Macro II, Spring 2015

Retake August 28, 2015

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Instructions. The exam consists of two parts, part one covering John's part of the course and part two covering Karl's.

Exam score. Part one contains three exam questions with a total maximum of 100 points. Part two contains four exam questions with a total maximum of 100 points. The exam score is the sum of the scores on part one and two divided by two.

Course score The course score is a weighted average of the exam score and the score on the problem sets. Weights are 4/5 on the exam and 1/5 on the problem sets. The threshold for pass is 50 and for pass with distinction 75.

The core of your answers should be based on what you have learned during the course. Make sure you specify your definitions and assumptions clearly.

Part I

1. **A growth model (50 points)** Consider the planning problem

$$\max_{\{C_t, K_{t+1}, L_t\}_{t\geq 0}} \sum_{t=0} \beta^t U(C_t, L_t)$$

$$\begin{aligned} \text{s.t. } C_t + K_{t+1} &= Y_t + (1-\delta) K_t \forall t \geq 0 \\ Y_t &= Z_t F(K_t, 1 - L_t) \\ & K_0 \text{ given} \end{aligned}$$

and where Z_t is a *deterministic* process with a constant growth rate γ, C_t consumption, L_t leisure and K_t capital. δ denotes depreciation and U and F satisfy standard concavity conditions.

(a) (10) Derive the optimality conditions for the planner by using the first order conditions for C_t, K_{t+1} and L_t. Express your results as

1. an Euler condition expressing the intertemporal optimality condition involving a trade-off between C_t and C_{t+1} and
2. an intratemporal optimality condition involving a trade-off between labor and leisure. Show the steps in your derivations!

(b) (10) Define what we mean by balanced growth in this model and explain in words why it may be a desirable property that it exists.

(c) (10) Now think of what properties of U and F are necessary for the existence of balanced growth in the model. Specifically, choose explicit examples of U and F and show that they are consistent with the properties of balanced growth you defined under b.

(d) (10) Now assume that Z_t follows a stationary, stochastic first-order Markov process with unconditional expectation $E(Z_t) = 1$. The model then becomes an RBC-model. Show that the Euler equation can be written in terms of $K's, L's$ and $Z's$ in different periods, i.e., as

$$E_t v_K (K_{t+2}, K_{t+1}, K_t, L_{t+1}, L_t, Z_{t+1}, Z_t) = 0$$

for some function v_K.

(e) (10) A linear approximation of v_K around the non-stochastic steady state can be written

$$\begin{aligned}
&E_t v_K\left(K_{t+2}, K_{t+1}, K_t, L_{t+1}, L_t, Z_{t+1}, Z_t\right) \\
&\approx v_{K,1} E_t\left(K_{t+2} - K_S\right) + v_{K,2}\left(K_{t+1} - K_S\right) + v_{K,3}\left(K_t - K_S\right) \\
&+ v_{K,4} E_t\left(L_{t+1} - L_S\right) + v_{K,5}\left(L_t - L_S\right) \\
&+ v_{K,6} E_t\left(Z_{t+1} - 1\right) + v_{K,7}\left(Z_t - 1\right)
\end{aligned}$$

Provide an expression for $v_{K,1}$ and $v_{K,5}$ using the underlying functions U and F and their derivatives.

2. **Wedge accounting (30 points)**. Chari, Kehoe and McGrattan (2007) deviced a method for calculating how the perfect market model predictions deviate from observed data. They defined wedges as deviations from the equilibrium conditions.

   (a) (10) Suppose individuals have a period utility function $U\left(C_t, L_t\right) = \ln C_t + \frac{\nu}{\nu-1}\phi_t L_t^{\frac{\nu-1}{\nu}}$. Let w_t denote the wage and normalize the price of the consumption good C_t to unity. Define the labor-leisure wedge (make sure it is zero if the perfect market equilibrium is exactly satisfied).

   (b) (10) In US data, how does the wedge you just defined vary over the business cycle? (Make sure your statement corresponds to the way you defined the wedge above).

   (c) (10) Provide an explanation (of your choice) to the cyclical pattern you just described. Make sure you explain clearly why (not necessarily very deeply) this might be an explanation.

3. **VAR's (20 points)**. Describe briefly what we mean by the concept "Identification of structural shocks in VAR's" and explain how this can be done using the recursive (triangular) method. Be brief, 200 words is likely to be more than enough.

Part II

4. **Short questions**. (50 points) Please answer briefly.

   (a) (5 points) Name three reasons why heterogeneity is important for macroeconomics.

   (b) (5 points) According to the data reported by Piketty, how is the development in the US and Europe different since 1970 in terms of capital income and labor income?

   (c) (5 points) Describe the main cross-country differences regarding intergenerational earnings mobility documented in e.g. Jantti et al (2006). In particular, name the countries with highest and lowest intergenerational earnings mobility.

   (d) (5 points) Which assumption(s) or condition(s) are required to justify representative agent modelling of aggregate dynamics and aggregate shocks, e.g. business cycles?

   (e) (6 points) Mention two different assumptions that lead to precautionary savings, i.e. that savings are higher in a world with idiosyncratic earnings uncertainty compared to a world without such uncertainty. Describe the two mechanisms.

   (f) (8 points) Please describe the assumptions and the equilibrium in the Aiyagari model. To get full points, please draw the borrowing limit, the demand and supply of capital curves (capital K on the x-axis, interest rate r on the y-axis) as well as the interest rate that would obtain if markets where complete. Describe the solution algorithm for this model in three brief bullet points.

   (g) (8 points) In non-search models of unemployment the wage is necessarily such that labor supply exceeds labor demand. Workers' market power (unions acting as monopolists resulting in a positive wage markup) is one theory of why wages don't clear the market. Describe the key parts of this theory and graph labor supply and labor demand, marking the employment implied by the theory.

(h) (8 points) In class we discussed three different models of endogenous labor force participation over the business cycle. Please describe the basics of the Krusell, Mukoyama, Rogerson and Sahin (2012) model, including characterization of the labor force participation decision. Which shock is most important for unemployment volatility in this model?

Larger question

5. **The Diamond-Mortensen-Pissarides model.** (50 points)
Consider a setup similar to the standard DMP model discussed in class (although here notation will be slightly different, intentionally). In particular, we have: risk-neutrality, homogenous workers, homogenous firms, a worker-firm match produces output y_t, wages, w_t, are determined by Nash bargaining, the cost of creating a vacancy is κ, free entry of firms, unemployment benefits, z, exogenous break-up rate, d, constant labor force participation normalized to unity, no intensive margin (choice of hours per worker). The discount factor is β. Denote the job finding rate with f_t and the vacancy filling rate with q_t.
Please define clearly any notation that you add.

(a) (7 points) Write down the value for a firm of being matched with a worker.

(b) (7 points) State the job creation condition implied by free entry, assuming that a vacancy filled today becomes a productive match next period:

(c) (8 points) Please write down and explain the value to a worker of being employed, compared to being unemployed. Assume that a worker that loses his job doesn't have the ability to look for a new job until the next period.

(d) (7 points) Using equations for flows into and out of unemployment in steady state, derive a steady state expression for the job finding rate with f as a function of the job separation rate and unemployment.

(e) (7 points) Without necessarily providing detailed derivation, please describe how an increase in the vacancy cost κ affects wages.

(f) (14 points) Assume a matching function $M_t = \gamma V_t^{1-\lambda} U_t^{\lambda}$ where V denotes vacancies and U unemployment. Consider the following social planner's problem:

$$\max_{\{V_t, N_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t E_t \left((y_t - z_t) N_t - \kappa V_t \right)$$

s.t.

$$N_{t+1} = (1-d) N_t + M_t$$
$$U_{t+1} = 1 - N_{t+1}$$
$$M_t = \gamma V_t^{1-\lambda} U_t^{\lambda}$$

Derive the expression for the socially optimal vacancy creation. Verbally argue which term(s) in the expression for optimal vacancy creation would change or drop out in a competitive equilibrium. Name and explain two externalities related to vacancy creation in search and matching models. State the Hosios condition.