Suggested answers for written Exam for the B.Sc. in Economics summer 2012

Macro B

Final Exam

August 21 2012
(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. When the central bank has ideal condition for conducting monetary policy all shocks are perfectly observable. Furthermore, the cental bank has complete knowledge about the functioning of the economy. Hence the impact of shocks and policy initiatives is fully known. As a consequence the central bank can immediately and perfectly observe and respond perfectly to the various types of shocks hitting the economy.

   There are no inside lags related to the recognition of shocks and decision and implementation of policy response and policy may be set optimally as the cental bank has complete knowledge about the impact on the economy of shocks and policy initiatives. The central bank has full credibility so that inflation expectations are firmly anchored by its inflation target and no outside lags exist. The economy responds immediately to changes in the policy rate. Interest rates are adjusted instantaneously throughout the economy to changes in the monetary policy rate and by assumption there are no delay before a change in the policy rate attains its (full) impact on aggregate demand and no additional time before a change in the output gap leads to a change in inflation.

   These assumptions are very heroic, but as a benchmark it is useful to know what stabilization policy can be expected to achieve under the most favorable circumstances imaginable. In reality, the central bank cannot identify the exact shocks hitting the economy. Many shocks cannot be directly observed right at the time when they hit the economy. In reality it has also proven difficult to distinguish between demand and supply shocks. Furthermore, it is hardly the case that the central bank knows the true structure of the economy. Thus, the central bank also has imperfect information in relation to how policy changes affect the term structure and private demand. Lags may be long and variable. As a result in practice the conduct of monetary policy is surrounded by various problems on timing and dosing etc. of policy.

2. When information is perfect the central bank is able to respond directly to the specific shock that has occurred. As argued above the central bank is able

respond perfectly the specific shock hitting the economy when conditions are ideal. Hence, the central bank can do better by responding to the exact shock than by responding to output and inflation gaps which may materialize from shocks with a lag. This is reflected in the optimal policy function where wach shock has its own term.

Demand shocks may be stabilized perfectly since they do not raise a dilemma between stabilizing output and stabilizing inflation. Supply shocks on the other hand raises a dilemma for the central bank. A negative supply shock for example reduces output while at the same time increase inflation. In that case a lowering of the monetary policy rate in order to stimulate demand will lead to higher inflation bringing inflation further away from target. The optimal response depends on the weights in the social loss function attached to fluctuations in employment and inflation, a_l, a_π respectively.

It could be noted that mark-up shocks and productivity shocks - both are supply shocks - call for different monetary policy reactions (different coefficients in the optimal monetary policy function (A.2)). For instance when an adverse markup shock hits the economy the AS curve shifts upwards. Then the central bank will accept a lower level of output. If it were to increase output, it would push inflation further above target. (Also in the text book it is assumed that the cost of increasing inflation rises with the square of the inflation gap). In case a negative productivity shock is shifting the AS curve upwards the central bank accepts an even lower level of output compared to a markup shock with the same direct cost effect. This is so because a higher output can only be sustained by requiring workers to put in more hours when productivity is low. This is not optimal when their efforts are unusually low as an even higher labor input is required. To stimulate labour supply a higher wage rate is needed which in turn drives marginal costs and hence inflation even higher.

3. From equation (A.1´´) we have directly that

$$y^e_{t+1,t} - \bar{y} = -\alpha_2(i^e_{t+1,t} - \pi^e_{t+2,t} - \bar{r}) + v_{t+1}$$

Combine this with equation (A.3) for to get

$$y^e_{t+1,t} - \bar{y} = -\alpha_2(i^e_{t+1,t} - \pi^e_{t+2,t} - \bar{r}) + y^e_{t+2,t} - \bar{y}$$

from which (A.4) follows directly.

Combine the output gap in the current period (A.1´) with (A.3):

$$\begin{aligned} y_t - \bar{y} &= -\alpha_2(i_t - \pi^e_{t+1} - \bar{r}) + v_t \\ &= -\alpha_2(i_t - \pi^e_{t+1} - \bar{r}) + y^e_{t+1,t} - \bar{y} \\ &= -\alpha_2(i_t - \pi^e_{t+1} - \bar{r}) + \left[-\alpha_2(i^e_{t+1,t} - \pi^e_{t+2,t} - \bar{r}) + y^e_{t+2,t} - \bar{y}\right] \\ &= y^e_{t+2,t} - \bar{y} - \alpha_2(i^e_{t+1,t} - \pi^e_{t+1+1,t} - \bar{r}) - \alpha_2(i_t - \pi^e_{t+1,t} - \bar{r}) \quad \text{(A.5)} \end{aligned}$$

Notice that $\pi^e_{t+1+1,t} = \pi^e_{t+2,t}$.Then we may back out the final result (A.6) by noticing that the expected output gap in period $t+2$, $y^e_{t+2,t} - \bar{y}$ may be described by an equation analogous to the expected output gap in period $t+1$ found above. The same goes for any subsequent period. Thus continuing to eliminate the expected output gaps in that way leads to the result

$$y_t - \bar{y} = -\alpha_2 \left[(i_t - \pi^e_{t+1,t} - \bar{r}) + \sum_{i=1}^{\infty} (i^e_{t+i,t} - \pi^e_{t+1+i,t} - \bar{r}) \right] \quad \text{(A.6)}$$

4. When economic agents form forward looking expectations the current output gap depends not only on the current real interest rate but also on all expected future real interest rates. This follows directly from (A.6) (the sum). Hence the current output gap is a function of the expected future monetary policy. In addition to setting the current policy rate this analysis propose two ways policy makers may use to influence economic activity if economic agents find the central bank credible: They may make announcements on the future policy rate and/or they may change inflation expectations. On top of setting the current policy rate they can make announcements on future policy rates.

   Announcing that the policy rate is to stay low for a prolonged period of time will in itself stimulate the economy thereby adding to the effect of reducing the current policy rate. Correspondingly announcing that the policy rate will be lifted as soon as possible curbs the effect on activity from lowering the current rate.

   Thus when ranking the 3 policies described in the exercise in a declining order with respect to the impact on economic activity we get :

b. The central bank reduces the monetary policy rate by say 0.25 % point and announces that it intends to keep the policy rate low for a prolonged period.

a. The central bank reduces the monetary policy rate by say 0.25 % point.

c. The central bank reduces the monetary policy rate by say 0.25 % point and announces that it intends to raise the policy rate as fast as possible

Another way policy makers may influence the economy is by changing inflation expectations. For instance higher inflation in the future may be promised. Promising higher inflation may however be at odds with the credibility of inflation targeting.

5. Interest rates are bounded from below by a zero floor. Thus in a situation where activity drops as a result of a severe negative demand shock, policy makers may find themselves in a situation where rates can not be lowered (further). Then the economy is caught in the so-called liquidity trap. The results above suggest policy initiatives that may be used in such a situation. Policymakers may try to stimulate economic activity by promising to keep interest rates low or by promising that future inflation will be higher. However, markets may not find it a credible economic policy for the central bank to allow higher inflation and output gaps when the recession is over as there may be social losses related to a higher inflation.

Problem B

1. The economy is small. Anything that happens in the economy is without any substantial effect on the foreign economy.

   The economy is specialized. Domestic and foreign produced goods are imperfect substitutes. So the price on domestic produced goods may deviate from the price on foreign produced goods. The endogenous adjustment of relative prices on domestic goods is a mechanism for macroeconomic adjustment to long run equilibrium.

2. The uncovered interest parity (UIP) is a financial arbitrage condition. When capital mobility is perfect domestic and foreign assets are perfect substitutes. Investors can reallocate their portfolios instantaneously and without any costs. Assuming investors are risk neutral the arbitrage condition whereby the return on domestically denominated financial assets is tied to the return on foreign denominated assets may be written

$$1 + i = \left(1 + i^f\right) \times \frac{E^e_{+1}}{E}, \tag{B.2.1}$$

   where E is the current exchange rate and $E^e_{+1}$is the expected exchange rate. 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. Using the approximation $\ln(1 + x) \approx x$ when x is small the uncovered interest parity (UIP)

$$i = i^f + e^e_{+1} - e, \tag{B.2.2}$$

   follows directly. If investors are risk averse a risk premium is added.

   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 UIP holds then it follows directly from (B.2.2) 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 the central bank has to sell foreign currency and buy domestic currency the maintain the 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.

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 $i \neq i^f$ 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.

3. The connection between the short term and the long term interest rates (effective yield) can be described by the yield curve. The current long-term interest rate is determined by the current and the expected future short term interest rates. The central bank can control the short term interest rates (through the policy rate). The long-term interest may be influenced by movements in short term interest rate and the central banks willingness to secure stability of output and inflation.

   Formally this connection may be described by financial arbitrage condition

$$\left(1 + i^l_t\right)^n = (1 + i_t) \times \left(1 + i^e_{t+1}\right) \times \left(1 + i^e_{t+2}\right) \times ... \times \left(1 + i^e_{t+n-1}\right) + \varepsilon_t, \quad \text{(B.3.1)}$$

   where i^l_t is the long-term interest rate in period t, i_t is the short-term interest rate at period t and i^e_{t+j} is the expected short-term interest rate in period $t + j$. ε_t is a risk premium risk averse borrower is willing to pay to eliminate risks of swings in the interest rate as it is the compensation required by the lender for eliminating the borrowers' risk.

   The left-hand side of (B3.1) is the total amount a borrower should pay back at time $t + n$ when using a fixed long-term interest rate. The right-hand side of (B3.1) is the total amount of money a borrower expect to pay back at time $t + n$ using the short-term interest rate which is "rolled over" each period at the expected short-term interest rate.

If investors are risk neutral $\varepsilon_t = 0$ and using the approximation $\ln(1+x) \approx x$ (B.3.1) may be rewritten as

$$\begin{aligned} n \ln\left(1+i_t^l\right) &= \ln(1+i_t) + \ln\left(1+i_{t+1}^e\right) + \ln\left(1+i_{t+2}^e\right) + ... + \ln\left(1+i_{t+n-1}^e\right) \Longleftrightarrow \\ n i_t^l &= i_t + i_{t+1}^e + i_{t+2}^e + ... + i_{t+n-1}^e \Longleftrightarrow \\ i_t^l &= \frac{1}{n}\left(i_t + i_{t+1}^e + i_{t+2}^e + ... + i_{t+n-1}^e\right). \end{aligned} \tag{B.3.2}$$

This is called the expectations hypothesis which states that the long-term interest rate is seen as a simple average over the expected short-term interest rate over the corresponding period.