The charter of the FED states that the FED should endeavor to keep inflation low (price stability) and promote growth (low unemployment). Suppose at the end of the day the FED decides that inflation should be 4%. How, on a day to day basis does the FED go about implementing this policy? How often should the FED revise it's decision of 4%? In addition, in the last section we saw that the two goals of low inflation and low unemployment are in conflict with each other. So here we will go into more detail about the exact objectives of the FED.

I   Rules vs. Discretion

This section follows to some degree the 2004 Nobel Prize work of Kydland and Prescott. The first question is: how often should the FED change it's policy? We consider two cases:

Definition 40 *MONETARY POLICY RULE. The FED policy (money supply, interest rates, inflation) is set for an extended period of time.*

Definition 41 *DISCRETIONARY MONETARY POLICY. The FED policy is set each period.*

Examples of rules:

- Increase the money supply by 2% per year.

- Change money supply to keep the exchange rate fixed at one peso per dollar.

Examples of discretion:

- Vote each year for the change in the money supply.

- Vote each year to decide what exchange rate to target.

US uses discretionary, most other countries use rules. What are the advantages and disadvantages?

A Rules and "activist" or counter cyclical policies are not the same

Consider the policy: increase the money supply by 1% for every 1% unemployment above the natural rate. The policy is a rule because the policy is set once for many periods (even though the money supply changes from period to period, the *rule* for how the money supply is set is fixed). The policy is counter cyclical because the FED seeks to reduce unemployment (by increasing the money supply and inflation, causing firms to misperceive the increase in demand as a relative increase, and thus increase employment) when unemployment is high due to a recession.

On the other hand, consider a policy to increase the money supply at 1% per year. The policy is also a rule, but the money supply change is the same regardless of the business cycle (booms and recessions). Therefore, the policy is not counter cyclical.

B Rules are difficult to define

1 "Discretionary" policies that look like rules

The US monetary policy seems very discretionary. The FED has policy meetings and votes. FED watchers on Wall Street look at the size of Bernanke's briefcase. If the briefcase is thick, they believe that Bernanke will have to use a lot of data to convince the Federal Reserve Govenors to change policy.

But analysts have found the FED governors usually vote a certain way. John Taylor has shown that the following rule is very similar to the outcomes of the FED votes over time:

$$R_t = 2\% + \pi_t + \frac{1}{2}\left(\pi_t - 2\%\right) - \frac{1}{2}\left(u_t - NR\right) \tag{80}$$

Here NR is in the range of 5-6 percent. Thus although the FED policy is technically discretionary, it looks very much like a rule in practice. An exception was the period of 2002-2006, where the FED Funds rate was well below the rate implied by the Taylor Rule. Taylor and others have argued that such unusually low interest rates sparked the housing bubble.
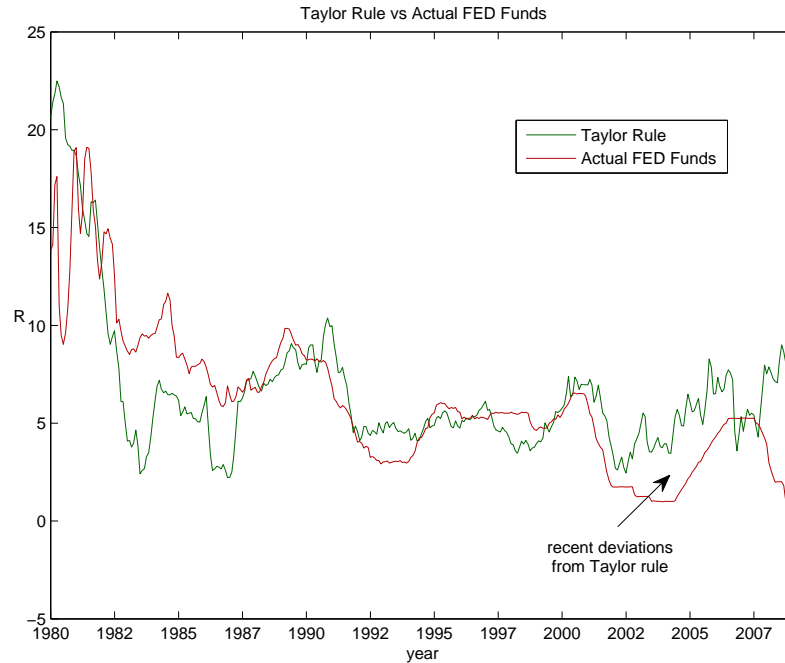
Figure 33: The Taylor Rule

2 Rules can look very discretionary

Similarly, all rules can be broken at any time. Your professor may have a rule to exercise three times per week. Nonetheless, the rule may be broken often enough so that an analysis of your professor's exercise habits may look very discretionary. Similarly, a central bank may have a rule to keep inflation low, but may have a history of violating that rule, when say unemployment is high or when the government needs seniorage revenue.

We defined a RULE as a monetary policy set once for many periods. DISCRETIONARY policies are set every period. We are implicitly assuming the central bank has access to a COMMITTMENT TECHNOLOGY: a way of tying ones hands to avoid breaking a rule. At the end we will discuss how difficult it is for the FED to stick to a rule. Of course, the FED will set the rule or discretion to acheive goals of low unemployment and/or low inflation.

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C   Which is best?
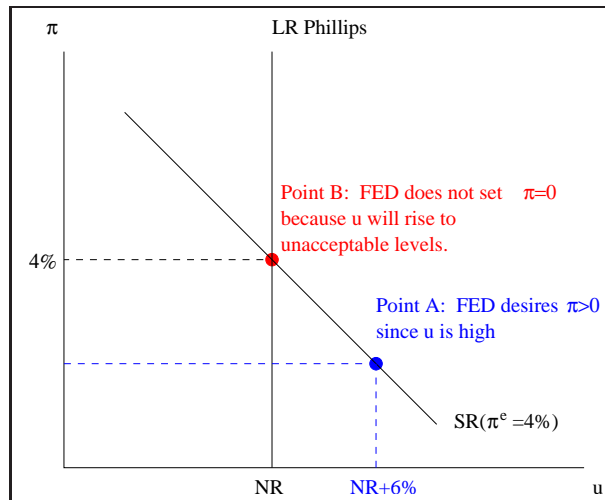
1   Optimal Rule: Graphical Analysis

In this section, we will assume that the FED is able to choose an inflation rate by selecting a money supply growth rate or a Federal Funds interest rate. In the next section, we will look more closely at how precisely the FED can achieve a target inflation rate.

In this section we will also use the Lucas Monetary Misperceptions model. Recall that $\pi_t^e = \pi_t$ in the long run and hence $u = NR$. But then the long run policy is obvious. Since $u = NR$, monetary policy can only affect inflation. Therefore, minimize inflation by setting $\pi = 0$. This is the monetary policy "rule," which is set once for the long run. Graphically, we can choose any point on the Long run Phillips curve. We therefore choose the point where inflation is zero and unemployment is equal to the natural rate.
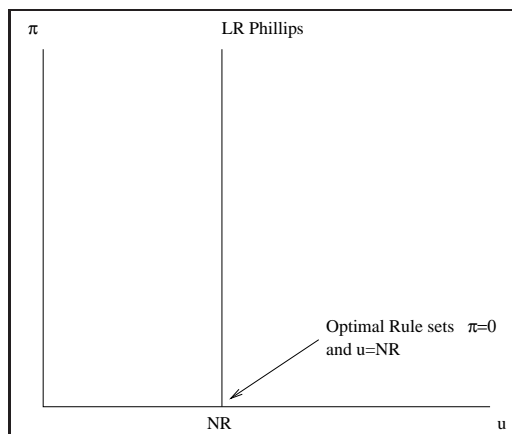
In practice, the rule is usually to set inflation equal to 1-2% as the CPI typically overstates inflation.

In the short run, the discretionary policy might be different. In the graph below, at point "A" we might increase inflation if in the short run we value low unemployment more than low inflation. Or consider point "B," where a recession might be too painful to endure in the short run. The FED stays at "B" rather than attempt to get inflation down to zero.

Figure: π vs u diagram. Labels: π (vertical axis), LR Phillips, 4%, Point B: FED does not set π=0 because u will rise to unacceptable levels., Point A: FED desires π>0 since u is high, SR(π^e =4%), NR, NR+6%, u

But in the long run, the discretionary policy features $u = NR$ and inflation above zero. This is worse than the rule of $u = NR$ and inflation equal to zero. SR goal in fact neglects the effect on expectations when we increase the money supply. We don't care that expectations increase, since that only affects inflation and u tommorrow. But in fact we should consider that increasing the money supply now has worse consequences down the road since inflationary expectations rise. In contrast, the rule takes a long run view and sets inflationary expectations equal to zero.

Figure: π vs u diagram. Labels: π (vertical axis), LR Phillips, u<NR, π>4%, Under optimal discretion, on average u equals the natural rate and π>0, 4%, u>NR , π<4%, SR(π^e =4%), NR, Optimal Rule sets π=0 and u=NR, SR(π^e =0%), u

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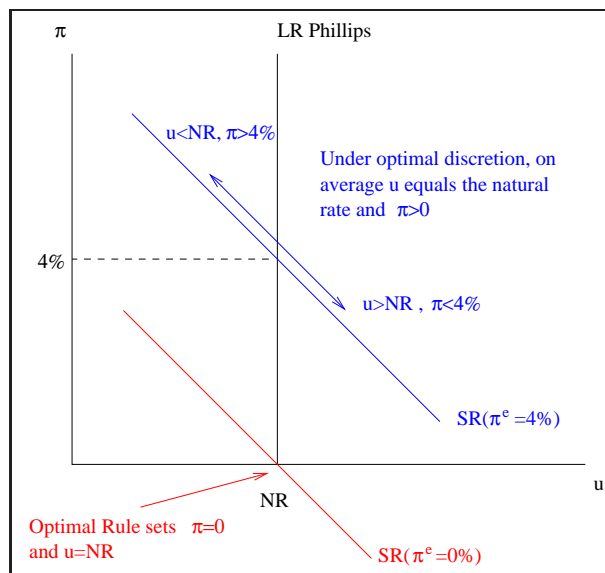
2 Algebriac Method

Here we will again show that rules are better than discretion, but in an algebriac way that makes clear what the objectives of the FED are.

The charter of the FED states that the FED should endeavor to maintain price stability (low inflation) and sustainable growth (low unemployment or increasing GDP growth). As we have seen, these goals are somewhat contradictory, the FED cannot always have both low unemployment and low inflation. So each FED chair must weight these two goals. Ben Bernanke might heavily weight low unemployment while Paul Volker might heavily weight low inflation.

The FEDs OBJECTIVE FUNCTION mathematically states how much the FED weights the goals of low inflation and low unemployment. Suppose for example we have the objective function:

$$\text{obj} = \min_{\pi_t} \left\{ Au_t + \frac{B}{2}\pi_t^2 \right\} \tag{81}$$

Here we see that unemployment has weight A while inflation has weight $\frac{B}{2}$. We can also interpret the objective function as saying that a one percent decrease in unemployment improves the economy in the FED's view of the world by A, while a decrease in inflation from one percent to zero improves the economy in the FED's view of the world by $\frac{B}{2}$. In addition, if inflation is high the FED heavily weights bringing down inflation: decreasing inflation from 11% to 10% improves the FED's objective by $\frac{B}{2}11^2 - \frac{B}{2}10^2 = \frac{21B}{2}$.

Next we derive the optimal rule according to the FED's objective. Recall the rule is set once for the long run so $\pi^e = \pi$ and hence $u = NR$. Thus:

$$\text{obj} = \min_{\pi_t} \left\{ A \cdot NR + \frac{B}{2}\pi^2 \right\} \tag{82}$$

So the way to make the objective as small as possible is to set $\pi = 0$, since the FED can affect inflation but not unemployment in the long run. Mathematically, to minimize we find the value of π where the derivative or slope is equal to zero:

$$\frac{d\ \text{obj}}{d\pi_t} = 0 + 2 \cdot \frac{B}{2}\pi = 0 \tag{83}$$

$$B\pi = 0 \ \rightarrow \ \pi = 0 \tag{84}$$

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Next we find out how good a job the optimal rule does in implementing the FEDs objective:

$$\text{obj} = A \cdot NR + \frac{B}{2} 0^2 = A \cdot NR \tag{85}$$

The rule does a decent job. The rule is unable to do much about unemployment, but reduces inflation to zero. Thus the value of the objective under the rule is $A \cdot NR$.

The optimal discretion is set each period and thus we do not necessarily have $\pi^e = \pi$. Recall that unemployment is:

$$u = NR + k \cdot a \left(\pi_t^e - \pi_t \right) \tag{86}$$

Plugging in the value of u into the FED's objective results in:

$$\text{obj} = \min_{\pi_t} \left\{ A \cdot \left(NR + k \cdot a \left(\pi_t^e - \pi_t \right) \right) + \frac{B}{2} \pi^2 \right\} \tag{87}$$

$$\text{obj} = \min_{\pi_t} \left\{ A \cdot NR + A \cdot k \cdot a\pi_t^e - Aka \cdot \pi_t + \frac{B}{2} \pi^2 \right\} \tag{88}$$

The optimal discretion is not obvious. So we need to find the slope or derivative and set it equal to zero:

$$0 + 0 - Aka + 2 \cdot \frac{B}{2} \pi = 0 \tag{89}$$

$$-Aka + B\pi = 0 \rightarrow \pi = \frac{Aka}{B} \tag{90}$$

So the optimal discretionary policy in fact has an inflation rate that is constant but above zero. The FED makes a tradeoff each period between inflation and unemployment and is willing to live with a little inflation to keep u down.

We next see how well the optimal discretion does in implementing the FED's goals. In the long run $\pi^e = \pi$ so $u = NR$. Thus:

$$\text{obj} = A \cdot NR + \frac{B}{2} \left(\frac{Aka}{B} \right)^2 > A \cdot NR \tag{91}$$

So the optimal discretion does not do very well. The optimal discretion has both some unemployment and some inflation, and thus the value of the objective is higher than the value of the objective with the optimal rule. Thus the rule does a better job acheiving the

FED's objective.

In summary, the rule provides lower average inflation and the same long run unemployment as discretion. One can also show the optimal rule has more variable unemployment and less variable inflation than the optimal discretion. Clearly, households do not like unemployment to vary, as their income will vary as well, but Lucas has found that the extra variance in unemployment is quite small for the US economy. Finally, rules are more transparent, which means that firms make less monetary misperceptions so there is less misallocation of resources.

So why do some countries, like the US, not use a fixed rule? One problem that was noted by Kydland and Prescott was:

Definition 42 *TIME INCONSISTENCY: Long run goals are inconsistent with short run goals, and are therefore difficult to stick to.*

Consider the problem of how many times per week to exercise. The optimal rule might be 3 times per week. If I could commit to this rule, then I would find that in the long run I get the benefit of being in shape. Consider now the optimal discretion. Each day, I face a decision. If I exercise, I incur short run costs of taking time to exercise. The benefit I get from exercising *today* is minimal: I will still be in about the same shape as I was yesterday. So I decide not to exercise, but instead say I will go tommorrow. But then tommorrow the same decision is made. Thus the time inconsistency problem makes it difficult to stick to the optimal rule.

One solution is to change the design of the institution. Many central banks, such as the ECB, have no stated goal to reduce unemployment. Instead, their only goal is price stability. So we see the ECB respond less to the financial crises than the US did. Nonetheless, charters can also be rewritten in times of crises, so the solution is only partial.

3 The Lucas Critique

Whether using rules or discretion, the FED typically uses a computer with thousands of equations that model household and firm behavior to decide what the optimal policy is. In a famous paper, Lucas argued that there is a subtle problem with this procedure. Once the FED implements the optimal rule or discretion, households and firms will change their behavior, changing for example their money demand in reponse to the new policy. But then the thousands of behavior equations change, meaning that the derived optimal rule or discretion is no longer optimal. Thus we have

Definition 43 *LUCAS CRITIQUE: Implementing an optimal policy cause behavioral changes which make the policy no longer optimal.*

EXAMPLE: Consider our optimal discretionary policy of $\pi = \frac{Aka}{B}$. Here a is a parameter which reflects firm behavior. Specifically, a is the number of firms which fail to observe changes in the inflation rate. Now suppose we implement the optimal policy given $a = 10$, $A = 5$, and $B = 10$, which is $\pi = \frac{10 \cdot 5}{10} = 5\%$. Now the inflation rate is constant at 5%. Since the inflation rate is low and constant, firms have little incentive to pay attention to the inflation rate. They know just to increase prices 5% each year. Thus a will likely rise, perhaps to $a = 20$, but then the optimal discretionary policy changes to $\pi = \frac{20 \cdot 5}{10} = 10\%$, and so on.

II   FED Targeting I: R vs H

The FED charter states that the FED should endeavor to keep inflation and unemployment low. Suppose Bernanke weights these two objectives and comes up with an optimal policy, say $\pi = 4\%$. How exactly does the FED go about acheiving this goal on a day to day basis? After all, the FED cannot force firms to raise prices by 4%. Further, the inflation rate is reported only monthly. Thus the FED only gets one observation per month as to how close the FED is to the target inflation rate.

The answer is the FED chooses a short run or intermediate target. The FED might know for example through the money market, that by increasing the supply of high powered money H by 2.8% that the money supply will rise by about 3.5%. The FED might then use the classical model with monetary misperceptions to find that the resulting fall in R and increase in investment demand might cause prices to rise by 4%. So the FED instead adopts a day-to-day target of increasing the supply of high powered money by 2.8%.

$$\Delta H = 2.8\% \ \rightarrow_{model} \ \Delta M = 3.5\% \ \rightarrow_{model} \ \pi = 4\% \tag{92}$$

Definition 44 *The TARGET or OPERATING INSTRUMENT is the short term or intermediate variable that the FED tries to control on a day-to-day basis.*

What variable should the FED target? Historically, the FED has targeted the price of gold (pre WWII), the nominal exchange rate (Bretton Woods system post WWII), bank reserves (1979-82), and currently the FED Funds Rate. Three criteria exist.

1. MEASURABLE. The target should be measurable at least daily.

2. CONTROLLABLE. The FED should be able to increase or decrease the target.

3. PREDICATBLE. Changing the target should have a predictable effect on the FED's long term goals regarding π and u.

We will start with a basic problem of choosing between targeting R, the FED Funds Rate, and H, the high powered money stock. We will see that these differ primarily according to predictability. Later we will look at the nominal exchange rate, which is under some circumstances more predictable, but can be difficult to control.

A Measurability and Control of R and H

The FED's control of the money supply is not precise. Remember, the FED can only control H. Actual money supply depends on currency to deposit ratio and excess reserves held by the bank, and money demand. The FED can influence R, but independent control of H and R is impossible: the FED cannot both increase high powered money and raise interest rates. For example:
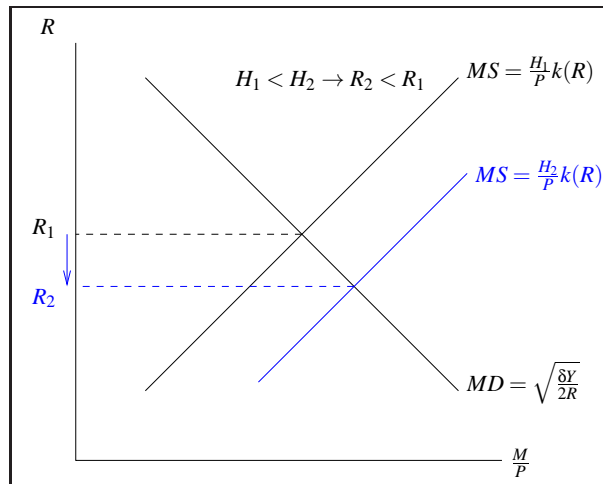
Let us compare our two possible targets. Both R and H are measurable on a moment to moment basis. The current FED Funds Rate is published daily in the Wall Street Journal, and one can check the quotes by the minute in bond markets. Similarly, the FED can count how much high powered money it prints.

Both R and H are controllable. Here's how:

1. Bernanke takes a suitcase full of printed money and another suitcase full of tbills down to Wall Street and goes to the trading pit, buys tbills whenever $R > R^*$ and sells

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tbills if $R < R^*$. Suppose $R > R^*$ and the FED buys tbills with printed money. The printed money quickly (everything is computerized), ends up in a bondholder's checking account, where it can be loaned out on the FED Funds Market. The additional supply of loans pushes the interest rate down. If the FED has added the correct amount of money, the interest rate should arrive at $R = R^*$. If not, the FED may need to make a small correction. The New York FED is amazingly accurate in determining how much printed money is needed to change the Fed Funds rate. Even in turbulant times the NY FED can typically adjust the interest rate to within 1/8 of a percent.

2. Bernanke buys or sells tbills until $H = H^*$.

So the two instruments differ only in their predictability. Recall that to predict the effect on inflation, we need to know how the target affects the money supply and then how the money supply affects inflation. We will focus on how the target affects the money supply on the theory that the more precisely we can control the money supply, the more precisely we can control inflation.

1   Uncertain Money Demand

If money demand is uncertain or volatile, targeting H works best (most precise control of the money supply):
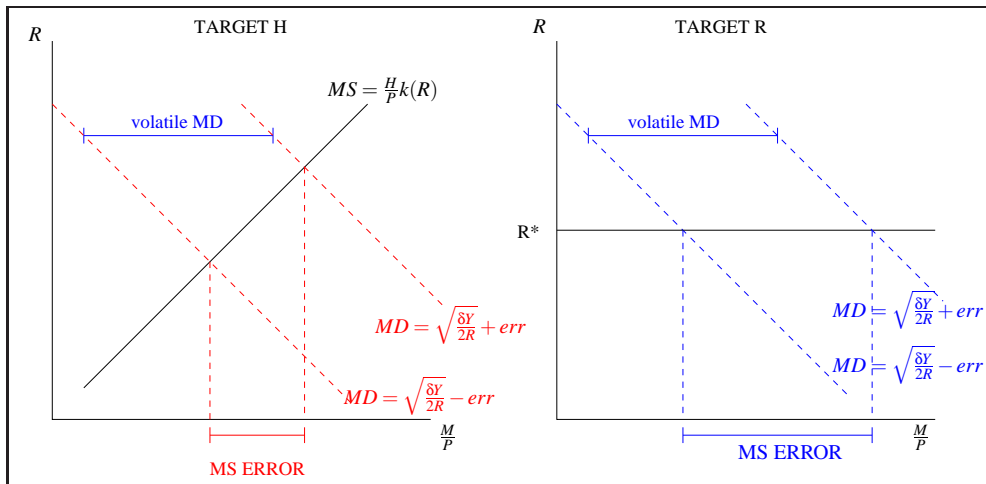

This was the case in 1979-82. High inflation made money demand quite volatile: High inflation led to high inflationary expectations and low money demand. Inflationary expectations are quite volatile since they amount to people's thoughts which can vary from moment to moment. Thus typically when inflation is high targeting H works best.

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Note how by trying to control R, the FED amplifies the effect of a money demand shock on money supply. If households suddenly demand more currency, the interest rate begins to rise, but also so does money supply as banks loan out excess reserves for households to hold in cash. To counter the increase in interest rates, the FED injects high powered money, adding to the amount already loaned out from excess reserves.

2 Uncertain Money Supply

Here targeting R works best (most precise control of money supply).
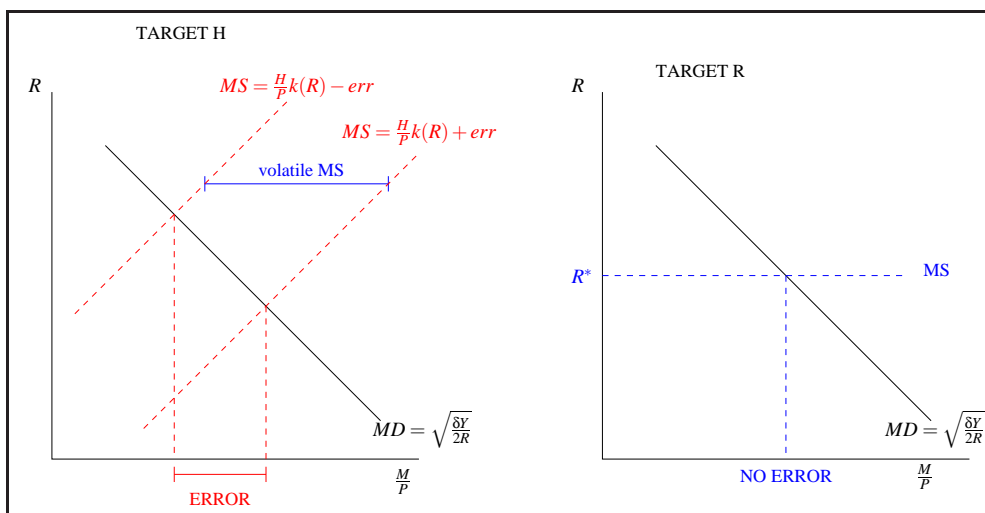
If only money supply is volatile, we can precisely control the money supply by targeting the FED Funds Rate. Suppose for example that banks excess reserves are volatile. If banks for some reason unknown to the FED begin to loan out more excess reserves, then if the target is H, the money supply rises. However, if the target is R, then as the banks loan out excess reserves, the interest rate begins to fall. To keep R at the target rate, the FED begins to sell tbills (decrease H) until $R = R^*$ again. In fact, to keep $R = R^*$ the FED will buy with tbills all of the excess reserves loaned out by banks.

B Other Considerations

It is sometimes politically difficult for the FED to justify high interest rate targets. When R needs to be high to decrease inflation, it is sometimes more convienent to target H. In actuality, FED can control M to plus or minus 1% by targeting the FED Funds Rate under moderate inflation.

III Target E

The nominal exchange rate (E) is the most common target. Exchange rate targeting is used throughout Latin America and Asia. Also known as

Definition 45 *FIXED EXCHANGE RATES: the central bank buys and sells in the foreign exchange market to keep the nominal exchange rate fixed.*

A How

Let us suppose that the nominal exchange rate equals the units of foreign currency required to buy one dollar. Thus E is the value of the dollar, $E = \frac{\text{units of foreign currency}}{\$1}$.

The FED and all major central banks keep reserves of foreign currency in their vaults (F). Suppose Ben Bernanke gets a suitcase full of Euro's and dollars, flies to Chicago or London, and walks into the trading pit. If $E > E^*$, Ben sells printed dollars until $E = E^*$.
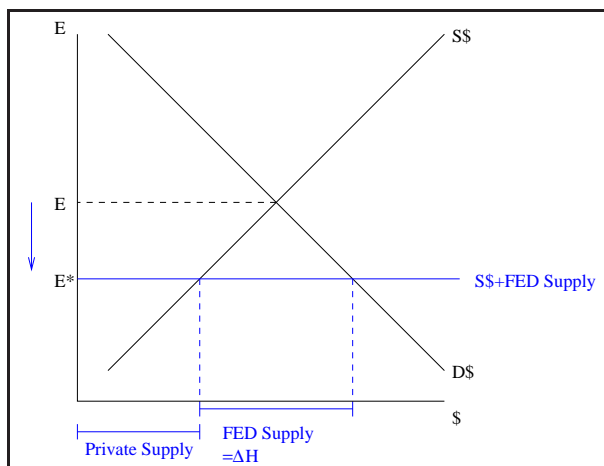
The result is foreign currency reserves increase and the US money supply increases. According to the graph, the high powered money H increases by the horizontal distance between the private supply of dollars and the FED supply of dollars needed to get $E = E^*$. Call this amount ΔH. Thus the money supply increases by $\Delta H k(R)$. Further, the FED has purchased E foreign reserves (Euros) with each printed dollar, so the FED's supply of foreign reserves increases according to:

$$F_t = F_{t-1} + E^* \Delta H \tag{93}$$

If $E < E^*$, Ben sells Euro reserves and buys dollars:

E

S$

E*   D$+FED Demand

E

D$

$

FED Demand

Private Demand =ΔH
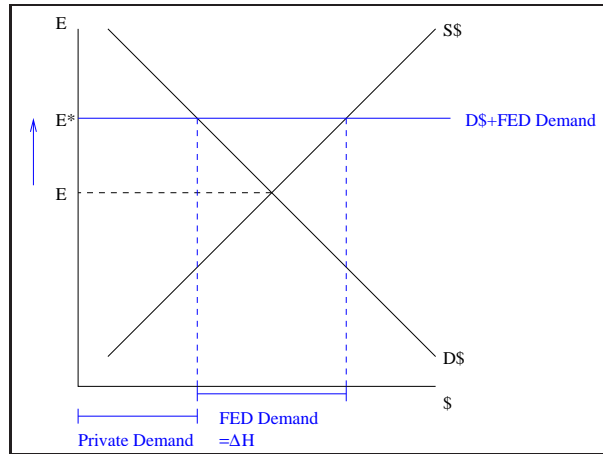
The result is foreign currency reserves decrease and the US money supply decreases. The equations are the same, but now ΔH is negative. The high powered money falls by ΔH, the money supply falls by $\Delta H k(R)$, and foreign reserves fall according to:

$$F_t = F_{t-1} + E^* \Delta H \tag{94}$$

Note that by targeting E, we give up control of M and R: We cannot simultaneously increase E and increase M or decrease R.

B Evaluation as a target

1 Measurability

Let us evaluation E as a target. The foreign exchange rate is measurable. Quotes can be obtained on a moment to moment basis from the London or Chicago currency exchange markets.

2 Predictability

The nominal exchnage rate can have a predictable effect on inflation. I claim that when a nominal exchange rate is targeted, the domestic inflation rate will equal the foreign inflation rate. To see this, recall that the real exchange rate, or the number of foreign goods required to buy one US good is given by:

$$e = \frac{\text{foreign goods}}{\text{US good}} = \frac{P \cdot E}{P^f} \tag{95}$$

Here P^f is the foreign price level. The above equation can be derived as follows. Start with one basket of US goods, which has value equal to P, the US price level. Take the P dollars to the foreign exchange market, where each dollar is worth E Euros. Thus we can obtain $P \cdot E$ Euros for each US good. Now we buy European goods with our Euros. We can buy:

$$P \cdot E \text{ Euros } \cdot \frac{1 \text{European good}}{P^f \text{ Euros}} = \frac{P \cdot E}{P^f} = e \text{ European goods} \tag{96}$$

Thus with one US good we can by $\frac{P \cdot E}{P^f}$ European goods. Now note that the real exchange rate is determined by demand and supply for US and foreign goods. Things like demand for Japanese cars and US computers are not directly related to monetary policy. Thus if $E = E^*$ and $e = \bar{e}$, then it must be the case that P and P^f move together, or that the percentage change in P equals the percentage change in P^f or the US inflation rate equals the foreign inflation rate.

An example is the recent run up in world wide food prices in countries that target the dollar. The US printed money, causing US prices to increase, especially food and energy. Increased demand for for foreign currencies like the Chinese Yuan would normally cause the Yuan to appreciate. To prevent this, China (and other similar countries), printed their domestic currencies to increase local inflation. The nominal exchange rate therefore does not need to adjust to keep the real exchange rate constant.

Now let us suppose that a country has had a history of high and unstable inflation, like Argentina. By targeting a nominal exchange rate to a country with low and stable inflation rate, like the US, then the Argentinian inflation rate will be very predictable. In fact, the Argentinian inflation rate will equal the US inflation rate. Further, because the inflation rate is low and predictable, Argentinian inflationary expectations should also become low and predictable, adding to the stability of the inflation rate.

C Control Problems: Speculative Attacks

1 Credibility

In effect, the Central Bank of Argentina is establishing some credibility by borrowing the credibility of the US. Demanders of money are perhaps not confident the Central Bank of Argentina will stop printing lots of Pesos, but know the US will not print lots of dollars.

Of course, the central bank of Argentina could abandon the target of E^* and begin printing Pesos at any time. So a target exchange rate is not always viewed as credible by those who demand money. And if the target is not credible, inflationary expectations may

rise, causing money demand to fall, and therefore inflation to rise. The Central Bank of Argentina can do several things to increase credibility, which we will discuss below.

2   Control Problems: Speculative Attacks

The nominal exchange rate is sometimes not controllable. This is the main problem with choosing E as a target. The nominal exchange rate is difficult to control for two reasons. First, is that E balances supply and demand in the real sector. As soon as the FED stops intervening in the foreign exchange market, supply and demand cause E to return to E^*. So at a minimum, daily intervention is required to keep E at the target.

The second reason why E is difficult to control is the speculative attack.

Definition 46 *SPECULATIVE ATTACK. Bets by investors that the value of a currency will fall.*

Here's how a speculative attack works. Recall that in each period foreign reserves evolve according to:

$$F_t = F_{t-1} + E^* \Delta H \tag{97}$$

Now if $\Delta H > 0$, no problem exists, the FED can print money as long as the FED has ink and foreign reserves will continue to rise. But suppose that ΔH is negative, that is $E^* > E$. Eventually, F_t will fall to zero. When that happens, the FED will be out of foreign reserves, and therefore will be unable to prevent the value of the dollar from falling from E^* back to E.

Definition 47 *A DEVALUATION is a sudden fall in the exchange rate or a drop in the target exchange rate.*

Now suppose a wily investor observes the FED is low on reserves. A profit making opportunity exists as follows. Take one dollar and buy E^* Euros. Wait for the dollar to drop in value from E^* back to E. Then sell the Euros and buy dollars. The investor can buy

$$E^* \text{ Euros } \cdot \frac{\$1}{E \text{ Euros}} = \$\frac{E^*}{E} \tag{98}$$

dollars with his/her Euros. Profits are then:

$$\text{Profits } = \$\frac{E^*}{E} - \$1 > 0 \tag{99}$$

Since $E^* > E$, the investor makes positive profit from this investment.

But now suppose our wily investor is not unique and everyone adopts this trading strategey. Then in fact everyone is selling dollars and no one is buying dollars, except the FED. The FED can then run out of reserves in a matter of hours or days. Then the speculative attack works and the currency falls in value all at once in spectacular fashion.

Notice also that the FED has lost money in the speculative attack. The investors' profits correspond to identical losses for the FED.

So the nominal exchange rate is a measurable target which has predictable effects on inflation, but can be difficult to control due to speculative attacks. There are two ways for the Central Bank to try to prevent speculative attacks. The first is to maintain very high reserves, preferably through a currency board.

Definition 48 *A CURRENCY BOARD is a version of fixed exchange rates where the Central Bank maintains a fixed percentage of foreign currency in reserve and stands ready to exchange currency at the target exchange rate.*

Suppose the Central Bank of Argentina has a target exchange rate is E^* dollars per peso (I am assuming here that Argentina is the domestic economy), the Central Bank has F_t reserves, and suppose that foreign reserves equal to rr fraction of the total high powered money stock. Then the Central Bank can print high powered money so that:

$$rr \cdot H = \frac{F_t}{E^*} \tag{100}$$

In the case of Argentina, $E^* = 1$ and $rr = 1$, so the Central Bank had a supply of Pesos equal to their dollar reserves. Clearly, no speculative attack can occur in this case: even

if every Peso was sold in the foreign exchange market (or to the Central Bank, since the Central Bank will also exchange one peso per dollar), the Central Bank could buy every Peso and not run out of dollars. Thus E^* would not fall, and since investors know that a speculative attack will fail, they will not sell Pesos to begin with.

In practice, rr is sometimes less than one, which means that a speculative attack is difficult, but not impossible. Although the currency board is more credible than fixed exchange rates, it too can be abandoned. If investors feel that the Central Bank may abandon the currency board and begin printing money, they may begin selling Pesos.

The second way to increase credibility is to completely dollarize, and stop using a domestic currency. In this case, speculative attacks are not possible, since no domestic currency exists. However, since the central bank does not print money, it gives up all seniorage revenues. A former student of this class, who went abroad to study countries that dollarize, was told by the Central Bank of Ecuador that the loss of seniorage revenues was the biggest difficulty with dollarization. In fact, many countries that dollarize such as Ecuador end up printing a second currency for seniorage revenue.

D   Example 1: Speculatve Attack in Mexico, mid 1990s

1. Suppose Mexico has a high deficit, and uses seniorage (prints pesos) to pay for the deficit.

2. We have an increase in the Mexican inflation rate and so E falls as the value of the peso falls.

3. Central bank buys pesos with foreign currency reserves to keep $E = E^*$. In effect, foreign reserves are being used to pay for government expenditures, that is to pay for the deficit:

4. A speculative attack is inevitable here. When reserves get close to zero, as they did in the mid 1990's, a speculative attack results and reserves drop to zero. Mexico was then forced to abandon the target E^* (a devaluation occured).

E   Example 2: Great Britian and the EU

Great Britian (GB) decided not to join the European monetary union, and instead decided to maintain a seperate currency, the pound. Here is why:
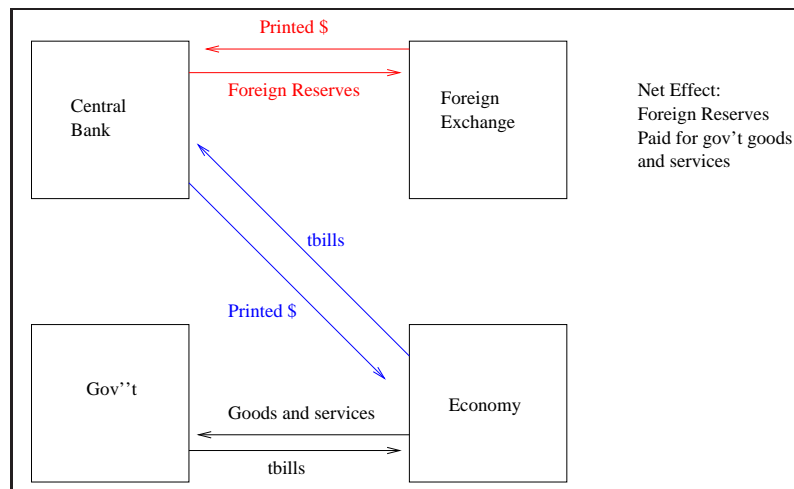
1. Suppose Germany (EU) is in a boom and GB in a recession. GB would like to increase the MS and Germany would like to decrease the MS. The effect would be an increase in British inflation and a decrease in German inflation. The net result is then a fall in the value of the pound.

2. Since the exchange rate is fixed, this is impossible. If the pound is targeted to the Euro, GB cannot persue an independent monetary policy. Therefore, GB decided it would rather have an independent monetary policy.

3. Robert Mundell has argued that if labor and capital are mobile, this is no big deal. If GB is in a recession workers can just get jobs in Germany. But of course labor is not as mobile from GB as it is from within the EU. Therefore it is not surprising that GB decided not to join the EU.

F   Effects of a change in E

An increase in E causes the value of the dollar to rise, which means a dollar buys more foreign goods. Imports become cheap and exports expensive. This implies a decrease in net exports. Thus exporters tend to favor a weak currency. But, cheap import prices typically also means lower inflation as prices since imports often constitute a signficant fraction of consumer goods (especially in developing countries). Further, domestic companies often lower prices to match the cheap imports.

Thus politically speaking if exporters have a stronger voice in government, they may persuade the Central Bank to set a low target E. Conversely, if consumers and importers

have a stronger voice, then the Central Bank may set a higher target E. This assumes that prices are relatively sticky and do not adjust to keep the real rate constant.

G Pros and Cons summary

Our three criteria:

1. Measurable: yes.

2. Predictable: yes, especially if foreign inflation is low and stable relative to domestic inflation.

3. Controllable: difficult, due to speculative attacks.

 Other issues:

1. Political temptations exist to increase or decrease E depending on the relative political power of consumers and exporters respectively.

2. Inflationary expectations fall if countries promise to peg to a low inflation country. But the target must be credible.

3. A fixed E encourages trade by reducing currency risk, according to some theories. However, evidence in the data is that trade increases with a floating E. The reality is that the possibility of speculative attacks means not all currency risk is eliminated.

4. Countries may not want to give up seniorage revenues or the ability to have an independent monetary policy.

5. Fixed exchange rates may encourage excessive risk taking. Suppose a bank in Thailand borrows abroad (borrows dollars) and lends Thai Bahts domestically. Then if the value of the Baht falls, then when the bank is paid back, there will not be enough of the less valuable Bahts to pay back the dollars that the bank borrowed.

IV Other Possible Targets

Other targets are possible, but are used much more rarely than the above three.

A   Commodity Price Target

One can target a specific commodity price, such as a price of gold equal to $2000 per ounce. The US keeps large reserves of gold in Fort Knox. If the price of gold falls, the FED would buy gold with printed money. If the price of gold rises, then the FED would sell gold reserves. We can view this as a currency board, with gold rather than foreign currency. Let G be gold reserves, then:

$$rr \cdot H = P_G G. \tag{101}$$

The right hand side is the dollar value of the gold.

At one time, this was by far the most common target. However, commodities have become a much smaller part of the economy over the last 100 years. Thus gold prices are not great predictors of inflation. Further, speculative attacks are certainly possible if the Central Bank runs short on gold reserves. Thus control problems arise unless the Central Bank maintains large, expensive, reserves of gold.

B   Asset Prices

Greenspan sometimes "talked down" stock prices when they rose and often increased the money supply after a stock market crash ("the Greenspan put"). A fall in asset prices can sometimes signal deflation or a banking crises, so flooding the market with money might be a good idea. On the other hand, it is never clear, even to the FED, what the "correct" stock price is, and therefore what asset price to target.

C   Index of Inflation Indicators

The European Central Bank (ECB) uses an index of inflation indicators. When the index rises, the ECB reduces the money supply and when the index falls the ECB increases the money supply. However, the index is difficult to control: each variable in the index changes in different ways when the money supply changes and each has a different prediction of the inflation rate. Thus the index is difficult to control.

V   Evaluation of Targeting

Many central banks publish their long term inflation targets, usually in the range of 1-2%. This provides us with an opportunity to see how good of a job targeting does at acheiving

the Central Banks goals.

Recall the quantity theory:

$$MV = PY \tag{102}$$

One can derive a version of the quantity theory which says the percentage changes in dollars spent and dollars purchased must be equal:

$$\Delta M + \Delta V = \pi + \Delta Y \tag{103}$$

Consider now the EU, which publishes an inflation target of 2%. Growth in the EU averages about $\Delta Y = 2\%$ as well, so assuming on average no change in velocity:

$$\Delta M + 0 = 2\% + 2\% \quad \rightarrow \quad \Delta M = 4\% \tag{104}$$

One should observe an average increase in the money supply of 4% over reasonable periods of time if the EU is to meet its goal. In fact, EU money supply growth has averaged 4.5%, and inflation has been greater than 2%. Hence either the ECB's inflation target is really not 2%, or their short term and intermediate targets are under-predicting inflation.