Department of Economics

Economics 325 Intermediate Macroeconomic Analysis Final Exam Professor Sanjay Chugh Fall 2009 December 17, 2009

NAME:

The Exam has a total of four (4) problems and pages numbered one (1) through nine (9). Each problem's total number of points is shown below. Your solutions should consist of some appropriate combination of mathematical analysis, graphical analysis, logical analysis, and economic intuition, but in no case do solutions need to be exceptionally long. Your solutions should get straight to the point – **solutions with irrelevant discussions and derivations will be penalized.** You are to answer all questions in the spaces provided.

You may use two pages (double-sided) of notes. You may **not** use a calculator.

Problem 1	/ 25
Problem 2	/ 25
Problem 3	/ 25
Problem 4	/ 25
TOTAL	/ 100

**Problem 1: Consumption and Savings in the Two-Period Economy (25 points).** Consider a two-period economy (with no government), in which the representative consumer has no control over his income. The lifetime utility function of the representative consumer is  $u(c_1, c_2) = \ln c_1 + \ln c_2$ , where ln stands for the natural logarithm. We will work here in purely real terms: suppose the consumer's **present discounted value of ALL lifetime REAL income is 26.** Suppose that the real interest rate between period 1 and period 2 is zero (i.e., r = 0), and also suppose the consumer begins period 1 with zero net assets.

a. (17 points) Set up the lifetime Lagrangian formulation of the consumer's problem, in order to answer the following: i) is it possible to numerically compute the consumer's optimal choice of consumption in period 1? If so, compute it; if not, explain why not. ii) is it possible to numerically compute the consumer's optimal choice of consumption in period 2? If so, compute it; if not, explain why not. iii) is it possible to numerically compute the end of period 1? If so, compute it; if not, explain why not.

## **Problem 1 continued**

b. (8 points) To demonstrate how important the concept of the real interest rate is in macroeconomics, an interpretation of it (in addition to the several different interpretations we have already discussed in class) is that it reflects the rate of consumption growth between two consecutive periods. Using the consumption-savings optimality condition for the given utility function, briefly describe/discuss (rambling essays will not be rewarded) whether the real interest rate is positively related to, negatively related to, or not at all related to the rate of consumption growth between period one and period two. For your reference,

the definition of the rate of consumption growth rate between period 1 and period 2 is  $\frac{c_2}{c} - 1$ 

(completely analogous to how we defined in class the rate of growth of prices between period 1 and period 2). (**Note:** No mathematics are especially required for this problem; also note this part can be fully completed even if you were unable to get all the way through part a).

**Problem 2: The Keynesian-RBC-New Keynesian Evolution (25 points).** Here you will briefly analyze aspects of the evolution in macroeconomic theory over the past 25 years. Address each of the following in no more than three brief phrases/sentences each.

**a.** (8 points) Describe **briefly** what the Lucas critique is and how/why it led to the demise of (old) Keynesian models.

**b.** (9 points) In writing down utility functions and production functions for use in "RBC-style" macro models, the assumed functions are typically "estimated" using data (i.e., a common assumption is the logarithmic utility function we have often used, based on some statistical evidence that it is consistent with observed microeconomic and macroeconomic evidence). Is this practice subject to a "Lucas-type critique?" **Briefly** explain why or why not?

**c.** (8 points) Briefly define and describe the neutrality vs. nonneutrality debate surrounding monetary policy today. Which type of shock does this debate concern?

**Problem 3: Optimal Tax Policy (25 points).** Consider our static (i.e., one period) consumption-leisure framework from Chapter 2. In this problem, you will use this framework as a basis for offering guidance regarding optimal (i.e., the "best") labor income tax policy.

Recall the basic consumption-leisure optimality condition

$$\frac{u_l(c,l)}{u_c(c,l)} = (1-t)w,$$

in which all of the notation is as in Chapter 2: t denotes the labor income tax rate, w denotes the real wage, c denotes consumption, l denotes leisure,  $u_c$  denotes the marginal utility of consumption, and  $u_l$  denotes the marginal utility of leisure.

Suppose that **firms are monopolistically competitive** (rather perfectly competitive). It can be shown in this case that when firms are making their profit-maximizing choice regarding labor hiring, the following condition is true:

$$mpn = w(1 - monpol)$$
.

Here, *mpn* denotes the marginal product of labor and *monpol* is a measure of the degree of monopoly power that firms wield. For example, if *monpol* = 0, then firms wield no monopoly power whatsoever, in which case we are back to our perfectly-competitive framework of firm profit maximization from Chapter 6. If instead *monpol* > 0, then firms do wield some monopoly power. (**Notes:** The variable *monpol* can never be less than zero. You also do not need to be concerned here with how the above expression is derived – just take it as given. **Further**, note that there are **no** financing constraint issues here whatsoever.)

Suppose the following:

- 1. The only goal policy makers have in choosing a labor tax rate *t* is to ensure that the **perfectly-competitive outcome in labor markets is attained.**
- 2. Any monopoly power that firms have cannot be **directly** eliminated by policy makers. That is, if *monpol* > 0, the government cannot do anything about that; all the government can do is choose a tax rate *t*.

Based on all of the above, derive a relationship between the optimal (i.e., in the sense that it attains the goal of policymakers described in point #1 above) labor income tax rate and the degree of firms' monopoly power. Very carefully explain all your logic and arguments, including any mathematical derivations involved. (Note: There are a number of logical steps to the argument, which are left to you to determine.) (OVER)

Problem 3 continued

**Problem 4: Financing Constraints and Labor Demand (25 points).** In our class discussion about the way in which financing constraints affect firms' profit maximization decisions, we focused on the effects on firms' physical capital investment. In reality, most firms spend twice as much on their wage costs (i.e., their labor costs) than on their physical investment costs. (That is, for most firms, roughly two-thirds of their total costs are wages and salaries, while roughly one-third of their total costs are devoted to improving or expanding their physical capital.)

For many firms, payment of wages must be made **before** the receipt of revenues within any given period. (For example, imagine a firm that has to pay its employees to build a computer; the revenues from the sale of this computer typically don't arrive for many weeks or months later because of delays in the shipping process, the retail process, etc.) For this reason, firms typically need to borrow to pay for their ongoing wage costs.<sup>1</sup> But, because of asymmetric information problems, lenders typically require that the firm put up some financial collateral to secure loans for this purpose.

Here, you will analyze the consequences of financing constraints on firms' wage payments using a variation of the accelerator framework we studied in class.

For simplicity, suppose that the representative firm, which operates in a two-period economy, must borrow in order to finance only period-2 wage costs; for some unspecified reason, suppose that period-1 wage costs are not subject to a financing constraint.

As in our study of the accelerator framework in class, the representative firm's two-period discounted profit function is

$$P_{1}f(k_{1},n_{1}) + P_{1}k_{1} + (S_{1} + D_{1})a_{0} - P_{1}w_{1}n_{1} - P_{1}k_{2} - S_{1}a_{1}$$
  
+ 
$$\frac{P_{2}f(k_{2},n_{2})}{1+i} + \frac{P_{2}k_{2}}{1+i} + \frac{(S_{2} + D_{2})a_{1}}{1+i} - \frac{P_{2}w_{2}n_{2}}{1+i} - \frac{P_{2}k_{3}}{1+i} - \frac{S_{2}a_{2}}{1+i}$$

and suppose now the financing constraint that is relevant for firm profit-maximization is

$$\frac{P_2 w_2 n_2}{1+i} = S_1 a_1 \,.$$

(The present-discounted-value appears on the left-hand-side because we are conducting the analysis, as always, from the perspective of the beginning of period 1.) The notation is as always: *P* denotes the nominal price of the output the firm produces and sells; *S* denotes the nominal price of stock; *D* denotes the nominal dividend paid by each unit of stock; *n* denotes the quantity of labor the firm hires; *w* is the **real** wage;  $a_0$ ,  $a_1$ , and  $a_2$  are, respectively, the firm's holdings of stock at the end of period 0, period 1, and period 2;  $k_1$ ,  $k_2$ , and  $k_3$  are, respectively, the firm's ownership of physical capital at the end of period 0, period 1, and period 2; *i* denotes the nominal interest rate between period 1 and period 2; and the production function is denoted by *f*(.). Also as usual, subscripts on variables denote the time period of reference for that variable. Finally, because this is a two-period framework, we know  $a_2 = 0$  and  $k_3 = 0$ . (**OVER**)

<sup>&</sup>lt;sup>1</sup> The commercial paper market, about which much has been discussed in the news media in the past year, is one type of channel for such firm financing needs.

## **Problem 4 continued**

The Lagrangian for the firm's profit maximization problem is thus

$$P_{1}f(k_{1},n_{1}) + P_{1}k_{1} + (S_{1} + D_{1})a_{0} - P_{1}w_{1}n_{1} - P_{1}k_{2} - S_{1}a_{1}$$

$$+ \frac{P_{2}f(k_{2},n_{2})}{1+i} + \frac{P_{2}k_{2}}{1+i} + \frac{(S_{2} + D_{2})a_{1}}{1+i} - \frac{P_{2}w_{2}n_{2}}{1+i} - \frac{P_{2}k_{3}}{1+i} - \frac{S_{2}a_{2}}{1+i}$$

$$+ \lambda \left[ S_{1}a_{1} - \frac{P_{2}w_{2}n_{2}}{1+i} \right]$$

in which  $\lambda$  denotes the Lagrange multiplier on the financing constraint.

a. (5 points) Based on the Lagrangian above, compute the first-order conditions with respect to  $k_2$  and  $a_1$ .

b. (5 points) Based on the Lagrangian above, compute the first-order conditions with respect to  $n_1$  and  $n_2$ .

## **Problem 4 continued**

Suppose that at the beginning of period 1, the real return on STOCK,  $r^{STOCK}$ , all of a sudden falls below *r*, the real return on riskless ("safe") assets. Suppose that before this shock occurred (i.e., in "period zero"), it was the case that  $r = r^{STOCK}$ .

c. (5 points) Below is a graph of the investment (capital) market in period 1. Does the adverse shock to  $r^{STOCK}$  shift either the investment demand and/or the savings supply function? If so, explain how, in what direction, and why.



**d.** (5 points) Below is a graph of the labor market in period 1. Does the adverse shock to  $r^{STOCK}$  shift either the labor demand and/or the labor supply function? If so, explain how, in what direction, and why.



## **Problem 4 continued**

e. (5 points) Below is a graph of the labor market in period 2. Does the adverse shock to  $r^{STOCK}$  shift either the labor demand and/or the labor supply function? If so, explain how, in what direction, and why.

