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Solution to written exam for the M. Sc in Economics International Monetary Economics

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1. This question consists of five sub–questions all requiring only short answers. They relate to the following learning objectives: describe and explain Covered Interest Rate Parity (CIP), Uncovered Interest Rate Parity (UIP), and Purchasing Power Parity (PPP) and be able to summarize the empirical evidence on these parity conditions; describe the institutional features of the foreign exchange market products (spot and forward contracts) and be able to distinguish between speculation and arbitrage; describe the main models of exchange rate determination (the Monetary approach to the exchange rate, Dornbusch overshooting model, the portfolio balance model and Lucas asset pricing model) and use these models to analyze the effects of monetary and fiscal policy on the exchange rate, and summarize the empirical evidence on these models.

   (a) True. News that interest rates will be higher in the future will imply an appreciated dollar in the future, which through UIP, will imply an immediate appreciation of the dollar.

   (b) True. If UIP holds then if the government wants to maintain an exchange rate target, that is, the change in the exchange rate is zero, then it must adjust the interest rate such that it is equal to the foreign exchange rate. The two goals are interrelated and cannot be independent according to UIP.

   (c) True. The real exchange rate appreciates through the Balassa–Samuelson effect and the nominal exchange rate then appreciates as well. US prices fall and the nominal exchange rate appreciates. Both effects lead to a real exchange rate appreciation.

   (d) True. The country sells its domestic currency for foreign currency as the first step in sterilized intervention (and then sells domestic bonds for domestic currency as the second step in order to prevent the domestic money supply from rising).

   (e) True, all three models predict the same effect on the exchange rate. An open market purchase of domestic assets imply that the money supply increases, there is excess supply of money.

2. This question relates to the learning objective: "describe the main models of exchange rate determination (the Monetary approach to the exchange rate, Dornbusch overshooting model, the portfolio balance model and Lucas asset pricing model) and use these models to analyze the effects of monetary and fiscal policy on the exchange rate, and summarize the empirical evidence on these models;".

   (a) All these models emphasize the importance of relative money supplies in explaining exchange rates, the money supply is the main factor behind exchange rate movements. Another similarity is that all types of models except the sticky-price portfolio model (which is a variant of the portfolio balance model) assume that UIP holds and that agents are risk averse. There is no risk premium in UIP. However, in some models it is straightforward to also include a risk premium but in general they assume that domestic and foreign bonds are perfect substitutes. All these models are based on the assumption that PPP holds either in both the short–run and in the long–run or only in the long–run.

   The flexible–price model assumes that PPP holds continuously and that prices adjust instantaneous to changes in demand and supply. As a consequence, the exchange rate will adjust instantaneously to these price changes through PPP. Output and expected inflation also affects the exchange rate since such changes relate to the money demand.

   The sticky–price models assume that prices (and maybe also wages) are sticky, they do not adjust in the short–run to changes in demand and supply. This further implies that there will be short–run deviations from PPP through exchange rate overshooting effects.

   The sticky–price portfolio model relaxes the assumption about risk neutrality and introduces a new source to exchange rate movements. Changes in risk perceptions, political risk and so on will affect the relative riskiness and lead to adjustments in the exchange rate. In principle, these models add demand and supply for domestic and foreign assets under the assumption that these assets are not perfect substitutes.

   (b) In general the empirical evidence suggest that all models fail. There are very few examples of supportive evidence. One type of model could be rejected using one currency but not rejected using another currency. Results are also sample dependent. In general, we cannot reject models using data for hyper–inflation countries. For post–Bretton Woods data we usually reject the models. There are several reasons for this failure and rejection of the models may not necessarily mean that these models are wrong. One main reason for the poor empirical results is that expectations matter and are crucial when modeling exchange rates but they are difficult to measure empirically.

   There are, however, empirical results supporting models when using cross–section regressions and when using long–run tests of different models. These tests usually support the theory. The conclusion from the empirical literature is that exchange rate models are less useful when predicting exchange rates in the short–run but work well when predicting long–run movements.

(c) Following up on this discussion above we know that theoretical exchange rate models are relatively useless when predicting short–run movements in exchange rates, the general result is that it is better to use a simple random walk model. However, for long–run predictions the models work well. There are some rare examples in the literature where an empirical exchange rate model beats a random walk model. In this regard it is a general conclusion from the literature that non–linear models do not perform better than linear ones.

One possible reason why it is difficult to forecast exchange rates is that investors have different behavior and react differently to new information, i.e., heterogenous agents. This can explain that fundamentals may not fully explain actual movements in exchange rates and why it is so difficult to forecast exchange rates.

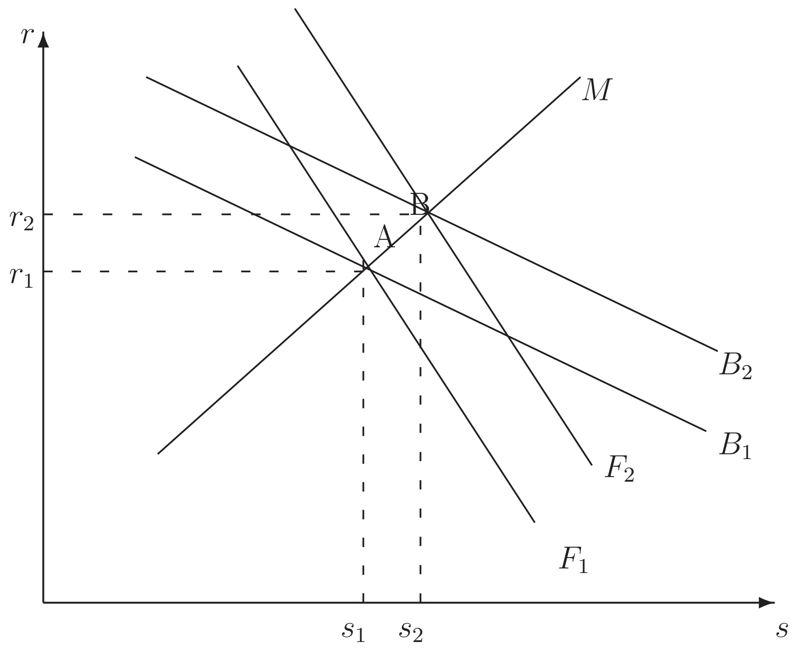
3. This question also relates to the learning objective: "describe the main models of exchange rate determination (the Monetary approach to the exchange rate, Dornbusch overshooting model, the portfolio balance model and Lucas asset pricing model) and use these models to analyze the effects of monetary and fiscal policy on the exchange rate, and summarize the empirical evidence on these models;".

The question specifies that during a one–year period the Swedish Krona depreciated relative to the Euro but the interest rate increased during the same period. Using the portfolio balance model we find that these are the effects of a sterilized foreign exchange operation. But it could also be that domestic Swedish bonds became more risky or that budget deficits were financed through borrowing from households (bond-financed expenditures). However, this latter explanation is less likely since Sweden had a budget deficit surplus during the period.

Consider the effects of a sterilized foreign exchange operation as shown in the graph below. First, the central bank increases the supply of domestic bonds (contractionary open market operation). This will lead to excess supply of domestic bonds and therefore falling prices implying that the interest rate must increase holding the exchange rate constant. The B schedule must therefore shift up to the right to B_2.

For a given interest rate, there is excess demand for foreign bonds. The F schedule shifts up to the right to F_2. The shortage of foreign bonds in the portfolios requires the exchange rate to depreciate (holding the interest rate constant) which in turn tends to increase the domestic currency value of investor's remaining holdings of foreign bonds.

The total effect is an increase in the interest rate and a depreciated exchange rate (the new equilibrium is at point B). This is consistent with the behavior of the SEK during the period May 2000 until September 2001.



4. This question relates to the learning objective "describe, explain and compare first, second and third generation models of currency crises and apply these models to analyze actual currency crises". The question relates to the first generation model discussed in Pilbeam 17.2 and Sarno and Taylor section 8.1. Compared to the standard model covered during lectures, the accounting identity in equation (2) is now defined in logarithmic form from the central bank's balance sheet.

   (a) Equation (1) is a money market equilibrium condition where the real money demand depends negatively on the domestic interest rate. Equation (2) is the accounting identity mentioned above from the central bank's balance sheet. Notice that it is in logarithmic form. The monetary base is equal to domestic credit plus net foreign reserves. Equation (3) is the standard PPP relation whereas equation (4) is the UIP relation under the assumption that agents are risk neutral or equivalently that domestic and foreign assets are identical (which is the reason why there is no risk premium). Note that we have assumed that the foreign price level and the foreign interest rate are normalized to zero. All variables are in logarithms except where noted (in equation (2)).

   (b) To show that
   $$m - s = -\lambda \dot{s}$$
   we simply insert (3) and (4) into (1). Note that there is a missprint in the exam, γ should be λ.

   (c) We now assume that domestic credit grows at a constant rate μ. Thus, the fixed exchange rate regime is only a secondary goal, the primary objective of the central bank or government is to let domestic credit grow at a constant rate. At the same time the monetary authority decides to maintain a fixed exchange rate, i.e., the fixed exchange rate is $\bar{s}$ and $\dot{s} = 0$. To derive the growth rate of reserves under these assumptions we first note that this implies from above that m must be constant such that increases in domestic credit must be balanced by declines in reserves. Since there are no simple formulas for $\ln(D + R)$ we might take a linear approximation (which is not required). Instead, what we have done earlier in the curriculum is to approximate the central bank's balance sheet and assumed that $m = d + r$ where variables are in logs. We know that since $d_t = \ln(D_t)$ we have that $d_T = d_0 + \mu T$. The growth rate of foreign reserves must therefore be negative and as an approximation equal to $-\mu$ (which is the case we have covered in the curriculum). Also note that it will not be necessary to explicitly derive the growth rate of foreign reserves below, we will denote the growth rate with δ, for example, and we know that $\delta < 0$. This implies that $r_t = r_0 - \delta t$.

(d) We know that $r_t = r_0 - \delta t$ implying that the time when reserves are exhausted is given by

$$t_N = \frac{r_0}{\delta}.$$

Since we cannot in a simple way determine δ this is as far we can go. What is important however is that given that we know that as domestic credit is growing, foreign reserves must be declining at the rate δ. A larger initial level of reserves and a smaller growth will delay the time when reserves are exhausted.

(e) To derive the shadow exchange rate $\tilde{s}$ we first note that after the collapse of the fixed exchange rate $dst/dt = dm_t/dt = dd_t/dt = \mu$ since under floating exchange rates $m_t = \ln(D_t) = d_t$. Use these relations in the relation in (b) such that

$$\tilde{s} = d_t + \lambda\mu.$$

At the time of the collapse of the fixed exchange rate, the shadow exchange rate is given by

$$\tilde{s} = \lambda\mu + d_{t_A}$$

and since $d_{t_A} = d_0 + \mu t_A$ we find that

$$t_A = \frac{\ln\left(1 + \frac{R_0}{D_0}\right)}{\mu} - \lambda$$

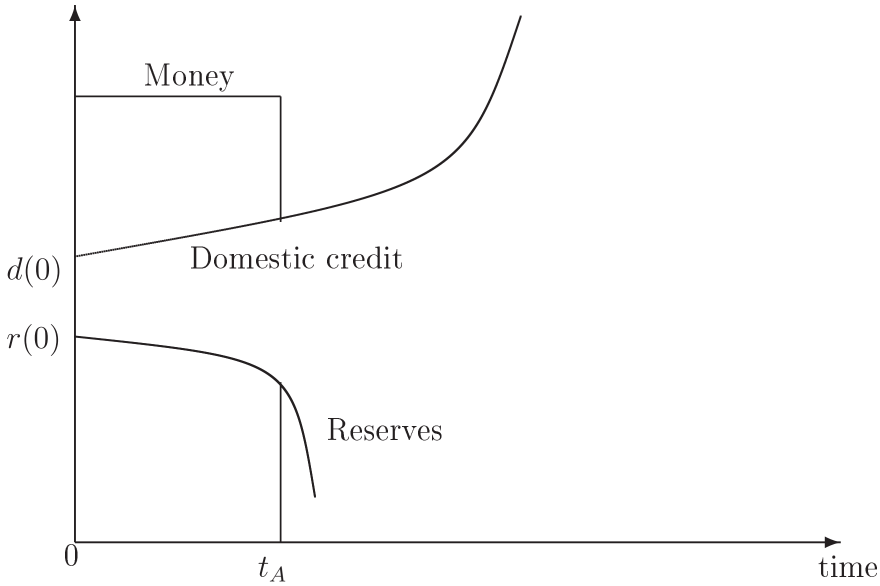
since $\tilde{s} = m_0$ at the time of the attack where $\dot{m} = \dot{s} = 0$ and that $m_0 = \ln(D_0 + R_0)$. The time of collapse can be delayed by increasing initial reserves relative to initial domestic credit and for a smaller growth rate of domestic credit.

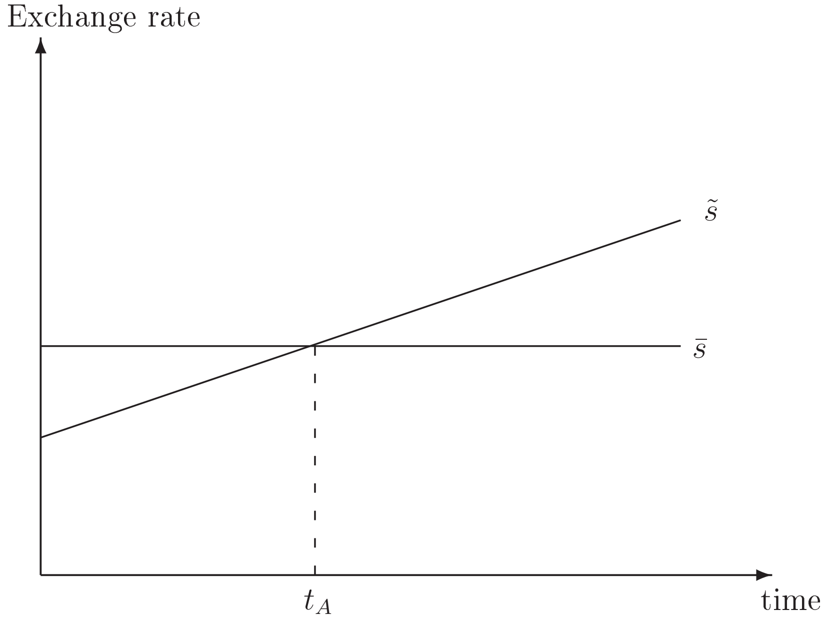
(f) The level of reserves at the time of the attack is $r_{t_A} = r_0 - \delta t_A$ which can be compared to the solution above. Inserting we find that

$$r_{t_A} = r_0 - \delta\frac{\ln\left(1 + \frac{R_0}{D_0}\right)}{\mu} + \delta\lambda$$

which will be positive unless $\delta \frac{\ln\left(1+\frac{R_0}{D_0}\right)}{\mu}$ is very large. For this to be a large number, initial reserves must be (much) larger than initial domestic credit and the growth rate of domestic credit must be small. Otherwise we conclude that the level of reserves when the attack occurs is positive.

(g) The graphs below illustrate how the main variables of the model behave before and after the speculative attack. Note that domestic credit and foreign reserves are not linear (see equation (2)). The reason why reserves jump downward discontinuously when the attack occurs is that before the collapse, anticipated depreciation is zero and immediately after the attack anticipated depreciation jumps up since the steady growth in domestic credit translates into a steady growth of money in the floating exchange rate regime. The exchange rate is continuous at the collapse and there is a downward jump in the demand for domestic currency which can only be satisfied by a discontinuous jump in foreign reserves. Foreign reserves fall to zero at the time of the attack. Prior to the attack, the exchange rate is fixed and there is no anticipated depreciation implying that the money supply is fixed. The growth of domestic credit is balanced by a decline in reserves.




Exchange rate
$\tilde{s}$
$\bar{s}$
t_A
time