University of Copenhagen
Department of Economics
Michael Bergman

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

February 18, 2014

Number of questions: This exam consists of 2 questions.

This exam focuses on two main parts of the curriculum, exchange rate regimes, more specifically the choice of exchange rate regimes and and third generation currency crisis models.

1. **Evaluation of fixed and flexible exchange–rate regimes and monetary unions** This question relates to the following learning objectives: explain and describe the main characteristics of the European Monetary Union; explain the theory of optimum currency area and apply this theory to the analysis of the European Monetary Union.

   The model consist of the following equations as stated in the question

$$Md_t = Pi_t + \eta Y_t - \sigma r_t + U_t^1$$

$$Pi_t = \alpha P_t + (1-\alpha)(S_t + P_t^*)$$

$$Yd_t = \theta(s_t + P_t^* - P_t) - \beta\left(r_t + P_t - P_{t+1|t}\right) + \pi Yn + U_t^2$$

$$Ys_t = \phi(P_t - W_t) + U_t^3$$

$$O(P) = (P - Pn)^2$$

   where notation is standard. Assume that $\eta(\theta + \beta) > \alpha$.

   (a) Give a brief interpretation of the main assumptions and economic mechanisms underlying the equations.

   The first equation is a standard money demand function where the real balance depends negatively on the interest rate and positively on output (or income).

   The second equation states that the domestic price level is a weighted average of domestic and foreign prices where $0 < \alpha < 1$ is the weight of domestic goods in overall consumption basket.

   The third equation is a standard aggregate demand function for domestic output which depends on the real exchange rate (foreign demand), the real interest rate and the natural (or target) rate of output.

The fourth equation is aggregate supply stating that output is inversely related to the real wage.

The last equation is the objective function where $0 < \omega < 1$ is the relative weight attached to output stability and Pn is the target price level.

It is assumed in the model that UIP holds and that agents are risk neutral and that we have one–period wage contracts. The wage is set one period ahead such that $Y = Yn$ (before the shocks affect the economy and become known). There are three shocks to this economy, U_t^1 is a money demand shock, U_t^2 is the aggregate demand shock and U_t^3 is the aggregate supply shock.

Lastly, it is assumed that $\eta(\theta + \beta) > \alpha$. This assumption has consequences for the relative slope of the money demand and aggregate demand relations. The assumption implies that the Md-schedule is steeper than the Yd–schedule.

The model applies to both fixed and flexible exchange rates. Equilibrium requires that $Ms_t = Md_t$ and that $Ys_t = Yd_t$. Under fixed exchange rates: $s_{t+1|t} = s_t$ implying that $r_t = r_t^*$. Money supply is endogenous (the money stock adjusts passively to shifts in Yd and Ys. Under floating exchange rates: Exchange rate and interest rate are exogenous but tied together through UIP (the exchange rate and the interest rate adjust to restore equilibrium). Money supply is exogenous.

(b) Determine the equilibrium graphically in the price–output plane. Comment!

Derive the aggregate demand schedule. Solve for P_t in the aggregate demand function such that

$$P_t = \frac{\theta}{\theta+\beta}(s_t + P_{t^*}) - \frac{\beta}{\theta+\beta}\left(r_t - P_{t+1|t}\right) + \frac{\pi}{\theta+\beta}Yn - \frac{1}{\theta+\beta}Yd_t - \frac{1}{\theta+\beta}Ut_2$$

and find that the slope of this curve is $-\frac{1}{\theta+\beta}$.

Next we derive the money demand schedule, use the money demand function and insert the expression for Pi_t and then solve for P_t, this gives

$$P_t = -\frac{\eta}{\alpha}Y_t + \frac{\sigma}{\alpha}r_t + \frac{1}{\alpha}Md_t - (\frac{1}{\alpha} - 1)(s_t + P_{t^*}) - \frac{1}{\alpha}Ut_2$$

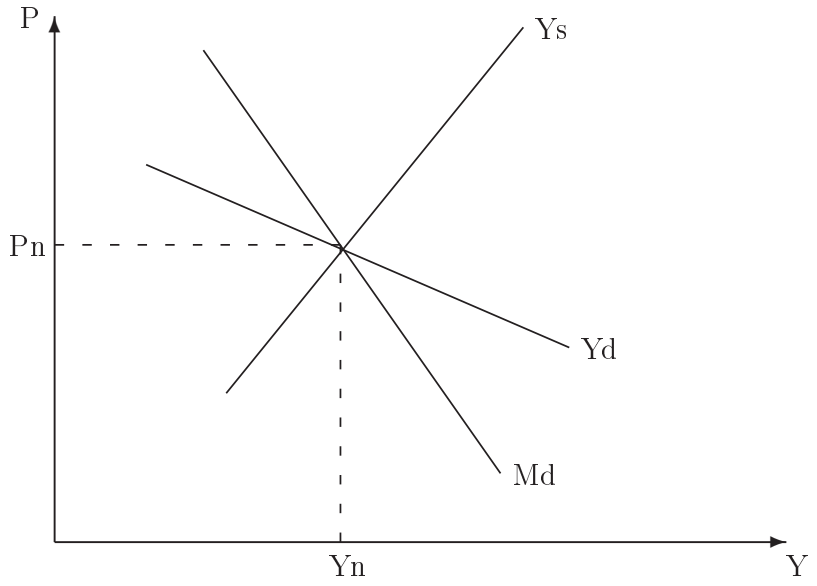
with slope equal to $-\frac{\eta}{\alpha}$.

Finally, use the aggregate supply function in to solve for P_t

$$P_t = \frac{1}{\theta}Ys_t + \phi w_t - Ut_3$$

with slope $\frac{1}{\theta}$. Note that if $\theta \to 0$, then the slope approaches ∞ (a vertical line).

We can then illustrate the model in the following graph



In the graph we note that a positive money demand shock shifts the Md–curve down, for given Y, P must fall to restore equilibrium. There is excess demand for money above the Md–curve. Increases in Yd and Ys causes shifts up and to the right.

If $\eta(\theta+\beta) > \alpha$, as is given above, then the Yd–curve is flatter than the Md–curve. This implies that we have assumed a small open economy. If α is small, foreign prices determine the general price level to a larger extent which implies a small open economy. If α is large, then it is likely that $\eta(\theta+\beta) < \alpha$ such that the Yd–curve is steeper than the Md–curve. This is the case of a large relatively closed economy.

The three shocks have only short–run effects on the economy. Therefore, the economy will adjust to the shocks and will eventually return to the initial equilibrium in the long–run.

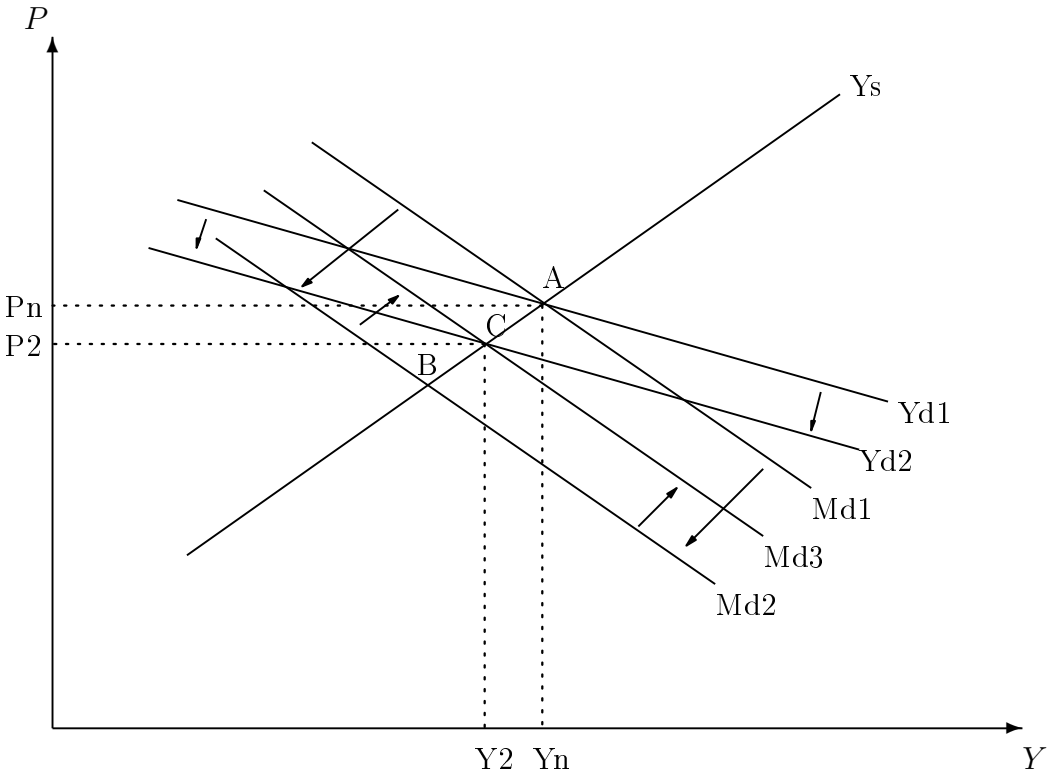
(c) What is the optimal exchange rate regime if the economy is affected by aggregate demand or money demand shocks? Explain carefully!

First consider money demand shocks. Assume that the economy is hit by an unanticipated positive money demand shock. No other shocks affect the economy and the economy is in full equilibrium. There will be excess demand for money which causes a shift down of the Md–curve. The exchange rate will appreciate. What happens depends on whether the exchange rate is fixed or flexible.

Fixed exchange rates: There will be excess demand for money which causes a shift down of the Md–curve, shift down from Md_1 to Md_2. The CB has to intervene and defend the exchange rate. The CB buys foreign bonds and sells domestic money which expands the monetary base. As the monetary base expands, the

money demand shifts back to its initial position, from Md_2 to Md_1. The effects are illustrated in the graph below.

Floating exchange rates: There will be excess demand for money which causes a shift down of the Md–curve, shift down from Md_1 to Md_2. When the exchange rate appreciates, aggregate demand will shift down, less foreign demand leads to a fall in aggregate demand for domestic goods. Yd shifts from Yd_1 to Yd_2. The rise in the interest rate leads to lower money demand and the Md–curve shifts up from Md_2 to Md_3 (use UIP and that an appreciation leads to an expected depreciation in the long–run). New equilibrium at point C, see the graph below.



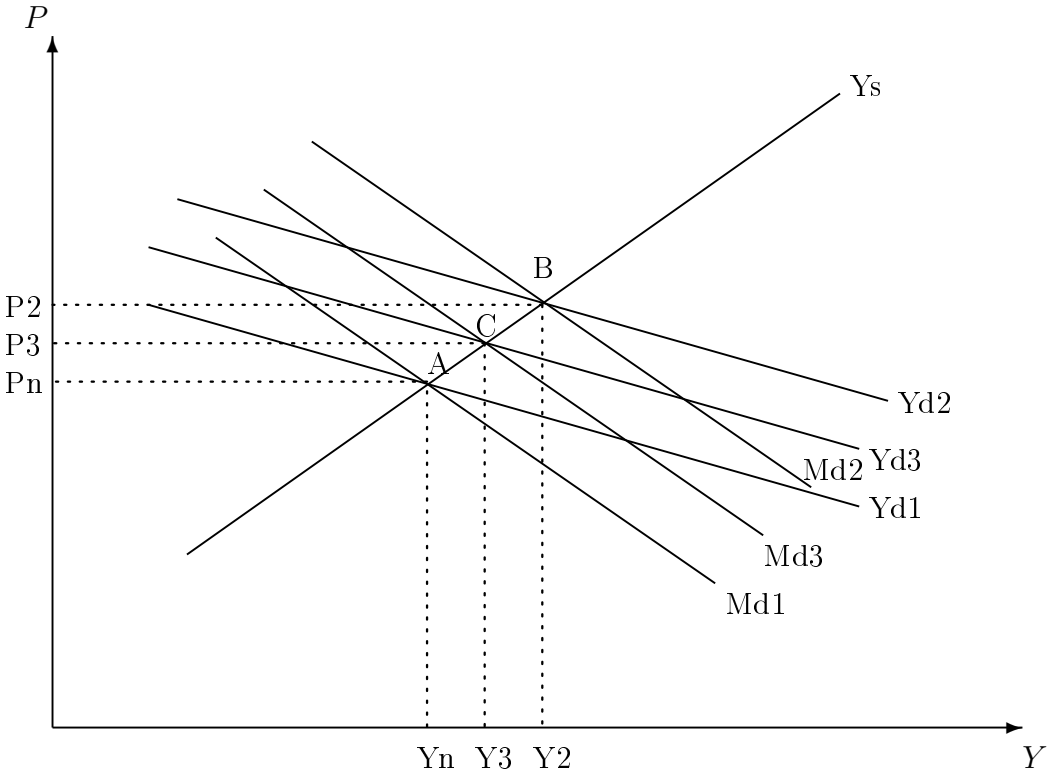
Comparison: If the objective is to minimize fluctuations in output and price level, then it is optimal to have a fixed exchange rate.

Next, we consider aggregate demand shocks. Assume that the economy is hit by a positive aggregate demand shock. This leads to a shift up in the Yd–curve. As a result, there will be excess demand for money which will cause the exchange rate to appreciate (same as in the case above).

Fixed exchange rate: The CB has to intervene by selling domestic money and buying foreign bonds. The Md–curve shifts up to Md_2. New short–run equilibrium at point B as illustrated in the graph below.

Floating exchange rate: The excess demand for money leads to an appreciation and therefore a shift down in the Yd–curve from Yd_2 to Yd_3 (lower export demand). The Md–curve will shift up to Md_3 since the interest rate has increased

(through UIP) and this will reduce Md. New short–run equilibrium at point C, see the graph below.



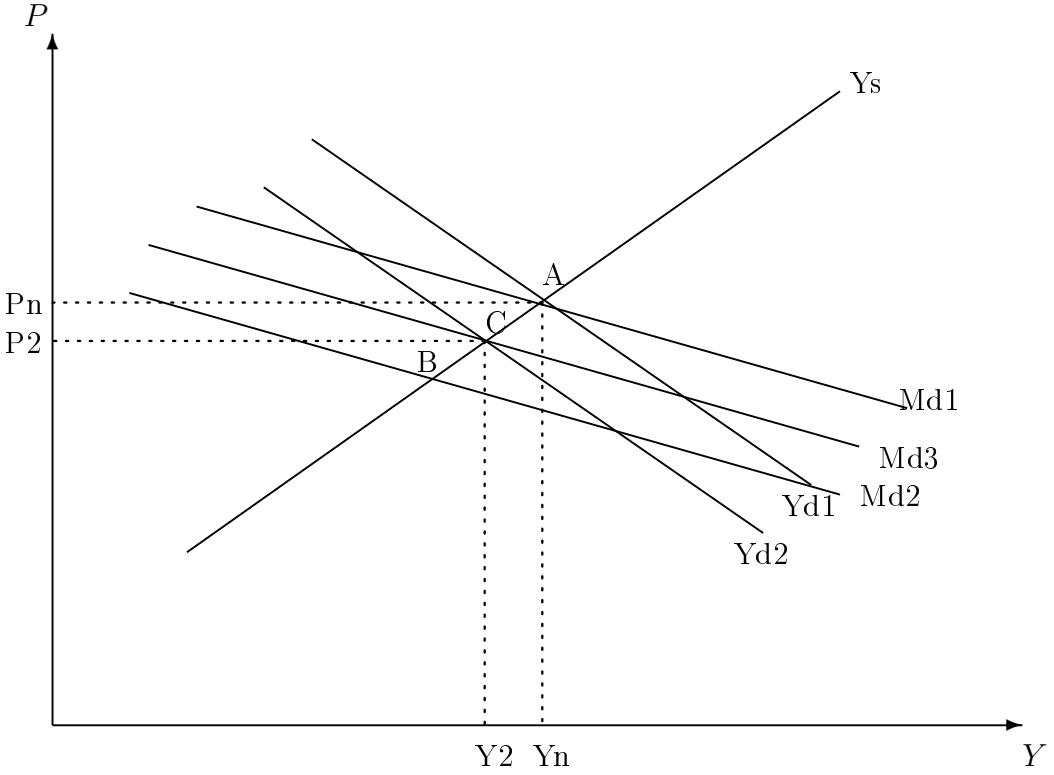
Comparison: Floating exchange rate is optimal if the economy is affected by aggregate demand shocks.

(d) Assume now that $\eta(\theta+\beta) < \alpha$. Illustrate the model graphically. What is the optimal exchange rate regime if the economy is affected by aggregate demand or money demand shocks? Explain carefully!

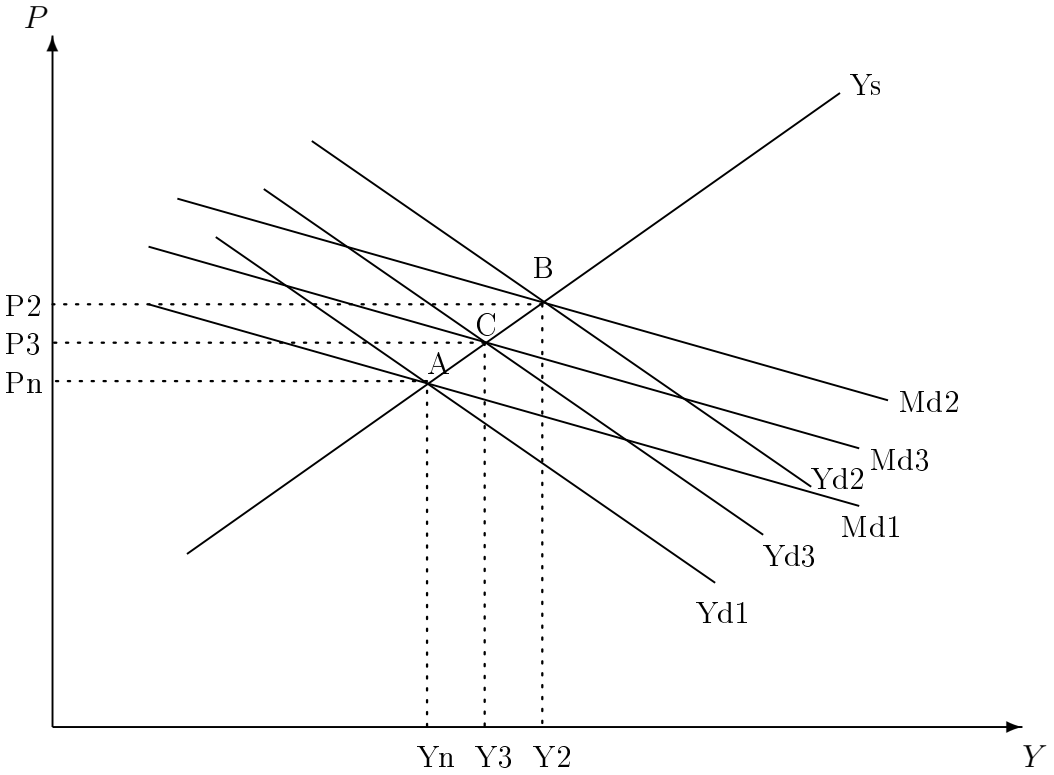
In this case we are considering a large fairly closed economy and the assumption implies that the Yd–schedule is steeper than the Md–schedule. The question is whether this would affect the conclusions drawn in the previous question.

Consider first money demand shocks. As above we assume that the economy is hit by an unanticipated positive money demand shock. There will be excess demand for money which causes a shift down of the Md–curve. The exchange rate will appreciate. Under fixed exchange rates excess demand for money causes a shift down of the Md–curve, from Md_1 to Md_2. The CB has to intervene and defend the exchange rate. The CB buys foreign bonds and sells domestic money which expands the monetary base and as the monetary base expands, the money demand shifts back to its initial position, from Md_2 to Md_1, see the graph below. Under floating exchange rates there is excess demand for money which causes a shift down of the Md–curve, down from Md_1 to Md_2. When the exchange rate appreciates, aggregate demand will shift down, less foreign demand leads to a fall in aggregate

demand for domestic goods. Yd shifts from Yd_1 to Yd_2. The rise in the interest rate leads to lower money demand and the Md–curve shifts up from Md_2 to Md_3 (use UIP and that an appreciation leads to an expected depreciation in the long–run). New equilibrium at point C, see the graph below. The adjustments as well as the conclusion regarding which exchange rate regime is optimal would not change!



The same conclusions hold for aggregate demand shocks. If the economy is hit by a positive aggregate demand shock there ia a shift up in the Yd–curve. As a result, there will be excess demand for money which will cause the exchange rate to appreciate and under fixed exchange rates the CB has to intervene by selling domestic money and buying foreign bonds. The Md–curve shifts up to Md_2 and there is a new short–run equilibrium at point B in the graph below. Under floating exchange rates excess demand for money leads to an appreciation and therefore a shift down in the Yd–curve from Yd_2 to Yd_3. The Md–curve will shift up to Md_3 since the interest rate has increased (through UIP) and this will reduce Md. New short–run equilibrium at point C. The graph below illustrates.



(e) How are the results of the evaluation using the model above related to optimum currency area criteria? What criteria are related to the effects of structural shocks?

The model above suggests that the choice of exchange rate regime depends on the type of shock affecting the economy, the objectives of the monetary authority, and the structure of the economy (the degree of openness). The analysis is related to at least the following three optimu7m currency area criteria: **Degree of openness:** The argument is that countries that are open to trade and trade heavily form an optimum currency area. A high degree of goods market integration and similar production structures implies symmetric shocks diminishing the need for exchange rate adjustments. **Degree of product diversification:** Countries whose production and exports are widely diversified and of similar structure form an optimum currency area. This argument is based on the discussion about asymmetric shocks. In countries with highly diversified production and with similar structure the effect of a shocks is symmetrical (a shock to a certain industry has similar effects in countries with similar structure, a supply shock in our model). Highly diversified economies are better candidates for monetary union than less–diversified economies since diversification provides insulation against shocks. Krugman suggests the opposite. Monetary union induces greater industrial specialization, less diversification, and provides less insulation against shocks. **Homogeneity of preferences criterion:** Currency union member countries must share a wide consensus on the way to deal with shocks. In other words they should have the same objective

function.

(f) What are the arguments for imposing restrictions of fiscal policy in a monetary union?

The main reason is that most modern democracies seem to exhibit a government deficit bias. There are several reasons for this. Fiscal policy may become too expansionary before elections (political business cycles). Various interest groups are lobbying in favor of expenditure increases or tax decreases benefiting the own group without regard for the economy–wide effects. Political parties that risk losing the next election may want to favor their own constituency while still in power. A government may be tempted to reach short–term policy goals even if this implies long–term costs (the time inconsistency problem).

A common currency implies that part of the costs of large budget deficits and government debt, in terms of effects on interest and exchange rates as well as inflation, may be shifted on to other countries. If markets fear that governments accumulate too large debts such that it cannot longer service the debt then there will be massive capital outflows, a collapse of the exchange rate and other asset markets. In a monetary union, it is the common exchange rate that will be affected and there is a risk that there will be contagious effects on to asset markets throughout the union. The threat of default in one member country could spillover to other member countries. The consequences of excessive deficits and debts include an undesirable distortion of consumption over time and among generations, higher interest rates and dramatic fiscal consolidation efforts when government debt problems are ultimately addressed. The answer to all these potential problems is to put restrictions on national fiscal policy. SGP was thought to provide such constraints.

(g) Explain briefly the main ingredients of the Stability and Growth Pact.

The Stability and Growth Pact consists of the following three elements: (1) A political commitment by all parties involved (Commission, member states, Council). (2) Preventive arm: Preventive elements through regular surveillance aiming at preventing budget deficits exceeding the 3% reference value. All member states must submit stability or convergence programs which are examined by the Council. There is an early warning procedure in the event a significance changes in the budgetary position of a member state. (3) Corrective arm: Dissuasive elements which in the event of the 3% reference value being breached, require member states to take immediate corrective action and, if necessary, allow for the imposition of sanctions.

The Stability and Growth Pact outlines an 'excessive deficit procedure'. This procedure aims at preventing fiscal indiscipline. Budget deficits are viewed as excessive if they are above 3% of GDP. Member states should adopt a medium–term budgetary goal of 'close to balance or a surplus' where the medium term is

defined as about three years. The Pact defines exceptional circumstances as a case when real GDP falls by 2% or more in a year. The Pact also defines an intermediate situation when real GDP declines by less than 2% but more than 0.75% per year. Under these exceptional circumstances, the budget deficit is allowed to exceed the 3% ceiling.

If ECOFIN decide that the deficit is excessive, then the country must take corrective action. If the country refuses to correct the deficit, there may be sanctions. The fine is retained from payments from the EU to the country (CAP, Structural and Cohesion Funds). The fine is imposed every year when the deficit exceeds 3%. The annual amount of deposits may not exceed the upper limit of 0.5% of GDP. The fine is initially considered as a deposit: If the deficit is corrected within 2 years, the deposit is returned. If it is not corrected within two years, the deposit is considered a fine. Interest on the deposits and the yield from fines are distributed among member states without an excessive deficit, in proportion to their share in the total GDP of eligible member states.

2. **Third Generation Currency Crisis model** 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.

   Consider the ABB model of currency crisis. The model consists of the following two main equations: The IPLM-curve

$$E_1 = \frac{1+i^*}{1+i_1}\frac{M_2^s}{m^d\left(y_2, i_2\right)} \tag{1}$$

   and the Wealth-curve

$$y_2 = \sigma f\left((1+\mu)(1-\alpha)\left[y_1 - (1+r_0)d_1^c - (1+i^*)\frac{E_1}{P_1}d_1^f\right]\right). \tag{2}$$

   It can be shown that the slope of the Wealth-curve is given by

$$\left.\frac{dy_2}{dE_1}\right|_{y_2>0} = -\frac{(1+\mu)(1-\alpha)(1+i^*)d_1^f f'(k_2)}{P_1}.$$

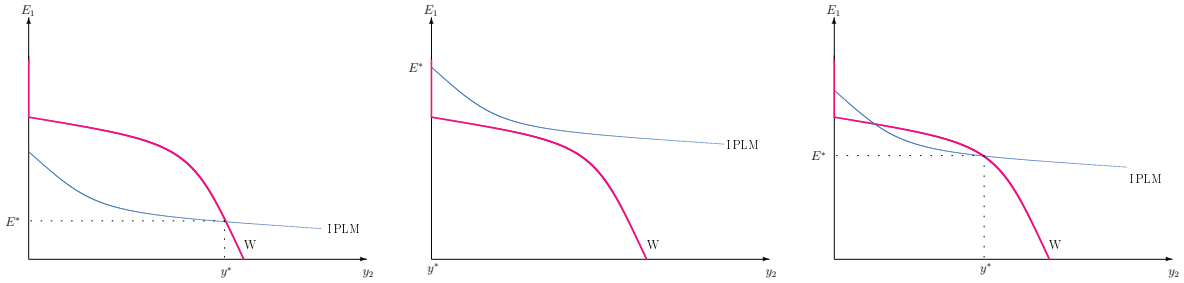
   (a) Explain the main underlying assumptions of this model including how currency crises are generated.

   PPP holds *ex ante* but not necessarily *ex post*. There is an exogenous supply shock affecting the economy in period 1 and the central bank can respond by altering the interest rate. Prices are sticky implying that a shock to PPP leads to a change in nominal exchange rates (P_t is preset at time $t-1$). Central Bank credibly targets inflation from period 2 but not in period 1 if there is a supply shock implying that i_t for $t \geq 2$ is predetermined. Standard production function but the capital

stock depends on borrowing and the cash flows from earlier period. This implies that the capital stock and thus production are predetermined. Imperfect credit markets: firms are credit constrained, they can only borrow a fixed share of their current wealth or cash flow and they are forced to borrow abroad. In period 1 there is an unanticipated shock and potential monetary policy response in period 1. Since there are no shocks other than in period 1 and the central bank targets inflation, monetary policy and thus the interest rate is constant from period 2 onwards. $P_t = E_t \, \forall \, t \neq 1$ and inflation is constant and equal to the rate of change in the exchange rate since PPP holds.

(b) Illustrate the model in the y_2-E_1-plane and provide an explanation to the graph.

Under the assumption that there is a supply shock in period 1 we can illustrate the model in the following three graphs. The IPLM–curve is always downward sloping. If there is no shock, the W–curve is vertical. If a negative shock hits the economy the W–curve collapses to a downward sloping curve as illustrated in the graphs. There are three possibilities. In the first graph, there is only one equilibrium with relatively high output. In the second graph, there are three possible equilibria. One with relatively high output, one with low output (unstable equilibrium) and one where output is zero (viewed as a currency crisis in this model). In the third graph there is only one equilibrium with output equal to zero and a depreciated currency (a currency crisis).



(c) What is the appropriate monetary policy response to prevent a currency crisis?

Monetary policy, i.e., a change in i_1 cannot affect the W–curve. Tight monetary in period 1, i.e., $M_1^s \downarrow$ or $i_1 \uparrow$ or $M_2^s \downarrow$, will affect the IPLM–curve, it will shift down. If so, then restrictive monetary policy is optimal.

(d) Consider next the medium term effects of a shock in period 1. The IPLM–curve illustrating the relationship between the exchange rate in period 1 and output in period 3 is given by

$$E_1 = \frac{(1+i^*)^2}{(1+i_1)(1+i_2)} \frac{M_3^S}{m^d(y_3, i_3)} \tag{3}$$

and assuming that the economy evaded a crisis in the first period we have the

following expression for output in period 3:

$$y_3 = f\left\{(1+\mu)(1-\alpha)\left[y_2 - (1+i^*)\frac{P_1}{E_1}d_2\right]\right\}. \tag{4}$$

It can be shown that the slope of the W3–curve is given by

$$\frac{dy_3}{dE_1} = f'(k_3)(1+\mu)(1-\alpha)\left\{\frac{dy_2}{dE_1} + (1+i^*)P_1\left[-\frac{1}{E_1}d_2'(E_1) + \frac{1}{E_1^2}d_2(E_1)\right]\right\} \tag{5}$$

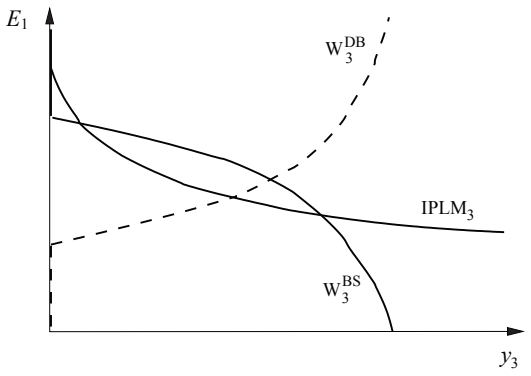
Illustrate the model in the y_3-E_1-plane. Explain carefully!

E_1 affects y_3 through the following three different channels (one negative and two positive channels); (1) A negative effect: $\frac{dy_2}{dE_1} < 0$, a depreciation in period 1 leads to lower output in period 2 and therefore less working capital to use in period 3. (2) Even though lower firm wealth at the end of period 2 means lower period–3 output, the reduced borrowing also means that there is less debt to repay ($d_2'(E_1) < 0$). (3) Finally, as there are no surprises in period 2, and PPP thus holds *ex post*, the domestic price increases (in case the exchange rate depreciates) implying a reduction in the period–2 debt burden.

There are no shocks in period 2 implying that PPP holds *ex post*, the price level must increase and there is a real exchange rate appreciation that lowers the burden of foreign currency debt. An equivalent argument is that higher inflation implies a lower real interest rate which reduces the burden of domestic debt.

If the balance sheet effect dominates, W_3^{BS}, then the slope is negative. Currency crises in period 3 cannot be ruled out and there are multiple equilibria.

If the debt burden effect dominates, W_3^{DB}: If the positive effects dominate such that the slope is positive then currency crises cannot be ruled out but there cannot be multiple equilibria. Conclusion: If the economy avoided a crisis in period 2, there is still the possibility of a crisis in period 3.

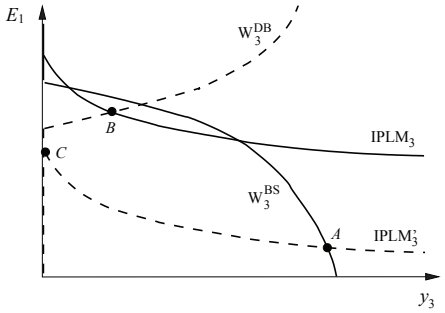


(e) Discuss how monetary policy used in the short-run to evade or prevent a currency crisis affect the economy in the medium term.

The IPLM–curve is a function of the interest rate i_1 and will move down in case the interest rate is increased. The W–curve does not depend on i_1 and will therefore remain at its initial position. The optimal short–run response to a shock (and to prevent a currency crisis) is to raise the interest rate.

Balance–sheet effect dominates; W_3^{BS}; Interest rate hike in period 1 $\Rightarrow$ IPLM–curve shifts down $\Rightarrow$ good equilibrium A; tight monetary policy is efficient.

Debt burden effect dominates; W_3^{DB}; Crisis is avoided *without* raising the interest rate; equilibrium B and a crisis is avoided also in period 3. Tight monetary policy is used to avoid a crisis in period 1; IPLM–curve shifts down $\Rightarrow$ equilibrium C and there will be a crisis in period 3.



Intuition: Interest rate hike in period 1 $\Rightarrow$ nominal exchange rate appreciation such that a crisis is avoided in period 1 $\Rightarrow$ lower prices in the medium term in order to restore PPP: Lower inflation $\Rightarrow$ higher real interest rate $\Rightarrow$ increased burden of domestic debt. Real exchange rate depreciation $\Rightarrow$ increased burden of foreign currency debt. If these effects are strong, then there will be a crisis in the medium term even though a crisis was avoided in first period.

(f) Is this model and its predictions consistent with developments prior to and during the Asian crisis? Discuss triggers as well as the policy response in the Asian countries.

In principle yes, the model is designed to explain the Asian crisis. The underlying arguments are that moral hazard problems makes a currency vulnerable to speculative attacks. Our model suggest that foreign currency debt is essential and that it interacts with capital market imperfections and moral hazard. Weak position of the Asian banking system and increased percentage of non–performing loans combined with fixed exchange rate made the economies vulnerable. Speculative attacks were regarded as more likely to succeed.

Large CA deficits and increasing short–term foreign debt during end of 1996 $\Rightarrow$ pressure on Thai Bath. Thai property company failed $\Rightarrow$ property market collapsed $\Rightarrow$ bank problems $\Rightarrow$ Bank of Thailand tried to support the banking sector but it was not sufficient. Thai stock market fell. In June 1997 the finance minister resigned and the stock market fell sharply. Bank of Thailand supported

the fixed rate ⇒ foreign reserves declined, a major finance company failed and could not pay foreign and domestic creditors. In July Thailand abandoned the fixed rate ⇒ 18 percent devaluation, discount rate increased to 12.5 percent and stock market up by 8 percent. Crisis spread to other countries: July 11: Philippine Peso floating, July 14: Malaysian Ringgit floating, August 14: Indonesian Rupiah floating.