Suggested answers for written Exam for the B.Sc. in Economics winter 2013–14

Macro B

Final Exam

February 17 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. Equation (A.1) is a financial arbitrage condition that establish a connection between the short term and the long term interest rates (effective yield) – the yield curve.

   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 initially expected short-term interest rates for each of the future n years. The left-hand side is the total amount the firm should pay had the back instead chosen to finances the project through a fixed long-term interest rate. If the right-hand side is lower than the left-hand side, no firms will 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.

   This simplistic argument requires the lender and borrower to be risk neutral. Although not asked for the student could add that, neither lender nor borrower knows how interest rates change in the future and therefore a risk premium could be added to the tight hand side of the equation. The lender is likely to prefer to be able to re-negotiate the terms of the load each period rather than commit to a interest 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. Using the approximation $\ln(1+x) \approx x$ (B.3.1) may be rewritten as

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

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.

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, the central banks willingness to secure stability of output and inflation and through the central banks communication.

3. It follows directly from equation (A.2) that if a period is one year then the effect of a temporary 1 percentage point reduction in the short tem interest rate lasting for one year will have an effect on the long term interest rate of $1/n$. Hence, the reduction 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.

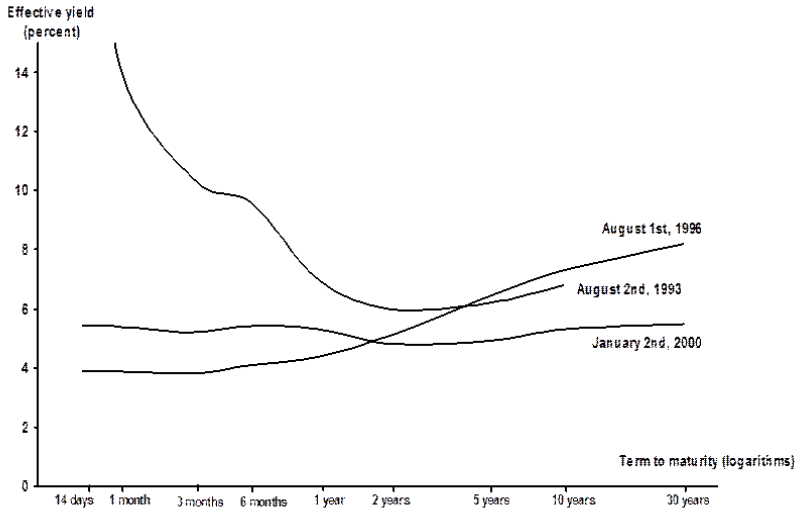
4. Aggregate damand depends mainly on the longer-term interest rates. Aggregate demand is stimulated by a reduction in long-term interest. Therefore the positive impact on aggregate demand from economic policy is larger the more long-term interest rates are reduced. In option b the central bank informs economic agents that it intends to keep the short-term interest rate at a low level for an extended period lasting more than a year. Hence, expected short-term interest rates are at a low level for several periods. Accordingly the impact on the long-term interest rate is strong. Option c tells us that the short-term interest rate is at a low level for less than a year. Hence the effect on the long-term interest rate will only be small. Option a is in between option b and c.

5. Central bank credibility plays a crucial role for the central banks ability to affect total demand in the economy. To affect total demand the central bank has to 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. Instead they 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.

In the extreme case where thecentral bank has no credibility it can not affect future short term interest rates at all through communication. In this situation the only (and negible) effect on long term interest rates comes from the observed reduction in the policy rates.

6. 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 look like the following (taken from the textbook) 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. Short-term interest rates were so high on this specific occasion because the Danish Central Bank hiked interest rates to defend the Danish currency during the EMS crisis. The yield curve at this date 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. This i scenario c in the question.

In scenarion a (August 1st 1996) short term interest rates are currently low and are expected to rise, the slope of the yield curve is positive.

In a situation where no change in the short-term interest rates are expected, the yield curve is flat (January 2nd, 2000). This is scenario b.

7. Interest rates are bounded from below by a zero foor. 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. Another option for the central bank is to promise that future infation will be higher. However, markets may not deem such a policy credible because when the recession is over there may be social losses related to a higher inflation target.

Problem B

1. Equation (A.1) is an arbitrage condition stating that the required return from investing in shares (the right-hand side) has to equal the return from investing in bonds plus a risk premium (the left hand side).

   For simplicity the market rate of interest on bonds r is assume to be constant. rV_t is the interest income that the shareholder could have earned during period t had shares been sold at the initial market value V_t and invested the the amount in bonds. Thus, rV_t is the opportunity cost of investing in shares. The risk premium ε is included because investing in a bond is considered less risky than investing in shares. The risk premium reflects that stock prices in general are more volatile than bond prices and interest payments, so in the absence of a risk premium, the risk-averse investor would prefer to hold "low-risk" bonds rather than "high-risk" shares if expected returns from these investments were identical. The right-hand side of (B.1) reflects the expected return from investing in stocks, *i.e.* the expected real dividend from owning stocks during period t, D_t^e plus an expected capital gain $V_{t+1}^e - V_t$ (the difference between the expected real market value at the beginning of period $t+1$ and the the actual real market value of the firm at the beginning of period t).

   Showing (A.2) is straight forward.

$$(r+\varepsilon)V_t = D_t^e + V_{t+1}^e - V_t \Longrightarrow \tag{B.1}$$

$$(1+r+\varepsilon)V_t = D_t^e + V_{t+1}^e \Longrightarrow$$

$$V_t = \frac{D_t^e + V_{t+1}^e}{1+r+\varepsilon} \tag{B.2}$$

   Equation (B.2) states that the market valuation of stocks in the current period equals the present value of next periods expected valuation of the stock and the expected dividend payment. The discount factor is the market interest rate for investing in bonds plus a risk premium ε for investing in shares.

2. Equation (B.3) assumes that the risk adjusted return on stock market return does not systematically outpace return on the bond market. To derive (B.4),

one may start with (B.2), lead it one period to obtain a measure of V^e_{t+1} and insert this into (B.2). Proceeding in this way for all future periods gives

$$\begin{aligned} V_t &= \frac{D^e_t + V^e_{t+1}}{1+r+\varepsilon} && \text{(B.2)} \\ &= \frac{D^e_t + (\frac{D^e_{t+1}+V^e_{t+2}}{1+r+\varepsilon})}{1+r+\varepsilon} \\ &= \frac{D^e_t}{1+r+\varepsilon} + \frac{D^e_{t+1}}{(1+r+\varepsilon)^2} + \frac{V^e_{t+2}}{(1+r+\varepsilon)^2} \\ &= \frac{D^e_t}{1+r+\varepsilon} + \frac{D^e_{t+1}}{(1+r+\varepsilon)^2} + \frac{D^e_{t+2}}{(1+r+\varepsilon)^3} + ... + \frac{V^e_{t+n}}{(1+r+\varepsilon)^n} \\ &= \sum_{n=0}^{\infty} \frac{D^e_{t+n}}{(1+r+\varepsilon)^{n+1}} && \text{(B.4)} \end{aligned}$$

where (B.3) is used to obtain the last expression.

Equation (A.4) states that the market value of the firm equals the present discounted value of the expected future dividends paid out by the firm. This is called "fundamental" because the valuation of the firm reflects the firm's fundamental ability to generate future cash flows to its owners.

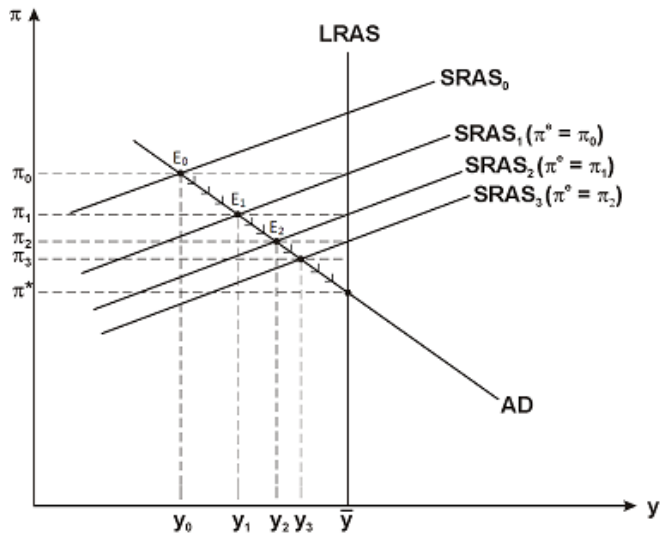
3. In the figure the real stock price and the present value of real dividends is shown using either a constant discount rate or a market interest rate. Hence, the figure takes equation (B.4) to the data although by its very nature actual dividends are only an indicator for all future expected dividends. The figure shows that stock prices fluctuations are much larger than fluctuations in discounted dividends. Equation (B.4) offers three possible explanations for the observed stock market volatility and why this volatility may be perfectly rational:

   - Fluctuations in the (growth rate) of expected future real dividends D^e_t.
   - Fluctuations in the (expected) real interest rate r.
   - Fluctuations in the required risk premium on shares, ε.

   The theory is compatible with rational behavior although nothing is said about how expectations are formed. All being said is how stock prices relate to future dividends. The model says nothing about how expectations on r, D and ε are formed.

Problem C

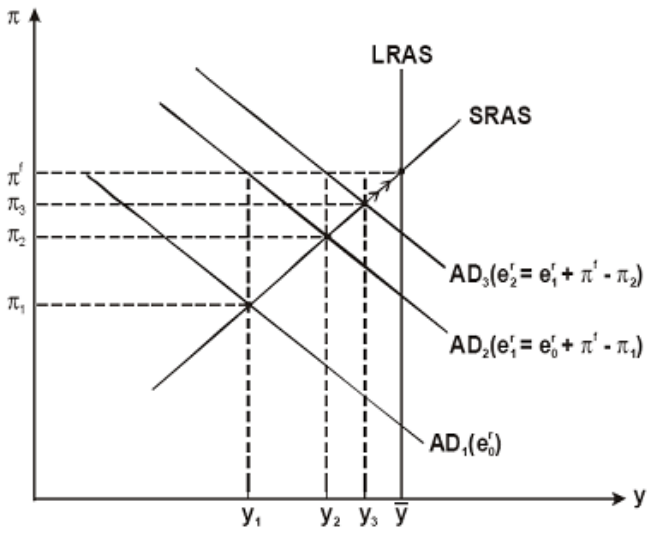
1. For the closed economy the central bank play a crucial role as the "mechanism" that ensures convergence to equilibrium. In order to describe the convergence proces assume that a negative supply shock has hit the economy and the short run equilibrium E_0 in the figure below is realized. Due to the assumption og static expectations inflation in period 1 is expectations to be π_0.These expectations are translated into the wage claims and therefor the AS-cirve for period 1 intersects the LRAS-curve at $(\overline{y}, \pi_0)$ .In period 1 actual inflation is however below expectations $\pi_1 < \pi_1^e = \pi_0$ as activity is below the structural level. Hence, increases in marginal product is relative high and accordingly marginal costs increase at a relative low pace compared to the previous period (and expectations). 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 figure where 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 stimulates total private demand.

For the open economy with fixed exchange rates the real exchange rate plays a crucial role. Assume 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). The convergence process may be illustrated in a figure like the following.



2. Equation (C.1) states that in optimum the consumer is indifferent between consuming an extra unit today and saving an extra unit today. The left-hand

side is the marginal rate of substitution, MRS, which expresses how much utility decreases today relative to the increase in future utility if an infinite small part of today's consumption is postponed to the future. The marginal rate of substitution between present and future consumption (the left-hand side) must equal the relative price of present consumption (the right-hand side). Also, it follows directly from the characteristics of the utility function u that C_2 is increasing in r and declining in ϕ.

For $r = \phi$ optimization implies $C_1 = C_2$. In this situation the consumer will smooth consumption completely.

Capital markets makes it possible for the consumer to shift consumption between different phases in life. Hence, consumption in a given period is not restricted completely by income in this period. Instead the consumer may trade consumption between the periods at a given market rate. This makes it possible for the consumer to obtain higher utility (illustrated in the figure below where the optimal consumption stream is at a higher indifference curve than the indifference curve going through the income stream (Y_1, Y_2). An illustration may be the following.