# Inflation, Phillips Curve, and Central Bank Commitment

## Reading: Williamson, chapter 17

Should we care about inflation?

- inflation rates in most developed countries are relatively low – in the US the last time inflation rate exceeded 10% was in 1980
- some spectacular "hyperinflationary" episodes in history: Argentina's 20,000% inflation rate in 1989-1990; Austria's 10,000% inflation rate in 1921-22
- recently, Zimbabwe seems to have outdone everyone else: official inflation rate in 2008 *exceeded* 200 million %; a bottle of beer costing 100 billion Zimbabwean dollars would cost 150 billion an hour later.

# Introduction (con't)

So should we care about inflation?

- hyperinflation is clearly disastrous for an economy
- what about low inflation rates? moderate inflation rates of around 10%?
- recall that many developed economies have some form of inflation targetting rule? In the EU, the explicit inflation target is $\leq 2\%$, and in the US, the Fed cares about "price stability".

# Introduction (con't)

If inflation is undesirable, then why do governments let it happen?

- hyperinflationary episodes commonly due to large budget deficits: to finance these deficits, the governments work the printing presses overtime; but as inflation becomes higher, there is a need to print more money, and this leads in time to spiralling inflation rates

- but hyperinflation is rare. In a lot of other countries which had at most moderate rates of inflation, what happened was that central banks exploited the Phillips Curve relationship beginning from the late 1950s.

# Phillips Curve

In the late 1950s, Phlilips published a paper that showed a negative relationship between the rate of change of nominal wage (can think of this as a proxy for inflation) and the unemployment rate in the UK.

This negative relationship between inflation and unemployment seemed to be a pretty robust relationship across various countries.

And it led to an argument where central banks can trade off unemployment and inflation:
- if you want to have low unemployment, you will have high inflation.

# Phillips Curve (con't)

Another way to think about this Phillips Curve is to consider inflation versus real output: since unemployment is negatively related to real output from trend, and unemployment is negatively related to inflation, then the implication is a positive relationship between inflation and real output from trend.

For the rest of this lecture we will refer to the Phillips curve as a positive relationship between the inflation rate and the real aggregate output from trend.
$i_t$ : inflation rate at time $t$
$Y_t^T$ : trend real aggregate output at time $t$
$Y_t$ : actual real aggregate output at time $t$

$$i_t = H\left(Y_t - Y_t^T\right),$$

where $H$ is an increasing function (figure 17.1)

# Phillips Curve (con't)

Looking at the data for the US over time, it is clear that the Phillips curve relationship has changed over time. (figures 17.2-17.8)

In fact, in figures 17.9 and 17.10, observe that inflation rate and deviations of real GDP from trend seem uncorrelated.

# Phillips Curve (con't)

We consider two stories in trying to explain why the Fed in the US allowed moderate inflation rates of around 10% in the 1970s and 1980s.

1. **The central bank learning story**: high inflation in the 1970s was caused by a lack of understanding of the Fed in how the economy works; but once they learnt that higher inflation cannot permanently increase output, then they quickly reduced inflation.

2. **The central bank commitment story**: high inflation in the 1970s was caused by the Fed's inability to commit to not using unanticipated inflation to increase output in the short run.

# Friedman-Lucas Money Surprise Model

To evaluate these two stories, we use a version of the **Friedman-Lucas money surprise model**.

Suppose that the central bank can control the inflation rate by controlling the money supply growth rate (inflation rate is the policy variable of the central bank).

In this world, workers have imperfect information about all the prices, and hence the price level, in the economy (say, because some goods are only purchased infrequently). A worker knows his nominal wage rate, but can only infer what his real wage rate is, because he does not know the exact price level.

# Friedman-Lucas Money Surprise Model (con't)

Hence, if the central bank brings about a surprise increase in the inflation rate (i.e., the inflation rate is unanticipated), then a worker's nominal wage will also tend to increase at a higher rate. However, the worker sees only his higher nomianl wage rate, but does not realize that it is because of a higher inflation rate. So each worker mistakenly believes his real wage rate has increased, and therefore increases the quantity of labor supplied (again assuming the substitution effect dominates), which leads to an increase in aggregate output.

# Friedman-Lucas Money Surprise Model (con't)

Basically in this model, surprise increases in inflation rates cause increases in aggregate output above trend, which can be summarized this way:

$$i_t - i_t^e = a\left(Y_t - Y_t^T\right),$$

where $a$ is a positive constant which is constant across time, and $i_t^e$ is the expected inflation rate.

Rewriting the above, we get

$$i_t = i_t^e + a\left(Y_t - Y_t^T\right),$$

which we graph in "Figure 17.11": note that when $i_t = i_t^e$, $Y_t = Y_t^T$.

# Friedman-Lucas Money Surprise Model (con't)

Note that the position of the Phillips curve depends on $i_t^e$. If $i_t^e$ changes, then the Phillips curve shifts.

Suppose $i_t^e$ increases to $\widehat{i}_t^e$: Phillips curve shifts up; "Figure 17.12", which may help explain why the Phillips curve is "unstable" across time.

# Central Bank Learning Story

Recall we want to explain why the Fed allowed inflation in the 1970s to be so high before taming inflation starting from the 1980s?

In this story, we start by thinking of the central bank as having objectives related to inflation and aggregate output (say because it wants to maximize public welfare), and that the central bank thinks the Phillips curve is a stable relationship which it can exploit.

To start, suppose that the central bank has a desired/optimal inflation rate, $i^*$. In reality, many central banks do target inflation, and in particular want a low rate of inflation: in the EU, $i^* = 0 - 2\%$.

Because there is an optimal level of inflation $i^*$, if the current inflation rate $i_t > i^*$, then less inflation is preferred; but if $i_t < i^*$, then more inflation is preferred.

# Central Bank Learning Story (con't)

Note that we assume the central bank prefers high aggregate output to less aggregate output. So we can represent the central bank's preferences over inflation and aggregate output as in "Figure 17.13"

- the further $i_t$ is from $i^*$, for the central bank to be indifferent it must be because $Y_t$ is higher

- the indifferences curves are concave for $i_t > i^*$ and convex for $i_t < i^*$. To see this, suppose that $i_t > i^*$. When inflation gets increasingly higher, the more increasingly undesirable it is for the central bank, and so to compensate him to stay on the same indifference cuve you have to give him increasingly higher levels of $Y_t$. The case where $i_t < i^*$ is symmetric.

# Central Bank Learning Story (con't)

Now we want to explain how the central bank can exploit the Phillips curve.

Suppose that the central bank treats the Phillips curve as a stable relationship, so it thinks it can simply choose the point on the Phillips curve that it prefers.

Suppose that in "Figure 17.14" the indifference curve that passes through point A is steeper than the Phillips curve at point A. Then the central bank is willing to increase money supply growth so as to surprise workers with a higher than expected inflation rate to obtain a higher output than $Y_t^T$. In fact, the optimal choice for the Fed is point B, where the Phillips curve is tangent to the highest possible indifference curve. At B, $\widehat{i}_t > i_t^e$ and $\widehat{Y}_t > Y_t^T$.

So the central bank has done it! Trade off inflation for higher output!

# Central Bank Learning Story (con't)

But that is not the end of the story.

At point B the public is being fooled because their inflation expectation is $i_t^e$ whereas $\widehat{i}_t > i_t^e$. In other words, the public's inflation expectations is not correct.

At some point the public is going to learn that they are being fooled. See "Figure 17.15" where the central bank initially picks point A on Phillips Curve $PC_1$.

So the public will revise their inflation expectations upwards to, say, $\widehat{i}_t^e$, which causes the Phillips Curve to shift up to $PC_2$. But if the Phillips Curve is now $PC_2$, then the Fed now chooses point B where $PC_2$ is tangent to the highest possible indifference curve.

# Central Bank Learning Story (con't)

But at point B the public is once again being fooled, because the actual inflation is higher than their expected inflation rate of $\widehat{i}_t^e$. Again, the public will revise their inflation expectation upwards. Ultimately the economy comes to rest at point D where $i_t = i_t^e = \widetilde{i}_t^e$ so the public's expectations about inflation are correct, and the central bank no longer has an incentive to change the inflation rate.

However, notice that moving from point A to point D gained us nothing in terms of output as the output always settles down at trend output.

In other words, since the Phillips Curve is not stable, the central bank cannot exploit the perceived tradeoff between inflation and output.

# Central Bank Learning Story (con't)

So once the central bank understands how the Phillips Curve changes with expectations, it wants to set its money growth rate such that $i_t = i^*$ and the economy will settle at point E after expected inflation adjusts downwards again.

This story fits the data for the period 1947-1969 where the Phillips Curve appears to have shifted up in a manner like the movement from point A to point D of "Figure 17.15".

By the early 1980s, the Fed understood what had happened, and thus it began moving the economy from point D to point E of "Figure 17.15.

In this story, the central bank learns from mistakes, however costly it was, and however long it took. Edmund Phelps, 2006 Nobel Prize winner in Economics, was the first to point out that in the long run there is no tradeoff between inflation and unemployment.

# Central Bank Learning Story (con't)

There are two problems with this story.

1. This story assumes that people are not fully rational and were only gradually adjusting their expectations to the changes of the policies of the Central Banks (**adaptive expectations**).

2. It assumes that Central Banks can **commit** not to create inflation.

# Central Bank Commitment Story

In this story, unlike the central bank learning story, people are assumed to be fully rational, so the public cannot be fooled, and understands that in equilibrium it must be that $i_t = i_t^e$. This is a version of the **rational expectations hypothesis** which states that economic agents cannot make systematic errors, i.e., they use all information efficiently.

In what we are learinng, this means that agents understand the Fed's preferences over output and inflation and will use this information efficiently to predict how the Fed will behave.

# Central Bank Commitment Story (con't)

If central bank can commit, then it will choose $i_t = i^*$, and equilibrium is at point A where $Y_t = Y_t^T$ (because it knows it cannot systematically fool people). See "Figure 17.16"

However, if the central bank cannot commit, and if $i_t^e = i^*$, and if the Phillips Curve passing through point A is $PC_1$, then the central bank will choose to be at point D where $PC_1$ is tangent to the highest possible indifference curve, implying that $i_t > i_t^e = i^*$, so we cannot be at point A.

In equilibrium the Phillips Curve is tangent to the highest possible indifference curve such that $i_t = i_t^e$ and $Y_t = Y_t^T$. That is, point B on $PC_2$.

Point A is preferred to point B, but because of the Fed's inability to commit A cannot be achieved.

# Central Bank Commitment Story (con't)

A problem with the central bank commitment story is that it does not explain the run up in inflation in the 1970s in the US or why inflation fell in the 1980s: does it really have anything to do with changes in the Fed's ability to commit?

It has been argued by Barro and Gordon that if you think of the central bank as playing a repeated game with the public, then the central bank cares about its long term reputation, so it is possible for the equilibrium to be at point A (because the central bank understands that if it misbehaved then the equilibrium will be at point B forever).

# Central Bank Commitment Story (con't)

But even if this reputation story makes sense, what was it about the 1970s that made the Fed not care about its reputation anymore by accepting high inflation?

This is not to say that the commitment story is unimportant. But rather that the central bank learning story may best fit the data in the 1970s and 1980s.