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Solutions: Written exam for the M. Sc in Economics International Monetary Economics

January 9, 2012

Number of questions: This exam consists of 3 questions.

1. This question consists of four 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" and "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".
   (a) True, the efficient market hypothesis can be adjusted for risk making it a joint hypothesis of a model of equilibrium returns including a risk premium and rational expectations.
   (b) False, there are two PPP puzzles, the first is that long–span and panel data studies find evidence supporting PPP whereas univariate methods in general do not, and the second is that if PPP holds, the second PPP puzzle is that there is a high degree of persistence in real exchange rates with half–lifes between three and five years.
   (c) True, higher productivity in the tradable goods sector will lead to lower prices in the tradable sector which implies a real appreciation since PPP holds for tradable goods.
   (d) False, an increase in the interest rate leads to a depreciated currency since a higher domestic interest rate either leads to a fall in the demand for money and therefore a depreciation, or that a higher interest rate implies a higher inflation rate if we assume that the real interest rate is constant and a higher inflation rate leads to a depreciation.

2. This question relates to the learning objective "explain the theory of optimum currency area and apply this theory to the analysis of the European Monetary Union".
   (a) The benefits of a monetary union include:

- Stimulus to intra–monetary union trade: Removing exchange rate uncertainty stimulates international trade. It is often argued that exchange rate variation inhibit international trade by increasing uncertainty about future income streams measured in home currency. Such fluctuations can only be eliminated using currency hedging which could be costly for businesses in particular small and medium–sized firms. In Europe this argument is very strong since a large proportion of international trade is intra–European. It can be argued that hedging can remove uncertainty at short–term horizons but is more costly and may not remove medium– and long–term (over one–year horizons) uncertainty. Another contributing factor is that there are no transaction costs involved for intra–currency union trade since participating countries are using the same currency. These administration costs can be substantial, EU Commission have estimated total transaction costs to about 0.4 percent of EU GDP per year. Empirical evidence on the effects of currency unions on trade suggests substantial and significant positive effects.
- More efficient allocation of factors of production: Removal of capital controls and free mobility of labor which in addition to the removal of exchange rate uncertainty may lead to a more efficient allocation of factors of production, factors of production mainly capital tend to move from regions where marginal productivity is low to regions where it is high. As wages and salaries are expressed in the same currency this is expected to result in a better allocation of labor. However, labor mobility is very low in Europe, much lower than in for example the US.
- Economizing of foreign exchange reserves and seignorage benefits: It is often argued that currencies for small open economies tend to fluctuate more than currencies of large countries. The average of the economic performance of a group of small countries is more stable than it is for each individual country. Therefore it is expected that large currencies fluctuate less than currencies for the individual countries. This implies less need to hold foreign exchange reserves. Replacing a number of individual currencies with one common currency implies that there is no need to hold reserves to manage intra–EMU exchange rates. The euro is a major currency which would tend to increase holdings of this currency in non–EMU countries foreign reserves which will result in seignorage benefits. These gains have been estimated to be around 0.75 percent of EU GNP.
- Savings in administrative costs for businesses: Removing exchange rate uncertainty will reduce costs related to the management of exchange rate risk in businesses.
- Greater liquidity and rationalization of financial markets: In a single currency area bonds and stocks are denominated in the same currency making it more

straightforward to compare risk and return. As a result it can be expected to increase liquidity and a reduction of transaction costs. Improved liquidity and cheaper and more transparent sources of finance is a significant benefit from a monetary union. Prior to the euro, European financial markets were segmented whereas they have become more transparent and liquid after the euro.

- Greater price transparency: Consumers and businesses gain from greater price transparency as it is very simple to compare prices if these are quoted in the same currency. It is argued that this would lead to less price differences in at least pre–tax prices. This is a benefit for consumers and businesses but an expense for multinational companies.

The main costs of a monetary union are:

- Loss of monetary autonomy: Entering a monetary union implies that the country gives up the ability to pursue an independent monetary policy. This could be a huge cost if the economic developments differ from other union member states, for example if business cycles are not synchronized. The common monetary policy may not be optimal in all regions or countries within the union as monetary policy is set based on the average union–wide inflation rate. In some countries the common monetary policy may be too expansionary whereas it may be too restrictive in other countries.
- Loss of national macroeconomic policy autonomy: Entering a monetary union implies that a country can no longer determine their own inflation which could be a problem if preferences differ across countries. Some countries may prefer higher inflation in order to benefit from lower unemployment whereas other countries prefer a lower inflation rate at the expense of somewhat higher unemployment. Within a monetary union all member states have to accept a common inflation rate which could lead to very different levels of unemployment.
- Loss of inflation tax: Within a monetary union where monetary policy targets inflation it is no longer possible for a country to increase inflation in order to reduce the real value of government debt. Reducing the real value of debt or the value of the monetary base constitutes an inflation tax.
- Regional disparities: Some countries entering a monetary union may gain more than other countries. Free capital movement may affect a region negatively and may have undesired social effects. This can be the result even though the union as a whole could benefit. Since there are no fiscal transfers in EMU, the burden to counteract and correct such regional disparities lies on national fiscal policy. It may be that a nation specific fiscal policy cannot mitigate these effects.

- Loss of exchange rate policy instrument: When a country enter a monetary union it gives up the exchange rate policy instrument. It is no longer possible to use depreciation to adjust for too large wage increases, for example. A country cannot use the exchange rate instrument to correct external disequilibria.
- Transition costs: Replacing national currency with the new currency is not costless. These one–off costs may be substantial for the banking system but there are also benefits as banks only have to deal with one currency instead of many different currencies.

3. 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 specifically concerns an alternative formulation of the so called ABB model where UIP is replaced with an assumption that the nominal exchange rate is generated by a Martingale (in essence a random walk). This case has been discussed during lectures but not on a very detailed level and the underlying paper is included in the curriculum.

   (a) The first equation is the production function where output is a function of current real wealth w_t and the credit multiplier μ_t. An underlying assumption is that entrepreneurs except from using current real wealth also can borrow a multiple of this wealth in each period, i.e., they can borrow $\mu_t w_t$. Under the assumption that the credit constraint is binding, entrepreneurs can use $w_t + \mu_t w_t$ for production each period.

   Equation two is the profit function. In each period t, entrepreneurs can borrow in either domestic currency at interest rate i_{t-1} or in foreign currency at the constant foreign rate of interest i^*. At the end of period t, nominal operating profits net of financing costs are given by equation two where d_t^c is debt issued in domestic currency and $d_t^f = d_t - d_t^c$ is debt issued in foreign currency. The first term on the right hand side of this equation represents operating profits, the second term is the cost of domestic currency debt, and the third term represents the cost of foreign–currency debt expressed in domestic currency units.

   Equation three is total real wealth available for production where it is assumed that a fraction α of profits is distributed as dividends.

   Other main assumptions: As stated in the question PPP holds ex ante but not necessarily ex post. If there is a supply shock, PPP does not hold ex post. This is an important assumption that is in the core of the model and makes the model useful for studying currency crises.

   (b) Inserting (2) for period $t-1$ in (3) yields

$$\frac{1-\alpha}{p_{t-1}}\left[p_{t-1}y_{t-1} - (1+i_{t-2})\,p_{t-2}d_{t-1}^c - (1+i^*)\,\frac{s_{t-1}}{s_{t-2}}p_{t-2}d_{t-1}^f\right]$$

which is then inserted into (1) remembering that PPP holds if there is no shock, i.e., that $s_{t-2} = p_{t-2}$ such that we obtain equation (4)

$$y_t = f\left((1+\mu_t)(1-\alpha)\left[y_{t-1} - (1+i_{t-2})\frac{p_{t-2}}{p_{t-1}}d^c_{t-1} - (1+i^*)\frac{s_{t-1}}{p_{t-1}}d^f_{t-1}\right]\right).$$

This real–sector equation or the W–curve shows how credit constrained entrepreneurs respond to changes in the exchange rate. The third term on the right–hand side of this equation represents the cost of foreign–currency debt in terms of domestic–currency. This simple fact drives the negative relationship between output and the exchange rate in the previous period. It captures the balance–sheet effect of currency depreciations.

(c) From *ex ante* purchasing power parity we have that $p_{t+1} = E_t(s_{t+1})$. Thus the monetary equilibrium can be re–written as $m^s_{t+1}/E_t(s_{t+1}) = m^d(y_{t+1}, i_{t+1})$. Using the martingale assumption, we have that $E_t(s_{t+1}) = s_t$ and it then follows that

$$s_t = \frac{m^s_{t+1}}{m^d(y_{t+1}, i_{t+1})}. \tag{1}$$

This equation describes an LM curve consistent with a martingale process for the exchange rate (or MLM–curve), when purchasing power parity holds *ex ante*. It shows how (expected) monetary conditions in period $t+1$ affect the period t exchange rate, and indicates a negative relationship between output and the previous period spot exchange rate. Intuitively, the expectation of an increase in output over period t+1 causes increased demand for money for that period, leading to nominal currency appreciation. The anticipation of this future appreciation increases the attractiveness of holding domestic currency in period 1, causing the latter to appreciate.

(d) Simplifying the first equation, we obtain

$$d_t \leq \mu_t w_t$$

implying that

$$\mu_t = \frac{c}{(1-q)(1+i_{t-1})\frac{p_{t-1}}{p_t} - c}$$

where the credit multiplier μ_t, depends negatively on the interest rate i_{t-1} and positively on the probability q reflecting monitoring or the degree of financial development. Using our assumptions that the exchange rate is a martingale and that PPP holds *ex ante* we find that the credit multiplier is given by

$$\mu_t = \frac{c}{(1-q)(1+i_{t-1})\frac{p_{t-1}}{s_{t-1}} - c}.$$

It is easy to see that the credit multiplier depends negatively on the interest rate, a higher interest rate and a depreciated currency implies a tightening of the credit constraint.

(e) The slope was given in the question. From this equation, and using our results above, we find that the slope is ambiguous, it can be positive, zero or negative. The reason is that an increase in the nominal exchange rate (a depreciation) has two effects on output. It raises the cost of foreign–currency debt (the balance sheet effect), with a negative impact on output — as can be seen from the second square brackets in the wealth equation in (4); but it also relaxes the credit constraint — as is shown in the slope of the wealth equation; and impacts positively on y, reflecting increased availability of external funds. In the absence of some form of policy response, the effect of a change in the nominal exchange rate becomes ambiguous. There is a negative foreign–currency debt effect, and a positive credit constraint effect.

We can then distinguish between the following cases. The first case is when the foreign currency debt effect dominates, $\frac{\mu'}{1+\mu}\Pi_t < (1+i^*)\, d_t^f$. In this case the slope of the W–curve is always negative. The limit is when $d_t^c = 0$.

The second case is when the credit constraint is not binding corresponding to very large values of the credit multiplier μ in which case the W–curve is vertical. This is also the case if credit markets are absent, $\mu = 0$, and $d_t = d_t^c = 0$.

The third case is when there is no foreign debt, $d_t^f = 0$, implying that the slope of the W–curve is positive.

As a fourth possibility, we have that the slope can be positive when the exchange rate is low (an appreciated currency) and negative for higher values of the exchange rate.

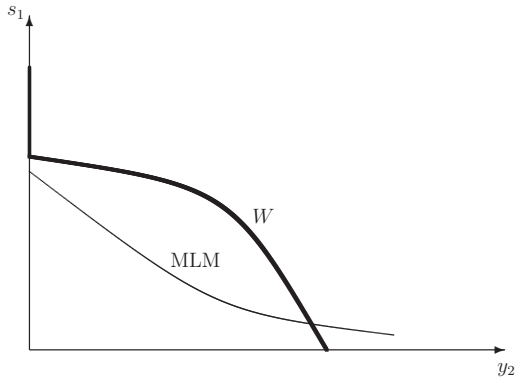
The slope of the W–curve determines whether there can be a currency crisis or not. As discussed above, we have several possibilities. However, only two cases are of interest when discussing currency crises: when the slope of the W–curve is negative; and when it is positive for small values of the exchange rate, but negative for large values. In case the slope of the W–curve is vertical, there can be no currency crisis since there is no equilibrium with high nominal exchange rate and output arbitrarily close to zero. The same holds for the case when the slope is positive, i.e., when foreign debt is zero.

(f) The model consists of two equations, the MLM-curve and the W–curve and can be illustrated in the output–exchange rate plane. Starting in period 1, the timing of events is as follows: first the price level is set for one period, and firms invest. An unanticipated shock then occurs. This shock takes the form of an unanticipated shock to technology, leading to lower output and a depreciated currency.

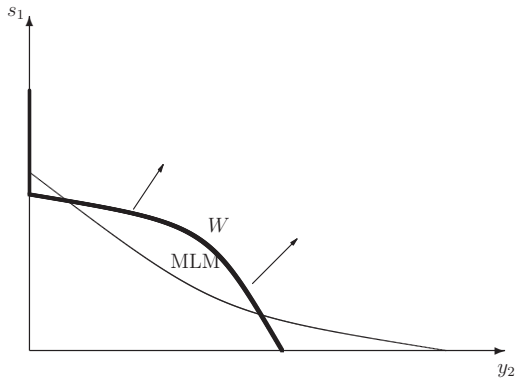
As mentioned above, only two cases are interesting, when the slope of the W–curve is negative, the foreign currency debt effect dominates, or when it is first positive and then turns negative for large values of the exchange rate. As the predictions are identical it suffice to examine the first case.

Initially the W–curve is vertical (it must be vertical if there is no shock to the

economy). Suppose the economy is hit by an unexpected negative supply shock. This will lead to a shift of the W–curve to the left such that for given exchange rate, output will be lower. The slope of the curve will be negative. The new equilibrium, since the MLM–curve is not affected, implies therefore a depreciated currency and lower output. If the new W–curve intersects the y–axis below the point where the MLM–curve intersects the y–axis, there will be a new equilibrium with output close to zero or zero. Currency depreciation raises the cost of servicing foreign–currency liabilities contracted in period–1. Since p_1 is pre–determined, a depreciation causes an *ex post* deviation from purchasing power parity and the increase in the domestic–currency cost of foreign–currency liabilities is not hedged by an increase in revenues. This reduces period–1 profits which in turn reduces the capacity to borrow and invest in the second period. Hence we have a reduction in period–2 output. We refer to this outcome as a currency crisis if it occurs at point where the value of y_2 is arbitrarily close to zero — in practical terms the combination of a depreciated exchange rate with very low output.



(g) Optimal monetary policy response is to cut the interest rater. A fall in the interest rate in period 1 (or an increase of money supply in period 1) lowers the costs of domestic–currency debt, leads to an expansion of external debt funding which stimulates investment capacity which compensates for the negative effect from the depreciation on foreign–currency debt. The W–curve shifts to the right as illustrated in the graph below. The anticipation of increased output also tends to increase money demand which leads to the anticipation of an appreciation. The same principles apply when the slope of the W–curve is positive and negative.


s_1
W
MLM
y_2