

Comments and Discussion

Robert J. Gordon: Hall's paper makes a major contribution with its theoretical analysis of the role of turnover and quality adjustments in the process of wage setting. But it is seriously deficient when viewed as an attempt at comprehensive analysis of the inflation process. The major problem is the failure to assign any role to prices in the setting of wages; indeed, scarcely anywhere in this entire paper on the "inflation process" does the word "prices" appear. I have become convinced that monetary and fiscal policies influence wages not directly by raising or reducing the rate of unemployment, but indirectly through a chain of effects, first, on excess demand, then on prices in the product market, and finally on the demand for labor. My own contributions to *Brookings Papers* have estimated the effect on wages of product prices (as distinguished from consumer prices); and the experience of 1973, when rising farm prices raised consumer prices relative to nonfarm product prices and wages, can be cited as a prime example of the independent "channel of influence" through which product prices make themselves felt. If we are interested in *anything* about wages in the context of 1974 food and energy inflation, it is the channels by which an exogenous shock in prices relative to wages feeds through to the behavior of nonfarm wages.

Hall has responded in part to this criticism in his final section, "Postscript on the Role of Prices." His basic argument is that the product price adds no information beyond that already contained in the unemployment variable. Consider a standard labor market diagram with the nominal wage rate on the vertical axis and manhours on the horizontal axis, and with a negatively sloped labor demand curve that depends on the product price, and a positively sloped labor supply curve that depends on the ex-

pected consumer price level. An increase in the product price relative to workers' expectations about the price level—which occurs because these expectations take time to adjust—will shift the demand curve upward to a new intersection northeast of the original equilibrium position. In this simple case Hall is correct in asserting that the product price adds no information beyond that provided by the unemployment variable. The product price simply measures a vertical shift in labor demand, while the unemployment rate, usually introduced as a proxy for the net excess demand for labor, measures the same shift horizontally. When workers' expectations fully adjust to the new, higher, price level, the labor supply curve shifts up by the amount of the original shift in the demand curve, and the unemployment rate returns to its initial level. Rising wages and increasing unemployment are observed simultaneously, an anomaly explained in the conventional framework by lags in the formation of price expectations, and in Hall's framework by lags in the adjustment of the scale wage to the effective wage.

The redundancy of the product price variable disappears, however, in an individual labor market where labor input is supplied inelastically (that is, a market characterized by a vertical supply curve). For instance, an exogenous increase in the relative price of coal, such as has occurred during 1974, would raise the equilibrium nominal wage of coal miners without simultaneously changing their unemployment rate, *if* coal miners were initially fully employed and if union restrictions or geographical isolation prevented the recruitment of new coal miners from other industries or regions. An aggregate wage equation in which the explanatory variables include both unemployment and the relation between the current product price and expected consumer prices could explain the bulge in the aggregate wage index caused by higher coal wages, but Hall's equation would fail, since it includes only unemployment and lagged wages.¹

This example is not an empirical oddity, but may be potentially important to the extent that the prime-age segment of the adult-male labor force is characterized by a vertical labor supply curve. An external event occur-

1. I implicitly assume that nominal income, output, prices, and unemployment in the noncoal sector are unchanged. An alternative assumption more in tune with recent events would have policymakers hold nominal income constant in the whole economy, in which case the higher price of coal would then require a reduction in noncoal real output and an increase in noncoal unemployment. Hall's equation would be particularly inadequate in this case, since the aggregate wage index and the aggregate unemployment rate would be observed to increase together.

ring in a prosperous period—say, a devaluation—might raise the wage rate of adult males without any appreciable effect on their unemployment rate if initially their unemployment rate were near its irreducible “frictional” minimum.

Recent events have reminded us of another route by which prices may raise wage rates without a simultaneous reduction in unemployment. An increase in the relative price of farm products or foreign oil can raise the consumer price index without directly affecting the price of nonfarm products.² In graphic terms, in the nonfarm sector, the labor supply curve shifts up along the fixed labor demand curve as expectations adjust to the higher consumer prices, and employment falls while the wage rate increases. Once again Hall’s approach provides no explanation of the simultaneous increase in wage rates and unemployment.

In the United States the price deflator for consumer goods includes two important categories—farm products and imports—that are excluded from the index for nonfarm product prices, while the latter includes three categories—exports, structures, and producers’ durable equipment—that are excluded from the former. Numerous economic circumstances can cause the two indexes to diverge, and the private nonfarm wage rate will in general depend on both. In my own work for *Brookings Papers*, the wage rate depends on both price indexes, and the distinction between them adds explanatory power in a period like 1956, when an increase in the prices of investment goods relative to consumer goods contributed to an unusually rapid acceleration of wage increases.³ In this light, the slow growth of wage rates relative to consumer prices in 1973–74 can be seen partly as the result of the reduction in the ratio of private nonfarm prices to consumer prices, which in turn was due to higher farm and oil prices; the more immediate effect of devaluation on import than on export prices; and finally the price controls in the nonfarm sector.

Although Hall’s paper makes an important contribution to the theory of labor markets, it is not as general as one might wish. Hall adds varia-

2. Here I ignore substitution between domestic and foreign oil, which would tend to drive up the domestic nonfarm price index.

3. Between 1955:4 and 1956:4 the price deflator for producers’ durable equipment increased by 7.9 percent, as compared with an increase in the deflator for consumption of only 3.0 percent. A very large increase in social security contributions also raised wages during that period. Hall’s equation, which omits both of these factors, is forced to attribute all of the wage increase to lower unemployment, leading to a short-run Phillips curve that is too steep.

tions in labor quality to wage changes as a second instrument of employer policy. Unlike Mortensen,⁴ who allows simultaneous adjustment of worker quality and wage rates, Hall restricts the firm to quality adjustments in the short run, allowing adjustments of the scale wage only in subsequent periods. While this dynamic specification may be appropriate for the unionized sector of the economy with its long-term contracts, in a very substantial portion of the labor market wages may change frequently and at variable intervals. Wachter's paper in this issue provides ample evidence of the longer adjustment lags in the union sector, relative to nonunion industries. For the sizable nonunion segment of the labor market, I prefer Mortensen's approach:

If in the "short run" there is a general increase in demand for the products of firms, then each firm lowers the skill requirements attached to its vacancies and attempts to raise its wage offer relative to all others in the market in order to attract labor at a more rapid rate. The consequence of this joint strategy is that wage inflation is systematically associated with general lowering of minimum skill requirements.⁵

For the union sector and for some nonunion jobs in large organizations, however, Hall does advance beyond Mortensen in emphasizing that the bureaucratically set scale wage introduces a lag between changes in labor market conditions and in measured wage rates.

The Hall and Mortensen approaches share the disadvantage of operating symmetrically during periods of excess labor demand and supply. In Hall's model a decline in product demand leads initially to the appearance of more able applicants in the personnel office, and then to reductions in the scale wage. In many firms high-quality applicants would not be hired during a recession as long as experienced laid-off workers had not been recalled. Hall nevertheless advances the analysis by pointing to the possibility of downward flexibility of labor costs during a recession despite an inflexible scale wage. Even if a firm is not actively hiring, it may enhance the quality of its work force by laying off those workers who are least productive relative to their wage—that is, those on whom the firm makes the smallest profit.

Beyond his distinction between the scale and effective wages, Hall shows how the marginal and average effective wages can diverge. This is a novel

4. Dale T. Mortensen, "Job Search, the Duration of Unemployment, and the Phillips Curve," *American Economic Review*, Vol. 60 (December 1970), pp. 847–62.

5. *Ibid.*, p. 855.

and interesting idea: new workers may be paid more than old ones in the sense that they provide labor services of lower quality for the same wage, and yet old workers may not quit if their wage rate contains a premium for the specific human capital that their employer has invested in them. Unfortunately, an empirical test of this source of lags in the response of average wage rates to changes in product demand cannot be made without personnel records. On a theoretical basis, the same lag in the data can be explained in the context of the formation of price expectations.

While the elimination of price expectations from the wage equation might be justified as one step toward eliminating unobservable variables, Hall's scale wage is just as unobservable in the aggregate economy and must be estimated by extrapolating observable wages, just as the expected rate of inflation has been estimated from data on the response of interest rates to past inflation. In fact, one can argue that expected inflation is more readily observable than the scale wage, given the substantial and growing body of U.S. survey data on the question.

The primary policy conclusions of Hall's empirical estimates are (1) that the natural rate of unemployment is 5.5 percent, so that the unemployment rate must be held above that level if the rate of wage change is to decelerate, and (2) that the slope of the short-run Phillips curve relationship is fairly steep, with an increase of 1 percentage point in the unemployment rate sufficient to reduce the marginal effective wage by 1.0 percent. The 5.5 percent estimate of the natural rate is somewhat higher than that in my own work, but not by enough to merit comment, especially since the data are not capable of drawing fine lines between hypotheses. But the steep slope of Hall's Phillips curve may mislead policymakers into believing that a short, sharp recession that raises the unemployment rate to, say, 7.0 percent will cause an immediate and marked reduction in wage inflation, as occurred in Hall's data in 1958 and 1961.

There are four possible sources of error in Hall's slope coefficient. First, his omission of tax and price variables leads his equation to attribute an acceleration in wage inflation entirely to reduced unemployment in episodes like 1956 and 1966 when taxes and product prices rose during periods of falling unemployment. Second, using compensation instead of earnings corrected for changes in interindustry employment mix means treating a procyclical increase in high-wage employment in durable goods industries as an increase in the wage rate, thus raising the estimated coefficient on the unemployment variable. Third, measurement error tends to intensify the

uptrend of the compensation series relative to wage rates during 1956–57, 1964, and 1966.⁶ Finally, sensitivity tests with my data sources indicate that the coefficient on unemployment in the wage equation became substantially smaller in the late 1960s compared with the late 1950s, and thus a 1961-type recession may take substantially longer to tame inflation than Hall's results suggest.⁷ This shift in structure may have occurred in response to the greater availability of unemployment benefits, welfare payments, and food stamps which reduce the burden of unemployment, tending both to lengthen it and relieve the pressure on workers to accept lower wages.

James Tobin: As always, Bob Hall has given us a stimulating and thought-provoking paper. It is full of insights on labor markets and wage setting, which in some degree reconcile the often divergent views of labor economists and macro theorists. I believe the paper opens a number of promising lines of inquiry.

It has been a dismal experience over the years to come to the Brookings panel meetings and see the empirical long-run Phillips curve shift steadily upward and become steeper and steeper. Now Hall has outdone his predecessors, including himself, and tells us that the natural rate of unemployment—he calls it the equilibrium rate—exists and is about 5.5 percent. I find one consolation in this estimate. No one can identify a 5.5 percent natural rate with optimal unemployment or voluntary search unemployment or frictional unemployment matched by vacancies. If the lowest unemployment rate consistent with nonaccelerating inflation is so high, it must be because the wage-setting institutions of this economy have an inflationary bias. I do not think Hall himself attaches any normative significance to his equilibrium rate.

This paper gives no prescription for diminishing the equilibrium rate, nor are the appropriate measures apparent from the structure of the model. According to Hall, the basic problem is that the unemployment rate must rise above 5.5 percent before employers can find workers at the prevailing wage scale who are qualified for the job categories for which replacement

6. See Figure 1 in my "Inflation in Recession and Recovery," *Brookings Papers on Economic Activity* (1:1971), p. 117.

7. Walter Y. Oi, "On Measuring the Impact of Controls: A Critical Appraisal" (paper presented to the Rochester Conference on Wage-Price Controls, November 9, 1973; processed), Table 1.

hiring or new recruiting is necessary. In tighter labor markets employers are continuously placing new and old workers in jobs in which their productivity falls short of the scale wage.

Hall's basic insight is his distinction between the scale wage, s , and the marginal effective wage, w' . The wage scale is designed to put workers in jobs for which they are qualified—that is, for an allocation of worker types to job types that maximizes output per effective (or quality-weighted) labor input. When the labor market is tight, as measured by some unemployment rate u , w' exceeds s because new workers are placed in jobs beyond their qualifications. When the labor market is slack, w' is smaller than s because new workers are available who are overqualified for the jobs to which they are assigned. The equation is $w' = sg(u)$, where $g(u)$ is the wage-adjustment function, and the natural rate of unemployment is u^* where $g(u^*) = 1$.

According to Hall, employers—or employers and unions in collective bargains—attempt to set the scale wage each period to equal their estimate of the marginal effective wage for that period. Their belief is that $\ln w'$ depends on its own lagged values. Thus s depends on lagged values of w' , which means it depends on lagged values of $sg(u)$. The weight of any past year's scale wage in today's setting of that wage therefore depends on how tight the labor market was that year.

THE FORMAL MODEL

Hall's model of wage determination is a new version of the accelerationist, or natural-rate, hypothesis. In order to understand it, I have found it helpful to look explicitly at its formal properties.

The basic equation is a difference equation in the marginal effective wage, w' :

$$(1) \quad \ln w'(t) = \sum_{\tau=1}^n \beta_{\tau} \ln w'(t - \tau) + \ln g(u(t)).$$

(The numbering of equations here does not correspond to Hall's.) The summation on the right is the prediction of $\ln w'(t)$ from past history. Hall denotes it $\ln Ew'(t)$, and sets the scale wage $s(t)$ equal to it. (I will simply use a hat to denote a predicted value—for example, \hat{w} .) He assumes throughout that

$$\sum_{\tau=1}^n \beta_{\tau} = 1.$$

When $g(u(t))$ exceeds 1, the actual wage $w'(t)$ is pushed above the scale wage—that is, above the predicted value $\hat{w}'(t)$. The reverse occurs when $g(u(t))$ is less than 1.

For notational economy, let $z(t) = \ln w'(t)$ and $f(t) = \ln g(u(t))$. Let us also, following Hall's empirical specification, let $n = 3$. Equation (1) then becomes

$$(2) \quad z(t) - \beta_1 z(t - 1) - \beta_2 z(t - 2) - (1 - \beta_1 - \beta_2)z(t - 3) = f(t).$$

Following Hall, let

$$\mu = \sum_{i=1}^n \beta_i \tau = \beta_1 + 2\beta_2 + 3\beta_3.$$

Then the two parameters of the difference equation are β_1 and μ :

$$(3) \quad z(t) - \beta_1 z(t - 1) - (3 - \mu - 2\beta_1)z(t - 2) - (\beta_1 - 2 + \mu)z(t - 3) = f(t).$$

I consider several cases:

(a) $\mu = 0, f(t) = 0$ for all t . When $\mu = 0$, according to Hall, there is only one unemployment rate compatible with steady nonaccelerating inflation or deflation, the one for which $g = 1$ and $f = 0$. At this natural rate of unemployment, any steady rate of inflation is possible.

(b) $\mu = 0, f(t) = f \neq 0$ for all t . According to Hall, there will be accelerating inflation when f is a constant positive number, accelerating deflation when f is a constant negative number.

(c) $\mu \neq 0, f(t) = f$ for all t . In these cases, according to Hall, there is for any given value of μ a relationship $m(f)$ which tells the steady inflation rate consistent with each value of f .

Given case (a), in which $\mu = 0, f(t) = 0$, the general solution of (3) is

$$(4) \quad z(t) = c_1 + c_2 t + c_3(\beta_1 - 2)^t.$$

Recall that, in this case, $\beta_1 - 2 = \beta_3$.

The c s are related to the initial conditions as follows:

$$(5) \quad \begin{cases} c_1 + c_3 = z(0) \\ c_1 - c_2 + c_3\beta_3^{-1} = z(-1) \\ c_1 - 2c_2 + c_3\beta_3^{-2} = z(-2). \end{cases}$$

In particular, if the initial values of z show steady inflation—that is, $z(-1) = z(0) - m, z(-2) = z(0) - 2m$ —then $c_3 = 0, c_2 = m, c_1 = z(0)$, and $z(t) = z(0) + mt$. This is Hall's "natural rate" proposition for this case. Equation (4) also shows that the steady inflation path is stable pro-

vided the absolute value of β_3 is smaller than 1—that is, $1 < \beta_1 < 3$. The model per se does not exclude instability, but Hall's empirical estimates are well within the interval for stability. Of course, in a stochastic version of (3) and (4), the value of c_2 , the component that represents the steady inflation rate, m , would vary, and random shocks could also keep the third component of (4) from vanishing.

For case (b), in which $\mu = 0$, $f(t) = f \neq 0$, the solution is

$$(6) \quad z(t) = c_1 + c_2 t + c_3(\beta_1 - 2)^t + \frac{ft^2}{2(3 - \beta_1)}.$$

The final term of (6) is the "acceleration" component. It has the same sign as f if β_1 is less than 3, and it will dominate the path if β_1 is also larger than 1. If β_1 exceeds 3, the third term will dominate, though in which direction it carries the rate of inflation depends on the initial conditions rather than on the sign of f . If β_1 is less than 1, the third term gives an explosive sawtooth oscillation, which will eventually dominate. Thus Hall's accelerationist proposition—that $f \neq 0$ leads to accelerating inflation when $\mu = 0$ —is consistent with his empirical estimates of β_1 .

Fluctuation of u around the equilibrium rate u^* for which $f = 0$, will activate the final term of (6) even if f averages zero. Moreover, because of the nonlinearity of $f(u)$, unemployment averaging u^* means that f is on average positive.

For case (c), in which $\mu \neq 0$, $f(t) = f$, the solution is

$$(7) \quad z(t) = c_1 + c_2 x_2^t + c_3 x_3^t + (f/\mu)t.$$

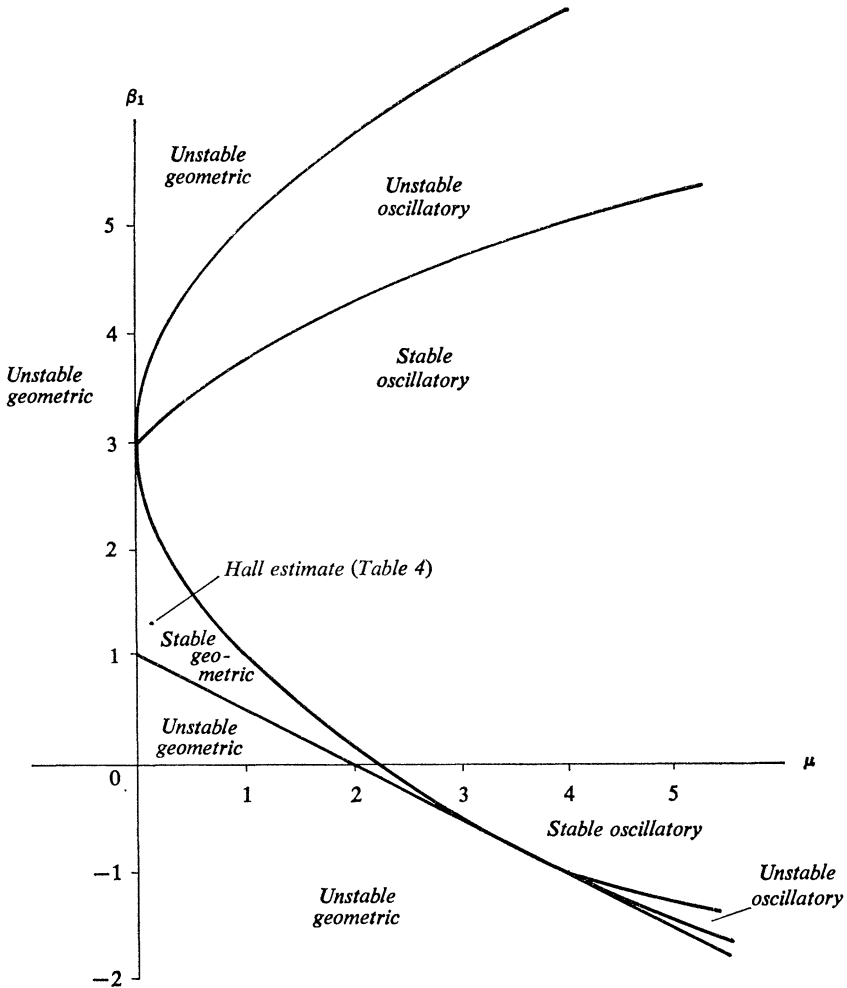
Here

$$(8) \quad x_2 = \frac{\beta_1 - 1}{2} + \frac{\sqrt{(3 - \beta_1)^2 - 4\mu}}{2}$$

$$x_3 = \frac{\beta_1 - 1}{2} - \frac{\sqrt{(3 - \beta_1)^2 - 4\mu}}{2}.$$

In the diagram below the various possibilities of (7) in relation to β_1 and μ are graphed. Here stability means that both x_2 and x_3 are less than 1 in absolute value (or that their modulus is if they are conjugate complex roots). If the stability conditions are satisfied, then steady inflation at the rate f/μ eventually dominates the path. As the diagram indicates, there is *always* instability at negative values of μ ; and for positive μ extreme values of β_1 are associated with instability. Hall's empirical estimates fall in the area where the model is stable and nonoscillatory.

The relation $m = f/\mu$ (for $\mu \neq 0$) is a long-run Phillips curve. For $\mu > 0$ it implies a higher steady-state inflation for a lower unemployment rate. For $\mu < 0$ the long-run Phillips curve slopes the wrong way, but it is in any case irrelevant since the path is unstable.



COMPARISON WITH STANDARD THEORY

According to standard theory, a sufficient condition for acceleration is $\Sigma\beta_\tau = 1$. In Hall's model the additional condition $\mu = \Sigma\beta_\tau = 0$ is necessary. His empirical results do not reject the hypothesis that this condition

is met. But neither do they exclude positive values for μ . In any case, the paper leaves in mystery the source of the additional condition. For example, the popular model of adaptive expectations implies a positive μ , since all the β_τ are positive, in geometrically decaying series. Yet it has been generally accepted that this model is accelerationist, provided that $\Sigma\beta_\tau = 1$ and that the coefficient of expected wage (or price) inflation is equal to unity in the wage equation.

To illuminate the mystery, I shall compare a standard model and Hall's model. It is more convenient, and I think less artificial, to use continuous rather than discrete time. The symbols are the same as in the preceding section; \hat{z} represents the anticipated value of z , and the notation $x'(t)$ means the derivative of x with respect to t .

My version of the standard model is as follows:

$$(9) \quad \hat{z}(t) = \int_{-\infty}^t \beta(t-x) z(x) dx = \int_0^{\infty} \beta(\tau) z(t-\tau) d\tau,$$

where

$$\int_0^{\infty} \beta(\tau) d\tau = 1.$$

In the adaptive expectations case,

$$\begin{aligned} \beta(\tau) &= \gamma e^{-\gamma\tau} \\ \mu &= 1/\gamma. \end{aligned}$$

Differentiating (9) with respect to t gives

$$(10) \quad \hat{z}'(t) = \beta(0) z(t) + \int_{-\infty}^t \beta'(t-x) z(x) dx = \beta(0) z(t) + \int_0^{\infty} \beta'(\tau) z(t-\tau) d\tau.$$

Note that

$$\int_0^{\infty} \beta'(\tau) d\tau = -\beta(0).$$

Differentiating (10) with respect to t gives

$$(11) \quad \hat{z}''(t) = \beta(0) z'(t) + \int_0^{\infty} \beta'(\tau) z'(t-\tau) d\tau.$$

The short-run Phillips relation is

$$(12) \quad z'(t) = \alpha \hat{z}'(t) + f(t),$$

where the natural-rate proposition is that $\alpha = 1$. Combining (10), (11), and (12) gives

$$(13) \quad \frac{\hat{z}''(t)}{\beta(0)} = f(t) + \alpha z'(t) + \int_0^\infty \frac{\beta'(\tau)}{\beta(0)} z'(t - \tau) d\tau.$$

In case of adaptive expectations,

$$\frac{\beta'(\tau)}{\beta(0)} = -\beta'(\tau),$$

and the last term in (13) is $-\hat{z}'(t)$. Thus (13) says, when $\alpha = 1$, that acceleration \hat{z}'' will have the same sign as f . For general $\beta(\tau)$, \hat{z}'' will also depend on the past history of z' . But there is no long-run Phillips curve, as can be seen by setting all past $z' = m$. The integral in (13) will equal $-m$. Current \hat{z}' will equal m , and there will be zero acceleration only if $f = 0$.

Hall's model differs by replacing (12) with an equation in levels rather than rates of change. With $\alpha = 1$, his short-run "Phillips" curve is

$$(14) \quad z(t) = \hat{z}(t) + f(t),$$

or

$$(15) \quad z'(t) = \hat{z}'(t) + f'(t).$$

Consequently, in (13), Hall would have $f'(t)$ instead of $f(t)$. This means that zero acceleration is possible when f is constant though not zero, as indicated for case (c) of the previous section.⁸

However, Hall also appears to assume $\beta(0) = 0$. This means that the sum of the $\beta'(\tau)$ is zero. In (11), therefore, there will be zero acceleration of \hat{z} if z' has been forever constant. This is why it is necessary to investi-

8. Hall acknowledges equation (15), but he says his short-run Phillips curve is orthodox nonetheless. In proof, he subtracts $z(t - 1)$ from both sides of his discrete-time version of (14). This, of course, cannot change its content, which is that each period the scale wage is set to an effective wage predicted on the assumption that f will be zero. It seems quite arbitrary to assume that the gap between actual and expected wages is closed fully in precisely the time unit of the model. The continuous-time counterpart of Hall's model might be $z' = \eta(\hat{z} - z) + f$. But one would certainly wish to add a \hat{z}' term to that expression, as Hall has not done. He is, I believe, mistaken in his assertion that the standard Phillips curve makes the actual wage change depend, apart from $f(u)$, on the difference between expected and current wage—my $\hat{z} - z$, his $E(\Delta \log w)$ —rather than on the change in the expected wage (my \hat{z}' , his $\Delta \log \hat{w}$).

gate, as the previous section does, the conditions under which z' can be constant, and why it turns out to be possible even if $f \neq 0$.

Natural-rate theorists will object with some logic to Hall's formulation, which permits his scale wage and effective wage to diverge by a constant percentage forever if $f \neq 0$ and $\mu \neq 0$. Every period employers and workers try to predict the effective wage, and every period they underpredict (or overpredict) by the same margin. Yet they never learn. Clearly, Hall's model needs a catch-up term, so that the scale wage is advanced faster when it is lagging behind the effective wage.

OTHER COMMENTS

Behind Hall's formal model stands a vision of labor markets that invites some comments.

First, Hall's scale wage is the central parameter of a structure of wages corresponding to job classifications, a structure assumed to remain constant over time and the business cycle. Workers come in quality grades, but their wages depend on their job assignments rather than on their productivity. At the equilibrium unemployment rate, an employed worker is assigned to the job for which he has a comparative advantage. The wage scale is geared to this situation. In other states of the labor market, up- or downgrading of workers alters productivity and drives a wedge between effective labor cost and the scale wage.

Job classifications have been determined, capital equipment installed, and relative wage scales set for a particular mix of labor grades. If we are to believe Hall's results, it is the employment mix corresponding to 5.5 percent unemployment. The mix corresponding to 4 percent would be different, particularly in having more low-skill and inexperienced labor, and the comparative-advantage calculations would come out differently. Why do we have one equilibrium rate rather than the other? Why doesn't the availability of unemployed labor alter the structure of wages and jobs and induce a lower equilibrium unemployment rate?

Second, why is the new scale wage set to equal the marginal effective wage? The employer, Hall argues, will not wish his scale wage to diverge from those of other employers, because then he will not attract the most efficient quality mix of workers. This argument seems to assume that the existing mix of employees is proper; if not, marginal recruitment of a proper mix will not rectify the situation. Here as elsewhere, it would help

if Hall specified the production function of the firm in jobs and skill grades, so that the effects of using workers in jobs above or below their grades are clearly derived. Hall also argues that collective bargaining will make no difference, since the union too has an interest in equality of w' and s . This claim seems to be based on the union's responsibility for the jobs of everyone hired, and it is not always justified.

Third, turnover is essential to Hall's theory. Only because there are always some employers and workers in the market, by choice or otherwise, do effective wages change and pull scale wages along. Intersectoral shifts in product demand and labor supply are the sources of constant turnover and mobility. This phenomenon suggests a disaggregated model in which differences among markets, industries, and firms play an essential role. Instead, Hall's model for the economy as a whole is no different from his model for an individual firm. The fiction of the representative firm permits him to ignore aggregation difficulties.

Fourth, Hall's wage adjustment function $g(u)$ takes the form $\psi_0 - \psi_1 \log u$. However, the parameters of $g(u)$ are allowed to take values in the effective wage equation different from those used in the scale wage equation. One of the pairs is just arbitrarily assumed. The difference is contrary to the model, and $g(u)$ should be constrained to be the same wherever it appears in Hall's equation (3).

My last two comments refer to the introductory material. In these days when new mutants of inflation appear before economists have figured out the old types, we should be modest in our claims for our theories. Hall is concerned with the wage-price-wage dynamic in a closed system. Specifically, he is dealing with the part of the U.S. economy Galbraith calls the "planning" system, as distinct from the "market" system. This is where wages, and prices too, are bureaucratically—though not necessarily monopolistically—administered. In this economy competition works indirectly; wages and prices move when excess demand or supply at existing wages or prices induces business firms to change them. Recently we have learned that even the U.S. industrial economy is not immune from external inflationary shocks, whether from overseas or the domestic agricultural sector. In agriculture and other sectors where self-employment is the pattern, wages are not administered and they are not rigid in the face of fluctuations in product demand or prices.

Finally, while I applaud the integrative intent of Hall's opening paragraph, I must register a mild dissent. Inflation certainly is a monetary

phenomenon, if only by its definition as a decline in the purchasing power of the monetary unit of account. But the determinative sovereignty of any particular quantity denominated in the unit of account is another matter. What we can agree is that in the long run the value of a dollar is determined by the magnitudes of all exogenous variables, stocks or flows, denominated in dollars. But this does not commit us to a belief that M_1 or M_2 or M_{19} is sufficient unto itself to determine the price level, or even that it is exogenous.

General Discussion

Considerable discussion centered on Hall's estimate of the equilibrium unemployment rate. Hall thought part of the reason for the high estimate was his use of the quality-corrected wage index. George Perry noted that he had developed and used a similar wage index which displayed a secular rise relative to the official wage index, because the latter was held down artificially by the growing relative importance of lower-wage workers. In a model linking prices to wages via productivity, such a drift would be offset by a comparable drift in quality-corrected productivity relative to the official measure, so long as wages were proportional to workers' productivity. But Hall's model never went through the wage-productivity-price cycle, a fact that need not bias Hall's estimates, though it does make them harder to relate to other studies. In any case, Perry noted, Hall had estimated the equilibrium unemployment rate using his five industries as 5.1 percent. Taken together with his estimate of 5.5 percent from aggregate data, his results are not very different from those of studies that take account of the changing composition of unemployment.

Hall stressed that he was not advocating the equilibrium unemployment rate, but only describing it as the rate that does not cause inflation to accelerate. He did not see any obvious policy prescription arising from his estimate of the equilibrium rate; in particular, he denied any usefulness for public employment, which he characterized as just another way to spend government money and as a movement along, rather than a shift of, the Phillips curve.

James Tobin saw the assumption of fixed relative wages within the firm as unrealistic. Hall pictures an employer, who has a multidimensional labor input problem, as having only one parameter—the scale wage—to

control. Hall replied that this simplification in the theory did not seem crucial to him and that a more elaborate model would become intractable without adding much to his picture of wage determination for the economy as a whole.

Arthur Okun questioned Hall's specification that employers set the scale wage equal to the expected marginal effective wage. Such a practice would be optimal only in a world of certainty equivalence. It would not be optimal in an uncertain world if the loss from setting the scale wage above the marginal effective wage is not equal to the loss from setting it below. There are all sorts of asymmetries in the employer's wage problem: paying too little means getting low quality in the new workers he is hiring; paying more than he needs to means raising the wage of all his workers. He can easily raise a wage through a bonus, but would find it difficult to dock an employee after a wage has been set. Similarly, it is easier to promote an employee than to demote one. On balance, the asymmetries seem to point to setting the scale wage below the marginal effective wage.

Christopher Sims argued that the Hall model should be estimated as a system of at least three simultaneous equations, allowing for the endogeneity of the right-hand variables. Hall agreed, but thought that the parameters would not be very sensitive to specification error.

Sims also offered some insights from the theory of rational expectations on how the adjustments specified in the model might be unrealistic. First, people are likely to change any linear, fixed-weight forecasting scheme in response to the way the variables have been behaving recently. Second, he saw no reason to assume that the weights of the forecasting scheme (the β s) sum to one.