the ROW domestic demand shock, we draw on evidence on historical current account surplus reversals from the April 2010 *WEO*. This work focuses on five case studies that had similar characteristics preceding their current account reversals to those in countries that have large surpluses today. It finds that in the couple of years following a reversal, private consumption growth was between 1 and 3 percentage points (pp) above pre-reversal growth rates. Therefore, we simulate a shock that raises the level of consumption by around 5% relative to its starting position after two years. This is consistent with faster consumption growth of around 2.5pp relative to pre-reversal trends for two years. This fairly sizable shock, which is towards the top of the IMF's range, is motivated by today's historically large current account imbalances.[10]

The charts in Appendix 1 show the effects of this shock on the United Kingdom, United States and ROW. The increase in consumption in the ROW leads to an increase in ROW output; the deterioration in the current account position, of around 1% of GDP, is not sufficient to reduce aggregate demand in the ROW. At the two-year horizon, this shock improves the US current account by around 2.5% of GDP, which would be sufficient to close the deficit at its end-2009 levels. This is driven by the rise in demand for US output by ROW consumers and expenditure switching by US households to US output, which is now cheaper following a depreciation of the US real effective exchange rate of around 4%. The UK current account also improves for similar reasons, though the depreciation of the United Kingdom's real effective exchange rate is smaller, at around 3%. The increase in ROW consumption leads real interest rates to increase internationally, leading consumption in the United States and the United Kingdom to decline. However, the improvements in the US and UK current account positions are enough to offset the declines in consumption in those economies, so US and UK aggregate demand rises overall. The increases in demand push up on firms' real marginal costs and lead inflation rates to increase in the United States, United Kingdom and the ROW.[11] Therefore, an increase in

[10] We have chosen to analyse the effects of temporary, rather than permanent, shocks. Implicitly, this reflects our belief that the US current account deficit is the result of temporary shocks occurring in the past. We think these shocks have caused the system to move away from its steady state, without changing it. Accordingly the world economy could be expected to converge back to the original steady state. To understand the transitional dynamics *back* to the steady state, we therefore focus on *temporary* shocks likely to unwind the deficit. By doing that we are ignoring base effects, ie the fact that shocks could have a different effect when they occur in a system that is in steady state, rather than out of steady state. Analysing the impact of permanent shocks, base effects and revaluation effects would make interesting extensions to the paper.

[11] These increased inflation rates do not explicitly reflect increases in commodity prices, which are absent from this model. Lipińska and Millard (2010) consider the international spillover effects of productivity shocks in a model with explicit commodity production and consumption.

domestic demand in the ROW improves global imbalances without losses in output in any of the countries, but at the cost of higher inflationary pressures around the world.

3.2 A negative demand shock in the United States

In this subsection, we consider the effects of a fall in United States domestic demand on global imbalances. Domestic demand in the United States fell substantially following the financial crisis in 2007-08 and further falls may, for instance, be triggered by another loss of confidence.

As with the positive domestic demand shock in the ROW, we model this decline in domestic demand as a consumption preference shock (albeit with the opposite sign). To facilitate comparisons with the simulation in Section 3.1, the fall in US domestic demand is calibrated to be of the same magnitude as the rise in ROW demand.

The charts in Appendix 2 show the responses of the United States, United Kingdom and the ROW to this shock. At the two-year horizon the shock improves the US current account by close to 3% of GDP – that is, enough to close the current account deficit fully at its end-2009 level. The improvement in the US current account position reflects a fall in US import demand and expenditure switching to US output by US consumers as a result of the depreciation of the US real effective exchange rate, which is around 4%. ROW and UK consumers also increase their spending on US output. But since the improvement in the current account balance is not enough to offset the fall in domestic demand, US output falls in response to this shock.

The impact on the United Kingdom of a shock to domestic demand in the United States depends on whether the shock occurs only in the United States or is common to both the United States and the United Kingdom. A shock to US domestic demand in the absence of a common shock in the United Kingdom causes the UK current account balance to worsen, as US demand for UK goods declines. There is a small appreciation of the UK real effective exchange rate, despite an initial depreciation. Given the fall in world real interest rates resulting from the decline in US consumption, consumers in the United Kingdom are able to raise their own consumption, to their benefit. However, the worsening of the UK current account position is such that overall aggregate demand in the United Kingdom falls. Applying the same shock to both the United Kingdom and the United States gives a similar pattern of responses (both qualitatively and quantitatively) in the United Kingdom as in the United States. Consumption, output and inflation all fall, while the current account balance improves and the real effective exchange rate depreciates (Appendix 2B).

In response to a negative demand shock in the United States (and the United Kingdom), output in the ROW declines, consistent with the deterioration in the current account balance. As well as reflecting the decline in US (and UK) demand for ROW output, the deterioration in the ROW current account balance is driven by expenditure switching by ROW consumers to the now cheaper US (and UK) goods (resulting from the real effective appreciation of the ROW exchange rate). Owing to the United Kingdom's small share in world output, the quantitative impact on the ROW is broadly similar for shocks to the United States alone and to both the United States and United Kingdom together.

3.3 A positive productivity shock in the US traded goods sectors

On the supply side, the US current account could improve if there were higher productivity growth in the United States compared to the rest of the world. This was the case in the 1990s, when productivity growth in both the US traded and non-traded goods sectors outpaced its major competitors. Therefore, in this section we consider a positive productivity shock to the traded goods sector in the United States. (Results for a productivity shock to the non-traded sector are broadly similar and are not reported.)

A positive productivity shock in the traded goods sector leads to a rise in traded goods output and a fall in traded goods prices. The fall in the price of US traded goods relative to traded goods abroad causes a switch in global demand towards US goods – US consumers switch to buying more of their own traded goods and foreign consumers buy more US exports. This improves the US current account. The increase in world demand for US goods causes a nominal dollar appreciation and this, along with the fall in domestic prices, pushes down on inflation and stimulates demand in the United States. US consumers expect the increase in their incomes to die away over time and so smooth their consumption by lending some of their higher income abroad. This also acts to improve the current account.

To calibrate the size of the productivity shock, we focus on productivity growth in the traded sector in the mid-to-late 1990s. In this period, the average annual productivity growth rate in the United States totalled 6%, whereas that in the United Kingdom, Japan, Germany, France and Italy averaged 2.5%. We therefore simulate a scenario where US productivity growth is 3.5% higher than the ROW and the United Kingdom for two years, but the differential then dies away over time.[12] Although productivity growth in the United States has been high compared with other developed countries since the crisis, arguably, this scenario is optimistic for US productivity growth relative to the ROW. This is because, in recent years, the importance in world trade of developing economies (many of which are the surplus countries that are represented by the ROW) has grown significantly. These economies have relatively high productivity growth rates, which the United States may struggle to outpace.

According to the charts in Appendix 3, at the two-year horizon, the US current account to GDP ratio improves by 0.8pp, US traded output is 6% higher, US total output rises by 1.5%, and inflation falls by over 1pp. The US monetary authority reacts to the fall in inflation and cuts interest rates by around 45 basis points. The US terms of trade deteriorates by over 3% as the price of US traded goods falls relative to traded goods produced abroad but the internal real exchange rate appreciates as non-traded goods become more expensive relative to traded goods. The latter reflects the well-known Balassa-Samuelson effect. This offsets some of the terms of trade deterioration and the overall US real effective exchange rate depreciates slightly at first, but over time, appreciates by around 0.7%.

[12] In line with previous exercises, we implement this as a *temporary* shift in productivity levels, which implies the productivity *growth* profile described above.

A positive productivity shock in the US traded sector has two offsetting effects on output in the other two countries. First, there is a boost to output in the United Kingdom and the ROW as US incomes rise and along with them US demand for UK and ROW exports. Second, output in the United Kingdom and the ROW falls as world demand shifts towards relatively cheaper US goods. Our results show that the latter effect dominates and thus output in the United Kingdom and ROW falls.

The fall in demand for UK goods (both by UK and US consumers) results in a deterioration of the UK current account to GDP ratio of around 0.5pp. Producers reduce their prices as they try to regain market share and this, along with the fall in import prices from the United States, results in a 0.9pp fall in UK consumer price inflation at the two-year horizon and a 0.5pp fall in ROW CPI inflation. Ultimately, UK and ROW agents end up consuming more as they can now afford more of the cheaper US imports.

That said, not including capital and investment in the model might mean that we overestimate the impact of productivity shocks on the US current account. This could happen for two main reasons. First, some of the increase in demand for capital could be satisfied through increases in imports. Second, consumers might want to take advantage of higher levels of future production by consuming more today, which would also tend to increase the deficit.

To summarise, the positive shock to the US traded sector results in a fall in output and inflation in the United Kingdom at the two-year horizon, but again consumption increases due to the increase in imports from the United States. Inflation also falls in the ROW but output is less affected than in the United Kingdom. The US experience is different from the demand shock in that now output and consumption both rise, whereas inflation falls. Notably, the response of the current account to GDP ratio (0.8pp) is smaller in the case of this shock than after the previously discussed demand shocks.

3.4 What if Asian currencies remained fixed to the dollar?

In reality, a number of countries operate nominal exchange rate pegs with the US dollar. This has been the case for China and many oil exporters, which account for a large share of the ROW's surpluses. In this section we examine the effects of the ROW pegging its nominal exchange rate with the United States. We implement this policy as in Markovic and Povoledo (2007); in that paper, the authors consider the effects of different shocks under different exchange rate regimes using a similar model, but calibrated to the United States, Europe and Asia. The results are reported in Table B.

For the most part, the differences between floating and fixed exchange rates are not quantitatively large. This is likely to be because, to an extent, inflation in the ROW and the United States adjusts to deliver the equilibrating real exchange rate movements. In practice, it is common for the foreign exchange interventions associated with maintaining an exchange rate peg to be sterilised, which neutralises the impact on the domestic price level, at least in the short-run.

Our simulations show that there is a little less rebalancing when the ROW operates an exchange rate peg with the United States in response to both a positive demand shock in the ROW and a negative demand shock in the United States than otherwise. In both instances the change in real exchange rates is smaller (though only slightly so, given the responses of inflation), leading to less of an expenditure switching effect following the shocks. The quantitative differences between responses to positive productivity shocks in the US trading (and non-trading) sector are also small for floating and fixed exchange rates regimes.

The ROW's peg affects the United Kingdom's response to the demand shocks in the ROW and United States in different ways. In response to the positive demand shock in the ROW, when the ROW pegs to the dollar, the United Kingdom sees a smaller real exchange rate depreciation and less of an improvement in its current account position. By contrast, in response to a negative US demand shock, the ROW's peg increases the impact on the United Kingdom's current account position, which worsens by more compared to when exchange rates are flexible. That is, the ROW's peg appears to reduce the impact of ROW shocks on the United Kingdom's real exchange rate and current account (which is also true for the United States); but it minimises the impact of US shocks on the ROW's current account and real exchange rate, leading to greater fluctuations in the corresponding variables for the United Kingdom.

Table B: Overview of simulation results for fixed exchange rates between US and ROW

	Calibrated size of the shock					
	US			UK		
	Output	*Inflation*	*Real exchange rate*	*Output*	*Inflation*	*Real exchange rate*
A positive demand shock in the ROW	1.0	4.8	3.4	1.1	5.2	2.4
A negative demand shock in the US	-3.5	-5.0	3.5	-1.1	-3.5	-0.8
A negative demand shock in the US and the UK	-3.6	-5.3	3.4	-3.7	-5.0	2.2
A positive productivity shock in the US traded sector	1.3	-1.2	0.0*	-0.3	-0.8	0.6

* The initial negligible move in the US real effective exchange rate is subsequently followed by an appreciation of 0.6%.

4 Comparison of results from other work

In this section we review selectively the literature on rebalancing, focusing on papers that consider the implications of an unwinding of the US current account deficit from the viewpoint of a quantitative model. We also compare our results, summarised in Table C, with those of some previous studies

In a series of papers, Obstfeld and Rogoff (2000, 2004, 2005, 2007) develop a framework for analysing the effects of shocks that unwind the US current account deficit on the US real exchange rate. This framework is based on a static two or three-country model in which output is given exogenously and the real exchange rate adjusts to unwind current account imbalances. Obstfeld and Rogoff's 2005 paper uses a three-country model comprising the United States, Europe and Asia, while the others focus on two-country models featuring the United States and the ROW. The papers suggest that an unwinding of the US current account deficit, from its widest point of around 6% of GDP, might lead to a depreciation of the dollar real exchange rate of around 30%. The 2005 paper also considers the unwinding of global imbalances when all three regions have freely floating exchange rates, and when the Asian currency stays fixed against the dollar, in which case there is a sharp appreciation of Europe's currency.[13]

To close the deficit fully from its widest position, our results suggest that a real depreciation of between 0.5% and 10% would be necessary, depending on the shock. Naturally, this estimate is subject to large uncertainty, given that it is based on a stylised model and informed but arbitrary assumptions about parameters. This range is smaller than the deficit-closing depreciation predicted in Obstfeld and Rogoff's analysis. One explanation that may account for these differences is that Obstfeld and Rogoff assume that output is held fixed – ie their model is of an endowment economy. This means that in their framework prices have to do all the work to equilibrate demand and supply, thus exaggerating the movement of the real exchange rate. Adding to this, the exogenous output assumption implies that factors of production are immobile between sectors.[14] With factor mobility, the internal real exchange rate[15] would appreciate due to labour market arbitrage and offset the terms of trade deterioration as it does in our analysis. However, in their model, the internal real exchange rate depreciates, adding to the deterioration in the terms of trade. That said, Ferrero *et al* (2008) find that depreciations of a similar size to those found by Obstfeld and Rogoff are associated with rebalancing using a two-country DSGE model.

Spange and Zabczyk (2006) use the framework developed by Obstfeld and Rogoff (2005) to analyse the effects of shocks unwinding the US current account deficit on the real exchange rates for the United States, ROW and the United Kingdom. Using the equivalent calibration for the elasticity of substitution that we have in this paper, Spange and Zabczyk (2006) find that closing a deficit of just over 6% of GDP, results in a 1.4% depreciation of the sterling real effective exchange rate after a shock in the US tradable goods sector, and a 0.9% appreciation after a negative shock to US demand.[16] Our results suggest similarly small movements for the UK real effective exchange rate. In particular, for an unwinding of the US current account at 6% of GDP, the UK real exchange rate is estimated to appreciate by around 0.3% in response to a

[13] It should be noted that given the set-up of Obstfeld and Rogoff's model, ie flexible prices and an inflation-targeting central bank, movements in the nominal and real exchange rates are equal in their analysis.
[14] This assumption is particularly important for the real exchange rate effects following a traded sector productivity shock.
[15] The internal exchange rate reflects the relative price between the traded and non-traded goods between two countries.
[16] In Spange and Zabczyk the real exchange rate movements range from a depreciation of 1.4% to an appreciation of 4.2% depending on model parameters. Here, we quote their figures for the same elasticity of substitution parameters as we have in this model.

negative demand shock in the United States, depreciate by 6% in response to a positive demand shock in the ROW and depreciate by around 2.3% in response to a positive productivity shock in the US tradable goods sector.

Blanchard *et al* (2005) use a portfolio balance model and estimate that the dollar would need to depreciate by 90% to close the US current account. Unlike Blanchard *et al*, where a movement in the exchange rate is exogenously imposed, in our setting the exchange rate and the current account are endogenously determined and the fall in the dollar is a by-product of fundamental shocks that rebalance global savings.

Faruqee *et al* (2007) ask a similar question to ours. They use the IMF's Global Economic Model to simulate a loss in appetite for US assets, which improves the current account by 1.5pp. They find a depreciation of the US real effective exchange rate (also immediate), of around 6%. They also find that this shock results in a fall in US output of around 1%.

Table C: Overview of simulation results

	Calibrated size of the shock						**Shock necessary to improve US current account by 1pp**					
	US			**UK**			**US**			**UK**		
	Output	*Inflation*	*Real exchange rate*	*Output*	*Inflation*	*Real exchange rate*	*Output*	*Inflation*	*Real exchange rate*	*Output*	*Inflation*	*Real exchange rate*
A positive demand shock in the ROW	1.2	5.6	4.1	1.3	5.9	2.9	0.4	2.1	1.5	0.5	2.2	1.1
A negative demand shock in the US	-3.3	-4.4	4.1	-0.8	-2.3	-0.1	-1.1	-1.5	1.4	-0.3	-0.8	-0.05
A negative demand shock in the US and the UK	-3.4	-4.7	4.1	-3.5	-4.2	2.8	-1.2	-1.7	1.4	-1.2	-1.5	1
A positive productivity shock in the US traded sector	1.3	-1.2	0.1*	-0.2	-0.9	0.5	1.6	-1.5	0.1	-0.3	-1	0.6

* The initial depreciation of the US real effective exchange rate is subsequently followed by an appreciation of 0.37%.

The interaction of global imbalances and monetary policy regimes has also been investigated. Markovic and Povoledo (2007) use a three-country model similar to the one used in this paper to analyse how the transmission of US shocks to Europe might be affected by Asia's choice of exchange rate regime. They find that when Asia pegs to the United States, the impact of US shocks on Europe is larger than otherwise, in line with our findings for the impact of US and ROW shocks on the United Kingdom in this paper. Ferrero *et al* (2008) find that the monetary policy regime has a bigger influence over the behaviour of domestic variables (such as inflation and output) compared to international variables (such as the current account and the real exchange rate).

In general, most analysis agrees on the directional impact of a US current account improvement on the US dollar real effective exchange rate, but unsurprisingly, there is a lot of uncertainty as to the likely quantitative impacts depending on the nature and calibration of each model.[17]

5 Conclusion

In this paper we have used a three-country DSGE model to analyse the effects of a number of shocks that could contribute to a further unwinding of global imbalances. First, we consider the effects of a positive domestic demand shock in the ROW, which here we interpret as broadly representing surplus countries. This shock is calibrated to lift ROW consumption by a similar amount to some of the larger increases in consumption seen in past episodes of current account surplus reversals, as studied by the IMF. Second, we consider the effects of a similarly sized shock that reduces US consumption. Finally, we consider the impact of a supply shock that raises US productivity relative to other countries.

Our results suggest that the demand shocks we analyse would be sufficient to close the US current account deficit at its end-2009 level. The supply shock in the United States, as calibrated, has a more modest impact on the US current account deficit. The results are not changed significantly when the ROW operates a nominal exchange rate peg with the United States. This is because inflation rates change to deliver equilibrating adjustments in real exchange rates in our model. In practice, however, sterilisation of any exchange rate interventions associated with maintaining a peg are likely to limit their effects on the domestic price level, at least in the short run.

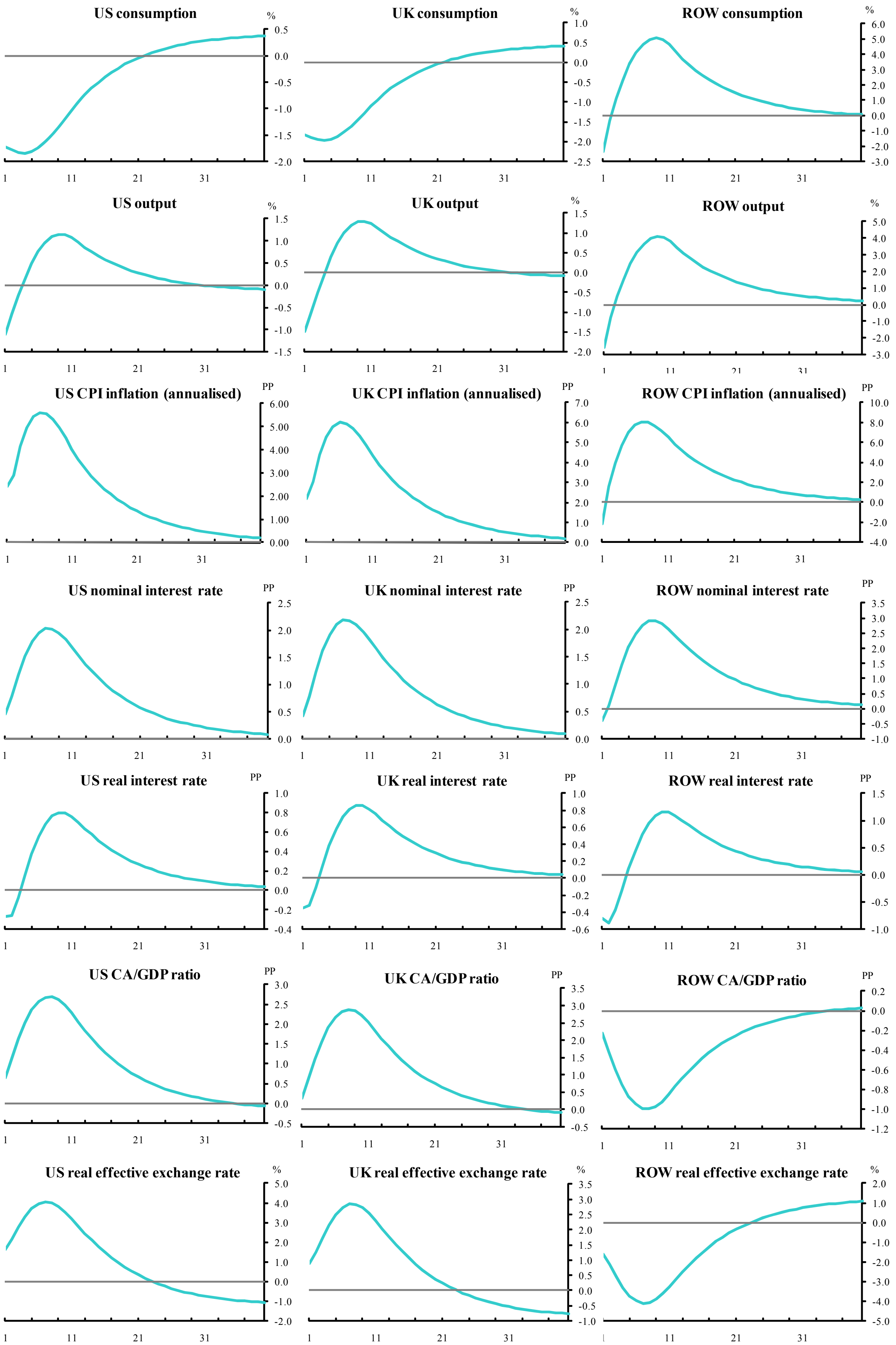
In all our simulations US saving must increase to unwind the current account deficit, but this does not necessarily imply a fall in US consumption. In particular, a positive productivity shock in the United States could raise both consumption and savings. The unwinding of global imbalances is likely to be followed by a rise in US output, unless it is to be brought about by a negative demand shock in the United States. This shock is also the only one which leads to a global fall in output. In all cases, the US real effective exchange rate has to depreciate, although in the case of the productivity shock to the US traded sector the initial depreciation is followed by an appreciation induced by the Balassa-Samuelson effect.

The implications for UK output and inflation and the sterling real effective exchange rate vary depending on the nature of the shock that drives global rebalancing. A rebalancing of surplus countries' demand towards consumption would boost UK output, though would raise inflationary pressures. This shock would be associated with a depreciation of the sterling real effective exchange rate. Further weakness in domestic demand in the United States would contribute to weaker output and inflation in the United Kingdom, and a real appreciation of sterling. Productivity gains in the United States, would lead the United Kingdom to import more

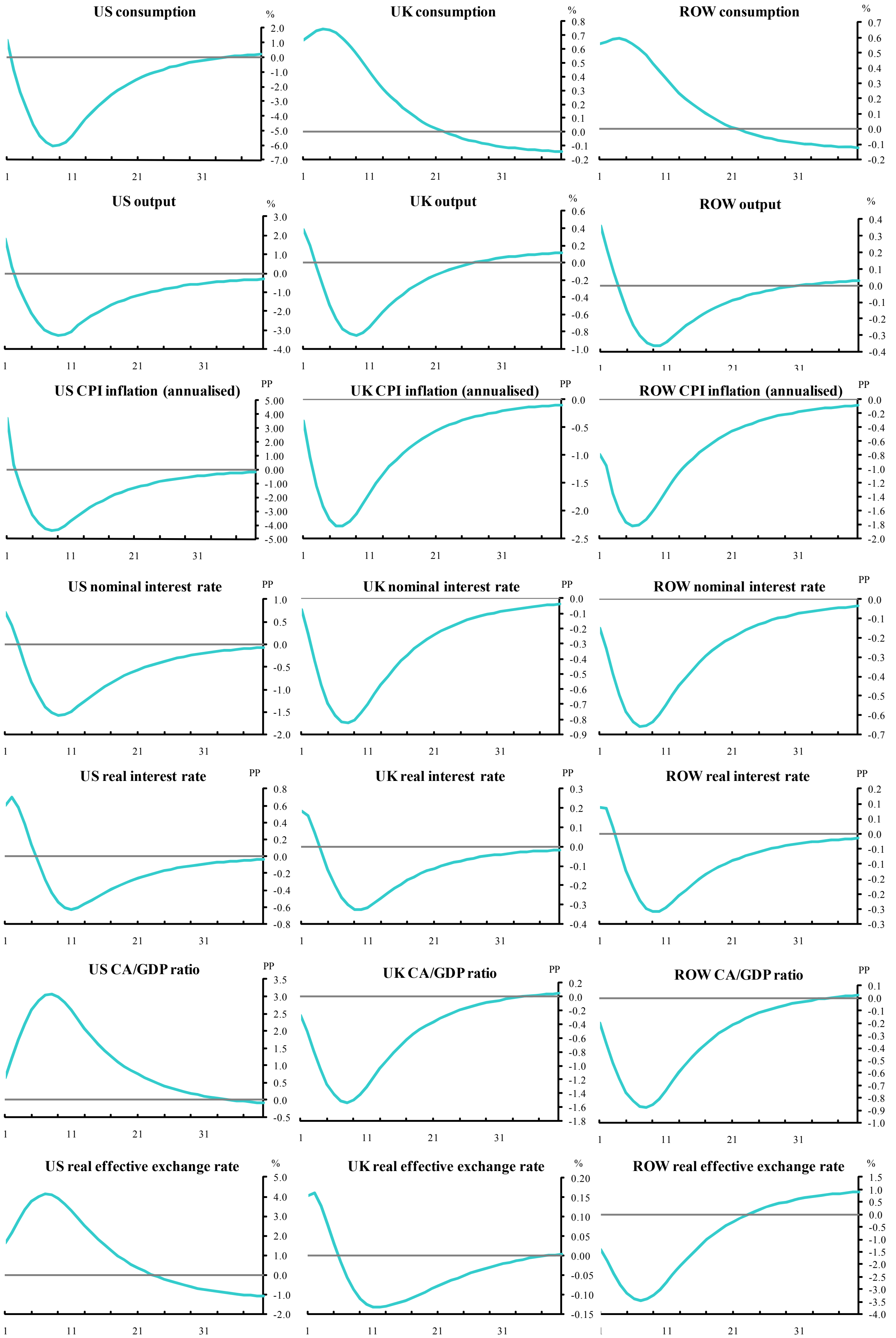
[17] Note also that since the model we use does not contain capital, direct comparisons of impulse responses to, say, productivity shocks with those from models that account for this adjustment channel need to be conducted with care.

US goods, weighing down on UK output. Inflationary pressures would also be reduced in this scenario, and there would be a real depreciation.

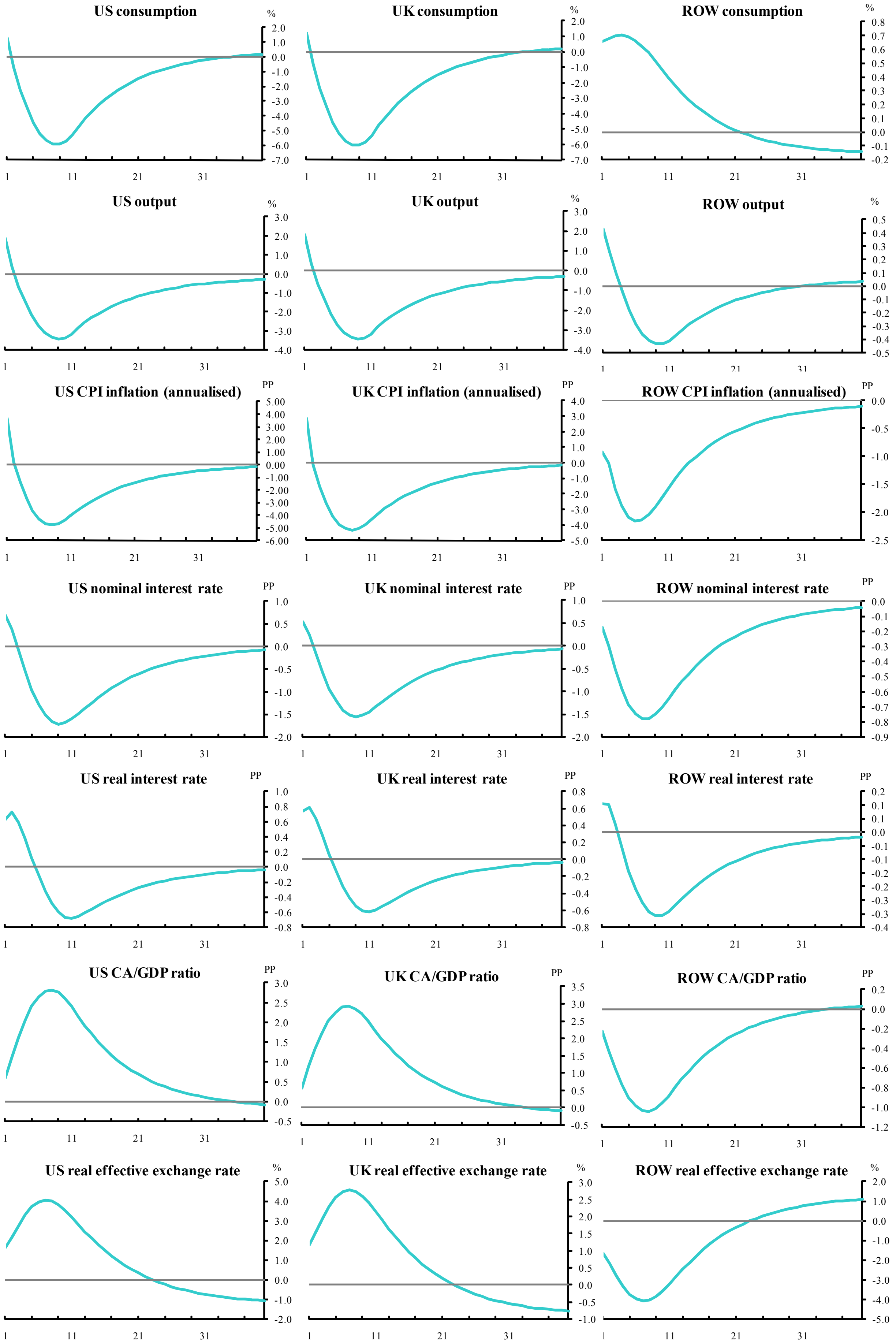
Appendix 1: Impulse responses to a positive demand shock in the rest of the world



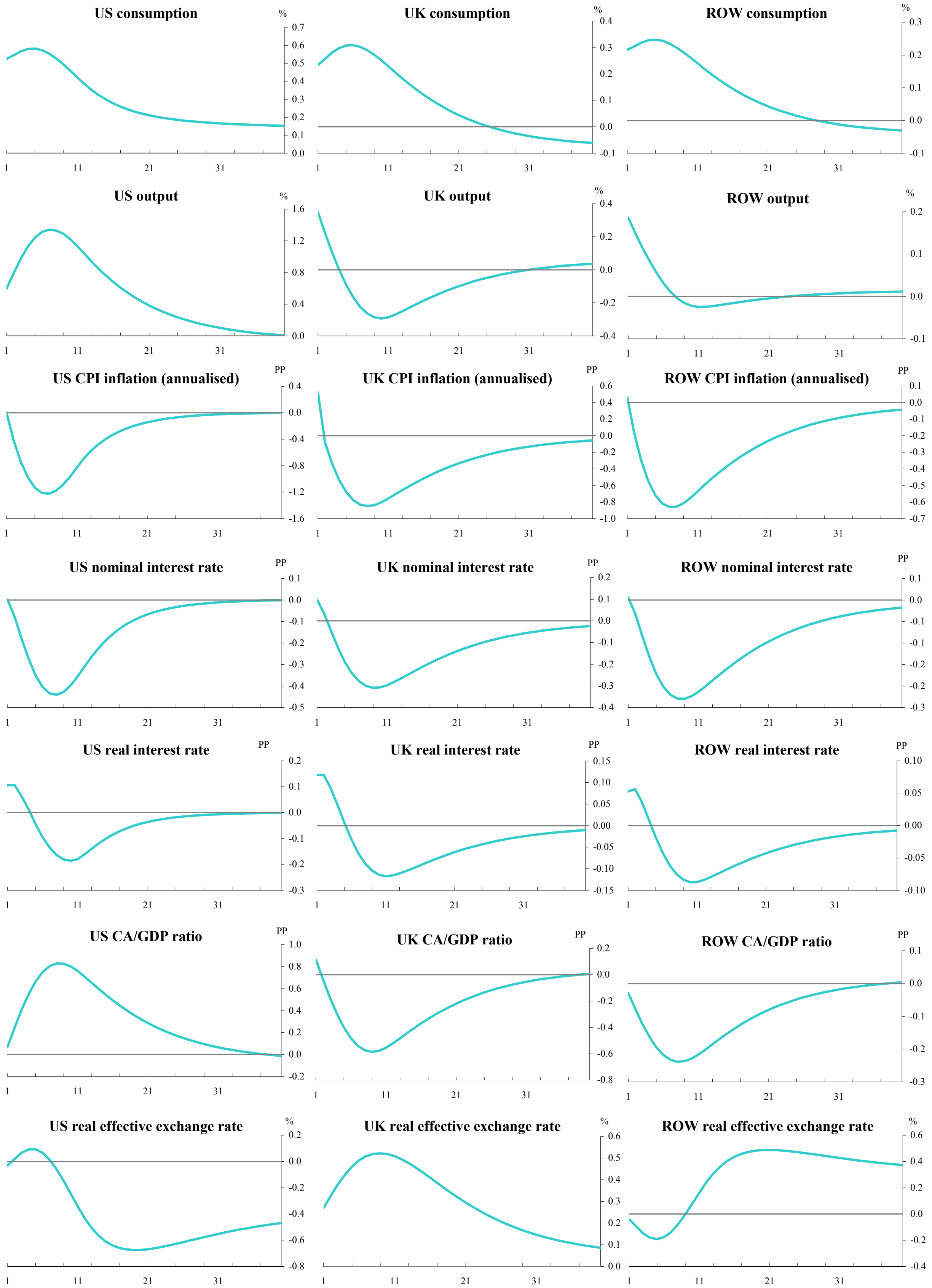
Appendix 2A: Impulse responses to a negative demand shock in the United States



Appendix 2B: Impulse responses to a negative demand shock in the US and the UK



Appendix 3: Impulse responses to a positive productivity shock in the US traded sector



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