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

Macro B and Macro 3

Final Exam

February 20, 2012

(3-hour 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.

All questions of both problems should be answered

Problem A

1. Start ignoring ε_t: Then the right-hand side of (A.1) is the total amount of money a firm is expected to pay back at time $t+n$ if financing an n-year running investment project using the short-term interest rate which is "rolled over" each period at the expected short-term interest rate. The left-hand side is the total amount the firm should pay back if it instead finances the project through a fixed long-term interest rate. Hence, (A.1) is a financial arbitrage condition: if the right-hand side was lower than the left-hand side, no firms would finance investment projects through the long-term interest rate *et vice versa*. Therefore, in a financial market equilibrium the left-hand side is expected to equal the right-hand side. However, this simplistic argument requires the lender and borrower to be risk neutral. However, neither lender nor borrower knows how interest rates change in the future and therefore the lender would like to prefer to be able to re-negotiate the terms of the load each period rather than commit to a fixed-exchange rate. Likewise, the borrower would like to eliminate the risk of rising interest rates and prefers to borrow at fixed rate. Hence, in equilibrium with risk averse investors a risk premium, ε_t, is plausible. The risk premium is the price the 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.

2. Deriving (A.2) is easily done by taking logs to (A.1) (after assuming risk neutral investors through setting $\varepsilon_t = 0$ (assumption 1))

   $$n \ln\left(1+i_t^l\right) = \ln\left(1+i_t\right) + \ln\left(1+i_{t+1}^e\right) + \ln\left(1+i_{t+2}^e\right) + ... + \ln\left(1+i_{t+n-1}^e\right),$$

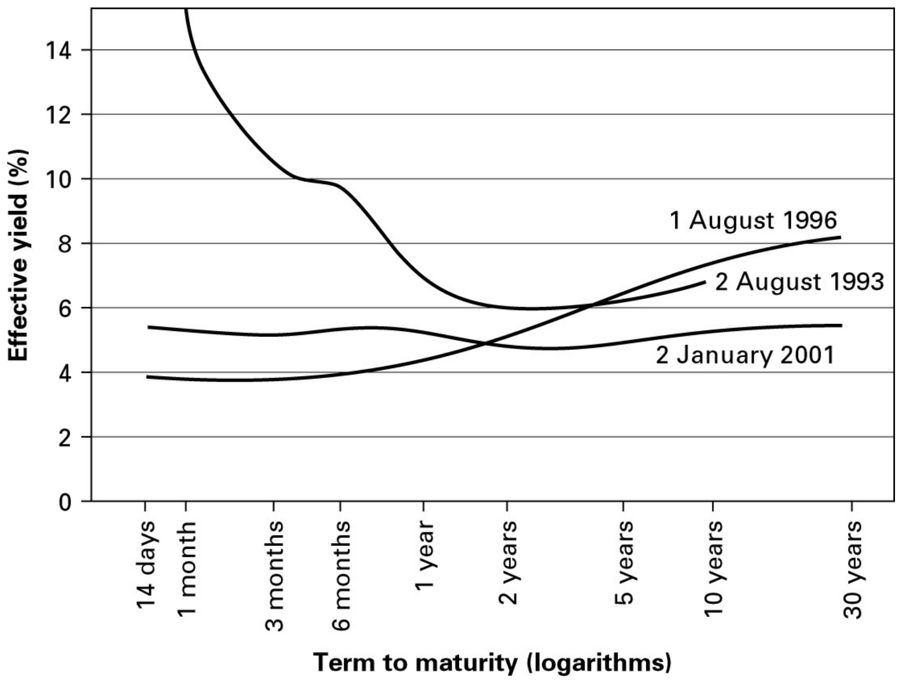
   and using the approximation $\ln(1+i) \approx i$ (assumption 2)

   $$\begin{aligned} ni_t^l &= i_t + i_{t+1}^e + i_{t+2}^e + ... + i_{t+n-1}^e \Longleftrightarrow \\ i_t^l &= \frac{1}{n}\left(i_t + i_{t+1}^e + i_{t+2}^e + ... + i_{t+n-1}^e\right). \qquad \text{(A.2)} \end{aligned}$$

   (A.2) is called expectations hypothesis and states that the long-term interest rate is seen as a simple average over the expected short-term interest rate over the corresponding period.

4. Hence, an increase in next year's expected one-year interest will affect the current 10-year interest by one-tenth of a percentage point. Correspondingly, the 30-year interest rate will be affected by 1/30 of a percentage point.

5. The yield curve measures the term structure of the interest rates. It reports the (effective) interest rates on instruments of different maturities. An illustration could be something like



A.1 The term structure of interest rates in Denmark

which shows the term structure in Denmark on three different dates. The term structure on August 2, 1993 tells that the short-term interest rates were much higher than the long-run interest rates. It reflects a situation where short-term interest rates were set at a level which were expected to be way above its long-run level. Hence, according to (A.2) the long-run interest rates is lower than the 1-month interest rates because the 1-month interest rates is expected to fall. (The reason why short-term interest rates were so high on this specific occasion is because the Danish Central Bank hiked interest rates to defend the Danish currency during the EMS crisis).

a. This explanation makes the answer to 3.a rather obvious: since short-term interest rates are currently low and are expected to rise, the slope of the yield curve is positive.

b. In a situation where no change in the short-term interest rates are expected, the yield curve is flat.

6. To be able to affect total demand in the economy, the central bank must be able to control the interest rates that firms use to finance its investment projects and the interest rates the consumers use to finance their consumption. Neither, consumers nor firms use the very short-term rate that the central bank controls, but use longer-term interest rates for these purposes. If the central bank is unable to provide the market with information regarding the expected development in short-term interest rates, it cannot affect the long-term interest rats and is ultimately unable to control it.

Problem B

1. The model decribes an open economy. In the case where $h = \theta = 0$, monetary policy is aiming at keeping the nominal exchange rate constant, cf. question B.2.

   (B.1) is the goods market equilibrium. A higher value of the real exchange rate is associated with higher output, because an increase in the real exchange rate means that domestic goods becomes cheaper relative to foreign ones which improves domestic producers' competitiveness and leads to a higher level of net exports. A higher real interest rate is associated with lower output, since increased real interest rates detoriates investments and possibly consumption and by assumption the sum of investment and consumption. An increase in public consumption is associated with higher output. Finally, the goods market equilibrium contains a demand shock capturing the effects from foreign demand and expectations regarding future growth.

   (B.2) is derived from the definition of the real exchange rate $E^r = EP^f/P$, where E is the nominal exchange rate, P^f is the foreign price level and P is the domestic price level. Taking logs and first differences leads to (B.2) which then states that the current value of (log of) the real exchange rate is equal to last period's value plus the inflation differential between the foreign and domestic country. When inflation is highest abroad, the value of e^r will fall over time, hence this corresponds to a depreciation of the real exchange rate.

(B.3) and (B.4) are definitions of the *ex ante* real interest rate in the domestic country and abroad.

(B.5) is the monetary policy rule. It can be described as a simple Taylor rule in the sense that the central bank reacts to swings in inflation, but not to the output gap. The rule states that the targeted level of inflation is equal to the foreign level of inflation.

(B.6) is a fiscal policy rule. Long-run government consumption is equal to $\bar{g}$ but whenever the output gap, $y - \bar{y}$, is negative, g is increased above $\bar{g}$ *et vice versa*.

(B.7) states that inflation expectations are constantly equal to the long-run foreign level of inflation.

(B.8) is the uncovered interest rate parity (UIP) condition. It is an arbitrage condition stating that the expected yield from buying from bonds must equal that of buying domestic bonds. Seen from the perspective of a domestic investor, the yield from buying domestic bonds is simply the nominal interest rate, while the expected yield from buying domestic bonds consists of the nominal interest rate plus the expected exchange rate gain. It is seen that no risk premium is present which implicitly informs us that the agents in this model are risk neutral.

(B.9) states how expectations regarding the nominal exchange rate are formed. The relationship given here is a very simple one and states that next period's expected exchange rate is equal to the current value plus a reversal of last period's development in the nominal exchange rate. Hence, if the currency depreciated by $e - e_{-1}$ from last period, it is expected to appreciate by $\theta\,(e - e_{-1})$ to the next period *et vice versa*.

(B.10) states that the domestic long-run real interest rate is equal to the foreign one.

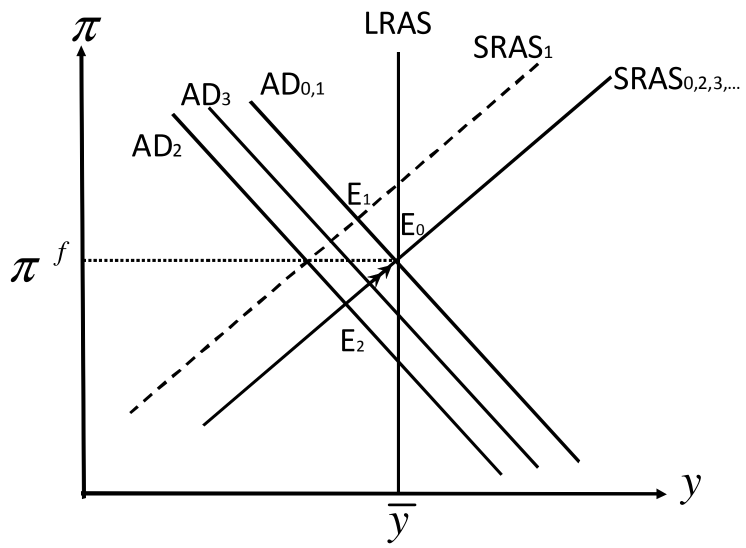
(B.11) is the short-run aggregate supply curve before inflation expectation are inserted. The correlation between output and inflation is positive since a higher level of production calls for higher levels of employment which reduces labour's marginal product leading to increased growth in marginal costs and higher levels of inflation.

2. When $h = \theta = 0$ the model describes an economy in which the central bank uses monetary policy to ensure a fixed nominal exchange rate. When $h = 0$ we see from (B.5) that the monetary rule collapses to a rule where the domestic central bank sets the domestic interest rate equal to the rate chosen by the foreign central bank. From the UIP condition this is seen to be consistent with a constant nominal exchange rate and (B.9) coupled with the assumption $\theta = 0$ states that the financial markets find the peg credible, since they never expect the nominal exchange rate to change from the current period to the next. Due to the Danish fixed-exchange rate policy – which fairly can be judged succesful – this appears a reasonable assumption if the scope of the model is to analyze the Danish economy. On the other hand, the model is not a reasonable one regarding Germany. First of all because, Germany is a major Euroland country which – through the ECB – designs monetary policy to ensure a stable developement in inflation without aiming at keeping the nominal exchange rate stabel towards any currency.

3. It is easily seen from (B.12) and (B.13) that only the AD curve depends upon k. Hence, the SRAS is unaffected by the value of k. The slope of the AD curve depends upon k and it is seen that the higher the value of k, the steeper is the AD curve. The negative slope of the AD curve reflects that an increase in inflation leads to lower output through the loss of competiveness. The steeper the AD curve is, the less will a given increase in the inflation rate be associated with a drop in output. This is because public consumption will be increased once demand drops.

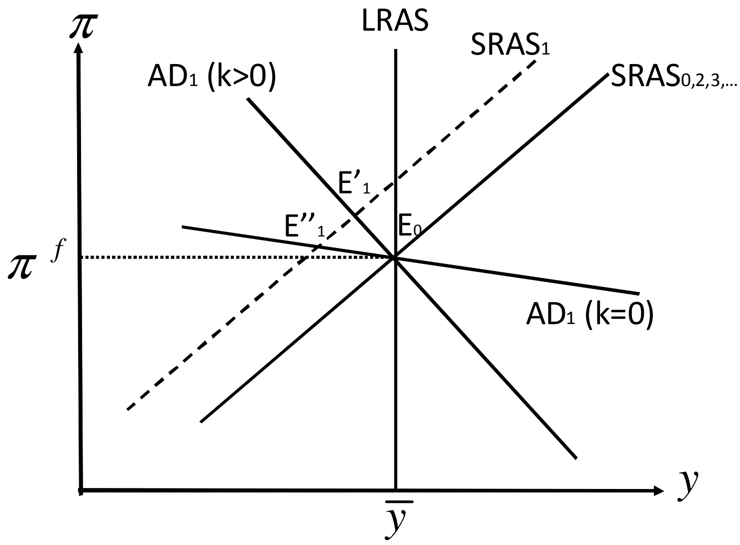
4. The graphical illustration of a one-period negative supply shock is given in figure B.1. In period 1 one the economy is hit by a one-period negative supply shock. This shifts the SRAS upwards reflecting that a given level of production can only longer be achieved at a higher level of inflation than previously. Hence, the short-run equilibrium shifts from E_0 to E_1. The shock is gone in period two and therefore the SRAS shifts back to its original position from period 2 onwards. However, the domestic inflation rate that

exceeds the foreign one in period 1, leads to a loss of competiveness because the real exchange rate increases shifting next period's AD curve downwards. This is seen through (B.2). In the new short-run equilibrium, E_2, inflation is lower than abroad and therefore the real exchange rate depreciates leading to an upwards revision of the AD curve. This gradually restores the domestic economy's competitiveness and ensures convergence towards the long-run equilibrium E_0.



B.1 Negative supply shock

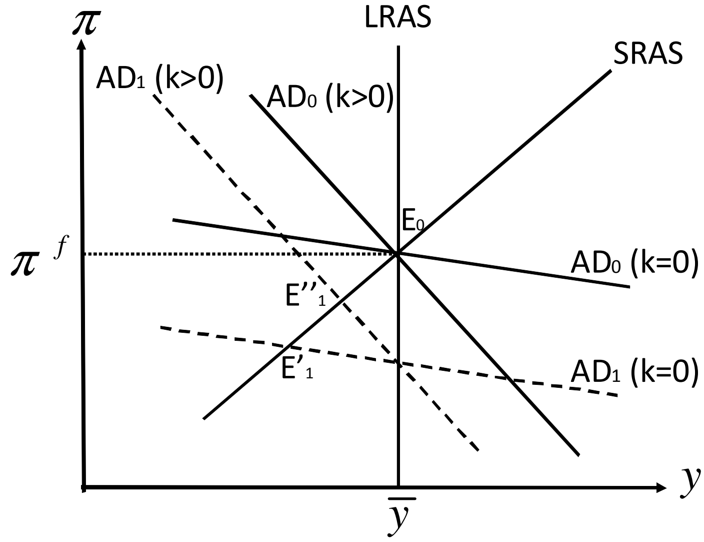
The short-run response in inflation and output under the two different regimes are illustrated in figure B.2. In the case where fiscal policy is passive ($k = 0$), we see that output drops by more than in the case where fiscal policy is active. The cost of stabilizing output is that inflation increases more when fiscal policy is active.



B.2 Short-run responses to a negative under two different fiscal-policy regimes

The economic intuition is simply that when the economy has been hit by a negative supply shock which generates inflationary pressure, this pressure is being further stimulated by public consumption since this leads to higher levels of employment which brings down the marginal product of labour which again increases marginal costs leading to higher rates of inflation. Hence, a government trying to counteract a negative supply shock faces a trade off whether to stabilize output or inflation.

5. This is not the case when the economy is hit by a demand shock as seen from figure B.3. When fiscal policy is active, short-run swings in both output and inflation is seen to be smaller than if fiscal policy was passive.



B.3 Negative demand shock under two different fiscal policy regimes

The reason is that fiscal policy works through the demand side of the economy and therefore an expansive fiscal policy will work towards stabilizing both output and inflation. As opposed to the supply shock, production possibilites are not worsened. Therefore the lower level of production is associated with lower levels of inflation since (increases in) marginal costs have dropped. Hence, the policy makers have no trade off.

6. The students are not asked to derive (B.14) – (B.16), though here it is done. Recast the model consisting of (B.12),(B.13) and (B.2) (here we have not yet assumed $s_t = s_{t+1} = v_t = v_{t+1} = 0$, but the students are encouraged to do this)

$$\hat{\pi}_t = e^r_{t-1} - \frac{1+\beta_3 k}{\beta_1}\hat{y}_t + \frac{1}{\beta_1}v_t \tag{B.12'}$$

$$\hat{\pi}_t = \gamma\hat{y}_t + s_t \Longleftrightarrow \hat{y} = \frac{1}{\gamma}\hat{\pi}_t + \frac{1}{\gamma}s_t \tag{B.13'}$$

$$e^r_t = e^r_{t-1} - \hat{\pi}_t \tag{B.2'}$$

Substituting (B.13') into (B.12')

$$\begin{aligned} \gamma\hat{y}_t + s_t &= e^r_{t-1} - \frac{1+\beta_3 k}{\beta_1}\hat{y}_t + \frac{1}{\beta_1}v_t \Longleftrightarrow \\ e^r_{t-1} &= \frac{1+\beta_3 k+\beta_1\gamma}{\beta_1}\hat{y}_t - \frac{1}{\beta_1}v_t + s_t, \end{aligned}$$

which – along with (B.13') – is inserted into (B.2')

$$
\begin{aligned}
&\frac{1+\beta_3 k+\beta_1\gamma}{\beta_1}\hat{y}_{t+1}-\frac{1}{\beta_1}v_{t+1}+s_{t+1}=\frac{1+\beta_3 k+\beta_1\gamma}{\beta_1}\hat{y}_t-\frac{1}{\beta_1}v_t+s_t-(\gamma\hat{y}_t+s_t)\Longleftrightarrow\\
&\frac{1+\beta_3 k+\beta_1\gamma}{\beta_1}\hat{y}_{t+1}=\frac{1+\beta_3 k}{\beta_1}\hat{y}_t+\frac{1}{\beta_1}\left(v_{t+1}-v_t\right)-s_{t+1}\Longleftrightarrow\\
&\hat{y}_{t+1}=\frac{1+\beta_3 k}{1+\beta_3 k+\beta_1\gamma}\hat{y}_t+\frac{1}{1+\beta_3 k+\beta_1\gamma}\left(v_{t+1}-v_t\right)-\frac{\beta_1}{1+\beta_3 k+\beta_1\gamma}s_{t+1}\Longleftrightarrow\\
&\hat{y}_{t+1}=\alpha\hat{y}_t+\beta\left(v_{t+1}-v_t\right)-\beta\beta_1 s_{t+1}, \qquad \text{(S.1)}
\end{aligned}
$$

where

$$
\begin{aligned}
\alpha &\equiv \frac{1+\beta_3 k}{1+\beta_3 k+\beta_1\gamma}\\
\beta &\equiv \frac{1}{1+\beta_3 k+\beta_1\gamma},
\end{aligned}
$$

Correspondingly, we can solve for the convergence in $\hat{\pi}_{t+1}$ by using (S.1) and (B.13')

$$
\begin{aligned}
\frac{1}{\gamma}\hat{\pi}_{t+1}+\frac{1}{\gamma}s_{t+1} &= \alpha\left[\frac{1}{\gamma}\hat{\pi}_t+\frac{1}{\gamma}s_t\right]+\beta\left(v_{t+1}-v_t\right)-\beta\beta_1 s_{t+1}\Longleftrightarrow\\
\frac{1}{\gamma}\hat{\pi}_{t+1} &= \alpha\frac{1}{\gamma}\hat{\pi}_t+\beta\left(v_{t+1}-v_t\right)-\left(\beta\beta_1+\frac{1}{\gamma}\right)s_{t+1}+\alpha\frac{1}{\gamma}s_t\Longleftrightarrow\\
\hat{\pi}_{t+1} &= \alpha\hat{\pi}_t+\beta\gamma\left(v_{t+1}-v_t\right)-\left(\gamma\beta\beta_1+1\right)s_{t+1}+\alpha s_t \qquad \text{(S.2)}
\end{aligned}
$$

in the absence of shocks – $s_t = s_{t+1} = v_t = v_{t+1} = 0$ – (S.1) and (S.2) can be solved to

$$
\begin{aligned}
\hat{y}_t &= \alpha^t\hat{y}_0\\
\hat{\pi}_t &= \alpha^t\hat{\pi}_0.
\end{aligned}
$$

We see that this system is stable since

$$
0<\alpha=\frac{1+\beta_3 k}{1+\beta_3 k+\beta_1\gamma}<1.
$$

Furthermore, it is easily seen (the students do not have to derive $\partial\alpha/\partial k$ to fulfil the argument) that the larger the value of k, the higher is the value of α. Since α measures the persistence of any deviation in y from its long-run level, we can conclude that an active fiscal policy tends to prolong the transistion towards long-run equilibrium.

The reason is that convergence towards long-run equilibrium is driven by improvements in competitiveness. Hence, the lower inflation is, the larger will be improvements in competiveness. But by stimulating demand, inflation is raised (through higher employment => lower MPL => higher MC etc...) and the convergence period is prolonged.