

# Exam 2. Econ420. Spring 2010

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## Instructions:

- Answer all questions.
- *Explain* your answers – do not just state them.
- *Show* your derivations – do not just state the final result.
- Do not refer to any notes or books. You may use a calculator.
- The total time is 75 minutes.
- The total number of points is 100.

# 1 Growth and Ideas

Consider the following modified Romer model:

- Production functions:

$$Y_t = A_t^\alpha L_{yt} \quad (1)$$

$$\Delta A_t = A_{t+1} - A_t = \bar{z} A_t L_{at} - d A_t \quad (2)$$

- Resource constraint:

$$\bar{N} = L_{yt} + L_{at} \quad (3)$$

- Allocation of labor:

$$L_{at} = \ell \bar{N} \quad (4)$$

$$L_{yt} = (1 - \ell) \bar{N} \quad (5)$$

There are two changes relative to the original Romer model: the exponent  $\alpha$  on labor in the production function for goods and the depreciation term  $d A_t$  in the production function for ideas (which is the same as the depreciation term in the Solow model). Assume that  $0 < \alpha < 1$  and  $0 < d < 1$ .

## Questions:

1. [8 points] Derive the growth rates of  $Y_t$  and of  $A_t$  as functions of exogenous parameters.
2. [14 points] Plot the time paths of  $\log(Y_t)$  and  $\log(A_t)$  for an economy that experiences a permanent increase in depreciation ( $d$  rises) at date  $t_0$ . Explain what you plot.
3. [8 points] Explain why the non-rivalry of ideas leads to increasing returns to scale. What does non-rivalry mean?

# 2 Walrasian Labor Market

Consider a Walrasian labor market with a downward sloping labor demand curve and an upward sloping labor supply curve.

1. [4 points] Plot the labor market diagram and mark equilibrium wages and employment.
2. [9 points] Now assume that the government subsidizes wages. If the worker earns  $w$  the firm pays  $w^F = w(1 - \tau)$ , where  $\tau$  is the subsidy rate. How does the subsidy change labor demand? Add the new labor demand curve to your plot, which should have  $w$  on the vertical axis (not  $w^F$ ).

3. [6 points] How does the wage subsidy change labor supply? Assume that the subsidy is available for only one year. Explain.
4. [8 points] How does the wage subsidy affect equilibrium wages (before and after tax) and employment?
5. [8 points] How would your answer change if the subsidy were permanent? Explain.

### 3 Inflation

1. [9 points] Explain why money is neutral in the long run, but not in the short run.
2. [8 points] According to the Quantity Theory, how would financial innovation affect inflation? Assume that financial innovation generates a rising velocity of money. To answer this question, you should state the Quantity Theory's main equation and derive the inflation rate from it. We did this in class under the assumption of a constant velocity.
3. [8 points] Some are concerned that deflation could limit the Fed's ability to keep the real interest rate low. Explain this concern.
4. [10 points] Assume you can invest money at a nominal interest rate of 10% per year. The price level of consumption today is 200. Next year it will be 210. If you give up one unit of consumption, how much can you consume next year? Show your steps.
  - (a) Show that your answer is consistent with the Fisher equation.

## 4 Answers

### 4.1 Growth and Ideas

1.  $g(Y) = \alpha g(A)$  and  $g(A) = \bar{z}\ell\bar{N} - d$ .
2. Straight lines with kinks at  $t_0$ . The  $\log(Y)$  line is flatter than  $\log(A)$  line. Explanation: higher  $d$  reduces  $g(A)$ . But no jump in  $A$  at  $t_0$ ; we are not changing the stock of ideas, just the growth rate.
3. We think constant returns to all rival factors - the replication argument. But non-rival ideas do not need to be replicated. Example: build 2 factories to double output. No need to double the number of blueprints. Nonrivalry means: an idea can be used at the same time by multiple users.

### 4.2 Walrasian Labor Market

1. See slides.
2. This is exactly the wage tax we did in class, except that tax rate is now negative. The subsidy raises labor demand. It is still the case that  $w^F = MPL$ . But now  $w = w^F/(1 - \tau)$ . So labor demand increases. Obvious intuition: if the government pays part of the worker's wage, the firm wants to hire more of the now cheaper labor. [Which is incidentally exactly what the Stimulus Package subsidy for hiring new workers does.]
3. The subsidy does not change labor supply (no income effects). Or one could say: small positive income effect, so labor supply goes down a little.
4. Worker's wages rise. Firm wages fall. Employment rises. See figure 1. Note that firm wages must fall. The relationship between firm wages and employment has not changed. Firms only higher more workers because they cost less.
5. Now labor supply is reduced. Worker's wages rise by more. Employment and firm wages are ambiguous. To see this, shift labor supply up in figure 1.

### 4.3 Inflation

1. In the long-run all prices are flexible (as are quantities). If I double money supply and all prices double, nothing "real" has changed. All markets still clear. In the short run, this does not work because prices and quantities need time to adjust.
2.  $MV = PY$  implies  $g(P) = g(M) - g(Y) + g(V)$ . Rising velocity has exactly the same effect as rising money supply. It does not matter whether we have more money in the economy or whether the same supply is used more often in transactions.

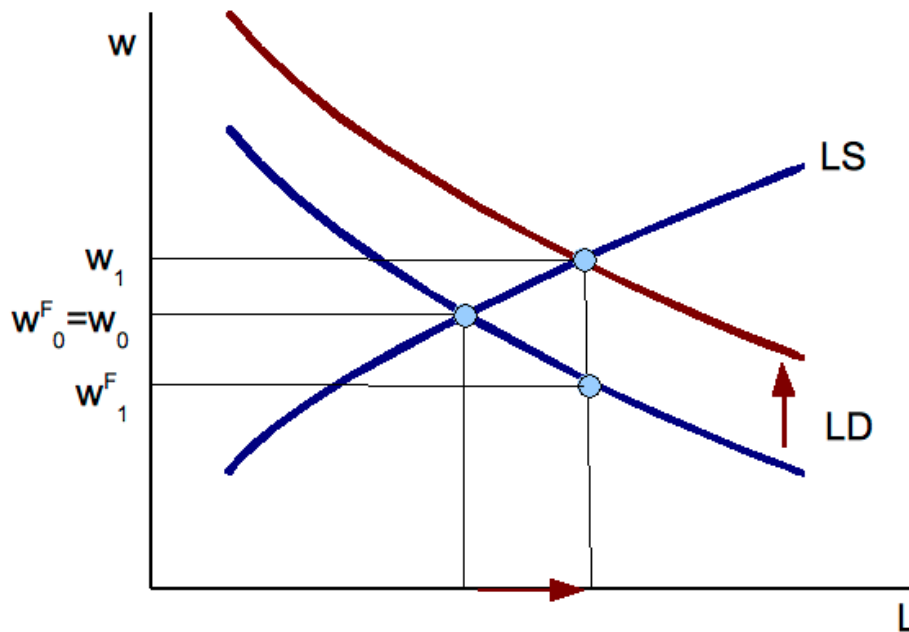


Figure 1: Wage subsidy

3. Fisher equation:  $r = i - \pi$ . With inflation, the Fed can lower  $i$  until the real interest rate is as close to zero as it wants (or even negative). With deflation:  $\pi < 0$ . There is no way for the Fed to drive  $i$  below 0. Therefore, the Fed cannot drive  $r$  below the rate of deflation.
4. Give up a unit of consumption today and save \$200. Invest \$200 for one year and earn \$220. Buy 1.05 units of consumption at price 210. The real interest rate is 5%. Which is what the Fisher equation says:  $r = i - \pi = 10\% - 5\%$ .

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