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Abstract

A central aspect of the recent debate on global imbalances and the US current account deficit is the role of the exchange rate peg being followed by China and other Asian economies. While one view has stressed the need for Asian currency appreciation, another focuses on the importance of fiscal adjustment and more generally adjustment in relative savings rates in the US and Asian economies. This paper develops a simple two-region open economy macroeconomic model to analyze the alternative impacts of currency appreciation and fiscal adjustment on the current account. We stress a number of structural features of emerging Asian economies that may make currency appreciation an ineffective means of current account adjustment relative to fiscal policy changes. In addition, we note that there may be a welfare conflict between regions on the best way to achieve adjustment.

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"We believe China's currency policies and the deep undervaluation of its currency, the yuan or renminbi, have not only contributed to job loss and business failure in the United States, but they are also leading to major international exchange rate and trade imbalances and have become a destabilizing force in the global economy."

Letter from US Senators to Dick Cheney, January 22, 2004ℓ.

1. Introduction

Global current account imbalances, and more specifically the large deficit in the United States and the surplus in China and other Asian economies, continue to attract considerable attention both among policy makers and academics. While the academic literature has focused predominantly on the sustainability of the US current account deficit and on the exchange-rate consequences of its elimination, many policy makers have focused narrowly on the need for a renminbi revaluation. In face of China's reticence, the US congress has threatened to impose trade restrictions as a way to generate the equivalent type of relative price adjustment that would be caused by such an appreciation.

In view of the intense interest that current account adjustment has raised, a natural question to ask is whether, in the particular context of the policy discussion taking place, exchange rate appreciation is either effective in achieving its goal or a desirable part of an overall adjustment policy. Our view is that this question can be addressed only within a multi-country general equilibrium context. For example, many early papers simply used estimates of trade-balance equations for the US to ask what change in the real exchange rate of the dollar would be consistent with an adjustment of a given size in the current account, assuming exogenous paths for domestic and foreign income (the other variables typically included in such equations). The 'required' change in the real exchange rate was then mechanically distributed among trading partners, but there was little attention paid to what specific policy levers should be adjusted in order to achieve these changes, or the general equilibrium consequences of such changes. More generally, without a general equilibrium framework, it is not possible to analyze the consequences of alternative policy levers (besides exchange rate appreciation) which might achieve a similar sized adjustment in the current account.

This paper analyzes the impact of an exchange rate appreciation on the current account within an open economy macro model of the Obstfeld and Rogoff (1995) variety. Our analysis is particularly focused on the case of the US (country '*A*'), and China (country '*B*') current account. We develop a model of trade between an emerging market economy and an advanced economy. The model incorporates three realistic asymmetries between the two countries; a) country *B* sets export prices in dollars, b) country *B* holds a large fraction of dollars as gross assets, and c) country *B* uses a substantial fraction of intermediate imports in export production. In this environment, we ask whether an appreciation of the currency of the emerging market economy is likely to improve the current account position of the advanced economy. In addition, we investigate a set of alternative fiscal policies that are designed to influence the current account, and contrast their effects to that of a currency appreciation.

We find that for realistic trade elasticities, and incorporating the asymmetries discussed above, it may be difficult for a country *B* appreciation to generate a fall in its current account (rise in country *A* current account). In fact, an appreciation may have the opposite effect on its current account. While all the factors mentioned above are important, the critical limitations are points a) and c) above. When country *B* sets its export prices in country *A*'s currency, a nominal appreciation has no immediate effect on prices of imports in country *A*. In addition, when country *B* uses a substantial component of country *A* imports in its production process, an nominal appreciation of a given amount implies a much smaller effective appreciation, and a much more limited effect on the current account (and in fact its current account may even improve). In this sense, we find a reason for 'elasticity pessimism'. Calibrating to the US China trading relationship, we find reason to doubt that a Chinese currency appreciation would lead to a deterioration in its current account.

On the other hand, we find that fiscal policy can always improve the current account, independent of trade elasticities. Either a savings subsidy in *A* or a savings tax in *B* will improve country *A*'s current account.

There is substantial debate on the size of trade elasticities however (see Ruhl, 2005). With high enough elasticities, both types of policies have the ability to improve country *A*'s current account in principle. But they have very different impacts on other variables. In particular, an appreciation in country *B* (with high trade elasticities) is uniformly contractionary for that country, reducing its consumption and output on impact, and leading to a lower permanent stock of net foreign assets and consumption. But the appreciation is expansionary for country A – it raises both present and future consumption and output. The policy of fiscal adjustment does not rely on any relative price changes, working instead of the inter-temporal margin. A savings subsidy in country A, while improving its current account, does so by reducing both country *A* and country *B* consumption, and also reducing global output. This policy reduces country *A* demand so much that, despite a fall in output, its current account improves. On the other hand, a savings tax in country *B* works in the reverse direction, raising output and consumption in both countries, while improving the country *A* current account.

Given that different policies that have a similar impact on the current account have substantially different effects on other macroeconomic variables, it is likely that the countries will fail to agree on an appropriate set of policies to achieve current account adjustment. We conduct a limited welfare analysis of the impacts of alternative policies in order to explore this issue. The results indeed suggest that there may be a conflict among countries on the instruments to achieve adjusment. A country *B* appreciation can achieve current account improvement for *A* (with high elasticities), but this reduces *B*'s welfare, while raising *A*'s welfare. *A* fiscal adjustment in country *A* is likely to reduce both country's welfare, but falls on *A* much more heavily. On the other hand, a fiscal adjustment designed to stimulate consumption in *B* may raise welfare for both countries.

There is a growing literature on the interpretation of the US current account deficit and the problem of global imbalances. Obstfeld and Rogoff (2005) takes a microeconomic perspective and asks what changes in relative prices between traded and non-traded goods and between different categories of traded goods will result from a given adjustment in the current account balance.[1] The adjustment in the current account is assumed to come about through a change in aggregate expenditures in the US and abroad. Our results do not in any way conflict with this analysis. Our model also suggests that an adjustment in the patterns of global spending would require a real exchange rate adjustment, and depending on the current stance of monetary policies being followed by each country, this may be reflected in a nominal depreciation for the deficit country. Our argument however is based on an interpretation of the reverse channel – would a nominal appreciation on the part of a surplus country help to facilitate adjustment in and of itself. Our results generate some skepticism on this front. According to our analysis, it is just as likely that the appreciation would have a perverse effect.

The presence of valuation effects of exchange rate adjustment also plays an important role in our model. This has been a subject of active interest in recent papers by Ghironi et al. (2005), Gourinchas and Rey (2005), and Tille (2003), (2005).

The paper is organized as follows. The next section sets out the basic model. Section 3 looks at alternative policies designed to achieve adjustment in the current account. Section 4 examines some welfare implications. A short conclusion follows.

2. The two country model

In the model there are two countries, A and B. Country A has a monetary policy focused entirely on internal goals, while country B pegs its exchange rate against country A. Country A's currency is used in pricing all internationally traded goods. That is, it acts as the world reference currency for export price setting, both for country A exporters and country B exporters. We take as given that an objective of policy is to effect a change in the current account position of country A relative to country B.[2] Specifically, assume that the policy aims to improve country A's current account position. We explore alternative policies designed to achieve this goal. We focus on two policies in particular; a revaluation of country B's currency, and a fiscal adjustment that may take place in country A or B. If the fiscal adjustment occurs in A, it takes the form of a savings subsidy, thus encouraging a reduction in present consumption relative to future consumption. But if the fiscal adjustment takes place in B, it takes the form of a savings tax. Both currency appreciation or fiscal policies can improve country A's current account, but, as we see, they have quite different consequences for other variables.

1 See also Cavallo and Tille (2006), who incorporate asset valuation effects into Obstfeld and Rogoff's (2005) model.

2 This assumption avoids the difficult question of current account sustainability, and more generally, why the current account is important from a policy perspective. To the extent that surplus countries seldom attempt to adjust their current accounts downwards, we might view the objective here as coming from external political pressures.

In both cases, the impact of these policies will be felt only in the short run. For the case of a currency appreciation, since this is a nominal policy change only, its impact depends only on its surprise effect, and monetary neutrality will apply again once prices have adjusted. To maintain a comparison of the impact of a nominal appreciation with fiscal policy incentives, we assume that the latter are transitory policies. Of course, the focus only on short run policy impacts necessarily restricts the scope of our analysis. But in fact much of the policy discussion on the problem of global imbalances has revolved around the issue of nominal appreciation of the Chinese renminbi. This limited approach to current account adjustment essentially ensures that, by using any standard analytical modelling approach, the long run impact of the policy will be minimal. In fact, many commentators have previously made the point that Chinese currency appreciation could at best only have a minor impact on the trend of US current account deficits. Our use of the standard open macro models in effect builds this feature into the analysis. Despite this limitation however, the model allows us to clearly highlight a number of key features in the recent debate.

2.1 Households

Households in country i have preferences given by:

$$U = \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{C_{is}^{1-\rho}}{1-\rho} - \eta_i H_{is} \right]$$

where C_i is country i's consumption aggregate, H_i is labor supply, and $\beta < 1$ is the subjective discount factor used by country i households. For simplicity, assume that the countries are of equal size, so that if the world population is normalized to unity then the measure of both households and firms within each country is set at 0.5. In addition, we assume that:

$$C_i = \left[\alpha^{\frac{1}{\theta}} C_{ii}^{1-\frac{1}{\theta}} + (1-\alpha)^{\frac{1}{\theta}} C_{ij}^{1-\frac{1}{\theta}} \right]^{\frac{\theta}{\theta-1}}, \qquad i = A, B, \quad j \neq i$$

where C_{ii} represents country i's consumption of country i's good, etc. If $\alpha > 0.5$ then there is 'home bias' in consumption baskets.

This form of preferences implies the following price index:

$$P_i = \left[\alpha P_{ii}^{1-\theta} + (1-\alpha) P_{ij}^{1-\theta} \right]^{\frac{1}{1-\theta}}.$$

The flow budget constraint of country *B* is given by:

$$P_{Bt} C_{Bt} + F_{Bt+1} + S_t F_{At+1} = (1 + r_{Bt}) F_{Bt} + (1 + r_{At}) S_t F_{At} + \Pi_{Bt} + W_{Bt} H_{Bt} \, ,$$

where $F_{Bt} + S_t F_{At}$ represents country *B*'s net foreign assets, consisting of F_{Bt} currency *B* denominated bonds, and F_{At} currency *A* denominated bonds, where S_t is the exchange rate (currency *B* price of currency *A*). Currency *A* (*B*) bonds pay a return of r_{At}, (r_{Bt}). Π_{Bt} is the total profit of country *B* firms, and W_{Bt} is the country *B* wage.

2.2 Firms

We follow the conventional formulation whereby within each country, products are differentiated and each single product is produced by a monopolistically competitive firm that sets its price one period in advance. Production technologies are different across countries. For country *A*, production is carried out with labor alone. A firm j in country *A* has the following production function:

$$Y(j)_{At} = H(j)_{At}$$

Firms in country *B* combine intermediate imports with labor to produce. Intermediate imports comprise country *A*'s composite good. Thus, a firm j in country *B* has production function:

$$Y(j)_{Bt} = \min\left[\frac{H(j)_{Bt}}{\gamma}, \frac{I(j)_{Bt}}{1-\gamma}\right]$$

Thus, country *B* must use imported intermediate inputs in fixed proportion with local inputs in order to produce. This captures the widely acknowledged empirical characteristic that the export good production of many emerging market economies has a large imported component.[3]

As discussed above, goods pricing policies differ between the two countries.[4] In country *A*, prices of goods sold to domestic residents and to country *B* residents are set in advance in terms of country *A*'s currency. This implies that if there is an unanticipated (country *B*) exchange rate appreciation, import prices fall in country *B*. In country *B* on the other hand, prices for sale in the domestic market are set in local currency, but prices for sale in country *A* are set in terms of currency *A*. Thus, there is 'local currency pricing' for exports sold to country *A*.[5] This means that an unanticipated depreciation of currency *A* has no immediate impact on import good prices in the local *A* market.

The profit function of a country *A* representative firm may then be written as:

$$\Pi_{iAt} = (P_{AAt} - W_{At})(Y_{AAt} + Y_{ABt}) \tag{1}$$

where Y_{ijt} represents demand for country i goods from country j households. Since prices for country *A* goods are the same for both *A* and *B* households, we may just aggregate the demand from the two sources.

For the country *B* firms, on the other hand, profits are comprised of sales to country *B* households and country *A* households separately. Profits of the representative country *B* firm are then:

$$\Pi_{iBt} = P_{BBt}Y_{BBt} + S_t P_{BAt} Y_{BAt} - \gamma W_{Bt}(Y_{BBt} + Y_{BAt}) - (1-\gamma) S_t P_{AAt}(Y_{AAt} + Y_{BAt}) \tag{2}$$

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3 Stiglitz (2005) notes that there is a high import content of China's exports to the US.

4 Goldberg and Tille (2006) note that in 2003, more than 99 percent of US exports and 93 percent of imports were invoiced in dollars. The use of dollar invoicing for Asian trade is well established. See McKinnon and Schnabl (2003), for instance.

5 Clearly this also requires the ability to segment national markets during the period over which prices are set.

Here, in contrast to (1), country *B*'s sales to *A* are priced in country *A*'s currency, so that, for given P_{BAt}, an appreciation of country *B*'s currency (a fall in S_t) will, ceteris paribus, reduce profits for country *B*. But note also that since country *B*'s production requires intermediate imported goods (in fixed proportion $1-\gamma$ to output), an appreciation of *B*'s currency will also reduce costs for country *B* firms directly.

Firms in countries *A* and *B* will set prices to maximize expected profits, given the demand schedules they face from their domestic residents and from abroad. Given the assumption of product differentiation with elasticity of substitution λ between differentiated products, where $\lambda > 1$, there is a well defined profit maximization solution.

2.3 Policy

We focus on two types of policy mechanisms; monetary policy and fiscal policy. With respect to monetary policy, we make the following assumptions. Country *A*'s monetary authority is focused purely on domestic goals. This is captured by the assumption that nominal interest rates are set by a 'Taylor-type' rule, adjusting to domestic ination (for simplicity we omit the output gap from this rule), so that:

$$R_{At+1} \equiv (1 + r_{At+1}) = \beta^{-1} \left[\frac{P_{At}}{P_{At-1}} \right]^{\omega},$$

with $\omega > 1$ capturing the stance of monetary policy.

The monetary policy of country *B* is focused solely on the exchange rate. In fact, we may assume that country *B* simply chooses the exchange rate S_t directly in each period as an exchange rate peg. We can then investigate the impact of an unanticipated appreciation of currency *B* (instigated by country *B*'s monetary authority).

The fiscal policy we examine is designed so as to affect savings rates. Since our objective is to look at policies that would increase country *A*'s current account, we model either a policy designed to increase country *A*'s savings rate, or a policy to reduce country *B*'s savings rate. Specifically, we amend the model so as to allow for a subsidy to saving in country *A*, financed by a lump-sum tax, or a tax on saving in country *B*, financed by a lump-sum subsidy. In the first case the effective rate of return on currency *A* denominated assets for residents of country *A* becomes $R_{At+1} = (1 + r_{At+1})(1 + \epsilon_{At})$, where ϵ_{At} represents the subsidy on the gross return on savings between period t and t+1. In the second case, the return to country *B* savers is $R_{At+1} = \frac{(1+r_{At+1})}{(1+\epsilon_{At})}$. A similar condition holds in each case when we define the return on *B* denominated assets. Again, we will look at an unanticipated (temporary) increase in either ϵ_{At} or ϵ_{Bt}.

2.4 Equilibrium: Flexible Prices

An equilibrium of the model is easily described. Households choose individual consumption of domestic and foreign goods (given prices and their income), labor supply, and overall savings. Firms set prices given their demand and marginal cost. Finally, markets for each good clear.

If all prices are fully flexible, we can describe the equilibrium as follows:

$$W_{it} = \eta_i C_{it}^{\rho}, \quad i = A, B, \tag{3}$$

$$\frac{C_{Bt}^{-\rho}}{P_{Bt}} = E_t \beta \frac{C_{Bt+1}^{-\rho}}{P_{Bt+1}} (1 + r_{iBt+1}), \quad i = A, B, \tag{4}$$

where 1+ $r_{ABt+1} \equiv \frac{S_{t+1}}{S_t}\frac{1+r_{At+1}}{1+\epsilon_{Bt+1}}$, and 1+ $r_{BBt+1} \equiv \frac{1+r_{Bt+1}}{1+\epsilon_{Bt+1}}$.

$$\frac{C_{At}^{-\rho}}{P_{At}} = E_t \beta \frac{C_{At+1}^{-\rho}}{P_{At+1}} (1 + r_{iAt+1}), \quad i = A, B, \tag{5}$$

where 1 + $r_{AAt+1} \equiv (1+r_{At+1})(1+\epsilon_{At+1})$, and 1 + $r_{BAt+1} \equiv \frac{S_t}{S_{t+1}}(1+r_{Bt+1})(1+\epsilon_{At+1})$.

$$P_{AAt} = \frac{\lambda}{\lambda - 1} W_{At}, \tag{6}$$

$$P_{BBt} = \frac{\lambda}{\lambda - 1} \left[\gamma W_{Bt} + (1-\gamma) S_t P_{AAt}\right], \tag{7}$$

$$S_t P_{BAt} = \frac{\lambda}{\lambda - 1} \left[\gamma W_{Bt} + (1-\gamma) S_t P_{AAt}\right], \tag{8}$$

$$Y_{At} = (1-\gamma) Y_{Bt} + \alpha \left(\frac{P_{AAt}}{P_{At}}\right)^{-\theta} C_{At} + (1-\alpha) \left(\frac{S_t P_{AAt}}{P_{Bt}}\right)^{-\theta} C_{Bt}, \tag{9}$$

$$Y_{Bt} = Y_{BBt} + Y_{ABt} = (1-\alpha) \left(\frac{P_{BAt}}{P_{At}}\right)^{-\theta} C_{At} + \alpha \left(\frac{P_{BBt}}{P_{Bt}}\right)^{-\theta} C_{Bt} \, . \tag{10}$$

Equations (3) describe the implicit labor supply equation in each country. Equation (4) is country *B*'s Euler equation governing optimal inter-temporal consumption behavior, described for assets of each currency denomination. Equation (5) is country *A*'s inter-temporal Euler equation for each type of asset. Equations (6), (7), and (8) describe the optimal pricing of the representative firm in country *A* and B. Note that in country B, marginal cost is an average of the nominal wage and the cost of the intermediate input (country *A*'s good). Finally, (9) and (10) describe goods market clearing in the two countries.

In combination with the flow budget constraint of country *B*, and the monetary policy rule of country *A*, this system implicitly determines the equilibrium sequence of variables $C_{it}, W_{it}, Y_{it}, P_{AAt}, P_{BBt}, P_{BAt}, S_t,$ and F_t.

2.5 Sticky Prices

In order to conduct some simple policy experiments, we assume that there is an unanticipated shock to the exchange rate or to the savings subsidy in period t, after the prices of all goods have been set for this period. But prices can adjust freely after one period, and there are no subsequent shocks. This follows exactly the approach of Obstfeld and Rogoff (1995) in looking at the impacts of monetary and fiscal policy in their *Exchange Rate Redux* model.

2.6 Solution

To provide simple analytic insights into the effects of policies at this stage, we make two further assumptions. We assume that each country begins in a steady state with zero *net* foreign assets, so that for country *B*, we have $F_{Bt} + S_t F_{At}$ = 0, *before* the appreciation in the exchange rate. In this case, the current account is initially zero.[6] In addition, to simplify the algebra, we choose the η_i parameters for each country so that the terms of trade, defined as $\frac{S_t P_{AAt}}{P_{BBt}}$, is initially equal to unity. We will then log-linearize the model around this initial steady state. Denote lower case letters as log deviations from the initial steady state, hence $x_t = \ln(X_t) - \ln\left(\overline{X}\right)$. We define the log deviation of the country *B* terms of trade as τ_t.

2.6.1 Period t+1 solution

In period t + 1, the period after the shock, all prices have adjusted. Since, once prices have adjusted, the nominal exchange rate appreciation can have no real effects in and of itself, and since the fiscal policy shock is temporary, the only impact of the initial shocks on period t + 1 real variables that can occur is through changes in net foreign assets, i.e. changes in the current account in period t. In addition, since, from time t +1 onwards, there are no more shocks, by assumption, the global economy will achieve a steady state in real terms beginning at period t +1. This is equivalent to the statement that any changes in net foreign assets inherited from period t are sustained permanently (as in Obstfeld and Rogoff 1995).

Note also that, since after the initial shock, the future path of all variables is known, the two assets must be perfect substitutes thereafter. Hence it must be that 1 + $r_{Av+1} = \frac{S_v}{S_{v+1}}(1 + r_{Bv+1})$, for all $v \geqq t$, i.e. after the initial shock. Hence, from time t + 1 onwards, we may define a composite net foreign assets aggregate $F_{t+1} = F_{At+1} + S_{t+1}F_{Bt+1}$, which earns a return r_{At+1}.[7]

Using the assumptions made so far, and the definition of the price index, we may write the log deviation in $\frac{P_{BBt}}{P_{Bt}}$, the ratio of country *B*'s good price to the country *B* CPI, as $-(1-\alpha)\tau_t$. Thus, it is negatively related to country *B*'s terms of trade. Using this and the equivalent relationship for country *A*, in combination with the goods pricing and labor supply conditions for country *A* and *B*, we may write, for period t + 1 (and onwards):

$$-(1-\alpha\gamma)\tau_{t+1} = \rho c_{Bt} \tag{11}$$

$$(1-\alpha)\tau_{t+1} = \rho c_{At} \tag{12}$$

[6] While it would be possible to assume that country *A* begins with a current account deficit, this would substantially complicate the algebra, without materially affecting the results. In fact, Lane and Milesi Ferretti (2006) indicate that for 2004, China had a very small NFA position, so this assumption is not too inaccurate.

[7] This analysis is more general than it seems. Even were we to explicitly allow for future shocks, the results we derive here and in the next section will still hold in expectation, since, up to a first order approximation, the model displays certainty equivalence.

The intuition behind (11) is easy to see. A rise in consumption in country *B* will shift back the labor supply curve, increasing marginal costs for country *B* firms. This leads to an increase in the optimal price of country *B*'s good, raising its terms of trade (reducing τ_{t+1}). The opposite applies to (12).

Now taking a log linearization of the market clearing condition for good *B* in period t+1 gives:

$$y_{Bt+1} = \alpha\gamma c_{Bt+1} + (1-\alpha\gamma)c_{At+1} + \theta\alpha\left[(1-\alpha)\gamma + (1-\alpha\gamma)\right]\tau_{t+1} \tag{13}$$

Output in country *B* is positively related to the movement in world consumption demand, and positively related to the country *B* terms of trade (relative price of country *A* good).

From country *B*'s flow budget constraint in period t+1, beginning at F_{t+1} = 0, we have:

$$c_{Bt+1} = \overline{r}\frac{dF_t}{\overline{PC}} + y_{Bt+1} - \frac{(1-\gamma)+\gamma(1-\alpha)}{\gamma}\tau_{t+1} \tag{14}$$

The notation $\overline{r}\frac{dF_t}{\overline{PC}}$ on the right hand side of (14) indicates that we differentiate around an initial point with F_t = 0, and that changes in net foreign assets are permanent. This equation says that country *B*'s consumption in period t+1 is higher, relative to the initial steady state, the higher is the change in period t net foreign assets, the greater the change in country *B* output, and the lower is the movement in the country's terms of trade. Note that as should be expected, a deterioration in the terms of trade is more costly for the country, the higher is $1-\gamma$, the share of output produced by imported goods.

Now define the variable $\Delta c_{t+1}{=}c_{Bt+1} - c_{At+1}$ as the difference in the consumption movement between country *B* and country *A* in period t + 1. Combining (11), (12), (13) and (14), we arrive at the following relationship between consumption in period t + 1 and the change in net foreign assets:

$$\Delta c_{t+1} = \overline{r}\frac{dF_t}{\overline{PC}}\left(\frac{1}{1-\alpha\gamma+\rho\sigma}\right) \tag{15}$$

where $\sigma \equiv \frac{\alpha\gamma\theta(\gamma(1-\alpha)+1-\alpha\gamma)-(1-\gamma)-(1-\alpha)\gamma}{\gamma(2-\alpha\gamma-\alpha)}$

So long as $1-\alpha\gamma+\rho\sigma > 0$, a rise in country *B* net foreign assets leads to a rise in its relative consumption. A sufficient condition for this is that $\theta > \frac{1}{\alpha}$. Conditions (15) gives a link from the impact of a currency appreciation or a fiscal policy shock in period t on the period t current account to future consumption output, and terms of trade.

2.6.2 Period t Solution

Now we focus on the log linearization of the model at period t, when all nominal prices are pre-set. From country *B*'s market clearing condition, we may write:

$$y_{Bt} = \alpha\gamma c_{Bt} + (1-\alpha\gamma)c_{At} + \alpha\gamma(1-\alpha)s_t \tag{16}$$

Expression (16) says that output of good *B* increases when world demand rises, or when there is a country *B* nominal depreciation. Note that a nominal depreciation of country *B*'s exchange rate is equivalent to a time t terms of trade deterioration for country *B*. This raises demand for its good, since it raises import prices for country *B* residents. But we see that the link between the terms of trade and demand is weaker in period t, when prices are pre-set (compare (16) with (13)). The reason is that the depreciation does not affect prices of country *B'*s good facing households in country *A*, since country *B* goods sold in *A* are all pre-set in terms of country *A*'s currency. Thus, a depreciation in *B*'s currency does not stimulate country *A*'s demand for *B*'s goods. This gives us one reason to be skeptical about the impact of an appreciation on the current account.

We may differentiate the consumption Euler equations (5) and (4) in the two countries, and again, writing in terms of country relatives responses, we have:

$$\Delta c_t = \frac{1}{1+\gamma(1-2\alpha)}\Delta c_{t+1} + \alpha\frac{s_t}{\rho} + \frac{\epsilon_t}{\rho}\,, \tag{17}$$

where $\epsilon_t = \epsilon_{At} + \epsilon_{Bt}$.

The interpretation of this expression is as follows. A country *B* depreciation will however cause a current period real depreciation for country *B* residents. This causes an anticipated real exchange rate appreciation, reducing the effective real interest rate, and therefore raising current consumption relative to future consumption. A rise in ϵ_{At}, a subsidy to country *A* saving, will raise the effective real interest for country *A* residents, reducing current country *A* consumption relative to future consumption. Likewise, a tax on country *B* saving, ϵ_{Bt}, will have a similar impact on the consumption differential. Note finally that the coeffcient on Δc_{t+1} is not unity because movements in expected future relative consumption will cause anticipated terms of trade and real exchange rate movements via (11) and (12), when there is some degree of home bias in preferences.

Now we differentiate the flow budget constraint for country *B* in time t to get:

$$c_{Bt} + \frac{dF_t}{\overline{PC}} = y_{Bt} - \alpha\frac{(1-\gamma)}{\gamma}s_t + (1+\overline{r})fs_t \tag{18}$$

where $f \equiv \frac{\overline{F}_A}{\overline{PC}}$ represents the initial *gross* currency-A denominated asset holding to GDP position for country *B*. The right hand side of this expression indicates that the movement in country *B*'s income depends positively on total output, and negatively on the terms of trade. The terms of trade effect arises from two sources. First, the presence of imported goods in production means that a depreciation reduces real income. But there is also a valuation effect on the currency *A* denominated component of initial bond holdings. If $f > 0$, a surprise nominal appreciation of country *B*'s currency reduces the real value of bond holdings, and reduces real income.

Now putting together (18) and (13), we get:

$$(1-\alpha\gamma)\Delta c_t + \frac{dF_t}{\overline{PC}} = \left[\theta\alpha\gamma(1-\alpha) - \alpha\frac{(1-\gamma)}{\gamma} + (1+\overline{r})f\right]s_t\,. \tag{19}$$

Combining this with
(15), we have:

$$
\begin{aligned}
& (1-\alpha\gamma)\Delta c_t + \frac{(1-\alpha\gamma+\rho\sigma)}{\overline{r}}\Delta c_{t+1} \\
= & \left[\theta\alpha\gamma(1-\alpha) - \alpha\frac{(1-\gamma)}{\gamma} + (1+\overline{r})f\right] s_t.
\end{aligned} \tag{20}
$$

This describes a 'quasi-budget constraint', in log difference form, indicating a desire to smooth out the wealth effects of policy shifts coming from exchange rate changes between current and future periods. We can take this expression in combination with the 'relative Euler equation' expression (17) to solve for Δc_t and Δc_{t+1} as functions of s_t and ϵ_t. Then we can determine the impact of each policy on the country *B* current account, i.e. on $\frac{dF_t}{\overline{PC}}$.

The resulting expressions for Δc_t and $\frac{dF_t}{\overline{PC}}$ are:

$$
\begin{aligned}
\Delta c_t = & \left[\upsilon\frac{\left(\alpha(\theta\gamma(1-\alpha) - \frac{(1-\gamma)}{\gamma} - \frac{(1-\alpha\gamma)}{\rho}) + (1+\overline{r})f\right)}{\Gamma} + \frac{\alpha}{\rho}\right] s_t \\
& + \left[\frac{1-\alpha\gamma+\rho\sigma}{\Gamma}\right]\frac{\epsilon_t}{\overline{r}\rho}
\end{aligned} \tag{21}
$$

$$
\begin{aligned}
\frac{dF_t}{\overline{PC}} = & \frac{1-\alpha\gamma+\rho\sigma}{\overline{r}\gamma}\left(\alpha(\theta\gamma(1-\alpha) - \frac{(1-\gamma)}{\gamma} - \frac{(1-\alpha\gamma)}{\rho}) + (1+\overline{r})f\right)s_t \\
& \frac{(1-\alpha\gamma+\rho\sigma)}{\overline{r}\Gamma}\frac{\epsilon_t}{\rho}
\end{aligned} \tag{22}
$$

where $\Gamma = \left[\upsilon(1-\alpha\gamma) + \frac{(1-\alpha\gamma+\rho\sigma)}{\overline{r}}\right]$, and $\upsilon = \frac{1+\alpha(1-\gamma)}{1+\gamma(1-2\alpha)}$.

We can now examine how a nominal appreciation in country *B* or a savings subsidy (tax) in country *A* (*B*) affects the current account at time t.

3. Adjustment in the Current Account

3.1 Nominal Appreciation

From equation (22), the condition required for an exchange rate appreciation to reduce the current account for country *B* is that

$$
\left(\alpha(\theta\gamma(1-\alpha) - \frac{(1-\gamma)}{\gamma} - \frac{(1-\alpha\gamma)}{\rho}) + (1+\overline{r})f\right) > 0 \tag{23}
$$

This rather complicated expression can be broken down in the following way. Take the special case with no imports in production, so that γ = 1, and zero initial foreign currency bond holdings, so that f = 0. In this case, the condition becomes $\theta > \frac{1}{\rho}$. This says that an appreciation will reduce the current account only if the intra-temporal elasticity of demand for home goods, θ, exceeds the inter-temporal elasticity of substitution in consumption across time periods; $\frac{1}{\rho}$. The effect of the appreciation in this case combines two conflicting effects. The fall in the relative price of country *B* imports reduces demand for *B*'s good, and reduces output in *B*. This leads to a deterioration in the current account. But the appreciation also raises real interest rates in country *B*, (since it generates an anticipated real depreciation). This reduces total absorption in country *B*, leading to an improvement in the current account. The intra-temporal effect dominates the inter-temporal effect only if the elasticity of demand for country *B*'s good exceeds the inter-temporal elasticity of substitution in consumption.

When $\gamma < 1$ however, the impact of an appreciation on the trade balance changes significantly. In this case, as we saw from (18), an appreciation of the currency raises real income, ceteris paribus, by reducing the cost of imported intermediates. Country *B* households then smooth some of this (temporary) real income increase by increased savings, leading to an improvement in the current account.

Finally, when $f > 0$, an exchange rate appreciation has an asset revaluation linkage to the current account. The fall in the real value of the gross currency *A* denominated bonds component of net foreign assets reduces saving, and the current account.[8]

Will an appreciation reduce the current account? We can speculate on this question by inserting some plausible parameter estimates in (22). We choose parameters so as to roughly reflect the position of the US as country *A* and China as country *B*.

The US ratio of imports to GDP is around 12 percent, and exports to GDP 7 percent. Since our initial condition assumes a steady state where these two numbers are equal, we take an average and set α = 0.9, so that imports to GDP in country *A* equals 11 percent. In China, the ratio of exports to GDP is around 29 percent. In the model, this is $\frac{1-\alpha\gamma}{\gamma}$. To match this, given α = 0.9 implies that γ = 0.84. This implies that imported intermediates account for 16 percent of production in China. There is substantial debate on the size of the trade elasticity θ. Ruhl (2005) notes that the elasticity is likely to be larger in the long run, when considering the response to changes in tariffs, than the short run, at the frequency of macroeconomic shocks. He estimates an elasticity below of 2 in the short run, but around 6 in the long run. As discussed previously, the present exercise is more relevant to the short run perspective. In this case, typical estimates of the elasticity lie between one and two. We follow Obstfeld and Rogoff (2005) in setting θ = 2. We follow common practice in assuming ρ = 1 (logarithmic inter-temporal utility). The results are quite insensitive to ρ in fact.

Our approximation is around a value of net foreign assets to GDP equal to zero. In fact, NFA to GDP for China was quite low until very recently (2 percent in 2003 and 8 percent in 2004, as reported by Lane and Milesi Ferretti 2006). Note however that f measures *gross* holdings of country *A* denominated assets to GDP for country *B*. These measures are much higher. The major component of gross dollar denominated assets is foreign exchange rate reserves. Lane and Milesi-Ferretti's (2006) estimates indicate a ratio of foreign exchange rate reserves to GDP of 37 percent for China in 2004. Measured in terms of PPP-based GDP, this implies a reserve to GDP ratio of around 10 percent. Thus we set f = 0.1. Finally, we assume that $\overline{r}$ = 0.02.

8 Note that country *A*'s gross asset position must be the mirror image of country *B*'s position, so that, for $f > 0$, an appreciation of currency *B* must have positive valuation effects for *A*.

Table 1 reports the estimated of a ten percent appreciation on the current account (as a fraction of GDP) for this baseline calibration and for some alternative parameter values. For the baseline case, we find in fact that currency appreciation actually *improves* China's current account by over one percent of GDP. The combination of a relatively small trade elasticity and an important role for intermediate imports in production implies that the appreciation has a relatively small expenditure switching effect, and a substantial real income effect through reduced prices of intermediate imports, which combines so as to increase net foreign assets.

While the valuation effect tends to go the other way, since an appreciation reduces the real value of US dollar denominated assets, which reduces savings, this effect is relatively small when measured in terms of PPP-adjusted GDP. If gross asset revaluation effects were absent (i.e. $f = 0$), the positive impact of an appreciation on the current account would be larger – over 2 percent of GDP.

On the other hand, if we assume a trade elasticity at the higher end of the estimates, setting $\theta = 6$ (as in Ruhl 2005), then expenditure switching is much larger, and the appreciation leads to a current account deterioration of about 1.5 percent of GDP. Even with this very high elasticity however, it would necessitate a substantial appreciation (33 percent) in order to generate a five percent of GDP reduction in the current account balance.

To summarize this section, we may conclude that, based on empirical estimates of trade and saving elasticities, the importance of imported intermediates in China's export supply, and the scale of gross holdings of US denominated assets, it is far from clear that a nominal appreciation would even push the Chinese current account surplus in the right direction. In our baseline case, the current account actually improves. Even if trade elasticities are much higher, so that the current account moves in the desired direction, the effect may be relatively small. The key channels which limit the impact of an appreciation on the current account are the practice of dollar currency pricing of exports, which limits the pass-through of depreciation in the importers currency, and the scale of imported intermediate imports. Since these imports are priced in US dollars, a fall in the cost of the intermediate inputs generates an effective nominal appreciation that is much less than the actual appreciation. Consequently, the affect of the appreciation on the current account is muted, or even in the wrong direction.

We should note that this analysis does not conflict with that of Obstfeld and Rogoff (2005), who argue that a real US dollar depreciation is a necessary part of an adjustment in the US current account. In fact, the same mechanism works in our model in the long run. A persistent fall in country *A* absorption will reduce world demand for country *A* goods and reduce country *A*'s terms of trade and real exchange rate. But this is a real adjustment mechanism which is quite divorced from the question of whether a nominal currency change could have the desired effect on the current account. In regard to this second question, which has essentially dominated the actual policy discussion of the US-China global imbalances debate, our results are quite negative.

3.2 Fiscal Policy

If the role for currency depreciation in influencing the trade balance is limited, what can be done with other policy tools? Here we look at the influence of fiscal policy adjustments. With respect to a country *A* savings subsidy (or a country *B* savings tax) this will always improve country *A*'s current account (and reduce *B*'s current account). The fiscal policy acts directly either by tilting country *A*'s spending away from the present and towards the future period, or tilting country *B*'s spending towards the present. Either policy directly improves the country *A* trade balance. Table 1 illustrates the impact of a 10 percent savings subsidy in country *A* (or tax in country *B*) on the country *B* current account. The baseline estimate implies an improvement in the current account equal to 2.4 percent of GDP. Moreover, unlike the impact of an appreciation this estimate is quite insensitive to alternative values of the trade elasticity. The reason is that the primary impact of a savings subsidy (or tax) is through *inter-temporal* rather than *intra-temporal* channels. Thus a savings subsidy in country *A* reduces present consumption relative to future consumption, but has no immediate impact on the relative price of country *B*'s exports.

3.3 Discussion

A fiscal policy can clearly move the current account in the right direction, but a nominal appreciation may or may not achieve this. But even if an appreciation does reduce country *B*'s current account, the impact of nominal appreciation and fiscal policy are quite different with respect to other variables. If the nominal appreciation reduces the country *B* trade balance, then it will reduce country *B* output in time t, and lead to a permanent fall in consumption in country *B*. Current consumption falls directly due to the fall in income arising from the fall in output, and future consumption will fall because the current account deterioration leads to a permanent fall in net foreign assets.

On the other hand, the appreciation has a positive impact on country *A* consumption. To see this, note that the improvement in country *A*'s current account balance will lead to a rise in country *A*'s period $t + 1$ consumption, as the country is wealthier. But, anticipating this rise in consumption, and in the absence of any compensating monetary policy, current consumption must also rise. If the country *A* trade balance improves, this must mean that country *A*'s output must rise by even more. Thus, the appreciation is unambiguously expansionary for country *A* – both output and consumption rise, with consumption rising permanently, while it is clearly contractionary for country *B* – output and consumption falls, with the fall in consumption being permanent. The improvement in *A*'s trade balance is generated by sharply asymmetric responses of macroeconomic aggregates in the two countries.

The impact of a fiscal policy shock will depend on its source. A savings subsidy in country *A* will lead to both a fall in both country's consumption. The fiscal shock causes no change in relative prices, and since the country *A* inflation rate at time t is predetermined, it causes not any endogenous response of monetary policy, and therefore doesn't affect real interest rates. Thus, demand and output fall in both countries. The improvement in the country *A* trade balance occurs because country *A* consumption falls by more than output. At time $t + 1$ and beyond, country *A*'s net foreign assets are higher, and it has a higher long run consumption, while the opposite applies to country *B*.

For a consumption subsidy instituted in country *B*, there is an immediate rise in output and consumption in both countries, as the rise in country *B* demand, without any relative price changes, will raise output in both countries. The rise in country *A*'s current account will ensure that its consumption rises in the future, while that of country *B* falls in the future.

4. Welfare Comparison

Our simple experiments do not easily lend themselves to a full welfare analysis. However, we can provide some insight into the welfare implications of alternative policies by computing the ex-post impact on utility of each country of policies designed to achieve a given impact on the current account balance. Thus, we may ask, given an objective of reducing the country *B* current account by a x percent of GDP, which policy rule has the least welfare cost, and which country gains or loses? Since the analysis of the previous section is based on the assumption that the policy changes were unanticipated, we will evaluate the welfare effects simply by differentiating household utility, beginning at an initial steady state, and incorporating the consumption and employment effects of the different shocks. We do not attempt to label this as an optimal policy rule in any way. Rather, our objective is simply to ascertain, from a welfare perspective, where the tensions between the two countries would lie, based on the different alternative forms of current account adjustment.

From Corsetti and Pesenti (2001), it is well known that the welfare impact of monetary policy shocks in an open economy will depend on the conflict between the incentive to generate a surprise expansion in monetary policy, so as to increase employment above its socially inefficient level (generated by monopoly price distortions), and the incentive for a surprise contraction, so as to increase the country's terms of trade. If the elasticity of substitution across goods within countries is equal to the elasticity of substitution in goods across countries, then these two incentives exactly offset each-other. In order to calibrate the welfare impact of alternative policies, we make this assumption in evaluating welfare.

Table 2 illustrates the results. We assume that the objective of policy is to reduce country *B*'s current account by 5 percent of GDP. We then choose an appreciation rate, or a change in ϵ_{At} or ϵ_{Bt} to achieve this. Computing the impact on consumption and employment, both contemporaneously and in the long run, we evaluate the impact on country *A* and country *B* utility. Since for our baseline calibration, with $\theta = 2$, an appreciation cannot reduce the country *B* current account at all, we use the alternative assumption of $\theta = 6$, i.e. a much larger trade elasticity. Since the expressions are in terms of differential utility, we can interpret only the sign of the expressions, and the size of the utility effects of one policy change relative to another – i.e. the absolute utility number has no clear interpretation. A negative in the dU_B-appreciation cell indicates that country *B* loses from an appreciation which reduces its current account by 5 percent of GDP.

Table 2 illustrates that there is a fundamental asymmetry in the welfare effects of a currency appreciation. Utility of country *B* falls, while utility of country *A* rises. On the other hand, because fiscal policies do not affect current relative prices, utility effects of these policies tend to move in the same direction. A savings subsidy in country *A* reduces output and consumption in both countries, and reduces utility in both countries.[9] Country *A* utility falls by more however. Comparing the alternative policies of currency appreciation in by *B* versus a savings subsidy by *A*, we see that there is a welfare conflict between the countries. Country *A* would clearly prefer an appreciation by country *B*, while country *B* would prefer a fiscal adjustment on the part of *A*. Thus, if the alternative policies for current account adjustment are appreciation in *B* versus fiscal adjustment in *A*, the two countries have quite different interests.

On the other hand, a savings tax by country *B*, while having an identical impact on the current account as a subsidy in *A*, has very different welfare effects. In this case, welfare increases in *both* countries. Thus, in principle, both countries could agree on such a policy. In relative terms, however country *A* would still prefer a country *B* currency appreciation.

5. Conclusions

There is a widespread view that a currency appreciation by China is necessary feature of the adjustment to global imbalances. Using a simple analytical open economy macro model, we argue that given empirical estimates of short run trade elasticities, in combination with the high import content of exports and dollar currency pricing of exports, a nominal appreciation by China may have little impact on the current account in the short run – in fact the immediate effect may be perverse. As an alternative a fiscal adjustment either on the part of the US or China does not depend on trade elasticities, and may be effective in moving the current account. Nevertheless, there is likely to be a fundamental conflict of interest between the different countries in the welfare effects of alternative policies.

[9] Note that the fall in consumption reduces utility, while the fall in output raises utility (because of the disutility of labor supply). But since employment and output are inefficiently low to begin with, the second effect is dominated by the first.

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Table 1. Impact of Alternative Policies on *B* current account

10% Appreciation	Current account response (% of GDP)
Baseline case	1.5
f = 0	2.4
θ = 6	-1.5
10% Fiscal Subsidy	
Baseline case	-2.43
θ = 6	-2.45

Table 2. Welfare impact of policies

Baseline	Appreciation	Fiscal adjustment in *A*	Fiscal adjustment in *B*
dU_B	-	-3.7	6.8
dU_A	-	-9.1	1.33
θ = 6	Appreciation	Fiscal adjustment in *A*	Fiscal Adjustment in *B*
dU_B	-3.7	-0.9	0.33
dU_A	4.6	-3.17	2.55