The Economics of the Phillips Curve: Formation of Inflation Expectations versus Incorporation of Inflation Expectations

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March 2011

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This paper examines the theory of the Phillips curve, focusing on the distinction between "formation" of inflation expectations and "incorporation" of inflation expectations. Phillips curve theory has largely focused on the former. Explaining the Phillips curve by reference to expectation formation keeps Phillips curve theory in the policy orbit of natural rate thinking where there is no welfare justification for higher inflation even if there is a permanent inflation – unemployment trade-off. Explaining the Phillips curve by reference to incorporation of inflation expectations breaks that orbit and provides a welfare economics rationale for Keynesian activist policies that reduce unemployment at the cost of higher inflation.

Key words: Phillips curve, formation of inflation expectations, incorporation of inflation expectations, backward bending Phillips curve.

JEL ref.: E00, E31, E52

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I Introduction: the Phillips curve and macroeconomics

The Philips curve is a central component of macroeconomics, providing a structural equation that determines the rate of inflation as a function of the rate of unemployment. It is also central for policymaking since it constitutes a basic constraint on policy. If policymakers choose to stimulate economic activity, ultimate outcomes are constrained to lie on the Phillips curve which determines the set of sustainable inflation – unemployment outcomes. There is no lasting unemployment - inflation trade-off if the long-run Phillips curve is vertical.

This paper examines the theory of the Phillips curve theory, focusing on the critical distinction between "formation" of inflation expectations and "incorporation" of inflation expectations. Phillips curve theory has historically focused on the former and neglected the latter. That has had profound and little appreciated implications for Phillips curve theory and macroeconomics.

The critical juncture in this history was the Friedman (1968) – Phelps (1968) reformulation of Phillips curve theory in the late 1960s. That reformulation shifted the focus of Phillips curve research to the issue of expectation formation, closing an alternative research program suggested by Tobin (1971a, 1971b) that focused on incorporation of inflation expectations.

Tobin's alternative program was abandoned because it is logically incompatible with macro models that have a single aggregate labor market, and instead requires adoption of multi-sector labor markets. This gave the Friedman – Phelps approach a strategic advantage since it was compatible with single good – single labor market macro models that macroeconomists are familiar with and which are also easier to use.

Explaining the Phillips curve by reference to expectation formation dramatically twists the economic welfare and policy implications of Phillips curve theory. As long as the Phillips curve is explained by reference to formation of inflation expectations, it will remain in the orbit of natural rate thinking where there is no welfare justification for monetary policy aimed at reducing unemployment. In contrast, explaining the Phillips curve by reference to incorporation of inflation expectations breaks that orbit and provides a welfare economics rationale for Keynesian activist policies that reduce unemployment at the cost of higher inflation.

II The original Phillips curve: the Phillips-Lipsey nominal wage model

The history of the Phillips curve begins with Phillips' (1958) seminal paper that reported a negative relation in the United Kingdom between the rate of nominal wage change and the unemployment rate over the period 1861 and 1957. Phillips' finding was quickly incorporated into macroeconomics as if it were a theoretically founded relation.

In this regard, an article by Samuelson and Solow (1960) was especially influential, as it suggested how the Phillips curve might be relevant for anti-inflation policy. Since provision of policy guidance has always been an important motivation behind Keynesian structural macroeconomic modeling, this provided an impetus for incorporating the Phillips curve in macro models.

Though quickly incorporated into theoretical macroeconomics, the Phillips curve was actually an empirical finding. That means it has always needed a theoretical explanation.[1] Lipsey (1960) offered a first theoretical explanation, arguing the Phillips curve reflected a process of gradual disequilibrium adjustment in a conventional aggregate labor market. That process was described as follows:

(1.1) $w = f(u - u^*)$ $\qquad$ $f(0) = 0, f' < 0, f'' < 0$

where w = nominal wage inflation; u = actual unemployment rate; and u^* = rate of unemployment (frictional and structural) associated with full employment. According to the Lipsey model, conditions of excess labor demand cause nominal wage inflation, while conditions of excess labor supply cause nominal wage deflation.

Lipsey's (1960) theoretical formulation of the Phillips curve was quickly adopted, but almost immediately the empirical Phillips curve began to display instability, shifting up in unemployment rate – inflation space. This shift prompted search for a theoretical repair, and that repair ended up fundamentally transforming macroeconomics and shifting it in a direction that still holds.

IV The Friedman – Phelps Phillips curve: adaptive expectations in an aggregate neo-classical labor market

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[1] Tobin (1972, re-printed 1975, p.45) has a lovely description of the Phillips curve as "an empirical finding in search of a theory, like Pirandello characters in search of an author."

The theoretical repair and transformation of the Phillips curve involved two steps. Step one was the recognition that labor markets determine real wages. Consequently, if the Phillips curve is the product of imbalance between labor supply and demand, it should determine real wage inflation. That implies a Phillips curve of the form[2]

(2.1) $\omega = f(u - u^*)$ $\qquad$ $f(0) = 0, f' < 0, f'' < 0$

ω = real wage inflation. Defining real wage inflation as

(2.2) $\omega = w - \pi$

π = rate of price inflation. Substituting equation (2.2) into equation (2.1) then implies the Phillips curve should take the form

(2.3) $w = f(u - u^*) + \pi$

Step two was Friedman (1968) and Phelps' (1968) incorporation of inflation expectations into the nominal wage adjustment process, so that the Phillips curve becomes

(2.4) $w = f(u - u^*) + \pi^e$

π^e = expected inflation. Assuming labor is the only cost of production and there is no productivity growth, actual inflation is then given by

(2.5) $\pi = w$

Substituting (2.5) into (2.4) then yields a Friedman – Phelps price inflation Phillips curve given by

(2.6) $\pi = f(u - u^*) + \pi^e$

This formulation places inflation expectations center stage and it has essentially set the course of Phillips curve research for the past forty years.

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[2] If there is labor productivity growth real wages should grow at the rate of productivity growth. That implies adding a constant term to equation (2.1). For simplicity, the issue of productivity growth is abstracted from throughout the paper.

There are three major analytical implications from this simple framework. First, the long run Phillips curve is vertical because the long run equilibrium rate of unemployment is determined by labor supply and demand, which is independent of inflation. Long-run equilibrium requires inflation expectations are fulfilled so that

(2.7) $\pi = \pi^e$

Substituting (2.7) into (2.6) then implies $f(u - u^*) = 0$ so that $u = u^*$. In the long run the economy settles at the full employment rate of unemployment, which Friedman (1968) termed the natural rate of unemployment. Natural unemployment consists of frictional and structural unemployment and is independent of the inflation rate. Consequently, the long run Phillips curve is vertical because the natural rate is independent of inflation and therefore consistent with any equilibrium rate of inflation.

This argument against a trade-off is fully consistent with neo-classical theory, according to which labor markets determine real wages and employment through the interaction of labor demand and supply. Since neither labor demand (the marginal product of labor) nor labor supply (the monetary value of the marginal disutility of labor) are affected by inflation, employment and unemployment are also unaffected by inflation. *Ergo*, there can be no permanent equilibrium trade-off between inflation and unemployment.

Second, though there is no long-run trade-off between inflation and unemployment, there can be a short-run trade-off if inflation expectations are adaptive and formed with a lag. Consequently, faster nominal aggregate demand growth is not immediately neutralized by a jump in inflation expectations.

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By stimulating nominal aggregate demand, policy makers can immediately lower unemployment because inflation expectations are initially pre-determined by the adaptive mechanism. This causes a movement along the initial short-run Phillips curve. However, thereafter inflation expectations start to increase, causing the economy to shift to a higher short-run Phillips curve and eventually track back to a new point on the long-run Phillips curve where expected inflation again equals (higher) actual inflation.

Third, though the Friedman – Phelps model allows no permanent trade-off along a given short-run Phillips curve, policy can still lower unemployment permanently if policymakers are willing to persistently accelerate inflation. In this event, policymakers keep accelerating nominal demand growth and staying one step ahead of workers' inflation expectations which are formed adaptively. In effect, policymakers have the economy moving upward along the family of short-run Phillips curves. By accelerating nominal demand growth, policymakers can ensure that actual inflation always exceeds expected inflation, thereby keeping labor markets away from the natural rate of unemployment.

V The Lucas Phillips curve: rational expectations in an aggregate neo-classical labor market

The Friedman – Phelps reformulation of the Phillips curve introduced inflation expectations and placed formation of inflation expectations center stage. Lucas (1972, 1973) cemented the new research focus on expectation formation by replacing adaptive expectations with rational expectations, and this further diminished the claims regarding existence of an inflation–unemployment policy trade-off.

With rational expectations the long-run Phillips curve remains vertical, but there is no longer a family of short-run Phillips curves for the monetary authority to openly exploit. And nor can the monetary authority accelerate inflation to keep unemployment down.[3] Instead, deviations from the natural rate can only come as a result of surprise shocks and policy can do nothing to systematically move economic outcomes below the natural rate.[4]

The Friedman – Phelps – Lucas synthesis has had an enormous transformative impact on macroeconomics and that impact remains present. First, the triumph of the vertical long run Phillips curve did away with the prior Keynesian discourse about full employment and full employment policy. Instead, full employment was replaced by the natural rate of unemployment and full employment policy was replaced by microeconomic labor market flexibility policy aimed at lowering the natural rate by weakening unions and worker protections.

Second, Lucas' introduction of rational expectations shifted the attention of economics to the implications of expectation formation for policy. Rational expectations require agents understand what policy is doing, which leads to analyzing policy in terms of "systematic rules". That reframes policy in terms of establishing an optimal policy rule. To be effective the rule must be believed by the public, which leads to the problems of time consistency of policy (Kydland and Prescott, 1977) and policy credibility. That

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[3] In a non-stochastic rational expectations model agents have perfect foresight and the economy is always on the long-run Phillips and there are no short-run Phillips curves. In a stochastic model the monetary authority can engage in surprise monetary expansions that lower the unemployment rate and raise inflation, but those surprises cannot be systematically repeated as agents will learn to anticipate them.

[4] The only policy that is effective is random policy that pushes the unemployment rate above and below the natural rate with equal probability. However, that increases economic volatility, which is welfare reducing. The best that policy can do is to offset shocks and reduce the variability of fluctuations around the natural rate.

then leads to issues such as central bank reputation and central bank independence (Barro and Gordon, 1983a).

Third, the Friedman – Phelps – Lucas synthesis fundamentally transforms the economic welfare interpretation of using macroeconomic policy to lower unemployment. According to natural rate theory deviations from the natural rate are an economic distortion that lowers economic welfare. This follows from neo-classical labor market theory that represents the economy as achieving best feasible employment outcomes given tastes, technology, and the distribution of endowments. In such a world monetary policy can only lower unemployment by "fooling" workers about expected inflation, which reduces workers' welfare. That is a dramatically different view from the Keynesian view embodied in Samuelson and Solow's (1960) original interpretation of the policy implications of the Phillips curve.

A corollary of this "fooling" characterization is that natural rate theory interprets policy as an antagonistic game played between opportunistic policymakers and the public rather than a benevolent game between public servants and the public (Barro and Gordon, 1983b).

VI Tobin's neo-Keynesian Phillips curve: the route not taken

The Friedman – Phelps - Lucas explanation of the empirical instability of the Phillips curve dramatically transformed macroeconomics. However, Tobin (1971a, 1971b) suggested another approach to explaining the Phillips curve that identified the critical issue as incorporation of inflation expectations rather the formation of inflation expectations.

A simplified version of Tobin's model is given by the following two equations:

(3.1) $w = f(u - u^*) + \lambda\pi^e$ $\quad\quad\quad\quad\quad\quad\quad\quad$ $0 < \lambda < 1, \ f' < 0, \ f'' < 0$

(3.2) $\pi = w$

Substituting (3.2) into (3.1) then yields a short-run Phillips curve given by

(3.3) $\pi = f(u - u^*) + \lambda\pi^e$

Applying the long run equilibrium condition that expected inflation equal actual inflation ($\pi^e = \pi$) yields a long-run Phillips curve given by

(3.4) $\pi = f(u - u^*)/[1 - \lambda]$

The slope of this long-run Phillips curve is given by $d\pi/du = f'/[1 - \lambda] < 0$. The long run Phillips curve is therefore negatively sloped and there exists a permanent trade-off between inflation and unemployment.

As with the Friedman – Phelps model, if inflation expectations are formed adaptively there is a family of short-run Phillips curves, each indexed by the level of inflation expectations. However, there is also a long-run negatively sloped Phillips curve that is steeper than the short-run Phillips curve ($d\pi/du|_{LR} = f'/[1-\lambda] < d\pi/du|_{SR} = f' < 0$). This long-run Phillips curve crosses each short-run Philips curve at the point where actual inflation equals expected inflation ($\pi = \pi^e$).

One feature is that the long-run negatively sloped Phillips curve holds regardless of whether inflations expectations are formed adaptively or rationally. If inflation expectations are formed rationally then agents have perfect foresight given the non-stochastic nature of the model. That means expected inflation equals actual inflation at all times ($\pi^e = \pi$) so that agents are always on the long-run Phillips curve (i.e. there is no family of short-run Phillips curves and the long- and short-run Phillips curves are one). However, despite this, the long-run Phillips curve remains negatively sloped. That shows

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that formation of inflation expectations is not the critical question when it comes to the Phillips curve.

Analytically, the key feature of Tobin's neo-Keynesian Phillips curve is that the coefficient of inflation expectations in equation (3.1) is less than unity ($\lambda < 1$). That means incorporation of inflation expectations into nominal wage-setting is less than complete, and it is this rather than the formation of inflation expectations that is critical for the existence of a Phillips trade-off.

In this regard, there is a long history of empirical support for the proposition that the coefficient of inflation expectations is less than unity. Tobin (1971b, p.26) writes: "The most important empirical finding is that α_{21}, the coefficient of feedback of price inflation on to wages, is significantly less than one." That finding has been reaffirmed by Brainard and Perry (2000), though they also report that the coefficient is variable. Thus, it was low in the 1950s and 1960s, rose in the 1970s, and has since fallen back.

This raises the theoretical question of why incorporation of inflation expectations is less than unity. The problem is it is hard to construct a justification in an aggregate labor market model. That is because according to such a model the labor market determines real wages and failure to fully incorporate inflation expectations would constitute systematic money illusion. That in turn would erode the real wage over time, causing systematic disequilibrium.

VII Tobin's multi-sector disequilibrium Phillips curve: explaining less than full incorporation of inflation expectations

The clue to solving the puzzle why empirical estimates of the Phillips curve show

less than full incorporation of inflation expectations was suggested by Tobin who argued

the Phillips curve is the product of a multi-sector phenomenon:

"The myth of macroeconomics is that relations among aggregates are enlarged analogues
of relations among corresponding variables for individual households; firms, industries,
markets. That myth is a harmless and useful simplification in many contexts, but
sometimes it misses the essence of the phenomenon." (Tobin, 1972, re-printed 1975,
p.45)

For Tobin, the Phillips curve is a disequilibrium phenomenon, the product of the

combination of downward nominal wage rigidity plus persistent recurring disequilibria at

the sector level. Disequilibria are always arising at the sector level and some sectors have

unemployment because of downward nominal wage rigidity. Greater aggregate demand

pressure reduces unemployment by reducing the proportion of sectors with

unemployment, but it raises inflation in sectors at full employment.

A multi-sector disequilibrium approach suggests why macroeconomic policy may

lower unemployment in a welfare improving way, thereby countering the Friedman –

Phelps – Lucas "fooling" argument. Unfortunately, Tobin (1972) articulated the

theoretical argument in terms of a multi-sector economy with downward nominal wage

rigidity rather than a multi-sector economy with incomplete incorporation of inflation

expectations.

The logic of the multi-sector Phillips curve is as follows. Slower nominal wage

increases in sectors below full employment helps them adjust relative to sectors at full

employment. That slower nominal wage increase is achieved by incomplete incorporation

of inflation expectations. The reason why workers do not simply lower nominal wages is

labor exchange is characterized by conflict and moral hazard, which causes workers to

resist wage reductions imposed from within the employment relationship for fear that firms are trying to cheat them. However, workers are willing to accept some real wage reduction imposed from outside the employment relationship via adjustment of the general price level since this is beyond the control of individual firms. Furthermore, workers are often nominal debtors (due to mortgage obligations, etc) and that provides another reason to resist nominal wage reduction.[5]

Palley (1994, 1997) provides a formal multi-sector model that incorporates such wage setting behavior, and the result is an economy with a negatively sloped long-run Phillips curve in which there is a permanent trade-off between inflation and unemployment.[6] Where the economy settles on that Phillips curve is determined by the rate of aggregate nominal demand growth that determines the equilibrium rate of inflation.

This multi-sector approach to the Phillips curve can be captured by the following simple model. There are N identically sized sectors and nominal wage adjustment at the sector level is given by

$$(4.1) \quad w_i = \begin{cases} f(u_i - u^*) + \lambda\pi^e & u_i > u^*, \ 0 \le \lambda \le 1, \\ f(u_i - u^*) + \pi^e & u_i < u^* \end{cases}$$

where $i = 1,\ldots, N$ and $u^* =$ full employment rate of unemployment. The critical innovation is that nominal wage adjustment in sectors with less than full employment only partially incorporates inflation expectations. Less than full incorporation helps restore full employment but it is accomplished without recourse to nominal wage cuts

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[5] The microeconomic foundations for such labor market behavior are developed in Palley (1990). Bewley (1999) provides empirical evidence that is supportive of this microeconomic logic.
[6] Akerlof et al. (1996) have also developed a model of a negatively sloped long-run Phillips curve. However, they emphasize firm heterogeneity and overlook inflation expectations.

from within the employment relation that are resisted by workers for fear of opportunism by firms.

Workers have rational expectations so that

(4.2) $\pi = \pi^e$.

Sector price inflation and aggregate nominal wage and price inflation are given respectively by

(4.3) $\pi_i = w_i$

(4.4) $w = \Sigma w_i / N$

(4.5) $\pi = \Sigma \pi_i / N$

Aggregate unemployment and the proportion of sectors with unemployment are given respectively by

(4.6) $u = \Sigma u_i / N$

(4.7) $s = s(u)$ $0 < s < 1, s' > 0$

s = proportion of sectors below full-employment. Equation (4.7) embodies the implicit assumption that there is a positive monotonic relationship between the aggregate unemployment rate and the proportion of sectors below full employment

When this pattern of sector wage adjustment is aggregated it yields wage and price inflation Phillips curves of the form

(4.8) $w = [1 - s(u)]f(u^- - u^*) + s(u)f(u^+ - u^*) + [1 - s(u) + s(u)\lambda]\pi^e$

u^- = unemployment rate in sectors above full employment, u^+ = unemployment rate in sectors below full employment. The price inflation equation is then given by

(4.9) $\pi = F(u - u^*)/s(u)[1 - \lambda]$ $F_u < 0$

The function F(.) defines the weighted average sector disequilibrium component of nominal wage inflation which is given by

(4.10) $F(u - u^*) = [1 - s(u)]f(u^- - u^*) + s(u)f(u^+ - u^*)$

The aggregate coefficient of inflation expectations in equation (4.8) can be defined as

(4.11) $\Lambda = 1 - s(u) + s(u)\lambda \leq 1$ $\qquad\qquad\qquad\qquad \Lambda_u < 0$

It is a weighted average of incorporation of inflation expectations by sectors at full employment and those below full employment. It is less than unity as long as there are some sectors below full employment, which holds as long as $s(u) > 0$. Differentiating with respect to u yields

$d\Lambda/du = [\lambda - 1]s_u < 0$

The aggregate coefficient for incorporation of inflation expectations therefore falls as unemployment rises. The logic is simple. As more sectors experience unemployment they hold back on fully incorporating inflation expectations in nominal wage demands, lowering the aggregate coefficient.

Differentiating equation (4.9) with respect to the unemployment rate yields the slope of the Phillips curve which is given by

(4.9) $\pi = F(u - u^*)/s(u)[1 - \lambda]$

$d\pi/du = \{s(u)F' - F(u - u^*)s_u\}/\{s(u)^2[1 - \lambda]\} < 0$

The slope of the Phillips curve is therefore negative so that there is a permanent trade-off between inflation and unemployment. As u falls s(u) tends to zero so that the slope eventually becomes infinite and the Phillips curve becomes vertical. That corresponds to a situation when all sectors are at or beyond full employment.

The key variable is the aggregate coefficient of inflation expectations, Λ, which is a weighted average of the sector coefficients of inflation expectations. The aggregate is less than unity because sectors with unemployment do not fully incorporate expected inflation in their nominal wage settlements. As the unemployment rate and proportion of sectors with unemployment decreases, the aggregate coefficient of inflation expectations increases. When all sectors are at full-employment it becomes unity. At that stage the Phillips curve becomes vertical and the inflation-unemployment trade-off disappears.

The multi-sector framework is essential as this structure explains why the aggregate coefficient of inflation expectations is less than unity and why it can vary with the aggregate unemployment rate. The Phillips curve steepens and the marginal inflation – unemployment trade-off weakens as more and more sectors reach full employment and fully incorporate inflation expectations.
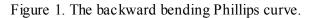
The method of formation of inflation expectations is secondary. In the above model workers are assumed to have perfect foresight (i.e. rational expectations) and a Phillips trade-off still exists. Having adaptive expectations would not change this. The only effect would be to create a separate additional family of short run Phillips curve, each indexed by the level of inflation expectations, that intersect the long-run Phillips curve at the point where $\pi^e = \pi$.
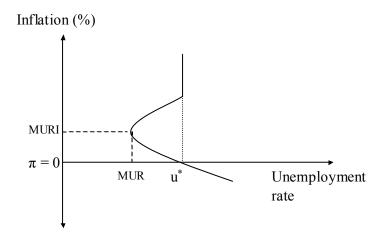
VIII The backward bending Phillips curve: near-rational expectations

The Phillips curve has historically been viewed as negatively sloped. Akerlof, Dickens, and Schultz (2000) have presented a model which has the Phillips curve bending backward. According to their model, the curve is initially negatively sloped in

unemployment – inflation space, then bends back and becomes positively sloped, and ultimately becomes vertical.

Such a backward bending Phillips curve is shown in Figure 1. In place of a non-accelerating inflation rate of unemployment (NAIRU) that acts as a constraint on the sustainable minimum unemployment rate, there is a minimum unemployment rate (MUR) that pairs with a minimum unemployment rate of inflation (MURI). The MURI is the inflation rate that obtains at the point of inflexion when the Phillips curve bends backward.

Figure 1. The backward bending Phillips curve.

Whereas Tobin (1972) proposed a multi-sector approach to the Phillips curve, Akerlof et al. (2000) adopt a multi-agent approach in which agents differ in their degree of rationality. That approach makes formation of inflation expectations the foundation of the Phillips trade-off and therefore remains stuck in the Friedman-Phelps-Lucas research tradition.

The argument is some agents (workers) have near-rational inflation expectations and they systematically under-estimate inflation at low rates of inflation. This constitutes a form of "money illusion", and it is this money illusion that enables a trade-off between inflation and unemployment. However, as actual inflation increases workers progressively reduce the extent of money illusion (i.e. reduce their underestimate of actual inflation). That reversal causes the Phillips curve to bend back and eventually become vertical at high levels of inflation when workers fully correct their underestimate.

The model can represented in a conventional Phillips curve framework by the following equations:

$$(5.1) \ w_i = \begin{cases} f(u - u^*) + \pi^e_R & i = R \\ f(u - u^*) + \pi^e_{NR} & i = NR \end{cases}$$

$$(5.2) \ \pi^e_R = \pi$$

$$(5.3) \ \pi^e_{NR} \begin{cases} = p(\pi) \leq \pi & \pi < \pi^C \quad p' > 0 \\ = \pi & \pi \geq \pi^C \end{cases}$$

$$(5.4) \ \pi_i = w_i$$

$$(5.5) \ w = s w_{NR} + [1 - s] w_R$$

$$(5.6) \ \pi = s \pi_{NR} + [1 - s] \pi_R$$

$$(5.7) \ s = s(\pi) \qquad\qquad 0 \leq s \leq 1, \ s' < 0$$

The critical feature of the model is there are two types of agents – rational (R) and near-rational (NR). Rational agents have perfect foresight rational expectations and their expected inflation equals actual inflation, as described by equation (5.2). Near-rational agents have near rational expectations and consistently under-estimate inflation when inflation is low. Equation (5.3) describes the determination of their inflation expectations.

NR agents underestimate inflation when it is less than π^C, though the error also falls as inflation rises. They correctly estimate inflation when it is at or above π^C.

Equation (5.7) describes the proportion of NR agents in the economy. As inflation rises, the proportion falls as more and more agents become aware of their underestimate.

Combining equations (5.2), (5.3) and (5.7) yields an expression for economy-wide inflation expectations given by

(5.8) $\pi^e = s(\pi)\pi^e_{NR} + [1 - s(\pi)]\pi^e_R$

Combining (5.8) with (5.1) and (5.7) then yields an aggregate equation for the Phillips curve given by

(5.9) $\pi = f(u - u^*) + s(\pi)\pi^e_{NR} + [1 - s(\pi)]\pi^e_R$

There are now two regimes: one where inflation is equal to or greater than π^C and the proportion of NR agents has shrunk to zero; the other where inflation is below π^C and the proportion of NR agents is non-zero.

In the regime where $\pi \geq \pi^C$ all agents are rational and the Phillips curve is given by

(5.10.a) $\pi = f(u - u^*) + \pi^e$

(5.10.b) $\pi^e = \pi$

The Phillips curve therefore reduces to the natural rate vertical Phillips curve and there is no trade-off.

In the regime where $\pi < \pi^C$ some agents are non-rational and the Phillips curve is given by

(5.11) $\pi = f(u - u^*) + s(\pi)p(\pi) + [1 - s(\pi)]\pi$

Differentiating with respect to u yields

$d\pi/du = f'/[\ s(\pi) + \pi s' - s'p(\pi) - p's(\pi)]\ \substack{> \\ <}\ 0$

The sign of this expression is ambiguous and depends on the rate of inflation. The numerator is negative, but the denominator is ambiguous. When π is low, $s(\pi)$ is large and the denominator will be positive if it dominates, making the Phillips curve negatively sloped. As inflation increases $s(\pi)$ falls and the term involving π gains greater weight, causing the expression to change sign so that the denominator becomes negative and the Phillips curve bends back.

The economic logic of the Akerlof et al. (2000) backward bending Phillips curve is as follows. Initially, higher inflation lowers unemployment by fooling NR agents. However, as inflation increases, fewer and fewer agents are "fooled" by inflation. Additionally, those who are fooled are fooled by less. These effects contribute to making the Phillips curve steeper (i.e. the marginal effect of inflation fooling diminishes). Eventually, as the proportion of NR agents shrinks, further increasing inflation actually increases unemployment by further reducing the number of NR agents and lowering the extent to which remaining NR agents are fooled.

IX The backward bending Phillips curve with incomplete incorporation of inflation expectations.

Akerlof et al. (2000) redirect attention back to the issue of formation of inflation expectations and generate a Phillips curve because some workers systematically underestimate inflation. Palley (2003) provides an alternative explanation of the backward bending Phillips that rests on a multi-sector construction of the economy in which there is less than complete incorporation of inflation expectations in sectors with unemployment.

The key innovation is that workers in sectors with unemployment become increasingly resistant to excessively fast reductions in the general purchasing power of their wages. They therefore respond to increased inflation by increasing the extent of incorporation of inflation expectations. Such a mechanism was suggested by Rowthorn (1977), albeit in the context of a single sector economy.

The model is the same as that in section VII and described by equations (4.1) – (4.7). As before, there are two sector nominal wage adjustment regimes. One when a sector is below full employment ($u_i > u^*$), and another when a sector is at or above full employment ($u_i > u^*$). However, there is an additional equation determining the coefficient of inflation expectations in sectors with unemployment, given by:

$$(6.1)\ \lambda = \begin{cases} \lambda(\pi^e) < 1 & \pi^e < \pi^C,\ \lambda' > 0 \\ 1 & \pi^e \geq \pi^C \end{cases}$$

This coefficient depends on the rate of inflation. In low inflation environments there is less than full incorporation of inflation expectations. However, as inflation increases the degree of inflation expectation incorporation rises, and inflation expectations are fully incorporated when $\pi^e \geq \pi^C$.

There are now two regimes to consider. Regime one is when all sectors are at full employment so that proportion of sectors with unemployment is zero and $s(u) = 0$. Regime two is when some sectors have unemployment and $s(u) > 0$.

When all sectors are at full employment (regime one) the coefficient of inflation expectations is unity in all sectors. In this case the aggregate Phillips curve is given by:

$$(6.2)\ \pi = F(u - u^*) + \pi^e \qquad F_u < 0,\ \pi^e \geq \pi^C$$

$$(6.3)\ \pi^e = \pi$$

This is the same as the natural rate vertical Phillips curve and there is no inflation – unemployment trade-off,

When some sectors have unemployment (regime two) the aggregate Phillips curve is given by:

(6.4) $\pi = F(u - u^*) + [1 - s(u)]\pi^e + s(u)\lambda(\pi^e)\pi^e$ $\qquad$ $F_u < 0, \pi^e < \pi^C$

(6.5) $\pi^e = \pi$

The critical feature is that as long as $\pi^e < \pi^C$ the aggregate coefficient of inflation expectations will be less than unity because workers in sectors with unemployment less than fully incorporate inflation expectations.

Substituting (6.5) into (6.4) and differentiating with respect to u yields the slope of the Phillips curve, which is given by

$d\pi/du = \{F' + s'\pi[\lambda(\pi) - 1]\}/s(u)\{[1 - \lambda(\pi)] - \pi\lambda'\} \begin{smallmatrix} > \\ < \end{smallmatrix} 0$

The sign of this expression is ambiguous. The denominator is negative, but the numerator is ambiguous. For low rates of inflation, $\lambda(\pi)$ will be small so that the numerator is positive and the slope of the Phillips curve is negative. However, as inflation increases, $\lambda(\pi)$ increases so that the numerator becomes negative and the Phillips bends back and become positively sloped.

The economic logic is that when inflation is low sectors with unemployment do not fully incorporate aggregate inflation in their wage demands, enabling an increase in real demand that lowers unemployment in those sectors and in aggregate. However, as inflation increases, workers in these sectors start increasingly resisting too rapid real wage erosion. That diminishes the beneficial effect of inflation, causing the Phillips curve to steepen. As inflation increases further the Phillips curve bends back because workers

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start to ratchet up their incorporation of inflation expectations faster than the increase in inflation.

For low inflation rates there is an unemployment trade-off, but once again it has nothing to do with formation of expectations, misperceptions, or fooling. Workers have perfect foresight but choose not to fully incorporate their inflation expectations.

Replacing perfect foresight with adaptive expectations would complicate the model. Instead of a single backward bending Phillips curve that is both the short-run and long-run Phillips curve, there would be a long-run Phillips curve and a family of short-run Phillips curves each indexed by a particular level of adaptive expectations. As inflation expectations increase, each short-run Phillips curve will become steeper because the coefficient of feedback of inflation expectations, $\lambda(\pi^e)$, becomes larger in equation (6.4). Each individual short-run Phillips curve is also convex because of the $F(u - u^*)$ and $s(u)$ terms in equation (6.4). This is illustrated in Figure 2.
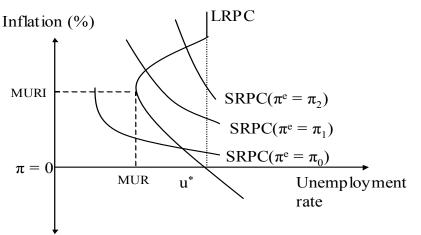
Figure 2. The backward bending Phillips curve (LRPC) with adaptive expectations ($\pi_2 > \pi_1 > \pi_0$).

Such a configuration helps explain the econometric difficulties surrounding the Phillips curve. A single backward bending Phillips curve that becomes vertical will on its own produce a complicated scatter plot. A backward bending Phillips curves that is crossed by a family of short-run Phillips curves will produce a scatter plot that is bunched and looks close to random. That makes it enormously difficult to estimate econometrically the Phillips curve.

X Worker militancy, conflict, and the Phillips curve

In the above model the slope of the backward bending Phillips curve and its turning point depend on how rapidly workers start to display real wage resistance (i.e how sensitive λ is to π^e). If workers start displaying real wage resistance at low inflation rates, the Phillips curve will be steep and bend back at a relatively low rate of inflation and high rate of unemployment. If real wage resistance only develops slowly, the Phillips curve will be flatter and will bend back at a higher rate of inflation and lower rate of unemployment.[7]

This links the Phillips curve to Post Keynesian concerns with the inflation effects of labor market conflict and worker militancy. It also closes a hole in Post Keynesian conflict inflation theory which has no theory of how inflation expectations fit into the Phillips curve.[8]

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[7] The model presented in this section is based on Palley (2009).
[8] Indeed, if inflation expectations are introduced in the standard Post Keynesian model (Myatt, 1986; Dalziel, 1991; Lavoie, 1992; Palley, 1996) and workers correctly anticipate inflation, the Post Keynesian Phillips curve is vertical for the same reason the neo-Keynesian Phillips curve (Tobin 1971a, 1971b) was vertical, unless the feedback of inflation expectations is less than unity. That begs the question addressed in this paper.

Worker militancy can be thought of as a political attitude that influences wage behavior. Such a militancy effect can be incorporated by re-specifying the sector nominal wage adjustment process as follows

$$(7.1)\ w_i = \begin{cases} f(u_i - u^*) + \lambda\pi^e & u_i > u^*,\ 0 \le \lambda \le 1, \\ f(u_i - u^*) + \pi^e & u_i < u^* \end{cases}$$

$$(7.2)\ \pi = \pi^e$$

$$(7.3)\ u^* = u(\psi) \qquad\qquad u_\psi > 0$$

$$(7.4)\ \lambda = \begin{cases} \lambda(\pi^e,\ \psi) < 1 & \pi^e < \pi^C,\ \lambda_{\pi e} > 0,\ \lambda_\psi > 0 \\ 1 & \pi^e \ge \pi^C \end{cases}$$

where ψ = labor militancy variable. The model is identical to that described in section IX except for the addition of a labor militancy variable.

Labor militancy affects the inflation process in two ways. First, equation (7.3) has labor militancy raising the unemployment rate at which workers start to demand higher wages. Greater militancy means unemployment has less of an intimidation effect on wage demands so that wage inflation picks up at a higher rate of unemployment.

Second, equation (7.4) has an increase in labor militancy raise the coefficient of inflation expectations, thereby increasing the incorporation of inflation expectations for any given rate of expected inflation. That means nominal wage inflation incorporates more expected inflation.

Using equations (7.1) – (7.4) and equations (4.3) – (4.7) yields the following aggregate nominal wage Phillips curve
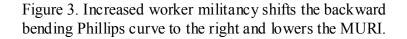
$$(7.5)\ w = \begin{cases} F(u - u^*(\psi)) + [1 - s(u) + s(u)\lambda(\pi^e,\ \psi)]\pi^e & \pi^e < \pi^C \\ F(u - u^*(\psi)) + \pi^e & \pi^e \ge \pi^C \end{cases}$$
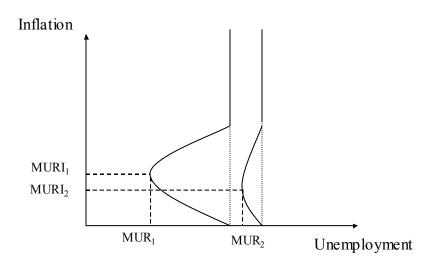
The price inflation Phillips curve is then given by

(7.6) $\pi = F(u - u^*(\psi))/s(u)[1 - \lambda(\pi^e, \psi)]$ $\pi^e < \pi^C$

Like the Phillips curve in section IX, this Phillips curve is backward bending. Likewise,

when $\pi^e \geq \pi^C$ the Phillips curve is vertical.

Figure 3 shows the effect of increased worker militancy on the Phillips curve.

Greater worker militancy causes a generalized rightward shift of the Phillips curve by

increasing the unemployment rate consistent with zero inflation. Additionally, it

generates more rapid feedback of inflation expectations that causes the Phillips curve to

bend back at lower rates of inflation and higher rates of unemployment. Greater militancy

therefore lowers the minimum unemployment rate of inflation ($MURI_1 > MURI_2$). The

reverse holds for reduced militancy.

Figure 3. Increased worker militancy shifts the backward
bending Phillips curve to the right and lowers the MURI.

This formulation has important policy consequences. It is widely believed

that the current era is one of reduced labor militancy. Indeed, as far back as 1999

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former Federal Reserve Chairman Alan Greenspan (1999) openly commented about workers' heightened sense of job insecurity tamping down real wages. In terms of the above model, this can be interpreted as reduced militancy that has shifted the Phillips curve left and increased the MURI, creating space for the monetary authority to push for a lower rate of unemployment.

XI Near-rational expectations versus incomplete incorporation of expectations: why it matters

Near-rational expectations (Akerlof et al., 1996, 2000) and incomplete incorporation of inflation expectations (Palley, 1994, 1997, 2003) can both explain the Phillips curve and why it might also be backward-bending. However, the two theories have dramatically different economic welfare implications, and they also have different empirical implications.

With regard to economic welfare implications, the critical feature is that the near-rationality approach relies on misperceptions and fooling to generate a Phillips trade-off. As in the Friedman (1968) – Phelps (1968) – Lucas–Rapping (1969) world, near-rationality has workers being fooled to supply more labor. At low rates of inflation, near-rational workers systematically under-estimate inflation and they therefore supply more labor than they would if they had full information or rational expectations. Such fooling is sub-optimal from a welfare standpoint since it forces a departure from the full information equilibrium. Consequently, the policy recommendation from a model that generates a Phillips trade-off on the basis of near-rationality is to either have zero inflation or an inflation rate above π^C at which rate all agents are rational and correctly anticipate inflation.

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In contrast, the nominal wage conflict approach involves no fooling. Instead, inflation helps circumvent mistrust between workers and firms over adjusting wages from within the employment relation. It does so by imposing wage adjustments from outside the relation via the general price level. That helps reduce disequilibrium unemployment and it unambiguously raises economic welfare by avoiding wasteful unemployment. That was Tobin's (1972) original rationale for why a little bit of inflation could increase economic welfare by greasing the wheels of labor market adjustment.

Which theory is to be preferred? There are both theoretical and empirical reasons to prefer the incomplete incorporation of inflation expectations hypothesis. With regard to theory, the near-rational expectations approach relies on some workers having near-rational expectations. Who are those workers, and why are only some near rational. In less polite language, who are the fools and why do they not learn? The incomplete incorporation of inflation expectations approach views the nominal wage adjustment problem as generic and afflicting all sectors and workers. However, at any particular time only those sectors with unemployment are affected by it.

With regard to empirics, the near-rationality approach predicts that, at low rates of inflation, surveys of inflation expectations obtained from randomly selected participants should be systematically below actual inflation and rationally formed inflation expectations. This is because the pool of respondents will include a mix of near-rational and rational agents, and the former systematically under-estimate inflation. The inflation expectations incorporation hypothesis implies no such bias about the public's inflation expectations.

Second, in contrast to the near-rational expectations hypothesis, the inflation expectations incorporation hypothesis provides a theoretical explanation of Brainard and Perry's (2000) finding that the coefficient of inflation expectations increased in the 1970s. One reason is that workers may have become more militant. A second reason is that the economy may have been operating on the positively sloped portion of the backward bending Phillips curve. In that region, high inflation prompts workers to resist too rapid real wage erosion by incorporating more of their inflation expectations into nominal wage setting.

XI Conclusion

The Phillips curve is an essential part of macroeconomics, yet its history has been one of initial theoretical confusion followed by subsequent neglect of alternative theoretical explanations. The Friedman – Phelps – Lucas explanation of the Phillips curve fundamentally changed the direction of Phillips curve research, making formation of inflation expectations the critical question. That change truncated interest in an alternative approach to explaining the Phillips curve that identified incorporation of inflation expectations into nominal wage setting as the critical factor.

Forty years on, macroeconomics remains dominated by the issue of formation of expectations and there seems little awareness of the significance of expectation incorporation. Near-rational expectation formation can explain the existence of a negatively sloped Phillips curve, but it cannot provide a welfare economics rationale for exploiting the trade-off. That keeps macroeconomic policy stuck in the policy orbit of natural rate thinking. In contrast, explaining the Phillips curve by reference to rational but incomplete incorporation of inflation expectations breaks that orbit and provides a

rationale for Keynesian activist policies that reduce unemployment at the cost of higher inflation.

Academic research is path dependent, and once a particular path is chosen it is difficult to reconsider paths not taken. In the case of Phillips curve research that has had enormous implications for macroeconomics and macroeconomic policy because of the profound significance of the Phillips curve.

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