Chapter-3

Analytical Framework: Expectations Augmented Phillips Curve

Economists had looked into the relationship between unemployment and inflation before 1958. Infact, a variant of this relationship was investigated as early as 1926 by Irvin Fisher[1]. However, it was AW Phillips[2] a British economist at London School of Economics, who brought out a study of relationship between unemployment rate and change in money wage rates in the British economy during the period 1861-1957. The equation that was chosen to fit the actual data is,

$$Infl(w) + a = b\,U^{\gamma}$$

where, Infl(w) is the rate of change of wage rate, U is percentage unemployment a,b and γ are parameter constants b and γ were estimated by applying the least squares method constant, a, was obtained through "trial and error" method. Phillips found an inverse relationship between the rate of change in money wage rate and the rate of unemployment. This finding of inverse relationship between wage growth rate and unemployment led to the notion that there might be a trade-off between unemployment and inflation. The perception is that if the government tries to reduce inflation by constrictionary monetary and fiscal policy, then unemployment will surely rise. Thus one would expect a negative correlation between unemployment and inflation. The unusual method employed to estimate the equation given above invited criticism from many quarters.

Richard Lipsey[3] worked on the same data and makes some modification in the original equation of AW Phillips and proposed to estimate an alternative equation given below. He estimated this equation by applying standard statistical technique.

$$Infl(w) = a + bU^{-1} + cU^{-2}$$

Lipsey repeats Phillips's work but uses standard statistical techniques to eliminate the econometric problems associated with Phillips's method. His equation can be made arbitrarily close to the oneestimated by Phillips by choosing appropriate values for the parameters a,b and c.

[1]Fisher Irving(1926).
[2]A.W.Phillips(1958).
[3]R.G.Lipsey (1960).

Thus if Phillips's equation were correct, it would be corroborated by the fit for Lipsey's equation. However, the parameter magnitudes obtained by Phillips do not corroborate the Phillips estimates, though he does obtain a negative non-linear relationship confirming Phillips basic findings. Thus, a simple Phillips curve, depicting a inverse relationship between growth rate of nominal wages and unemployment rate, can be written as:

$$Infl(w) = - \delta (U) \qquad \ldots.(1)$$

where, Infl(w) is wage growth rate and , U, is actual unemployment rate. δ, is a positive constant representing the sensitivity of wage growth rate to the change in unemployment rate.

After this, a number of rationalizations for the existence of a negative relationship between wage inflation and unemployment have been given in the literature. Phillips has been criticized for his failure to provide theoretical basis of the negative relationship between wage inflation and unemployment rate.

Friedman(1968) in an alternative explanation argued that short-run Phillips curve, which are not vertical , arise due to the misperception of workers as to whether real wages have also increased following an increase in the nominal wages. Friedman claimed that Phillips had made three mistakes (i) he failed to distinguish between nominal wages and real wages (ii) he ignored temporary and, permanent trade-offs between wage inflation and unemployment rate and (iii) he did not assign a role to expected inflation. According to Firedman, there is only one long run, i.e. natural rate of unemployment which is compatible with any perceived rate of inflation. Hence, there is a series of short run Phillips curves each conditional on expected rate of price inflation.

Following Friedman's contribution in terms of distinction between nominal and real wage rate, inflation expectations, and natural rate of unemployment, the modified Phillips curve- Inflation expectations augmented Phillips curve in equation (1) can be written as[4]:

$$Infl(GNPD) = Infl(GNPD)^{e} - \delta (U - U^{*}) \qquad \ldots.(2)$$

[4]Dornbusch, Fischer and Startz (2002). P.104

where, Infl(GNPD) is actual price inflation rate[5], $Infl(GNPD)^e$ is expected inflation rate, U is actual unemployment rate, U* is natural(long run) unemployment rate, δ is a positive constant which represents the response of price inflation rate to a change in the deviation of actual unemployment rate from natural rate of unemployment.

More recent explanations of Phillips curve have stressed the importance of imperfect competition. According to this explanation wages are set through bargains between trade unions and employers. The natural rate of unemployment in Friedman's model is replaced with the non-accelerating inflation rate of unemployment[6] - NAIRU. If unemployment is less than NAIRU unions bargain for a wage greater than at equilibrium. Money wages increase more than NAIRU and so do product prices as employers respond to their potential loss of profit per unit of output. Lower unemployment is associated with higher wage and hence price inflation; there is a Phillips curve at least in the short run.

From operational point of view, however, the expectations augmented Phillips curve (2) requires further elaboration on NAIRU or natural rate of unemployment (U*) and expected inflation $Infl(GNPD)^e$.

Natural rate of unemployment or the long run unemployment rate is measured by the trend rate of unemployment. For modeling the expectations of inflation rate, there are two approaches; adaptive expectation model and rational expectations[7]model. In the present work, we have employed adaptive expectations scheme according to which the current expected price inflation is equal to the one period lagged actual price inflation[8] i.e.,

$$Infl(GNPD)^e = Infl(GNPD)_{-1} \quad \ldots.(3)$$

Thus, in light of (3), the expectation augmented Phillips curve (2) becomes,

[5] Assuming a constant real wage rate, actual price inflation rate Infl(GNPD) , will be equal to nominal wage inflation rate (Infl(w)).

[6] The NAIRU can be estimated by identifying a rate of unemployment where the inflation rate neither accelerates nor deaccelerates.

[7] The expectation of a variable is said to be rational for a given information set if it is the same as the conditional expectation of that variable.

[8] According to adaptive expectation scheme $Infl(GNPD)^e - Infl(GNPD)^e_{-1} = \lambda[Infl(GNPD)_{-1} - Infl(GNPD)^e_{-1}]$, where λ is speed of adjustment , $0<\lambda\leq 1$ when $\lambda=1$, $Infl(GNPD)^e = Infl(GNPD)_{-1}$.

$$Infl(GNPD) = Infl(GNPD)_{-1} - \delta (U - U^*) \quad \ldots.(4)$$

It is obvious equation (4) that empirical implementation of the expectation augmented Phillips curve given by equation (4) would require data on unemployment in addition to prices. The empirical investigators has to proceed by recognizing the limitation of non-availability of data on unemployment in India. Like any other low developed countries, India has no comprehensive data on the extent of overall unemployment. Broadly, there three sources of data on unemployment in India. First is the population census which collects information on economic activity of the people. The census data provides an inventory of human resources of the country showing their number, characteristics, occupation and distribution among various branches of economy with 10 years gap. For growth of labour force the classification followed is: main workers and marginal workers; rural and urban workers ; mail workers and female workers. Second, National Sample Survey Organisation(NSSO) has been conducting quinquennial surveys on a regular basis since 1972-73 to generate national level data on unemployment and employment in India. The NSSO has, over time developed and standardized measures of employment and unemployment. But these surveys are done with a gap of 5 years in the initial stages. The NSSO collects data on employment and unemployment using three broad measures or approaches on urban and rural population 1. Usual Status; 2. Current Weekly Status; and 3. Current Daily Status. Third, sources is on the basis of registration in the employment exchanges which gives a gross under estimate of unemployment in India.

Thus, it can be said that no source provides regular, reliable and well defined long time series data on unemployment in India. And therefore, a meaningful source of data on unemployment to be employed for the estimation of expectations augmented Phillips curve can be treated as non-existent. Therefore, we need to reformulate equation (4) in a way that can be estimated from a reasonably reliable and available set of data.

To that end, expectation augmented Phillips curve in equation (4) can, for the save of convenience, can be written as:

$$Infl(GNPD) = Infl(GNPD)_{-1} - \delta (U - U^*) - h(U - U_{-1}) \quad \ldots.(5)$$

where, Infl(GNPD) and $Infl(GNPD)_{-1}$ represent respectively actual and expected rates of inflation. U, U_{-1}represent respectively the current and lagged unemployment rates; and U*, δ and h are

positive parameters the natural rate of unemployment, the sensitivity of prices to the labour market disequilibrium, and the sensitivity of the rate of inflation to the rate of recovery in the economy.

Since simple Phillips curve lies at the root of the aggregate supply curve and the two differ only in terms of gap between unemployment rates and output respectively, it is possible to write,

$$U^* - U = \alpha ((y-y^*)/ y^*) \quad \ldots. (6)$$

where α is a positive constant such that $\alpha = 1-U^*$.

Similarly, a close link can be established between changes in the unemployment rate over time and the deviation of actual output growth from the trend rate of growth. Okun(1983) formally quantified such a relationship which is now knowns a 'Okun's Law'. It can be written symbolically as;

$$U-U_{-1} = -(1/q) (Gy-Gy^*) \quad \ldots.(7)$$

where, q is Okun's parameter reflecting the cost of cyclical unemployment; and Gy and Gy* are respectively the actual and trend rates of output growth.

Substituting equation (6) and (7) in equation (5) we get

$$Infl(GNPD) = Infl(GNPD)_{-1} - \delta ((y-y^*)/ y^*) - h/q(Gy-Gy^*) \quad \ldots.(8)$$

This form of inflation augmented Phillips curve can be estimated empirically with the help of the data on price and output. The explicit mention and requirement of unemployment data is avoided.

Equation (8) represents our basic equation for the expectation augmenting Phillips curve. A deterministic version of the equation to be empirically estimated can be stated as :

$$Infl(GNPD)_t = \beta_0 + \beta_1 Infl(GNPD)_{t-1} + \beta_2((y_t-y_t^*)/ y_t^*) + \beta_3(Gy-Gy^*) \ldots.(9)$$

where, β_0, is intercept and represents the 'autonomous' rate of inflation which is independent of the expected rate of inflation, the output gap (unemployment rate), and the deviation of actual from potential output growth rate (rate of recovery) in the economy. β_1 is the coefficient of expected rate of inflation and is important for making a distinction between short run and long run Phillips curve. If $\beta_1=0$, it means there is complete money illusion in the wage bargaining process. It would be

money wage rather than real wage that mattered. If $\beta_1=1$, it implies that there is no long run trade-off between inflation rate and unemployment rate and the Phillips curve is vertical in the long run. If $0<\beta_1<1$, then the long run Phillips curve is not vertical. β_2 represents sensitivity of wages(hence prices) to the labour market disequilibrium and determines the slope of the Phillips curve. β_3 , represents the sensitivity of the rate of inflation to the rate of recovery in the economy.