# Final Exam

*This is a closed-book exam: you may not use any books or notes. It is due at the CPR reception desk by 5:00 pm on Thursday, May 6. There is no official time limit but the best way to practice for the comp would be to do it in 3-4 hours at one sitting.*

## 1 Investment and Taxation, Theory (15 points)

A price-taking firm maximize the stock market value of its equity, which is given by the following:

$$V = \int \left( p(1-T)q - c(1-S)I^{\phi} \right) e^{-rt} dt$$

subject to the production function and accumulation constraint shown below:

$$q = k , \qquad \frac{dk}{dt} = I - \delta k$$

where $p$ is the purchaser's price of the firm's output, $T$ is the corporate tax rate, $k$ is the firm's capital stock, $c$ is the price of investment goods, $S$ is an investment tax credit, $I$ is the amount of investment, $r$ is the interest rate, and $\phi$ and $\delta$ are parameters. You may assume that $\phi > 1$. The optimum for this problem can be characterized by the following equations of motion:

$$\frac{d\lambda}{dt} = (r + \delta)\lambda - p(1-T)$$

$$\frac{dk}{dt} = \left( \frac{\lambda}{c(1-S)\phi} \right)^{1/(\phi-1)} - \delta k$$

where $\lambda$ is the multiplier associated with the accumulation constraint.

Construct a phase diagram for this model and use it to analyze two experiments: a surprise increase in $T$ taking place immediately, and an anticipated increase in $S$ two years in the future. Draw a separate phase diagram for each experiment and draw appropriate integral curves for $\lambda$, $I$ and $k$.

## 2 Investment and Taxation, Literature (30 points)

Discuss the strengths and weaknesses of the adjustment cost model as a vehicle for understanding the response of investment to changes in tax policy. *Note: you won't have time to cover everything so be sure to identify and discuss the most important issues.*

# 3 Optimal Taxation (20 points)

Consider the following "principles" often put forth by various liberal and conservative proponents to guide the taxation of different commodities:

1. "All commodities should be taxed at the same rate, in order to avoid extra distortions in the tax system."

2. "Tax rates should be inversely related to the elasticity of demand."

3. "Tax rates should be such that the compensated change in the consumption of each commodity should be the same."

4. "Luxuries should be taxed at higher rates than necessities, in order to redistribute income."

5. "Pareto efficient taxation entails taxation of goods at uniform rates."

Based on you knowledge of optimal commodity taxation, describe how these principles relate to each other. In particular, under what assumptions are each of these principles relevant, and which principle(s) can be viewed as special cases of the other(s)? Explain your reasoning. You score will depend on the quality of your answer.

# 4 Tax Incidence (35 points)

Consider an economy with two production sectors, energy (E) and materials (M). Each sector produces its output using inputs of only two factors: skilled and unskilled labor. The energy industry is relatively small and is skilled labor accounts for 70% of its costs; the materials industry is much larger and skilled labor accounts for about 60% of its costs. Households in the economy are aggregated into four categories with the characteristics shown in the following table:

| Household Number | Labor Endowment | Energy Budget Share |
|---|---|---|
| 1 | 1 unit skilled | 15% |
| 2 | 1 unit skilled | 5% |
| 3 | 1 unit unskilled | 15% |
| 4 | 1 unit unskilled | 5% |

Household 1, for example, has an endowment of 1 unit of skilled labor and spends 15% of its budget on energy. You may assume that each household's preferences between energy and materials can be represented by a Cobb-Douglas utility function, and that labor supply is completely inelastic. Also, you may assume that the wage for skilled labor is substantially higher than the wage for unskilled labor.

Government revenue is currently generated by a combination of two taxes: a fixed dollar (unit) tax on labor that does not distinguish between skilled and unskilled workers or between the industries in which they work (e.g., each unit of labor must pay $1000), and a fixed dollar (unit) tax on materials.

The government needs to raise additional revenue and wants you to evaluate the distributional and efficiency effects of the policies listed below. Each policy would be designed to raise the same amount of real government revenue.

| Policy | Description |
|--------|-------------|
| A | Raise the dollar value of the tax on labor. |
| B | Impose a surcharge on skilled labor. |
| C | Impose a surcharge on skilled labor used in industry E. |
| D | Impose a tax on output of E. |

Please discuss the distributional and efficiency implications of each policy. Your answer should be qualitative (that is, don't try to compute anything) but be sure to explain your reasoning as thoroughly as possible.