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Morten Spange and Pawel Zabczyk

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Morten Spange[*]

and

Pawel Zabczyk[**]

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[*] Bank of England, Threadneedle Street, London, EC2R 8AH.
Email: morten.spange@bankofengland.co.uk

[**] Bank of England, Threadneedle Street, London, EC2R 8AH.
Email: pawel.zabczyk@bankofengland.co.uk

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Abstract

This paper investigates the potential implications for sterling of the US current account returning to balance. The analysis is conducted using a three-country model comprising the United Kingdom, the United States and a block that is meant to represent the rest of the world. The main conclusion from our analysis is that the potential implications for sterling of a US current account reversal are highly uncertain – one can derive a wide range of estimates for the potential changes. Estimates of the sterling adjustments are smaller than the implied movements in the dollar and depend heavily on (a) the cause of the US current account adjustment; (b) the assumptions one makes about the associated adjustment of the UK current account deficit; and (c) assumptions about key model parameters.

JEL classification: F31, F32, F41.

Summary

The US current account deficit reached a new high of 6.3% of GDP in 2004 Q4. The deficit is large in comparison with the current account balances of other countries and this has led a number of commentators to question its sustainability. This paper explores the potential implications for sterling of a restoration of the US current account deficit to balance. The analysis is based on a model calibrated to represent the United Kingdom, the United States and a third region covering the rest of the world. Different triggers that might bring about a realignment of the US current account deficit are considered. We begin by analysing the implications of a negative shock to US consumers' demand. In addition, we study a scenario in which such a demand shock is supplemented by a positive productivity shock in the US tradable sector – helping the United States bridge its trade deficit and so improving the current account. Finally, we also assess the impact of revaluation effects on international investment positions and how this affects the results.

Our analysis suggests that the magnitude of sterling adjustment depends heavily on (a) the cause of the US current account adjustment, ie the type of shock that brings it about; (b) the assumptions made about the associated adjustments of the United Kingdom and rest of the world current account deficits, ie how the adjustment to the US unwinding is split geographically; and (c) assumptions about key judgements such as the degree of substitutability between different types of goods (tradable and non-tradable) and goods produced in different regions.

Assuming that the UK current account deficit deteriorates in proportion to sterling's share in the dollar effective exchange rate index (ERI), we can derive estimates for movements in the sterling real effective ERI ranging from a depreciation of 1.4% to an appreciation of 4.2%, depending on different judgements about substitutability and the cause of the adjustment. If we assume that the dollar pegs maintained by a number of Asian economies result in a larger proportion of the adjustment falling on the United Kingdom, then the model generates estimates ranging from a depreciation of the sterling real ERI of 0.7% to an appreciation of 4.9%. However, in the event that all current accounts were to move to balance (implying a UK current account improvement) the model predicts a real ERI sterling depreciation in the range of 0.6% to 7.8%. It is important to note that the

exchange rate movements presented in this paper are a symptom of rebalancing global demand, and they are not associated with unemployment or recessions.

1 Introduction

The US current account (CA) deficit reached 6.3% of GDP in 2004 Q4. Although in the past other industrialised countries have run deficits of similar magnitudes, at least three features suggest that the current US experience is unique. First, since the United States is a relatively closed economy, the deficit amounts to more than 50% of total US exports. Second, as noted by Obstfeld and Rogoff (2005), the US deficit amounts to over 80% of the total reported surpluses of all countries in the world (ie it is very important internationally). Finally, data on investment returns suggest that the capital needed to finance the deficit has not been attracted by higher *ex-post* returns on US assets. For instance, despite US net foreign direct investment (FDI) being relatively small, the United States has continually profited from returns on gross FDI assets that have exceeded returns from foreign direct investment liabilities (enjoying net profits of approximately 1% of GDP annually). (1)

While it is true, as pointed out by Lane and Milesi-Ferretti (2004), that the global capital market has deepened in recent years, the current situation has nevertheless led a number of commentators to question the sustainability of the US deficit and spurred an intensive debate on the potential implications of a US current account unwinding – see for instance Obstfeld and Rogoff (2000), (2004), (2005), Roubini and Setser (2004), Blanchard *et al* (2005) and Kamin, Leduc and Croke (2005). In this paper we take a UK perspective and analyse the likely impact of a US current account reversal on the sterling-dollar and sterling effective real exchange rates.

Most of the analysis in the current literature has focused on the impact of a US current account deficit unwinding on the dollar. A view shared by many authors is that the return of the US current account deficit to sustainable levels is likely to be accompanied by a substantial dollar depreciation. For instance, Blanchard *et al* (2005) analyse a portfolio balance model in which exchange rates and the current account are jointly determined. They ask what exchange rate movements would restore the US current account deficit to balance and find that the dollar depreciation might be as large as 90%. The framework we adopt and the policy exercises we consider are based on Obstfeld and Rogoff (2004). Their

(1) It seems that the differences in returns cannot be solely explained by higher riskiness of US FDI (eg on account of investment in emerging markets). See also Box 1.2 in the IMF's Autumn 2005 *World Economic Outlook* for a discussion of related issues.

focus differs from that of Blanchard *et al*, as they analyse the likely exchange rate movements following an array of external shocks that rebalance the US current account. Obstfeld and Rogoff estimate a dollar depreciation of roughly 35% but suggest that the dollar might overshoot by twice that magnitude in the short to medium run.

To investigate the implications of a US current account unwinding for sterling, we extend the two-country Obstfeld and Rogoff model (2004) to three countries.[(2)] In the model, each country is assumed to be inhabited by a representative consumer that optimises his utility by consuming goods produced in all regions of the world. This gives rise to international trade and determines real exchange rates. We adapt a centre-periphery structure taken from Corsetti *et al* (2000) and calibrate the model to represent the United Kingdom, United States and the rest of the world (ROW). One advantage of the centre-periphery approach is that it allows us to assume that UK goods are closer substitutes with US goods than with goods produced in the ROW. We find this plausible given the relatively similar types of goods produced in the United Kingdom and United States.

We consider the same triggers that might bring about a realignment of the US current account deficit as Obstfeld and Rogoff (2004). Given the magnitude of the required adjustment, a fall in US demand - related to a rise in savings - is likely to be the only shock that, on its own, could close the current account. We also consider the implications of a scenario in which a demand shock is supplemented by a positive 5% productivity shock in the US tradable sector - helping the United States bridge its trade deficit and so improving the current account. Finally, we analyse the impact of revaluation effects on international investment positions. Since around 95% of US foreign liabilities are denominated in dollars, and approximately 65% of US foreign assets are denominated in other currencies, any dollar depreciation improves the US net foreign asset position and reduces the interest paid by the United States on its foreign debt.[(3)] This reduces the size of the demand shock needed to restore the current account to balance. To analyse the extent to which these effects impact on exchange rates and relative price comovements we conduct a third experiment in which valuation effects are taken into account.

(2) Obstfeld and Rogoff (2005) use a three-country framework (though slightly different from ours) to consider the implications of Asian dollar pegs on likely exchange rate movements.
(3) The numbers quoted come from Tille (2003). Gourinchas and Rey (2005) quote broadly similar values. See also Lane and Milesi-Ferretti (2001) for an analysis of net foreign asset positions for a number of countries.

Our results illustrate that estimates of the likely impact on sterling depend heavily on the assumptions one adopts about the adjustment of the UK current account and model parameters. Assuming that the UK current account deficit deteriorates in proportion to sterling's share in the dollar exchange rate index (ERI), a US current account reversal leads to a sterling real exchange rate appreciation of around 4% under our benchmark calibration. This result is not much altered by the addition of a supply shock or by consideration of revaluation effects. Under alternative assumptions about values of elasticities however, the sterling real appreciation following the demand shock ranges from 0.1% to 4.2%. Alternative assumptions about the extent to which the reduction in the US current account deficit affects the United Kingdom could result in appreciations of around 5%. However, in the event that all current accounts were to move to balance (implying a UK current account improvement) the model predicts a sterling real depreciation of around 3% under the benchmark calibration. Note that the exchange rate fluctuations found here are not associated with unemployment or recessions. Instead they are a symptom of a global rebalancing of demand.

The paper is structured as follows. In Sections 2 and 3 we set up the model and outline the calibration. We analyse and discuss the results in Section 4 and some concluding comments are offered in Section 5.

2 The model

We set up a static model consisting of three regions - the United Kingdom, the United States and the ROW. Each region is inhabited by a representative consumer who derives utility from consuming domestic and foreign goods. It is assumed that two main types of goods exist, namely goods that can be traded across countries and non-tradable goods that can only be consumed in the country in which they are produced. We follow the centre-periphery approach of Corsetti *et al* (2000) which allows us to set different elasticities of substitution between UK and US goods, and between UK/US goods and goods produced in the ROW. In the following we will refer to the United Kingdom as country A, the United States as country B, the ROW as country C and the aggregate of United Kingdom and United States as P. Specifically, the consumption bundle of country j is given by

$$C^j = \left[\alpha^{\frac{1}{\theta}}\left(C_T^j\right)^{\frac{\theta-1}{\theta}} + (1-\alpha)^{\frac{1}{\theta}}\left(C_N^j\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \quad ; \quad j \in \{A, B, C\}$$

where C_T^j and C_N^j denote country j's representative agent's consumption of tradable and non-tradable goods respectively. The parameter θ measures the elasticity of substitution between traded and non-traded goods while α denotes the weight that consumers put on the consumption of tradable goods. Minimising the cost of obtaining one unit of consumption leads to the usual consumer price indices:

$$P^j = \left[\alpha \left(P_T^j\right)^{1-\theta} + (1-\alpha)\left(P_N^j\right)^{1-\theta}\right]^{\frac{1}{1-\theta}} \quad ; \quad j \in \{A, B, C\}$$

where P_T^j and P_N^j are the prices of traded and non-traded goods in country j respectively.

To account for the fact that consumers have preferences for goods produced in all countries, tradable goods consumption can be decomposed as:

$$C_T^j = \left[\left(n_P \gamma_P^j\right)^{\frac{1}{\rho}} \left(C_P^j\right)^{\frac{\rho-1}{\rho}} + \left(1-\gamma_P^j n_P\right)^{\frac{1}{\rho}} \left(C_C^j\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}} \quad ; \quad j \in \{A, B\}$$

$$C_T^C = \left[\left(1-(1-n_P)\gamma_C^C\right)^{\frac{1}{\rho}} \left(C_P^C\right)^{\frac{\rho-1}{\rho}} + \left((1-n_P)\gamma_C^C\right)^{\frac{1}{\rho}} \left(C_C^C\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}$$

where C_P^j is the consumption of goods produced within the 'P'-block, composed of the United Kingdom and United States, by the representative agent in country j and C_C^j is the consumption aggregate of goods produced within the ROW. The coefficient n_P measures the size of the 'P'-block and $1-n_P$ denotes the size of the ROW. The parameter ρ captures the elasticity of substitution between goods produced in the 'P'-block and the ROW while the γ's are a measure of preference bias - ie the extent to which consumers prefer goods produced within a certain region. The case in which $\gamma_k^j > 1$ corresponds to positive bias as it implies that country j 's preferences for goods produced within region k are greater than justified by the size of region k. Again, the definitions of the consumption bundles lead to the following definitions of prices:

$$P_T^j = \left[n_P \gamma_P^j \left(P_P^j\right)^{1-\rho} + \left(1-\gamma_P^j n_P\right)\left(P_C^j\right)^{1-\rho}\right]^{\frac{1}{1-\rho}} \quad ; \quad j \in \{A, B\}$$

$$P_T^C = \left[\left(1-(1-n_P)\gamma_C^C\right)\left(P_P^C\right)^{1-\rho} + (1-n_P)\gamma_C^C \left(P_C^C\right)^{1-\rho}\right]^{\frac{1}{1-\rho}}$$

where P_P^j and P_C^j denote prices in country j of goods produced in the P-block and the ROW respectively. Finally, the aggregate US-UK bundle can be decomposed as follows:

$$C_P^A = \left[\left(n_A \gamma_A^A\right)^{\frac{1}{\psi}} \left(C_A^A\right)^{\frac{\psi-1}{\psi}} + \left(1-\gamma_A^A n_A\right)^{\frac{1}{\psi}} \left(C_B^A\right)^{\frac{\psi-1}{\psi}}\right]^{\frac{\psi}{\psi-1}}$$

$$C_P^B = \left[\left(1-(1-n_A)\gamma_B^B\right)^{\frac{1}{\psi}} \left(C_A^B\right)^{\frac{\psi-1}{\psi}} + \left((1-n_A)\gamma_B^B\right)^{\frac{1}{\psi}} \left(C_B^B\right)^{\frac{\psi-1}{\psi}}\right]^{\frac{\psi}{\psi-1}}$$

$$C_P^C = \left[\left(n_A \gamma_A^C\right)^{\frac{1}{\psi}} \left(C_A^C\right)^{\frac{\psi-1}{\psi}} + \left(1-n_A \gamma_A^C\right)^{\frac{1}{\psi}} \left(C_B^C\right)^{\frac{\psi-1}{\psi}}\right]^{\frac{\psi}{\psi-1}}$$

with the corresponding price indices:

$$P_P^A = \left[n_A \gamma_A^A \left(P_A^A\right)^{1-\psi} + \left(1 - \gamma_A^A n_A\right)\left(P_B^A\right)^{1-\psi}\right]^{\frac{1}{1-\psi}}$$

$$P_P^B = \left[\left(1 - \left(1 - n_A\right)\gamma_B^B\right)\left(P_A^B\right)^{1-\psi} + \left(1 - n_A\right)\gamma_B^B \left(P_B^B\right)^{1-\psi}\right]^{\frac{1}{1-\psi}}$$

$$P_P^C = \left[n_A \gamma_A^C \left(P_A^C\right)^{1-\psi} + \left(1 - n_A \gamma_A^C\right)\left(P_B^C\right)^{1-\psi}\right]^{\frac{1}{1-\psi}}$$

where ψ is the elasticity of substitution between goods produced in the United Kingdom and the United States and n^A is the relative size of country A in the P-block. Since the United Kingdom and the United States produce relatively similar types of goods it is reasonable to assume that their tradable goods are close substitutes relative to those produced in the ROW. Moreover, it seems plausible to assume that tradable goods produced in different countries are closer substitutes than tradable goods are with non-tradable goods. Hence, when conducting the analysis we shall assume that:

$$\psi \geq \rho \geq \theta$$

We define the bilateral terms of trade τ^A and τ^B and bilateral real exchange rates q^j as:

$$\tau^A = \frac{P_C^i}{P_A^i} \qquad \tau^B = \frac{P_C^i}{P_B^i} \qquad q^j = \frac{\varepsilon^j P^C}{P^j}$$

where ε^j denotes the nominal exchange rate between country j and C and $j \in \{A, B\}$, $i \in \{A, B, C\}$.(4) The law of one price is assumed to hold, but differences in consumer preferences and the existence of non-tradable goods will give rise to deviations from purchasing power parity.

To compute the effective terms of trade ETT and the real effective exchange rates $REER$ we use geometric averages, ie

$$ETT^i = \left(\frac{\tau^i}{\tau^j}\right)^{E_{i,j}} \left(\tau^i\right)^{1-E_{i,j}} \quad ; \quad REER^i = \left(\frac{q^i}{q^j}\right)^{E_{i,j}} \left(q^i\right)^{1-E_{i,j}}$$

where $E_{i,j}$ is the weight of country j's currency in country i's exchange rate index and $i, j \in \{A, B\}$. Unless otherwise specified, in the remainder of this paper we shall be focusing on changes in effective rather than bilateral variables. Note also that defining hatted variables as percentage changes leads to:

$$\widehat{ETT}^i = E_{i,j}\left(\widehat{\tau}^i - \widehat{\tau}^j\right) + \left(1 - E_{i,j}\right)\widehat{\tau}^i \quad ; \quad \widehat{REER}^i = E_{i,j}\left(\widehat{q}^i - \widehat{q}^j\right) + \left(1 - E_{i,j}\right)\widehat{q}^i$$

(4) Note that the real exchange rate between countries A and B would be given by: $\frac{q^A}{q^B}$.

The current accounts are defined as:

$$CA^j = P^j_j Y^j_T + iF^j - P^j_T C^j_T \tag{1}$$

where CA^j and F^j stand for country j's current account and stock of net foreign assets respectively (both in country j's home currency), Y^j_T denotes country j's tradable output, i is the interest rate and $j \in \{A, B\}$. We assume throughout that net trade and net financial assets add up to zero internationally, ie

$$CA^C = -\frac{1}{\varepsilon^A} CA^A - \frac{1}{\varepsilon^B} CA^B \quad ; \quad F^C = -\frac{1}{\varepsilon^A} F^A - \frac{1}{\varepsilon^B} F^B \tag{2}$$

In order to solve the model we assume CPI targeting in all three countries:

$$P^A = P^B = P^C = 1$$

which implies that nominal and real exchange rate movements will be identical and hence any exchange rate movements can be interpreted as both nominal and real.

To keep the model tractable, we additionally assume, in line with Obstfeld and Rogoff (2004), that output is exogenous, nominal prices are fully flexible and also that the interest rate i and net foreign asset positions F^j are exogenous.[(5)] With these assumptions in place the optimality of consumers' spending decisions makes it possible to derive values of the 'equilibrium' terms of trade τ^j , ratios of traded to non-traded goods prices $x^j = P^j_T / P^j_{NT}$ and real exchange rates q^j as functions of the Y's, CA's, F's and i. Full details of the procedure can be found in Appendix B.

3 Calibration

To calibrate the relative country size parameters (n's) we use shares of country GDP to world GDP. As a proxy for the world aggregate, we use the IMF measure of world output in US dollars at market exchange rates.[(6)] The relative sizes of the countries obtained using this method equal 5.2% for the United Kingdom, 28.9% for the United States, and 65.9% for the ROW.

When calibrating the preference bias parameters (γ's) we match empirically observed trade shares. The existence of six preference bias parameters allows us to calibrate six γ's

(5) Clearly, some of these simplifying assumptions are unrealistic. Consequently, in the remainder, we briefly speculate on the likely implications of relaxing them.
(6) We use the value for 2004 taken from the IMF *World Economic Outlook* (2005b).

independently. We can therefore ensure that the model implied ratios of imports to GDP for the United Kingdom, United States and ROW match those observed in the data - 28%, 12.5% and 4.5% respectively.[7] Additionally, our calibration ensures that the shares of UK, US and ROW imports coming from their respective trading partners match those observed in the data.

The parameter α, which measures the weight of tradable goods in consumption, is critical for our results. To obtain a sensible estimate of α, which, following Obstfeld and Rogoff (2004), we assume to be identical across countries, we use the UK 'input-output annual supply and use tables' compiled by the Office for National Statistics.[8] These tables provide a breakdown of GDP into 124 categories and give export and import penetration shares of each of these output groups. We define an output group as 'tradable' if either the import or export penetration share is greater than 10%. This leads to an estimate of the share of tradable goods of 36.8%, which is broadly in line with those reported by the IMF (2005a).[9]

For the elasticities of substitution between tradables and non-tradables and between tradable goods produced in different countries we use values taken from the literature. In what we will refer to as our benchmark calibration we take an elasticity of substitution between traded and non-traded goods (θ) of 1 and elasticities of substitution between goods produced in different countries (ψ and ρ) of 2. However, as significant uncertainty is associated with these numbers we report results for a range of elasticities.[10]

The initial current account positions are -6.3% of US GDP and -1.7% of UK GDP

(7) The ROW numbers are computed as a residual. See also Appendix C for more details.
(8) Note that with the shares of tradable goods being identical across countries, the preference bias parameters implicitly determine the openness of the countries.
(9) For the sake of comparability, note that the IMF estimate for the United States equals 32%. Similarly our ROW block consists of Japan (with an IMF estimate of α equal to 30%), euro area (30%), emerging Asia (61%) and the 'IMF' ROW (42%).
Our approach to calibrating the share of tradable goods resembles that discussed in Batini, Jackson and Nickell (2002), except that instead of using the sum of export and import penetrations as a threshold, we use the maximum of the two. Had we exactly followed their methodology, our estimate of α would have increased to 44.9%.
(10)Note that in the tables the elasticity of substitution between tradable and non-tradable goods never falls below one. In general, lowering that elasticity increases exchange rate movements associated with a current account reversal. Consequently the results we report can be treated as conservative estimates. Note also that even though the case of $\psi > \rho$ may be considered more plausible than $\psi = \rho$, we take the latter as our benchmark. This is done for consistency with Obstfeld and Rogoff (2004), where these two coefficients are equal by construction.

respectively. We assume that the nominal interest rate equals 5% for all countries. Arguably, this ignores the fact that the United States currently pays less interest on its liabilities than it earns on its assets. Despite this, the simplifying assumption can be shown to have negligible impact on the results, as the amount of interest proceeds is dwarfed by the size of total current account deficits.

To compute how exchange rate movements affect the value of net foreign assets we need data on the currency composition of the US and UK net international investment positions (NIIP). For the United States we rely on data from Tille (2004) which show that the US NIIP is made up of a US dollar net liability position of 66.1% of US GDP and net asset positions of 7.3% of GDP in sterling and 30.7% of GDP in other currencies.[(11)] To our knowledge, no comparable data exist for the United Kingdom. To derive the currency composition of outward foreign direct investment we therefore transform data on UK banks' outward FDI by country into a currency-based measure using the official IMF country currency classification (and taking account of exchange rate block arrangements and *de facto* pegs). As a proxy for the currency composition of portfolio and 'other' investment we used data on the currency composition of UK banks' external liabilities and claims (which excludes FDI). Finally, we also use existing data on the currency composition of UK official reserves. These sources suggest that the United Kingdom's net international investment position is composed of a net sterling liability position equal to 32.0% of UK GDP and net asset positions of 10.1% of GDP in US dollars and 19.7% in other currencies (adding up to a total of -2.2% of GDP at the end of 2003).[(12)]

Finally, to compute the sterling effective real exchange rate we use the dollar's weight in the new sterling ERI measure constructed by the Bank of England ($E_{A,B} = 17.5\%$),[(13)] while for the dollar we use sterling's weight in the dollar ERI provided by the Board of Governors of the Federal Reserve System ($E_{B,A} = 5.2\%$). An overview of the parameters can be found in Table O.

(11)The numbers had to be slightly re-scaled to account for the fact that we were consistently using the current cost and not the market value based measure which Tille reported (there was a 2 percentage points difference between the two measures at 2003).
(12)Note that the UK series is very volatile.
(13)For more details on how the measure is constructed see www.bankofengland.co.uk/publications/news/2005/045.htm (note that we use 2004 weights not reported therein).

4 Results

To evaluate the likely impact of an unwinding of the US current account deficit on exchange rates, we conduct three simulations. In the first, which we refer to as the 'demand shock' scenario, we assume that US consumers' demand is hit by a negative shock. Given fixed endowments, this leads the United States to lower its imports and increase its exports, thereby inducing a current account improvement without any impact on output. We assume that the magnitude of the shock is such that the US current account moves to zero, which allows us to set the current account exogenously.

In the second simulation, labelled the 'supply shock' scenario, output in the US tradable goods sector is assumed to increase by 5%. While this is significantly smaller than the 20% shock considered by Obstfeld and Rogoff (2004), it still exceeds the cumulated difference between de-trended GDP growth in the United States and the ROW during the 1990s IT boom.[14] The supply shock is assumed to be accompanied by a fall in US domestic demand of such magnitude that the US current account moves back to balance (ie the accompanying demand shock is smaller than in the previous exercise). Finally, in the third scenario we redo the demand shock while allowing exchange rate movements to revalue the US net foreign asset position.

When conducting all of these experiments in a three-country set up, we need to make an assumption about the behaviour of the UK current account. It turns out that this assumption is key for the results we derive. We consider four alternatives. In our benchmark case, we assume that a fraction of the US current account reversal equal to sterling's weight in the dollar ERI (5.2%) falls on the United Kingdom. This results in the UK current account deteriorating from -1.7% to -3.5% of UK GDP. For reference, note that over the period 1985 Q4 - 1991 Q1, when the last sizable improvement of the US current account took place (from -3.2% to 0.7% of US GDP) the UK current account deteriorated by 2.5 percentage points (from -0.1% to -2.4% of UK GDP). This change, though in all likelihood not entirely attributable to the improvement in the US CA position, was somewhat larger than our assumed UK benchmark current account adjustment.[15]

(14) Arguably, this period witnessed an unusually large discrepancy between US and ROW growth.
(15) As a caveat note that the 1991 observation may be blurred by transfers to the United States and United Kingdom meant to defray the costs of the first Gulf War.

Table A: Effect of return to balance of the US current account, demand shock

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**25.8**	**-0.3**	**-26.1**	**4.2**	**-26.1**
1	3	2	18.1	-2.7	-20.8	0.9	-20.7
1	3	3	21.1	-0.9	-22.0	3.0	-21.9
2	2	2	17.3	0.0	-17.3	3.0	-17.3
2	3	2	16.1	-3.3	-19.4	0.1	-19.3
2	3	3	13.3	-0.4	-13.7	2.0	-13.7

In the alternative scenarios, we assume first that all current account imbalances are resolved (ie the UK current account moves to zero), second that the entire adjustment falls on the rest of the world, implying that the UK current account deficit remains equal to 1.7% of GDP, and finally, that no adjustment falls on countries with exchange rates pegged to the dollar. In the latter case, since we do not explicitly model exchange rate pegs, we simply assume that current accounts of 'pegging' countries are insulated from exchange rate movements. As a result current accounts of the remaining countries have to adjust by more - eg the post-adjustment UK current account deficit increases to 3.9% of UK GDP. In what follows, we report and comment on the results for all three shocks under different parameterisations. (16)

4.1 Demand shock

As mentioned previously, in our benchmark case we assume that the UK current account deteriorates by 1.8 percentage points from -1.7% to -3.5% of GDP. For this to happen, UK goods must become relatively less attractive, which accounts for the resulting sterling appreciation. As can be seen from Table A, the sterling effective exchange rate appreciation amounts to 4.2% in the benchmark case. Under the assumption that goods produced in different regions are closer substitutes than in the benchmark scenario, the sterling appreciation associated with the current account adjustment is smaller (ranging from 0.1% to 4.2%).

(16)Note that under our assumption of CPI targeting all exchange rate changes reported in the tables and referred to in the text can be interpreted as both nominal and real.

Table B: Effect of return to balance of the US current account, demand shock, exchange rate decomposition

Value of θ	Value of ψ	Value of ρ	Change in UK nontradable to tradable price	Change in US nontradable to tradable price	Change in ROW nontradable to tradable price	Change in £ Terms of Trade	Change in $ Terms of Trade
1	**2**	**2**	**6.7**	**-20.3**	**7.6**	**3.6**	**-14.1**
1	3	2	3.1	-18.4	6.2	-1.8	-8.6
1	3	3	5.9	-18.7	7.5	2.3	-8.9
2	2	2	3.3	-10.2	3.8	3.6	-14.1
2	3	2	0.9	-10.2	3.7	-3.6	-16.9
2	3	3	2.9	-9.4	3.8	2.3	-8.9

From the UK perspective the elasticity of substitution between the United Kingdom and United States turns out to be of particular importance. If US goods are assumed to be more substitutable with UK goods than with goods produced in the ROW, the sterling appreciation is significantly smaller than in the benchmark case (compare line 2 to line 1 in Table A). This is because the assumed fall in US demand leads to an increased net supply of US goods and hence higher US exports. The higher net supply of US products needs to be absorbed by consumers in the United Kingdom and ROW. When US and UK goods are closer substitutes than US and ROW goods, consumers will primarily attempt to replace UK goods using US substitutes. This implies that to ensure that demand for UK products continues to equal supply, their relative price needs to fall. This is what causes the fall in UK terms of trade, and it is also the reason why this fall only occurs under asymmetric elasticity calibrations (lines 2 and 5 of Table B). Clearly, the resulting fall in UK terms of trade is also the driving force responsible for smaller sterling real exchange rate movements.

Note that the relatively modest effective sterling appreciation covers large movements in bilateral exchange rates with a £/ $ exchange rate appreciation of 25.8% in the benchmark case (ranging from 13.3% to 25.8% under the different parameter values). Also note that given symmetric elasticities the assumption that the US current account reversal falls proportionately on the United Kingdom and ROW implies that changes in the £/$ exchange rate are very similar to those in the ROW/$ exchange rate and consequently that there is little change in the £/ROW exchange rate.

From the US perspective, the terms of trade fall following the demand shock makes US-produced goods more attractive to foreigners. In addition, the fall in US consumers'

Table C: Effects of return to balance of the US current account, supply shock

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**24.1**	**-0.4**	**-24.5**	**3.9**	**-24.5**
1	3	2	19.1	-5.7	-24.8	-1.4	-24.5
1	3	3	18.9	-0.9	-19.8	2.6	-19.7
2	2	2	17.0	-0.1	-17.1	2.9	-17.1
2	3	2	17.7	-4.7	-22.5	-0.8	-22.2
2	3	3	12.5	-0.4	-12.9	1.9	-12.9

Table D: Effect of return to balance of the US current account, supply shock, exchange rate decomposition

Value of θ	Value of ψ	Value of ρ	Change in UK nontradable to tradable price	Change in US nontradable to tradable price	Change in ROW nontradable to tradable price	Change in £ Terms of Trade	Change in $ Terms of Trade
1	**2**	**2**	**6.8**	**-15.8**	**7.8**	**3.9**	**-15.9**
1	3	2	1.2	-15.3	7.4	-4.5	-16.7
1	3	3	6.0	-14.0	7.6	2.4	-10.0
2	2	2	3.4	-7.9	3.9	3.9	-15.9
2	3	2	0.2	-8.5	4.2	-5.5	-23.1
2	3	3	3.0	-7.0	3.8	2.4	-10.0

tradable goods consumption leads to a fall in the marginal utility of non-traded goods. This results in a fall in demand for non-traded goods. However, given fixed supply assumed in the model, consumption of non-traded goods cannot change (given that this is a static long-run analytical framework, such an assumption is clearly a strong restriction). It must therefore be the case that the relative price of non-traded goods falls in the United States to keep demand at a constant level. In the United Kingdom and the ROW opposite relative price movements occur. These relative price movements add to the dollar depreciation, which equals 26.1% under the benchmark calibration (and ranges from 13.7% to 26.1% under different values of elasticity parameters).

4.2 Supply shock

In the second experiment, a positive shock to US tradable goods productivity is assumed to increase the supply of US tradables by 5%. As can be seen from Table D, the resulting fall in US terms of trade is greater than in the pure 'demand shock' simulation - Table B. This

Table E: Effect of return to balance of the US current account, demand shock including revaluation effects

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**23.8**	**-0.3**	**-24.1**	**3.9**	**-24.1**
1	3	2	16.9	-2.5	-19.4	0.9	-19.3
1	3	3	19.7	-0.8	-20.5	2.8	-20.4
2	2	2	16.4	0.0	-16.4	2.8	-16.4
2	3	2	15.2	-3.1	-18.2	0.1	-18.1
2	3	3	12.8	-0.3	-13.1	2.0	-13.1

occurs because the quantity of goods that needs to be sold to the United Kingdom and the ROW increases - necessitating a bigger gain in competitiveness.[(17)] However, as the marginal utility of non-tradables is increasing in the consumption of tradables, the higher production of tradable goods also implies that the resulting fall in the marginal utility of non-tradable goods is now smaller. Consequently, the relative price of non-traded/traded goods does not have to fall by as much as in the purely demand-driven case. Therefore, although the terms of trade fall by more, the resulting real dollar depreciation (24.5% under the benchmark parametrisation) is smaller than without the increase in productivity (compare Table C to Table A). The benchmark sterling appreciation is consequently also a little smaller. In fact, in the calibrations with asymmetric elasticities (rows 2 and 5 of Table C), we now see a modest sterling depreciation. This is due to the fact that when UK goods are close substitutes with US goods then an increase in US supply pushes the relative price of UK goods down, which is reflected in falls in UK terms of trade in the relevant rows of Table D. Finally, a comparison of Tables C and A also shows that when the elasticities of substitution are symmetric, the added impact of a rise in US productivity on sterling is muted.

4.3 Revaluation effects

As pointed out previously, the dollar depreciation increases the dollar value of the US foreign asset position. Consequently, accounting for revaluation effects improves the US current account by reducing net interest payments. Therefore, regardless of the exact

(17)This is a standard result in the literature, see eg Benigno and Thoenissen (2003).

calibration, revaluation effects reduce the movements in the terms of trade and the exchange rate associated with the adjustment. However, since interest payments constitute a relatively minor fraction of overall current account imbalances, the effect on the results is small. As shown in Table E, the estimated sterling appreciation ranges from 0.1% to 3.9%, which is very similar to the 0.1% to 4.2% range reported in Section 4.1. We also make an attempt to include valuation effects of the United Kingdom's net foreign investment position in our calculations, but this turns out to have negligible impact on the results.

Some papers, such as for instance Gourinchas and Rey (2005), have found revaluation effects to be more important. Our analysis suggests that although revaluation effects have a relatively large impact on the net foreign asset position, this does not correspond to a large impact on the current account. The reason for this is that when computing the effect on the current account, the sizable shift in the net foreign asset position gets multiplied by the 5% interest paid on foreign liabilities, which significantly reduces its impact.

4.4 Alternative scenarios

In this section we investigate the sensitivity of our results to the assumption made about the evolution of the UK current account (which deteriorates from -1.7% of GDP to -3.5% of GDP in the benchmark case). We consider three alternative scenarios. In the first, we assume that all current accounts go to zero (ie we consider a global rebalancing shock). In the second, the UK current account remains at its pre-shock level. Finally, in the third scenario we make some allowance for the fact that current accounts of countries pegging to the dollar are relatively insulated from exchange rate adjustments. This implies that a relatively larger fraction of the US current account reversal falls on the United Kingdom and results in an increase in the implied UK current account deterioration to 3.9% of GDP. The results for our three canonical exercises (demand, supply and revaluation shock) are reported in Tables F to N in Appendix A and are discussed below.

In the case in which all current account imbalances are resolved we find that rather than appreciate, the sterling effective exchange rate depreciates. The reason for this is that the UK current account is now assumed to improve from its initial deficit. Similar to the United States, a UK current account improvement is associated with a depreciation. Once again, however, there is a wide range of potential outcomes depending on the character of the shock and the model parameters. Tables F, I and L show a range of possible sterling depreciations between 0.6% and 7.8%.

The case in which the UK current account deficit is unaffected is an intermediate one. The implications for sterling are thus between those of the benchmark and global rebalancing exercises (see Tables G, J and M).

Finally, in the case in which the potential effect of the dollar-pegged currencies is taken into account, the sterling appreciation is likely to be larger than in the benchmark exercises (compare Tables H, K and N with A, C and E respectively). We also note that because the United Kingdom is so small (in particular it never accommodates more than 3.9% of the US CA adjustment), whatever happens in the United Kingdom does not have material implications for the dollar ERI.

5 Concluding remarks

Summing up, we find that the model is able to generate a wide range of responses of the sterling real exchange rate to a US current account reversal. Importantly, as these are symptoms of a rebalancing of global demand, they are not associated with unemployment or recessions. Taking a closer look at the numbers it turns out that in particular the assumptions made about the 'post shock' behaviour of the UK current account are quantitatively important for the sterling depreciation (alternatively this can be seen as an assumption on the way in which the US current account reversal is split between the United Kingdom and the ROW). In fact, the question of how much of the US current account reversal falls on the United Kingdom seems to be more important for sterling than the issue of whether the rebalancing is associated with a shock to US productivity or is purely demand driven. Finally, for all the shocks considered, we find that the effective dollar depreciation is (a) much larger than the movements in the sterling effective exchange rate; and (b) relatively insensitive to assumptions about how the adjustment is split between the United Kingdom and the ROW.

An important limitation of the present model is that supply is exogenous. Among other things this implies that the Balassa-Samuelson effect is absent. In a more realistic model higher productivity in the tradable sector would drive up wages, which would put upward pressure on the price of non-tradable goods. This would reverse the relative fall in the price of tradable goods in the case of a productivity shock, which would then limit the extent of the dollar depreciation. Also in the case in which productivity is held constant, labour mobility would limit the extent to which the relative price of non-tradable and tradable goods would be able to adjust.

In addition to the absence of important supply-side factors, the model completely abstracts from dynamics. The results presented should thus be interpreted as long-run results, ie how things will look after all adjustments have taken place. Assuming that the pass-through from nominal exchange rates to prices is less than perfect in the medium term, the shorter-term nominal exchange rate movements may be bigger than those reported in this paper. However, it has also been argued that a 3% of GDP current account deficit would be sustainable for the United States in the medium term. If this is correct, current account adjustments might well be smaller than assumed here and so the associated exchange rate movements would also be smaller.

The model also abstracts from financial market linkages. It is assumed that there is a fixed nominal interest rate applying to all internationally traded assets. In a more realistic framework interest rates would move in response to exchange rate fluctuations. This would spill back on exchange rates through uncovered interest rate parity and through the effect of interest rate movements on aggregate demand. Moreover, whereas it is often argued that exchange rates reflect factors other than 'fundamentals' we abstract from all such considerations leaving them for potential future extensions.

Appendix A - Tables

Table F: Effects of a demand shock, all current accounts balanced

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**19.3**	**-7.3**	**-26.6**	**-2.7**	**-26.2**
1	3	2	12.1	-9.3	-21.3	-5.5	-20.8
1	3	3	14.9	-7.6	-22.4	-3.7	-22.1
2	2	2	13.9	-3.7	-17.6	-0.6	-17.4
2	3	2	12.9	-6.9	-19.8	-3.5	-19.5
2	3	3	10.1	-3.8	-13.9	-1.4	-13.7

Table G: Effects of a demand shock, UK current account unaffected

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**22.5**	**-3.9**	**-26.4**	**0.8**	**-26.2**
1	3	2	15.1	-6.0	-21.1	-2.3	-20.8
1	3	3	18.0	-4.2	-22.2	-0.3	-22.0
2	2	2	15.6	-1.9	-17.5	1.2	-17.4
2	3	2	14.5	-5.1	-19.6	-1.7	-19.4
2	3	3	11.7	-2.1	-13.8	0.3	-13.7

Table H: Effects of a demand shock, UK current account adjusts more than proportionally

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**26.5**	**0.4**	**-26.1**	**4.9**	**-26.1**
1	3	2	18.7	-2.1	-20.8	1.5	-20.7
1	3	3	21.8	-0.2	-21.9	3.7	-21.9
2	2	2	17.6	0.3	-17.3	3.4	-17.3
2	3	2	16.5	-2.9	-19.4	0.5	-19.2
2	3	3	13.7	0.0	-13.7	2.4	-13.7

Table I: Effects of a supply shock, all current accounts balanced

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**17.6**	**-7.4**	**-25.0**	**-3.0**	**-24.6**
1	3	2	13.1	-12.2	-25.3	-7.8	-24.7
1	3	3	12.6	-7.6	-20.2	-4.1	-19.8
2	2	2	13.6	-3.7	-17.3	-0.7	-17.1
2	3	2	14.5	-8.4	-22.9	-4.4	-22.4
2	3	3	9.3	-3.8	-13.2	-1.5	-13.0

Table J: Effects of a supply shock, UK current account unaffected

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**20.9**	**-3.9**	**-24.7**	**0.5**	**-24.5**
1	3	2	16.1	-9.0	-25.1	-4.6	-24.6
1	3	3	15.7	-4.3	-20.0	-0.8	-19.8
2	2	2	15.3	-1.9	-17.2	1.1	-17.1
2	3	2	16.1	-6.6	-22.7	-2.6	-22.3
2	3	3	10.9	-2.1	-13.0	0.2	-12.9

Table K: Effects of a supply shock, UK current account adjusts more than proportionally

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**24.8**	**0.4**	**-24.5**	**4.6**	**-24.5**
1	3	2	19.7	-5.0	-24.8	-0.7	-24.5
1	3	3	19.5	-0.2	-19.7	3.3	-19.7
2	2	2	17.3	0.3	-17.0	3.3	-17.1
2	3	2	18.1	-4.4	-22.4	-0.5	-22.2
2	3	3	12.9	0.0	-12.9	2.2	-12.9

Table L: Effects of a demand shock accounting for revaluation effects, all current accounts balanced

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**17.1**	**-7.3**	**-24.4**	**-3.0**	**-24.0**
1	3	2	10.8	-9.0	-19.8	-5.5	-19.3
1	3	3	13.4	-7.5	-20.8	-3.8	-20.4
2	2	2	12.9	-3.7	-16.6	-0.8	-16.4
2	3	2	11.9	-6.7	-18.6	-3.4	-18.2
2	3	3	9.5	-3.8	-13.3	-1.5	-13.1

Table M: Effects of a demand shock accounting for revaluation effects, UK current account unaffected

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**20.4**	**-3.8**	**-24.2**	**0.4**	**-24.0**
1	3	2	13.8	-5.7	-19.6	-2.3	-19.3
1	3	3	16.5	-4.1	-20.7	-0.5	-20.4
2	2	2	14.7	-1.9	-16.5	1.0	-16.4
2	3	2	13.5	-4.9	-18.4	-1.7	-18.2
2	3	3	11.2	-2.1	-13.2	0.2	-13.1

Table N: Effects of a demand shock accounting for revaluation effects, UK current account adjusts more than proportionally

ELASTICITY OF SUBSTITUTION PARAMETERS			IMPACT ON BILATERAL EXCHANGE RATES			IMPACT ON EFFECTIVE EXCHANGE RATES	
Value of θ	Value of ψ	Value of ρ	Change in £/$ Exch. Rate	Change in £/RoW Exch. Rate	Change in $/RoW Exch. Rate	Change in £ Eff. Exch. Rate	Change in $ Eff. Exch. Rate
1	**2**	**2**	**24.4**	**0.4**	**-24.0**	**4.6**	**-24.1**
1	3	2	17.5	-1.9	-19.4	1.5	-19.3
1	3	3	20.3	-0.1	-20.4	3.5	-20.4
2	2	2	16.7	0.3	-16.4	3.2	-16.4
2	3	2	15.5	-2.7	-18.2	0.5	-18.1
2	3	3	13.1	0.0	-13.1	2.3	-13.1

Table O: Calibration (see also Appendices B and C for details)

DATA					
Initial Current Account Positions			Initial Net Foreign Asset Positions		Nominal Interest Rate
UK CA	US CA		UK NFA	US NFA	
-1.7%	-6.3%		-2.2%	-22.1%	5%
ca^{A}	ca^{B}		f^{A}	f^{B}	
-0.046	-0.169		-0.059	-0.597	
SIZE PARAMETERS			PREFERENCE BIAS		
Relative Size of the UK	Relative Size of the US	Relative Size of the ROW	US Weight on US Goods	US Weight on UK Goods	US Weight on ROW Goods
5.0%	30.4%	64.6%	0.69	0.01	0.30
PREFERENCE BIAS					
UK Weight on US Goods	UK Weight on UK Goods	UK Weight on ROW Goods	ROW Weight on US Goods	ROW Weight on UK Goods	ROW Weight on ROW Goods
0.09	0.24	0.68	0.08	0.04	0.88
PARAMETER VALUES					
α	n_{P}	n_{A}	γ_{A}^{A}	γ_{B}^{B}	γ_{C}^{C}
0.370	0.341	0.153	4.898	1.162	1.332
			γ_{P}^{A}	γ_{P}^{B}	γ_{A}^{C}
			0.949	1.973	2.309

Appendix B - Derivations

This appendix outlines the procedure used to solve the model.

Optimal behaviour by the agent leads to the following demand equations for tradable goods:

$$\begin{aligned}
Y_T^A &= n_A\gamma_A^A n_P\gamma_P^A \alpha n_A n_P \left(\frac{P_A^A}{P_P^A}\right)^{-\psi}\left(\frac{P_P^A}{P_T^A}\right)^{-\rho}\left(\frac{P_T^A}{P^A}\right)^{-\theta} C^A \\
&+ \left(1-(1-n_A)\gamma_B^B\right) n_P\gamma_P^B \alpha (1-n_A) n_P \left(\frac{P_A^B}{P_P^B}\right)^{-\psi}\left(\frac{P_P^B}{P_T^B}\right)^{-\rho}\left(\frac{P_T^B}{P^B}\right)^{-\theta} C^B \\
&+ n_A\gamma_A^C\left(1-(1-n_P)\gamma_C^C\right)\alpha(1-n_P)\left(\frac{P_A^C}{P_P^C}\right)^{-\psi}\left(\frac{P_P^C}{P_T^C}\right)^{-\rho}\left(\frac{P_T^C}{P^C}\right)^{-\theta} C^C \\
Y_T^B &= \left(1-\gamma_A^A n_A\right) n_P\gamma_P^A \alpha n_A n_P \left(\frac{P_B^A}{P_P^A}\right)^{-\psi}\left(\frac{P_P^A}{P_T^A}\right)^{-\rho}\left(\frac{P_T^A}{P^A}\right)^{-\theta} C^A \\
&+ (1-n_A)\gamma_B^B n_P\gamma_P^B \alpha (1-n_A) n_P \left(\frac{P_B^B}{P_P^B}\right)^{-\psi}\left(\frac{P_P^B}{P_T^B}\right)^{-\rho}\left(\frac{P_T^B}{P^B}\right)^{-\theta} C^B \\
&+ \left(1-\gamma_A^C n_A\right)\left(1-(1-n_P)\gamma_C^C\right)\alpha(1-n_P)\left(\frac{P_B^C}{P_P^C}\right)^{-\psi}\left(\frac{P_P^C}{P_T^C}\right)^{-\rho}\left(\frac{P_T^C}{P^C}\right)^{-\theta} C^C \\
Y_T^C &= \left(1-\gamma_P^A n_P\right)\alpha n_A n_P \left(\frac{P_C^A}{P_T^A}\right)^{-\rho}\left(\frac{P_T^A}{P^A}\right)^{-\theta} C^A \\
&+ \left(1-\gamma_P^B n_P\right)\alpha (1-n_A) n_P \left(\frac{P_C^B}{P_T^B}\right)^{-\rho}\left(\frac{P_T^B}{P^B}\right)^{-\theta} C^B \\
&+ (1-n_P)\gamma_C^C \alpha (1-n_P)\left(\frac{P_C^C}{P_T^C}\right)^{-\rho}\left(\frac{P_T^C}{P^C}\right)^{-\theta} C^C \\
Y_N^A &= (1-\alpha) n_P n_A \left(\frac{P_N^A}{P^A}\right)^{-\theta} C^A \\
Y_N^B &= (1-\alpha) n_P (1-n_A)\left(\frac{P_N^B}{P^B}\right)^{-\theta} C^B \\
Y_N^C &= (1-\alpha)(1-n_P)\left(\frac{P_N^C}{P^C}\right)^{-\theta} C^C
\end{aligned}$$

Now, defining:

$$\begin{aligned}
\Psi_T^A &\equiv n_P\gamma_P^A & \Psi_T^B &\equiv n_P\gamma_P^B & \Psi_T^C &\equiv (1-n_P)\gamma_C^C \\
\Psi_P^A &\equiv n_A\gamma_A^A & \Psi_P^B &\equiv (1-n_A)\gamma_B^B & \Psi_P^C &\equiv n_A\gamma_A^C
\end{aligned}$$

and:

$$\Xi_{TA,A} \equiv \Psi_P^A \Psi_T^A \qquad \Xi_{TA,B} \equiv \left(1-\Psi_P^B\right)\Psi_T^B \frac{(1-n_A)}{n_A} \qquad \Xi_{TA,C} \equiv \Psi_P^C\left(1-\Psi_T^C\right)\frac{1-n_P}{n_A n_P}$$

$$\Xi_{TB,A} \equiv \left(1-\Psi_P^A\right)\frac{n_A \Psi_T^A}{(1-n_A)} \qquad \Xi_{TB,C} \equiv \left(1-\Psi_P^C\right)\left(1-\Psi_T^C\right)\frac{1-n_P}{(1-n_A)\,n_P} \qquad \Xi_{TB,B} \equiv \Psi_P^B \Psi_T^B$$

$$\Xi_{TC,A} \equiv \left(1-\Psi_T^A\right)\frac{n_A n_P}{(1-n_P)} \qquad \Xi_{TC,B} \equiv \left(1-\Psi_T^B\right)\frac{(1-n_A)\,n_P}{(1-n_P)} \qquad \Xi_{TC,C} \equiv \Psi_T^C$$

allows us to write:

$$Y_T^A = \alpha n_P n_A \Bigg[\Xi_{TA,A}\left(\frac{P_A^A}{P_P^A}\right)^{-\psi}\left(\frac{P_P^A}{P_T^A}\right)^{-\rho}\left(\frac{P_T^A}{P^A}\right)^{-\theta} C^A + \Xi_{TA,B}\left(\frac{P_A^B}{P_P^B}\right)^{-\psi}\left(\frac{P_P^B}{P_T^B}\right)^{-\rho}\left(\frac{P_T^B}{P^B}\right)^{-\theta} C^B + \Xi_{TA,C}\left(\frac{P_A^C}{P_P^C}\right)^{-\psi}\left(\frac{P_P^C}{P_T^C}\right)^{-\rho}\left(\frac{P_T^C}{P^C}\right)^{-\theta} C^C\Bigg] \quad \textbf{(B-1)}$$

$$Y_T^B = \alpha n_P (1-n_A) \Bigg[\Xi_{TB,A}\left(\frac{P_B^A}{P_P^A}\right)^{-\psi}\left(\frac{P_P^A}{P_T^A}\right)^{-\rho}\left(\frac{P_T^A}{P^A}\right)^{-\theta} C^A + \Xi_{TB,B}\left(\frac{P_B^B}{P_P^B}\right)^{-\psi}\left(\frac{P_P^B}{P_T^B}\right)^{-\rho}\left(\frac{P_T^B}{P^B}\right)^{-\theta} C^B + \Xi_{TB,C}\left(\frac{P_B^C}{P_P^C}\right)^{-\psi}\left(\frac{P_P^C}{P_T^C}\right)^{-\rho}\left(\frac{P_T^C}{P^C}\right)^{-\theta} C^C\Bigg] \quad \textbf{(B-2)}$$

$$Y_T^C = \alpha (1-n_P) \Bigg[\Xi_{TC,A}\left(\frac{P_C^A}{P_T^A}\right)^{-\rho}\left(\frac{P_T^A}{P^A}\right)^{-\theta} C^A + \Xi_{TC,B}\left(\frac{P_C^B}{P_T^B}\right)^{-\rho}\left(\frac{P_T^B}{P^B}\right)^{-\theta} C^B + \Xi_{TC,C}\left(\frac{P_C^C}{P_T^C}\right)^{-\rho}\left(\frac{P_T^C}{P^C}\right)^{-\theta} C^C\Bigg] \quad \textbf{(B-3)}$$

$$Y_N^A = (1-\alpha)\, n_P n_A \left(\frac{P_N^A}{P^A}\right)^{-\theta} C^A \quad \textbf{(B-4)}$$

$$Y_N^B = (1-\alpha)\, n_P (1-n_A) \left(\frac{P_N^B}{P^B}\right)^{-\theta} C^A \quad \textbf{(B-5)}$$

$$Y_N^C = (1-\alpha)(1-n_P) \left(\frac{P_N^C}{P^C}\right)^{-\theta} C^C \quad \textbf{(B-6)}$$

For future reference we note that:

$$q^i = \frac{\varepsilon^i P^C}{P^i} = \frac{\varepsilon^i \left[\alpha\left(P_T^C\right)^{1-\theta} + (1-\alpha)\left(P_N^C\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\alpha\left(P_T^i\right)^{1-\theta} + (1-\alpha)\left(P_N^i\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}$$

$$= \frac{\varepsilon^i P_T^C}{P_T^i} \times \frac{\left[\alpha + (1-\alpha)\left(\frac{P_N^C}{P_T^C}\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}{\left[\alpha + (1-\alpha)\left(\frac{P_N^i}{P_T^i}\right)^{1-\theta}\right]^{\frac{1}{1-\theta}}}, \quad i \in \{A, B\} \quad \textbf{(B-7)}$$

and that simple substitutions yield:

$$\frac{\varepsilon^{i}P_{T}^{C}}{P_{T}^{i}}=\frac{\left[\left(1-\Psi_{T}^{C}\right)\left[\Psi_{P}^{C}\left(\tau^{i}\right)^{-(1-\psi)}+\left(1-\Psi_{P}^{C}\right)\left(\tau^{j}\right)^{-(1-\psi)}\right]^{\frac{1-\rho}{1-\psi}}+\Psi_{T}^{C}\right]^{\frac{1}{1-\rho}}}{\left[\Psi_{T}^{i}\left[\Psi_{P}^{i}\left(\tau^{i}\right)^{-(1-\psi)}+\left(1-\Psi_{P}^{i}\right)\left(\tau^{j}\right)^{-(1-\psi)}\right]^{\frac{1-\rho}{1-\psi}}+\left(1-\Psi_{T}^{i}\right)\right]^{\frac{1}{1-\rho}}} \quad \textbf{(B-8)}$$

where $i,j\in\{A,B\}$ and $i\neq j$. Inserting the definitions of the current accounts **(1)** and **(2)** into the goods market equilibrium conditions **(B-1)**, **(B-2)**, **(B-3)**, **(B-4)**, **(B-5)** and **(B-6)**, gives us:

$$\begin{aligned}
P_{A}^{A}Y_{T}^{A}=&\Xi_{TA,A}\left(P_{P}^{A}\right)^{\psi-\rho}\left(\frac{P_{A}^{A}}{P_{T}^{A}}\right)^{1-\rho}\left[P_{A}^{A}Y_{T}^{A}+iF^{A}-CA^{A}\right]\\
&+\frac{n_{A}}{1-n_{A}}\Xi_{TA,B}\left(P_{P}^{B}\right)^{\psi-\rho}\left(\frac{P_{A}^{B}}{P_{T}^{B}}\right)^{1-\rho}\frac{\varepsilon^{A}}{\varepsilon^{B}}\left[P_{B}^{B}Y_{T}^{B}+iF^{B}-CA^{B}\right]\\
&+\frac{n_{P}n_{A}}{1-n_{P}}\Xi_{TA,C}\left(P_{P}^{C}\right)^{\psi-\rho}\left(\frac{P_{A}^{C}}{P_{T}^{C}}\right)^{1-\rho}\varepsilon^{A}\left[P_{C}^{C}Y_{T}^{C}+\left\{\frac{1}{\varepsilon^{A}}CA^{A}+\frac{1}{\varepsilon^{B}}CA^{B}-i\left(\frac{F^{A}}{\varepsilon^{A}}+\frac{F^{B}}{\varepsilon^{B}}\right)\right\}\right]\\
P_{N}^{A}Y_{N}^{A}=&\frac{1-\alpha}{\alpha}\left(\frac{P_{N}^{A}}{P_{T}^{A}}\right)^{1-\theta}\left[P_{A}^{A}Y_{T}^{A}+iF^{A}-CA^{A}\right]\\
P_{B}^{B}Y_{T}^{B}=&\frac{1-n_{A}}{n_{A}}\Xi_{TB,A}\left(P_{P}^{A}\right)^{\psi-\rho}\left(\frac{P_{B}^{A}}{P_{T}^{A}}\right)^{1-\rho}\frac{\varepsilon^{B}}{\varepsilon^{A}}\left[P_{A}^{A}Y_{T}^{A}+iF^{A}-CA^{A}\right]\\
&+\Xi_{TB,B}\left(P_{P}^{B}\right)^{\psi-\rho}\left(\frac{P_{B}^{B}}{P_{T}^{B}}\right)^{1-\rho}\left[P_{B}^{B}Y_{T}^{B}+iF^{B}-CA^{B}\right]\\
&+\frac{n_{P}\left(1-n_{A}\right)}{1-n_{P}}\Xi_{TB,C}\left(P_{P}^{C}\right)^{\psi-\rho}\left(\frac{P_{B}^{C}}{P_{T}^{C}}\right)^{1-\rho}\\
&\times\varepsilon^{B}\left[P_{C}^{C}Y_{T}^{C}+\left\{\frac{1}{\varepsilon^{A}}CA^{A}+\frac{1}{\varepsilon^{B}}CA^{B}-i\left(\frac{F^{A}}{\varepsilon^{A}}+\frac{F^{B}}{\varepsilon^{B}}\right)\right\}\right]\\
P_{N}^{B}Y_{N}^{B}=&\frac{1-\alpha}{\alpha}\left(\frac{P_{N}^{B}}{P_{T}^{B}}\right)^{1-\theta}\left[P_{B}^{B}Y_{T}^{B}+iF^{B}-CA^{B}\right]\\
P_{C}^{C}Y_{T}^{C}=&\frac{1-n_{P}}{n_{P}n_{A}}\Xi_{TC,A}\left(\frac{P_{C}^{A}}{P_{T}^{A}}\right)^{1-\rho}\frac{1}{\varepsilon^{A}}\left[P_{A}^{A}Y_{T}^{A}+iF^{A}-CA^{A}\right]\\
&+\frac{1-n_{P}}{n_{P}\left(1-n_{A}\right)}\Xi_{TC,B}\left(\frac{P_{C}^{B}}{P_{T}^{B}}\right)^{1-\rho}\frac{1}{\varepsilon^{B}}\left[P_{B}^{B}Y_{T}^{B}+iF^{B}-CA^{B}\right]\\
&+\Xi_{TC,C}\left(\frac{P_{C}^{C}}{P_{T}^{C}}\right)^{1-\rho}\left[P_{C}^{C}Y_{T}^{C}+\left\{\frac{1}{\varepsilon^{A}}CA^{A}+\frac{1}{\varepsilon^{B}}CA^{B}-i\left(\frac{F^{A}}{\varepsilon^{A}}+\frac{F^{B}}{\varepsilon^{B}}\right)\right\}\right]\\
P_{N}^{C}Y_{N}^{C}=&\frac{1-\alpha}{\alpha}\left(\frac{P_{N}^{C}}{P_{T}^{C}}\right)^{1-\theta}\left[P_{C}^{C}Y_{T}^{C}+\left\{\frac{1}{\varepsilon^{A}}CA^{A}+\frac{1}{\varepsilon^{B}}CA^{B}-i\left(\frac{F^{A}}{\varepsilon^{A}}+\frac{F^{B}}{\varepsilon^{B}}\right)\right\}\right]
\end{aligned}$$

Following the example of Obstfeld and Rogoff (2004) we introduce new variables:

$$\sigma_T^A \equiv \frac{Y_T^A}{Y_T^C} \qquad \sigma_T^B \equiv \frac{Y_T^B}{Y_T^C} \qquad \sigma_N^A \equiv \frac{Y_N^A}{Y_T^A} \qquad \sigma_N^B \equiv \frac{Y_N^B}{Y_T^B} \qquad \sigma_N^C \equiv \frac{Y_N^C}{Y_T^C}$$

$$ca^A \equiv \frac{CA^A}{P_A^A Y_T^A} \qquad ca^B \equiv \frac{CA^B}{P_B^B Y_T^B} \qquad x^A \equiv \frac{P_N^A}{P_T^A} \qquad x^B \equiv \frac{P_N^B}{P_T^B} \qquad x^C \equiv \frac{P_N^C}{P_T^C}$$

$$\tau^A \equiv \frac{P_C^A}{P_A^A} \qquad \tau^B \equiv \frac{P_C^A}{P_B^A} \qquad f^A \equiv \frac{F^A}{P_A^A Y_T^A} \qquad f^B \equiv \frac{F^B}{P_B^B Y_T^B}$$

which allows us to rewrite the system of equations as:

$$\begin{aligned}
1 = &\left(\Psi_T^A \left[\Psi_P^A + \left(1-\Psi_P^A\right)\left(\frac{\tau^A}{\tau^B}\right)^{1-\psi}\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^A\right)\left(\tau^A\right)^{1-\rho}\right)^{-1} \\
&\cdot \Xi_{TA,A}\left(P_P^A\right)^{\psi-\rho}\left[1+if^A-ca^A\right] \\
&+\left(\Psi_T^B \left[\left(1-\Psi_P^B\right) + \Psi_P^B\left(\frac{\tau^A}{\tau^B}\right)^{1-\psi}\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^B\right)\left(\tau^A\right)^{1-\rho}\right)^{-1} \\
&\cdot \left(\frac{n_A}{1-n_A}\right)\Xi_{TA,B}\left(P_P^B\right)^{\psi-\rho}\frac{\tau^A}{\tau^B}\frac{\sigma_T^B}{\sigma_T^A}\left[1+if^B-ca^B\right] \\
&+\left(\left(1-\Psi_T^C\right)\left[\Psi_P^C + \left(1-\Psi_P^C\right)\left(\frac{\tau^A}{\tau^B}\right)^{1-\psi}\right]^{\frac{1-\rho}{1-\psi}} + \Psi_T^C\left(\tau^A\right)^{1-\rho}\right)^{-1} \\
&\cdot \left(\frac{n_p n_a}{1-n_p}\right)\Xi_{TA,C}\left(P_P^C\right)^{\psi-\rho}\left[\frac{\tau^A}{\sigma_T^A} + ca^A - if^A + \left(ca^B - if^B\right)\frac{\tau^A}{\tau^B}\frac{\sigma_T^B}{\sigma_T^A}\right]
\end{aligned}$$

and:

$$\begin{aligned}
1 = &\left(\Psi_T^A \left[\Psi_P^A\left(\frac{\tau^B}{\tau^A}\right)^{1-\psi} + \left(1-\Psi_P^A\right)\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^A\right)\left(\tau^B\right)^{1-\rho}\right)^{-1} \\
&\cdot \left(\frac{1-n_a}{n_a}\right)\Xi_{TB,A}\left(P_P^A\right)^{\psi-\rho}\frac{\tau^B}{\tau^A}\frac{\sigma_T^A}{\sigma_T^B}\left[1+if^A-ca^A\right] \\
&+\left(\Psi_T^B \left[\left(1-\Psi_P^B\right)\left(\frac{\tau^B}{\tau^A}\right)^{1-\psi} + \Psi_P^B\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^B\right)\left(\tau^B\right)^{1-\rho}\right)^{-1} \\
&\cdot \Xi_{TB,B}\left(P_P^B\right)^{\psi-\rho}\left[1+if^B-ca^B\right] \\
&+\left(\left(1-\Psi_T^C\right)\left[\Psi_P^C\left(\frac{\tau^B}{\tau^A}\right)^{1-\psi} + \left(1-\Psi_P^C\right)\right]^{\frac{1-\rho}{1-\psi}} + \Psi_T^C\left(\tau^B\right)^{1-\rho}\right)^{-1} \\
&\cdot \left(\frac{(1-n_a)n_p}{1-n_p}\right)\Xi_{TB,C}\left(P_P^C\right)^{\psi-\rho}\left[\frac{\tau^B}{\sigma_T^B} + ca^B - if^B + \left(ca^A - if^A\right)\frac{\tau^B}{\tau^A}\frac{\sigma_T^A}{\sigma_T^B}\right]
\end{aligned}$$

while for the non-tradable goods we obtain:

$$\sigma_N^A = \frac{1-\alpha}{\alpha}\left(x^A\right)^{-\theta}\left[\Psi_T^A\left\{\Psi_P^A + \left(1-\Psi_P^A\right)\left(\frac{\tau^A}{\tau^B}\right)^{1-\psi}\right\}^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^A\right)\left(\tau^A\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}\left(1+if^A-ca^A\right)$$

$$\sigma_N^B = \frac{1-\alpha}{\alpha}\left(x^B\right)^{-\theta}\left[\Psi_T^B\left\{\left(1-\Psi_P^B\right)\left(\frac{\tau^B}{\tau^A}\right)^{1-\psi} + \Psi_P^B\right\}^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^B\right)\left(\tau^B\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}\left(1+if^B-ca^B\right)$$

$$\sigma_N^C = \frac{1-\alpha}{\alpha}\left(x^C\right)^{-\theta}\left[\left(1-\Psi_T^C\right)\left\{\Psi_P^C\left(\frac{1}{\tau^A}\right)^{1-\psi} + \left(1-\Psi_P^C\right)\left(\frac{1}{\tau^B}\right)^{1-\psi}\right\}^{\frac{1-\rho}{1-\psi}} + \Psi_T^C\right]^{\frac{1}{\rho-1}} \times\left(1+\frac{\sigma_T^A}{\tau^A}\left[ca^A-if^A\right]+\frac{\sigma_T^B}{\tau^B}\left[ca^B-if^B\right]\right)$$

The preceding five equations allow us to solve implicitly for τ^A, τ^B, x^A, x^B and x^C as functions of P_P^A, P_P^B and P_P^C. The exchange rates q^A and q^B can subsequently be obtained by inserting **(B-8)** into **(B-7)**.

To eliminate P_P^A, P_P^B and P_P^C we assume that all countries target the consumer price level, ie

$$P^A = P^B = P^C = 1 \qquad \textbf{(B-9)}$$

It can then be shown that **(B-9)** is equivalent to:

$$P_P^A = \left(\alpha\left[\Psi_T^A + \left(1-\Psi_T^A\right)\left(\frac{P_C^A}{P_P^A}\right)^{1-\rho}\right]^{\frac{1-\theta}{1-\rho}} + (1-\alpha)\left(\frac{P_N^A}{P_P^A}\right)^{1-\theta}\right)^{\frac{1}{\theta-1}}$$

$$P_P^B = \left(\alpha\left[\Psi_T^B + \left(1-\Psi_T^B\right)\left(\frac{P_C^B}{P_P^B}\right)^{1-\rho}\right]^{\frac{1-\theta}{1-\rho}} + (1-\alpha)\left(\frac{P_N^B}{P_P^B}\right)^{1-\theta}\right)^{\frac{1}{\theta-1}}$$

$$P_P^C = \left(\alpha\left[\left(1-\Psi_T^C\right) + \Psi_T^C\left(\frac{P_C^C}{P_P^C}\right)^{1-\rho}\right]^{\frac{1-\theta}{1-\rho}} + (1-\alpha)\left(\frac{P_N^C}{P_P^C}\right)^{1-\theta}\right)^{\frac{1}{\theta-1}}$$

where we can substitute in for the price ratios from:

$$\frac{P_C^A}{P_P^A} = \left[\Psi_P^A \left(\frac{1}{\tau^A}\right)^{1-\psi} + \left(1-\Psi_P^A\right)\left(\frac{1}{\tau^B}\right)^{1-\psi}\right]^{\frac{1}{\psi-1}}$$

$$\frac{P_C^B}{P_P^B} = \left[\left(1-\Psi_P^B\right)\left(\frac{1}{\tau^A}\right)^{1-\psi} + \Psi_P^B \left(\frac{1}{\tau^B}\right)^{1-\psi}\right]^{\frac{1}{\psi-1}}$$

$$\frac{P_C^C}{P_P^C} = \left[\Psi_P^C \left(\frac{1}{\tau^A}\right)^{1-\psi} + \left(1-\Psi_P^C\right)\left(\frac{1}{\tau^B}\right)^{1-\psi}\right]^{\frac{1}{\psi-1}}$$

$$\frac{P_N^A}{P_P^A} = \left[\Psi_P^A \left(\frac{P_A^A}{P_T^A}\right)^{1-\psi}\left(\frac{1}{x^A}\right)^{1-\psi} + \left(1-\Psi_P^A\right)\left(\frac{P_B^A}{P_T^A}\right)^{1-\psi}\left(\frac{1}{x^A}\right)^{1-\psi}\right]^{\frac{1}{\psi-1}}$$

$$\frac{P_N^B}{P_P^B} = \left[\left(1-\Psi_P^B\right)\left(\frac{P_A^B}{P_T^B}\right)^{1-\psi}\left(\frac{1}{x^B}\right)^{1-\psi} + \Psi_P^B \left(\frac{P_B^B}{P_T^B}\right)^{1-\psi}\left(\frac{1}{x^B}\right)^{1-\psi}\right]^{\frac{1}{\psi-1}}$$

$$\frac{P_N^C}{P_P^C} = \left[\Psi_P^C \left(\frac{P_A^C}{P_T^C}\right)^{1-\psi}\left(\frac{1}{x^C}\right)^{1-\psi} + \left(1-\Psi_P^C\right)\left(\frac{P_B^C}{P_T^C}\right)^{1-\psi}\left(\frac{1}{x^C}\right)^{1-\psi}\right]^{\frac{1}{\psi-1}}$$

and:

$$\frac{P_A^A}{P_T^A} = \left[\Psi_T^A \left[\Psi_P^A + \left(1-\Psi_P^A\right)\left(\frac{\tau^A}{\tau^B}\right)^{1-\psi}\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^A\right)\left(\tau^A\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}$$

$$\frac{P_B^A}{P_T^A} = \left[\Psi_T^A \left[\Psi_P^A \left(\frac{\tau^B}{\tau^A}\right)^{1-\psi} + \left(1-\Psi_P^A\right)\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^A\right)\left(\tau^B\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}$$

$$\frac{P_A^B}{P_T^B} = \left[\Psi_T^B \left[\left(1-\Psi_P^B\right) + \Psi_P^B \left(\frac{\tau^A}{\tau^B}\right)^{1-\psi}\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^B\right)\left(\tau^A\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}$$

$$\frac{P_B^B}{P_T^B} = \left[\Psi_T^B \left[\left(1-\Psi_P^B\right)\left(\frac{\tau^B}{\tau^A}\right)^{1-\psi} + \Psi_P^B\right]^{\frac{1-\rho}{1-\psi}} + \left(1-\Psi_T^B\right)\left(\tau^B\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}$$

$$\frac{P_A^C}{P_T^C} = \left[\left(1-\Psi_T^C\right)\left[\Psi_P^C + \left(1-\Psi_P^C\right)\left(\frac{\tau^A}{\tau^B}\right)^{1-\psi}\right]^{\frac{1-\rho}{1-\psi}} + \Psi_T^C \left(\tau^A\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}$$

$$\frac{P_B^C}{P_T^C} = \left[\left(1-\Psi_T^C\right)\left[\Psi_P^C \left(\frac{\tau^B}{\tau^A}\right)^{1-\psi} + \left(1-\Psi_P^C\right)\right]^{\frac{1-\rho}{1-\psi}} + \Psi_T^C \left(\tau^B\right)^{1-\rho}\right]^{\frac{1}{\rho-1}}$$

Appendix C - Calibration

This appendix lists the equations used to calibrate parameters reported in Table O.

As mentioned previously, when calibrating the model, n_A and n_P are chosen so that the United Kingdom and the United States match their relative shares of real world nominal GDP. This implies that:

$$n_P = \frac{GDP_{UK} + GDP_{US}}{GDP_{World}} \qquad n_A = \frac{GDP_{UK}}{GDP_{UK} + GDP_{US}}$$

When calibrating the preference bias parameters (γ's) we ensure that model-implied trade shares $T_{X,Y}$ and import shares I_X (derived for a steady state in which all prices are equal) match their counterparts in the data. This gives us the following six equations:

$$I_{UK} = \alpha \left[\Psi_T^A \left(1 - \Psi_P^A\right) + \left(1 - \Psi_T^A\right)\right] \qquad T_{UK,US} = \frac{\Psi_T^A \left(1 - \Psi_P^A\right)}{\Psi_T^A \left(1 - \Psi_P^A\right) + \left(1 - \Psi_T^A\right)}$$

$$I_{US} = \alpha \left[\Psi_T^B \left(1 - \Psi_P^B\right) + \left(1 - \Psi_T^B\right)\right] \qquad T_{US,UK} = \frac{\Psi_T^B \left(1 - \Psi_P^B\right)}{\Psi_T^B \left(1 - \Psi_P^B\right) + \left(1 - \Psi_T^B\right)}$$

$$I_{ROW} = \alpha \left(1 - \Psi_T^C\right) \qquad T_{ROW,US} = 1 - \Psi_P^C$$

where, for generic countries X and Y, $T_{X,Y}$ is the share of X's imports produced in Y, I_X is the import to GDP ratio of country X (both taken from data) and γ's can be backed out using:

$$\Psi_T^A \equiv n_P \gamma_P^A \qquad \Psi_T^B \equiv n_P \gamma_P^B \qquad \Psi_T^C \equiv \left(1 - n_P\right) \gamma_C^C$$

$$\Psi_P^A \equiv n_A \gamma_A^A \qquad \Psi_P^B \equiv \left(1 - n_A\right) \gamma_B^B \qquad \Psi_P^C \equiv n_A \gamma_A^C$$

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