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A substantial fraction of cyclical unemployment is better characterized as fluctuations of the "frictional" or "natural" rate than as deviations from some relatively stable natural rate. Shifts of employment demand between sectors of the economy necessitate continuous labor reallocation. Since it takes time for workers to find new jobs, some unemployment is unavoidable. This paper presents evidence that most of the unemployment fluctuations of the seventies (unlike those in the sixties) were induced by unusual structural shifts within the U.S. economy. Simple time-series models of layoffs and unemployment are constructed that include a measure of structural shifts within the labor market. These models are estimated and a derived natural rate series is constructed.

I. Introduction

Some unemployment is unavoidable in free market economies. Variations of factors, such as the demand for their products or the cost of inputs to production, require firms continually to adjust the size of their labor force. Even in periods of stable aggregate employment, continuous labor reallocation within the United States results in almost 5 percent of employment leaving old jobs for new ones every month. Because it takes time for separated workers to be matched to jobs, some positive level of unemployment will always exist. Economists have long recognized this fact and have labeled this necessary quantity of unemployment the "frictional," "natural," or "equilibrium" unemployment rate.

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Since the widespread acceptance of the natural rate hypothesis, economists have come to view cyclical unemployment as deviations from some relatively stable natural rate. In this paper, it will be argued that, given a definition of the natural rate based on microeconomic foundations, much of cyclical unemployment is better described as fluctuations of the natural rate itself. As much as half of the variance of unemployment over the postwar period can be attributed to fluctuations of the natural rate brought about by the slow adjustment of labor to shifts of employment demand between sectors of the economy.

Several models describing the determinants of the equilibrium rate of unemployment have been put forth in the microfoundations literature (see, e.g., Phelps et al. 1970; Hall 1979). The Lucas and Prescott (1974) model is perhaps the one most relevant to this paper. In their paper, Lucas and Prescott explicitly derive the equilibrium unemployment rate from the assumptions that labor is exchanged in many spatially distinct markets and that labor mobility between markets is time consuming. While aggregate demand is assumed to be constant in their model, the product demand in individual markets is subject to stochastic fluctuations. Random fluctuations of product demand within markets induce fluctuations of labor demand and lead to temporary wage differentials between markets. These wage differentials encourage shifts of sectoral labor supply as workers leave low-wage markets for high-wage markets. Since the process of moving from one market to another is time consuming, a positive level of unemployment exists in stationary equilibrium.

The stationary equilibrium described by Lucas and Prescott assumes that the process generating market-specific demand fluctuations has constant variance over time and therefore yields a constant equilibrium unemployment rate. In the real world there is little reason to believe that the variance of firm-specific or market-specific demand is time invariant. In some periods, such as the mid-sixties, product demand, and thus derived labor demand, may grow relatively uniformly across labor market segments. In other periods, such as the decade of the seventies, exogenous events such as the end of the war in Viet Nam, oil boycotts and price increases, and changing import competition in manufactured goods can induce dramatic shifts of demand between labor market segments over relatively short intervals. Allowing the variance of individual market demands to vary over time in the Lucas and Prescott model leads to an equilibrium unemployment rate that itself varies as the quantity of required labor reallocation within the economy changes.

Casual evidence suggests that part of the higher unemployment rates of the last decade (the average adult male unemployment rate increased from 3.6 percent in the sixties to 4.5 percent in the seventies) may be due to the unusual volatility of employment demand over the period. Between 1969 and 1980, manufacturing's share of aggregate employment fell from 28.7 percent to 22.4 percent, a decline of 22.8 percent. Over the same period, retail trade; finance, insurance, and real estate (FIRE); and service industries' share of total employment grew by 10.1 percent, 14.2 percent, and 23.3 percent, respectively. To put these numbers into some perspective, note that manufacturing's share of employment fell by only 6.1 percent between 1958 and 1969. The shifts of industry employment shares, while significant in themselves, understate the full magnitude of employment shifts by not accounting for the shifts of employment that took place within broad industry groupings.

The cyclical pattern of unemployment over the decade provides further supporting evidence for the hypothesis that unusually large sectoral shifts contributed to unemployment increases. The shifts of employment shares over the last decade did not take place smoothly over the period. The shift out of durable manufacturing, in particular, seems to be better described as the result of three distinct shocks than as a secular trend: Durable manufacturing's share of total employment fell by 12.6 percent in 1970–71, by 9.1 percent in 1975, and by 5.3 percent in 1980. With the exception of a modest 3.1 percent increase in 1973, its share remained relatively stable over the remainder of the decade. These three periods of falling employment in durable manufacturing coincided with the three cyclical increases in unemployment over the decade: The annual unemployment rate increased by 2.4 percentage points in 1970–71, by 2.9 points in 1975, and by 1.3 points in 1980. Note that in all three downturns of the economy, employment (as well as employment shares) actually rose in retail trade, FIRE, and service industries. Further, with the exception of the modest increase in 1973, the share of durables did not significantly increase as unemployment abated. These last two facts support the hypothesis that sectoral shifts played a role in inducing the general economic downturn as opposed to the downturn inducing temporary shifts of employment.

In the remainder of this paper, evidence will be presented to support the hypothesis that a significant fraction of cyclical unemployment over the postwar era can be explained by the slow adjustment of labor to exogenous shifts of sectoral employment demand. In Sections II and III we conduct an analysis of the effects of dispersion in employment demand on aggregate layoffs and unemployment. A measure of this dispersion is constructed and included in a flow model of the unemployment rate. Finally, in Section IV the dispersion series is combined with the parameter estimates from the unemployment model to construct an estimated equilibrium or natural unemployment rate series.

II. Layoffs

In a typical month, between 4 and 5 percent of all workers flow through the labor market. While over half of this flow is voluntary, the overwhelming fraction of unemployment stems from involuntary employment separations, layoffs initiated by firms in response to economic conditions (see table 1). Cyclical fluctuations of the unemployment rate are directly related to fluctuations of the aggregate layoff rate. Therefore, this section will analyze the determinants of the layoff rate as a prelude to our analysis of cyclical unemployment.

Even in periods of growing aggregate employment, a significant fraction of the labor force is laid off every month. Positive layoffs in periods of growing employment reflect the variance of employment demand within the economy: Even when most firms are hiring new workers, there are always some firms issuing layoffs. While this simple observation is widely recognized, the importance of the dispersion in hiring conditions in determining the aggregate layoff rate is not as well understood. Far fewer layoffs would be generated in an economy where employment was growing at 2 percent per year in all firms than would be generated in an economy where employment was growing at 8 percent per year in half of all firms and by −4 percent in the remaining firms, despite the fact that both economies would have identical aggregate growth rates.

Many factors determine the level of hiring done by individual firms. Changes in product demand, changes in capital and raw material costs, and changes in wage rates influence firms' hiring decisions. Rather than model these factors explicitly, we will divide the factors that affect firm hiring into two components: those that affect all firms in the economy and those that are specific to individual firms. More specifically, we will assume that the net hiring rate of a typical firm, h_t, is equal to the aggregate hiring rate, H_t, plus a random disturbance, ϵ_t:

$$h_t = H_t + \epsilon_t. \tag{1}$$

Here, ϵ_t is assumed to be distributed with mean zero and variance σ_t^2, according to the density function $f(\epsilon \mid \sigma_t)$; σ_t is a measure of the dispersion of employment demand conditions throughout the labor market. Shocks to the economy that have differing impacts on firms, such as a rise in oil prices, will lead to an increase in σ_t.

Net hiring, h_t, which may be positive or negative, is equal to the

TABLE 1

TOTAL PRIVATE UNEMPLOYMENT RATES

YEAR	JOB LOSERS	JOB LEAVERS	LABOR FORCE		TOTAL UNEMPLOYED
			New Entrants	Reentrants	
1967	1.6	.6	.5	1.2	3.8
1968	1.3	.5	.5	1.2	3.6
1969	1.2	.5	.5	1.2	3.5
1970	2.2	.7	.6	1.5	4.9
1971	2.8	.7	.7	1.7	5.9
1972	2.4	.7	.8	1.7	5.6
1973	1.9	.8	.7	1.5	4.9
1974	2.4	.8	.7	1.6	5.6
1975	4.7	.9	.8	2.0	8.5
1976	3.9	.9	.9	2.0	7.7
1977	3.2	.9	1.6	2.0	7.1
1978	2.5	.8	.9	1.8	6.0
1979	2.5	.8	.8	1.7	5.8
1980	3.7	.8	.8	1.8	7.1

SOURCE.—Handbook of Labor Statistics.

difference between accessions to and layoffs from the firm:

$$h_t = a_t - l_t. \tag{2}$$

If we further assume that all separations from the firm are either layoffs or quits, we also have

$$h_t = \Delta e_t + q_t, \tag{3}$$

where Δe_t is the rate of change of employment and q_t is the quit rate. Finally, we will assume that firms do not simultaneously hire and lay off workers. While this assumption is not literally true (firms may wish to change the composition of their employment, which would lead to simultaneous hiring and layoffs), it is a reasonable approximation for the majority of firms if we do not include discharges for cause in our definition of layoffs. The layoff and accession rates of the firm can now be expressed as:

$$l_t = \max(0, -h_t), \tag{4}$$

$$a_t = \max(0, h_t). \tag{5}$$

Given these assumptions, we can derive the aggregate layoff rate as a function of H_t and σ_t. Appealing to the law of large numbers, we assume that the aggregate layoff rate equals the expected layoff rate of a typical firm:

$$L_t = E(l_t \mid H_t, \sigma_t) = -\int_{-\infty}^{-H_t} (H_t + \epsilon) f(\epsilon \mid \sigma_t) d\epsilon = g(H_t, \sigma_t), \tag{6}$$

where

$$\partial g / \partial H_t = -\int_{-\infty}^{-H_t} f(\epsilon \mid \sigma_t) d\epsilon = -F(-H_t \mid \sigma_t) \; \begin{matrix} < 0 \\ > -1 \end{matrix}, \tag{7}$$

$$\partial g / \partial \sigma_t > 0, \tag{8}$$

and $F(\,)$ is the cumulative distribution function associated with the density function $f(\,)$. The aggregate accession rate, A_t, can be similarly derived as $A_t = H_t + g(H_t, \sigma_t)$.

Figure 1 depicts a graphical derivation of A and L from the $f(\,)$ distribution. The shaded area of the f_1 distribution, to the left of zero, is the truncated density function of firms having $H + \epsilon < 0$. The mean of this truncated density function is $-L$. Similarly, A is the mean of the unshaded positive portion of f_1. Increasing σ spreads the distribution from f_1 to f_2. Firms that had been laying off workers prior to the increase in σ now increase their layoffs by an amount exactly equal to the increase in accessions in firms that are hiring. Shifting f to the left (a decline of H) decreases all firms' net hiring by the amount of the shift. Those firms laying off workers now increase their layoffs. Firms

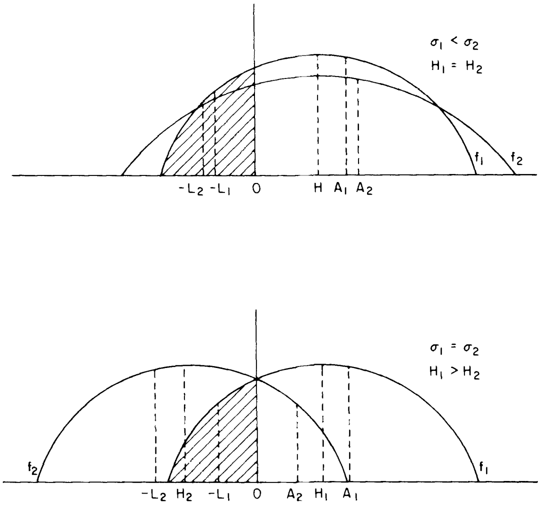

FIG. 1.—Derivation of L from the f distribution

having accessions reduce their hiring. Those firms that had accessions less than the shift now lay off workers.

A heuristic explanation can be given for the magnitude of the first derivative of the $g(\ )$ function given in equation (7). An increase of dH in H causes all firms to increase their desired hiring by dH. For all firms experiencing layoffs, there will be a dH reduction of layoffs. For firms that are hiring, there is no reduction in layoffs. Thus the aggregate change in layoffs is just $-dH$ multiplied by the fraction of firms experiencing layoffs, $F(-H \mid \sigma)$.

Table 2 presents estimates of several linearized versions of equation (6), using the manufacturing layoff rate as the dependent variable. The variable $\hat{\sigma}_t$ serves as a proxy for σ_t and is defined as the variance of $\Delta e_t + q_t$ among the 21 two-digit manufacturing industries:

$$\hat{\sigma}_t = \left\{\sum_{i=1}^{21} c_i[\Delta e_{it} + q_{it} - (\Delta E_t + Q_t)]^2\right\}^{\frac{1}{2}},$$

where c_i is the ith industry's 1968 share of total manufacturing employment. Note that all variables are in rate form. The equations in table 2 were estimated using both monthly and quarterly data by Cochrane-Orcutt least squares.

The estimation results strongly support the hypothesized relationship between L_t, H_t, and σ_t given by equations (6)–(8). The estimated t-statistics on the $\hat{\sigma}_t$ coefficient ranged from 7.9 to 13.7, which indicates a significantly positive relationship between the variance of hiring conditions and the aggregate layoff rate. The H_t coefficients

TABLE 2

LAYOFF REGRESSIONS (1958–77)

Equation Number	Period	Constant	$\Delta E + Q$	ΔE	Q	$(\Delta E+Q)^2$	$\hat{\sigma}$	Time Trend	$\hat{\rho}$	D-W	SE	R^2
1	Monthly	1.746	−.289	. . .	. . .	. . .	.284	. . .	.80	2.26	.195	.89
		(.082)	(.014)				(.036)					
2	Monthly	2.127	−.299	. . .	. . .	. . .	.301	−.003	.66	2.15	.189	.90
		(.090)	(.013)				(.036)	(.001)				
3	Monthly	2.162	−.347	. . .	. . .	.012	.295	−.003	.64	2.21	.188	.90
		(.087)	(.025)			(.006)	(.037)	(.000)				
4	Monthly	2.147	. . .	−.349	−.331	.011	.288	−.003	.64	2.22	.188	.90
		(.090)		(.021)	(.033)	(.006)	(.038)	(.001)				
5	Quarterly	1.505	−.376	. . .	. . .	. . .	.586	. . .	.78	2.30	.149	.93
		(.092)	(.017)				(.042)					
6	Quarterly	1.885	−.391	. . .	. . .	. . .	.600	−.008	.51	2.10	.139	.94
		(.085)	(.017)				(.045)	(.001)				
7	Quarterly	1.990	−.497	. . .	. . .	.039	.559	−.009	.55	2.33	.126	.95
		(.085)	(.031)			(.009)	(.041)	(.001)				
8	Quarterly	1.960	. . .	−.498	−.391	.034	.457	−.009	.72	2.20	.124	.95
		(.117)		(.028)	(.048)	(.009)	(.054)	(.002)				

NOTE.—Standard errors in parentheses.

ranged from −.289 to −.391 (without the H_t^2 term), which is consistent with equation (7). A random increase of one manufacturing job will lower manufacturing layoffs by one with approximate probability ⅓ and will increase manufacturing accessions by one with approximate probability ⅔.

The relatively good fit and high significance of H_t and $\hat{\sigma}_t$ in estimation is not particularly surprising. The $g(\,)$ function was derived primarily from identities, the assumption of a relatively stable $f(\,)$ distribution over time, and the assumption that firms do not simultaneously hire and lay off workers. No other behavioral assumptions were required. The estimation also required $\hat{\sigma}_t$ to be a reasonable proxy for σ_t; a sufficient condition for this is that the firm-specific hiring terms, ϵ, be correlated within industries.

While the estimates in table 2 have little behavioral content, and thus are better thought of as conditional expectations than as structural estimation, they do point out the inadequacies of explaining layoffs (and, as we shall show, unemployment) by purely aggregate measures. Most empirical macro models have equations explaining employment growth but pay little attention to the sectoral composition of that growth. The results of this section suggest that an attempt to explain layoffs by aggregate employment growth alone ignores an important determinant of the cyclical pattern of layoffs.

III. Unemployment

Two types of factors determine the level of unemployment in the economy: those that influence the size of the flow into unemployment and those that determine the duration of individual unemployment spells. An important feature of the model below is that sectoral shifts of demand which would have no impact on the level of unemployment or income if labor allocation were instantaneous will have an impact when it takes time for laid-off workers to be reemployed. Unemployment is simply the time it takes workers displaced from contracting firms to find employment in expanding firms. The quantity of unemployment generated by shifts of employment demand will thus depend on the speed with which workers find new jobs. If workers have strong firm or industry attachments, due in part to firm- and industry-specific skills and to wage premiums associated with seniority, they are reluctant to seek employment in other sectors of the economy. Thus the process of adjustment to sectoral shifts tends to be slow and typically involves significant unemployment before labor adjusts fully to new patterns of employment demand.

In this section, an attempt will be made to measure directly the impact of dispersion in employment demand on aggregate unemployment. In the first part of this section, a reduced-form unemployment equation is derived from a simple flow model of the unemployment process. The equation is then estimated, and the impact of sectoral shifts on cyclical unemployment is assessed.

The starting point of our analysis is the flow identity

$$\Delta U_t = \theta_{1t} - \theta_{2t}, \tag{9}$$

where θ_{1t} is the flow into unemployment in period t, θ_{2t} is the flow out of unemployment in period t, and ΔU_t is the change in the unemployment rate. All labor market variables will be expressed as rates throughout this section.

The flow into unemployment consists of three components: layoffs, quits that have not found employment prior to leaving their last job (less than 40 percent of total quits according to Mattila [1974]), and labor force entrants. We model the flow into unemployment as

$$\theta_{1t} = L_t + a_0 + a_1 Q_t + \eta_{1t}, \tag{10}$$

where η_1 is a random disturbance and the last three terms in (10) are designed to capture the nonlayoff flow into unemployment.

Layoffs in the model will be determined by a linearized version of equation (6):

$$L_t = b_0 - b_1(\Delta E_t + Q_t) + b_2\sigma_t + \eta_{2t}. \tag{11}$$

The level of voluntary labor turnover is given by

$$Q_t = c_0 - c_1 U_t + \eta_{3t}. \tag{12}$$

The common assumption that quits vary inversely with labor market tightness, as measured by U_t, is embodied in (12). A somewhat more general version of (12) would make Q_t a function of σ_t and a measure of unexpected monetary growth, DMR, but this generalization will not affect the final specification of the unemployment equation that will be estimated later in this section.

In an economy where prices and wages adjust rapidly, where little uncertainty exists about the distribution of prices and wages in the economy, and where firm-specific skills and worker-firm attachments are relatively unimportant, the distribution of time it takes unemployed workers to find employment would be relatively constant. One possible way of modeling the flow out of unemployment under these assumptions would be to assume a constant probability p of finding a job in every period. In this case the flow out of unemployment would be a constant fraction of last period's unemployment, $\theta_{2t} = pU_{t-1}$.

These assumptions, however, are not very realistic, and they run counter to the popular practice of modeling unemployment duration as a function of unanticipated inflation. There is a strong theoretical foundation in recent search and contract theories of unemployment, as well as considerable empirical support, for the hypothesis that unanticipated inflation or unanticipated monetary policy affects unemployment duration. We will therefore make θ_{2t} a function of unanticipated monetary policy, in addition to last period's unemployment:

$$\theta_{2t} = pU_{t-1} + \sum_{i=0}^{k} \alpha_i \mathrm{DMR}_{t-i} + \eta_{4t}, \tag{13}$$

where DMR is Barro's[1] measure of unanticipated monetary policy. We chose the DMR series, rather than constructing an entirely new series on expectational errors, because it works well in explaining unemployment movements and because many readers are familiar with its construction and properties, which facilitates comparison of the model estimated in this section with existing studies.

The final equation necessary to close the model is the identity:

$$E_t + U_t \equiv 1. \tag{14}$$

Equations (9)–(14) can be solved to yield a dynamic reduced-form equation for the unemployment rate in terms of the exogenous variables of the model σ and DMR and the predetermined variable U_{t-1}:

$$U_t = B_0 + B_1\sigma_t - \sum_{i=0}^{k} \lambda_i \mathrm{DMR}_{t-i} + B_2 U_{t-1} + \eta_t. \tag{15}$$

Equation (15) gives the specification of the unemployment equation that will be estimated in this paper. It should be noted that, while an attempt has been made in this section to derive (15) from structural relationships, it is similar to more ad hoc unemployment equations that have been estimated elsewhere in the literature (see, e.g., Sargent 1973 or Barro 1977), with the exception of the σ_t term. It is the inclusion of σ_t that distinguishes (15) from previous models and, given the simplified derivation of (15), a more ad hoc interpretation of its origins may be appropriate.

Table 3 presents estimates of several versions of equation (15), using annual data for the nonagricultural economy over the postwar period. Again it was necessary to construct a proxy for σ_t; however, here the proxy had to measure sectoral shifts beyond those in manufacturing industries. The variable $\hat{\sigma}_t$ was constructed using the common 11-industry decomposition of aggregate employment according to the following formula:

$$\hat{\sigma} = \left[\sum_{i=1}^{11} \frac{x_{it}}{X_t} (\Delta \log x_{it} - \Delta \log X_t)^2\right]^{\frac{1}{2}},$$

[1] The DMR series used in estimation was updated from Barro (1981). A description of the series can be found in Barro (1977).

TABLE 3

UNEMPLOYMENT EQUATIONS

Equation Number	Period	Constant	$\hat{\sigma}_t$	$\hat{\sigma}_{t-1}$	DMR_t	DMR_{t-1}	DMR_{t-2}	U_{t-1}	Time Trend	R^2	SE	D-W
1	1948–80	.276	53.9	. . .	−13.6	−26.0	. . .	.489	.056	.852	.573	2.30
		(.577)	(9.0)		(7.2)	(8.0)		(.100)	(.032)			
2	1948–80	2.622	. . .	. . .	−19.9	−34.5	. . .	.300	.058	.654	.861	1.65
		(.634)			(10.9)	(12.1)		(.143)	(.019)			
3	1948–80	.062	55.9	18.9	−19.1	−23.3	−6.7	.369	.073	.871	.557	2.30
		(.592)	(9.0)	(9.9)	(7.7)	(8.0)	(10.0)	(.137)	(.017)			
4	1948–80	.991	54.3	33.4	−24.2	−26.1	−23.9	. . .	.111	.833	.620	1.75
		(.534)	(10.0)	(9.3)	(8.2)	(8.9)	(8.6)		(.013)			
5	1948–80	.126	52.6	. . .	−15.3	−16.6	. . .	.728	. . .	.739	.748	1.69
		(.756)	(11.8)		(9.3)	(10.1)		(.114)				
6	1948–70	.967	47.4	. . .	−12.6	−30.7	. . .	.417	. . .	.741	.651	2.20
		(1.000)	(13.8)		(9.4)	(10.6)		(.151)				
7	1960–80	−.533	66.6	. . .	−15.1	−6.6	. . .	.650	.036	.921	.434	2.10
		(.589)	(12.1)		(6.6)	(8.2)		(.122)	(.023)			

NOTE.—Standard errors in parentheses.

where x_{it} is employment in industry i and X_t is aggregate employment. Figure 2 contains a plot of the constructed $\hat{\sigma}_t$ series along with the unemployment rate; actual values for the constructed series appear in table 4. A time trend was also included in the equations to capture demographic and other changes that may have occurred in the labor market over the period.

All coefficient estimates are of the correct sign and are highly significant with the exception of coefficients for some of the longer lags of $\hat{\sigma}_t$ and DMR_t. Further, the estimates are quite robust to changes in the sample period and changes in specification. Equation (15) may be solved for U_t (with U_{t-1} eliminated) in terms of infinite lags on σ_t, DMR_t, and η_t. Equation (4) of table 3 excludes U_{t-1} and includes longer lags on $\hat{\sigma}_t$ and DMR_t. Although U_{t-1} is highly significant and clearly belongs in the model, its exclusion does not alter the signs or statistical significance of the other included variables, as is so often the case in simple time-series models. In addition, the estimated long-run $\hat{\sigma}_t$ multiplier is not terribly sensitive to the inclusion of U_{t-1}: In equations (1) and (3), with U_{t-1} included, the long-run $\hat{\sigma}_t$ multipliers are 105 and 118, respectively. In equation (4), with U_{t-1} excluded, the long-run multiplier is 88.

One characteristic of particular interest in the estimates is the effect of excluding $\hat{\sigma}$ from the equation. While the fit of the equation worsens considerably when $\hat{\sigma}$ is dropped, the magnitudes of the DMR coefficients change relatively little. This result follows from the fact that $\hat{\sigma}$ is virtually orthogonal to DMR. Consider the following regression of $\hat{\sigma}_t$ on its own lagged values and current and lagged values of DMR:

$$\underset{(.005)}{\hat{\sigma}_t = .024} - \underset{(.193)}{.051\hat{\sigma}_{t-1}} + \underset{(.106)}{.033\hat{\sigma}_{t-2}} - \underset{(.171)}{.108\text{DMR}_t} - \underset{(.170)}{.045\text{DMR}_{t-1}},$$

$$R^2 = .035, \bar{R}^2 = -.103.$$

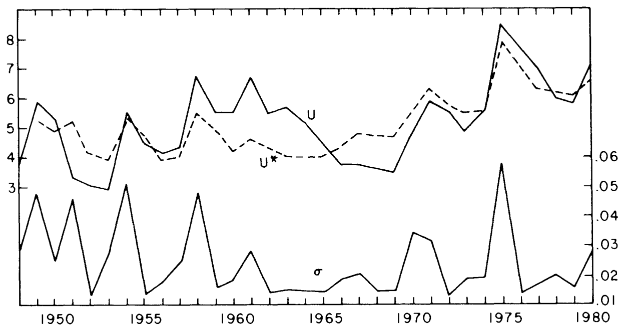

FIG. 2

TABLE 4

UNEMPLOYMENT SERIES

				Detrended		
Year	U_t	U_t^*	$U_t - U_t^*$	U_t	U_t^*	$\hat{\sigma}_t$
1948	3.8	. . .	. . .	. . .	. . .	.0262
1949	5.9	5.3	.6	6.9	6.3	.0482
1950	5.3	5.0	.3	6.3	6.0	.0251
1951	3.3	5.3	−2.0	4.2	6.2	.0461
1952	3.0	4.1	−1.1	3.9	5.0	.0138
1953	2.9	3.9	−1.0	3.7	4.7	.0283
1954	5.5	5.4	.1	6.2	6.1	.0508
1955	4.4	4.5	−.1	5.0	5.1	.0147
1956	4.1	3.8	.3	4.7	4.4	.0186
1957	4.3	4.0	.3	4.8	4.5	.0248
1958	6.8	5.5	1.3	7.2	5.9	.0489
1959	5.5	4.9	.6	5.8	5.2	.0160
1960	5.5	4.2	1.3	5.7	4.5	.0181
1961	6.7	4.6	2.1	6.9	4.8	.0282
1962	5.5	4.3	1.2	5.5	4.4	.0148
1963	5.7	4.0	1.6	5.7	4.1	.0156
1964	5.2	4.0	1.2	5.1	4.0	.0158
1965	4.5	4.1	.4	4.3	3.9	.0149
1966	3.8	4.3	−.5	3.6	4.1	.0194
1967	3.8	4.7	−.9	3.5	4.4	.0216
1968	3.6	4.7	−1.1	3.2	4.3	.0157
1969	3.5	4.7	−1.2	3.0	4.2	.0157
1970	4.9	5.7	−.8	4.3	5.2	.0347
1971	5.9	6.5	−.6	5.3	5.8	.0325
1972	5.6	5.8	−.2	4.9	5.1	.0133
1973	4.9	5.5	−.6	4.1	4.8	.0192
1974	5.6	5.6	−.0	4.7	4.8	.0196
1975	8.5	7.9	.6	7.5	6.9	.0583
1976	7.7	7.1	.6	6.7	6.1	.0138
1977	7.0	6.3	.7	5.9	5.2	.0171
1978	6.0	6.2	−.2	4.8	5.0	.0200
1979	5.8	6.1	−.3	4.5	4.9	.0165
1980	7.1	6.7	.4	5.7	5.4	.0284

Virtually none of the variance of $\hat{\sigma}_t$ is explained by its own lagged values or by DMR. We can thus strongly reject Granger causality of $\hat{\sigma}_t$ by DMR, which lends some support to our assumption that σ is truly exogenous. Further support of the hypothesis that σ is exogenous is provided by the low explanatory power of the other included variables in the unemployment equation:

$$\hat{\sigma}_t = \underset{(.009)}{.042} - \underset{(.198)}{.013}\hat{\sigma}_{t-1} - \underset{(.156)}{.094}\text{DMR}_t - \underset{(.165)}{.128}\text{DMR}_{t-1}$$

$$- \underset{(.0022)}{.0032}U_{t-1} - \underset{(3.0E-4)}{6.4E - 5}T,$$

$$R^2 = .173, \bar{R}^2 = .020.$$

IV. The Natural Rate

The regression results of Sections II and III suggest that the process of labor reallocation in response to the shifting pattern of employment demand is a significant source of cyclical unemployment. In this section, a measure of the unemployment induced by the fluctuations of σ_t will be constructed and discussed.

Since the widespread acceptance of the natural rate hypothesis, economists have come to view cyclical unemployment as deviations of unemployment from some relatively stable natural rate. The natural rate is thought of as the level of frictional unemployment (necessary to carry out the continuous process of labor allocation) that would occur in a steady state when agents correctly perceive the distribution of prices and wages throughout the economy. The view that the natural rate is relatively constant and that it is the unemployment necessary to accommodate the process of labor reallocation seems to conflict with the regression results. The latter would seem to indicate strong cyclical patterns in the volume of required labor allocation.

Part of the source of this contradiction stems from the variety of meanings given to the term "natural rate." In much of the microfoundation literature (see, e.g., Lucas and Prescott 1974), equilibrium unemployment arises because firms face continuous fluctuations in demand for their products even when aggregate demand is stable. There is nothing in this literature to suggest that the equilibrium unemployment will be time invariant. Rather, we would expect periods of rapidly shifting demand—whether induced by changes in taste, import prices, technological change, or whatever—to be associated with increases in the natural, or equilibrium, rate of unemployment.

In much of the recent equilibrium business cycle literature, these events, which might be thought of as leading to shifts of demand and increases of the natural rate, are modeled as aggregate supply shocks. Unemployment is viewed as consisting of three components: a relatively constant natural rate, unemployment associated with expectational errors, and unemployment associated with supply shocks. Given this characterization, it may not be unreasonable to view the natural rate as constant or evolving slowly over time as a result of changes in the demographic and institutional characteristics of the labor market. Here, however, the term "natural rate" must be given a somewhat different interpretation, that is, the level of unemployment associated with the average or typical quantity of labor reallocation required within the economy. Events that require unusual labor reallocation lead to deviations from, rather than shifts of, the natural rate.

In what follows we will construct a measure of the natural rate that is more closely related to the microfoundations concept than the business cycle model concept. In terms of the unemployment equation (15), we will define the natural rate as that level of unemployment that would have existed if current and past values of DMR_t and η_t had been identically zero. It is given by the equation

$$U_t^* = \sum_{i=0}^{\infty} B_2^i (B_0 + B_1 \hat{\sigma}_{t-i} + B_3 T_{t-i}), \tag{16}$$

where B_3 is the coefficient of the time trend variable T.

A series for the natural rate was calculated using the estimates of equation (3) in table 3. They are presented along with the actual values of U_t and $\hat{\sigma}_t$ in table 4 and figure 2. While equation (16) makes U_t^* a function of the infinite history of $\hat{\sigma}_t$, the weights die off so quickly that only a few years of lagged data are necessary to construct reasonable approximations. Nevertheless, the requirement of previous observations of $\hat{\sigma}_t$ precludes estimating U_t^* over the entire sample.

The U_t^* series varies significantly over the 1949 and 1980 period, tracking movements in U_t reasonably well. Over half of the variance in U_t can be explained by U_t^*; the simple correlation between U_t and U_t^* is .74. Of course, part of the reason for the high correlation between U_t and U_t^* is that they both have trended upward over the postwar period. Column 5 of table 3 presents a constructed natural rate series using the formula given in equation (16), but replacing the value of the time trend with its average value over the period. It is thus a detrended measure of the natural rate that reflects only fluctuations due to current and lagged values of $\hat{\sigma}_t$. The correlation of this series with the detrended unemployment series is .60.

The pattern of U_t and U_t^*, revealed in figure 2, points out the variety of sources of cyclical unemployment. Unemployment over the seventies is particularly well explained by U_t^*, which suggests that real factors influencing the natural rate were the major source of cyclical unemployment. This observation is consistent with the popular view that supply shocks were responsible for much of the cyclical activity of the last decade. In marked contrast, unemployment over the sixties is characterized by significant deviations from U_t^*. In 7 of the 8 years between 1956 and 1963, monetary growth was below its expected level, as indicated by DMR, which resulted in unemployment significantly above the natural rate in the late fifties to early sixties. In 5 of the 6 years between 1964 and 1969, monetary growth was above its expected level, which resulted in unemployment below the natural rate in the late sixties.

V. Concluding Remarks

While explicit consideration of stabilization policy is beyond the scope of this paper, there are policy implications in its findings. Our analysis suggests that much of the unemployment of the seventies could not have been avoided through aggregate monetary and fiscal policies. Such policies may have been successful in delaying or smoothing the cyclical pattern of unemployment, but since inadequate demand was not the source of unemployment, aggregate demand policies were not an appropriate cure. This is in marked contrast to the early sixties, where our estimates suggest that unemployment was well above the natural rate, due in part to several years of lower-than-anticipated monetary growth (as measured by DMR) or, more generally, to a contractionary set of aggregate demand policies. The inability of aggregate demand policies to eliminate unemployment induced by "real" factors does not rule out a role for all policy. Targeted demand policies, or supply-side policies aimed at easing the transition of workers from declining to growing sectors of the economy, or policies to stimulate productivity in declining sectors may be appropriate. The nontrivial task of analyzing stabilization policy within a disaggregated framework would seem to be a productive line for future research.

The model developed in this paper does not claim to give a total description of the operation of labor markets or the process of unemployment. It does, however, suggest some of the limitations of aggregate models that do not explicitly account for the multisectoral character of production and employment and the imperfect short-run mobility of resources between sectors. It also suggests that non-monetary factors, whether viewed as supply shocks or as shifts of the natural rate, have been an important source of cyclical unemployment and deserve greater attention in the business cycle literature.

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