Econ 434 Professor Ickes

Fall 2008

Midterm Exam II: Answer Sheet

1. *(20%) Germany and China produce 2 goods: cell phones, the traded good, denoted by T; and haircuts, the non-traded good, denoted by N. Each good is produced in competitive markets with labor as the sole input. Workers are paid their marginal revenue product. Cell phones have no trade costs while haircuts have prohibitively high trade costs. The hourly wage rate in Germany is w euros; that in China is w^* yuan. Denote the exchange rate by e (euros per yuan). Suppose that in one hour a German worker can produce q cell phones while in China a worker produces q^* cell phones. In both countries a worker can produce one haircut per hour. Suppose the price of a cell phone is one euro. Let $q = 20$ and $q^* = 10$.*

   (a) *If $e = 0.5$ what will be the yuan price of cell phones?*

   brief answer A cell phone will cost 2 yuan, since the cell phone is tradeable and has the same price in all countries. Thus, $P_T^* = \frac{1}{e}P_T$, or $2 = \frac{1}{.5}(1)$.

   (b) *What will the hourly wage in Germany be? What will the hourly wage (in yuan) in China be?*

   brief answer The marginal product of labor in the traded goods sector in Germany is $q = 20$, so $w = 20$ euros. The marginal product of labor in traded goods in China is $q^* = 10$, so $w^* = 20$ yuan (or 10 euros).

   (c) *What will the price of haircuts be in each country?*

   brief answer The price of haircuts will be 20 euros in Germany and 20 yuan in China.

   (d) *Suppose German labor productivity in cell phones doubles. What will happen to the price of haircuts in Germany? What will happen to the real exchange rate between Germany and China? Explain.*

   brief answer The price of haircuts will double (to 40 euro) since wages will double when productivity rises. Hence, the price level of German goods rises relative to China so its real exchange rate will fall (recall $Q = \frac{eP^*}{P}$). The rise in productivity makes German wages rise and non-traded goods prices must rise in Germany. Since nothing changes in Japan German goods are more expensive.

   brief digression I did not ask you to do this, but it is easy to think of a numerical example. If you recall equation (28) from the lecture notes, we derived

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

   so, for example, we could let $\alpha = .333$ and $\alpha^* = .6$. Then we would have $Q = \frac{\left(\frac{20}{2}\right)^{.6}}{\left(\frac{20}{1}\right)^{.333}} = 1.468$ Now let productivity in German double. Then we have $Q = \frac{\left(\frac{20}{2}\right)^{.6}}{\left(\frac{40}{1}\right)^{.333}} = 1.1655$.

2. *(25%) Consider a small open economy with a fixed exchange rate. Initially, the exchange rate is set at a sustainable level. Suppose that the demand for the country's exports increases unexpectedly, and that this increase persists. What must the central bank do to keep the exchange rate fixed? Explain, using graphs were possible.*

brief answer The increase in demand for our exports implies that the supply of foreign exchange has increased relative to demand, since foreigners will be selling foreign exchange to purchase our exports. To keep the exchange rate from falling, the central bank must purchase the excess foreign exchange. It does this by selling dollars. This is evident in figure 1 where the supply has shifted to S_1 and in absence of intervention the exchange rate would fall to $\tilde{e}_1$. The CB purchases the excess supply of foreign exchange $= X$ in figure 1.

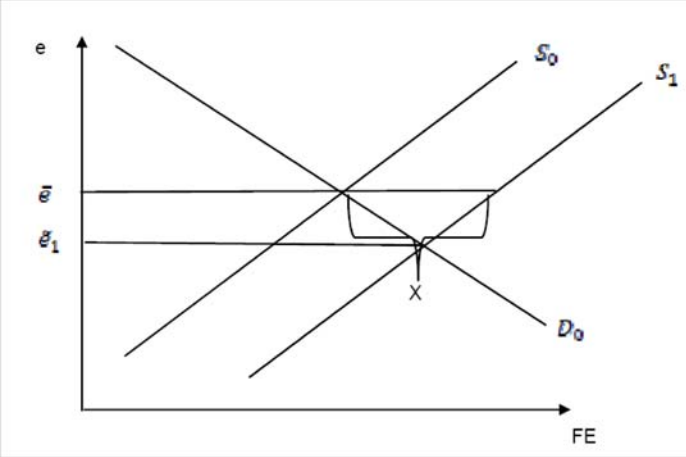

Figure 1: A Rise in the Supply of Foreign Exchange

(a) *If this increase in export demand is expected to persist, can the central bank permanently keep its obligation and maintain the current fixed exchange rate? Explain. If the central bank keeps the exchange rate fixed what will happen to the stock of money in the economy? Explain.*

brief answer The CB can always print more money, so all it has to do is build enough warehouses to store the foreign exchange. It can do this without limit.[1] As the CB accumulates foreign exchange the monetary base will rise, since $MB = IR + DS$, from the definition of the central bank's balance sheet. The money supply will thus rise because the money supply is a multiple of the monetary base. Of course, it may be possible to sterilize the inflow. If the CB can sterilize the inflow (we did not get to discuss the conditions under which this is successful prior to the exam) then it has to offset the change in reserves with an open market operation. Simply set $\Delta DS = -\Delta IR$. In this case reserves are rising, so the CB must sell domestic securities to sterilize the inflow. Purchasers of the securities will pay the CB in money so the liabilities of the CB are extinguished that way.

[1]Presumably it may have to hire James Bond, 007, to defend against a plot to blow up Fort Knox. But security is a fixed cost pretty much. Today, the problem is protecting the Fed's computers anyway, not the US gold supply.

(b) *Now suppose that instead of increasing, export demand had decreased (all else the same). If investors are rational and the central bank tries to maintain the fixed exchange rate how will your answer to part (a) change? Explain.*

brief answer Now the supply of foreign exchange has decreased, so there will be upward pressure on the exchange rate. To offset the excess demand for foreign exchange the CB will have to sell its reserves. This reduces the monetary base unless the CB sterilizes. So it reduces the money stock. This process cannot go on forever. The central bank has a finite supply of reserves – it cannot print foreign currency – so this cannot go on forever. Investors will see that the CB will eventually run out of reserves, so they will start selling before the reserves run out.

(c) Is it possible to determine when the exchange rate will change, if at all, in part (b)? Explain.

brief answer Yes, the currency collapses when the shadow rate is equal to the fixed rate. We can use figure 2 to see this. Reserves are falling period after period due to the excess supply of dollars in the market. If speculators wait for reserves to collapse to zero then they incur a large capital loss. So they sell sooner. The time of the collapse is at time t_c when the shadow rate is equal to the peg. In our case when the public realizes that the fall in demand for exports is permanent.

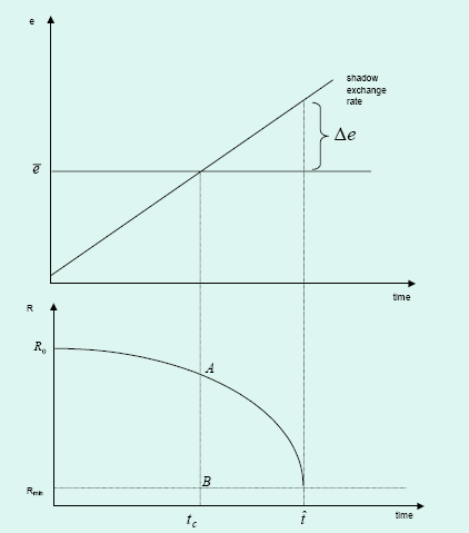

Figure 2: Collapse of an exchange rate

3. *(30%) Macronesia is a large open economy with a large current account deficit. The size of this deficit is unsustainable. What will happen to the real exchange rate? Why? Explain how the magnitude of the change in the real exchange rate depends on:*

brief answer The real exchange rate has to rise so that our goods become more competitive The dollar will fall in real terms, so foreign prices will be higher than domestic prices. This is needed to shift production towards traded goods, and to reduce consumption on non-traded goods.

(a) *The extent to which Macronesia is open.*

brief answer The more open is Macronesia the greater the share of traded goods in the economy. That means less of a shift in Q is needed. The production frontier in figure 3 is flatter when a higher share of the economy is traded goods. If the economy was closed we would be more to the southeast where the frontier is steeper.

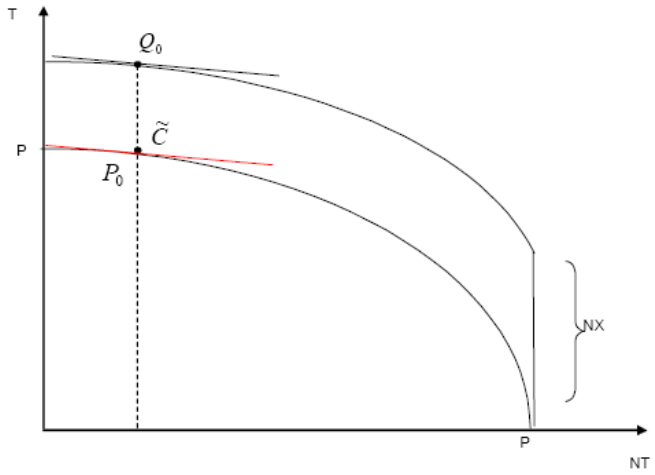

Figure 3: An Open Macronesia

(b) *The extent to which capital markets are developed.*

brief answer This is irrelevant. Capital market development tells us how long it will take till the dollar starts to adjust, but the real exchange rate adjusts because *goods* markets are imperfectly integrated, not capital markets.

(c) *The willingness of consumers to substitute traded for non-traded goods.*

brief answer The greater the willingness to substitute – the flatter the indifference curves – the smaller the needed adjustment in Q. If agents are indifferent between mustard and mustard gas it does not take a large price adjustment to get them to switch. If, on the other hand, marginal utility falls rapidly as consumers leave their preferred bundles, then a large price adjustment is needed.

4. *(25%) Suppose one estimates the following equation:*

$$e_{t+1} - e_t = \alpha + \beta(F_t - e_t) + \gamma X_t + \varepsilon_t \tag{1}$$

where e_t is the spot exchange rate at time t, F_t is the forward exchange rate at t (the time t price of foreign exchange in period $t+1$), X_t is any other potentially useful information known at time t, and ε_t is a random error.

(a) *Explain why equation (1) is a test of uncovered interest parity (UIP)? What critical assumptions, if any, are needed for this to be a test of UIP?*

brief answer Uncovered interest parity says that $i - i^* = \frac{\widehat{e}_{t+1} - e_t}{e_t} \equiv \delta$, the expected depreciation of currency. Covered interest parity says that $i - i^* = \frac{F_t - e_t}{e_t} \equiv f$, the forward premium. Hence, if the former is true we would expect that the expected exchange rate would equal the forward rate; i.e., $\widehat{e}_{t+1} = F_t$. Of course we do not have data on the expected exchange rate. But if we assume that *agents form expectations rationally*, then they use all the available information they have to form expectations about future exchange rates. This means that e_{t+1} and $\widehat{e}_{t+1}$ should only differ based on stuff that is unknowable at time t; i.e., future information, so the expectations error should be random. Time t information is obviously used when people decide whether to undertake future transactions, so it is contained in F_t. Hence, if expectations are rational, e_{t+1} and F_t should only differ based on information unknowable at time t. So the difference between e_{t+1} and F_t should be a random error with a mean of zero. The critical assumption here is that expectations are formed rationally. This leads to the prediction that markets are efficient if the costs of arbitrage are small and there are no risk premia.

(b) *What values should we expect to find for α, β, and γ if UIP holds? Explain.*

brief answer Obviously we expect to find $\widehat{\beta} = 1$, and $\widehat{\alpha} = \widehat{\gamma} = 0$, where the hats refer to estimated values. All the information contained in X_t should be in F_t, so there should be no additional effect, hence $\gamma = 0$.

(c) *Do empirical tests confirm our predictions (regarding α, β, γ)? Explain.*

brief answer No! Typically they find that $\widehat{\gamma} \neq 0$, and even worse $\widehat{\beta} < 0$! This is the forward discount puzzle.

(d) *Given the typical estimated values of β can we make money using equation (1)? Explain what we should do in order to make money. Why aren't these gains arbitraged away?*

brief answer Suppose that $\widehat{\beta} < 0$. This implies that countries with positive interest differentials will experience currency appreciation rather than depreciation. Hence, we should borrow in the country with low interest rates and invest in the country with high interest rates. If the currency in the latter country appreciates we will earn capital gains plus interest differentials. This is the carry trade. Why these gains aren't arbitraged away is not clear. It could be a time-varying risk premium, but that would not explain negative β. Also, it would not explain why β is smaller in industrialized countries than emerging market economies. Presumably, the reason is that when the carry trade unwinds the losses are really large. And it takes lots of money to earn money at the carry trade. So you would have to have a lot of leverage, and then when it did unwind the whole market could collapse. So perhaps it is the asymmetric losses and gains that account for the lack of complete arbitrage.