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

February 23, 2012

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1. This question consists of 4 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, explain and compare first-, second- and third-generation models of currency crises and apply these models to analyze actual currency crises."
   (a) False! Anticipated shocks are already incorporated in the price whereas unanticipated shocks are not. An unanticipated shock to a fundamental will lead to a jump in the exchange rate.
   (b) True! According to UIP and CPI it must be the case that a systematically undervalued forward exchange rate (in relation to the spot rate) this may be interpreted as a positive risk premium attached to the foreign currency.
   (c) True! It is fiscal policy (budget deficits financed by increasing domestic credit) together with the assumption that the money supply is constant implying falling foreign reserves that creates this inconsistency.
   (d) True! There is the possibility that there are multiple equilibria in second generation models. If private agents' expectations of a devaluation is low, the government will not devalue whereas if expectations are high, the government has incentive to devalue since the costs of maintaining the exchange rate are high.

2. This question has two parts, the first considers the failure of not rejecting exchange rate models empirically and the second question focuses on why speculation may be destabilizing under floating exchange rates. The question relates to the following two learning objectives: "describe the main models of exchange rate determination (the Monetary approach to the exchange rate, Dornbusch overshooting 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"; "describe the institutional features of the foreign exchange market products (spot and forward contracts) and be able to distinguish between speculation and arbitrage."

(a) There are many reasons why empirical tests very often reject exchange rate models. Among the most important reasons are:

- Exchange rates are not only affected/determined by monetary policy, fiscal policy and the monetary–fiscal policy mix may affect exchange rates.
- Exchange rates depend not only on present fundamentals but also future fundamentals. Introducing expectation (UIP) we can show that the actual exchange rate is a function of current and future expected fundamentals. In empirical tests we usually use only current and lagged values of fundamentals.
- The "Peso problem" may be of importance. Even if the models are correct, it may be the case that expected events do not materialize. This would affect the actual exchange rate but it may look as if the exchange rate moves in a way not predicted by our model, the exchange rate movement is unrelated to the supposed underlying fundamental.
- Distinction between unanticipated and anticipated shocks could be important. It is very difficult to model such shocks and to integrate these aspects into the exchange rate models. If the exchange rate market is efficient, only unanticipated shocks should matter. Anticipated changes in fundamentals are already incorporated into the price.
- Expectations are not homogeneous. In our models we always assume homogeneous expectations and very often also rational expectations. Empirical evidence suggest that all agents cannot form rational expectations and that they even use different exchange rate models or technical analysis when forming expectations.
- Demand for money may not be stable over time, it may also be the case that there is no money demand function. Most models we have discussed here incorporates a money demand function.
- Real shocks may also be important.
- Structural changes in financial markets and in the real economy may also affect the empirical tests.

(b) There are several arguments as to why speculation can be destabilizing. The main argument is that private speculation can produce the wrong exchange rate, either deviating from the fundamental based exchange rate or a currency which could be sub-optimal from the viewpoint of resource allocation.

- Traders on the foreign exchange market may be too risk-averse. This could imply that they attach a too large probability of depreciation on weaker currencies and too large probability of appreciation on stronger or safer currencies. Actual exchange rates will then move accordingly and disconnect the actual value from fundamentals.

- The existence of bandwagon effects where "speculation feeds speculation". The idea is that there are self-generating speculation where agents are not using fundamentals to form expectations but tend to follow the actions of other agents. Speculative behavior can generate more speculative behavior. Both bandwagon effects and excessive risk-aversion imply that agents do not use all information available or news efficiently.
- Uncertainty is another source for destabilization. If there is uncertainty about the correct exchange rate model and agents use the wrong model or at least a defective model, the expectations even for rational speculators will be wrong which in turn will produce the wrong exchange rate, an exchange rate disconnected from fundamentals.This problem could be even more severe if agents cannot distinguish relevant from irrelevant information or news. The result may be excessive volatility.
- Peso problem. As above, the exchange rate is a function of actual fundamentals and expected future fundamentals. Agents perceptions about future fundamentals may not be correct and exchange rates will move in anticipation of future events that may not materialize.
- Rational bubble. If agents realize that a currency is overvalued they may still hold this currency if they believe that it will continue to appreciate in the future, thus building on the existing bubble. This may be viewed as rational. The expectations is that the currency can be sold in the future at a higher price and that the expected gain exceeds the risk of holding the currency.

3. 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, 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 presents a version of the familiar Dornbusch model. The idea is to derive the main results in the model and then illustrate the overshooting effect. In addition to this, the last question considers the effect of an increase in the long-run level of output and whether there will be an overshooting effect in this case also.

   (a) The model consists of the five equations given in the exam

$$y^d = \alpha \left(s + p^* - p \right), \tag{1}$$

$$m - p = \eta y - \sigma r, \tag{2}$$

$$\dot{p} = \pi \left(y^d - \bar{y} \right), \tag{3}$$

$$r - r^* = \mathrm{E}\dot{s} \tag{4}$$

and

$$\mathrm{E}\dot{s} = \theta\left(\bar{s} - s\right). \tag{5}$$

Equation (1) is the aggregate demand function where demand is a function of the real exchange rate. A depreciation of the nominal exchange rate (an increase in s) leads to an increase in (foreign) demand. Higher domestic prices (foreign prices) reduces (increases) demand on domestic goods. Equation (2) is the standard money demand function. Inflation is determined by the supply function in equation (3) where $\bar{y}$ is the long-run level of output. When aggregate demand exceeds the long-run level of output, prices will increase (π measures the speed of price adjustment). Equation (4) is the UIP relation where it is assumed that agents are risk neutral such that the risk premium is equal to zero (or equivalently that domestic and foreign bonds are perfect substitutes). Finally, equation (5) describes expectations formation. When the exchange rate deviates from its long-run equilibrium value it will adjust according to this relation. If the exchange rate depreciates (s increases) it is expected to appreciate and return to its long-run level in the future. The speed of adjustment is measured by the parameter θ.

In addition to these relations it also assumed that PPP holds in the long-run but, since prices are sticky, not in the short-run. The exchange rate is fully flexible and will adjust immediately to changes in demand and supply.

Long-run equilibrium in the model is when the goods market and the money market are in equilibrium and PPP holds. The economy is in equilibrium when the exchange rate corresponds to the level given by PPP, when aggregate demand is equal to aggregate supply and there is asset–market equilibrium (the money market is in equilibrium). Note that the money market always is in equilibrium, the exchange rate responds immediately whereas price stickiness implies both that the goods market can be out of equilibrium and that PPP does not hold in the short-run. In addition, long-run equilibrium requires that the domestic interest rate is equal to the foreign interest rate such that the exchange rate is expected to be constant.

(b) Show that the equilibrium price level is given by

$$\bar{p} = m - \eta\bar{y} + \sigma r^{*} \tag{6}$$

and that the equilibrium exchange rate is given by

$$\bar{s} = \left(\frac{1}{\alpha} - \eta\right)\bar{y} + m + \sigma r^{*} \tag{7}$$

and explain the economic rationale behind these relations.

To show that the equilibrium price level is given by (6) we use the UIP relation (solve for r in UIP) and insert the expectations formation in (5) such that

$$r = r^{*} + \theta\left(\bar{s} - s\right)$$

and then we insert this into the money demand function in (2)

$$m - p = \eta y - \sigma \left(r^* + \theta \left(\bar{s} - s \right) \right)$$

and rearranging this

$$p = m - \eta y + \sigma \left(r^* + \theta \left(\bar{s} - s \right) \right)$$

and finally we obtain the equilibrium price level as

$$\bar{p} = m - \eta \bar{y} + \sigma r^*$$

since $y = \bar{y}$ and $s = \bar{s}$ in equilibrium.

To show that the equilibrium exchange rate is given by (7) we insert (1) into (3) and note that in equilibrium $\dot{p} = 0$ such that (and normalizing the foreign price level to zero)

$$\bar{s} - \bar{p} = \frac{\bar{y}}{\alpha}$$

where we insert the solution for the long-run equilibrium price level such that we obtain

$$\bar{s} = \left(\frac{1}{\alpha} - \eta \right) \bar{y} + m + \sigma r^*.$$

(c) In order to derive the money market equilibrium we use the result above that

$$p = m - \eta y + \sigma \left(r^* + \theta \left(\bar{s} - s \right) \right)$$

which we can rewrite using the equilibrium price level as

$$p = \bar{p} - \sigma \theta \left(s - \bar{s} \right).$$

The slope of this curve in the s–p–plane is $-\sigma\theta$.

The goods market equilibrium curve is derived using equation (3) and (1), i.e.,

$$\dot{p} = \pi \left(\alpha \left(s + p^* - p \right) - \bar{y} \right).$$

In equilibrium $\dot{p} = 0$ as above which will imply that $\alpha \left(\bar{s} + p^* - \bar{p} \right) - \bar{y} = 0$ and using the definition of the real exchange rate we find that $\bar{y} = \alpha \bar{q}$. Inserting this in the equation above we find the goods market equilibrium curve

$$\dot{p} = \pi \left(\alpha \left(s + p^* - p \right) - \alpha \bar{q} \right) = \pi \alpha \left(q - \bar{q} \right).$$

Note that the slope of this curve is 1. This implies that the slope of the goods market equilibrium curve coincides with the 45–degree line depicting PPP. This must be reflected in the graph.

The graph below illustrates the model. G is the goods market equilibrium curve (which coincides with PPP or the 45–degree line). M is the money market equilibrium curve. As in the standard Dornbusch model, the size of the overshooting effect can be derived from

$$p = m - \eta y + \sigma \left(r^* + \theta \left(\bar{s} - s \right) \right).$$

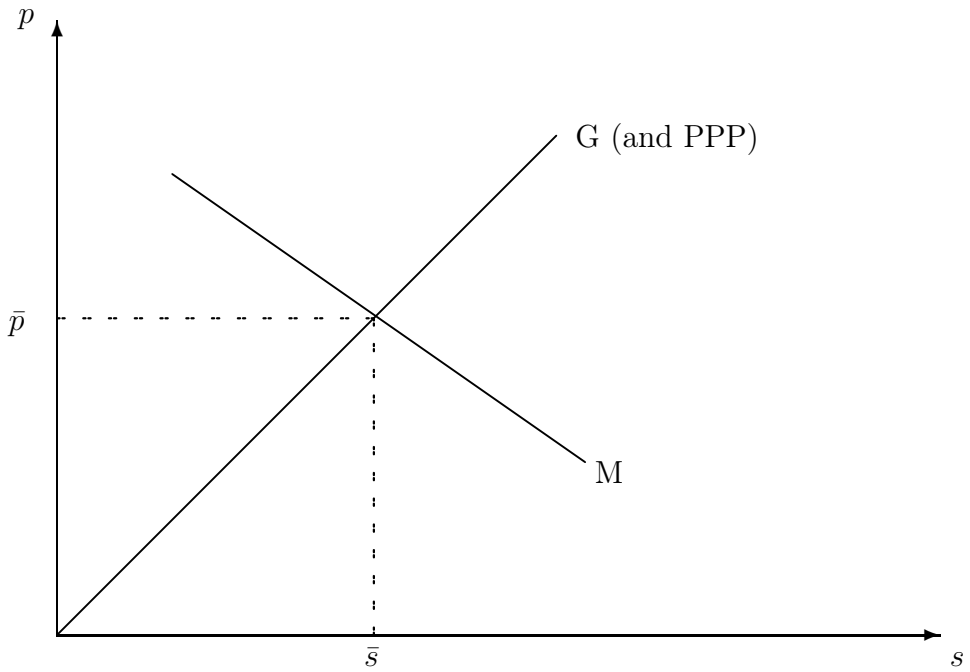
Take the total differential of this equation noting that $dp = 0$ in the short–run, long–run homogeneity requires that $d\bar{s} = dm$ and that output as well as the foreign interest rate are constant we find that

$$-dm = \sigma\theta \left(dm - ds \right)$$

which implies that the overshooting effect is determined by

$$\frac{de}{dm} = 1 + \frac{1}{\sigma\theta}$$

which is the same as in the original Dornbusch model.



(d) Consider now an increase in the long-run level of output. As is standard when analyzing the Dornbusch model we first consider the long-run effects. As can be seen from the relation determining the equilibrium price level, i.e.,

$$\bar{p} = m - \eta\bar{y} + \sigma r^*$$

we note that an increase in $\bar{y}$ must imply that the equilibrium price level falls. How is the equilibrium exchange rate affected? This can be seen from the relation

determining the equilibrium exchange rate

$$\bar{s} = \left(\frac{1}{\alpha} - \eta\right)\bar{y} + m + \sigma r^*.$$

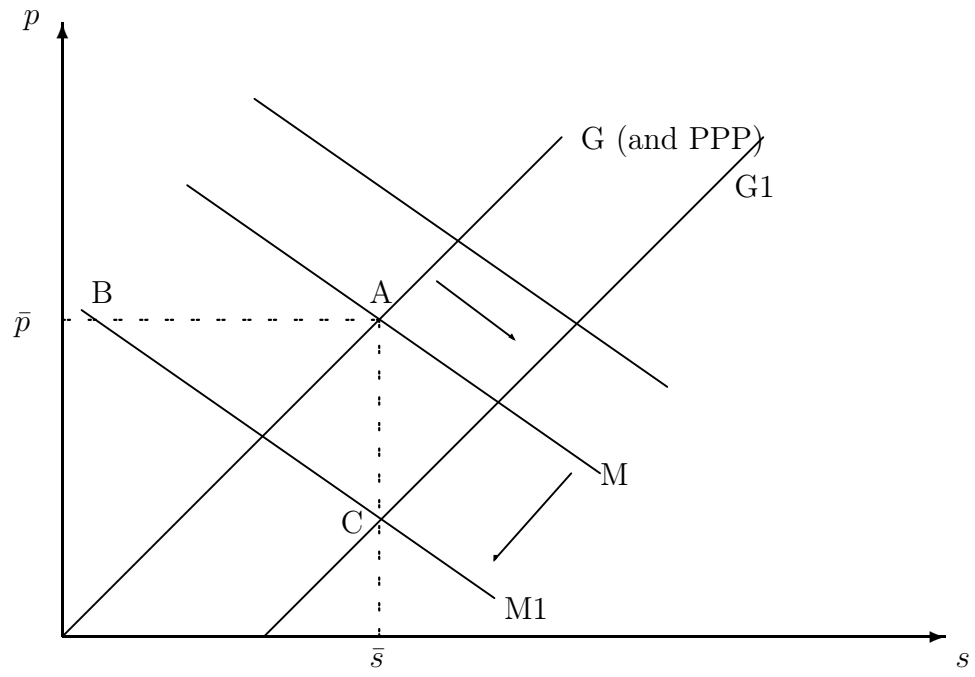
The effect is determined by $\frac{1}{\alpha} - \eta)$ implying that the exchange rate could either fall or increase. At the same time we found above, using the definition of the real exchange rate as above, that

$$\bar{s} - \bar{p} = \frac{\bar{y}}{\alpha}$$

implying that $\bar{p}$ falls more than $\bar{s}$, $\bar{s} - \bar{p} > 0$ if $\bar{y}$ increases. The real exchange rate must be higher since $\bar{q} = \frac{\bar{y}}{\alpha}$.

What happens in the short-run? The graph below illustrates. Assume that the economy initially is in equilibrium, point A. There is a shift in long-run level of output. As above we know that a higher long-run level of output must imply a lower long-run price level. From the relation describing the goods market equilibrium we note that for a given price level, the exchange rate s must be higher, therefore the goods market curve must shift to the right to G1 as shown in the graph below. Using the relation for the money market equilibrium we find that given the exchange rate s a lower equilibrium price level requires a lower p, the money market curve must shift down to M1. In the short-run prices are fixed implying that the exchange rate must appreciate (point B is the short-run equilibrium). As prices start to adjust (fall) we are moving along the new money market equilibrium curve towards point C which is the long-run equilibrium. As can be seen in the graph the long-run equilibrium exchange rate is equal to the initial equilibrium value but this may not be the case, the long-run equilibrium is determined by the term $\frac{1}{\alpha} - \eta)$ which can be both positive or negative. Therefore, we cannot determine whether there will be an overshooting effect in this case.

The intuition behind this result is that with sticky prices, higher output will tend to increase money balance which in turn will lead to higher interest rate. A higher interest rate will according to UIP that the exchange rate is expected to depreciate. For this to happen, the exchange rate must first appreciate in the short-run, in the graph we move from point A to point B. Otherwise the exchange rate cannot be expected to depreciate. There will be an overshooting effect only if the equilibrium exchange rate appreciates.


p
G (and PPP)
G1
B
A
$\bar{p}$
M
C
M1
$\bar{s}$
s