Alternative Measures of Slackness in the Labor Market and Their Relationship to Wage and Price Inflation

by

John Haltiwanger and Mark Plant
University of California, Los Angeles

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The unemployment rate is popularly used as a measure of economic well-being and within the professional literature it is taken to be a rough measure of the wasted resources in the labor market. As the macroeconomic theory of labor market interactions has developed, the measures used to gauge "slackness" in the labor market have changed. Nevertheless, the reported unemployment rate is still frequently used in empirical work as a measure of excess capacity in the labor market (e.g., Sims (1980), Ashenfelter and Card (1982)). The purpose of this paper is to develop several competing measures of slackness in the labor market based upon recent developments in the literature. The time series properties of these alternative measures of slackness will be examined and we will investigate the empirical relationship between these alternative measures and wage and price inflation.

It is now well-known that in a dynamic economy there are several sources of unemployment. The turnover of the labor force due to life-cycle employment changes and non-trivial search costs generate frictional unemployment. The changing output mix of the economy over time requires the reallocation of labor and thus generates structural unemployment. Contract theory tells us that incentives for long term attachments induce optimal temporary layoffs as a means of maintaining profitable labor force attachments during temporary slumps. Frictional, structural and contractual unemployment can all be interpreted as being consistent with the labor market being in dynamic equilibrium. Alternatively, most cyclical unemployment is associated with the failure of the labor market to clear. This latter source of unemployment has received the most attention in the macroeconomics literature.

The problem for empirical work is to disaggregate observed movements in the aggregate unemployment rate into frictional, structural, contractual, and cyclical components. This already difficult task is made worse by the findings reported in Darby, Haltiwanger and Plant (1985a) that suggest that the covariance among these alternative sources is substantial. For example, structural unemployment is likely to increase during recessions since firms in declining industries may find it optimal to accelerate eventual reductions in their labor force at such times. In spite of these potentially important covariances, we attempt to disentangle movements in the component rates from the movement in the aggreggate unemployment rate.

Our methodology is based upon a characterization of the labor market as being comprised of many smaller markets which can, in theory, function relatively independently. In this paper, we view these smaller markets as being characterized by the demographic, occupational, and industrial characteristics of the workers. We measure the steady-state rate of unemployment in each of these smaller markets using the method proposed by Darby, Haltiwanger and Plant (1985a). First, measures of the average inflow and outflow rates into unemployment in the market in question are calculated from the available data. Then, the steady-state rate for that market is calculated as that rate to which the unemployment rate would converge if inflow and outflow rates were at their normal levels. We measure a time varying aggregate steady-state rate of unemployment by using actual labor force shares in each submarket as weights for each of the normal rates in the submarkets.

This time-varying steady-state rate captures changes in frictional and structural unemployment over time as the demographic, occupational and industrial composition of the labor market changes.

In addition to decomposing unemployment across these submarkets, we distinguish temporary layoff unemployment from other reasons for being unemployed. Contract theory suggests that workers on temporary layoff consider themselves attached to a firm. Accordingly, the search behavior of those on temporary layoff is likely to be substantially different than those who have no firm attachment. We discuss below the detailed definition of temporary layoff.

For each of our alternative decompositions, we characterize aggregate unemployment as the sum of three components. Specifically, the unemployment rate is the sum of the aggregate normal rate which captures structural and frictional components, temporary layoffs which capture contractual unemployment and a residual which captures cyclical unemployment.[1] Having decomposed unemployment in this fashion, we proceed on several fronts. First, we investigate the time series properties and interrelationships of these components. This includes a variance decomposition of the overall unemployment rate over these alternative components.

Second, we are interested in the relationship between movements in each of these components and movements in wage and price inflation. One hypothesis to be investigated is whether the breakdown in the relationship between the aggregate unemployment rate and wage and price

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[1] In a theoretical framework this residual is the appropriate measure of cyclical unemployment. In practice it is computed as a residual and thus it will also include measurement error and any non-steady-state unemployment other than temporary layoffs.

inflation over the 1970's is due to significant variation in the composition of unemployment among these alternative sources of "slackness." Further, we are interested in whether the magnitude and timing of the response of wage and price inflation to changes in labor market slackness differs substantially across these alternative measures.

Finally, we are interested in testing hypotheses about these alternative measures of slackness that are predicted by recent theoretical developments in the literature. For example, labor contract models with symmetric information and no enforcement problems predict fully contingent labor contracts. In such contracts there will be very little contemporaneous relationship between wages and temporary layoffs. In contrast, labor contract models with asymmetric information or other enforcement problems predict incomplete contracts in which renegotiation may serve as a substitute for a complete contingent contract. These latter models predict a potentially strong relationship between wages and temporary layoffs as workers and firms would tend to renegotiate when temporary layoffs increase. By examining the relationship between movements in temporary layoffs and wage and price inflation, we hope to shed light on these competing hypotheses.

II. Alternative Decompositions of Unemployment

The unemployment rate is defined by the Bureau of Labor Statistics (BLS) to be the percentage of workers in the labor force who are without work and who are either actively searching for work or expecting a recall from layoff. Economists interpret the unemployment rate within a theoretical framework which states that waste is inefficient and markets, when allowed to function without impediments to adjustment, will allocate resources so they are not wasted. The simplest interpretation of the unemployment rate is that it indicates the extent to which labor resources are being wasted, or alternatively the extent to which there is a surplus of labor resources. Economists have long since dispensed with this simplest view, recognizing that in a dynamic economy in which the allocation of labor resources is continually adjusting to market conditions, there will be some level of equilibrium or "natural" unemployment and unemployment in excess of this natural level indicates slackness in the labor market.

In most studies measures of the natural rate of unemployment have been computed using some type of average of observed unemployment rates. The implicit hypothesis imbedded in such a computation is that "on average" the labor market, or some sector of the labor market, is in equilibrium. Such a hypothesis is usually not grounded in a dynamic model of unemployment rate determination and thus ignores the fact the the stock level of unemployment is determined by flows into and out of unemployment. The correct measure of the natural rate then is the steady-state rate to which the dynamic system will return once perturbed from its equilibrium. Without an explicit model in hand there is no reason to suspect that this steady state rate would be the numerical average of the observed unemployment rates. Furthermore, in taking such simple averages, there are no observed behaviorial parameters that help us to determine whether such averages might be reasonable. Our method, as outlined below, is based on a well-defined parametric representation of the labor force, where the parameters defining the natural rate stem from well-formulated models of entry and exit rates from unemployment and can be verified (or rejected) using micro or macro data.

Darby, Haltiwanger and Plant (1985a, 1985b) have constructed a model which lends itself to the measurement of a steady state rate of unemployment. This steady-state characterization will be used to compute the alternative natural rates of unemployment presented in the empirical section of the paper. Consider a homogeneous sector of the labor force.[2] Let u denote the unemployment rate. Let π denote the probability per period that an unemployed person will exit unemployment by becoming employed or leaving the labor force. Let ϕ denote the fraction of the labor force entering unemployment in any given period and, finally, let γ denote the growth rate of the labor force. Then:

$$(1) \qquad \Delta u = \phi - ((\pi + \gamma)/(1 + \gamma))u_{-1}.$$

Let the growth adjusted probability $\pi^* = (\pi + \gamma)/(1 + \gamma)$ which is empirically dominated by π. We can interpret (1) as saying that the unemployment rate rises as the search rate exceeds the adjusted probability of employment times the lagged unemployment rate. Within this sector, the natural rate of unemployment can be found by setting $\Delta u = 0$ for the long-run equilibrium values $\bar{\phi}$, $\bar{\pi}$ and $\bar{\gamma}$:

$$(2) \qquad \bar{u} = \bar{\phi}((1 + \bar{\gamma})/(\bar{\pi} + \bar{\gamma})) = \bar{\phi}/\bar{\pi}^* .$$

Thus, the natural unemployment rate is the product of the normal entry rate $\bar{\phi}$ and the adjusted duration of search $(1/\bar{\pi}^*)$.

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[2] We will discuss later the exact definition of homogeneity and whether such a sector can be observed.

Using this formulation, a steady-state rate of unemployment for the labor force as a whole could readily be computed from available data. However, the assumption of homogeneity is important in the above formulation. If a group that is heterogeneous across values of π is in fact treated as homogeneous, the resulting steady-state rate of unemployment will be miscalculated. The appropriate procedure is to disaggregate the labor force into sectors that are homogeneous in their values of π and ϕ and an appropriate aggregation must be done across those sectors. If the relative (numeric) importance of those sectors in the labor force changes over time, the steady-state rate will change over time. Considerable care must be taken in choosing the time-varying weights for aggregation. In particular, use of actual unemployment shares as weights yields implausibly large variation in the aggregate steady-state rate of unemployment over the cycle. This is because variation in unemployment shares across sectors are strongly correlated with the cycle. As will become apparent below, our procedure avoids this problem that seems to be at the root of other estimates of the natural rate which fluctuate sharply with the cycle.

Assume that we have distinguished N different homogeneous groups, indexed by $i = 1, \ldots, N$. Let $t = 1, \ldots, T$ index time. Let $n^{i,t}$ denote the labor force size of group i in period t, and let n_t denote the size of the total labor force in period t. Then, to compute the aggregate natural rate at any given time t, we first construct within group natural rates:

$$\bar{u}_i = \bar{\phi}_i((1 + \bar{\gamma}_i)/(\bar{\pi}_i + \bar{\gamma}_i) .$$

We cannot simply take a weighted sum of these rates, since the appropriate weights would be unemployment rate shares and those unemployment rate shares reflect cyclical adjustment to deviations from the natural rate. Therefore we continue by computing:[3]

$$(3) \qquad \bar{\phi}_t = \Sigma \, (n_{i,t} \,/\, n_t) \, \bar{\phi}_i$$

$$(4) \qquad \bar{\pi}_t = \Sigma \left[\frac{(n_{i,t-1} \, \bar{u}_i)}{\Sigma \, (n_{j,t-1} \bar{u}_j)} \right] \bar{\pi}_i$$

$$(5) \qquad \bar{\gamma}_t = \Sigma \, \frac{n_{i,t}}{n_t} \, \bar{\gamma}_i$$

and finally:[4]

$$(6) \qquad \bar{u}_t = \bar{\phi}_t \, ((1 + \bar{\gamma}_t) \,/\, (\bar{\pi}_t + \bar{\gamma}_t))$$

The weights used in computing π_t reflect changes in the aggregate probability of escape from unemployment due to changes in the steady-state shares of unemployment across the N different homogeneous groups. For example, if a group with a low value of π_i increased in size (say due to increased labor force participation) then one would

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[3] The weights used in these averages may cause some confusion. For both $\bar{\phi}$ and $\bar{\gamma}$ current weights are used since we want to know the percentage of the current labor force who entered unemployment or the labor force respectively. For $\bar{\pi}$ the weights are lagged since we want to calculate the probability of having escaped unemployment the previous period.

[4] One potentially important effect not captured in using (6) to measure the natural rate is the rate of change of the shares in the labor force. That is , (6) takes into account changes in the shares in the labor force, but not how fast these shares are changing. The work of Lilien (1982) suggests that the rate of change of such shares may be important in measuring the natural rate.

expect the aggregate π to increase and the steady-state unemployment rate to decrease. However if that same group were simply more prone to layoff during a recession, so during certain periods they comprised a higher fraction of those unemployed (but not a higher fraction of the labor force) the steady-state rate would not change during recessionary periods. The steady-state rate reflects the unemployment rate to which the labor market would converge given the distribution of the labor force across the N different groups.

This procedure rests on the assumption that homogeneous groups of workers in terms of entrance and exit probabilities can be found and that the equilibrium values of these quantities do not vary over time. Clearly, if these assumptions are not correct, we may not correctly identify changes in the steady-state rate and may incorrectly attribute changes in the overall unemployment rate to disequilibrium adjustments in the labor market. Nevertheless, if groups that are less heterogeneous that the aggregate labor force can be identified, this procedure can help sort out fluctuations due to structural labor market changes from those due to cyclical (or non-structural) causes.

Having constructed a method for measuring the normal or natural rate of unemployment based upon steady state inflows and outflows, we now consider how one might decompose unemployment into alternative components. Given the calculation described above a natural decomposition would be

$$u_t = \bar{u}_t + u_t^r \tag{7}$$

where u_t^r represents residual slackness in the labor market. The difficulty with such a simple bivariate decomposition is that it does not differentiate types of "non-steady-state" unemployment. In particular, the fact that some layoff unemployment may be a result of implicit long-term contracts between employers and employees might lead one to differentiate temporary layoff unemployment from permanent layoff unemployment. Thus, an alternative decomposition is:

$$(8) \qquad u_t = \bar{u}_t + u_t^l + u_t^r .$$

where u_t^l represents the temporary layoff rate and u_t^r represents the residual slackness in the labor market. We turn now to the empirical implementation of these alternative components.

III. Measurement of Alternative Measures of Slackness

The natural rate calculation outlined above requires that we develop measures of ϕ_{it}, π_{it}, and γ_{it} for homogeneous sectors. The growth rate only requires information on the number of workers in that sector. Measurement of ϕ_{it} and π_{it} may be accomplished with net flow data available from the BLS using the procedure identified in Darby, Haltiwanger and Plant (1985a). To briefly recount the procedure, we have:

$$(9) \qquad \pi_{it} = 1 - (s_{it} - s_{it}^{0-4})/s_{it-1}$$

$$(10) \qquad \phi_{it} = s_{it}^{0-4}/n_{it}$$

where π_{it} is the proabability of exiting unemployment in period t and ϕ_{it} is the fraction of the labor force who entered unemployment. Here s_{it} is the number in group i unemployed in a given month, s_{it}^{0-4} is the number in group i who have been unemployed "0-4" weeks, and n_{it} is the number in the labor force. The problem with this methodology is how to use the available data to generate homogeneous sectors. From theoretical models in the literature on firm specific human capital accumulation, matching, and life cycle labor supply, one would expect a worker's inflow and outflow characteristics to depend on a worker's age, sex, occupation, industry, human capital, location and a host of other personal characteristics. At an aggregate level, we do not have sufficient data to calculate values of π_t and ϕ_t as a general function of these characteristics, nor have the necessary links between microeconomic studies of transition probabilities and aggregate data been made. Thus, we are constrained to look for groups that may reasonably be treated as homogeneous. The available data are limited. These data are available on the BLS LABSTAT data tape for the aggregate labor force and for certain select labor force breakdowns. In particular, these statistics are reported by detailed age (16-19, 20-24, 25-34, 35-44, 45-54, 55-64, 65+) and sex; by occupation; and by industry. These breakdowns are the most detailed that the published BLS data will allow. Further decomposition, for example into occupation groups within industry, is impossible. These breakdowns do not assure within group homogeneity. Nonetheless, calculating steady-state rates of unemployment using each of these breakdowns gives us some interesting and valuable information about the structure of unemployment in the

United States economy. The detailed data are available on a monthly basis from June 1976 to January 1985.[5]

Table 1 presents some descriptive statistics on the steady-state rates of unemployment computed using the four different breakdowns available to us. Recall that these rates are computed using data that begins in 1976, so the averages will be higher than one would expect to see if a longer time series were used. There is considerable variation in both the mean and standard deviation of the steady-state rate series. The large variances for the first breakdown indicates a substantial variation in the <u>labor force</u> shares of the component age-sex groups. Industrial shares do not seem to fluctuate much in this period and occupational shares are somewhere in between. The observed variation in mean steady-state rates indicates that the type of breakdown used could be critical in deciphering the composition of unemployment. Further evidence of this is given in Table 2 which reports correlation coefficients of these alternative measures of the steady-state rate. There is a reasonably high correlation between the age-sex, industry and occupation based steady-state rates.[6]

Figure 1 provides a plot of these alternative measures of the steady-state rate. Quarterly averages of the monthly values are plotted. There are distinctly different patterns that emerge from the alternative

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[5] Changes in occupation classifications in 1982 limit our occupation data sample to 1976:6 to 1982:12.

[6] The large variation in mean rates for the different breakdowns is due to the fact that we do not know what the homogeneous groups in fact are. Any group that is in fact heterogeneous, but measured as homogeneous will have a higher average value of π than if a weighted average of the average π values for the homogeneous groups were taken. This is shown in Darby, Haltiwanger and Plant (1985). Thus, the natural rate will change as measured groups change.

breakdowns. The age-sex based steady-state rate rises slightly in the late 1970's and declines sharply thereafter. This suggests that the commonly used argument that the steady-state rate was high during the 1970's because of a high proportion of young and female workers in the labor force is not an appropriate argument for the 1980's. By contrast, the industry based steady-state rate is relatively constant implying that changes in the industrial shares of the labor force have not been particularly important over this time period. Finally, we observe that the occupation based steady-state rate declines over the shorter sample that we have data available on occupational variables.

Having computed and characterized the alternative measures of the steady-state rate, we use these estimates along with the temporary layoff rate to decompose the aggregate unemployment rate in the manner given by equation (8). The temporary layoff rate is computed by the BLS as the ratio of employees who have been laid off but are expecting recall at sometime in the future to the labor force. As Feldstein (1978) notes, it is important to distinguish this series from the percentage of the labor force expecting recall within the next four weeks. Our measure is meant to capture workers who are expecting to return to the same employer and thus are not engaged in active search for another job. To use the contract theory idiom, these workers are still attached to the their firm. Thus our decomposition portions the unemployment rate into three components: the steady-state rate, the temporary layoff rate and the residual which is meant to capture the cyclical rate of unemployment.

Table 3 reports summary statistics of these alternative decompositions while Table 4 reports correlation coefficients from these alternative decompositions. Most of the mean of the actual rate of unemployment is accounted for by the steady-state rate. The mean of the temporary layoff rate is the second dominant factor. We observe in all cases that the mean residual slackness is relatively small as one would expect but that there is substantial variance in the residual slackness[7]. There is considerable variance in the temporary layoff rate as well while there is relatively little variance in each of the alternative measures of the steady-state rate. The correlation coefficients indicate a very high degree of correlation between the actual rate of unemployment and the residual measures of slackness. There is also a reasonably high correlation between the temporary layoff rate and either the actual or residual rate of unemployment. For this time period there is a significant negative correlation between the measures of the normal rate and the actual rate. This reinforces the visual evidence provided in Figure 1. In particular, this figure indicates that the evidence supports a slowly declining natural rate in the 1980's.[8]

Table 5 reports a variance decomposition of the actual rate of

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[7] That the mean residual slackness in negative in all cases (although for industry and occupation it is essentially zero) probably indicates a minor amount of double counting with these decompositions. If there are a certain number of temporary layoffs that are "normal" then these will be included both in the steady-state rate and the temporary layoff rate.

[8] A similar computation of a steady-state unemployment rate is done in Darby, Haltiwanger and Plant (1985) for the period from 1956 to 1983. The demographic breakdown used is by age and sex. The steady-state rate shows much more fluctuation over this period, with a large increase in the late 1960's and early 1970's as the baby-boom cohorts enter the labor force.

unemployment for each alternative breakdown. The residual measure of slackness accounts for about 50% of the variance in all cases. The temporary layoff rate accounts for about one-tenth of the variance and the covariance between the residual measure and the temporary layoff rate accounts for about 40% of the overall variance. In contrast, the steady-state rate of unemployment and the other covariances account for essentially none of the overall variance. These results indicate that over this period the overwhelming factors contributing to the variance of unemployment are the temporary layoff rate and the residual slackness in the labor market.[9]

Figures 2-4 illustrate the movements of these alternative measures of slackness over this period. One can see the co-movements in the temporary layoff and the residual series. However, the residual series is noisier and appears to lag behind movements in the temporary layoff series.

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[9] Note that we do not attribute the predominant variance to cyclical factors but instead to the residual. As previously noted, this residual may not exactly reflect cyclical factors if our demographic breakdowns do not ensure homogeneous groups or if there exists non-steady-state, non-cyclical unemployment.

IV. The Relationship Between Alternative Measures of Slackness in the Labor Market and Wage and Price Inflation

The relationship between slackness in the labor market and movements in wage and price inflation have and continue to be a source of concern to economists. The responsiveness of real wages to an increase in the degree of slackness in the labor market is taken to be a rough measure of how well the labor market clears. The problem has been how to specify and to measure the appropriate variables in this relationship. In this section, we take an eclectic approach to these issues by considering two ways to approach this problem. We first estimate a series of vector autoregressions which include measures of wage inflation, price inflation, and the components of the unemployment rate developed and estimated in the previous sections. The results from this analysis are intended to provide a sense of the timing of the relationships between these variables. In addition, we estimate more traditional expectations augmented wage equations. Our innovation here is that we include not just a single variable such as the unemployment rate to measure slackness but rather each of the components of the decomposition given in equation (8) above.

Tables 6-8 report the results from the vector autoregressions. There are five variables considered: wage inflation (dw/w), price inflation (dp/p) and the three components of the unemployment rate.[10] We regress each of these five variables on a constant, a time trend, and six lagged values of each variable. In these tables we report F-tests

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[10] Wage inflation is measured as the percentage change is average hourly earnings. Price inflation is measured as the percentage change in the consumer price index. The use of other measures of wages and prices do not change the results substantially.

of the statistical significance of sets of lagged regressors on each of the dependent variables. Both the F-test statistic and the marginal significance are reported. Each table reports the results for one of the four demographic breakdowns of the labor force. In most cases, lagged dependent variables are significant at the 5% level in explaining movements in the dependent variable. The consistent exception is price inflation (dp/p) which is usually only significant at the 10% level. The most interesting and surprising finding is the importance of lagged movements in temporary layoffs in explaining movements in wage and price inflation and the lack of much of a relationship between the residual measures of slackness and wage and price inflation. In almost all cases, lagged movements in temporary layoffs are significant in explaining movements in wage and price inflation.[11] The exception is with the occupation based measure of the steady-state rate of unemployment in which case lagged temporary layoffs are significant for explaining movements in price inflation but are only marginally significant in explaining movements in wage inflation. In contrast, lagged movements in the residual measure are insignificant in explaining movements in wage and price inflation. The exception is again with the occupation based measure of the steady-state rate in which the lagged residual measure is significant in explaining movements in price inflation but is only marginally significant in explaining movements in wage inflation.[12] We also find that lagged movements in the

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[11] Note further that the signs of the coefficients indicate an inverse relationship between temporary layoffs and wage and price inflation. That is, examination of the impulse response functions (not reported) indicates that a unit impulse in temporary layoffs induces a decline in the rate of wage and price inflation.

[12] The occupation-based steady-state regressions appear to yield slightly different results because of the shorter time period over which they were run. When we ran the other VAR's using the shorter time period, we obtain similar results to those reported here.

alternative measures of the steady-state rate of unemployment are insignificant in explaining wage and price inflation. Furthermore, lagged movements in wage inflation are insignificant for explaining movments in all variables except for wage inflation itself. In contrast, lagged movements in price inflation are significant for explaining movements in temporary layoffs but are insignificant for explaining movements in all other variables. Overall, the basic finding is that movements in temporary layoffs seem to be closely related to movements in wage and price inflation but that movements in the other measures of slackness (i.e., the steady-state the residual measure) do not seem to be closely related to movements in wage and price inflation.

In Table 9 we report vector autoregressions similar to those in the previous three tables, but rather than using the decomposed unemployment rate we use the gross unemployment rate as reported by the BLS on a monthly basis. There is a remarkable contrast between this VAR and the VAR's that include a decomposed unemployment rate. In particular, the unemployment rate and its lags are not significant in explaining changes in wages and prices. The lagged unemployment rate is only significant in explaining its own movements. This is an important distinction. Use of the unemployment rate as an unrefined measure of slackness in the labor market would lead one to conclude there was no relation between slackness in the labor market and wage and price inflation when, in fact, a more precise measure of slackness indicates that such an empirical relationship exists. This raises questions about the results reported in Sims (1980) and Ashenfelter and Card (1982) in which the actual unemployment rate is used in similar VAR estimations. Both papers find that the unemployment rate is unimportant for explaining wage and price inflation.

Table 10 reports estimates of expectations augmented wage equations. To capture expectations of price inflation, we use a 3rd order polynomial distributed lag on price inflation with a lag length of 36 months.[13] To capture slackness in the labor market we include all three components of the decomposition suggested by equation (8). A time trend is included to capture any trend in wages over this time period. A different wage equation is fit for each different breakdown of unemployment. The results in Table 10 are consistent with the surprising findings from the vector autoregressions. Increases in temporary layoffs have a significant and negative effect on wage inflation while increases in the residual measure of unemployment have a positive but mostly insignificant effect on wage inflation.[14] Changes in the steady-state rate of unemployment are positive but insignificant for movements in wage inflation. The sum of the coefficients on the PDL on price inflation is positive and significant in most cases. Further, the point estimates are within two standard deviations of being equal to one in most cases.

In Table 11, we report the result of running a similar wage regression using the aggregate unemployment rate as the sole measure of

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[13] Variation in the specification of the PDL do not change the results significantly.

[14] Note that since any specification error in the measurement of the natural rate is in the residual, one might expect the coefficient to be biased towards zero.

labor market slackness. Note that the coefficient on unemployment is insignificant over this period. Once again, unthinking use of the aggregate unemployment rate as a measure of slackness in the labor market would have lead to incorrect conclusions regarding this empirical relationship.

The puzzle that emerges from both the vector autoregression results and the estimates of the wage equations is why the temporary layoff rate is closely related to movements in wage and price inflation and the residual measure of slackness is not. This appears to be inconsistent with at least early versions of labor contract theory (e.g., Azariadis (1975), Feldstein (1976)) that are based on symmetric information environment. In that context, it was suggested that fully contingent long term contracts would emerge in which temporary layoffs would be part of the contract and wages for workers who were temporarily laid off but still attached to firms would likely be insulated from current labor market conditions. This is because current wages would be more like an installment payment on the long term contract. Viewed from this perspective, it would be the unattached workers who would be seen as putting downward pressure on contract values and hence wages. Supplementing this characterization of the labor market with search theory, one would expect that it would be deviations from the steady-state rate of unattached workers which would be important for explaining movements in contract values and wages. The residual measure of slackness that we have computed is intended to capture such deviations from the normal rate of unattached workers so one would expect it to be closely related to movements in wages and prices. This search and contract theoretic paridigm would predict exactly the opposite of what we have found empirically. Our evidence would lead us to reject this paradigm as a reasonable explanation of the relationship between wages and unemployment in the labor market. We can only speculate as to what sort of model might lead to such empirical results.

One way to reconcile our results with this tradition is to abandon the fully contingent, symmetric information environment of early contract theory. If, instead, we use an asymmetric information environment which inhibits the establishment of fully contingent contracts, our empirical results begin to make more sense. In an asymmetric information environment, one would expect renegotiation of contracts to serve as a substitute for fully specified contingent contracts (see, e.g., Shavell (1983), Hall and Lazear (1984) and Haltiwanger and Waldman (1985)). Contracts in this environment may take the very simple form of an agreement on a wage, allowing both parties to initiate either separations or renegotiation of that wage (see, e.g., Hall and Lazear (1984)). In this type of contract when a business cycle slump occurs, firms are likely to use temporary layoffs to absorb the slump. The increase in temporary layoffs is a signal to workers that demand has in fact fallen. Convinced that demand has fallen, workers will be more willing to renegotiate the wage (or the rate of wage increase) downwards. Since an attachment still exists in the case of temporary layoffs, the parties remain in contact with each other and this renegotiation can occur relatively quickly. Hence, one would expect to observe a fairly close contemporaneous relationship between movements in temporary layoffs and movements in wages in this environment. This is consistent with our empirical findings.

In contrast, no attachment exists by definition between unattached workers and potential employers of these workers. The process by which deviations from the normal rate of unattached workers has an influence on contract values and wages is likely to be much more complicated than the renegotiation process with temporarily laid off workers. To the extent that the lags in the adjustment process with unattached workers are long and variable, our results, which do not detect much of a cotemporaneous relationship between our residual measures of slackness and wage and price inflation, may not be so surprising.

There are other possible explanations for this surprising finding. Suppose one still hypothesized that the wages for workers with long term contracts are insulated from current labor market conditions but suppose as well that the labor market is characterized by a mix of a contractual sector and an auction market sector. Then, it may be that when a slump in demand occurs, temporary layoffs increase in the contractual sector while wages adjust in the auction market sector. This would be consistent with the relationship that we have found between temporary layoffs and wage and price inflation. This hypothesis is interesting because one would only expect to observe this relationship if there is a mix of contractual and auction market sectors. That is, if the labor market is purely an auction market or purely a contractual market, this explanation does not work. In order to distinguish between these competing hypotheses for the surprising finding reported in this paper, further analysis using disaggregated data is required.

V. Conclusion

Unthinking use of the unemployment rate as a measure of slackness in the labor market can lead to an incorrect picture of the labor market. Theoretical advances in search theory and contract theory suggest that a certain amount of unemployment can be viewed as "equilibrium" in nature. In this paper we have developed measures of slackness in the labor market that reflect the theoretical advances made in the study of unemployment rate dynamics. Our measurement of the steady-state rate of unemployment is derived from a dynamic model of labor force adjustment in which the natural unemployment rate is seen as the steady state rate to which the system would converge if not repeatedly shocked. This steady state rate is a function of the composition of the labor force. In particular, it depends on the distribution of unemployment exit and entrance probabilities among workers. Deviations from this natural rate are broken into two components: temporary layoffs in which a tie between firm and worker is maintained and a residual measure.

Our first interesting empirical result is that the decomposition of the labor force matters in calculating the natural rate. The structure of the labor force has changed with regards to age, sex and reason for unemployment, but very little with respect to industry or occupation over our brief sample period. The breakdown of the aggregate unemployment rate into its components will depend critically on how the labor force is decomposed into "homogeneous" groups.

Our second interesting result is that it is important to do such a breakdown if one wishes to measure the relationship between wages, prices and slackness in the labor market. Over our sample period, use of the aggregate rate would lead one to conclude no relationship, but using a disaggreagated unemployment rate as a measure of slackness uncovers an empirical relationship.

Our third interesting result is that during our sample period, the temporary layoff rate seems to matter a great deal in explaining wage and price inflation and that the residual unemployment rate matters little. This seems to be inconsistent with traditional contract and search theory that would posit little, if any, of a contemporaneous relationship between temporary layoffs and wage and price inflation. We offered some conjectures above however that in a world of asymmetric information, this empirical conclusion might not be so startling.

There remains much work to be done. To the extent that structural change takes place during downturns in the business cycle, there will be an empirical covariance between structural and cyclical fluctuations in unemployment. A sorting out these two components theoretically and empirically needs to be done. Second, the empirical consequences of contract negotiation under asymmetric information need to be developed and investigated in greater depth. Third, disaggregated analysis linking individuals' unemployment experience and and any associate wage changes is necessary. Overall, untangling the import of the various empirical measures of slackness in the labor market should keep economists employed for some time to come.

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Table 1
Descriptive Statistics on Measures of the Natural Rate of Unemployment

Breakdown	Mean	Std. Deviation	Minimum	Maximum
Age-Sex	7.43	0.109	7.20	7.57
Industry	6.97	0.019	6.94	7.01
Occupation	6.42	0.066	6.30	6.53

Table 2
Correlations Coefficients of Alternative Natural Rates

	Age-Sex	Industry	Occupation
Age-Sex	1.00		
Industry	0.84	1.00	
Occupation	0.85	0.87	1.00

Note: Correlation coefficients are computed on the sample from June, 1976 to December, 1982 since the occupation data ends in December, 1982. Correlation coefficients computed from the longer sample from 1976:6 to 1985:1 for the age-sex, age-sex-reason, and industry natural rates are very similar to those reported here.

Table 3
Summary Statistics for Alternative Breakdowns of the Unemployment Rate

		Mean	Standard Deviation	Minimum	Maximum
	u	7.58	1.380	5.67	10.81
Age-Sex:					
	$\bar{u}$	7.43	0.110	7.20	7.57
	u^l	1.20	0.430	0.61	2.26
	u^r	-1.05	1.100	-2.59	1.35
Industry:					
	$\bar{u}$	7.03	0.022	6.99	7.08
	u^l	1.20	0.430	0.61	2.26
	u^r	-0.65	1.034	-2.12	1.68
Occupation:					
	$\bar{u}$	6.42	0.066	6.31	6.53
	u^l	1.17	0.452	0.61	2.26
	u^r	-0.32	0.944	-1.48	2.38

Note: Occupation statistics computed from June 1976 to December 1982. All others from June 1976 to January 1985.

Table 4
Correlation Coefficients of Alternative Breakdowns

Age-Sex:

	u	$\bar{u}$	u^l	u^r
u	1.00			
$\bar{u}$	-0.67	1.00		
u^l	0.84	-0.51	1.00	
u^r	0.98	-0.75	0.78	1.00

Industry:

	u	$\bar{u}$	u^l	u^r
u	1.00			
$\bar{u}$	-0.67			
u^l	0.89	-0.68	1.00	
u^r	0.98	-0.63	0.79	1.00

Occupation:

	u	$\bar{u}$	u^l	u^r
u	1.00			
$\bar{u}$	-0.65	1.00		
u^l	0.91	-0.83	1.00	
u^r	0.99	-0.57	0.83	1.00

See note on Table 3

Table 5
Variance Decomposition of Unemployment Rates

Labor Force Breakdown:	(1)	(2)	(3)	(4)	(5)	(6)
Age-Sex	0.0063	0.0966	0.6323	-0.0250	-0.0943	0.3841
Industry	0.0002	0.0966	0.5587	-0.0066	-0.0147	0.3657
Occupation	0.0026	0.1208	0.5281	-0.0294	-0.0427	0.4205

Notes:

(1) Percent of total variance accounted for by normal rate
(2) Percent of total variance accounted for by temporary layoff
(3) Percent of total variance accounted for by residual
(4) 2 cov(.,.) of (1) and (2) as percent of total variance
(5) 2 cov(.,.) of (1) and (3) as percent of total variance
(6) 2 cov(.,.) of (2) and (3) as percent of total variance

For sample definitions, see table 3.

Table 6

Time Precedence Tests for Alternative Measures of Slackness and Wage and Price Inflation with Age-Sex Breakdown

Test for "Causality" of	By lagged	Maintained Lag Regressors	Test Statistic	Marginal Significance
dw/w	dw/w	$dp/p,\bar{u},u^l,u^r$	4.93	0.0003
dw/w	dp/p	$dw/w,\bar{u},u^l,u^r$	0.82	0.5571
dw/w	$\bar{u}$	$dw/w,dp/p,u^l,u^r$	0.95	0.4661
dw/w	u^l	$dw/w,dp/p,\bar{u},u^r$	2.63	0.0240
dw/w	u^r	$dw/w,dp/p,\bar{u},u^r$	1.04	0.4106
dp/p	dw/w	$dp/p,\bar{u},u^l,u^r$	0.72	0.6360
dp/p	dp/p	$dw/w,\bar{u},u^l,u^r$	1.87	0.0998
dp/p	$\bar{u}$	$dw/w,dp/p,u^l,u^r$	0.43	0.8530
dp/p	u^l	$dw/w,dp/p,\bar{u},u^r$	2.82	0.0168
dp/p	u^r	$dw/w,dp/p,\bar{u},u^l$	0.68	0.6684
$\bar{u}$	dw/w	$dp/p,\bar{u},u^l,u^r$	0.97	0.4545
$\bar{u}$	dp/p	$dw/w,\bar{u},u^l,u^r$	0.35	0.9049
$\bar{u}$	$\bar{u}$	$dw/w,dp/p,u^l,u^r$	5.06	0.0003
$\bar{u}$	u^l	$dw/w,dp/p,\bar{u},u^r$	0.61	0.7190
$\bar{u}$	u^r	$dw/w,dp/p,\bar{u},u^l$	0.51	0.7991
u^l	dw/w	$dp/p,\bar{u},u^l,u^r$	0.77	0.5965
u^l	dp/p	$dw/w,\bar{u},u^l,u^r$	3.15	0.0091
u^l	$\bar{u}$	$dw/w,dp/p,u^l,u^r$	0.65	0.6900
u^l	u^l	$dw/w,dp/p,\bar{u},u^r$	21.78	0.0001
u^l	u^r	$dw/w,dp/p,\bar{u},u^l$	2.66	0.0227
u^r	dw/w	$dp/p,\bar{u},u^l,u^r$	0.18	0.9802
u^r	dp/p	$dw/w,\bar{u},u^l,u^r$	0.28	0.9447
u^r	$\bar{u}$	$dw/w,dp/p,u^l,u^r$	0.32	0.9247
u^r	u^l	$dw/w,dp/p,\bar{u},u^r$	2.17	0.0565
u^r	u^r	$dw/w,dp/p,\bar{u},u^l$	11.46	0.0001

Table 7

Time Precedence Tests for Alternative Measures of Slackness and Wage and Price Inflation with Industry Breakdown

Test for "Causality" of	By lagged	Maintained Lag Regressors	Test Statistic	Marginal Significance
dw/w	dw/w	$dp/p, \bar{u}, u^l, u^r$	4.65	0.0006
dw/w	dp/p	$dw/w, \bar{u}, u^l, u^r$	1.09	0.3801
dw/w	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	1.23	0.3014
dw/w	u^l	$dw/w, dp/p, \bar{u}, u^r$	2.71	0.0208
dw/w	u^r	$dw/w, dp/p, \bar{u}, u^r$	1.24	0.2995
dp/p	dw/w	$dp/p, \bar{u}, u^l, u^r$	0.92	0.4835
dp/p	dp/p	$dw/w, \bar{u}, u^l, u^r$	1.90	0.0949
dp/p	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	1.23	0.3002
dp/p	u^l	$dw/w, dp/p, \bar{u}, u^r$	3.66	0.0035
dp/p	u^r	$dw/w, dp/p, \bar{u}, u^l$	1.53	0.1820
$\bar{u}$	dw/w	$dp/p, \bar{u}, u^l, u^r$	2.03	0.0738
$\bar{u}$	dp/p	$dw/w, \bar{u}, u^l, u^r$	0.35	0.9100
$\bar{u}$	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	6.63	0.0001
$\bar{u}$	u^l	$dw/w, dp/p, \bar{u}, u^r$	0.50	0.8061
$\bar{u}$	u^r	$dw/w, dp/p, \bar{u}, u^l$	1.35	0.2471
u^l	dw/w	$dp/p, \bar{u}, u^l, u^r$	0.79	0.5843
u^l	dp/p	$dw/w, \bar{u}, u^l, u^r$	3.71	0.0031
u^l	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	1.09	0.3793
u^l	u^l	$dw/w, dp/p, \bar{u}, u^r$	16.94	0.0001
u^l	u^r	$dw/w, dp/p, \bar{u}, u^l$	3.76	0.0029
u^r	dw/w	$dp/p, \bar{u}, u^l, u^r$	0.50	0.8028
u^r	dp/p	$dw/w, \bar{u}, u^l, u^r$	0.25	0.9559
u^r	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	1.03	0.4142
u^r	u^l	$dw/w, dp/p, \bar{u}, u^r$	2.07	0.0696
u^r	u^r	$dw/w, dp/p, \bar{u}, u^l$	13.99	0.0001

Table 8

Time Precedence Tests for Alternative Measures of Slackness and Wage and Price Inflation with Occupation Breakdown

Test for "Causality" of	By lagged	Maintained Lag Regressors	Test Statistic	Marginal Significance
dw/w	dw/w	$dp/p, \bar{u}, u^l, u^r$	2.09	0.0754
dw/w	dp/p	$dw/w, \bar{u}, u^l, u^r$	0.65	0.6869
dw/w	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	1.26	0.2950
dw/w	u^l	$dw/w, dp/p, \bar{u}, u^r$	1.76	0.1318
dw/w	u^r	$dw/w, dp/p, \bar{u}, u^r$	2.30	0.0529
dp/p	dw/w	$dp/p, \bar{u}, u^l, u^r$	1.27	0.2918
dp/p	dp/p	$dw/w, \bar{u}, u^l, u^r$	3.05	0.0148
dp/p	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	1.35	0.2582
dp/p	u^l	$dw/w, dp/p, \bar{u}, u^r$	2.29	0.0542
dp/p	u^r	$dw/w, dp/p, \bar{u}, u^l$	2.58	0.0326
$\bar{u}$	dw/w	$dp/p, \bar{u}, u^l, u^r$	0.66	0.6831
$\bar{u}$	dp/p	$dw/w, \bar{u}, u^l, u^r$	0.81	0.5681
$\bar{u}$	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	5.22	0.0005
$\bar{u}$	u^l	$dw/w, dp/p, \bar{u}, u^r$	0.82	0.5629
$\bar{u}$	u^r	$dw/w, dp/p, \bar{u}, u^l$	0.42	0.8612
u^l	dw/w	$dp/p, \bar{u}, u^l, u^r$	0.65	0.6863
u^l	dp/p	$dw/w, \bar{u}, u^l, u^r$	3.34	0.0092
u^l	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	1.68	0.1522
u^l	u^l	$dw/w, dp/p, \bar{u}, u^r$	9.59	0.0001
u^l	u^r	$dw/w, dp/p, \bar{u}, u^l$	2.64	0.0295
u^r	dw/w	$dp/p, \bar{u}, u^l, u^r$	0.28	0.9445
u^r	dp/p	$dw/w, \bar{u}, u^l, u^r$	0.41	0.8699
u^r	$\bar{u}$	$dw/w, dp/p, u^l, u^r$	0.73	0.6294
u^r	u^l	$dw/w, dp/p, \bar{u}, u^r$	0.81	0.5721
u^r	u^r	$dw/w, dp/p, \bar{u}, u^l$	10.48	0.0001

Table 9

Time Precedence Tests for the Aggregate Unemployment Rate and Wage and Price Inflation

Test for "Causality" of	By lagged	Maintained Lag Regressors	Test Statistic	Marginal Significance
dw/w	dw/w	dp/p,u	4.27	0.0008
dw/w	dp/p	dw/w,u	1.80	0.1093
dw/w	u	dw/w,dp/p	0.72	0.6401
dp/p	dw/w	dp/p,u	0.39	0.8804
dp/p	dp/p	dw/w,u	4.49	0.0006
dp/p	u	dw/w,dp/p	1.63	0.1493
u	dw/w	dp/p,u	0.45	0.8417
u	dp/p	dw/w,u	1.09	0.3726
u	u	dw/w,dp/p	374.67	0.0001

Table 10
Wage Equations

Dependent variable: dw/w

	Labor force breakdown:		
	Age-Sex	Industry	Occupation
Explanatory Variable:			
Constant	-0.009 (0.078)	-0.334 (0.206)	-0.091 (0.137)
$\bar{u}$	0.298 (1.020)	4.866 (2.891)	1.626 (2.073)
u^1	-0.450 (0.201)	-0.389 (0.202)	-0.573 (0.207)
u^r	0.220 (0.127)	0.175 (0.129)	0.425 (0.173)
π^e	0.493 (0.328)	0.555 (0.311)	0.211 (0.376)
Time Trend	-0.00003 (0.00003)	-0.000008 (0.000021)	-0.000006 (0.000047)
R^2	0.242	0.262	0.186
D.W.	2.87	2.81	2.83

Standard errors in parentheses. See table 3 for sample definitions.

Table 11
Wage Equation using Unemployment Rate

Dependent variable: dw/w

Explanatory Variable:	
Constant	0.010
	(0.003)
Time Trend	-0.336
	(0.132)
Unemployment Rate	-0.0313
	(0.0522)
π^e	0.1438
	(0.2708)
R^2	0.266
D.W.	2.84

FIGURE 1
NATURAL RATES

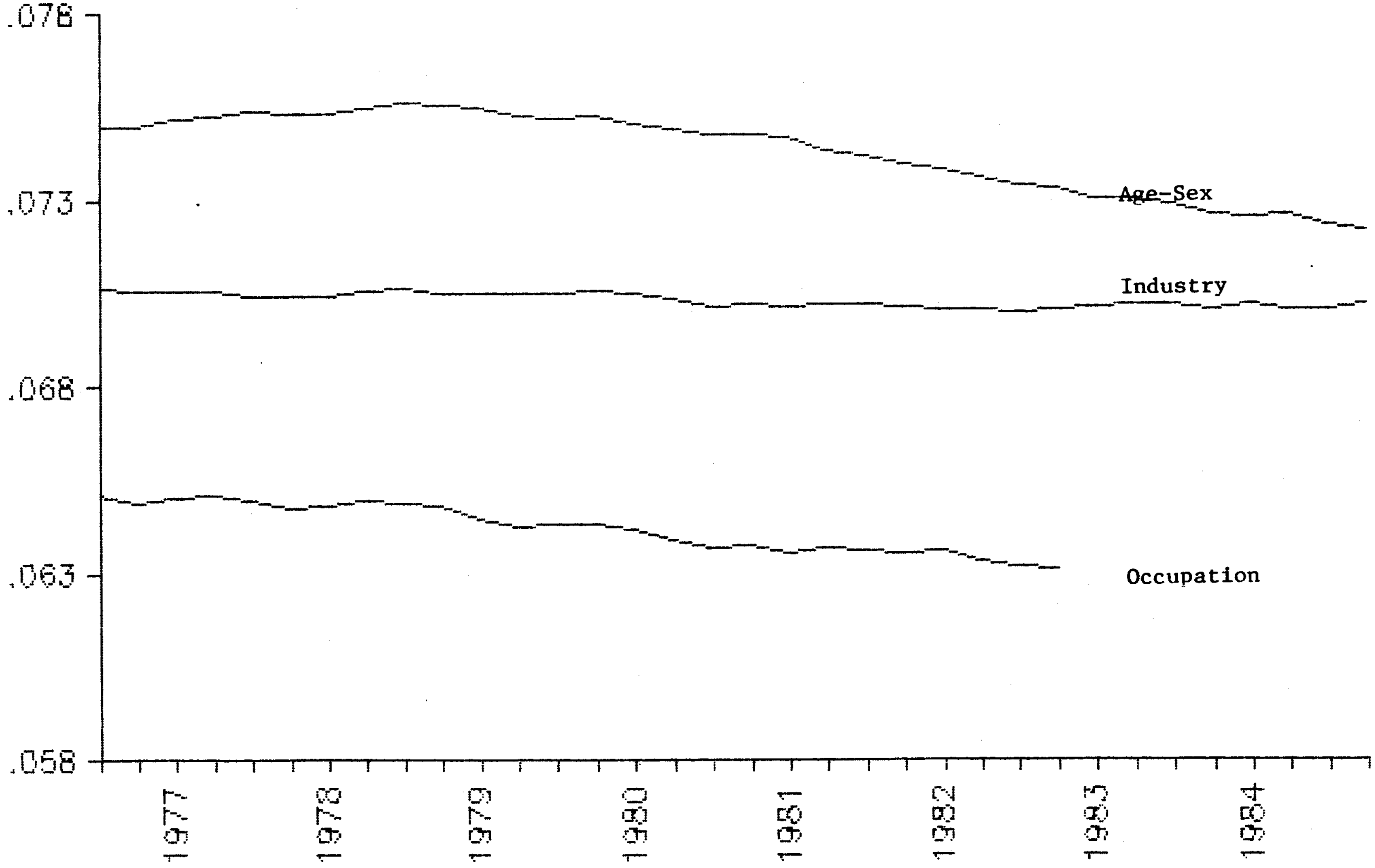

FIGURE 2

AGE-SEX

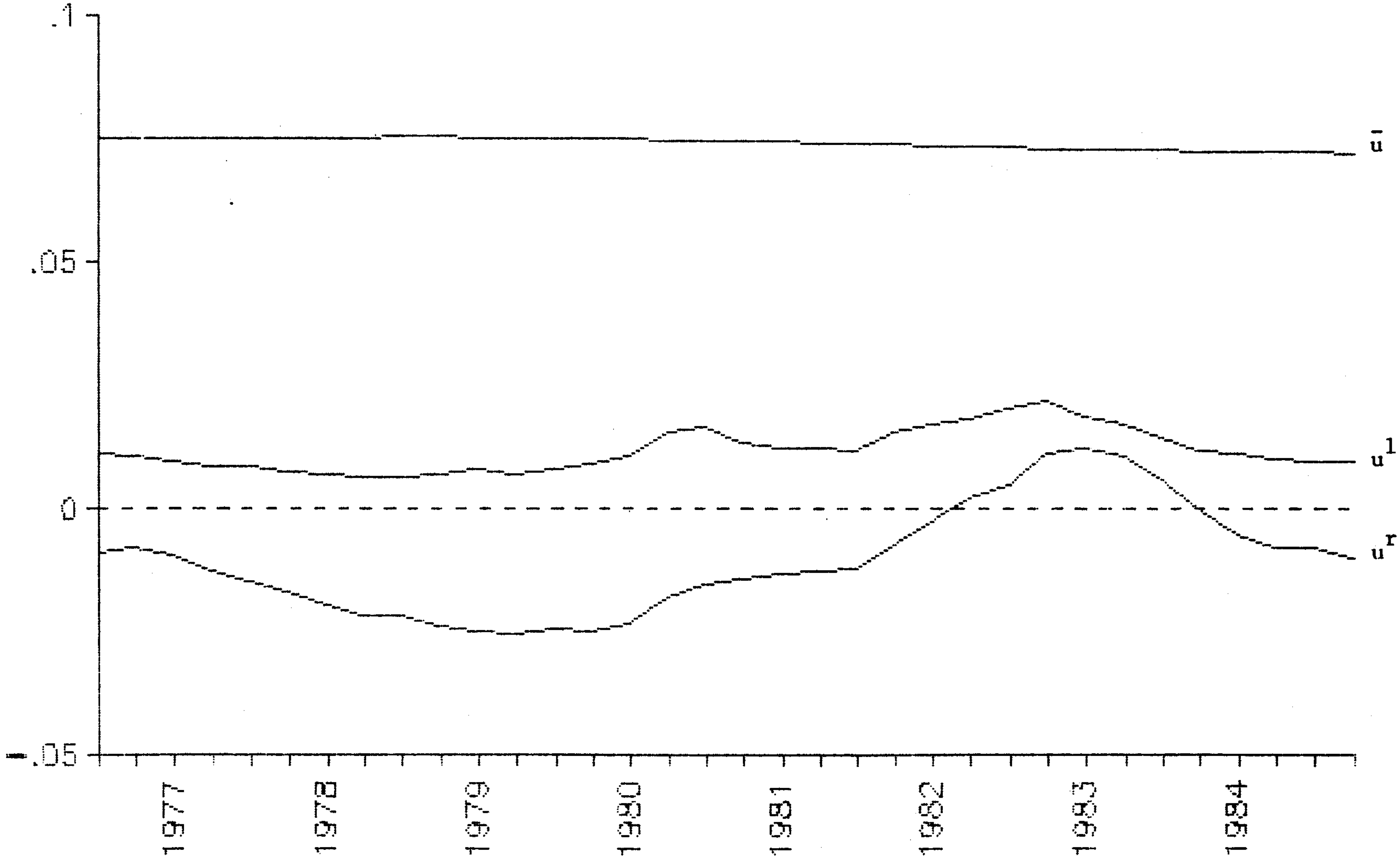

FIGURE 3

INDUSTRY

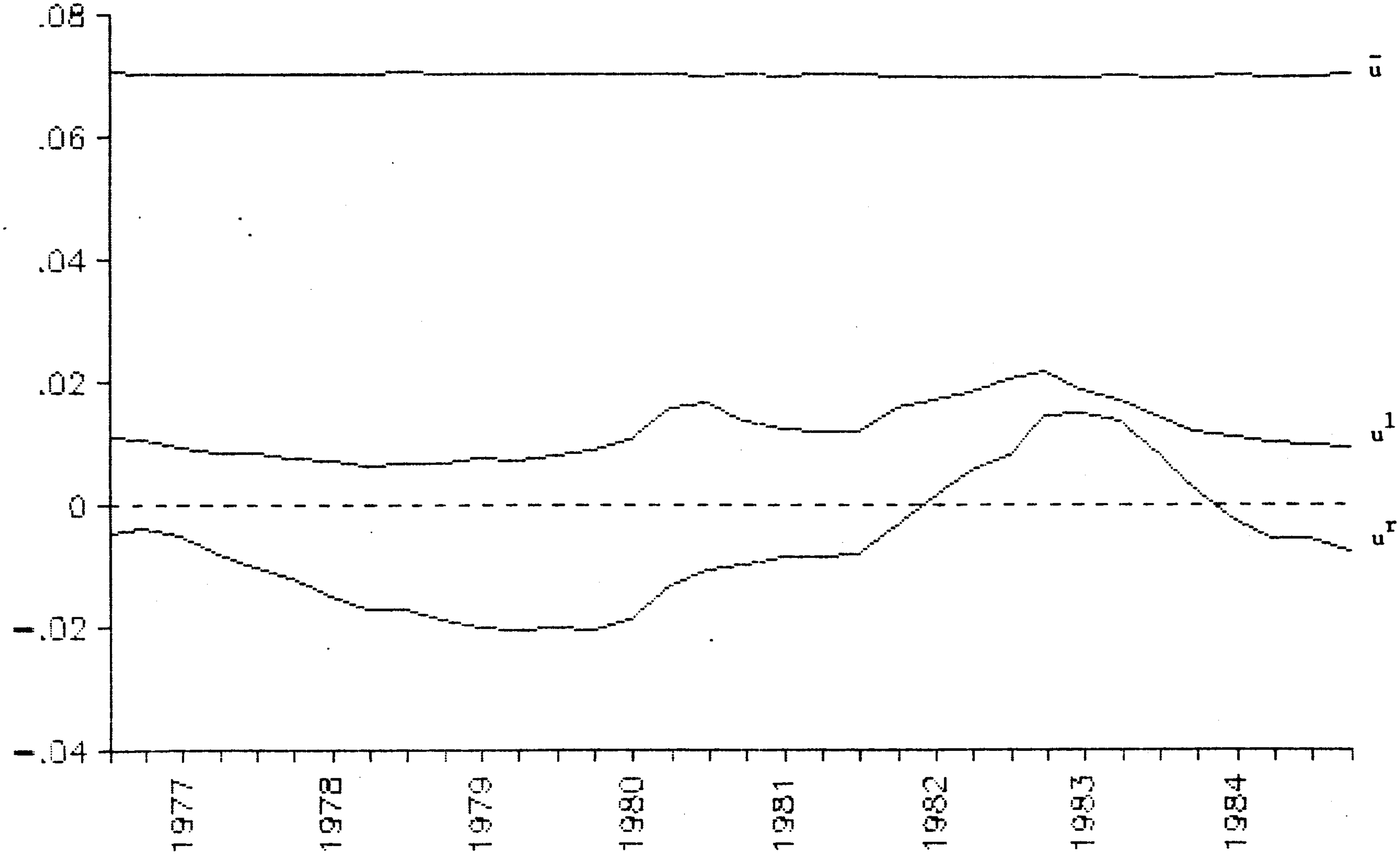

FIGURE 4

OCCUPATION