Currency Appreciation and Current Account Adjustment

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1 Introduction

Global current account imbalances, more specifically the large deficit in the United States and the surplus in China and some 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 imbalance and on the exchange-rate consequences of its elimination, many policy makers have focused narrowly on the need for a renminbi revaluation. In the absence of this, 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 and 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.

This paper analyzes the impact of an exchange rate appreciation on the current account within an open economy macro model. 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. 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.

The main question we address is how policies can be designed to achieve an improvement in country A's current account. We focus on two types of policies; a) an exchange rate appreciation in country B (a relative price policy), and b) a fiscal adjustment, represented either by a country A savings subsidy, or a country B savings tax (a direct expenditure policy).

We find that for realistic trade elasticities, and incorporating the asymmetries discussed above, it may be impossible 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 limitation is point c) above. 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 however substantial debate on the size of trade elasticities. With high enough elasticities, both types of policies have the ability to improve country A's current account. But they have very different impacts on other variables. In particular, an appreciation in country B 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 off the intertemporal 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.

There is a growing literature on the interpretation of the US current account deficit and the the problem of global imbalances. The celebrated paper by Obstfeld and Rogoff (1995) 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. 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 an 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.

2 The two country model

There are two countries, A and B. Country A has a monetary policy focused entirely on internal goals, while country C 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 C 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. 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.

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.

We note that the focus only on short run policy impacts necessarily restricts the scope of our analysis. But in fact policy discussion on the problem of global imbalances has been dominated by the focus on the need for a nominal appreciation of the Chinese renminbi. This 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

$$U = \sum_{s=t}^{\infty} \beta^{s-t} \left(\frac{C_{is}^{(1-\rho)}}{1-\rho} - \eta_i H_{is} \right), \tag{2.1}$$

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. Assume for simplicity 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

$$C_i = (\alpha^{\frac{1}{\theta}} C_{ii}^{\frac{\theta-1}{\theta}} + (1-\alpha)^{\frac{1}{\theta}} C_{ij}^{\frac{\theta-1}{\theta}})^{\frac{\theta}{\theta-1}}, \quad i = A, B, \quad j \neq i, \tag{2.2}$$

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:

$$P_i = (\alpha P_{ii}^{1-\theta} + (1-\alpha) P_{ij}^{1-\theta})^{\frac{1}{1-\theta}}, \quad i = A, B, \quad j \neq i. \tag{2.3}$$

The flow budget constraint of country B is given by:

$$P_{Bt}C_{Bt} + F_{Bt+1} + S_t F_{At+1} = (1 + r_{Bt})F_{Bt} + (1 + r_{At})S_t F_{At} + \Pi_{Bt} + W_{Bt}H_{Bt}, \tag{2.4}$$

where $F_{Bt}+S_tF_{At}$ represents country i'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 i 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 production function:

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

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

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

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.

As discussed above, pricing policies are different in the two country. 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 a (country A) exchange rate depreciation, 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 [1]. This means that a 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:

$$\Pi_{At} = (Y_{AAt} + Y_{ABt})(P_{AAt} - W_{At}), \tag{2.5}$$

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.

[1] Clearly this also requires the ability to segment national markets during the period over which prices are set

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

$$\Pi_{Bt} = P_{BBt}Y_{BBt} + S_t P_{BAt}Y_{BAt} - \gamma W_{Bt}(Y_{BBt} + Y_{BAt}) - (1-\gamma)S_t P_{AAt}(Y_{BBt} + Y_{BAt}). \quad (2.6)$$

Here, in contrast to (2.5), country B's sales to A are priced in country A's currency, so that, for given P_{BAt}, a depreciation of country A's currency (a fall in S_t, since we define S_t as the currency B price of currency A) 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), a depreciation of B's currency will also increase costs 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. The details are given in an appendix, and are quite standard. 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 interests are set by a 'Taylor-type' rule, adjusting to domestic inflation (for simplicity we omit the output gap from this rule), so that:

$$R_{A(t+1)} \equiv (1 + r_{A(t+1)}) = \beta^{-1}\left(\frac{P_{At}}{P_{A(t-1)}}\right)^{\sigma_\pi}, \quad \sigma_\pi > 1. \quad (2.7)$$

The monetary policy of country B is focused 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 then wish to explore 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 $\hat{R}_{At+1} = (1 + r_{At+1})(1 + \epsilon_{At})$, 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 $\hat{R}_{At+1} = \frac{(1+r_{At+1})}{(1+\epsilon_{Bt})}$ A similar condition holds in either 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 may describe the equilibrium as follows:

$$W_{it} = \eta_i C_{it}^{\rho}, \quad i = A, B, \tag{2.8}$$

$$\frac{C_{Bt}^{-\rho}}{P_{Bt}} = E_t\beta\frac{C_{B(t+1)}^{-\rho}}{P_{B(t+1)}}(1 + r_{iB(t+1)}), \quad i = A, B. \tag{2.9}$$

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

$$\frac{C_{At}^{-\rho}}{P_{At}} = E_t\beta\frac{C_{A(t+1)}^{-\rho}}{P_{A(t+1)}}(1 + r_{iA(t+1)}), \quad i = A, B. \tag{2.10}$$

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

$$P_{AAt} = \hat{\lambda}W_{At}, \tag{2.11}$$

$$P_{BBt} = \hat{\lambda}[\gamma W_{Bt} + (1-\gamma)S_tP_{AAt}], \tag{2.12}$$

$$P_{BAt} = \hat{\lambda}\frac{[\gamma W_{Bt} + (1-\gamma)S_tP_{AAt}]}{S_t}, \tag{2.13}$$

$$Y_{At} = (1-\gamma)Y_{Bt} + \alpha\left(\frac{P_{AAt}}{P_{At}}\right)^{-\theta}C_{At} + (1-\alpha)\left(\frac{S_tP_{AAt}}{P_{Bt}}\right)^{-\theta}C_{Bt}, \tag{2.14}$$

$$\begin{aligned} Y_{Bt} &= Y_{BBt} + Y_{BAt} \\ &= \alpha\left(\frac{P_{BBt}}{P_{Bt}}\right)^{-\theta}C_{Bt} + (1-\alpha)\left(\frac{P_{BAt}}{P_{At}}\right)^{-\theta}C_{At}. \end{aligned} \tag{2.15}$$

Equations (2.8) describe the implicit labor supply equation in each country. Equation (2.9) is country B's Euler equation governing optimal inter-temporal consumption behavior, described for assets of each currency denomination. Equation (2.10) is country B's inter-temporal Euler equation for each type of asset. Equations (2.11), (2.12), and (2.13) describe the optimal pricing of the representative firm in country A and B. The notation $\hat{\lambda} = \frac{\lambda}{1-\lambda}$ represents the optimal monopoly markup for the case of constant elasticity of demand. 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, (2.14) and (2.15) 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 [2]. 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 log-linearize the model around this initial steady state. Denote lower case letters as log deviations from the initial steady state, hence $x_t = \ln(X_t) - \ln(\bar{X})$. We define the log deviation of the country B terms of trade as τ_t.

[2] 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.

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 with certainty, the two assets must be perfect substitutes thereafter. Hence it must be that $1 + r_{A(v+1)} = \frac{S_{Bv}}{S_{B(v+1)}}(1 + r_{B(v+1)})$ for all periods $v \geq t$, i.e. after the initial shock. Hence, from time $t+1$ onwards, we may define a composite net foreign assets aggregate $F_{t+1} = F_{A(t+1)} + S_{t+1}F_{B(t+1)}$, which carries a return $r_{A(t+1)}$ [3].

Using the assumptions made so far, and the definition of the price index, we may write the log deviation in $\frac{P_{BB}}{P_B}$, 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):

$$-(1-\alpha\gamma)\tau_{t+1} = \rho c_{Bt}, \tag{2.16}$$

[3] 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.

$$(1-\alpha)\tau_{t+1} = \rho c_{At}. \tag{2.17}$$

The intuition behind (2.16) 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, reducing its terms of trade τ. The opposite applies to (2.17).

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

$$y_{B(t+1)} = \alpha\gamma c_{B(t+1)} + (1-\alpha\gamma)c_{A(t+1)} + \theta\alpha((1-\alpha)\gamma + (1-\alpha\gamma))\tau_{t+1}. \tag{2.18}$$

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:

$$c_{B(t+1)} = \bar{r}\frac{dF_t}{\bar{P}\bar{C}} + y_{B(t+1)} - \frac{(1-\gamma) + \gamma(1-\alpha)}{\gamma}\tau_{t+1} \tag{2.19}$$

The notation $\bar{r}\frac{dF_t}{\bar{P}\bar{C}}$ on the right hand side of (2.19) 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 $\Delta c_{t+1} = c_{Bt} - c_{At}$ as the difference in the consumption movement between country B and country A in period $t+1$. Combining (2.16), (2.17), (2.18) and (2.19), we arrive at the following relationship between consumption in period $t+1$ and the change in net foreign assets:

$$\Delta c_{t+1} = \bar{r}\frac{dF_t}{\bar{P}\bar{C}}\frac{1}{(1-\alpha\gamma+\rho\sigma)}, \tag{2.20}$$

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 (2.20) gives a link from the impact of a currency appreciation or a fiscal policy shock in period 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:

$$y_{Bt} = \alpha\gamma c_{Bt} + (1-\alpha\gamma)c_{At} + \theta\alpha\gamma(1-\alpha)s_t. \tag{2.21}$$

This 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 (2.18) with (2.21)). 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. 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 (2.10) and (2.9) in the two countries, and again, writing in terms of country relatives responses, we have:

$$\Delta c_t = \frac{1}{1+\gamma(1-2\alpha)}\Delta c_{t+1} + \alpha\frac{S_t}{\rho} + \frac{\epsilon_t}{\rho}, \tag{2.22}$$

where $\epsilon_t \equiv \epsilon_{At} + \epsilon_{Bt}$. 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 coefficient 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 (2.16) and (2.17), 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:

$$c_{Bt} + \frac{dF_t}{\bar{P}\bar{C}} = y_{Bt} - \alpha\frac{(1-\gamma)}{\gamma}s_t + (1+\bar{r})fs_t, \tag{2.23}$$

where $f \equiv \frac{F_{At}}{PC}$. The right hand side of this expression indicates that the movement in country B's income depends positively on total output, and 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 depreciation increases the real value of bond holdings, and raises real income.

Now putting together (2.23) and (2.21), we get:

$$(1-\alpha\gamma)\Delta c_t + \frac{dF_t}{\bar{P}\bar{C}} = \left(\theta\alpha\gamma(1-\alpha) - \alpha\frac{(1-\gamma)}{\gamma} + (1+\bar{r})f\right) s_t. \tag{2.24}$$

Combining this with (2.20), we have:

$$(1-\alpha\gamma)\Delta c_t + \frac{(1-\alpha\gamma+\rho\sigma)}{\bar{r}}\Delta c_{t+1} = \left(\theta\alpha\gamma(1-\alpha) - \alpha\frac{(1-\gamma)}{\gamma} + (1+\bar{r})f\right) s_t. \tag{2.25}$$

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 (2.22) 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 $\frac{dF_t}{\bar{P}\bar{C}}$.

The resulting expressions for Δc_t and $\frac{dF_t}{\bar{P}\bar{C}}$ are:

$$\Delta c_t =$$

$$\left[\upsilon\left(\frac{\alpha(\theta\gamma(1-\alpha) - \frac{(1-\gamma)}{\gamma} - \frac{1-\alpha\gamma}{\rho}) + (1+\bar{r})f}{\Gamma}\right) + \frac{\alpha}{\rho}\right] s_t$$

$$+\left[\frac{(1-\alpha\gamma)+\rho\sigma}{\Gamma}\right]\frac{\epsilon_t}{\bar{r}\rho} \tag{2.26}$$

$$\frac{dF_t}{\bar{P}\bar{C}} =$$

$$\frac{(1-\alpha\gamma)+\rho\sigma}{\bar{r}\Gamma}\left[\left(\alpha(\theta\gamma(1-\alpha) - \frac{(1-\gamma)}{\gamma} - \frac{1-\alpha\gamma}{\rho}) + (1+\bar{r})f\right) s_t\right]$$

$$-\frac{(1-\alpha\gamma)+\rho\sigma}{\bar{r}\Gamma}\left[(1-\alpha\rho)\frac{\epsilon_t}{\rho}\right], \tag{2.27}$$

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

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.

2.6.3 Appreciation and the Current Account

From equation (2.27), the condition required for an exchange rate appreciation to reduce the current account for country B is that

$$\alpha(\theta\gamma(1-\alpha) - \frac{(1-\gamma)}{\gamma} - \frac{1-\alpha\gamma}{\rho}) + (1+\bar{r})f > 0. \tag{2.28}$$

This rather complicated expression can be broken down in the following way. Take the special case with no imports in production, so that $\gamma = 1$, and zero initial foreign currency bond holdings, so that $f = 0$. In this case, the condition becomes

$$\theta - \frac{1}{\rho} > 0$$

. 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 is changed significantly. In this case, as we saw from (2.23), an appreciation of the currency raises real income 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 currency A denominated bonds reduces saving, and the current account.

Will an appreciation reduce the current account? We can speculate on this question by inserting some plausible parameter estimates in (2.27). 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 $\alpha = .9$, so that imports to GDP in country A equals 11 percent. In China, the ratio of exports to GDP is 29 percent. In the model, this is $\frac{1-\alpha\gamma}{\gamma}$. To match this, given $\alpha = .9$ implies that $\gamma = 0.84$. This implies that imported intermediates account for 16 percent of production in China.

We follow Obstfeld and Rogoff (2005) in setting $\theta = 2$, and follow common practice in assuming $\rho = 1$ (log inter-temporal utility). To estimate valuation effects, we use the ratio of China's US dollar reserves (roughly 500 billion US dollars) to its PPP based GDP. We estimate this at 16 percent, so that $f = .16$. Finally, we assume that $\bar{r} = .02$.

Table 1 reports the estimated of a one 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 slightly. 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.

Since the contribution of wealth effects due to devaluation of gross asset holdings actually work so as to reduce the current account, if these effects are absents (i.e. $f = 0$), the positive impact of an appreciation on the current account is larger. On the other hand, if we assume a larger trade elasticity, setting $\theta = 5$, then expenditure switching is much larger, and the appreciation leads to a current account deterioration.

We note also that the impact of currency appreciation on the current account is quite small. In the baseline case, a one percent appreciation leads to an improvement in the current account, but by less than 0.1 percent of GDP. With a higher trade elasticity ($\theta = 5$), the appreciation leads to a current account deterioration of .14 percent of GDP. To reduce the current account by 4 percent of GDP in this case, this would require a 28 percent currency appreciation.

Table 1.	
Appreciation	Current Account Country B
Baseline	0.08
f=0	0.24
$\theta = 5$	-.14
Fiscal Policy	
Baseline	-0.24

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 quite small. The key channel which limits the impact of an appreciation on the current account is 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.

2.6.4 Fiscal Policy and the Current Account

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 1 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 0.24 percent of GDP. Moreover, unlike the impact of an appreciation this estimate is quite insensitive to alternative values of the trade elasticity.

2.6.5 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 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. But if the country A trade balance improves, this means 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 countries 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. Because the terms of trade is unchanged, output falls by an equal proportion 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.

3 Conclusions

To be added..

References

[1] Friedman, Milton, (1953), "The Case for Flexible Exchange Rates, in Essays in Positive Economics (Chicago: University of Chicago Press), 157-203.

[2] Lane, Philip R., (2001), "The New Open Economy Macroeconomics: a Survey", Journal of International Economics 54, 235-266.

[3] Obstfeld, Maurice and Kenneth Rogoff, (1995), "Exchange rate Dynamics Redux", Journal of Political Economy 103, 624-660.

[4] Obstfeld, Maurice and Kenneth Rogoff, (2002), "The Unsustainable US Current Account Revisited", NBER d.p. 10869.