Exam Ph.D. Macroeconomics II

Department of Economics, Uppsala University

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Instructions

- Writing time: 5 hours.
- The exam is closed book.
- The exam has 76 points in total
- A passing grade requires a) at least 30 points on the exam, and b) 50 points in total for the course (incl the points you have from your problem sets).
- Start each question on a new paper. Write your anonymous code on all answer pages.
- You may write your solutions by pen or pencil; use your best handwriting.

- Answers shall be given in English.
- Motivate your answers carefully; if you think you need to make additional assumptions to answer the questions, state them.
- If you have any questions during the exam, you may call me (+46 730 606 796) at any time between 10 AM and noon.

1 Short Questions (4 points each)

Answer the question and, when applicable, provide a short explanation that *emphasizes economic intuition.*

1. How does the Burdett-Mortensen model solve the Diamond paradox?

2. Consider the basic DMP model studied in class. Does increasing the workers' bargaining power reduce the unemployment rate? Explain your reasoning.

3. What are the two sources of a precuationary savings motive in the standard incomplete-markets model?

4. Consider the following claim concerning business cycle accounting: The fact that the investment wedge is small in US data suggests that the basic RBC model explains fluctuations in the marginal product of capital very well. True or false? Explain your reasoning.

A McCall model with on-the-job wage growth (22 points)

Consider the McCall model. Time is continuous. Workers' utility is linear and the discount rate is r. Workers can be employed or unemployed. Unemployed workers recieve flow utility b and get job offers at rate λ_u. When recieving a job offer, the wage of that offer is drawn from a distribution with cdf $F(w)$ with finite support $\mathcal{W} = [w_{min}, w_{max}]$, and the unemployed household decides whether to accept or reject. If accepting, the worker becomes employed and stick with the wage contract until he/she is separated, which happens at the exogenous rate σ.

1. (3 points) Denoting the value of employment with $W(w)$ and unemployment with U, write the Bellman equations for an employed and unemployed worker

2. (3 points) Find the reservation wage equation, which implicitly determines the reservation wage as function of primitives.

Now, we assume that employed workers can experience wage growth on the job. Specifically, while employed, workers experience wage changes at rate $\lambda_w > 0$. When the shock is realized, an employed worker with current wage w draws an ϵ from a distribution with cdf $G(\epsilon)$ with finite support $\mathcal{E} = [0, \epsilon_{max}]$ and mean value $\bar{\epsilon}$. The new wage w' is then $w' = w(1 + \epsilon)$. All other assumptions of the model are unchanged.

3. (4 points) Write the new Bellman equation for an employed worker.

4. (4 points) Guess that a solution to the worker problem has an employment value $W(w)$ that is linear in w: $W(w) = kw + m$. What are the values of k and m if the Bellman equation of the employed worker is to be satisfied for all wages w?

5. (4 points) Using the guess, find the reservation wage equation. Is the reservation wage in this model higher or lower compared to the model without stochastic wage growth?

6. (4 points) In the model without stochatic wage growth, the mean-min ratio of observed wages is given by

$$Mm = \frac{\frac{\lambda}{r+\sigma} + 1}{\frac{\lambda}{r+\sigma} + \rho} \tag{1}$$

where λ is the job-finding rate and ρ is the average replacement rate (ρ is defined by $b = \rho\bar{w}$, where $\bar{w}$ is the average observed wage). If matched to the same data on the discount rate, separation rate, job-finding rate and average replacement rate, would you expect the model with stochastic wage growth to predict more or less residual wage dispersion compared to the model with constant wages on the job? Would it make a big difference?

Taxing capital investment in the Ayiagari model (25 points)

Consider an economy with a continuum (measure 1) of ex-ante identical households, each living for two periods. Each household i has utility U_i given by

$$U_i = \log(c_{i1}) + \beta E \log(c_{i2}) \tag{2}$$

where c_{i1}, c_{i2} are period 1 and 2 consumption, β is the discount factor and E is the expected value operator. In period 1, each household is endowed with y_1 units of output that can either be consumed, c_{i1}, or invested, k_i. In period 1, there is a proportional tax τ on investment, which is collected by the government, and then handed out lump-sum equally to all households in the same period. Denoting the aggregate capital stock with K, the period 1 budget constraint reads

$$c_{i1} + (1+\tau)k_i = y_1 + \tau K. \tag{3}$$

In period 2, households recieve income from the capital they saved in period 1 and from wages earned from supplying l_i efficiency units of labor. l_i is a random variable, i.i.d. across households and equals $1+\epsilon$ with probability 1/2 and $1-\epsilon$ with probability 1/2, with $0 \leq \epsilon < 1$.

The Law of large numbers imply that the aggregate efficiency units of labor supply $L = 1$. In period 2, output is produced by a competitive representative firm which operate a Cobb-Douglas production function $K^\alpha L^{1-\alpha}$, renting capital and labor services from the households at rate r and w, respectively.

1. (5 points) Write the household and firm problems and define a competitive equilibrium for this economy.

2. (5 points) Solve for the aggregate capital stock in this economy.

3. (5 points) Assume $\epsilon = 0$. Show that increasing τ decreases U_i.

4. (5 points) Show that around some given tax rate τ, there exist an $\epsilon > 0$ such that marginally increasing τ increases U_i.

5. (5 points) Provide the intuition for the last two results.

VAT taxes as demand management in the New-Keynesian model (13 points)

Consider the vanilla NK model discussed in class, but with two twists: First, instead of assuming a rule for the nominal interest rate $\hat{i}_t$, we assume that its path can be freely selected by the central bank. Second, we assume that there is a VAT tax, used to financed lump-sum payouts to the representative household. The household budget constraint therefore reads

$$(1+\tau_t)P_tC_t + Q_tB_{t+1} = W_tN_t + D_t + T_t + B_t \tag{4}$$

where τ_t is the VAT tax and T_t is the lump-sum payout from the government (which comes on top of the lump-sum payout of profits D_t from the firms). We also assume, as in class, that the household has standard McCurdy preferences: $U(C,N) = \log C - \frac{N^{1+\varphi}}{1+\varphi}$.

We are interested in log-linear deviations from steady state. As in the vanilla model, firm optimal price setting together with some equilibrium conditions imply a log-linear Phillips curve:

$$\pi_t = \beta E_t\pi_{t+1} + \kappa\hat{y}_t. \tag{5}$$

1. (13 points) Show that for any path of output $\hat{y}_t$ and inflation π_t that may be implemented with some path of the interest rate $\hat{i}_t$, there exist a path of the VAT tax τ_t that can also implement the same output and inflation path.