The Tale of the Phillips Curve
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Chapter 1

In the late 1950s, A. W. Phillips published an empirical paper showing a negative non-linear relationship between the rate of unemployment and the rate of change of nominal wages, on the basis of a long run of British historical data. Let u denote the rate of unemployment, and w denote the log of the nominal wage, while the dot notation (e.g. $\dot{w}$) indicates a time-derivative (dw/dt). In other words, for any x, $\dot{x}$ indicates the rate of change of x over time. The Phillips finding was that there appeared to exist a stable function g such that

$$\dot{w} = g(u) \text{ with } g' < 0 \tag{1}$$

which looks something like this on a graph:
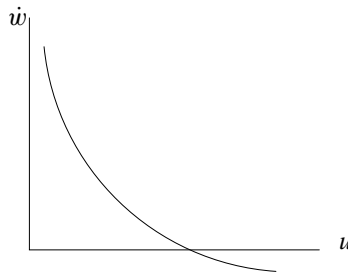
While Phillips himself did not attempt to explain this finding theoretically, it was soon suggested that the underlying force was aggregate demand (AD). An increase in AD will cause a rise in output and employment, and hence a fall in unemployment. This fall in unemployment then means that labor is in a stronger bargaining position, and will be able to press for bigger wage rises. A fall in AD will do just the opposite: lower output, raise unemployment, weaken labor's position and slow the rate of increase in wages. Given enough unemployment, wages will actually start to fall.

Chapter 2

In which we make a connection to price inflation. The rate of increase in unit labor cost (labor cost per unit of output) equals the rate of increase in the nominal wage minus the rate of increase in labor productivity (output per worker). Mathematically, if c stands for the log of unit labor cost and q stands for the log of labor productivity, we have

$$\dot{c} = \dot{w} - \dot{q}$$

Suppose, for the sake of simplicity, that the pace of improvement in labor productivity of labor, $\dot{q}$, is a constant. And suppose that firms set the price of their product as a simple percentage mark-up over unit labor cost. In that case the rate of change of prices (that is, inflation) will equal the rate of change of wages minus a constant. For example if wages are rising at an annual rate of 5 percent and productivity is advancing at 2 percent, then unit labor cost (and also prices) will be rising at 3 percent.

Under these simplifications the Phillips curve, which originally related wage-changes to unemployment, will serve equally well to relate inflation to unemployment. Let p denote the log of the price level and $\dot{p}$ its time-deriavtive, i.e. the rate of inflation. Then to get the $\dot{p}$ version of the Phillips curve we just shift the original curve down by the amount $\dot{q}$. Let's write the shifted variant as

$$\dot{p} = f(u) = g(u) - \dot{q} \tag{2}$$

Chapter 3

If the Phillips curve is interpreted as in Ch. 2, it seems to indicate a 'trade-off' between inflation and unemployment: more unemployment is associated with less inflation, and vice versa. It is then only a short step to the idea that this trade-off can be exploited by macro policy-makers. If we find unemployment to be the greater evil, we can expand aggregate demand (through monetary and/or fiscal policy as preferred), and achieve lower unemployment at the cost of a bit more inflation. Conversely, slowing inflation down requires a reduction in aggregate demand, and will cost us a higher rate of unemployment.

In many of the textbooks of the 1960s macro policy was presented in these terms: according to your preferences, choose the point on the Phillips curve which seems best (the least bad combination of the two ills, inflation and unemployment), and adjust aggregate demand to take you there.

Chapter 4

In which we meet Milton Friedman. Friedman argued that a vital ingredient was missing from the Ch. 3 interpretation of the Phillips curve, namely *expected* inflation. He said that the rate of increase of wages is governed by two factors, the rate of unemployment (as in our equation (1) above) and the expected rate of inflation. For a given level of unemployment, wages will rise faster, the higher is expected inflation. This makes sense if workers are interested in their real wage. Friedman would re-write (1) as follows:

$$\dot{w} = g(u) + \dot{p}^e$$

and hence also (2) becomes

$$\dot{p} = f(u) + \dot{p}^e \tag{3}$$

If Phillips found a stable statistical relationship wage increases and unemployment in the British data prior to the 1960s, this could only be because expected inflation had remained relatively constant over the period he examined. But what would happen if the government were to try to exploit the Phillips trade-off?

If they shoot for lower unemployment by raising aggregate demand, this raises the rate of increases in wages, which feeds through to higher price-inflation, which then, over time, feeds through into higher expected inflation. But then, according to (3), the whole Phillips curve shifts upward: the attempt to exploit the Phillips curve destroys its stability. We start to see distressing combinations of unemployment and inflation way off the original curve, as in the diagram.
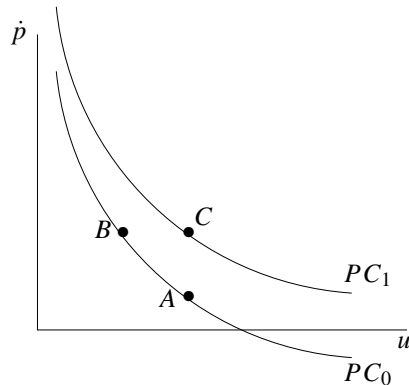
The government tries to shift the economy from point A to point B on the original Phillips curve, PC_0. Once expected inflation catches up with the actual inflation rate at point B, the curve shifts upward to PC_1. We end up at point C.

Friedman also introduced the concept of the 'natural rate of unemployment' (NRU) in this context. Equation (3) may be described as the 'expectations-augmented Phillips curve'. Now define $u^\star$ as that specific value of u such that $f(u^\star) = 0$. This is what Friedman calls the natural rate. Looking at (3), we can see that when $u = u^\star$, we will have $\dot{p} = \dot{p}^e$, that is actual and expected inflation will be equal. But if u is less than $u^\star$, that will raise $\dot{p}$ relative to $\dot{p}^e$ (remember that $\dot{p}$ and u are inversely related via the function f). In other words, unemployment

below its natural rate is associated with actual inflation higher than expected, and unemployment above the NRU is associated with lower than expected inflation.

Friedman's interpretation of this association is as follows: if the government tries to reduce an unemployment rate which—unknown to them, perhaps—is already equal to the natural rate, the only way to do so is to cause inflation to speed up above what people were expecting. But this creates an unstable situation. People's expectations tend to catch up with reality over time ('adaptive expectations'), and the result of trying to hold u below $u^\star$ will be *accelerating* inflation, with the Phillips curve drifting upward over time. This is the Monetarist diagnosis of the stagflation of the 1970s: Misguided Keynesian economists, thinking in terms of a stable inflation-unemployment trade-off, advocated monetary expansion in an effort to reduce unemployment, but the net result was a speed-up of inflation with no lasting gain in terms of lower unemployment. The economy tends to 'spring back' to its natural rate of unemployment, regardless of the rate of expansion of the money supply.

Chapter 5

In which we meet Robert Lucas. Going back to equation (3) once again, note that it can be written as

$$f(u) = \dot{p} - \dot{p}^e \tag{4}$$

But we have defined the NRU such that $f(u^\star) = 0$. Deviations of actual unemployment from the NRU are associated with *forecast errors* for the inflation rate (non-zero values of $\dot{p} - \dot{p}^e$). Now according to the 'rational expectations' hypothesis, which Robert Lucas introduced into macroeconomics, we should not find people making persistent, systematic forecast errors—such errors ought to be purely random. But then it follows that deviations of actual unemployment from the NRU ought to be purely random too. In a rational expectations economy, the government cannot push the unemployment rate away from the NRU, except by means of unpredictable changes in policy (e.g. unpredictable variations in money supply). In Lucas, the notion of an inflation–unemployment trade-off virtually disappears.

Comments

As students of macroeconomics, you should be aware of the arguments of Friedman and Lucas. But please note that I am not presenting them as 'truth' (personally I am very skeptical). The Friedman/Lucas arguments are sometimes presented as a devastating critique of Keynesian macroeconomics. How might Keynesians reply to this? Various responses have been offered:

1. The idea that Keynesians advocated exploiting the supposedly stable PC via deliberate monetary expansion is false. The speed-up of inflation in the USA in the late '60s and early '70s was rather connected to Vietnam war expenditure. The prominent American Keynesian James Tobin, among others, warned at the time that the economy was close to full employment, and that the military spending would be inflationary if it was not offset by a tax increase. But for political reasons the government did not want to raise taxes (eventually it did 'too little, too late'). The continuation and further acceleration of inflation in the 70s was due to 'supply shocks' in the form of huge rises in the world price of oil, not macroeconomic mismanagement.

2. At a rather different level, the actual theories of Friedman and Lucas may be questioned. Note that above we simply *defined* the NRU as that rate of unemployment which equates actual and expected inflation. For the NRU theory to have any grip on reality—rather than the status of a tautology—we need to add some substantive points, such as:

   (a) The NRU is stable over time.

   (b) The NRU has a real 'supply-side' interpretation as the rate of unemployment that results when all of the unemployed are either (i) simply moving between jobs, or (ii) effectively unemployable because of a lack of relevant skills, or (iii) choose not to work, because the real wage does not appear to be

high enough to offset the 'disutility of work'. In Keynes's language, the NRU must be the rate of unemployment consistent with zero 'involuntary unemployment'.

It is not at all clear that we can identify the $u^\star$ of the preceding equations with the NRU as defined *substantively* in (b) above. And as for (a), there is now considerable support for the *hysteresis* argument which says that $u^\star$ tends to follow the actual rate of unemployment up and down over time—so that it is not a stable reference point to which the economy always returns automatically.

References

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