Wage Dynamics: Reconciling Theory and Evidence

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U.S. macroeconometric evidence shows a negative relation between the rate of change of wages and the unemployment rate, conditional on lagged price inflation. This (wage) Phillips-curve relationship can be interpreted as a negative relation between the expected rate of change of the real wage and unemployment.

In contrast, most theories of the natural rate of unemployment imply what David Blanchflower and Andrew Oswald (1994) have labeled a ''wage curve,'' that is, a negative relation between the level of the real wage and unemployment, given the reservation wage and (if rent-sharing matters for wage determination) the level of productivity. For example, models of unemployment based on efficiency wages, matching (or bargaining) models, and competitive wage determination all generate such a wage-curve relation (Blanchard and Katz, 1997).

How can one reconcile the empirical Phillips-curve relation and the theoretical wage-curve relation? In this paper, we address this question and make three main points:

(i) We derive the condition under which one can go from the theoretical relation to a wage Phillips-curve specification that matches the U.S. empirical evidence. We show the constraints that such a condition imposes on the determinants of workers' reservation wages as well as the relative importance of workers' outside options (as opposed to match-specific productivity) in wage determination.

(ii) In the light of this condition, we reinterpret the presence of an ''error correction'' term in macroeconometric wage relations for most European economies but not in the United States.

(iii) We also show that whether this condition holds or not has important implications for the effects of a number of variables, from real interest rates to oil prices to payroll taxes, on the natural rate of unemployment.

I. The Phillips Curve and the Wage Relation

The relation between aggregate (annual) time-series data on wage inflation, price inflation, and unemployment in the United States is reasonably well represented by a textbook Phillips curve of the following form:

$$(1) \quad w_t - w_{t-1} = a_w + (p_{t-1} - p_{t-2})$$
$$- \beta u_t + \varepsilon_t$$

where p and w are, respectively, the logarithms of the price level and nominal wage, u is the unemployment rate, a_w is a constant, and ε is an error term. The usual interpretation of this equation is that the lagged inflation term $(p_{t-1} - p_{t-2})$ proxies for expected current inflation $(p_t^e - p_{t-1})$. Under this interpretation, we can rewrite (1) to yield

$$(2) \quad (w_t - p_t^e) = a_w + (w_{t-1} - p_{t-1})$$
$$- \beta u_t + \varepsilon_t.$$

The macroeconomic empirical wage equation implies that the (expected) log real wage depends on the lagged log real wage (with a coefficient of 1) and the unemployment rate. A low

unemployment rate leads to an increase in the expected real wage, and a high unemployment rate leads to a decrease in the expected real wage.

Turn now to theory. Almost all theoretical models of wage-setting generate a strong core implication: the tighter the labor market, the higher is the real wage, given the workers' reservation wage. Most efficiency-wage or bargaining models deliver a wage relation that can be represented (under some simplifying assumptions about functional form and the appropriate indicator of labor-market tightness) as

$$(3) \quad (w_t - p_t^e) = \mu b_t + (1 - \mu)y_t - \beta u_t + \varepsilon_t$$

where b is the log reservation wage and y is the log of labor productivity. The (expected) real wage depends on both the reservation wage (the wage equivalent of being unemployed) and the level of productivity. The parameter μ ranges from 0 to 1. In some efficiency-wage models, such as the shirking model of Carl Shapiro and Joseph Stiglitz (1984), productivity does not affect wages directly, so that $\mu = 1$. In bargaining models (e.g., Dale Mortensen and Christopher Pissarides, 1994), μ is typically less than 1 since wages depend on the surplus from a match and, thus, on productivity.

Inspection of the empirical wage equation (2) and the theoretical wage equation (3) shows two important differences. First, the reservation wage and level of productivity enter (3) but not (2). Second, the Phillips curve gives a relation between the change in the real wage and unemployment, whereas the theoretical model implies a relation between the level of the real wage (given the reservation wage and productivity) and unemployment. These two distinctions are in fact intricately related. They point to the need to look at the determinants of the reservation wage, to see whether and when one can reconcile the two specifications.

The reservation wage depends first on the generosity of unemployment benefits and the other forms of income support individuals can expect to receive if unemployed. The institutional dependence of unemployment benefits on previous wages suggests that reservation wages will move with lagged wages. Much psychological research, and fairness models of wage determination, also suggest that workers' aspirations in job search and wage bargaining are likely to be shaped by their previous earnings. The reservation wage depends on what the unemployed do with their time, what is typically called the utility of leisure but which also includes home production and earnings opportunities in the informal sector (the black and gray economies). A plausible benchmark is that increases in productivity in the informal and home production sectors are closely related to those in the formal market economy. The reservation wage finally depends on nonlabor income. It also seems reasonable, at least with Harrod-neutral technological progress, for productivity increases to lead to equal proportional increases in labor and nonlabor income.

Together, these factors suggest that the reservation wage is likely to depend on both productivity and lagged wages. The empirically reasonable condition that technological progress does not lead to a persistent trend in the unemployment rate puts an additional restriction on this relation, namely, that the reservation wage be homogeneous of degree 1 in the real wage and productivity in the long run. Rather than work with a general distributed lag relation, let us assume, for illustrative purposes, the following simple relation among the reservation wage, the real wage, and the level of productivity:

$$(4) \quad b_t = a + \lambda(w_{t-1} - p_{t-1}) + (1 - \lambda)y_t$$

where λ is between 0 and 1. Substituting this expression for the reservation wage into the wage relation (3) and rewriting gives

$$(5) \quad (w_t - p_t^e) = \mu a + \mu\lambda(w_{t-1} - p_{t-1}) + (1 - \mu\lambda)y_t - \beta u_t + \varepsilon_t.$$

A comparison of equations (2) and (5) implies that the theoretical wage relation is consistent with the Phillips-curve representation if and only if $\mu\lambda = 1$. This can only occur if two conditions are simultaneously satisfied:

(i) There is no direct effect of productivity on wages given the reservation wage ($\mu = 1$).

(ii) There is no direct effect of productivity on the reservation wage ($\lambda = 1$).

Both conditions are extreme but cannot be ruled out. For example, the Shapiro-Stiglitz efficiency-wage model, plus the assumption that the reservation wage depends only on unemployment benefits, which are in turn proportional to the previous wage, yields both conditions. The strong performance of a standard wage Phillips-curve specification on U.S. data therefore suggests that $\mu\lambda = 1$ may be a reasonable approximation for the United States.[1]

II. The United States versus Europe

It has been known for some time that there is a striking difference between the empirical wage–unemployment relations in the United States and Europe. The difference, which might appear at first to be rather esoteric, is the presence of an error correction term in the European but not in the U.S. wage equation. Our discussion gives a natural interpretation to this difference.

As a starting point, note that we can rewrite equation (5) as

$$(6) \quad (w_t - w_{t-1})$$

$$= \mu a + (p_t^e - p_{t-1})$$

$$- (1 - \mu\lambda)(w_{t-1} - p_{t-1} - y_{t-1})$$

$$+ (1 - \mu\lambda)\Delta y_t - \beta u_t + \varepsilon_t.$$

[1] The specification in equation (4) may be seen as imposing too fast an adjustment of the reservation wage to the real wage and to productivity. Our point goes through, however, for general specifications. The following example is also of interest. Suppose that b follows a partial adjustment process with respect to the real wage: $b_t = a + \delta b_{t-1} + (1 - \delta)(w_{t-1} - p_{t-1})$. Replacing in the wage equation, assuming $\mu = 1$, and rewriting gives

$$(w_t - w_{t-1}) = a + (p_t^e - p_{t-1})$$

$$- \beta(u_t - \delta u_{t-1}) + (\varepsilon_t - \delta\varepsilon_{t-1}).$$

Thus, slow adjustment of the reservation wage implies the presence of a lagged term for unemployment (with a positive coefficient), which is indeed a feature of U.S. data.

Wage inflation depends not only on expected inflation and the unemployment rate, but also on an error correction term, defined as the difference between the lagged real wage and lagged labor productivity. That this is in general a theoretically more appropriate specification of the wage relation than the Phillips curve was a point first made by J. D. Sargan as early as 1964. Equations along the lines of (6) have since been estimated for various OECD countries by a number of researchers (e.g., OECD, 1997).

These specifications differ in various ways, in particular in their construction of labor productivity (trend or actual) and of expected inflation. For our purposes, however, they consistently yield one main conclusion. The coefficient on the error correction term for the United States is close to zero with point estimates that are typically wrong-signed (i.e., implying a positive effect of the lagged real wage adjusted for productivity on current wage inflation), but small and insignificant. Put another way, the Phillips-curve specification, which is nested in equation (6), appears to provide a good description of the data. In most European countries, however, the error correction term comes in with a significant and right-signed coefficient. On average, $(1 - \mu\lambda)$ is around 0.25.

The discussion in the previous section provides an interpretation of these findings in terms of μ and λ. In the United States, both μ and λ are close to 1; in European countries, either μ or λ or both are significantly less than 1.

This interpretation raises in turn three questions. First, how seriously should we take conclusions about μ and λ derived from estimation of aggregate relations? Second, why does it matter what the values of μ and λ might be? Third, what may explain the differences in μ and λ across the two sides of the Atlantic? We briefly take each one in turn.

III. Micro versus Macro Data

The macroeconomic data clearly support a textbook wage Phillips-curve specification for the United States and a modified

specification with error correction but strong autocorrelation of wages for OECD Europe. The possibility of strongly autocorrelated unobservables that affect wages has led some to argue that estimation using aggregate data may spuriously bias the effects of lagged wages on current wages. Following this argument, Blanchflower and Oswald (1994) have argued that micro (state or regional) data provide a more appropriate testing ground for comparing Phillips-curve and wage-curve specifications. The typical empirical approach to comparing Phillips curves and wage curves on state (or regional) data has been to start from equation (5), to assume that the expected price inflation and productivity variables relevant for wage-setting are independent of the state and could thus be captured by time dummies (d_t), and to run

$$(7) \quad w_{s,t} = a_s + \gamma w_{s,t-1} - \beta u_{s,t} + d_t + \varepsilon_{s,t}$$

where s indexes state. Under these assumptions, the estimated value of γ will yield an estimate of $\mu\lambda$.

One of the main conclusions reached by Blanchflower and Oswald (1994) was that γ is indeed close to zero even in the United States. In other work (Blanchard and Katz, 1997), we have reexamined their evidence and concluded that the value of γ one obtains from such an approach is in fact close to 1. (Similar conclusions have been reached by David Card and Dean Hyslop [1997] for the United States and by Brian Bell [1996] for a number of other countries).

A more important point is that this approach, at least with its reliance on time fixed effects to capture aggregate variables, cannot give us a reliable estimate of $\mu\lambda$. If one relaxes the implicit assumption of no interstate labor mobility that is typically implicit in estimates of (7), wages in a state are likely to depend not only on lagged state wages, but also on the aggregate wage. In this case, the lagged aggregate wage effect will be hidden in the time fixed effects, leading to a downward bias in estimates of γ. This source of bias is likely to be especially important for the United States, where labor mobility is a major source of adjustment to state labor-market shocks (Blanchard and

Katz, 1992).[2] (This obviously does not imply that the aggregate equation is correctly specified or identified; but this is another issue.)

IV. Implications for the Natural Unemployment Rate

Whether μ and λ are equal to or less than 1 has important implications for the determination of the natural rate of unemployment.[3] Let us close our model of the labor market with a simplified "price-setting" or "demand-wage" relation of the form

$$(8) \quad w_t - p_t = y_t - x_t$$

where x represents any factor that decreases the wages firms can afford to pay (consistent with zero profits for competitive product markets or an equilibrium markup for noncompetitive product markets) conditional on the level of technology.

Combining equations (5) and (8) and ignoring expectational errors (replacing p_t^e by p_t) gives the equilibrium (natural) rate of unemployment, call it u_t^*:

$$(9) \quad u_t^* = (1/\beta)[\mu a - \mu\lambda\Delta y_t$$
$$+ \Delta x_t + (1 - \mu\lambda)x_{t-1} + \varepsilon_t].$$

If we assume that both x and y are constant and ε is equal to zero, this equation further reduces to

$$(10) \quad u^* = (1/\beta)[\mu a + (1 - \mu\lambda)x].$$

Thus, whether x has a permanent effect on the natural unemployment rate depends on whether $\mu\lambda$ is less than or equal to 1. If $\mu\lambda$ is

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[2] The approach is fine for asking about responses to state-specific shocks, but this is a different question from responses to macro (national) shocks. Also, in principle the approach can be extended to answer the question at hand by replacing time fixed effects by explicit aggregate variables. But it then faces the same problems of specification as the aggregate wage equation.

[3] We therefore disagree on this point with the arguments in recent papers by John Roberts (1997) and Karl Whelan (1997).

equal to 1, the level of x has no effect on the natural rate. If $\mu\lambda$ is less than 1, the higher the level of x, the higher is the natural rate.

Thus, if $\mu\lambda$ is indeed equal to 1 in the United States, but is less than 1 in Europe, this implies that factors such as the level of energy prices, interest rates, or payroll taxes will have no effect on the natural rate in the United States but will have an effect on the natural rate in Europe. Given the large movements in these variables over the last three decades, this is clearly a crucial difference between the two labor markets.

There is another issue for which the exact specification of the wage relation and the values of μ and λ have potentially important implications, namely, the implications for the relation between inflation and unemployment (when the wage and the price relations are combined). We want to mention it although we have only limited progress in solving it. Much of the recent empirical work in macroeconomics has built on the work of John Taylor (1980). In the standard specification, the wage is set equal to the average desired wage over the duration of a labor contract; the desired wage is then a function of the price level and the unemployment rate. Importantly, for our purposes, the reservation wage is implicitly held constant. This line of research has run into an empirical problem (see Jeff Fuhrer and George Moore [1995] for a discussion): it implies little or no direct dependence of inflation on lagged inflation. This is in contrast to the reduced-form evidence, which suggests a relation among the inflation rate, the lagged inflation rate with a coefficient equal to 1, and the unemployment rate. We suspect that taking into account the dependence of the reservation wage on past wages holds a key to understanding the dependence of inflation on itself lagged. But we have not established it yet.

V. What Explains the Difference Between Europe and the United States?

To summarize, the macro evidence clearly indicates a lack of an error correction term in the United States and substantial error correction effects for OECD Europe. Our conceptual framework attributes these differences either to differences in $(1 - \mu)$, the direct effect of productivity of wages ($1 - \mu = 0$ for the United States, $1 - \mu > 0$ in Europe), or to differences in $(1 - \lambda)$, the direct effect of productivity on the reservation wage ($1 - \lambda = 0$ for the United States, $1 - \lambda > 0$ in Europe), or both.

With respect to μ, the greater role of unions in wage-setting and more stringent hiring and firing regulations in Europe could play a role in these differences in wage-setting behavior. Suggestive evidence of a greater direct effect of firm productivity on wages in Europe than in the United States comes from John Abowd et al.'s (1998) comparisons of wage-setting in France and the United States using comparable matched employer–employee longitudinal data.[4] They find much stronger positive effects of productivity, capital intensity, and profitability on establishment wage differentials, conditional on worker characteristics, in France than in the United States.

With respect to λ, the role of the underground economy for the unemployed in many continental European economies may also be significant. However, we are not aware of direct evidence on this point.

Overall, our analysis indicates the importance of a better understanding of the determinants of reservation wages and of the importance of firm-specific rents as opposed to external labor-market conditions in wage-setting in both Europe and the United States.

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[4] For our purposes, however, we care not only about the effect of firm productivity, but also about the effects of sectoral and aggregate productivity on wages. The last two effects are not identified in Abowd et al.'s study.

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