Current Account Lecture Part Two

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Econ 434

Fall 2006

1. Introduction

Suppose that an economy has a large current account deficit as in the US. There are two questions we might want to ask. First, is the current account imbalance sustainable? Second, if not, how smooth will the adjustment be? That is, will the landing be smooth or some alternative to that? That is the question we turn to.

2. Sustainability

What do we mean by sustainability? This has something to do with the intertemporal budget constraint. In particular, can the economy continue to finance its current account deficit. When might a country be cut off from international borrowing?

It is useful to begin with the definition of the current account balance:

$$CA_t = K^f_{t+1} - K^f_t = Y_t + rK^f_t - C_t - G_t - I_t. \tag{1}$$

This can be re-written as

$$(1+r)K^f_t = C_t + G_t + I_t - Y_t + K^f_{t+1} \tag{2}$$

This is true for any period, so we can now move this forward one period:

$$(1+r)K^f_{t+1} = C_{t+1} + G_{t+1} + I_{t+1} - Y_{t+1} + K^f_{t+2}$$

or

$$K^f_{t+1} = \frac{C_{t+1} + G_{t+1} + I_{t+1} - Y_{t+1} + K^f_{t+2}}{1+r} \tag{3}$$

$$= \frac{C_{t+1} + G_{t+1} + I_{t+1} - Y_{t+1}}{1+r} + \frac{K^f_{t+2}}{1+r} \tag{4}$$

Now use expression (4) in (2) to eliminate K^f_{t+1} :

$$(1+r)K^f_t = C_t + G_t + I_t - Y_t + \frac{C_{t+1} + G_{t+1} + I_{t+1} - Y_{t+1}}{1+r} + \frac{K^f_{t+2}}{1+r} \tag{5}$$

and if you do this again you will get

$$(1+r)K^f_t = C_t+G_t+I_t-Y_t+\frac{C_{t+1} + G_{t+1} + I_{t+1} - Y_{t+1}}{1+r}+\frac{C_{t+2} + G_{t+2} + I_{t+2} - Y_{t+2}}{(1+r)^2}+\frac{K^f_{t+3}}{(1+r)^2},$$

and if we do it one more period we get:

$$\begin{aligned}(1+r)K^f_t &= C_t + G_t + I_t - Y_t + \frac{C_{t+1} + G_{t+1} + I_{t+1} - Y_{t+1}}{1+r} + \frac{C_{t+2} + G_{t+2} + I_{t+2} - Y_{t+2}}{(1+r)^2} \\ &\quad + \frac{C_{t+3} + G_{t+3} + I_{t+3} - Y_{t+3}}{(1+r)^3} + \frac{K^f_{t+4}}{(1+r)^3}\end{aligned}$$

We can see a pattern emerging. Notice that each time we keep moving the net foreign assets term farther to the future. Suppose we kept doing this all the way to some T far in the future. We would have:

$$(1+r)K^f_t = \sum_{s=t}^{t+T} \left(\frac{1}{1+r}\right)^{s-t} [C_s + I_s + G_s - Y_s] + \left(\frac{1}{1+r}\right)^T K^f_{t+T+1}. \tag{6}$$

Expression (6) is interesting. The first term is just the present value of *net imports*.[1] The second term is the present value of net foreign assets sometime far in the future. Our interest starts with this term.

How should we think about this "terminal" value of net foreign assets? In a finite horizon model we know this would have to be zero: we cannot have negative net assets in the last period of life since there is no future in which to pay it back. But it could not be optimal to have positive net foreign assets in the last period because we would never get to consume. So in a finite horizon model we would have something like $(1+r)^{-T}K^f_{t+T+1} = 0$. Of course this can be true only if $K^f_{t+T+1} = 0$. Now in the infinite horizon we just let $T \to \infty$. As $T \to \infty$ we require the present value of future net foreign assets to go to zero: $\lim_{T\to\infty} \left(\frac{1}{1+r}\right)^T K^f_{t+T+1} = 0$ Why?

[1] Or the present value of the negative of net exports. Or the present value of the negative of the trade balance.

- If $\lim_{T\to\infty}(1+r)^{-T}K^f_{t+T+1} < 0$ we would be running a Ponzi scheme.[2] If you examine (6) it is apparent that with $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T K^f_{t+T+1} < 0$ that the present value of what we spend is forever greater than what we produce. Foreigners would be lending to us continuously without end. Obviously our debt would have to grow faster than the rate of interest for $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T K^f_{t+T+1}$ to be strictly negative. But they would not do so, since they could consume resources themselves. No economy will provide resources to another for free forever. Hence, we cannot have $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T K^f_{t+T+1} < 0$

- What about the opposite: what if $\lim_{T\to\infty}(1+r)^{-T}K^f_{t+T+1} > 0$? This would mean that the present value of all the resources the home country uses never converges up to the present value of output. We would be making an unrequited gift to foreigners. This cannot be optimal. We would never consume all we produce.

Since we have shown that the present value of net foreign assets cannot become strictly negative or strictly positive as T goes to infinity, it follows that we have to have the condition that $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T K^f_{t+T+1} = 0$.

These considerations imply that our intertemporal budget constraint can be simplified. It now can be written as

$$(1+r)K^f_t = \sum_{s=t}^{t+T}\left(\frac{1}{1+r}\right)^{s-t}[C_s + I_s + G_s - Y_s]$$

which we can re-write as:

$$\begin{aligned} -(1+r)K^f_t &= \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}[Y_s - C_s - I_s - G_s] &(7)\\ &= \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}[TB_s] &(8)\end{aligned}$$

[2] Charles Ponzi duped investors by offerring incredible returns, which he at first paid from the deposits of new investors. He originally planned to use the resources to arbitrage international postage stamp prices. But he never did. Once the source of new deposits slowed, his scheme unravelled. But his name is now attached to the Ponzi game.

where the term in the brackets is just the economy's net exports or trade balance. We could read this as saying that *the economy's net debt today must equal the present value of future trade surpluses.* This means that an economy's resource transfer to foreigners must equal the value of the economy's initial debt to them. What this implies is that any debt today must be offset by future surpluses. So sustainability depends on what happens to the trade balance in the future, that is what happens to consumption (savings), income, and investment in the future. You can see then that our debt at any point in time would seem sustainable if investors *expect* either fast growth of income or slower growth of consumption, investment or government spending. If investors, for example, expected that future consumption or government spending would decrease relative to income then they would not fear our ability to pay the debt back.

Remark 1 *Notice that this is not a very stringent criteria. A country could run huge trade deficits as long as it commits to huge surpluses in the future. But how can a government commit to such a path?*

Remark 2 *A much more practical criteria is thus a non-increasing ratio of debt to gdp.*

Let us now consider what are the conditions that lead to a non-increasing ratio of debt to gdp. Suppose that the growth rate of the economy is given by $g : Y_{s+1} = (1+g)Y_s$. If the economy is to maintain a steady ratio of debt to output, $\frac{K_s^f}{Y_s}$, then debt must also grow at this rate (that is $K_{t+1}^f = (1+g)K_t^f$). Then using (1):

$$K_{t+1}^f - K_t^f = gK_t^f = rK_t^f + TB_t \tag{9}$$

which implies

$$\frac{TB_t}{Y_t} = \frac{-(r-g)K_t^f}{Y_t} = \frac{-K_t^f}{Y_t/(r-g)}. \tag{10}$$

The first equality in (10) implies that to maintain a constant debt-gdp ratio we need only pay out the excess of the interest rate over the growth rate.[3] The second equality shows

[3] Why do we expect that $r > g$? Suppose the opposite, that $r < g$. Then the premium we receive from deferring consumption (r) would be less than the rate at which consumption is growing. Why save so much in that case? We could reduce k by some small amount, increase consumption today, and still have rising consumption in the future. In fact, a fall in k would *increase* the rate of return. So we would get a Pareto improvement. This is not the case, however, if $r > g$. It is, in fact, easy to show that of all the steady state values of k the one that maximizes the level of consumption is that where $r = g$. So if $r < g$ the economy is dynamically inefficient.

that the necessary trade surplus is a fraction of GDP equal to the ratio of debt to the world market value of a claim to the economy's future GDP (i.e., $\frac{Y}{r-g}$). So $\frac{-(r-g)K_t^f}{Y_t}$ measures the burden that the foreign debt imposes on the economy. The higher the burden, the greater the likelihood that the debt is unsustainable, in the sense that the debtor country finds itself unable or unwilling to repay. It is interesting to note that this ratio does not need to get very high before countries get into debt crises, though there is no automatic threshold.

Remark 3 *Here is another way to see why $r > g$ means that a trade surplus is required to insure that foreign debt does not increase. From the current account identity (1) we know that $K_{t+1}^f - K_t^f = TB_t + rK_t^f$, or $K_{t+1}^f = TB_t + (1+r)K_t^f$ If we divide through by Y_{t+1} to get things in per-unit of GDP, we have*

$$\frac{K_{t+1}^f}{Y_{t+1}} = \frac{TB_t}{Y_{t+1}} + (1+r)\frac{K_t^f}{Y_{t+1}} = \frac{TB_t}{Y_t(1+g)} + (1+r)\frac{K_t^f}{Y_t(1+g)},$$

or

$$k_{t+1}^f = \frac{tb_t}{1+g} + \frac{1+r}{1+g}k_t^f \tag{11}$$

which we can write as

$$k_{t+1}^f = \frac{tb_t}{1+g} + \theta k_t^f$$

where $\theta = \frac{1+r}{1+g}$. If $r > g$, then $\theta > 1$ so net foreign assets will decline further unless $tb > 0$. Notice that I have ignored valuation effects in the definition of the current account.

Remark 4 *Here is still another way to think about this. Again start with $K_{t+1}^f - K_t^f = TB_t + rK_t^f$. It is useful to note that $\frac{K_{t-1}^f}{Y_t} = \frac{K_{t-1}^f}{Y_{t-1}(1+g)} = k_{t-1}^f\frac{1}{1+g}$. Notice also that $k_t^f =$*

$k_t^f\left[\frac{1}{1+g}+\frac{g}{1+g}\right]$. *Then dividing the current account expression by Y_{t+1} we have*

$$\frac{K_{t+1}^f}{Y_{t+1}}-\frac{K_t^f}{Y_{t+1}} = \frac{TB_t}{Y_{t+1}}+\frac{rK_t^f}{Y_{t+1}}=\frac{TB_t}{Y_t(1+g)}+\frac{rK_t^f}{Y_t(1+g)}$$

$$k_{t+1}^f-\frac{k_t^f}{1+g} = \frac{tb_t}{1+g}+\frac{r}{1+g}k_t^f \quad (12)$$

$$k_{t+1}^f-k_t^f\left(\frac{1+g}{1+g}\right)+k_t^f\left(\frac{g}{1+g}\right) = \frac{tb_t}{1+g}+\frac{r}{1+g}k_t^f \quad (13)$$

$$k_{t+1}^f-k_t^f = \frac{tb_t}{1+g}+\frac{r}{1+g}k_t^f-\frac{g}{1+g}k_t^f \quad (14)$$

$$= \frac{tb_t}{1+g}+\frac{r-g}{1+g}k_t^f \quad (15)$$

which is another way to express the dynamics of net foreign assets.[4]

To some extent this definition is a bit circular. The reason is that if the debt looks big the interest rate that a country has to pay will get big, which will make it very difficult to satisfy (10). In reality, r is not constant for countries in difficult debt circumstances.

Example We can use expression (11) or (15) to examine what happens to net foreign assets under different scenarios. In figure 1 we have $r = 0.5$ and $g = .03$. We have four cases: a trade deficit that gradually goes to zero, a trade deficit that goes immediately to zero, a trade deficit that goes to a surplus of 1.5% of GDP, and a trade deficit that goes to 3% of GDP. Notice that with a constant decline of the trade deficit to zero (i.e., no eventual surplus) we are on a clearly unsustainable path. It is a bubble that will surely burst. Notice further, that even with the trade deficit that goes to zero immediately, net foreign assets still implode (since $r > g$). With a trade deficit that eventually reaches 1.5% of GDP we are on a stable path, but foreign debt is still 50% of GDP 34 periods into the future.

[4] If you want to check that (11) and (15) are equivalent, subtract $\frac{k_t^f}{1+g}$ from both sides of (11). You have

$$k_{t+1}^f-\frac{k_t^f}{1+g}=\frac{tb_t}{1+g}+\frac{r}{1+g}k_t^f.$$

Note that the LHS of this expression is just $k_{t+1}^f-\frac{k_t^f}{1+g}=k_{t+1}^f-\left[k_t^f\left(\frac{1+g}{1+g}\right)-\frac{gk_t^f}{1+g}\right]$, so $k_{t+1}^f-k_t^f=\frac{tb_t}{1+g}+\frac{r-g}{1+g}k_t^f$, which is expression (15).

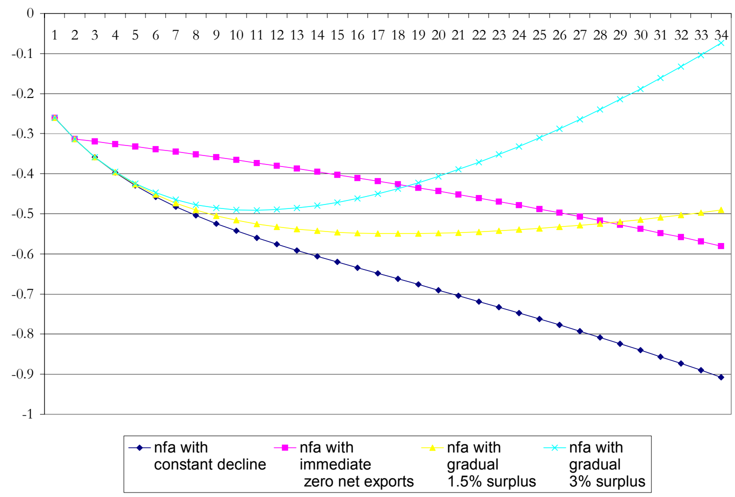

Figure 1: Debt Dynamics ($r = .05, g = .03$)

It is interesting to see what happens if the interest rate rises by 1%. Notice that in this case even when the trade balance goes to a surplus of 1.5% of GDP we are still on an dangerous path, with net foreign assets continuing to decline. Only in the case of the very optimistic trade deficit path are we on a stable path. It is important to note that in this example, we have a 6.5% improvement in the trade balance, from -0.05 to $. - .015$. This is quite a large change in the trade balance. One question is what could induce such a change in domestic spending.

Remark 5 *It is important to recall why we are looking at the trade balance paths and not the current account. Suppose that the current account remained at a constant share of GDP, for example. Since net foreign assets are negative, and since the current account is currently negative, interest payments on the foreign debt would continue to rise. This would mean that the trade deficit would have to decline – and go into surplus – to make room for the higher debt service. This is what happens to countries that are highly indebted. Eventually, they run deficits solely to finance past deficits, even if they are no longer living beyond their means. The trade surplus is the equivalent to the primary deficit in government budgets. The actual deficit is the primary deficit (current spending – net of interest payments – less taxes) plus interest payments on the national debt.*

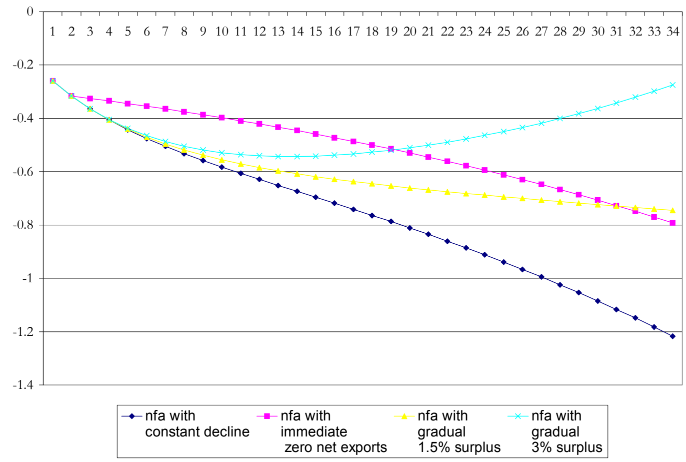

Figure 2: Debt Dynamics ($r = .06, g = .03$)

It is also worth noting what happens if the interest rate goes to 8%. This could happen in a financial crisis, for example. In that case, even with an optimistic trade balance path we only see doom. This shows the importance of the interest rate. In particular, if lenders fear default and demand a risk premium, then $r - g$ increases and the path quickly becomes unsustainable.With the chosen parameters, a spread of $r - g = 7.3\%$ stabilizes the most

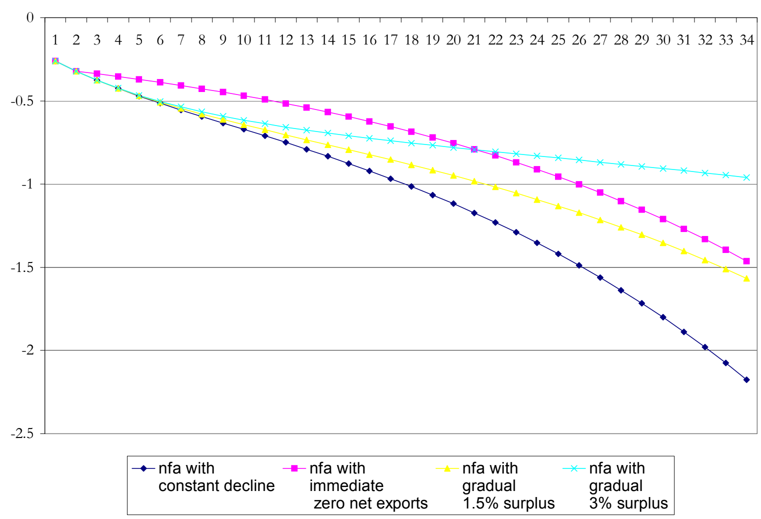

Figure 3: Debt Dynamics with $r = .08, g = .03$

optimistic path.

Also it is important to emphasize that it is $r - g$ that matters. If the current account deficit is incurred to increase productivity, presumably it will increase g. This is why we expect developing countries to have capital inflows.[5] So another question investors will ask is what will happen to the growth rate in the near future.

2.0.1. Valuation Effects

What about valuation effects? These are important for the US and perhaps other large economies. Basically they arise from two sources, differences in rates of return on assets and liabilities, and capital gains and losses that arise from the ability to borrow in domestic currency. How do valuation effects alter our understanding of debt dynamics?

Start with the current account identity augmented for capital gains:

$$K_t^f - K_{t-1}^f = CA_{t-1} + KG_t \tag{16}$$

where we have a slight change in the timing. Our net foreign asset position in time t depends on the current account balance and on any capital gains or losses on net foreign assets. Separating the current account into the trade balance and interest income we have:

$$K_t^f - K_{t-1}^f = TB_{t-1} + i^A A_{t-1} - i^L L_{t-1} + KG_t \tag{17}$$

where $i^A A_{t-1}$ is interest on gross foreign assets and likewise for liabilities, L. Notice that $K_{t-1}^f \equiv A_{t-1} - L_{t-1}$. We want to express variables in terms of ratios to output. It is useful to note that $\frac{K_{t-1}^f}{Y_t} = \frac{K_{t-1}^f}{Y_{t-1}(1+g)} = k_{t-1}^f \frac{1}{1+g}$. Notice also that $k_{t-1}^f = k_{t-1}^f \left[\frac{1}{1+g} + \frac{g}{1+g}\right]$, so that $k_{t-1}^f \frac{1}{1+g} = k_{t-1}^f - \frac{g}{1+g} k_{t-1}^f$. Hence, dividing both sides of (17) by Y_t we have:

$$k_t^f - k_{t-1}^f \left(\frac{1}{1+g}\right) = \frac{tb_{t-1}}{1+g} + \frac{i^A A_{t-1} - i^L L_{t-1}}{Y_t} + \frac{KG_t}{Y_t}$$

or

$$k_t^f - k_{t-1}^f + \frac{g}{1+g} k_{t-1}^f = \frac{tb_{t-1}}{1+g} + \frac{i^A A_{t-1} - i^L L_{t-1}}{Y_t} + \frac{KG_t}{Y_t}$$

[5] This is also why the current period seems so strange – capital flowing from the emerging to the rich (US) countries. We will offer some explanations later.

$$
\begin{aligned}
k_t^f - k_{t-1}^f &= \frac{tb_{t-1}}{1+g} + \frac{i^A A_{t-1} - i^L L_{t-1}}{Y_t} + \frac{KG_t}{Y_t} - \frac{g k_{t-1}^f}{1+g} \\
&= \frac{tb_{t-1}}{1+g} + \frac{i^A A_{t-1} - i^L L_{t-1} + KG}{Y_t} - \frac{g k_{t-1}^f}{1+g} \qquad (18)
\end{aligned}
$$

Now suppose that $KG_t = kg^A A_t - kg^L L_t$, that is capital gains are proportional to gross assets and liabilities. Then we can write (18) as

$$
k_t^f - k_{t-1}^f = \frac{tb_{t-1}}{1+g} + \frac{i_t^A A_{t-1} - i_t^L L_{t-1} + kg^A A_{t-1} - kg^L L_{t-1}}{Y_t} - \frac{g k_{t-1}^f}{1+g}. \qquad (19)
$$

Let $r_t^A = i_t^A + kg_t^A$ and likewise for liabilities. Then (19) can be simplified:

$$
k_t^f - k_{t-1}^f = \frac{tb_{t-1}}{1+g} + \frac{r_t^A A_{t-1} - r_t^L L_{t-1}}{Y_t} - \frac{g k_{t-1}^f}{1+g}. \qquad (20)
$$

Now let a_t and l_t be assets and liabilities as a share of gdp. Then $\frac{A_{t-1}}{Y_t} = a_{t-1}\left(\frac{1}{1+g}\right)$. Expression (20) can be written as:

$$
k_t^f - k_{t-1}^f = \frac{tb_{t-1}}{1+g} + \left(r_t^A a_{t-1} - r_t^L l_{t-1}\right)\frac{1}{1+g} - \frac{g k_{t-1}^f}{1+g} \qquad (21)
$$

Since $k^f = a - l$ by definition, we can write (21) as

$$
\begin{aligned}
k_t^f - k_{t-1}^f &= \frac{tb_{t-1}}{1+g} + \frac{r_t^A a_{t-1} - r_t^L l_{t-1}}{1+g} - \frac{g(a_{t-1} - l_{t-1})}{1+g} \\
&= \frac{tb_{t-1}}{1+g} + \frac{(r_t^A - g)a_{t-1}}{1+g} + \frac{(g - r_t^L)l_{t-1}}{1+g} \\
&= \frac{tb_{t-1}}{1+g} + \frac{(r_t^A - g)a_{t-1}}{1+g} + \frac{(g - r_t^L)(a_{t-1} - k_{t-1}^f)}{1+g}
\end{aligned}
$$

cancelling and collecting terms we obtain:

$$
k_t^f - k_{t-1}^f = \frac{tb_{t-1}}{1+g} + \frac{(r_t^A - r_t^L)}{1+g}a_{t-1} + \frac{r_t^L - g}{1+g}k_{t-1}^f. \qquad (22)
$$

The last term on the RHS of (22) is the legacy term we have encountered before. If the interest rate on debt exceeds the rate of growth we know that a positive trade balance is needed to maintain a constant ratio of net foreign assets to gdp. The new term is the middle term, $\frac{(r_t^A - r_t^L)}{1+g}a_{t-1}$, which is the *valuation effect*. If $r_t^A = r_t^L$ this term is zero and we have no valuation effect. But if $r_t^A > r_t^L$, that is we earn more on our assets than we pay on our debt, then net foreign assets can rise even if $\frac{tb_{t-1}}{1+g} + \frac{r_t^L - g}{1+g} k_{t-1}^f = 0$. This means that the gross scale of foreign assets matters.

These valuation effects matter. Consider figure 4 where we use pessimistic assumptions about r and g and assume that the trade balance goes gradually to a 1.5% surplus. Without the valuation effect we are on a doomed trajectory. But with valuation effects of 3% of GDP – a plausible level given recent estimates,[6] net foreign assets turn positive.

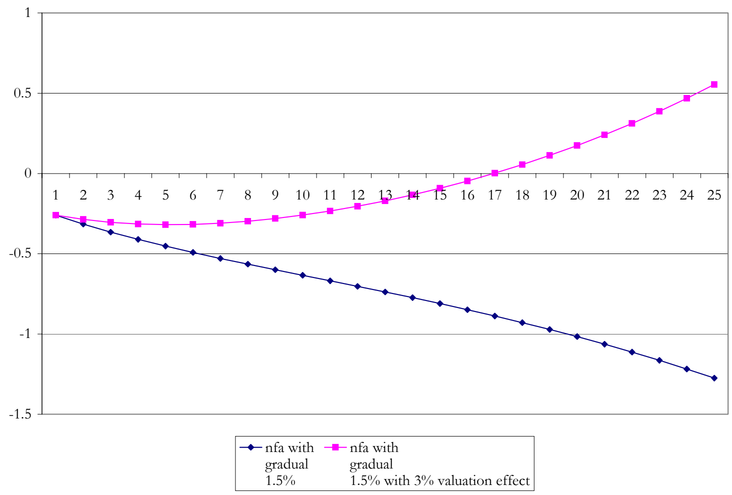

Figure 4: Net foreign assets with a valuation effect of 3% of GDP ($r = . - 08, g = .02$)

What causes positive valuation effects? Notice that this can only occur when foreign and domestic assets are not perfect substitutes. This will become important when we talk about interest parity. Imperfect substitutability leads to equilibrium interest differentials, perhaps due to a risk premium.

One key is the exorbitant privilege: we borrow in our own currency. Suppose the dollar unexpectedly (so it does not effect interest differentials) depreciates. Then the dollar rate of return on external assets will rise, and hence improve the net foreign asset position. In contrast, for emerging markets that are net debtors and whose external liabilities are primarily denominated in foreign currency, a real exchange rate depreciation raises the domestic-currency burden of foreign liabilities. This is an important problem for emerging market economies

[6] See, for example, the paper by Gourinchas and Rey, http://www.nber.org/~confer/2005/cas05/rey.pdf.

that are in a crisis situation. More generally, differential changes in asset prices (for example, in stock prices) across countries will tend to drive a wedge between returns on external assets and liabilities. This can especially happen if the US is a safe haven, or foreign countries seem very risky so that funds flow to the US due to lack of investment opportunities elsewhere.

A related reason why the US has positive valuation effects is that assets and liabilities are not effectively matched. The US tends to borrow short and invest long. Much of the liabilities are in T-Bills and other debt instruments. But US foreign assets are often equity investments. We are kind of like a bank. We intermediate the savings of the rest of the world and invest it overseas. But as with any bank there is always the threat of a bank run.

Notice, however, that the exorbitant privilege can evaporate. One big part is the capital gain we earn due to dollar depreciation; see figure 5. But how long will foreign lenders be willing to lend to the US and absorb such losses? Sustained capital losses, especially if the dollar is expected to depreciate further, could lead them to diversify portfolios. In that case, the gain from dollar depreciation is wiped out by the need to pay higher interest rates on new borrowing. But if $r^L \to r^A$ then the valuation effect goes to zero, or could even turn negative. If portfolio diversification goes far enough we lose the privilege altogether. How could this happen? A switch to the euro perhaps.

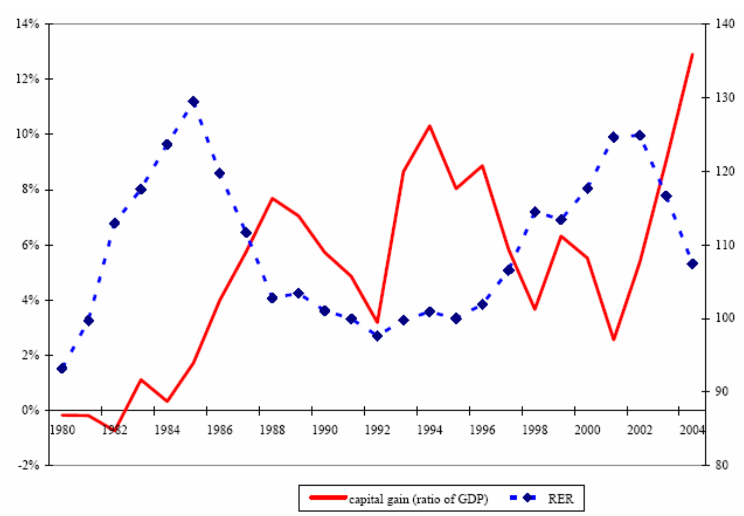

Figure 5: Dollar Depreciation and US Capital Gains

One reason this has not happened yet is that the major lender to the US recently has been central banks, rather than private investors. According to the BIS central banks purchased $440 billion worth of dollar assets in 2003, and probably even more in the last couple of years.[7] Central Bankers are less concerned with rates of return than private individuals. They may be willing to accept losses for other goals. But for how long? That is obviously a key question for sustainability.

3. Real Exchange Rate

Notice that to talk about adjustment of the current account we need to introduce the real exchange rate. Why? Why can't interest rates induce adjustment of the current account imbalance? The problem is that the interest rate coordinates savings and investment across countries. An increase in interest rates would certainly increase US savings and reduce investment, *ceteris paribus*. So one might think that this would result in an improvement in the current account. But a moment's reflection should make it clear that this will also lead to increases in savings in the rest of the world. But for the US current account balance to improve, someone else's current account balance must deteriorate. Hence, we need some change in a relative price that affects countries *differentially*. The interest rate affects countries symmetrically, so it cannot lead to the adjustment we need.

The real exchange rate is the critical variable (along with the rate of interest) in determining the capital account. As we shall see, this is because the real exchange rate is the relative price of goods across countries. Hence, changes in the real exchange rate affect the competitiveness of traded goods.

The nominal exchange rate, S, refers to the dollar price of foreign exchange.[8] As with most variables in economics we distinguish between the nominal and *real* values. The real exchange rate measures the cost of foreign goods relative to domestic goods. It gives a measure of

[7] Much of this from developing countries. According to Obstfeld: "In 2004, for example, developing countries' net lending to the United States was about $246 billion, out of the overall U.S. deficit of $666 billion. These same countries, however, accumulated even more dollar reserves in that year – primarily liquid dollar claims on the U.S. Treasury (p. 4)." See http://elsa.berkeley.edu/~obstfeld/KN_Obstfeld.PDF

[8] I use an S to denote spot exchange rate.

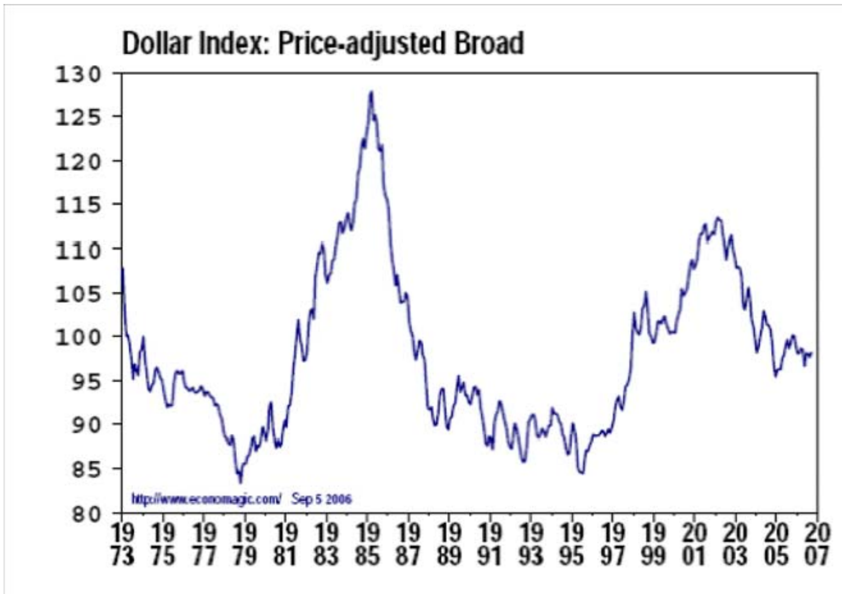

Figure 6: Real Exchange Rate of the Dollar

competitiveness, and it is a useful variable for explaining trade behavior and national income.

One of the great puzzles in international macroeconomics is why the real exchange rate is so volatile. Consider figure 6 which shows the real exchange rate since 1973. You can see that the real exchange rate is not only volatile, it does not appear to move around some equilibrium level. There are long swings. Given that this is a relative price one would suspect that such large changes would have big welfare implications on the economy. This is a second surprise – it appears that this is not the case either. These are two points to think about.

3.1. Definition

We can define the real exchange rate, Q, by

$$Q = \frac{SP^*}{P} \tag{23}$$

where P^* is the price level in the foreign country. An *appreciation* of the real exchange rate indicates that the foreign price (in dollars) of a bundle of goods has risen relative to the domestic price. If the real exchange rate appreciates it means that the real value of the dollar has depreciated; that is, the purchasing power of the dollar has fallen in relative terms.

Notice that to define the real exchange rate we need to specify the price levels. If the baskets of goods in the domestic and foreign countries were the same this would be straightforward; in practice, they are not. We typically use some broad measure of the price level, such as the GDP deflator or the CPI. It should be noted that this means that P will place a relatively heavy weight on goods produced and consumed domestically, while P^* will likewise place a relatively heavier weight on goods produced in the foreign country.[9] We will soon see the importance of this.

What causes changes in Q? Two specific causes are worth discussing here.

1. *A change in world relative demand for US goods.* Suppose that preferences shifted so that total world spending on US goods increased. This could be due to shifts in private demand towards US goods, or an increase in US government spending which is concentrated on US goods. At current exchange rates this would cause an excess demand for US goods. To restore equilibrium the relative price of US goods must rise relative to foreign goods; hence, Q must fall, and the dollar has appreciated in real terms. In other words, the purchasing power of the dollar has increased relative to foreign goods.

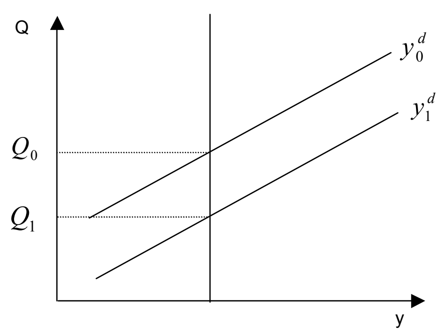

Figure 7: An Increase in the Demand for Domestic Goods

2. *A change in relative output supply.* Suppose that there is a relative technological shock that increases the efficiency of US output relative to foreign output. With given stocks of capital and labor US output rises. Hence, at unchanged world demand there is an excess

[9] This is especially true because of non-traded goods, which we shall discuss shortly.

supply of US output. Why? This positive supply shock raises US income (wealth), but not all of the increase in income is spent on domestic goods. Some will be spent on foreign goods. Hence, the increase in the demand for US goods will be less than the supply. To restore equilibrium the relative price of US goods must fall; in other words, Q must rise, and the dollar must fall in real terms. This real depreciation of the dollar (or real appreciation of the foreign currency, say the DM) means that the purchasing power of the foreign currency has increased. Thus relative productivity growth causes the real exchange rate to appreciate and the real value of the currency to depreciate.

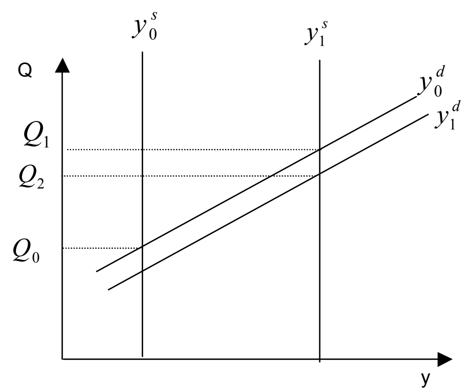

Figure 8: A change in relative supply

We will return to the topic of real exchange rate movements after we take a detour to discuss exchange rate determination when the real exchange rate is constant.

Why is the real exchange rate so important for thinking about the current account? Because it is the relative price of foreign goods in terms of domestic goods, changes in this variable will impact net exports, and hence, the current account. If a current account deficit is to be reversed an appreciation of the real exchange rate may be one of the mechanisms of adjustment.

3.2. A Special Case: Purchasing Power Parity

An interesting case to consider is the special case where the real exchange rate is constant over time. Suppose that the basket of goods that were produced in the US and Germany were identical, and that all goods were tradeable. In that case, net of transportation costs we would have the law of one price: arbitrage would insure that the dollar prices of the various goods would be identical across countries. This yields a theory of exchange rate determination known as PPP.

Notice that we could use the definition of the real exchange rate to write:

$$S_t = \frac{Q_t P}{P^*} \tag{24}$$

Now suppose that the real exchange rate is constant over time; hence, $Q_t = \overline{Q}$ for all time. Then

$$S_t = \frac{\overline{Q} P}{P^*} \tag{25}$$

and it follows that any changes in national price levels results in a movement of the exchange rate. PPP thus determines the exchange rate by the movements in relative price levels. If US inflation is higher than foreign inflation the exchange rate will appreciate and the dollar will depreciate relative to the foreign currency. It will take more dollars to purchase a DM. This is intuitive: the nominal exchange rate is the relative price of currencies, and inflation is the measure of the decrease in purchasing power of a currency. If the dollar is losing purchasing power faster than a DM, then the DM should gain in value relative to the dollar.

This can be seen more clearly, perhaps, by taking logs of both sides of (25):

$$s_t = \overline{q} + p_t - p_t^* \tag{26}$$

where we have used lower-case letters to refer to the log of a variable.[10] Now suppose we take first differences of (26), i.e., $\Delta s_t \equiv s_t - s_{t-1}$:

$$\Delta s_t = \Delta p_t - \Delta p_t^*. \tag{27}$$

Expression (27) says that the percentage change in the nominal exchange rate is equal to the difference between the inflation rates in the domestic and the foreign country.[11] When price

[10] If you detest taking logs see equation **??** where we derived the same expression without taking logs.

[11] Recall that $\frac{X_t - X_{t-1}}{X_{t-1}} = \frac{X_t}{X_{t-1}} - 1$ is the percentage change in X, and thus $1 + g = \frac{X_t}{X_{t-1}}$, where x is the percentage growth rate. Now if we take logs of this expression, for small g, it follws that $log(1 + g) \approx g \approx x_t - x_{t-1} \equiv \Delta x_t$.

levels are changing very rapidly these movements can dwarf all other factors, and then PPP provides a rather effective theory of exchange rate movements.

A simple example of this theory is provided by the Big Mac index. The Big Mac is essentially the same good in every country. Hence, we can compare the dollar price of Big Mac's across countries. Where the currency appears over-valued we should expect the exchange rate to appreciate, and vice versa. This does surprisingly well. See figure 9.

The hamburger standard

	Big Mac price in dollars*	Implied PPP† of the dollar	Under (−)/ over (+) valuation against the dollar, %
United States‡	3.06	–	–
Argentina	1.64	1.55	-46
Australia	2.50	1.06	-18
Brazil	2.39	1.93	-22
Britain	3.44	1.63§	+12
Canada	2.63	1.07	-14
Chile	2.53	490	-17
China	1.27	3.43	-59
Czech Republic	2.30	18.4	-25
Denmark	4.58	9.07	+50
Egypt	1.55	2.94	-49
Euro area	3.58**	1.05††	+17
Hong Kong	1.54	3.92	-50
Hungary	2.60	173	-15
Indonesia	1.53	4,771	-50
Japan	2.34	81.7	-23
Malaysia	1.38	1.72	-55
Mexico	2.58	9.15	-16
New Zealand	3.17	1.45	+4
Peru	2.76	2.94	-10
Philippines	1.47	26.1	-52
Poland	1.96	2.12	-36
Russia	1.48	13.7	-52
Singapore	2.17	1.18	-29
South Africa	2.10	4.56	-31
South Korea	2.49	817	-19
Sweden	4.17	10.1	+36
Switzerland	5.05	2.06	+65
Taiwan	2.41	24.5	-21
Thailand	1.48	19.6	-52
Turkey	2.92	1.31	-5
Venezuela	2.13	1,830	-30

*At current exchange rates †Purchasing-power parity
‡Average of New York, Chicago, San Francisco and Atlanta
§Dollars per pound **Weighted average of member countries
Sources: McDonald's; *The Economist* ††Dollars per euro

	Big Mac price in dollars*	Implied PPP† of the dollar	Under (−)/ over (+) valuation against the dollar, %
Aruba	2.77	1.62	-10
Bulgaria	1.88	0.98	-39
Colombia	2.79	2124	-9
Costa Rica	2.38	369	-22
Croatia	2.50	4.87	-18
Dominican Rep	2.12	19.6	-31
Estonia	2.31	9.64	-24
Fiji	2.50	1.39	-18
Georgia	2.00	1.19	-34
Guatemala	2.20	5.47	-28
Honduras	1.91	11.7	-38
Iceland	6.67	143	+118
Jamaica	2.70	53.9	-12
Jordan	3.66	0.85	+19
Latvia	1.92	0.36	-37
Lebanon	2.85	1405	-7
Lithuania	2.31	2.12	-24
Macau	1.40	3.66	-54
Macedonia	1.90	31.0	-38
Moldova	1.84	7.52	-40
Morocco	2.73	8.02	-11
Nicaragua	2.11	11.3	-31
Norway	6.06	12.7	+98
Pakistan	2.18	42.5	-29
Paraguay	1.44	2941	-53
Qatar	0.68	0.81	-78
Saudi Arabia	2.40	2.94	-22
Serbia & Montenegro	2.08	45.8	-32
Slovakia	2.09	21.6	-32
Slovenia	2.56	163	-16
Sri Lanka	1.75	57.2	-43
Ukraine	1.43	2.37	-53
UAE	2.45	2.94	-20
Uruguay	1.82	14.4	-40

Figure 9: The Big Mac Index

There are several reasons why PPP does not hold in the short run. Notice, that PPP is a theory of exchange rate determination based on goods flows. It is tied to trade (it is not the only theory of this kind), and it ignores capital flows. Exchange rates can also fluctuate because of expectations of future changes, though even these must be based on something. We have talked about current accounts. Of course, the need to finance deficits can lead to different rates of inflation, and so back to PPP. So it is not trivial to dismiss it. Here are some important issues.

- First, tariffs and transportation costs create a band in which prices can fluctuate before arbitrage becomes profitable.

- Second, permanent shifts in the terms of trade can cause Q to change, if countries differ in the composition of output. An oil shock (positive) will have a different effect on an energy producer and a producer of energy-intensive products. The latter country will experience a relative decline in the world demand for its goods, so its currency will experience a real depreciation.

- Third, if prices are sticky in the short run the law of one price, by definition, does not hold. Then it follows that movements in nominal exchange rates will also affect the real exchange rate. This may hold in the short run, but over longer periods of time prices do adjust and PPP is more likely to hold.

- Fourth, the presence of *non-traded* goods, is probably the most important factor. Think of haircuts versus wheat. Even if traded goods are identical across countries and obey the law of one price, non-traded goods do not. Shifts in the relative price of traded and non-traded goods can cause PPP to fail. This is rather easy to see.

3.3. International Price Levels

If PPP held then using nominal exchange rates to convert GDP's would be sufficient. If there are non-traded goods, on the other hand, dollar GDP's measured using nominal exchange rates are problematic. The reason is that price levels will differ across countries. Of course this cannot happen if PPP is true.

Is this important? Turns out yes. Suppose we measure the cost of purchasing an identical quality-adjusted basket of goods in different countries. We can measure this relative to the cost of purchasing it in the US. Call this price level $\widehat{P}$. Since we are measuring relative to the US we will set $\widehat{P}_{US} = 100$. It is not easy to measure such prices, but there is a large project

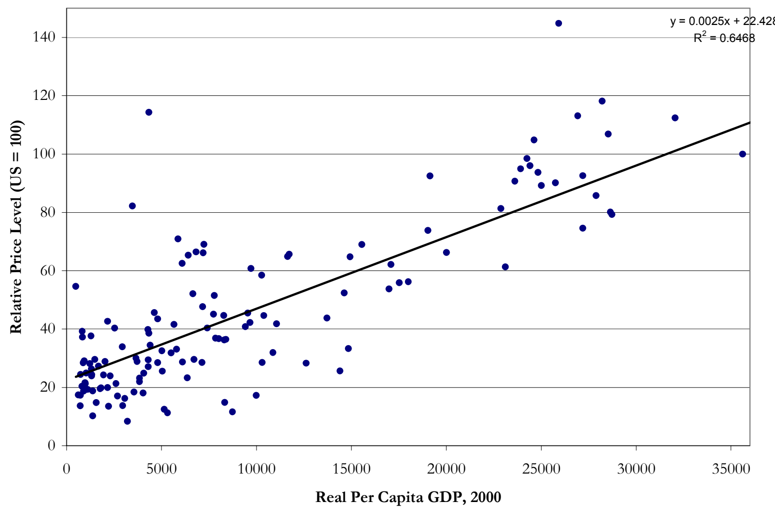

Figure 10: Real per capita incomes and relative prices, 2000

that has been doing this for some time – the Penn World Tables.[12]

Now suppose that we compare $\widehat{P}$ and real incomes across countries. Obviously if PPP held there would be no relationship. With non-traded goods, however, how might the relationship appear? One might suspect that as countries go richer they have a higher percentage of the consumption in traded goods. One might also suspect that non-traded goods are cheaper in poor countries – else, how could anybody in a poor country afford a haircut. This suggests that we might expect a positive relationship, as is in fact the case in figure 10.

The differences are practical and important. For example, in 2004 Chinese per-capita income measured at market exchange rates was \$1272, but at international prices it was \$6200. At international prices China is the second largest economy in the world. Only about 7th at market exchange rates. Japan, on the other hand had per-capita income of \$37,600 at market prices, but at international prices it was only \$31,400. Non-traded goods in Japan are very expensive, especially land.

Why does this happen? It is because of the difference across countries in the relative price of tradable goods. In poor countries tradable goods are relatively more expensive. So in poorer countries people consume higher shares of non-tradable goods. If we use a common

[12] You can access this online, for exampel at http://datacentre2.chass.utoronto.ca/pwt/.

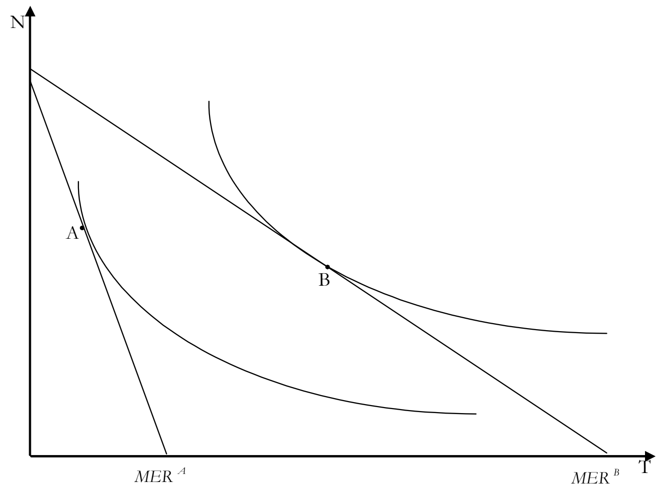

Figure 11:

set of international prices we incorporate the fact that people in poorer countries derive more of their welfare from non-traded goods. If we use market exchange rates we ignore this, and so it makes the poorer country seem even poorer than it is.

This is easily shown with a diagram. Suppose we have two countries and two goods. Good N is non-tradable and good T is tradable. Countries A and B consume at the points labelled in figure 12, which are the optimal consumption points given the relative prices that are faced in each country. We can assume that agents are identical so preferences look the same, though this is not critical. Country B is much richer than country A in any sense, and it clearly purchases a higher ratio of traded to non-traded goods. Welfare is higher as seen by the indifference curves. And people in country B could purchase the bundle labelled A because it lays within their budget line, but they do not (they purchase B) so they must not prefer it.

We have the two consumption choices in figure 11. We can see that country B is much richer than A.

We can easily measure GDP in the figure. For country A it is $Y_A = P_N^A N_A + P_T T_A$ and likewise for country B, where N_A and T_A are the respective quantities of non-tradables and tradables chosen in country A, and likewise for B. Suppose that market exchange rates are such that $P_T = 1$. Then the respective GDP's at market exchange rates are given by the intersection of the budget lines with the tradables axis; i.e, $MER^A = Y^A$ and $MER^B = Y^B$. So the ratio of GDP's is just $\frac{MER^B}{MER^A}$. Now suppose instead we value output at a common set of international prices – the dotted lines in figure 12. GDP's at international prices are IP^A and IP^B respectively. Clearly one can observe that $\frac{IP^B}{IP^A} < \frac{MER^B}{MER^A}$, which is what we set out to show. A common set of prices must give a better comparison that one using market exchange rates. What is left to explain is why non-tradables tend to be relatively more expensive in richer countries. We will return to this shortly.

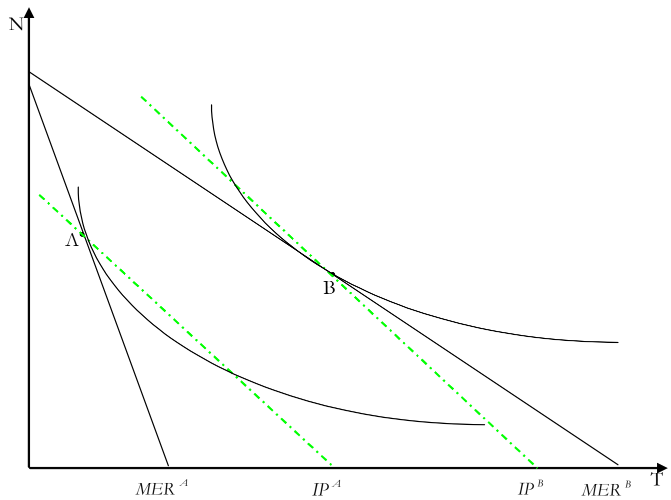

Figure 12: Market-exchange rate versus PPP comparisons

We can easily show how the presence of non-traded goods effects the real exchange rate. Let us write the price index of the domestic country as $P = P_n^{\alpha} P_t^{1-\alpha}$, where P_t is the price of traded goods, and α is the share of non-traded goods in the domestic price index. Now we can write the real exchange rate as:

$$\begin{aligned} Q &= S\left[\frac{P_n^{*\alpha^*} P_t^{*(1-\alpha^*)}}{P_n^{\alpha} P_t^{1-\alpha}}\right] = S\left[\frac{\left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*} P_t^*}{\left(\frac{P_n}{P_t}\right)^{\alpha} P_t}\right] \\ &= S\left(\frac{P_t^*}{P_t}\right)\left[\frac{\left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*}}{\left(\frac{P_n}{P_t}\right)^{\alpha}}\right] \end{aligned}$$

but if we assume that PPP holds for traded goods, it follows that $S\left(\frac{P_t^*}{P_t}\right) = 1$, so

$$Q = \left[\frac{\left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*}}{\left(\frac{P_n}{P_t}\right)^{\alpha}}\right]. \tag{28}$$

Expression (28) tells us that the real exchange rate will change if the *relative* price of non-traded goods changes in either the domestic or foreign country.

Notice that if take logs of both sides of (28), and use lower-case to represent the log of a variable, we obtain:

$$q = \alpha^*(p_n^* - p_t^*) - \alpha(p_n - p_t)$$

taking first differences, we obtain:

$$\Delta q = \alpha^*(\Delta p_n^* - \Delta p_t^*) - \alpha(\Delta p_n - \Delta p_t) \tag{29}$$

which says that the real exchange rate will depreciate if the relative price of non-traded goods (i.e., relative to traded goods) rises in the domestic country or decreases in the foreign country. Expressions (28) and 29) indicate that there are two sources of changes in the real exchange rate, differences in the shares of traded and non-traded goods (the $\alpha's$) and differences in the movements of prices.

A nice simplification arises if the two countries expend the same share on traded and non-traded goods. If $\alpha = \alpha^*$, then (28) is just

$$Q = \left[\frac{\left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*}}{\left(\frac{P_n}{P_t}\right)^{\alpha}}\right] = \left[\frac{\left(\frac{P_n^*}{P_n}\right)^{\alpha}}{\left(\frac{P_t^*}{P_t}\right)^{\alpha}}\right] = \left[\frac{\left(\frac{P_n^*}{P_n}\right)}{\left(\frac{P_t^*}{P_t}\right)}\right]^{\alpha} = \left(\frac{P_n^*}{P_n}\right)^{\alpha} \tag{30}$$

so that the real exchange rate depends only on the ratio of non-traded goods prices.

Similarly, (29) can be simplified to:

$$\Delta q = \alpha(\Delta p_t - \Delta p_n) - \alpha(\Delta p_t^* - \Delta p_n^*), \tag{31}$$

or

$$\begin{aligned} \Delta q &= \alpha(\Delta p_t - \Delta p_t^*) + \alpha(\Delta p_n^* - \Delta p_n) \\ &= \alpha(\Delta p_n^* - \Delta p_n) \end{aligned}$$

since $\Delta p_t = \Delta p_t^*$ if PPP for traded goods holds. This means that the change in the real exchange rate depends on differential growth in non-traded goods prices. If non-traded goods prices rise faster in the foreign country then the real exchange rate will appreciate and foreign prices will rise faster than domestic prices.

There is good reason to think that such changes do occur. The Balassa-Samuelson effect focuses on the impact of differential economic growth. It is argued that economic growth is associated with increased productivity in *traded* goods, so that they fall relative to the price of *non-traded* goods. You can think of traded goods as more tangible than non-traded goods (like haircuts). In countries that grow rapidly (or liberalize for that matter) non-traded goods will rise relative to traded goods. If this happens more rapidly in the domestic economy than in the rest of the world then q would fall.

This could also happen if non-traded goods are superior in consumer's demand functions. Either way, this relative price change causes the real exchange rate to decrease; in other words, the real value of the domestic country appreciates. This is, of course, what happened in Japan as rapid growth lead to very rapid increases in the price of non-traded goods (such as golf club memberships).

The fact that q is lower in countries that grow faster may also explain why the price level tends to be higher in richer countries when measured in common currency units. Americans often wonder how people in LDCs can live on incomes of $500 a year. Of course, there is real poverty, but it is also the case that because of non-traded goods, conversion at exchange rates gives an incorrect impression. That is, the differences in nominal incomes do not measure the true differences in purchasing power. This is because purchasing power of a currency differs depending on the shares of traded and non-traded goods. To see this, recall that from the definition of the real exchange rate, $Q_t = \frac{S_t P_t^*}{P_t}$, we can write:

$$q_t = s_t + p_t^* - p_t$$

hence,

$$p_t = s_t + p_t^* - q_t \tag{32}$$

which implies that countries with lower q will have higher price levels compared with prices elsewhere, since the foreign price level measured in units of domestic currency is just $s_t + p_t^*$. If productivity growth is rapid in the US relative to the foreign country, our price level will be higher, when measured in common currency units.

One way to think about this is simply that PPP values exchange rates according to the relative price of traded goods. But in LDC's the price of non-traded goods is lower. When these are included, the price level in the advanced country is higher. That is essentially what is implied by 32.

3.4. The Role of Productivity Growth

Here is a straightforward way to see why a country that has rapid growth in productivity experiences real exchange rate appreciation. The key notion is what happens to wages. The important point is that as labor can move between sectors the wage must be equal in the traded and non-traded goods sectors.

Consider a simple world where capital can flow across countries and across sectors, and where labor can flow across sectors. The country is small so the rate of interest is given at r^*. It is useful to think about the implications of competition for the returns to capital and labor in both sectors. Firms use capital and labor so that their marginal products are equal to the rate of interest and the wage respectively. For simplicity we can assume that traded goods have a price of unity. Our interest is in the relative price of non-traded goods to traded goods, p. The first-order conditions for capital and labor in both sectors are then:

$$MPK_T = A_T f'(k_T) = r^* \tag{33}$$

$$MPL_T = A_T[f(k_T) - f'(k_T)k_T] = w \tag{34}$$

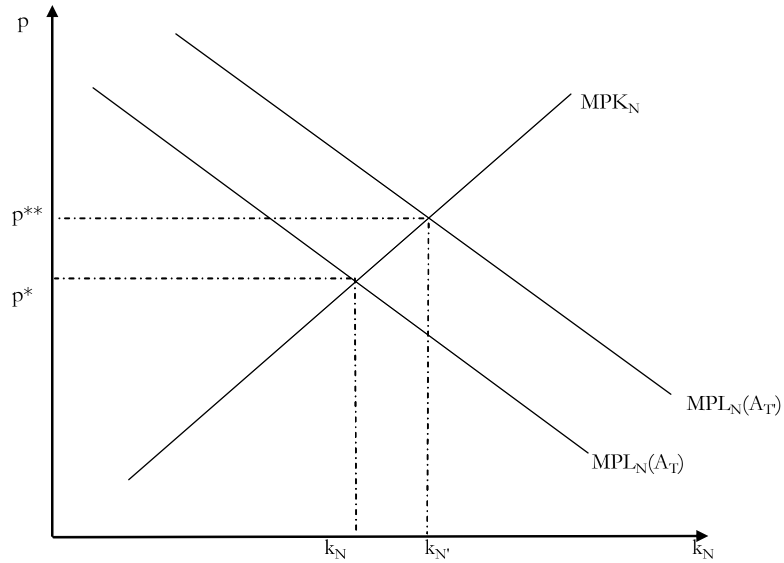

Figure 13: The relative price of non-tradables

for the traded goods sector, and

$$MPK_N = pA_N g'(k_N) = r^* \tag{35}$$

$$MPL_N = pA_N[g(k_N) - g'(k_N)k_N] = w \tag{36}$$

for the non-traded goods sector. Notice that the relative price of non-tradables only appears in the expressions (35) and (36).

We could use these first-order conditions to solve for p, but it is simpler to use a diagram. That is, we will consider the implications of (35) and (36) in $p - k_N$ space. But we should first note that from (34) we know that the wage must be a function of both A_T and k_T. In figure 13 we plot expressions (35) and (36). Notice that the MPK_N is positively sloped. Why? From (35) we can see that if p increases k_N must increase to keep the LHS from rising. This is just diminishing returns. Similarly, from expression (36) we can see that if p increases k_N must fall, else the LHS would be greater than the RHS. The relative price of non-tradables is thus given at p^*.

What happens if TFP in tradables, A_T, goes up? Clearly MPK_N does not shift, since this term does not appear in expression (35). But MPL_N will shift up because the wage must rise. This is evident from expression (34). So we can see from figure 13 that the relative price of non-tradables rises when productivity increases in the traded goods sector.

Now suppose that there are two identical countries, except that one of the countries consumes a higher share of tradable goods $(1-\alpha)$ in our notation. A_T goes up in both countries, so p goes up in both countries. You can see from (29) that the real exchange rate will rise for the country that has a higher share of non-tradables. This is the Balassa-Samuelson Effect.

Here is another way to derive this result. Start again with the definition of the price level as $P = P_n^{\alpha} P_t^{1-\alpha}$, and use asterisks for the foreign country. The law of one price implies that for tradable goods we have

$$P_t = eP_t^* \tag{37}$$

Now profit maximization means that wages equal marginal products. So we will have

$$\frac{w_t}{P_t} = MPL_t \text{ and } \frac{w_t^*}{P_t^*} = MPL_t^* \tag{38a}$$

or $P_t = \frac{w_t}{MPL_t}$. Then it follows that

$$\frac{w_t}{MPL_t} = e\frac{w_t^*}{MPL_t^*}$$

or

$$\frac{ew_t^*}{w_t} = \frac{MPL_t^*}{MPL_t} \tag{39}$$

Notice the implication of (39): the ratio of dollar wages in the tradeable goods sector is equal to the ratio of marginal products in traded goods. If productivity rises in tradable goods in country a so will its wage rate in tradables.

Now we connect wages in tradables and non-tradables in a given country. Labor market equilibrium requires that wages equalize. As a first approximation we will let $w_t = w_n = w$, and $w_t^* = w_n^* = w^*$. But profit maximization must imply that conditions like (38a) hold for non tradables:

$$\frac{w_n}{P_n} = MPL_n \text{ and } \frac{w_n^*}{P_n^*} = MPL_n^*$$

or

$$w_n = P_n MPL_n \text{ and } w_n^* = P_n^* MPL_n^*. \tag{40}$$

so

$$\frac{P_n^*}{P_n} = \frac{w_n^*}{w_n}\frac{MPL_n}{MPL_n^*} \tag{41}$$

Our final step is to consider productivity in non-tradables. Since our concern is with productivity growth in tradables it is not a bad assumption to assume that non-tradable productivity is equal across countries. Not much capital goes into a haircut. So we let $MPL_n = MPL_n^*$. Nothing would be affected if we let $MPL_n = \gamma MPL_n^*$ for example, as long as γ was constant. With $MPL_n = MPL_n^*$ (41) implies

$$\frac{P_n^*}{P_n} = \frac{w_n^*}{w_n} \tag{42}$$

.

Now we just put together the pieces. Start with the definition of the real exchange rate

$$\begin{aligned} Q &= \frac{eP^*}{P} = e\frac{P_n^{*\alpha}P_t^{*1-\alpha}}{P_n^{\alpha}P_t^{1-\alpha}} = \left(\frac{eP_n^*}{P_n}\right)^{\alpha}\left(\frac{eP_t^*}{P_t}\right)^{1-\alpha} \\ &= \left(\frac{eP_n^*}{P_n}\right)^{\alpha} \end{aligned}$$

since from (37) we know that $\left(\frac{eP_t^*}{P_t}\right)^{1-\alpha} = 1$. Now using expressions (42) and (38a) we obtain:

$$\begin{aligned} Q &= \left(\frac{eP_n^*}{P_n}\right)^{\alpha} = \left(\frac{ew_n^*}{w_n}\right)^{\alpha} = \left(\frac{ew^*}{w}\right)^{\alpha} \\ &= \left(\frac{eP_t^* MPL_t^*}{P_t MPL_t}\right)^{\alpha} = \left(\frac{MPL_t^*}{MPL_t}\right)^{\alpha} \end{aligned} \tag{43}$$

so we have shown that the real exchange rate depends on the ratio of marginal products of labor in tradables. It is apparent then that if the marginal product of labor in the tradeable goods sector rises in the foreign country relative to the home country the real exchange rate must appreciate. To see this formally, just take logs of (43) and differentiate with respect to time to get an expression for the growth rate of the real exchange rate (hats denote growth rates):

$$\widehat{Q} = \alpha \left[\widehat{MPL}_t^* - \widehat{MPL}_t \right]. \tag{44}$$

What does (44) imply? First, if all goods were tradeable, $\alpha = 0$, and thus the real exchange rate is constant. The higher the share of non-tradables the greater the impact of differential productivity growth on the change in Q.

Rising Yen The Balassa-Samuelson effect may also help explain the rising yen. In nominal terms the yen has strengthened greatly since WW2. Between 1950 and 1999 the dollar lost two-thirds of its value against the yen. Notice that much of this happened when there was a fixed exchange rate between the dollar and yen. What it reflects is higher Japanese inflation prior to 1973 than in the US. But subsequent to that US inflation was higher than in Japan. Yet, the movements in the exchange rate cannot be due to differences in inflation alone, however, as US inflation has not been that much higher than Japanese (though it has been and continues).

From the data we see that in real terms the dollar has depreciated against the yen for more than forty years. Why? Differential productivity growth in traded and non-traded goods. The relative price of non-traded goods in Japan has increased much more than in the US. After WW2 non-tradables in Japan were very cheap because the economy was still in recovery. As Japan recovered productivity increased in traded goods. The overall consumption basket must have been very cheap in that period. As the economy recovered the relative price of non-traded goods increased. This follows as productivity in the traded goods sector rises to world levels. Why? Because wages in the non-traded goods sector must rise as wages increase in the traded goods sector. It is harder to improve productivity in non-traded goods sectors. Think of golf club memberships.

The same result occurs in transition economies. Their traded goods sectors were very inefficient at the start of transition. As their economies improve the relative price of tradables rises. This raises average wages in the economy and their price levels rise relative to foreign

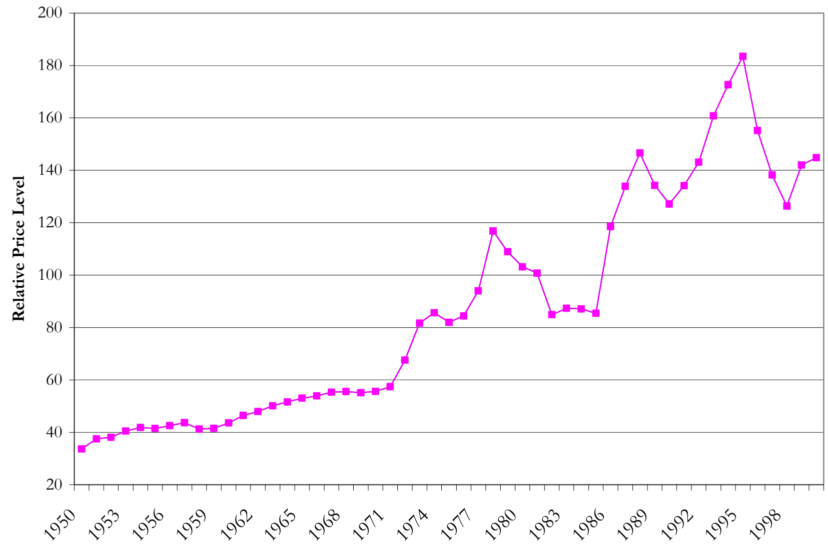

Figure 14: Japanese Relative Price Level

prices – their currencies appreciate in real terms. Of course, in these economies the appreciation is also due to recovery from the depreciated exchange rates that resulted from the initial collapse of their currencies and capital flight.

3.5. Home Bias and the Real Exchange Rate[13]

When we first discussed the current account we talked only about the real interest rate. Why then do we need real exchange rate adjustment for the trade balance to improve? The basic answer is what is called "home bias" in consumption, which I will explain. The important question to think about is whether the current account can improve without a change in the value of the dollar. Suppose that we decide to increase savings because we wake up hating the current account deficit. The question is whether we can accomplish this without the dollar changing in value. It is obviously an important policy issue.

To answer this question we need a simple model where the dollar plays some role. Here we will think of two-countries, the US and the rest of the world. So our net exports are the net

[13] This note is based on the appendix to Lecture 1 of Krugman, *Exchange Rate Instability.* See also Maurice Obstfeld and Kenneth Rogoff, "The Unsustainable US Current Account Deficit Revisited," at http://www.nber.org/papers/w10869.

imports of the rest of the world. You must notice then that if we are to improve our current account balance, the rest of the world must decrease theirs.

Our simple model has two elements. First, start with the trade balance, which we know is equal to income minus expenditure on domestic goods, a,

$$T \equiv NX = y - a. \tag{45}$$

Notice here that I have used the notation NX to remind that the trade balance is equal to net exports.[14] Let us just assume that a is given (normally we might think it depends on relative prices, but ignore this to make life simple, nothing important depends on this assumption). Expression (45) is an accounting identity, so it must hold true for any value of the real exchange rate; indeed, the real exchange rate does not directly appear in this expression. In figure 15 we can express this relationship as TT_0. Given the level of expenditure, a_0, and the level of output the trade balance is independent of p, the price of domestic goods in terms of foreign goods (the inverse of q, essentially),[15] by virtue of the accounting identity (45). In figure 15 when expenditure falls, we move to TT_1.

We must also worry about the world current account which we know adds to zero. World expenditure must equal world income, so

$$y^* + py = pa + a^* \tag{46}$$

where p is the relative price of domestic goods in terms of the numeraire, foreign good. This implies

$$a^* - y^* = p(y - a) \tag{47}$$

which just says that the excess demand for foreign goods is equal in value to the excess supply of domestic goods. You can see from this expression that, if the excess demand in the rest of the world is given (a big if), the only way that net exports can rise domestically is if p falls.

[14] Notice that a is not absorption. It is total domestic expenditure, that is total spending by people in the US. Absorption (usually A) is spending on domestic goods and services. When I write a I am referring to total expenditure, and y is total output. So if m is the share of purchases spend on imports, we can write total imports $M = ma$, and $M^* = m^*a^*$ for the foreign country.

[15] I am going to treat the foreign price level as the numeraire, so p is the price of domestic goods in units of the foreign good. Hence, if p rises we are less competitive, and vice versa. You can thus think of p as the inverse of the real exchange rate.

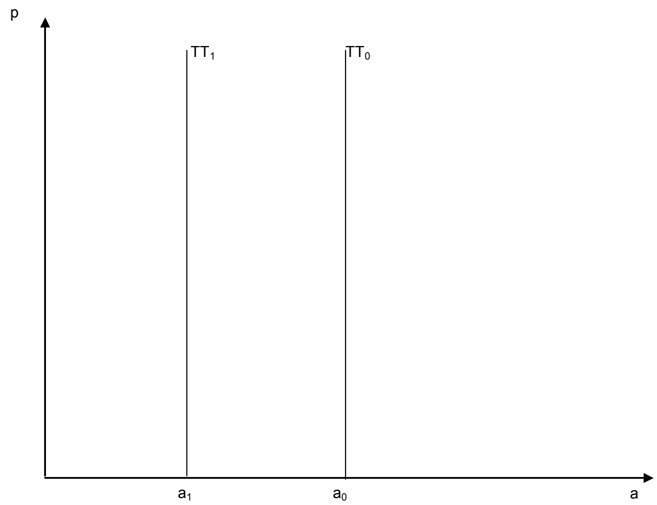

Figure 15: Expenditure and the Real Exchange Rate

Now from (45) the trade balance is the difference between income and expenditure. But it is also equal to net exports, which are just exports less imports. To make matters simple, let us suppose that imports are a fixed share of expenditure, and let these shares be given by m, and m^* respectively. Notice that our exports are the rest of the world's imports, m^*a^*, but this is measured in the foreign currency, so we have to divide by p to convert to units of domestic expenditure. Hence, we have

$$NX = \frac{1}{p}m^*a^* - ma \tag{48}$$

hence, using (48) into (47) we have

$$\begin{aligned} a^* - y^* &= p\left[\frac{1}{p}m^*a^* - ma\right] &(49)\\ &= m^*a^* - pma &(50) \end{aligned}$$

Some tedious algebra is now needed. Notice that from (46) we can write $py = pa + (a^* - y^*)$. But we can substitute for $a^* - y^*$ using (50) yielding:

$$py = pa + m^*a^* - pma$$

or

$$py = pa\,(1-m) + m^{*}a^{*} \tag{51}$$

now collect the terms with p,

$$\begin{aligned} py - pa(1-m) &= m^{*}a^{*} \\ py + pam - pa &= m^{*}a^{*} \end{aligned}$$

or

$$p\,[y + a(m-1)] = m^{*}a^{*} \tag{52}$$

We can now substitute for a^{*} in expression (52) since from (47) we know that $a^{*} = y^{*} + p(y-a)$, so we can write (51) as

$$p\,[y + a(m-1)] = m^{*}\,[y^{*} + p(y-a)] \tag{53}$$

collecting terms with p on the LHS we have $p\,[y + a(m-1)] - m^{*}p(y-a) = m^{*}y^{*}$ or

$$p\,[y + a(m-1)] - m^{*}py + m^{*}pa = m^{*}y^{*}$$

or

$$p\,[y(1-m^{*}) + a(m+m^{*}-1)] = m^{*}y^{*}$$

Thus we have

$$p = \frac{m^{*}y^{*}}{D} \tag{54}$$

where $D \equiv [y(1-m^{*}) + a(m+m^{*}-1)]$. Expression (54) is what we are after. It tells us how p varies with a, and how the presence of home bias, $m+m^{*}<1$ impacts the result.

So if there is home bias we have $m+m^{*}<1$, so if a rises D falls. Home bias means that the coefficient on a in D is negative. So when a rises D falls in expression (54). Hence, p must rise. Thus combinations of a and p that keep the world supply and demand for goods in balance must be upwards sloping. We have the UU curve in figure 16. If we start with the trade balance given by TT_0 and p_0, suppose that domestic expenditure is reduced. This shifts the TT curve to the left. Given UU, we see that the relative price of domestic goods must fall (the real exchange rate must rise).

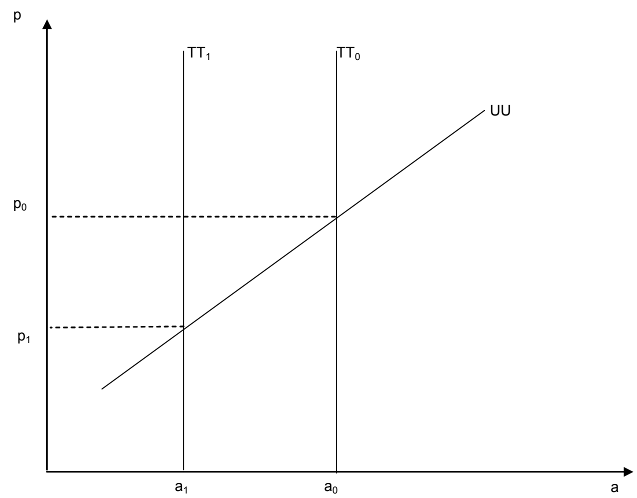

Figure 16: Real Depreciation

We are quite used to hearing politicians demand that foreigners expand their economies. We can now see why. Suppose that y^* increases. From expression (54) we can see that p would be higher for every value of a; in other words, the UU curve shifts upwards in figure 16. Hence, if foreign output rises as domestic expenditure falls then the dollar does not need to depreciate. That makes sense, not all the rise in foreign output will be purchased by foreigners. So there will be an excess supply of foreign goods, which will depress their relative price, offsetting the pressure on p to rise.

What has happened? With lower expenditure net exports must rise by virtue of the accounting identity. So net exports in the rest of the world must fall by the same amount. There is a *redistribution* of spending globally. How does this come about? World income has not changed (assume) so that means that *row* expenditure must have risen by the amount it fell in the US. But the *row* only spends $m^* < 1$ on US goods. So there will be an excess supply of our exports. The relative price of our goods must fall so that foreigners increase their expenditure on them. This is because of home bias. So the relative price of domestic goods must fall. That is why we have $p_1 < p_0$ in figure 16.

To see this more clearly, suppose that US output falls by Δa then (assume $p = 1$, initially) $\Delta a^* = -\Delta a$. Since we spend only m on imports, the fall in expenditure increases the supply of our goods in the world market by $(1 - m)\Delta a$, since this is the amount of stuff we used to buy that we are now trying to export. The rest of the world is spending more, but only m^* of this is on our goods, so demand rises by $\Delta a^* m^*$. Hence, the excess demand for US exports changes by

$$m^*\Delta a^* + (1 - m)\Delta a$$

and given the assumption that $\Delta a^* = -\Delta a$, this is just equal to

$$= \Delta a(1 - m - m^*)$$

It thus follows that if $m + m^* < 1$ the excess demand for US goods falls, and so its price must fall. If there was no home bias, on the other hand, if $m + m^* = 1$, then the fall in the demand for US exports would be zero, and no change in the relative price is required.

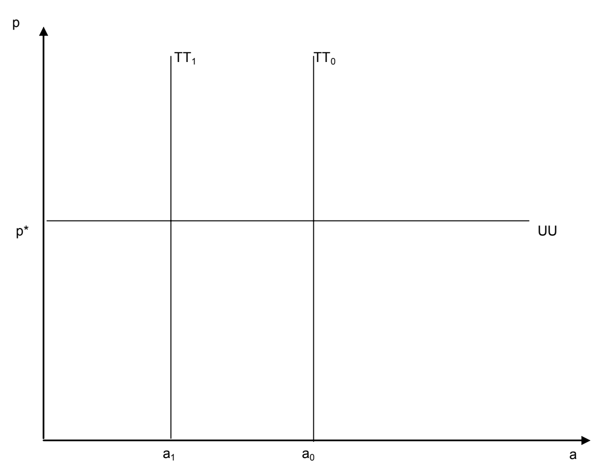

Figure 17: No Home Bias

One more point. Suppose that the economy becomes more closed. That means that UU becomes more steep. This follows because as $m + m^*$ gets smaller the effect of a given change in a on D is larger, so from (54) the change in p is larger. This follows because more closed means we purchase less imports, so $m + m^*$ gets smaller. With a steeper UU the required change in the real exchange rate is larger for any reduction in the trade balance.

Return now to the absence of home bias. What does this mean? If domestic and foreign goods are perfect substitutes it means that all goods are tradable. Notice, however, that if $m + m^* = 1$ then p is independent of a. In this case UU is horizontal in $p - a$ space. This case is given in figure 17, with a horizontal UU curve. If all goods are tradable we know the real exchange rate should not change due to PPP. There is only one consumer basket for all countries so we do not require a relative price change to shift expenditure from domestic to foreign goods. An interest rate change is sufficient. But if the consumption baskets differ then relative price changes – i.e., the real exchange rate – must shift to alter the composition of expenditure towards domestic goods.

One could also point out that the problem is even more complex. Home bias is related to preferences for our goods versus foreign goods. One could add, however, that to improve the trade balance we need to switch from non-traded to traded goods production. The required change in the real exchange rate depends on how subsitutable are traded and non-traded goods. If it is easy to subsitute the required change may not be that great, but if not, then a larger change will be needed.

4. Role of Nontraded Goods

We want to understand how the presence of non-traded goods impacts the adjustment of the real exchange rate. Consider a small economy so the country is a price taker in traded goods. Then we can treat foreign and domestic traded goods as a composite good, T. The country can transform capital and labor into traded and non-traded goods given the PPF labelled PP in figure 18.

Suppose the country initially received a transfer from the rest of the world equal to NX. Then consumption intially takes place at Q_0. Now suppose the transfer is withdrawn – this is the equivalent to improving the trade balance by the amount, NX. The transfer had allowed consumption of traded goods to be greater than what the economy produced. Now that the

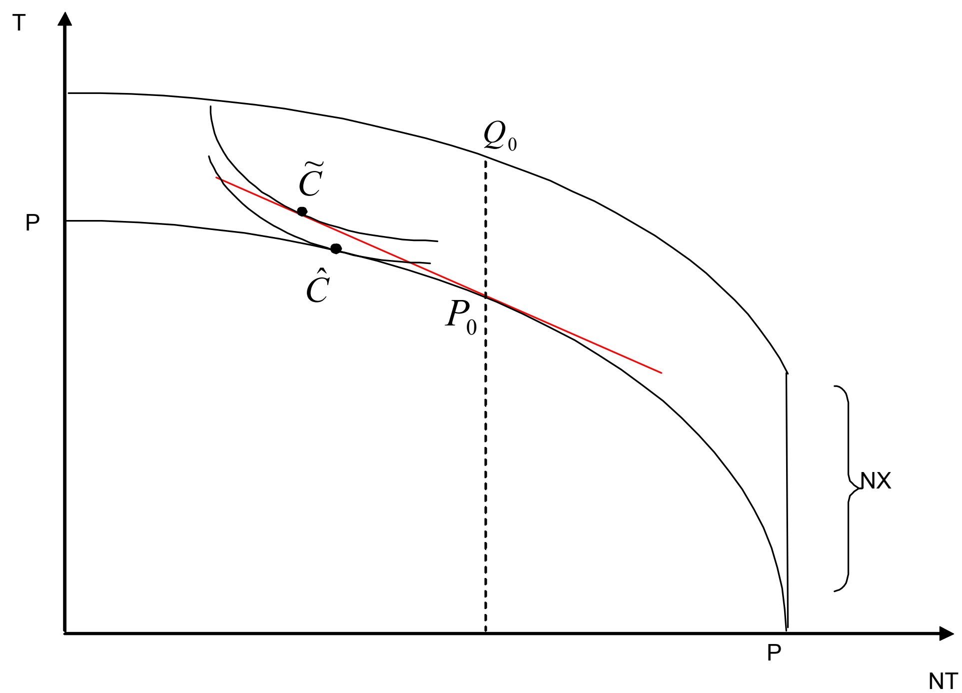

Figure 18: Adjustment with Nontraded goods

transfer is gone the economy can only consume traded goods equal to what is produced in the economy. Production is now at point P_0, since what is withdrawn from the economy are clearly only traded goods.

With an unchanged real exchange rate agents in this economy would prefer to consume at $\widetilde{C}$. But this is infeasible. There is an excess demand for traded goods at this point. So the price of traded goods must rise relative to non-traded goods, and consumption is at a point like $\widehat{C}$. It is clear that the relative price of traded goods is lower at point $\widehat{C}$ as the PPF is flatter than at P_0. The higher price of traded goods causes production to shift towards traded goods and reduces the consumption of them. So the real exchange rate increases – the real value of domestic currency falls.

You can also see that the amount by which the real exchange rate must change depends on how easy it is to switch production. If this were trivial, the PPF would be flat, and there would be no reason for it to change. But if it is hard to shift production it must shift more.

To see this more clearly, suppose that in the short run it is more difficult than in the long run. This seems realistic – elasticities are always higher in the long run than in the short

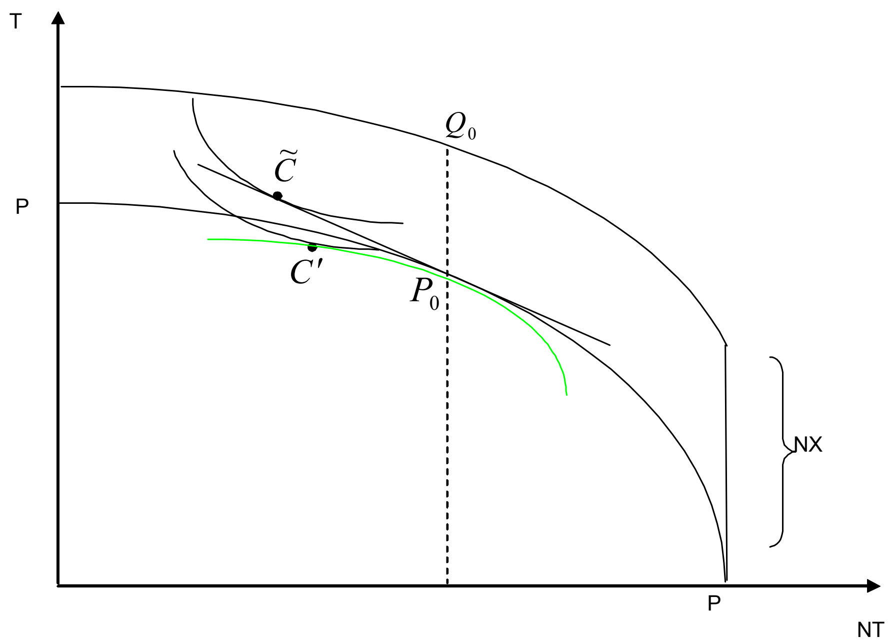

Figure 19: Adjustment with Short-run rigidity

run. Then we have figure 19 which is identical to figure 18 except for the short-run PPF which is tangent to P_0 but is flatter everywhere else. This represents the rigidity of short-run adjustment. Consumption now shifts to C' where the relative price of traded goods has risen even more than at point $\widehat{C}$ (which is left out of the picture for clarity). This means that the short-run increase in the real exchange rate is greater than the long-run increase. Hence, the real exchange rate adjusts more in the short run than in the long run: an example of what is called overshooting.

Now what if the economy were more open? How does this effect the required change in the real exchange rate? Consider figure 20 where initially consumption is farther to the northeast – a higher proportion of traded goods to nontraded goods. Again we have the same reduction in the transfer from abroad. This moves production to P_0. But the PPF is much flatter in this region, and consumption is already biased toward traded goods, so there is hardly any change in the demand for traded goods. Hence, there is little need for the real exchange rate to rise.

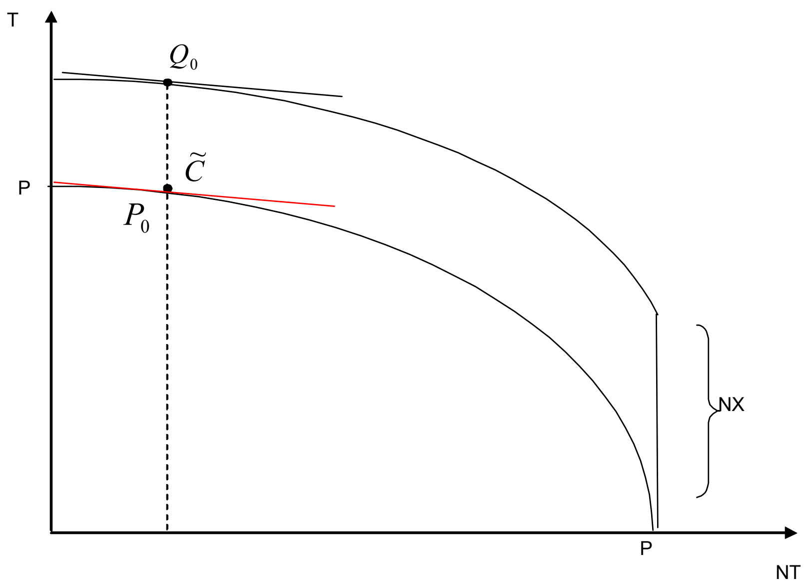

Figure 20: A More Open Economy

4.1. Final Point

A final point for now. Some, such as Alan Greenspan argue that correcting US CA deficits will not require large dollar depreciation because capital markets are highly integrated – the Feldstein-Horioka puzzle has disappeared. But this misses the point. Even if capital markets are fully integrated the real exchange rate must change if *goods markets* are not fully integrated. That is the point of this note. If there was no home bias, or more generally, if we had a one-good economy there would be no need for relative price adjustment. But with non-traded goods and home bias we do.

The impact of capital-market integration is on the amount we can borrow to finance CA deficits. Thus, it effects the timing of *when* the dollar will depreciate. How much the dollar must decline in real terms depends on how easy it is to increase net exports. This depends on the terms of trade and on how much of US production consists of non-tradables, and likewise for the rest of the world. The simplest way to think about it is that we cannot export non-tradable goods, so the larger the share of US production that is non-tradeable, the greater the change in relative prices needed to shift production that way. But our increase in net exports means less net exports in the rest of the world, so the impact on them depends on how easy it is for them to shift to more non-tradables. This note deals with this in a very simple way, but hopefully some of the point is clear.

It is important to understand the message here. What we have seen is that for the current account to improve the dollar must depreciate in real terms. This *does not mean real dollar depreciation will cause the current account to improve.* That is a different question. Real depreciation can lead to a current account improvement only if it results in more savings relative to investment. If it does not, the dollar could depreciate and the current account deficit could remain. Here we answered the opposite question: whether savings can rise relative to investment without the dollar having to depreciate. It is important to understand why these are different questions.

We must also ask the question of how the dollar actually changes value, so that will take us to the foreign exchange market. Notice, that the US does not set the dollar. For the dollar to adjust in real terms has implications for other currencies.