14.02 Principles of Macroeconomics
Fall 2005
Quiz 2 Solutions

Short Questions (30/100 points)

Please state whether the following two statements are TRUE or FALSE with a short explanation (3 or 4 lines). Each question counts 6/100 points.

1. The arbitrage law holds comparing *nominal* returns, but it does not have to hold comparing *real* returns.

    False. The arbitrage law prevents the possibility of earning free returns by exploiting price discrepancies. This is holds for both nominal and real returns.

2. The Phillips Curve, in all its forms, says that the rate of unemployment can only be different from the natural one if agents are surprised by inflation.

    True. The Phillips Curve is $\pi_t - \pi_t^e = -\alpha(u_t - u_n)$. Assuming that there are no nominal rigidities, $u_t \neq u_n$ if and only if $\pi_t^e \neq \pi_t$.

3. If a central bank were fully credible, it could always decrease inflation without any cost in terms of unemployment.

    False. If there are nominal rigidities, even a fully credible central bank has to pay a cost in terms of unemployment in a disinflation process.

4. In the medium run, a permanent increase in the nominal money growth of, say 10%, is reflected in a 10% increase in the inflation rate and a 10% increase in the real interest rate – leaving the nominal interest rate unchanged.

    False. In the medium run, an increase in nominal money supply will be reflected in an increase in the inflation rate and an increase in the NOMINAL interest rate – leaving the REAL interest rate unchanged (this is the Fisher Hypothesis). You can see that the statement has to be false from the following equation: $i = r_n + g_m$. When g_m goes up, i has to go up as well. Another reason to realize that the statement is false is that it violates the notion that money is neutral in the medium run.

5. The yield curve can never be downward sloping.

    False. The yield curve is downward sloping if financial markets expect short-term interest rates to be lower in the future.

Long Question I (40/100 points)
AS/AD

Assume that the following is true about the economy:

$$C = 82 + 0.1(Y - T)$$
$$I = 60 - 160i + 0.1Y$$
$$G = 20$$
$$T = 20$$
$$M^d = PY + 120 - 1000i$$
$$M^s = 200$$

Assume the following wage setting relation:

$W = P^e(z - 20u)$ where

$z = \dfrac{28}{10}$ is a parameter that represents the workers' bargaining power and u is the unemployment rate.

The following is the price setting relation:

$P = (1 + \mu)W$, where $\mu = 0.25$ is the markup.

The production function is $Y = N$.

The labor force is $L = 200$.

1) Derive the equation that characterizes the AS curve. (5 points)

The AS relation represents the equilibrium points in the labor market.

$$\begin{cases} P = (1 + \mu)W \\ W = P^e(z - 20u) \end{cases}$$
$$P = P^e(1 + \mu)(z - 20u)$$

Given that

$$u = \frac{U}{L} = \frac{L - N}{L} = 1 - \frac{Y}{200}$$
$$\mu = 0.25$$
$$z = \frac{28}{10}$$

we get

$$P = P^e(1 + 0.25)\left(\frac{28}{10} - 20\left(1 - \frac{Y}{200}\right)\right)$$
$$P = P^e\left(\frac{1}{8}Y - \frac{43}{2}\right).$$

2) Derive the equation that characterizes the AD curve. (5 points)

The AD relation represents the equilibrium points in the goods market and in the money market.

$$Y = C + I + G = 82 + 0.1(Y - 20) + 60 - 160i + 0.1Y + 20$$
$$Y = 160 + 0.2Y - 160i$$
$$Y = 200 - 200i \quad (IS \ relation)$$

$$M^d = PY + 120 - 1000i$$
$$M^s = 200$$
$$200 = PY + 120 - 1000i$$
$$80 = PY - 1000i$$
$$i = \frac{PY - 80}{1000} \quad (LM \ relation)$$

Combining the IS and LM relations gives

$$Y = 200 - \frac{PY}{5} + 16$$
$$P = \frac{1080}{Y} - 5$$

3) Compute the medium run equilibrium values for Y_n (the natural level of output), u_n (the natural rate of unemployment), P, and i. (5 points)

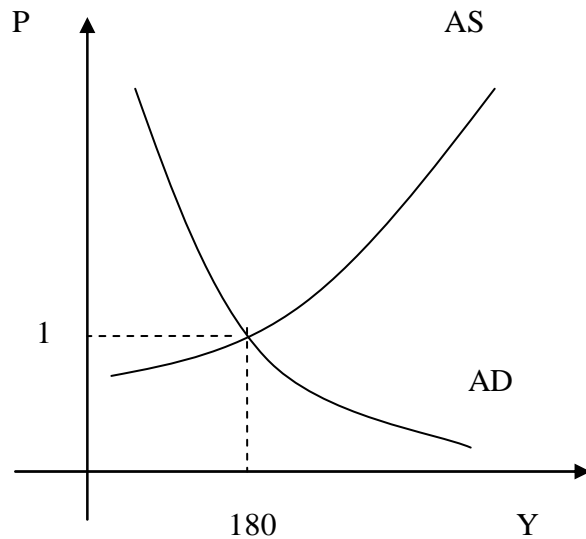*In the medium run equilibrium $P = P^e$ and $Y = Y_n = 180$.*

$$u_n = 1 - \frac{Y_n}{200} = 1 - \frac{180}{200} = 0.1 = 10\%$$
$$P = \frac{1080}{180} - 5$$
$$P = 1$$
$$i = \frac{PY - 80}{1000} = \frac{180 - 80}{1000} = \frac{100}{1000} = 10\%$$

4) On a graph in the $\{P,Y\}$ space draw the AS and AD curves and their intersection, showing the values of the equilibrium points on the two axes. (Note: you do not need t0o compute the intercepts of the AS and AD relations.)

Consider the effect of an increase in both G and T from 20 to 28.

5) Calculate the new medium run levels of Y_n, u_n, P, and i. (5 points)

The medium run equilibrium output Y_n and the medium run unemployment rate do not change: $Y_n = 180$, $u_n = 10\%$.

$Y = C + I + G = 82 + 0.1(Y - 28) + 60 - 160i + 0.1Y + 28$

$Y = 167.2 + 0.2Y - 160i$

$Y = 209 - 200i$ *(new IS relation)*

In equilibrium

$i = \dfrac{209 - 180}{200} = 0.145 = 14.5\%$

Combining the IS and LM relations gives

$Y = 209 - \dfrac{PY}{5} + 16$

$180 = 209 - \dfrac{180P}{5} + 16$

$36P = 45$

$P = 1.25$

6) Graph the dynamics that bring the economy to the new equilibrium. Label all curves (AS_{MR1}, AS_{SR}, AS_{MR2} and AD_{MR1}, AD_{SR}, AD_{MR2}), where *MR1* and *MR2* stand for the initial and new medium run equilibrium, respectively and *SR* stands for the short run. Label the initial and the new equilibrium with the associated values on the axes. (5 points)

P

AS''

AS'

AS

1.25

AD'

1

AD

180   Y
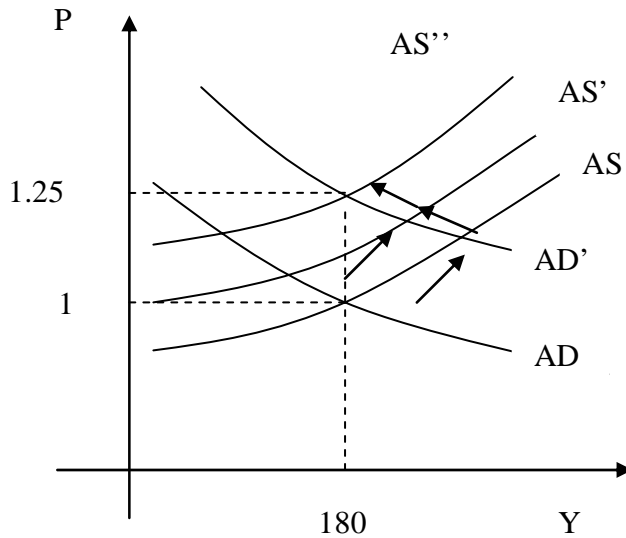
7) How does the composition of GDP change compared to part 3)? (5 points)

In the composition of GDP, $\Delta C = -0.8$, $\Delta I = -7.2$, *and* $\Delta G = 8$.

8) Would you get the same results as in part 7) following a change in monetary, rather than fiscal policy? Explain your answer. (5 points)

No. Monetary policy is neutral in the medium run. It cannot change I, C and i.
In the medium run, real money stock is the same as before the policy due to the increase in P. This implies that the medium-run nominal interest rate is equal to the original one. Thus, investment is the same as before. Consumption, which depends on the natural level of output, is also the same as before. Hence, monetary policy has no compositional effect.

5

Long Question II (30/100 points)
Inflation, Activity, and Nominal Money Growth

Assume that the economy is described by the following equations:

$$u_t - u_{t-1} = -0.5(g_{yt} - \overline{g}_y)$$ (Okun's Law)

$$\pi_t - \pi_t^e = -(u_t - u_n)$$ (Phillips curve)

$$g_{yt} = g_{mt} - \pi_t$$ (Aggregate Demand relation)

Also, assume: $\overline{g}_y = 0.05$ and $u_n = 0.05$.

1) Assume that at t=0 the economy is in the medium run equilibrium. What are u_0 and π_0 if we have the nominal growth rate of money $\overline{g}_m = 0.14$? (5 points)

$$\pi_0 = \overline{g}_m - \overline{g}_y = 0.14 - 0.05 = 0.09 .$$

$$u_0 = u_n = 0.05$$

2) Consider the case where $\pi_t^e = \pi_{t-1}$. Assume that the Central Bank is able to decrease inflation in t=1 by 2 percentage points (that is $\pi_1 = \pi_0 - 2\%$) and then keeps it fixed at that level ($\pi_2 = \pi_3 = ... = \pi_0 - 2\%$). How should the Central Bank change g_m in order to do that? Calculate the values of g_m for all the periods until the new medium run equilibrium is reached. (10 points)

In t=1 the Phillips Curve $\pi_t - \pi_{t-1} = -0.5(u_t - u_n)$ becomes $0.07 - 0.09 = -(u_1 - 0.05)$ and so

$$u_1 = 0.07 ,$$

From Okun's Law we get $0.07 - 0.05 = -0.5(g_{y1} - 0.05)$, which implies

$$g_{y1} = 0.01 .$$

From the Aggregate Demand relation we can now derive g_{m1}.

$$0.01 = g_{m1} - 0.07 . \text{ So } g_{m1} = 0.08 .$$

In t=2 the Central Bank needs to make sure that inflation stays at 7%, but it needs to still change money supply growth to bring the economy back to equilibrium. Plugging $\pi_1 = 0.07$ and $\pi_2 = 0.07$ into the Phillips Curve gives

$0.07 - 0.07 = -0.5(u_2 - 0.05)$ *which implies* $u_2 = 0.05$.

From Okun's Law $0.05 - 0.07 = -0.5(g_{y2} - 0.05)$ *we get* $g_{y2} = 0.09$.

Now we can use the aggregate demand relation to solve for money supply growth at time t=2: $0.09 = g_{m2} - 0.07$ *gives* $g_{m2} = 0.16$.

In t=3 the new medium run equilibrium is reached.

From Phillips Curve $u_3 = 0.05$

From Okun's Law $g_{y3} = 0.05$.

From Aggregate Demand $g_{m3} = 0.12$.

To summarize we have $g_{m1} = 0.08$, $g_{m2} = 0.16$, *and* $g_{m3} = 0.12$.

HINT!!! You can solve parts 3) and 4) using reasoning and intuition even if you didn't solve parts 1) and 2) of this question.

3) Assume that at t=0 there is a stock traded in the stock market that promises to pay a constant real dividend D for the next three periods (t=1, t=2, and t=3), such that its real price is $Q_0 = \dfrac{D}{1+r_1} + \dfrac{D}{(1+r_1)(1+r_2)} + \dfrac{D}{(1+r_1)(1+r_2)(1+r_3)}$ where r is the real interest rate.

At t=0 the stock market learns that the Central Bank is going to behave at t=1 as described in part 2).

Assume that the stock market is able to perfectly forecast the future real interest rate and that in each period the real interest rate decreases by the same percentage points by which the real money growth rate increases, and vice versa. The dynamics of the real money growth are as you derived in part 2).

Compare the value of the stock Q_0 in the old equilibrium and after the change in monetary policy. How does the expectation of the change in monetary policy at t=1 affect the share price at t=0? Does the price increase, decrease or stay the same? Explain why. (10 points)

In order to understand the price change in t=0 we have to compare Q_0 to the "Q_0" that was expected before the monetary policy was announced and the economy was supposed to stay at its equilibrium with high inflation: $Q_0^e = \dfrac{D}{1+r} + \dfrac{D}{(1+r)^2} + \cdot\dfrac{D}{(1+r)^3}$.

Call the natural real interest rate r. r is not affected by the monetary policy and it is reached again at t=3.

$r_1 = r + 4\%$

$r_2 = r_1 - 8\% = r - 4\%$

$r_3 = r_2 + 4\% = r$

Given this information, we can conclude that at t=0 the real stock price decreases since the effect of r_1 going up dominates the effect of r_2 going down.

4) Suppose that in part 2) wage-setters set $\pi_t^e = \pi_t$. How does this change your answer to part 3)? Explain. (5 points)

In this case the low inflation target level can be achieved immediately by decreasing the nominal money supply by 2 percentage points. The real money supply does not change and the real interest rate does not deviate from its natural value r. Thus, the real stock price does not change.