

Quiz 2 Solution Set
14.02 Macroeconomics
April 20, 2006

I. Answer each as True or False, and explain your choice.

1. The equilibrium real wage in the labor market is independent of the bargaining power of workers.

Ans:

True. The real wage is determined by the price setting relation and depends only on the markup.

Extra point: Uncertain. The price setting relation can be upward sloping due to decreasing returns to labor.

2. The credibility of the Central Bank determines whether money is neutral in the medium run.

Ans:

False. The neutrality of money always holds in the medium run. The credibility of the Central Bank determines the speed at which the economy adjusts to the new medium-run equilibrium in response to a monetary policy action.

3. In the medium run, positive nominal money growth always leads to inflation.

Ans:

False. Inflation in the medium run is equal to nominal money growth minus normal output growth (adjusted money growth). Thus, an economy has deflation in the medium run if output is growing faster than money.

Read Table I carefully, and answer questions 4 and 5 based on the evidence provided by the table.

Table I. Average Annual Rates of Growth of Output per Worker and Technological Progress in Four Rich Countries, 1950-2000

	<u>Rate of Growth of Output per Worker (%)</u>			<u>Rate of Technological Progress (%)</u>		
	1950-1973	1973-2000	Change	1950-1973	1973-2000	Change
	<1>	<2>	<3>	<4>	<5>	<6>
France	4.8	2.1	-2.7	5.3	1.6	-3.7
Japan	7.1	2.1	-5.0	7.0	1.4	-5.6
United Kingdom	3.4	1.7	-1.7	3.7	1.9	-1.8
United States	2.7	1.2	-1.5	2.9	1.4	-1.5

4. The slowdown in growth of output per worker starting in the mid-1970s is due to a sharp drop in the saving rate.

Ans:

False. Compare Columns 3 and 6 of Table I. In all four countries, the decrease in technological progress has been larger than or equal to the decrease in the growth rate of output per worker. If lower saving was to blame for the growth slowdown, the numbers would've been reversed.

5. Convergence of the growth rate of output per worker across countries during 1973-2000 has come from higher technological progress, rather than from faster capital accumulation, in the countries that started behind.

Ans:

True. Compare Columns 4 and 5 of Table I. During 1950-1973, the average annual rate of technological progress was substantially higher in France, Japan, and the United Kingdom than in the United States. During 1973-2000, the differences have narrowed a lot though have remained positive.

II. Short Questions:

1. The Labor Market

Assume wage setting is given by

$$\frac{W}{P^e} = B + f(u); f(0) = \infty, f(1) > 0 \text{ and } f'(u) < 0.$$

And price setting is given by

$$P = W(1 + \tau),$$

where W is the nominal wage, P the price level, P^e the expected price level, and u the unemployment rate. The new parameters are: B represents unemployment benefits, τ the payroll tax rate (for example, if $\tau = 0.2$, firms pay payroll taxes equal to 20% of the wage).

- a. Explain in words why unemployment benefits lead to an increase in the real wage in the wage setting equation.

Ans:

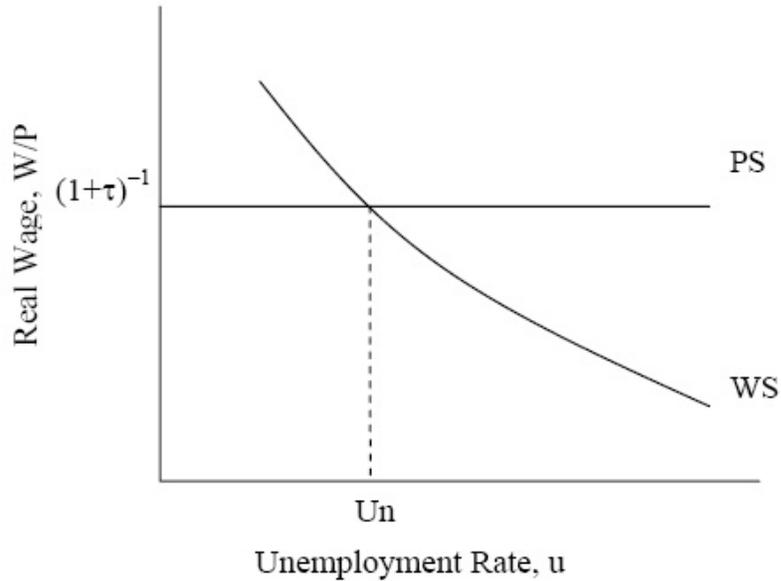
An increase in unemployment benefits raises the outside opportunity cost for workers and thus enhances their bargaining power in wage setting. As a result, better unemployment benefits leads to higher wages.

- b. Characterize the medium-run equilibrium unemployment (the natural rate of unemployment, u_n) graphically.

Ans:

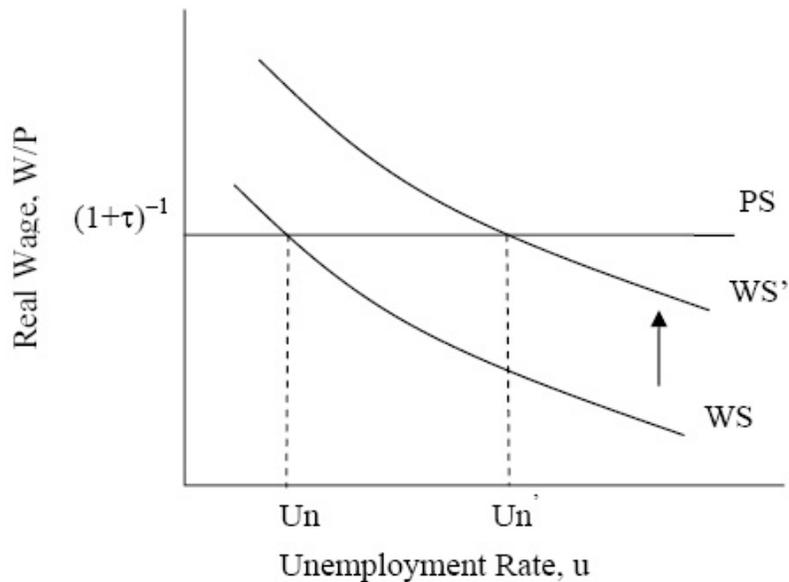
$P = P^e$ in the medium run, and this condition pins down the natural rate of unemployment. See Figure I.

Figure I



- c. Show graphically the effects of higher unemployment benefits on $\frac{W}{P}$ and u_n .
Ans:
An increase in B shifts up the wage setting curve, while the price setting curve stays the same. As a result, $\frac{W}{P}$ remains unchanged and u_n goes up. See Figure II.

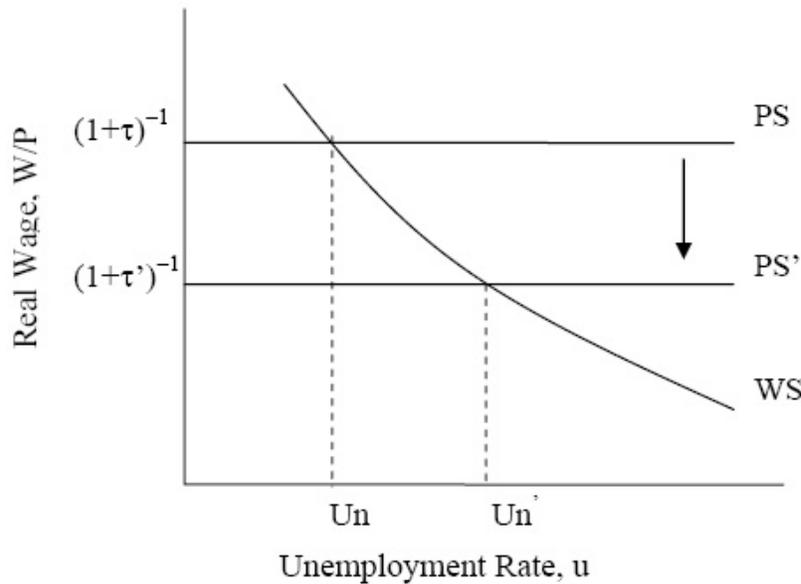
Figure II



- d. Show graphically the effects of higher payroll taxes on $\frac{W}{P}$ and u_n .
Ans:
An increase in τ shifts down the price setting curve, while the wage setting

curve stays the same. As a result, $\frac{W}{P}$ falls and u_n rises. See Figure III.

Figure III



- e. “Since higher unemployment benefits lead to higher unemployment, they should be eliminated.” Discuss.

Ans:

Loss of job is painful but inevitable. Unemployment benefits mitigate the pain, so a benevolent social planner who cares about the well-being of the unemployed would not eliminate the benefits.

- f. “Since payroll taxes lead to higher unemployment, they should be eliminated.” Discuss.

Ans:

Given spending, the government has to levy taxes one way or the other. Payroll taxes may increase unemployment, but income taxes may decrease saving. There is no magic tax.

2. Beyond the Short Run

Consider the IS-LM equations as follows:

$$Y = C(Y - T) + I(i, Y) + G$$

$$\frac{M}{P} = YL(i).$$

And assume that, in the medium run, Y returns to \bar{Y} .

- a. Consider an increase in G , financed by an equal increase in T . Show that, in the medium run, this fiscal expansion leads to a higher interest rate, and lower investment.

Ans:

Private consumption decreases by less than disposable income as the propensity to consume is typically less than one. Therefore, the increase in gov-

ernment spending exceeds the decrease in private consumption. Investment has to go down for output to return to its medium-run equilibrium, so such a fiscal expansion leads to a higher interest rate and lower investment. Note: $I(i, Y)$ is decreasing in i .

- b. Using what you learned from the Solow model, explain what lower investment implies for output in the long run.

Ans:

In the Solow model, investment just offsets depreciation in the steady state to maintain a constant level of capital stock,

$$I = \delta K \Leftrightarrow K = \frac{I}{\delta}.$$

Therefore, lower investment implies lower capital stock and lower output in the long run.

- c. “A fiscal expansion may increase output in the short run, but may decrease in the medium and the long run” Discuss.

Ans:

In the short-run, price does not adjust, so a fiscal expansion boosts output and money demand, and interest rate goes up. In the medium run, price increases, so does expected price, and output decreases, until Y returns to \bar{Y} (or price meets the expected level). However, nominal interest rate remains permanently higher, which leads to lower investment and lower output in the long run.

3. Technological Progress and Growth

Suppose that the economy’s production function is

$$Y = K^{\frac{1}{2}} (AN)^{\frac{1}{2}},$$

and that the saving rate is s and that the rate of depreciation is δ . Suppose further that the number of workers grows at g_N per year and that the rate of technological progress is g_A per year. s, δ, g_N and g_A are all positive constants.

- a. Find the steady-state values of:
- i. The capital stock per effective worker.
 - ii. Output per effective worker.
 - iii. Consumption per effective worker.
 - iv. The growth rate of output per effective worker.
 - v. The growth rate of output per worker.
 - vi. The growth rate of output.

Hint: Express the values in terms of the given parameters s, δ, g_N and g_A .

Ans:

In the steady state, the level of capital per effective worker remains constant, so

$$\begin{aligned} sY &= (\delta + g_A + g_N) K \\ sK^{\frac{1}{2}} (AN)^{\frac{1}{2}} &= (\delta + g_A + g_N) K \end{aligned}$$

⇒

$$\begin{aligned}\frac{K}{AN} &= \left[\frac{s}{(\delta + g_A + g_N)} \right]^2 \\ \frac{Y}{AN} &= \left(\frac{K}{AN} \right)^{\frac{1}{2}} = \frac{s}{(\delta + g_A + g_N)} \\ \frac{C}{AN} &= (1 - s) \frac{Y}{AN} = \frac{s(1 - s)}{(\delta + g_A + g_N)}\end{aligned}$$

$\frac{K}{AN}$ is constant, so is $\frac{Y}{AN}$, therefore,

$$\begin{aligned}g_{\frac{Y}{AN}} &= 0 \\ g_{\frac{Y}{N}} &= g_{\frac{Y}{AN}} + g_A = g_A \\ g_Y &= g_{\frac{Y}{N}} + g_N = g_A + g_N\end{aligned}$$

- b. Now suppose that the number of workers grows at $g'_N > g_N$. Based on your answers to part (a), explain whether people are better off in (a) or (b).

Ans:

People are better off in part (a). Given any set of initial values, the level of technology is the same in both (a) and (b), but the level of capital per effective worker is higher at every point of time in case (a). Thus, since $\frac{Y}{N} = A \frac{Y}{AN} = A \left(\frac{K}{AN} \right)^{\frac{1}{2}}$, output per worker is always higher in case (a).

- c. Now suppose that the number of workers grows at the same rate as in question (a), but now the saving rate s' is higher than in question (a). Based on your answers to part (a), provide the condition(s) under which people are better off in the steady state in case (c) than in case (a). Hint: write down the condition(s) in terms of s and s' .

Ans:

People are better off if consumption per capita is higher. In the steady state,

$$\frac{C}{N} = (1 - s) \frac{Y}{N} = (1 - s) A \left(\frac{K}{AN} \right)^{\frac{1}{2}} = (1 - s) A \frac{s}{(\delta + g_A + g_N)}$$

Since case (a) and (c) differ only in the saving rate, workers are better off in the steady state in case (c) if and only if

$$(1 - s') s' > (1 - s) s.$$