Written Exam at the Department of Economics summer 2020-R

Monetary Policy

Re-exam

August 18, 2020

(3-hour open book exam)

Answers only in English.

The paper must be uploaded as <u>one PDF document</u>. The PDF document must be named with exam number only (e.g. '127.pdf') and uploaded to Digital Exam.

This exam question consists of 5 pages in total

This exam has been changed from a written Peter Bangsvej exam to a take-home exam with helping aids. Please read the following text carefully in order to avoid exam cheating.

Be careful not to cheat at exams!
You cheat at an exam, if you during the exam:

- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text. This also applies to text from old grading instructions.
- Make your exam answers available for other students to use during the exam
- Communicate with or otherwise receive help from other people
- Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts
- Use parts of a paper/exam answer that you have submitted before and received a passed grade for without making use of source referencing (self plagiarism)

You can read more about the rules on exam cheating on the study information pages in KUnet and in the common part of the curriculum section 4.12.

Exam cheating is always sanctioned with a warning and dispelling from the exam. In most cases, the student is also expelled from the university for one semester.

PROBLEM A

Evaluate whether each of the following statements is true or false.
Explain your answers carefully.

1) In the New Keynesian model with sticky prices and sticky wages, it will generally be optimal for the central bank to keep the rate of wage inflation at zero.

2) When a central bank uses unconventional monetary policy, this invariably implies an expansion of the central bank's balance sheet.

3) In the basic New Keynesian model with sticky prices, a standard Taylor rule, and monetary policy shocks only, inflation, the output gap and the nominal interest rate are positively correlated.

PROBLEM B

This problem asks you to solve an open-economy version of the New Keynesian model. Consider an open economy described by the following three log-linear equations:

$$\pi_{H,t} = \beta \mathrm{E}_t \{\pi_{H,t+1}\} + \kappa_\nu \tilde{y}_t, \quad 0 < \beta < 1, \quad \kappa_\nu > 0, \tag{B.1}$$

$$\tilde{y}_t = \mathrm{E}_t \{\tilde{y}_{t+1}\} - \frac{1}{\sigma_\nu} \left(i_t - \mathrm{E}_t \{\pi_{H,t+1}\} - r_t^n\right), \quad \sigma_\nu > 0, \tag{B.2}$$

$$i_t = \rho + \phi_\pi \pi_{H,t} + \phi_y \widetilde{y}_t + \phi_y \widehat{y}_t^n, \quad \rho > 0, \quad \phi_\pi > 1, \quad \phi_y > 0, \tag{B.3}$$

where $\pi_{H,t}$ denotes domestic price inflation (or "producer price inflation"), $\widetilde{y}_t$ is the domestic output gap, and i_t is the domestic nominal interest rate. $\mathrm{E}_t \{\cdot\}$ is the rational expectations operator conditional on all information up to and including period t. Furthermore, $\widehat{y}_t^n \equiv y_t^n - y^n$ denotes the natural output gap, where natural output is given by:

$$y_t^n = \Gamma_a a_t, \quad \Gamma_a > 0,$$

while $y^n = 0$. Here, a_t represents a technology shock, which is described by a stochastic process with $\mathrm{E}_{t-1} \{a_t\} = 0$. Moreover, r_t^n denotes the natural real interest rate, defined as:

$$r_t^n \equiv \rho + \sigma_\nu \mathrm{E}_t \left\{\Delta y_{t+1}^n\right\}.$$

Finally, the economy is characterized by an uncovered interest parity condition, which reads as follows:

$$i_t = i_t^* + \mathrm{E}_t \{e_{t+1}\} - e_t, \tag{B.4}$$

where i_t^* denotes the foreign nominal interest rate, which is constant and equal to ρ, while e_t is the nominal exchange rate, defined as the price of foreign currency in terms of domestic currency.

1) Describe the economic mechanisms underlying each of the equations $(B.1)$-$(B.4)$.

2) Derive the solutions for $\widetilde{y}_t$ and $\pi_{H,t}$. How do these variables respond to an increase in a_t? Provide an economic explanation. Are the qualitative responses of these variables to a technology shock in line with those in a closed economy?

3) Use your solution from the previous question to show that the solution for the nominal interest rate is given by:

$$i_t = \rho - \frac{\Gamma_a \phi_\pi \kappa_\nu \sigma_\nu}{\sigma_\nu + \phi_y + \phi_\pi \kappa_\nu} a_t.$$

Comment on the sign of the response of the nominal interest rate to a technology shock. Then combine this result with $(B.4)$ to determine what happens to the nominal exchange rate in response to the shock (for the sake of the argument, you may take $\mathrm{E}_t \{e_{t+1}\}$ as given). Explain what this implies for domestic consumers.

4) Let π_t denote the domestic "consumer price inflation". Under certain conditions, it can be shown (you should not do this) that this variable is given by the following expression:

$$\pi_t = (1-\nu)\, \pi_{H,t} + \nu \Delta e_t, \quad 0 < \nu < 1,$$

where the parameter ν denotes the degree of openness of the economy, with low values of ν denoting a small degree of openness, and vice versa. Is it possible to determine the sign of the response of π_t to a positive shock to a_t? Provide a careful economic explanation of the different forces at play and the role of the parameter ν. [Hint: since the economy starts out in steady state, you may set $e_0 = 0$, so that $\Delta e_t = e_t$, and you may again assume that $\mathrm{E}_t \{e_{t+1}\}$ is given, and thus unaffected by a_t.]

PROBLEM C

This problem asks you to analyze optimal monetary policy in the New Keynesian model. The relationship between inflation π_t and the welfare-relevant output gap x_t is given by the following equation:

$$\pi_t = \beta \mathrm{E}_t \pi_{t+1} + \kappa x_t + u_t, \quad \kappa > 0, \tag{1}$$

where cost-push shocks u_t follow an AR(1) process:

$$u_t = \rho_u u_{t-1} + \varepsilon_t^u, \quad \rho_u \in [0, 1)\,.$$

Here, ε_t^u is an i.i.d. mean zero shock. There are no other shocks in the economy. The loss function of the central bank is given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(\vartheta x_t^2 + \pi_t^2 \right) \right], \quad \beta \in (0, 1)\,, \quad \vartheta > 0. \tag{2}$$

1) Set up the optimal policy problem under discretion and derive the relevant first order condition for the central bank. Discuss the economic interpretation of the FOC.

2) Set up the optimal policy problem under commitment and derive the relevant first order conditions for the central bank. Discuss the economic interpretation of the FOCs.

3) Explain with the help of the FOCs why commitment leads to an improved policy trade-off.