

Homework 3: Solutions
Monetary Theory and Policy: ECO 403

Question 1.

- a. The FED responds in a fixed way to changes in the economy (the FED cannot change the response to increasing the money supply growth rate to 2% or 3% in response to a one percent increase in unemployment for example), so we have a rule. An increase in unemployment results in a policy to increase the money supply, which lowers interest rates, which increases investment spending demand, which increases total demand and output, which in turn reduces unemployment. Thus the policy counters the original increase in unemployment with a decrease in unemployment. Thus the rule is counter-cyclical.
- b. The FED has discretion to change the policy. Thus the policy is discretionary. A recession is a period of low output and high unemployment. The policy to reduce interest rates is thus counter-cyclical.
- c. The Taylor rule is a rule. Since interest rates fall when unemployment rises, the rule is counter-cyclical.
- d. We have a vote which is discretionary. Interest rates fall, which cause GDP growth to rise, which is in the same direction as the decrease in GDP growth. Thus the policy is pro-cyclical.
- e. The FED responds in a fixed way, so we have a rule. If for example, inflationary expectations rise, then some firms raise prices too much, see a decrease in demand which they misperceive as relative, and fire workers, causing unemployment. The FED does not respond by decreasing or increasing inflation, so the rule is neither counter nor pro cyclical.

Question 2.

No. If the FED controls the nominal exchange rate, it must buy/sell foreign currency with printed money. Therefore, H will fluctuate, and therefore so will interest rates. For example, to increase E the FED must buy dollars in the foreign exchange market. The resulting decrease in H will cause interest rates to rise. Therefore the FED cannot independently increase E and decrease R , for example.

Question 3.

- a. The FED charter states that the FED should focus both on low inflation and low unemployment.

- b. The ECB charter states the ECB should only focus on price stability (low inflation) and not full employment. This would appear to resolve the time inconsistency problem since the short and long run goals are now the same: low inflation. However, the facts indicate the ECB still focuses somewhat on low unemployment, since inflation is often above 2%. In practice, a charter cannot fully resolve the time inconsistency problem. Regardless of what the charter says, the ECB will see unemployment and be tempted to ignore the charter and raise inflation. Charters can also be revoked or changed by the legislatures.

Question 4.

- a. The ECB buys sovereign debt with printed money. Therefore, inflation in Europe increases.
- b. No. The program results in inflation, which is inconsistent with the rule which says to focus on low inflation.
- c. The long run goal of low inflation conflicts with the short run goal (helping Greece, bailing out the banks that own Greek debt, preventing default, etc.) since the short run goal implies high inflation.
- d. No. The ECB ignored the charter and focused on the short term goal, which implies higher inflation. Some have in fact called the ECB moves illegal, but the ECB disagreed, using a different interpretation of the charter.

Question 5.

Suppose instead of a high powered money target or an interest rate target, the FED adopts a target for the money multiplier (k^*).

- a. Is k measurable? Explain carefully what data is required and whether or not the FED has this data.
 - b. Is k controllable? That is, explain how the FED increase or decrease k ?
 - c. Suppose money demand is volatile. Which has a more predictable effect on m , a high powered money target or an k^* target? Show graphically.
 - d. Suppose money supply is volatile. Which has a more predictable effect on m , a high powered money target or an k^* target? Show graphically.
- a. As noted in class, reserves are on deposit at the FED and are thus measurable. In addition, banks must report their reserve positions to the FED so that the FED knows

the bank is above the minimum required reserves, so rd is measurable. Therefore, the money multiplier,

$$k = \frac{cr + 1}{cr + r\bar{d}}, \quad (1)$$

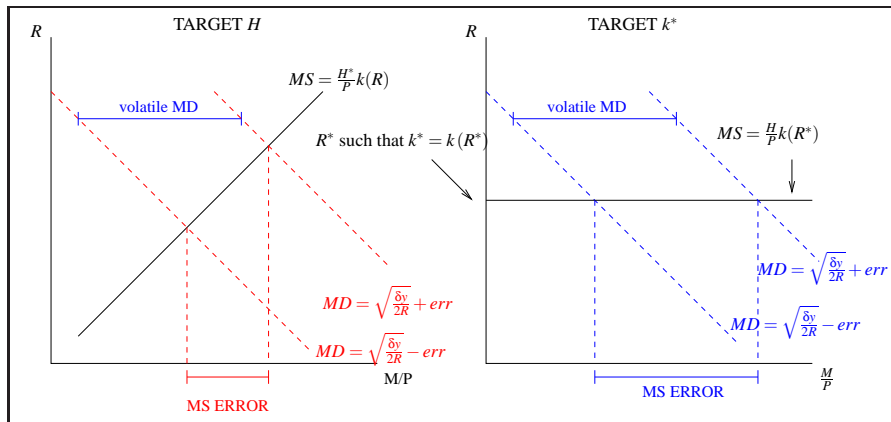
is measurable if the currency to deposit ratio $cr = C/D$ is measurable. Banks report checking deposits D to the FED. For C , we have $H = C + D$. Since the FED knows H and D , the FED can infer C and therefore k .

- b. The FED, by increasing H , lowers R , which induces banks to hold more excess reserves. In turn, a smaller fraction of dollars cycling through the banking system means less checking deposits are created per dollar of high powered money. So the money multiplier falls. Similarly, increasing R increases k . Indeed, since:

$$k(R) = \frac{cr + 1}{cr + rrr + e(R - R_0)}, \quad (2)$$

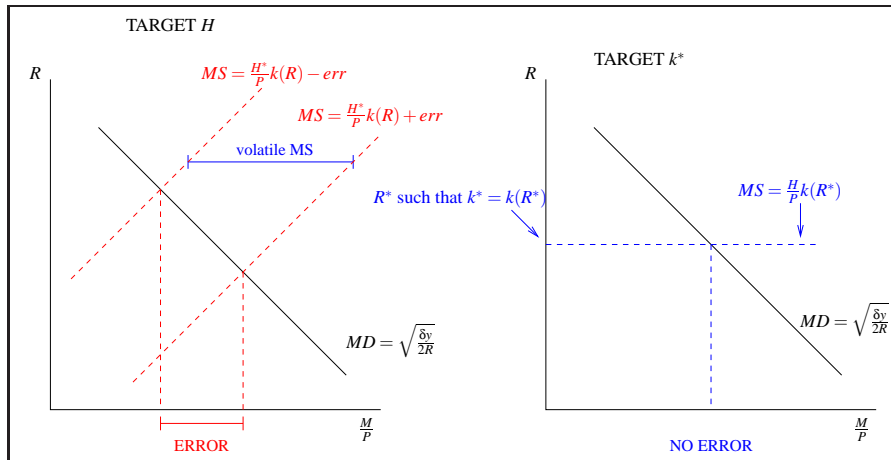
to get $k(R) = k^*$, the FED can simply compute the R^* that solves $k^* = k(R^*)$. That is: Changing k^* by changing rrr or R_0 is possible, but more difficult. Keep in mind that any change in rrr or R_0 also affects the interest rate. For example, if rrr falls, the interest rate falls as well because banks have more reserves to loan out. So k is changing both because rrr changes and because R changes.

- c. A target variable must be kept constant. To keep k constant requires R to be kept constant. So the graphs are identical to the case where R is targeted in class. For volatile money demand, we have:



Here H is a better target and has a more predicatable effect on m .

d. Here we have:



So k is a better target. When money supply drifts upward, banks have more reserves and so the interest rate for reserve loans, the FED Funds rate, falls. To counter the increase in reserves, the FED reduces H , reducing reserves and increasing the interest rate. Thus, m goes up because of the increase in m , but then falls due to the decrease in H . So m stays constant, reducing volatility.

Question 6.

- a. • For the rule, we focus on the long run goal where $\pi^e = \pi$ and thus $U = NR = 4$. The objective is:

$$\min \left\{ \frac{2}{3} + \frac{1}{3}4^2 + \frac{2}{3}\pi_t^2 \right\} \quad (3)$$

The minimum is where the slope or derivative is equal to zero:

$$2 \cdot \frac{1}{3} \pi_t = 0 \rightarrow \pi_t = 0 \quad (4)$$

So the rule is to keep inflation at zero. The FED can do nothing about unemployment, so it might as well focus on keeping inflation as low as possible.

- For the optimal discretionary policy, we focus on the current period where potentially $\pi^e \neq \pi$. Thus the FED can affect unemployment. The objective is:

$$\min \left\{ \frac{2}{3} + \frac{1}{3} \left(4 - \frac{3}{2} (\pi_t - \pi_t^e) \right)^2 + \frac{2}{3} \pi_t^2 \right\} \quad (5)$$

By substituting in the equation for u , we explicitly account for how our decision about π affects u . To take the derivative, we use the chain rule:

$$\frac{d}{d\pi} f(u(\pi)) = f'(u(\pi)) \cdot u'(\pi) \quad (6)$$

So we have:

$$2 \cdot \frac{1}{3} \left(4 - \frac{3}{2} (\pi_t - \pi_t^e) \right) \cdot \left(-\frac{3}{2} \right) + 2 \cdot \frac{2}{3} \pi_t = 0 \quad (7)$$

$$-4 - \frac{3}{2} (\pi_t^e - \pi_t) + \frac{4}{3} \pi_t = 0 \quad (8)$$

$$\frac{17}{6} \pi_t = 4 + \frac{3}{2} \pi_t^e \rightarrow \pi_t = \frac{24}{17} + \frac{9}{17} \pi_t^e \quad (9)$$

This is the optimal discretionary policy.

- b.
- In the long run $\pi^e = \pi$ and so for the rule $\pi = 0$ and $U = NR = 4$.
 - In the long run $\pi^e = \pi$ and so for the discretion $u = NR = 4$ and thus using (9):

$$\pi_t = \frac{24}{17} + \frac{9}{17} \pi_t \quad (10)$$

$$\frac{8}{17} \pi_t = \frac{24}{17} \rightarrow \pi = 3 \quad (11)$$

In the long run inflation is above zero with the discretion as the FED lives with some inflation in order to keep unemployment down in the short run.

- c.
- For the rule, in the long run we have $\pi = 0$ and $u = 4$. Plugging these into the objective gives:

$$obj = \frac{2}{3} + \frac{1}{3} 4^2 + \frac{2}{3} 0^2 = \frac{2}{3} + \frac{16}{3} = 6 \quad (12)$$

The FED can do nothing about unemployment in the long run, and so must live with some unemployment, but at least gets inflation down.

- For the discretion, we have in the long run $\pi = 3$ and $u = 4$. So:

$$obj = \frac{2}{3} + \frac{1}{3}4^2 + \frac{2}{3}3^2 = 6 + 6 = 12 \quad (13)$$

By focusing on short run goals and ignoring that expectations rise in response to increases in inflation, the FED lets inflation rise to 3% but is in the long run still unable to affect u . Thus the rule does a better job since $6 < 12$. The policies are a wash in terms of unemployment, but the rule has lower inflation.

- d. Unemployment rises if π^e rises. But then according to the optimal discretion π rises, which lowers unemployment since there is then less misperceptions. Thus the optimal discretion is counter-cyclical.
- e. The rule of $\pi = 0$ is the same regardless of whether unemployment is high or low, so the rule is neither pro nor counter-cyclical.
- f. • For the rule, we have $\pi = 0$. If $\pi^e = 3$ then according to the unemployment equation we have:

$$u = 4 - \frac{3}{2}(0 - 3) = 8.5 \quad (14)$$

The misperceptions cause some firms to raise prices too little. They see a decrease in demand which they misinterpret as relative, reducing output and firing workers. The value of the objective is:

$$obj = \frac{2}{3} + \frac{1}{3}8.5^2 + \frac{1}{3}0^2 = 24.75 \quad (15)$$

- For the discretion, we have $\pi^e = 3$ and using (9):

$$\pi = \frac{24}{17} + \frac{9}{17} \cdot 3 = 3 \quad (16)$$

Unemployment is thus:

$$u = 4 - \frac{3}{2}(3 - 3) = 4 \quad (17)$$

The value of the objective is:

$$obj = \frac{2}{3} + \frac{1}{3}(4)^2 + \frac{2}{3}(3)^2 = 6 + 6 = 12. \quad (18)$$

So the discretion does a better job in the short run since $12 < 24.75$. Short and long run goals are in conflict here.

- g. Yes, the short run goal of $\pi = 3$ is inconsistent with the long run goal of $\pi = 0$.
- h. Surprisingly, the answer is still yes. The short run goal is:

$$\pi = \frac{24}{17} + \frac{9}{17} \cdot 0 = \frac{24}{17}. \quad (19)$$

So the short run goal of $\pi = \frac{24}{17}$ is inconsistent with the long run goal of $\pi = 0$. The difference between the policies is smaller though, so the time inconsistency is less of a problem in this case.