Suggested answers for written Exam for the B.Sc. in Economics winter 2014

Macro B

Final Exam

January 15 2014
(3 hours closed-book exam)

Academic Aim: The aim of the course is to describe and explain the macroeconomic fluctuations in the short run, i.e. the business cycles around the long run growth trend, as well as various issues related to this, and to teach the methodology used in formulating and solving formal models explaining these phenomena. Students are to learn the most important stylized facts about business cycles and to acquire knowledge about theoretical dynamic models aimed at explaining these facts. In connection with this, the aim is to make students familiar with the distinction between deterministic and stochastic models. Furthermore, students are to gain an understanding of the distinction between the impulses initiating a business cycle and the propagation mechanisms that give business cycles a systematic character. Finally students are to learn how to use the models for analyzing the effects of macroeconomic stabilization policy under various assumptions regarding the exchange rate regime. To obtain a top mark in the course students should at the end of the course be able to demonstrate full capability of using the techniques of analysis taught in the course as well as a thorough understanding of the mechanisms in the business cycle models for open and closed economies, including the ability to use relevant variants and extensions of the models in order to explain the effects of various shocks and the effects of macroeconomic stabilization policies under alternative monetary and exchange rate regimes.

Problem A

1. Explain equation (A.1) is the production function for a representative firm in sector i. By assumption labor is the only input in production. Hence it is by nature a description of production in the short run. The marginal product of labor, $MP_L = dYi/dL = (1-\alpha)BL_i^{-\alpha}$, is deminishing as $0 < \alpha < 1$. It may be argued that MP_L is dinimishing as the capital stock is fixed. B is level of technology in production.

   Equation (A.2) describes the demand curve for the firm in sector i. The firms in sector i is producing goods that are differentiated to the goods produced in the other sectors in the economy. Hence, the firm has some monopoly power. The demand curve has a constant numerical price elasticy of demand equal to $\sigma = -(dY_i/dP_i)(P_i/Y_i)$. If the firm in sector i charges a price equal to the total-economy average ($P_i = P$) it will be able to sell and produce a $1/n$ of total output in the economy. If the firm charges a price above the total-economy average ($P_i > P$), the quantity sold and hence output in sector i will be below the total-economy average. The price elasticy parameter σ measures the strength of product market competition. The larger the elasticity, the larger is the decline in demand/production induced by higher prices. A larger value of σ is associated with a flatter demand curve; perfect competition results for $\sigma \to \infty$.

2. Marginal revenue is defined as the derivative of total revenue wrt. the quantity sold; $MR_i \equiv dTR_i/dY_i$. Total revenue is equal to the price of the goods sold time the quantity sold; $TR_i = P_iY_i$. Hence,

$$MR_i = \frac{d(P_iY_i)}{Y_i} = P_i + Y_i\frac{dP_i}{dY_i} = Pi\left(1 + \frac{Y_i}{P_i}\frac{dP_i}{dY_i}\right) = Pi\left(1 - \frac{1}{\sigma}\right)$$

   Marginal cost is total costs derived with respect to output. Labor is the only (variable) input in production. It follows that marginal cost of supplying an additional unit of goods is equal to the price of an extra unit of labour — the nominal wage rate W_i — divided by the marginal product of labors, MPL_i, which measures the additional units of output produced by an extra unit of labour. Hence MC_i is given by

$$MC_i = \frac{d\left(W_iL_i\right)}{dY_i} = W_i\frac{dL_i}{dY_i} = W_i\frac{1}{dY_i/dL_i} = \frac{W_i}{(1-\alpha)BL_i^{-\alpha}}$$

3. Equating MR_i and MC_i gives

$$\begin{aligned} & MR_i = MC_i \\ \Downarrow & \\ & Pi\left(1-\frac{1}{\sigma}\right) = \frac{W_i}{(1-\alpha)BL_i^{-\alpha}} \\ \Downarrow & \\ & P_i = \frac{\sigma}{\sigma-1}\frac{W_i}{(1-\alpha)BL_i^{-\alpha}} = m^p MC_i \end{aligned}$$

From this (A.6) follows directly. It is seen that pricies are set as an mark-up over marginal cost. Also, the mark up factor is decreasing in σ. Hence tougher product market competition is reflected in a lower mark-up over marginal cost. When σ is "high"a marginal increase the price charged will have a relative large negative impact on the quantity sold. As $\sigma \to \infty$ the mark-up factor $m^p \to 1$ (formally this may be shown by applying l'Hospitals rule) hence $P_i \to MC$. Thus, perfect competition pricing results.

4. From (A.7) it follows

$$\begin{aligned} \frac{d\varepsilon}{d\sigma} &= \frac{1}{1+\alpha(\sigma-1)} - \alpha\frac{1}{[1+\alpha(\sigma-1)]^2} \\ &= \frac{1}{1+\alpha(\sigma-1)}\left[1-\frac{\alpha}{1+\alpha(\sigma-1)}\right] > 0 \end{aligned}$$

(" $>$ " follows from $\sigma > 1$ and $0 < \alpha < 1$).

Demand for labour is more elastic when product market competition is tougher. The economic intuition: An increase in real wages is translated into rising marginal costs. This in turn makes the firm raise prices. But when doing so the quantity sold will decline *c.f.* (A.2) and therefore the firm is going to reduce demand for labour. The more competitive the goods market (σ "high"), the larger the decline in sales and consequently, the more labour demand will be reduced. Hence a "high" value of σ leads to a "high" value of ε.

5. The main idea in behind the Right to Manage model is that (taking the general price level as given) the (nominal) wage level is determined by a

monopoly union that covers the entire sector. The firm then determines employment based on the production technology and the product market demand curve while taking the wage level as given. If the union know the demand curve on the product market and the production technology employed by the firm it in effect also determines employment when formulating wage claims. If the union knows the prevailing general price level it also determines real wages when setting the nominal wage level.

Equation (A.8) is stating that the trade union cares about the real income gain obtained by the employed members $(w_i - b)$ and the number of members employed, L. The parameter η reflects the weight attached by the union to employment relative to the goal of a high real wage gain for employed union members. In the case where $\eta = 1$, the union is interested in the aggregate net income gain obtained by having members employed.

Maximizing (A.8) involves taking the derivative with respect to the real wage w_i

$$\frac{d\Omega(w_i)}{dw_i} = [L(w_i)]^{\eta} + \eta (w_i - b) [L(w_i)]^{\eta-1} \frac{dL(w_i)}{dw_i} = 0$$

$$\Downarrow$$

$$[L(w_i)]^{\eta} \left\{ 1 + \frac{\eta (w_i - b)}{w_i} \underbrace{\frac{dL(w_i)}{dw_i} \frac{w_i}{L(w_i)}}_{-\varepsilon} \right\} = 0$$

$$\Downarrow$$

$$(1 - \eta\varepsilon) w_i = -\eta\varepsilon b$$

$$\Downarrow$$

$$w_i = \frac{\eta\varepsilon}{\eta\varepsilon - 1} b$$

The union sets the real wage as a mark-up over the real rate of unemployment benefit. Wage claims will be higher the higher the real unemployment benefits.

The mark-up is lower the higher the values of η and ε. The union will be less aggressive with respect to wage claims when employment weighs heavily in union utility. Also, the union will be less aggressive with respect to wage

claims the more elastic labour demand is, that is the higher ε. The economic intuition is that when determining the wage level the union has to take into account the effect on employment. The higher the wage elasticity of labor, the large the decline in emlopyment from raising real wages. Thus it becomes more costly in terms of (lower) employment to claim higher wages so when weighing up the cost and the benefits from higher wages the costs are increased when ε is "high". *C.f.* question 4 ε is "high" when σ is "high" *i.e.* competition at the product market is fierce.

It could be noted that

$$\begin{aligned}\frac{dw_i}{d\varepsilon} &= \frac{\eta}{\eta\varepsilon-1} - \eta\frac{\eta\varepsilon}{(\eta\varepsilon-1)^2} \\ &= \underbrace{\frac{\eta}{\eta\varepsilon-1}}_{>0}\underbrace{\left[1 - \underbrace{\frac{\eta\varepsilon}{\eta\varepsilon-1}}_{>1 \text{ if } \eta\varepsilon>1}\right]}_{<0} < 0\end{aligned}$$

(The calculation for $dw_i/d\eta$ are parallel to the above).

6. At face value equation (A.10) it stating that a higher level of productivity, B, is associated with higher long-run employment. This is at odds with empirical observations. A way out of this is to formulate real unemployment benefits as in equation (A.11). According to growth theory, the wage level is closely correlated to the level of productivity in the long run. Hence, we should expect a parallel development in wages and productivity. Also, development in real unemployment benefits is closely related to real wages. If unemployment benefits are defined as a constant ratio of the wage level, we should also expect to observe unemployment benefits being proportional with the productivity level. This is exactly what is stated by equation (A.11).

   Inserting equation (A.11) into equation (A.10) gives equation (A.12) directly.

   It is seen that employment is no longer a function of productivity. The reason why productivity "disappears" is that when productivity goes up, so does unemployment benefits and — therefore — wages. Hence, marginal costs are not affected by increasing productivity — this is seen from (A.4).

Furthermore, it is seen from (A.12) that a more generous unemployment benefit system (a higher value of c) will lower the natural level of employment. When unemployment benefits are high, the outside option is more attractive. Hence, the cost associated with union members being unemployed is relatively low and accordingly wage claims are relatively high. Also, it is seen from (A.12) that higher the markups, $m^p$and m^w, are associated with lower long-run employment. The above anaysis showed that "high" levels of competition in the product markets goods leads to "low" markups. Hence, tougher goods market competition is associated with higher long-run employment. The reason is that the union will be less aggressive when formulating wage claims. This in turn implies relatively low marginal costs in production and therefore, the firm find it optimal to have a relatively high level of employment.

According to the model, the government is able to increase long-run employment in two ways. It may either impose structural policies aiming at increasing competition (that is decreasing m^p and m^w), or lower the compensation ration of uemployment benefits, c. Hence structural policies are needed to affect real varaibles in the long run.

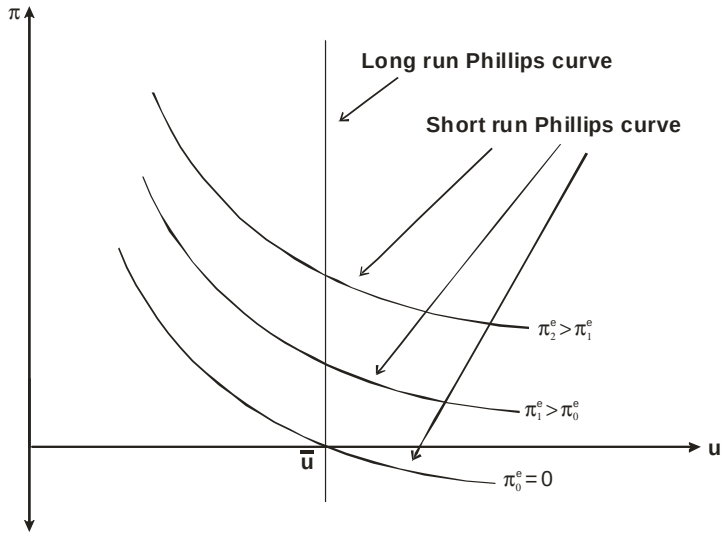
7. In the short run the govenment (or economic authorities in general) may affect unemployment (and employment). Lower interest rates or expansionary fiscal policy may foster lower unemployment in the short run. According to the Phillips curve it comes at a cost; namely higher inflation. The Phillips curve states that in the short run there is a trade-off between unemployment and inflation. For a given level of inflation expectations any combination of unemployment and inflation associated with this specific Phillips curve (which position is determined by π^e) may be obtained.

   In the short run the government can stimulate labour demand through expansive fiscal policy, such as increasing public consumption or lowering taxes (though not irrelevant, a discussion regarding Ricardian Equivalence, foreign trade effects or a counteracting monetary policy is not expected).

   The student could note, that the Danish Central Bank has no means of stimulating short-run employment since the purpose of Danish monetary policy to maintain the peg towards the euro. Hence, an active monetary

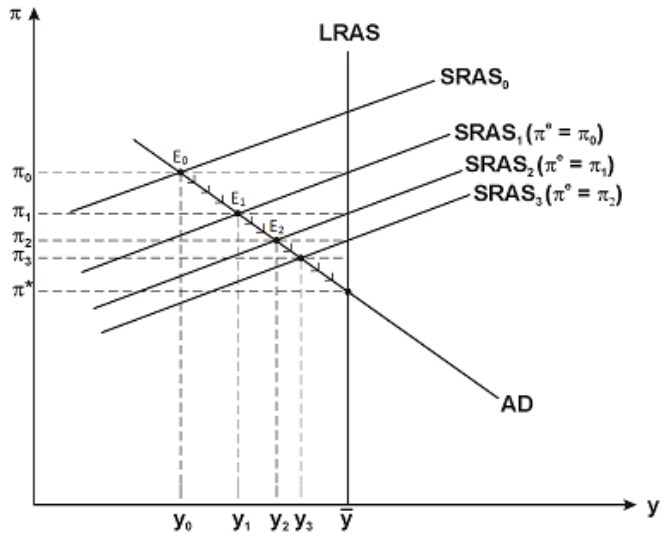
policy is not a feasible option.

An economic policy that is systematically focused on obtaining $u < \overline{u}$ will lead to an ever increasing inflation level. Wage setters (in the current context the union) will realise, that inflation is higher that expected and hence real wages lower and unemployment lower than targeted *i.e.* $\overline{u}$. As a consequence they will revise inflation expectations upwards. This will shift the Phillips curve upwards and . When economic authorities stimulate activity in order to obtain an unemployment level below the structural level $u < \overline{u}$ actual inflation will once again outpace expectations. This is a process that will continue until a shift in economic policy takes place. An illustration could look like the following.



Problem B

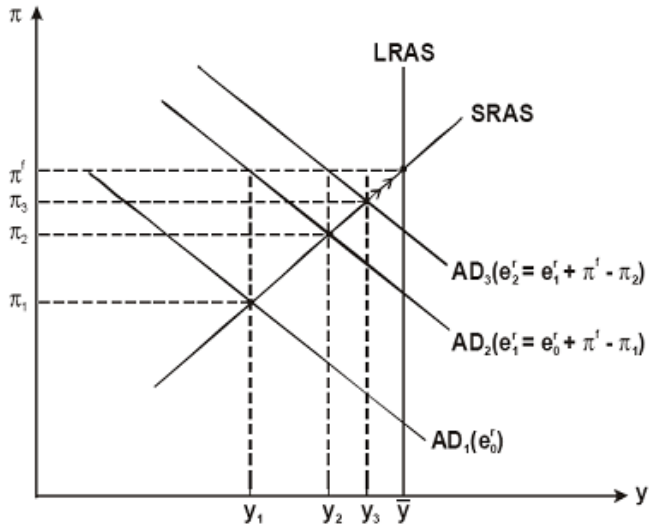
1. For the closed economy the central bank play a crucial role as the "mechanism" that ensures convergence to equilibrium. For instance in case of a recession inflation is falling. The central bank responds to this by lowering the policy rate. According to the Taylor principle the nominal rate is lowered so much that the real interest rate is lower too. This stimulates private demand. It could be noted that according to theory the effects on total private demand from a change in the real interest rate is ambiguous. A lower real interest rate stimulates investments but the effect on private consumption is indeterminate due to the possibility of counteracting income and substitution effects. Hence the effect on total private demand can not be determined with certainty. However, empirical evidence tells that there is a negative relationship so that a lower real interest rate is accompanied by higher total private demand. The convergence process for the closed economy may be illustrated as in the following.



Downward revisions in economic agents inflation expectations translates into lower wage demands which dampens inflation (through lower marginal costs and thereby lower product prices inflation). This leads the central bank to cut nominal interest rates so much that the expected (ex ante) real interest rate is lowered. This in turn stimulates total private demand. Hence a new

short run equilibrium – positioned at the AD curve – is obtained, where activity is higher and inflation is lower that in the previous period.

Though not asked for the student could note, that for the open economy foreign trade plays a crucial role and that convergence takes place through changes in the real exchange rate. For the open economy with fixed exchange rates the convergence process an illustration could look like the following.



We start out in an equilibrium, where both the domestics and the foreign economy is in a long run equilibrium. In this situation inflation in the domestic economy is equal to inflation abroad. Then the domestic economy is hit by a shock so that the economy end up in a recession. Domestic inflation is now below inflation abroad (as wage formation is dampened). This leads to an improvement in domestic competitiveness and accordingly demand for domestically produced goods increase (both in the domestic economy and abroad).

2. When explaining why policy makers are concerned about output fluctuations it is sufficient to explain that fluctuations in employment leads to welfare losses when the marginal product of labor (MPL) is declining and/or the marginal rate of substitution (MRS) which measures the additional income necessary to compensate the worker for the loss of leisure is increasing. Distortions means that $MPL > MRS$ so that the the amount necessary to

compensate the worker for supplying the additional labor is exceeded by the additional amount of output produced by this additional labor. If in this situation an economic boom leading to an increase in employment is followed by a recession leading to an equally sized decline in employment (relative to structural employment), then the welfare gain during the boom is lower that the welfare loss during the recession Accordingly fluctuations in employment leads to welfare losses. When the economy is booming a welfare gain amounting to the light gray area is obtained. However, in recession the welfare loss (the dark area) is even bigger.

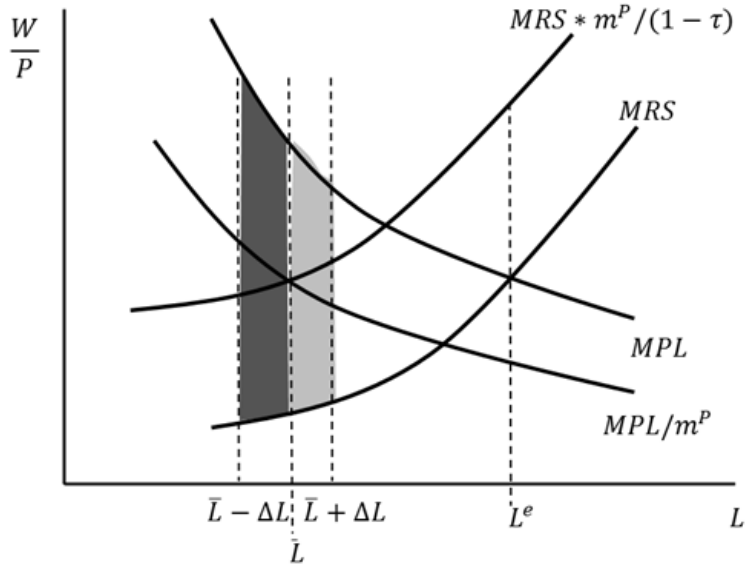


Figure .1:

The target for activity should be the structural output. The above analysis shows that $MPL > MRS$ when employment and hence activity is at the structural level. Hence at the structural level activity is below the efficient level. However, systematically pushing activity above that level would lead to an ever increasing inflation.

It could be added that assuming consumers have declining marginal utility in consumption, the marginal utility gain from a given increase in consumption is lower than the marginal utility loss from an equally sized drop in consumption. As a consequence, consumers prefer to experience constant

levels of consumption over time. That income is volatile over time does not exclude the possibility of consumers smoothing consumption by using private capital markets. However, if these are not perfect some consumers might find themselves unable to smooth consumption. In addition, problems of moral hazard and adverse selection may limit the scope for consumption smoothing through insurance markets.

When explaining why it is socially desirable to stabilize inflation it is sufficient that the student notes that stabilizing around a constant target value makes it easier for wage setters, consumers and firms to forecast inflation. A fluctuating inflation rate typically leads to unanticipated inflation, causing the ex post real interest rate and the ex post real wage to deviate from their ex ante expected levels. Due to this unanticipated inflation and the resulting explication errors makes economic agents will make suboptimal decisions and hence experience lower welfare relative to a situation where actual inflation equals anticipations. When economic agents makes expatiation errors on inflation an arbitrary redistribution of real income between lenders and borrowers takes place and real wages deviate from target resulting in deviations in employment relative to target/structural employment.

Regarding the target value it could be noted that even a stable positive inflation rate is socially costly due to so-called 'shoeleather costs', 'menu costs', relative price distortions due to staggered price setting. Also the tax system may fail to distinguish between nominal and real income from capital. As long as the rate of inflation is kept low these cost are likely to be small. The target rate should however be above zero as policy makers should take into account that a very low inflation rate and hence a low level of nominal interest rates reduces the scope for a cut in the real interest rate when the economy is hit by a negative shock, since the nominal interest rate cannot fall below zero. A very low inflation rate may also reduce the scope for a downward adjustment of real wages if nominal wages are downward sticky. To sum up, there is a trade of between on the one hand the cost of inflation and on the other hand the risk of ending up in a liquidity trap and a limited scope for reducing real wages through (unexpected) high inflation.

3. The uncovered interest parity (UIP) is essential when explaining the "im-

possible trinity". UIP which is a financial arbitrage condition (or rather absence of arbitrage) whereby the return on domestically denominated financial assets is tied to the return on foreign denominated assets may be stated as

$$i = i^f + e^e_{+1} - e,$$

where i is the domestic interest, i^f is the interest rate abroad and $e^e_{+1} - e$ is the expected reduction in the value of the domestic currency. If investors are risk averse a risk premium is added. If the value of the domestic currency is expected to be reduced (and increase in e) the domestic interest rate has to be larger than the foreign interest rate so that the expected investment return is the same when measured in the same currency.

The "impossible trinity" may be shown by assuming that two of the three policy goals are upheld. Then the third can not be obtained.

If cross-border capital flows are free and the exchange rate is fixed then from the UIP it follows directly that $i = i^f$. Hence, monetary policy can not be independent. If $i < i^f$ capital will flow out of the domestic economy. Investors sell domestic denominated assets (and thereby domestic currency) and buy foreign denominated assets (and thereby foreign currency). The central bank has to sell foreign currency and buy domestic currency to maintain a fixed exchange rate. However eventually the foreign exchange reserves are exhausted and the central bank can not defend the exchange rate any more. If $i > i^f$ capital will flow into of the domestic economy. This creates a pressure for an appreciation of the domestic currency as the foreign reserve keep growing.

If cross-border capital flows are free and monetary policy is independent, $i \neq i^f$, then $e^e_{+1} \neq e$ which is at odds with a fixed exchange rate.

If monetary policy is independent, *i.e.* $i \neq i^f$ and the exchange rate is fixed $e^e_{+1} = e$ then UIP stresses that capital can not move freely across borders as it would take an infinite foreign exchange reserve to uphold a fixed exchange rate.