

UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4325 – Monetary Policy**

Date of exam: Friday, May 19, 2017

Grades are given: June 12, 2017

Time for exam: 2.30 p.m. – 5.30 p.m.

The problem set covers 6 pages

Resources allowed:

- No written or printed resources – or calculator - is allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences)

The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

The exam consists of three parts, 1, 2 and 3. In the grading, problem 1 is given 30 per cent weight, problem 2 is given 20 per cent weight, and problem 3 is given 50 per cent weight. The max page limit should be respected, but is not required (i.e. a shorter answer may be just as good).

Problem 1a

Imagine that you are working as a senior advisor at the Federal Reserve Bank in May 2017, and the next monetary policy meeting is two weeks away. The federal funds rate is currently at 0,25 – 0,5 percent after a 25 basis points interest rate increase at the previous meeting, which was the first increase in 7 years. Including the upcoming May meeting, there are four more monetary policy meetings in 2017.

The economic development since the last meeting can be described as follows:

- The **jobs market** has continued to strengthen and unemployment fell to a cyclical low of 4.4 percent in April, aided by a combination of stronger job growth and fewer people entering and participating in the workforce.
- As a result, **wage growth** remains relatively high, particularly in high skilled areas such as information and professional services. Overall, however, nominal wage growth is expected to be 1.8 percent in 2017.
- **Economic growth** is moderate, and market participants consider its future development to be “fragile at best”.
- **Inflation** is on the rise. The headline measure is now at 2.2 per cent, whereas core inflation is 1.9 per cent.

- One key question raised by market participants is whether there is any further change in the *risks of positive or negative developments* hitting the economy. Right now, the risks are seen as "slightly skewed downward".
- It has been one interest rate increase so far in 2017. As of December, 2016, the median prediction was for three increases in 2017. Janet Yellen, the Fed chair, *signalled in her most recent speech* that she was comfortable with this forecast.

In the following, it is taken for granted that you are familiar with the Federal Reserve's mandate for monetary policy to the extent that we have covered it in this course.

Based on the information given above, you are asked to write a recommendation to Ms. Yellen on what to do with the interest rate at the next meeting. Ms. Yellen also wants your opinion on how to build up the press conference: which issues should be paid special attention to and should any forward guidance be offered? Your draft should make use of what you have learned in this course in general and the information given above, in particular.

Ms. Yellen asks for your personal opinion, and your draft should therefore give an independent and intuitive explanation for your choice.

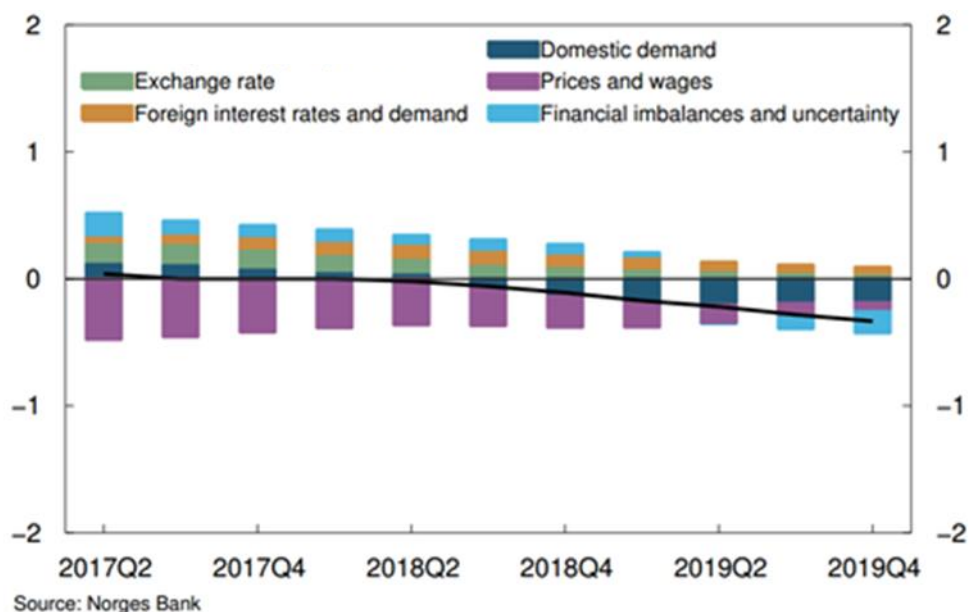
Your written answer should exceed one page, but be no more than three pages long.

Problem 1b

In this course (at lecture 2), you are presented with three different forms of central bank independence. Name the three forms and provide one example of each. In particular, explain under which form one finds the *inflation target*. Furthermore, give a brief recommendation on whether the Norges Bank and ECB inflation targets should be changed. For both central banks, your answer should (i) state what the target is today, (ii) include both arguments in favor of and against a change, and (iii) provide a clear recommendation. In sum, your answer should be no more than two pages long.

Problem 1c

In the latest Monetary Policy Report from Norges Bank, the following chart is presented:



Imagine that you work as a senior advisor at Norges Bank and are giving a presentation to a group of economists familiar with economics, but not this particular chart. This is the only chart in the presentation. The group has communicated that they want to understand Norges Bank's monetary policy and the current economic outlook.

Based on the chart and on what you have learned in this course, write down an intuitive economic explanation to the group. Next, state arguments both in favor of and against including this chart in the monetary policy report, and give a clear recommendation on whether it should be published in future reports. In sum, your answer should be no more than three pages long.

Problem 2

In order to maximize welfare in the Barro Gordon model, the central bank is assumed to fully control inflation by adjusting money supply ($\Delta m_t = \pi_t$) and minimize the following loss function:

$$L_t = \frac{1}{2} [(\pi_t - \pi^*)^2 + \lambda(y_t - y^*)^2] \quad (1)$$

where $\lambda > 0$ is the central bank's relative weight on the output gap and $\pi^* \geq 0, y^* > 0$ are the central bank's inflation target and output target, respectively, and where the socially optimal output level, y^* , is larger than the natural output level in the economy, $y_t^{natural}$. Furthermore, the economy is supply-side driven, with output described by the Lucas supply curve:

$$y_t = y_t^{natural} + \gamma(\pi_t - \pi_t^e) + \varepsilon_t, \quad \gamma > 1, E_{t-1}(\varepsilon_t) = 0 \quad \text{and} \quad \pi_t^e = E_{t-1}\pi_t \quad (2)$$

The following also holds: $\lambda > \frac{1}{\gamma^2}$

Problem 2a

Provide a brief interpretation of the Lucas supply curve.

Problem 2b

Assume that the central bank commits to the following policy rule prior to the formation of private expectations and prior to the realization of the shock:

$$\Delta m_t = \pi_t^{\text{commitment}} = a + b\varepsilon_t \quad (3)$$

and show that the optimal choice of a and b are:

$$a^* = \pi^* \quad (4)$$

$$b^* = -\frac{\lambda\gamma}{1-\lambda\gamma^2} \quad (5)$$

Problem 2c

Solve for realized output and inflation in this economy and interpret the results. In your answer, you should explain why the socially optimal output level cannot be achieved and describe how stabilization policy is conducted in the presence of a supply shock. The more variables/parameters interpreted, the higher is the score.

Problem 3

It can be shown that the non-policy block of equilibrium behavior in the New Keynesian model can be explained by the following two equations:

$$\pi_t = \beta E_t \{\pi_{t+1}\} + \kappa \tilde{y}_t + u_t, \quad 0 < \beta < 1, 0 < \kappa < 1 \quad (6)$$

$$\tilde{y}_t = E_t \{\tilde{y}_{t+1}\} - \frac{1}{\sigma} [i_t - E_t \{\pi_{t+1}\} - \rho], \quad 0 < \sigma < 1 \quad (7)$$

$$u_t = \rho_u u_{t-1} + \hat{u}_t, \quad 0 < \rho_u < 1$$

where $\tilde{y}_t = (y_t - y_t^{\text{natural}})$ is the output gap in period t , i_t is the nominal interest rate, $\frac{1}{\sigma}$ is the intertemporal elasticity of substitution, u_t is the cost-push shock and \hat{u}_t is white noise. u_t is known when monetary policy is determined. Introducing monetary policy, the central bank is committed to the following Taylor rule:

$$i_t = \rho + \phi_\pi \pi_t + \phi_{\tilde{y}} \tilde{y}_t, \quad \phi_\pi > 1, \phi_{\tilde{y}} > 0 \quad (8)$$

where $\phi_\pi, \phi_{\tilde{y}}$ are parameters set by the central bank.

Problem 3a

Price rigidity is a key element in the New Keynesian model. With Calvo pricing, it can be shown that gross inflation in this economy equals:

$$\Pi_t^{1-\varepsilon} = \theta + (1 - \theta) \left[\frac{P_t^*}{P_{t-1}} \right]^{1-\varepsilon}, \quad \varepsilon > 1, 0 < \theta < 1 \quad (9)$$

where $(1 - \theta)$ measures the fraction of firms that can reset their prices in any given period, while a fraction θ keep their prices unchanged. ε is the demand elasticity, P_t^* is the optimal price chosen by the firms who can reset prices in period t and P_{t-1} is the aggregate price level in period $t-1$.

For a steady state gross inflation rate equal to 1, log-linearize equation (9) around its steady state. Interpret the solution.

Problem 3b

We assume that equations (6), (7) and (8) yield a unique equilibrium solution. Use the method of undetermined coefficients (with the following guess parameters: α and ψ for the effect on the output gap and inflation in period t , respectively) to find the equilibrium solutions for inflation and the output gap in this economy in the presence of a positive cost-push shock. Your answer should include:

- i) Your calculation of the equilibrium solutions for inflation and output gap in the presence of the shock.
- ii) An interpretation of the economic mechanisms (the more effects interpreted, the higher is the score).

In your calculation, you do not have to insert for κ , but may consider κ a measure of price stickiness only. Also, you do not have to simplify the solutions. For instance, the solution for the full effect of a cost-push shock on the output gap can look like this:

$$\alpha u_t = \frac{-\frac{\phi_\pi}{\sigma(1-\beta\rho)} + \frac{\rho}{\sigma(1-\beta\rho)}}{1-\rho + \frac{\kappa\phi_\pi}{\sigma(1-\beta\rho)} + \frac{\phi_{\tilde{y}}}{\sigma} - \frac{\kappa\rho}{\sigma(1-\beta\rho)}} u_t$$

Problem 3c

Now, assume that the central bank instead of committing to a rule makes use of discretion and conducts optimal monetary policy from minimizing the following loss function:

$$L_t = \frac{1}{2} \{ \lambda^* \tilde{y}_t^2 + (\pi_t - \pi^*)^2 \} + F_t, \quad \pi^* = 0, \quad (10)$$

$$\text{subject to } \pi_t = \kappa \tilde{y}_t + f_t, \quad (11)$$

where π^* is the zero inflation target and where $F_t \equiv \frac{1}{2} E_t \sum_{k=1}^{\infty} \beta^k \{ \lambda^* \tilde{y}_{t+k}^2 + (\pi_{t+k} - \pi^*)^2 \}$ and $f_t \equiv \beta E_t \pi_{t+1} + u_t$ represent that the central bank must take expectations as given when formulating monetary policy. Households are expected to have rational expectations and the central bank targets the natural rate of output.

Explain why the central bank must take expectations as given when deriving optimal monetary policy in this setting. Derive the first order conditions and show that they can be combined in the following way:

$$\tilde{y}_t = -\frac{\kappa}{\lambda^*} \pi_t \quad (12)$$

(Hint: When deriving the first order conditions, equation (12) can be found directly without solving any of the first order conditions forward).

The optimal policy under discretion in the presence of a cost-push shock is known as “leaning against the wind of inflation”. Explain this concept based on the variables and parameters described in equation (12).

Problem 3d

When conducting optimal monetary policy under discretion, it can be shown that the equilibrium standard deviations of inflation and the output gap in the presence of a cost-push shock are:

$$\sigma_\pi = \left(\frac{\lambda^*}{\kappa^2 + \lambda^*(1-\beta\rho)} \right) \sigma_u \quad \text{and} \quad \sigma_{\tilde{y}} = -\left(\frac{\kappa}{\kappa^2 + \lambda^*(1-\beta\rho)} \right) \sigma_u, \text{ respectively.}$$

Use these standard deviations to draw the efficient policy frontier $(\sigma_{\tilde{y}}, \sigma_\pi)$ and explain how we should expect it to change with higher lambda.