PROBLEM SET 4
14.02 Principles of Macroeconomics
March 30, 2005
Due April 6, 2005

I. Answer each as True, False, or Uncertain, providing some explanation for your choice.

1. If the expectations formed by workers about the future responded to economic policy, then the cost of a disinflation policy could possibly be lower.

2. Sacrifice ratios are smaller in countries that have shorter wage contracts.

3. A permanent increase in money growth rate leads to a higher real interest rate in the medium run.

4. When the yield curve for bonds is downward sloping, it implies that the financial markets expect the short-term real interest rate to decrease in the future.

5. In theory, if the stock market fully anticipated a monetary expansion next period, stock prices will not change next period when the money growth rate actually increases.

6. Stock prices increase in response to an unexpected increase in consumer spending, since output will increase in the short run.

II. Output, Unemployment and Inflation

Consider an economy summed up by the 3 equations described in Chapter 9-2.

$$
\begin{aligned}
u_t - u_{t-1} &= -\beta(g_{yt} - \overline{g_y}) \\
\pi_t - \pi_{t-1} &= -\alpha(u_t - u_n) \\
g_{yt} &= g_{mt} - \pi_t
\end{aligned}
$$

Assume the following parameter values : $\alpha = \beta = 1$, $u_n = 5\%$, $\overline{g_y} = 0\%$

At time $t = 0$, $g_{mt} = 4\%$, $\pi_{t-1} = 4\%$, $u_{t-1} = u_n$

At time $t = 1$, the Central Bank lowers the growth of rate of money to $g_{mt} = 2\%$ (this policy shock was unanticipated by workers and firms at $t = 0$)

(a) Calculate the initial and final medium run equilibrium values, i.e., (π_0, u_0, g_{y0}) and (π_T, u_T, g_{yT}) (where T denotes the time period when the final medium run equilibrium is reached). Comparing the two, provide some reasons for why the differences, if any, arise.

(b) Now focus on the dynamics :

(i) Calculate (π_1, u_1, g_{y1}). Does the Phillips curve shift at time $t = 1$? Why or why not?

(ii) Calculate (π_2, u_2, g_{y2})

(iii) Denote the Phillips curve at time t (also called the short run Phillips curve) by PC_t. In a (u, π) space, draw PC_0, PC_1, PC_2, and PC_T

(c) Based on the given conditions, use a software of your choice (eg. $Excel^{\text{®}}$) to plot π_t against u_t for $t = -1, 0, 1, 2, \ldots 35$.

Instructions:

1. In a spreadsheet, label row 1 as follows:

t	$u_t - u_{t-1}$	$\pi_t - \pi_{t-1}$	u_t	π_t	g_{mt}	$\overline{g_y}$	u_n	g_{yt}

2. Fill up row 2 with the given values for $t = -1$. Leave the cells for $u_{-1} - u_{-2}$ and $\pi_{-1} - \pi_{-2}$ empty since we do not know anything about $t = -2$.

3. Fill up the cells for π_t, g_{mt}, $\overline{g_y}$ and u_n in row 3 with the given values.

4. The only trick for this simulation is for the columns corresponding to $u_t - u_{t-1}$, $\pi_t - \pi_{t-1}$, u_t and g_{yt}. In cell $D3$ (corresponding to u_0), type "= 0.5*(D2-(F3-E2-H3-G3))". Why?

5. Type the relevant formulas in cell $B3$, $C3$ and $I3$, similar to the way you did in step 4.

6. Up to this point, your spreadsheet should look like this

t	$u_t - u_{t-1}$	$\pi_t - \pi_{t-1}$	u_t	π_t	g_{mt}	$\overline{g_y}$	u_n	g_{yt}
-1			5	4	4	0	5	0
0	0	0	5	4	4	0	5	0

7. "Copy" row 3 from $B3$ to $I3$, then "paste" them to row 4, row 5, all the way to row 38 (for $t = 35$). Also label the time column.

8. Replace $F4$, $F5$, all the way to $F38$ by 2 to reflect the new monetary policy.

9. Highlight Column D and E, starting from row 2. Click the "Insert" tab at the top of the spreadsheet, then click "Chart", and finally click "XY (Scatter)."

10. Print your chart. You can also plot u_t and π_t against t. Try it and see what you get.

(d) Describe the evolution of the inflation rate and the employment rate (ie. the shape of the curve connecting (π_t, u_t)). Why is it like this?

III. Asset Pricing

(i) Consider a 1-year bond that promises to pay $\$X$ next year. The price of this bond this year is given by $\$P_{1t}$. Express $\$P_{1t}$ in terms of $\$X$ and i_{1t}. (the 1-year interest rate from t to $t+1$).

(ii) Suppose that at the beginning of year t, people expect the interest rate from year $t+1$ to the year $t+2$ to be the same as the current 1-year interest rate. Express the price of the 2-year bond ($\$P_{2t}$), which promises $\$Y$ in year $t+2$, in terms of $\$Y$ and i_{1t}.

(iii) Suppose that at the beginning of year t, people expect that the price of the 1-year bond (with the same promise) in year $t+1$ will be $\$P^e_{1\,t+1}$. What is $\$P^e_{1\,t+1}$? Suppose that the agent has $\$Z$ to invest, show that the agent is indifferent between investing all $\$Z$ in either of the two bonds, independent of $\$X$ and $\$Y$.

(iv) Suppose that at the beginning of year t, people expect the interest rate from year $t+1$ to year $t+2$ to be θi_{1t}, where $\theta > 1$. Is the price of the 2-year bonds in year t, $\$P_{2t}$, higher now? Why? Show your steps.

(v) Consider now a share, which is expected to pay a constant dividend $\$D^e_t = \$D$ every year as long as the investor holds it. Assume that dividends are paid at the end of each year. Also, the expected 1-year interest rate is a constant, $i^e_{1t} = i$, for all t. Express the ex-dividend price $\$Q_t$ in terms of i and $\$D$?

Suppose that the expected dividend payment in year t is proportional to the expected aggregate output in that year.

$$\$D^e_t = \alpha Y^e_t$$

And the ex-dividend price of the share is given by:

$$\$Q_t = \frac{\alpha \$Y^e_{t+1}}{1+i_{1t}} + \frac{\alpha \$Y^e_{t+2}}{\left(1+i_{1t}\right)\left(1+i^e_{1t+1}\right)} + \frac{\alpha \$Y^e_{t+3}}{\left(1+i_{1t}\right)\left(1+i^e_{1t+1}\right)\left(1+i^e_{1t+2}\right)} + \ldots$$

Consider the case that at the end of year $t = \tau$, the government announces to cut spending permanently, starting from $t = \tau + 1$.

(vi) What happens to the price level P, the interest rate i and the aggregate output Y in the medium run? Draw the relevant AS-AD *and* IS-LM diagrams to show your results. Denote the short-run price level, interest rate and output as P_{SR}, i_{SR} and Y_{SR} respectively; and medium-run price level, interest rate, output as P_{MR}, i_{MR} and Y_n respectively.

(vii) Assume that the economy is still under short-run adjustment in year $\tau + 1$ ($Y_{\tau+1} = Y_{SR}$), but back to the medium run equilibrium at the beginning

of year $\tau + 2$. Everyone expects this to happen! Write down the ex-dividend price $\$Q_\tau$ after the announcement in terms of P_{SR}, P_{MR}, Y_{SR}, Y_{MR}, i_{SR} and i_{MR} (as defined in (vi)) and α. Is $\$Q_\tau$ higher or lower than $\$Q_{\tau-1}$? (For simplicity, ignore all within-year changes.)