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CYCLICAL UNEMPLOYMENT: SECTORAL SHIFTS OR AGGREGATE DISTURBANCES?

Katharine G. Abraham
Lawrence F. Katz

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MASSACHUSETTS
INSTITUTE OF TECHNOLOGY
50 MEMORIAL DRIVE
CAMBRIDGE, MASSACHUSETTS 02139

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Katharine G. Abraham
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MIT and National Bureau of Economic Research;
MIT

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ABSTRACT

Recent work by David Lilien has argued that the existence of a strong positive correlation between the dispersion of employment growth rates across sectors (σ) and the unemployment rate implies that shifts in demand from some sectors to others are responsible for a substantial fraction of cyclical variation in unemployment. This paper demonstrates that, under certain empirically satisfied conditions, aggregate demand movements alone can produce a positive correlation between σ and the unemployment rate. Two tests are developed which permit one to distinquish between a pure sectoral shift interpretation and a pure aggregate demand interpretation of this positive correlation. The finding that σ and the volume of help wanted advertising are negatively related and the finding that σ is directly associated with the change in unemployment rather than with the level of unemployment both support an aggregate demand interpretation. A proxy for sectoral shifts that is purged of the influence of aggregate demand is then developed. Models which allow sectoral shifts in the composition of demand and fluctuations in the aggregate level of demand to affect the unemployment rate independently are estimated using this proxy. The results support the view that pure sectoral shifts have not been an important source of cyclical fluctuations in unemployment.

The business cycle literature typically assumes that aggregate disturbances, and in particular aggregate demand movements, are the primary cause of cyclical swings in unemployment (see , for example, Barro [1977]; Baily and Okun [1983]; and Tobin [1980]). The aggregate models utilized by macroeconomists usually fail to take into account the possibility that shifts in the sectoral composition of demand can have adverse macro consequences in an economy where resources are not instantaneously mobile across sectors. In a provocative recent paper, Lilien (1982a) argues that shifts in demand from some sectors to others, rather than movements in the level of aggregate demand, are in fact responsible for half or more of all cyclical variation in unemployment in the postwar period. Lilien's evidence on this point appears to have been rather widely accepted (see, for example, Barro [1984]; Bluestone, Harrison and Gorham [1984]; Grossman, Hart and Maskin [1983]; and Rosen [1984]).

The aggregate demand and sectoral shift explanations for cyclical unemployment have potentially quite different policy implications. A pure sectoral shift explanation seems to rule out a useful role for aggregate demand policies in moderating unemployment fluctuations. Thus, the degree to which each of these two possible sources contributes to cyclical unemployment is a matter of considerable importance.

Section I of this paper lays out both a pure sectoral shift explanation and a pure aggregate demand explanation for cyclical fluctuations in the unemployment rate. We show that either could produce the strong positive relationship between the cross-industry dispersion of employment growth rates and the unemployment rate that Lilien appeals to as evidence for his sectoral shift hypothesis. Section II argues that information on job vacancies can be used to distinguish between the pure sectoral shift hypothesis and the pure aggregate demand hypothesis. Estimates using the Conference Board help wanted index as a vacancy proxy offer strong support for the primacy of aggregate demand disturbances in producing cyclical fluctuations in unemployment. Evidence that the dispersion in employment growth rates is directly correlated with the change in the unemployment rate, rather than with the unemployment rate itself, corroborates this view. Section III considers a model which allows both sectoral shifts and aggregate demand fluctuations to produce independent effects on unemployment. Empirical estimates based on this model confirm that pure sectoral shifts have not been an important cause of cyclical movements in the unemployment rate. Section IV offers a few concluding comments.

I. Sectoral Shifts, Aggregate-Demand-Induced Business Cycles, and Dispersion in Employment Growth Rates

In this section of the paper, we demonstrate that either pure shifts in the structure of demand or pure shocks to the level of demand could produce a positive correlation between the dispersion of employment growth rates and the unemployment rate. This means that evidence of such a correlation cannot be taken as compelling support for the view that pure sectoral shifts have been an important cause of cyclical unemployment.

Sectoral Shifts

We begin by thinking about a hypothetical economy which never experiences fluctuations in aggregate demand around its trend rate of growth. If workers were perfectly mobile and perfectly substitutable, shifts in the sectoral composition of demand for labor that did not alter the aggregate level of demand for labor would have no effect on the unemployment rate. Employment losses in contracting firms would be exactly matched by employment gains in expanding firms. However, if frictions are present, then shifts in employment demand can lead to at least temporary increases in unemployment. This is the basis for the relationship posited in Lilien's work between σ_t, the dispersion in observed employment growth rates across sectors (an empirical proxy for the dispersion in the desired rates of employment growth across sectors) and U_t, the unemployment rate.

We represent the desired rate of employment growth in a particular sector as the sum of the aggregate trend rate of growth of employment, Γ, plus a random sector specific disturbance, ε^*_{it}:

$$(1) \qquad d \ln E^*_{it} = \Gamma + \varepsilon^*_{it}$$

where ε^*_{it} is assumed to be distributed with mean zero and time-varying variance σ^{*2}_t according to the distribution $f(\varepsilon^*/\sigma^*_t)$. A shock to the economy which necessitates that proportionally more labor be allocated to some sectors and proportionally less to others, but does not move aggregate demand off its trend path, may increase σ^*_t, the dispersion in desired employment growth rates, but does not affect Γ. We will refer to a shock of this sort which increases σ^*_t as a <u>mean preserving spread</u> in the rates of growth of labor demand across sectors.[1/] In a frictionless world, the change in the desired rate of employment growth in a sector will always equal the change in the actual rate of employment growth in the sector. A mean preserving spread leaves total employment no different than it would have been in the absence of the shock. In the presence of frictions, many of the people losing their jobs in the sectors experiencing negative shocks can expect to be out of work for some period of time, while searching for employment in the gaining sectors. Increases in σ^*_t, the dispersion in desired rates of employment change across industries, would raise the number of workers shifting to new sectors and thereby increase the unemployment rate. Unless there were some unusual configuration of bottlenecks in the labor market, one would expect σ_t^*, the dispersion in desired rates of employment change, to be tracked reasonably closely by σ_t, the dispersion in actual rates of employment change. This suggests that, in the absence of aggregate demand disturbances, pure sectoral shifts in the composition of demand would produce a positive correlation between the dispersion of employment growth rates and the unemployment rate.[2/]

Aggregate Demand Fluctuations

The preceding discussion completely ignores the potential effect of aggregate demand fluctuations on employment growth dispersion. This causes no problems for empirical analysis -- in the sense that the dispersion of employment growth rates can still safely be interpreted as a measure of intersectoral shifts à là Lilien (1982a) - provided that two conditions are satisfied. First, all sectors must have the same trend rate of growth. Second, sectors must not differ in their sensitivity to aggregate demand fluctuations.

If these conditions are violated, aggregate demand fluctuations can produce a positive correlation between the dispersion of employment growth rates (σ_t) and the unemployment rate (U_t), even in the absence of sectoral shifts of the sort motivating the previous discussion. Specifically, this will happen if either (1) industries' trend growth rates and cyclical sensitivities are negatively correlated; and/or (2) industries differ in their cyclical sensitivities and downturns tend to be steeper than upturns. Both of these sets of requirements seem to be satisfied empirically.

The theoretical argument proceeds in two steps. First, we show that, under either of the specified sets of conditions, aggregate demand fluctuations will produce a positive correlation between σ_t and the change in U_t (ΔU_t, equal to $U_t - U_{t-1}$). Second, we show that, with observations for periods of discrete length, ΔU_t and U_t itself are likely to be positively correlated. Taken together, these two results suggest that aggregate demand fluctuations are likely to generate a positive correlation between σ_t and U_t.

We first consider the implications of a negative correlation between industries' trend rates of growth and their cyclical sensitivities. This alone is sufficient for aggregate demand fluctuations to produce a correlation between σ_t and ΔU_t. Consider a hypothetical two-sector economy driven solely by transitory fluctuations in aggregate demand around its trend rate of growth. Employment in the first sector trends upward rapidly but is relatively unresponsive to cyclical movements in GNP; employment in the second sector trends upward less rapidly but is more responsive to fluctuations in GNP. (Think of sector one as services and sector two as manufacturing.) We can write:

(2) $$\ln E_{1t} = \zeta + \Gamma_1 t + \gamma_1(\ln Y_t - \ln Y_t^*)$$

and

(3) $$\ln E_{2t} = \zeta + \Gamma_2 t + \gamma_2(\ln Y_t - \ln Y_t^*)$$

where E_{1t} and E_{2t} are employment in the two sectors, t is a time trend, Y_t is actual GNP, Y_t^* is trend GNP, $\Gamma_1 > \Gamma_2$ (service employment is growing at a more rapid trend rate than manufacturing employment) and $\gamma_1 < \gamma_2$ (service employment is less cyclically responsive than manufacturing employment). A measure of the dispersion in the rate of growth of employment across sectors at any point in time is defined as:

(4) $$\sigma_t = [\frac{E_{1t}}{E_t}(\Delta \ln E_{1t} - \Delta \ln E_t)^2 + \frac{E_{2t}}{E_t}(\Delta \ln E_{2t} - \Delta \ln E_t)^2]^{1/2}$$

This is approximately equal to:

$$\left| \frac{1}{2}(\Gamma_1 - \Gamma_2) + \frac{1}{2}(\gamma_1 - \gamma_2)(\Delta \ln Y_t - \Delta \ln Y_t^*) \right|$$

if we assume that the two sectors are equal in size to start with, so that the employment share weights are approximately one half and the growth rate of total employment ($\Delta \ln E_t$) is approximately equal to the average of the growth rates of employment in each of the two sectors.

How will σ_t move over the business cycle? Figure 1 illustrates movements in σ_t using hypothetical parameter values and assuming that $\ln Y_t - \ln Y_t^*$ moves like a sine wave (see panel A). At the peak and again at the trough of the business cycle, the difference $\Delta \ln E_{1t} - \Delta \ln E_{2t}$ just equals $\Gamma_1 - \Gamma_2$, the difference in the trend rates of growth in the two sectors. The value of $\Delta \ln E_{1t} - \Delta \ln E_{2t}$ reaches a maximum midway from peak to trough (where GNP is falling most rapidly) and a minimum midway from trough to peak (where GNP is growing most rapidly). This implies that σ_t reaches a maximum midway between peak and trough, and a minimum midway between trough and peak (see panel C).[3/]

If U_t bears an Okun's law relationship to the percentage deviation of GNP from trend, then we can write:

(5) $$U_t = \omega + \theta(\ln Y_t - \ln Y_t^*)$$

where θ is negative. The change in U will reach a maximum midway from peak to trough (where GNP is falling most rapidly) and a minimum midway from trough to peak (where GNP is growing most rapidly). Thus, σ_t and ΔU_t will have similar movements and should be positively correlated.

We have demonstrated that the existence of a negative correlation between industries' trend rates of growth and their cyclical sensitivities is sufficient to produce a positive correlation between σ_t and ΔU_t. Differences in industries' cyclical sensitivities combined with asymmetry in the movement of aggregate demand around trend can also produce a positive correlation between σ_t and ΔU_t. If industries differ in their cyclical sensitivities and trend differences in growth rates are unimportant, then the dispersion in employment growth rates will be greatest when output is changing most sharply, whether falling or rising. Suppose that downturns in GNP always occur sharply over a short period of time, with recoveries in GNP occurring more gradually over a longer period of time. Then σ will tend to be larger in downturns than in upturns.

Appealing again to the existence of an Okun's law relationship between unemployment and the deviation of GNP from trend, the same pattern of output fluctuation will produce sharp increases in unemployment during downturns and more gradual reductions in unemployment during upturns. Thus, σ will tend to be large when ΔU is positive, and smaller when ΔU is negative; once again, σ_t and ΔU_t will have similar movements and should be positively correlated.

This argument has been developed assuming no difference in industries' trend rates of growth; business cycle asymmetries of the hypothesized variety will also contribute to a positive correlation between σ_t and ΔU_t in the case where industries' trend growth rates are negatively correlated with their cyclical sensitivities, so that this effect can operate to reinforce the preceding effect.

Thus far we have shown only that aggregate demand fluctuations can produce a positive correlation between the dispersion of employment growth rates and the change in the unemployment rate, with this possible via either of two routes. However, if ΔU_t and U_t are positively correlated, then σ_t and U_t should also bear a positive relationship to one another. In actual quarterly data for 1951:Q2 to 1982:Q4, the change in detrended U_t (ΔUDT_t) and detrended U_t (UDT_t) itself have a correlation of 0.256; in annual data for the same time period, ΔUDT_t and UDT_t have a correlation of 0.522.[4/] This positive correlation of U_t and ΔU_t <u>does not</u> imply that the unemployment rate series is necessarily explosive. In fact, a positive correlation between the level of a variable, X_t, and its first difference, $X_t - X_{t-1}$, is a basic property of a wide variety of stationary discrete time stochostic processes. For example, if a random variable X_t follows a stationary AR(1) process of the form

$$X_t = \phi X_{t-1} + e_t, \quad |\phi| < 1, \ e_t \text{ white noise,}$$

then the correlation between X_t and ΔX_t equals $\left(\frac{1-\phi}{2}\right)^{1/2} > 0$.[5/] Thus, it seems quite plausible that an aggregate-demand driven positive correlation between σ_t and ΔU_t could, through a positive correlation between ΔU_t and U_t, produce a positive correlation between σ_t and U_t.

Simulated Effects of Aggregate Demand Fluctuations

The actual economy is more complicated than the preceding discusson would suggest. However, so long as there is a negative correlation between industries' trend rate of growth and the responsiveness of their employment levels to cyclical swings in GNP and/or it is true both that industries differ in their cyclical sensitivities and that downturns tend to be sharper than upturns, we can expect aggregate demand fluctuations to produce a positive relationship between the dispersion of employment growth rates across sectors and the change in unemployment. Since changes in unemployment have been positively correlated with the level of unemployment, we can thus expect to observe a positive relationship between the variance of employment growth rates across sectors and the unemployment rate.

We have constructed a multiple sector simulation model to demonstrate the sort of movements in σ_t, ΔU_t, and U_t one might observe in the real world in response to fluctuations in aggregate demand. The essential ingredients of this simulation model are a set of equations relating the rate of change in employment in various sectors to change in aggregate demand and an Okun's-law equation relating the unemployment rate to aggregate demand.

We specify the change in the log of employment in each of eleven major sectors as:

$$(6)\ \Delta \ln E_{it} = \Gamma_{1i} + \Gamma_{2i}t + \sum_{j=0}^{4} \gamma_{ij}(\Delta \ln Y_{t-j} - \Delta \ln Y^*_{t-j}) + \varepsilon_{it}$$

where E_{it} is employment in sector i, t is a time trend, $\ln Y_t$ is log (GNP), $\ln Y^*_t$ is the trend value of log (GNP), and the Γ's and γ's are parameters.[6/] The results obtained are summarized in Table 1. It is significant for our purposes that there is a strong negative correlation across industries between the trend rate of growth in employment at the mean value of t and the responsiveness of employment to cyclical fluctuations in GNP. The simple correlation between the estimated value of $d \ln E_{it}/dt$, evaluated at the mean value of t, and the sum of the γ's equals -0.607; the rank correlation is -0.700.

The unemployment rate was also specified to be a function of the current and lagged gaps between actual and potential GNP:

$$(7)\qquad U_t = \omega + \sum_{j=0}^{4} \theta_j(\ln Y_{t-j} - \ln Y^*_{t-j}) + \eta t + u_t$$

where U_t is the civilian unemployment rate, t, $\ln Y_t$ and $\ln Y_t^*$ are as above, and ω, η and the θ's are parameters. A time trend was included in the equation since the unemployment rate seems to have drifted upwards over time and we are interested in exploring its cyclical movements, not its trend movements. The parameters in this equation were estimated using data for the same time period and the same serial correlation correction procedure as in the employment equations.

We then simulated various sectors' employment growth rates and the detrended unemployment rate by substituting the history of realized gaps between actual and trend GNP for the period from 1950:Q1 to 1982:Q4 into our simulation equation. Casual inspection of this output gap series suggests that its movements are asymmetric, with downturns steeper than upturns. Neftci (1984) has recently offered more formal evidence of this sort of business cycle asymmetry.

Values of $\hat{\sigma}_t$ were calculated according to the formula:

(8)
$$\hat{\sigma}_t = [\sum_{i=1}^{11} \frac{\hat{E}_{it}}{\hat{E}_t} (\Delta \ln \hat{E}_{it} - \Delta \ln \hat{E}_t)^2]^{1/2}$$

where the $\Delta \ln\hat{E}_{it}$'s are simulated employment growth rates based on the estimates from equation (6), the $\hat{E}_{it}$'s are simulated employment levels derived assuming actual employment levels at t=0, $\Delta \ln \hat{E}_t$ equals the simulated growth rate in total employment and $\hat{E}_t$ equals $\sum_{i=1}^{11} \hat{E}_{it}$.

Simulated values of the change in detrended U_t and detrended U_t itself were based on equation (7), but with t set equal to zero for all observations. Given the lags involved, this yielded simulated observations on σ_t, the change in detrended U_t and detrended U_t for 127 periods corresponding to 1951:Q2 through 1982:Q4.

What do the simulated data look like? And how do they compare to actual data? First, there is a strong positive correlation between $\hat{\sigma}_t$ and Δ UDT_t (ρ = 0.665). Second, Δ UDT_t and UDT_t are positively related (ρ = 0.256). Third, there is a positive correlation between $\hat{\sigma}_t$ and UD_t (ρ = 0.292). In actual quarterly data, σ_t and Δ UDT_t have correlation 0.554; Δ UDT_t and UDT_t have correlation 0.256; and σ_t and UDT_t have correlation 0.276. Our simulation results do not prove that aggregate demand fluctuations are responsible for the positive relationship between σ_t and the unemployment rate we see in actual data; however, these results do demonstrate that aggregate demand fluctuations easily could have produced such a positive relationship. Thus, the positive relationship between σ_t and the unemployment rate does not necessarily imply an important role for sectoral shifts in cyclical fluctuations.

II. Differentiating Between the Sectoral Shift and Aggregate Demand Hypotheses

While either pure sectoral shifts or pure aggregate demand fluctuations can produce a positive correlation between the dispersion in employment growth rates and the unemployment rate, the two processes can be distinguished empirically in other respects. In particular, the behaviour of job vacancies can reveal which has been the more important cause of the correlation between σ_t and U_t. The relationship between σ_t and the change in U_t can also be informative.

Predictions Concerning Cyclical Movements in the Job Vacancy Rate

One important difference between the mean-preserving spread sectoral shift story and the aggregate demand story lies with what each predicts for the behaviour of the job vacancy rate. If the pure sectoral shift hypothesis correctly captured why σ_t and U_t are positively related, then σ_t and V_t, the job vacancy rate, should also be positively related. In contrast, the aggregate demand scenario concerning the positive relationship between σ_t and U_t generates a negative relationship between σ_t and V_t.

These predictions rest on the existence of an inverse cyclical relationship between U_t and V_t. Strong aggregate demand can be expected to reduce the number of people unemployed and raise the number of vacant jobs; whereas weak aggregate demand can be expected to raise the number of people unemployed and reduce the number of vacant jobs. Thus, holding the structural characteristics of the economy fixed, one might expect to find plots of the job vacancy rate against the unemployment rate yielding a downward sloping UV curve. An increase in the unemployment rate that is caused purely by a negative shock to aggregate demand should be accompanied by a decrease in the job vacancy rate, as shown in the move from A to B in Figure 2.[7/]

Changes in the structural characteristics of the economy can shift the entire UV curve either inwards (improvements in worker/job matching) or outwards (worsening of worker/job matching). Increased dispersion in the desired rates of employment growth across sectors is one possible cause of an outward shift in the UV curve. An increase in the unemployment rate caused purely by an increase in the dispersion of desired employment growth rates should be accompanied by an increase in the job vacancy rate, as shown in the move from A to C in Figure 2.[8/, 9/]

The contrast of the predicted relationship between σ_t and V_t emerging from the sectoral shift story and that emerging from our aggregate demand story provides a means of empirically determining which is more important that we exploit in the empirical analysis which follows.

Using the Help Wanted Index as a Job Vacancy Proxy

Unfortunately, comprehensive job vacancy data have not been collected on an ongoing basis in the United States. The best available proxy for the number of vacant jobs is the Conference Board's help wanted index. This index is essentially an employment-weighted average of the number of help wanted advertisements in 51 major metropolitan newspapers, deflated so that 1967 equals 100.[10/] Dividing the national help wanted index by total nonagricultural payroll employment yields a reasonable proxy for the job vacancy rate. We use this normalized help wanted index (help wanted index divided by total nonagricultural payroll employment) as a vacancy rate surrogate in the analysis which follows.

An important question is whether the normalized help wanted index in fact does a good job of capturing cyclical fluctuations in the job vacancy rate. Appendix A presents some evidence on this point which suggests that short-term movements in help wanted advertising do a good job of tracking short-term movements in job vacancies.

Patterns of Movement in Annual Data

The left hand panel of Figure 3 plots the dispersion of employment growth rates (σ_t) calculated using annual average employment figures against the civilian unemployment rate, as in Lilien (1982a); it is clear that σ_t and U_t are positively correlated. The right hand panel of Figure 3 presents a similar plot, but with the normalized help wanted index -- our proxy for the job vacancy rate -- replacing the unemployment rate. The pure sectoral shift hypothesis implies that σ_t and the normalized help wanted index should move together; the pure aggregate demand hypothesis implies that they should move in opposite directions. The fact that σ_t and the normalized help wanted index move in opposite directions suggests that aggregate demand fluctuations, not sectoral shifts, are responsible for the positive correlation between σ_t and U_t observed in annual data.

Unemployment and Help Wanted Index Equations

The more formal evidence on the relationship between σ and U presented in Lilien (1982a) consists of unemployment rate models including current and lagged values of both σ and DMR, the unanticipated growth in the money supply, plus a lagged value of the unemployment rate, as explanatory variables. The DMR terms are intended to capture exogenous shocks to aggregate demand; if they captured aggregate demand shocks perfectly, the σ coefficients presumably would be uncontaminated by aggregate demand influences. Lilien (1982a) uses annual data to estimate his unemployment equations; the specification he chooses to focus most of his attention on is:

$$(9)\quad U_t = \alpha_0 + \alpha_1\sigma_t + \alpha_2\sigma_{t-1} + \alpha_3 DMR_t + \alpha_4 DMR_{t-1} + \alpha_5 DMR_{t-2} + \alpha_6 U_{t-1} + \alpha_7 t + u_t$$

where U represents the civilian unemployment rate, σ is the dispersion in employment growth rates across eleven sectors, DMR is the unanticipated growth in the money supply, t is a time trend, the α's are coefficients to be estimated, and u is the error term.

The first column of Table 2 presents an ordinary least squares (OLS) estimate of equation (9) fit with annual data for the sample period 1949 to 1980. All the variables in this model are identical to those used by Lilien; our time period differs slightly from his, starting in 1949 rather than 1948, since 1949 is the earliest year for which we could obtain data to estimate a comparable help wanted index model. Not surprisingly, we obtain coefficient estimates very close to those Lilien reports, including large and significant positive coefficients on both σ_t and σ_{t-1}.

Lilien interprets the positive coefficients on his σ terms as evidence of more rapid structural change raising the unemployment rate. A model like equation (9) but with the normalized help wanted index -- proxying for the job vacancy rate -- as the dependent variable offers a test of this interpretation:

$$(10) \quad NHWI_t = \beta_0 + \beta_1\sigma_t + \beta_2\sigma_{t-1} + \beta_3 DMR_t + \beta_4 DMR_{t-1} + \beta_5 DMR_{t-2} + \beta_6 NHWI_{t-1} + \beta_7 t + w_t$$

where $NHWI_t$ represents the normalized help wanted index, the β's are parameters and the other variables are defined above. Positive σ coefficients in the help wanted index equation would support the structural change interpretation; negative coefficients would suggest that σ is actually serving as an aggregate demand proxy.

Column (2) of Table 2 presents an OLS estimate of equation (10) which matches the unemployment model in column (1). In this help wanted index equation, the current value of σ_t takes on a large and statistically significant negative coefficient; the coefficient on the once-lagged value of σ_t is also negative though not significant. The fact that the σ variables do not take on positive coefficients -- and in fact assume negative coefficients -- in the help wanted index equation implies that the positive σ coefficients in the Table 2 unemployment equations cannot be interpreted as evidence of pure intersectoral shifts producing cyclical fluctuations in unemployment.[11/]

Is σ Correlated with U or Δ U?

A second important difference between the sectoral shift story and the aggregate demand story lies with whether they imply that σ_t is directly related to U_t or to ΔU_t. The sectoral shift story leads directly to a prediction that σ and U_t should be positively related. In the aggregate demand story, however, swings in aggregate demand produce a positive correlation between σ and ΔU_t; σ ends up being correlated with U_t only because ΔU_t and U_t have a positive relationship. Interestingly, when σ_t is estimated as a function of detrended U_t and the <u>change</u> in detrended U_t using annual data for 1948 to 1980, the following relationship emerges:

$$(11) \qquad \sigma_t = \underset{(0.006)}{0.019} + \underset{(0.002)}{0.002}\, UDT_t + \underset{(0.002)}{0.007}\, \Delta\, UDT_t$$

where the numbers reported in parentheses are standard errors. The data indicate that, holding UDT_t constant, σ_t is very significantly related to $\Delta\, UDT_t$; however, holding $\Delta\, UDT_t$ constant, σ has no significant relationship with UDT_t. It appears that σ and the change in unemployment are directly related, but that σ and unemployment itself are not. While this result could conceivably be reconciled with the sectoral shift explanation, it is a much more probable outcome of the aggregate demand model.[12/]

III. Decomposing Sectoral Shift and Aggregate Demand Influences on the Unemployment Rate

We have seen that the dispersion in employment growth rates across sectors is a poor proxy for the magnitude of pure sectoral shifts in labor demand occurring in the economy. In this section of the paper, we discuss one possible approach to better identifying the true effect of pure sectoral shifts on short term movements in the unemployment rate. While our approach is very similar to that of Lilien (1982b), our conclusions differ markedly from his. Our results do not provide support for the view that pure sectoral shifts have been an important source of cyclical fluctuations in unemployment in the postwar U.S.

Creating a Measure of Pure Sectoral Shifts in Labor Demand

The basic problem with using the σ measure discussed in the previous section of the paper as a measure of pure sectoral shifts is that both aggregate demand fluctuations and pure sectoral shifts can affect the dispersion in employment growth rates. The obvious solution is to separate employment growth rates in various sectors into that part which is linked to aggregate developments and that part which reflects sector-specific developments. A reasonable proxy for pure sectoral shifts would then be the dispersion in the sector-specific components of the employment growth rates.

The employment growth rate of a given sector can be specified as a function of aggregate and sector-specific factors. If sectoral employment growth can be reasonably separated into trend and non-trend components, then the employment growth rate for a particular sector i can be written as:

$$(12) \qquad \Delta \ln E_{it} = \Gamma_{1i} + \Gamma_{2i} t + S_i A_t + \varepsilon_{it}$$

where E represents employment, t is a time trend, A_t is a vector of aggregate demand variables, S_i is a parameter vector of sector specific responses to aggregate terms, and ε_{it} is a disturbance term reflecting non-trend sector-specific factors.[13/] To implement this specification empirically, one would ideally like to have variables in A that do a good job of capturing aggregate influences but are also exogenous to sector-specific shocks. On the one hand, if the variables included in A fail to capture all important aggregate demand influences, then the error terms in the employment growth equations will not represent pure sector-specific effects. On the other hand, if variables affected by sector-specific shocks are included in A, then employment growth attributed to these aggregate variables could in fact be the result of sector-specific factors.

The following equation represents one possible empirical specification:

$$(13) \quad \Delta \ln E_{it} = \Gamma_{1i} + \Gamma_{2i} t + \sum_{j=0}^{4} \gamma_{ji} \Delta DMR_{t-j} + \varepsilon_{it}$$

where DMR represents unanticipated growth in the money supply and ε_{it} is assumed to follow an AR(1) process. Thus ε_{it} can be written as:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + e_{it}$$

where e_{it} is a white noise innovation term. If the Δ DMR terms captured all the relevant aggregate influences on sectoral employment growth, then the ε_{it}'s would capture the purely sector-specific influences on growth.

The estimated innovations from the employment growth equations specified above can be used to construct a measure of residual dispersion in employment growth rates, which we will call SIGRESA:

$$(14) \quad SIGRESA_t = \sum_{i=1}^{N} \frac{E_{it}}{E_t} \left(\frac{\hat{e}_{it}}{\hat{v}_{e_i}}\right)^2$$

where N equals the number of sectors, E_{it} equals employment in sector i in period t, E_t equals total period t employment, and $\hat{e}_{it}$ equals the estimated innovation in the AR(1) error term $\hat{\varepsilon}_{it}$, and $\hat{v}_{e_i}$ is the estimated variance of the $\hat{e}_{it}$'s. Since we are interested in isolating innovations to the growth rate of employment in different sectors, it is appropriate to calculate SIGRESA using the $\hat{e}_{it}$'s rather than the $\hat{\varepsilon}_{it}$'s. The $\hat{e}_{it}$'s represent current sectoral shifts. The adjustment to past shifts, the lagged $\hat{e}_{it}$'s which make up $\hat{\varepsilon}_{it}$, can affect the unemployment rate and do so through the effect on lagged SIGRESA's on the unemployment rate. The $\hat{e}_{it}$ items are normalized by $\hat{v}_{e_i}$ for comparability with Lilien (1982b); it also turns out that the normalized SIGRESA measure captures more of the variation in unemployment and in the help wanted index than does a non-normalized measure.

There is an obvious potential problem with SIGRESA as a proxy for pure sectoral shifts in labor demand: unanticipated money growth is unlikely to the be only important exogenous influence on aggregate demand, so that the residuals used to construct SIGRESA are likely to reflect aggregate as well as sector-specific influences on employment growth rates. Evidence that the errors from employment growth rate equations like (13) were positively correlated across sectors would confirm that there is reason for concern. One reasonable response is to purge each sector's employment growth equation residuals of that component which moves together with the average residual. To do this, we fit OLS versions of equation (13) and calculate the weighted average residual from these equations for each time period:

$$(15) \quad AVERES_t = \sum_{i=1}^{N} \frac{E_{it}}{E_t} \cdot \varepsilon_{it} ,$$

where E_{it} equals employment in sector i in period t, E_t equals total period t employment, and ε_{it} is the period t residual from the OLS version of sector i's employment equation. This weighted average residual is then used as an explanatory variable in a new set of employment growth equations:

$$(16) \quad \Delta \ln E_{it} = \Gamma_{1i} + \Gamma_{2i} t + \sum_{j=0}^{4} \gamma_{ji} \Delta DMR_{t-j} + \kappa_i AVERES_t + \varepsilon_{it} ,$$

where κ is a parameter, ε_{it} is again assumed to follow an AR(1) process, and all other terms have been previously defined. The estimated innovations to the errors from these equations can be used to construct a new measure of residual dispersion in employment growth rates, which we will call SIGRESB, defined in exactly the same way as SIGRESA except based on equations like (16) rather than on equations like (13). Our use of $AVERES_t$ in constructing SIGRESB is very similar in spirit to Lilien's (1982b) estimation of a time fixed effect in the employment growth equations which underlie his sectoral shift proxy; our approach has the advantage that $AVERES_t$ is less likely to be dominated by large, erratic movements in the employment growth rate of a single small sector.[14/]

Both our approach and Lilien's approach suffer from the potential problem that the aggregate component introduced into the sector-specific employment growth equations can itself be affected by sector specific shocks: in a period in which shocks create a large need to reallocate labor across sectors, the adversely affected sectors may shrink without the positively affected sectors growing by the same amount, causing a drop in the average employment growth rate. However, since the aggregate component will only capture sectoral employment movements that are systematically associated with movements in the aggregate component, this should be a serious problem only in the unlikely event that pure sector specific shocks keep recurring over time in the same fixed pattern.

Unemployment and Help Wanted Index Equations

We have estimated both unemployment and help wanted index equations which include values of the SIGRESA and SIGRESB measures. The unemployment equations and the sectoral shift proxies appearing in them have been specified to make our results as comparable as possible to those reported in Lilien (1982b): the SIGRESA and SIGRESB measures were constructed using the normalized innovations to the residuals from AR(1) employment growth equations estimated with data for 29 sectors for the 1953:Q1 to 1982:Q2 sample period;[15/] the current and eight lagged values of one or the other of these sectoral shift proxies, plus a constant and the current and eight lagged values of DMR, were included in each equation; and all the equations were estimated allowing for an AR(4) error structure with data for the 1958:Q1 to

1982:Q1 sample period. The differences between our models and the central model in Lilien (1982b) are as follows: our DMR variable may not be identical to his; we use a detrended unemployment rate as the dependent variable rather than including a time trend directly in the estimating equation; and, of course, neither our SIGRESA nor our SIGRESB is identical to Lilien's measure of residual dispersion in employment growth rates. Only the last of these differences is apt to be important.[16]

The first column of Table 3 summarizes the parameter estimates from an unemployment equation for the civilian unemployment rate which includes current and lagged values of SIGRESA as explanatory variables. The sum of the coefficients on these SIGRESA terms implies that a one standard deviation change in SIGRESA is associated with a 0.962 percentage point (or 0.759 standard deviation) change in the detrended unemployment rate. Figure 4a plots both the actual detrended unemployment rate (UDT_t and a detrended "natural unemployment rate" series (UDT^*_t) calculated as the predicted value of unemployment based on the column (1) estimates, assuming that the SIGRESA terms take on their actual values, but that the DMR terms uniformly equal zero. It is clear from inspection of this plot that the actual unemployment rate moves around a good deal more than the natural rate series; over the 1958:Q1 to 1980:Q1 sample period, UDT_t has a standard deviation of 1.267 and a range of 4.970, while UDT^*_t has a standard deviation of only 0.515 and a range of only 2.133.[17]

As noted above, one serious concern with the SIGRESA series is that the employment growth equation residuals upon which it is based are likely to include a substantial aggregate demand component, in addition to capturing sector-specific influences. The errors in the sectors' employment growth equations are in fact highly correlated. Over the 1953:Q1 to 1982:Q1 sample period, all twenty-nine of the individual equation $\hat{e}_{it}$'s, the innovations to the equation (13) errors from which SIGRESA is calculated, are positively correlated with the employment-weighted average $\hat{e}_{it}$. Twenty-five of these twenty-nine positive correlations are significant at the 0.05 level; only the innovations to the errors in the tobacco manufacturers equation, the petroleum refining equation, the federal government equation and the state government equation are not significantly positively correlated with the weighted average $\hat{e}_{it}$. Some common unobserved factor or factors appear to be affecting the employment growth rates of many if not all of the twenty-nine sectors. The help wanted equation estimates reported in column (3) are consistent with the view that the error innovation terms used in constructing SIGRESA contain an aggregate demand component in addition to any sector-specific component. The sum of the coefficient on the current and lagged SIGRESA terms is not significantly positive; rather, it is slightly, though not significantly, negative.

The fact that the errors from which SIGRESA terms were constructed appear to contain an important common cross-sector component motivated our construction of SIGRESB, following the approach described above. The second column of Table 3 presents an unemployment equation which includes current and lagged values of SIGRESB as an explanatory variable. The point estimates of the sum of the coefficients on the nine SIGRESB terms in this model imply that a one standard deviation change in SIGRESB is associated with only a 0.278 percentage point (or 0.219 standard deviation) change in the unemployment rate; moreover, this point estimate is not significantly different from zero. Figure 4b plots both the actual detrended unemployment rate and a detrended natural rate series based on the point estimates of the coefficients in the column (2) model. This plot reveals a rather dramatic contrast between the cyclical volatility of the actual detrended unemployment rate, which swings around quite widely, and the comparative stability of the natural rate series. Over the 1958:Q1 to 1980:Q1 sample period, UDT_t has a standard deviation of 1.267 and a range of 4.970; the UDT_t^* series based on the column (2) model has a standard deviation of only 0.190 and a range of only 0.829. The sum of the SIGRESB coefficients in the help wanted index equation column (4) is also small and insignificant.[18/],[19/]

In our view, these results provide no support for the view that pure sectoral shifts are an important source of cyclical variation in the aggregate unemployment rate.

IV. Conclusion

Some previous research has taken the fact that the dispersion of employment growth rates and the unemployment rate are positively correlated to indicate that the former bears a causal relationship to the latter. We have provided evidence which strongly contradicts this interpretation. Our preferred interpretation is that fluctuations in aggregate demand affect both the dispersion of employment growth rates and the unemployment rate, producing a positive correlation between the two.

More generally, our work suggests the following two propositions. First, any labor market dispersion measure should be interpreted cautiously, since aggregate demand fluctuations, not just sector specific shocks, can have an important effect on such measures. Aggregate-demand-induced recessions are markedly uneven in their impact; the consequences of declines in aggregate demand can all too easily be mistaken for the consequences of long-term structural problems in particular sectors. Second, information on job vacancies can be very helpful for understanding why changes in the unemployment rate have occurred.

The major substantive conclusion of the paper is that pure sectoral shifts, as distinct from aggregate disturbances, appear to have contributed very little to observed post-war cyclical fluctuations in the unemployment rate.

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Footnotes

1. A formal, generalized notion of "variance" was introduced into the economics literature under the name of "mean preserving spread" by Rothschild and Stiglitz (1970). In this paper, we utilize "mean preserving spread" more informally as defined in the text.

2. Lucas and Prescott (1974) develop a model in which labor market frictions lead to unemployment when workers must be reallocated across sectors. This model seems to have motivated the empirical analysis in Lilien (1982a).

3. Figure 1 was drawn assuming that $\ln Y_t - \ln Y_t^*$ follows a sine wave path. It was also assumed that the time period required for $\ln Y_t - \ln Y_t^*$ to move through a complete cycle, the amplitude of the cycle, and the values of Γ_1, Γ_2, γ_1, and γ_2 were such that $|\Gamma_1 - \Gamma_2|$ always exceeds $|(\gamma_1 - \gamma_2)(d\ln Y_t - d\ln Y_t^*)|$. This makes σ a monotonically decreasing function of $d\ln Y_t - d\ln Y_t^*$. If $|(\gamma_1 - \gamma_2)(d\ln Y_t - d\ln Y_t^*)|$ exceeded $|\Gamma_1 - \Gamma_2|$ at any point during the upturn, σ would decrease to zero, increase a bit, fall back to zero, then finally increase again as the economy moved from trough to peak. However, there would have to be larger differences between the cyclical responsiveness of the two sectors and/or larger fluctuations of GNP around trend over shorter time periods than seems reasonable for this to happen. Even if this flip-flopping pattern did emerge, σ and dU would still be positively correlated.

4. We present results based on values of U_t with a linear trend removed both here and elsewhere, since we are concerned with explaining short term fluctuations in unemployment, independent of trend movements in the level of unemployment. Using detrended data rather than non-detrended data never has an important effect on the results.

5. This positive relationship between the level of a variable and the change in the variable depends on the length of the time intervals between observations. It appears to shrink in importance for finer measurement intervals of the unemployment rate series. As noted above, the correlation between UDT_t and $\Delta\ UDT_t$ is only 0.256 in quarterly data for 1951 to 1982, as compared to 0.522 in annual data for the same time period.

6. We began by estimating $\ln E_{it}$ equations for this simulation. The AR(1) corrected $\ln E_{it}$ equations yielded first order autoregressive parameters quite close to 1 with some residual serial correlation remaining. Estimating $\Delta \ln E_{it}$ equations thus seemed more appropriate. None of the conclusions derivable from the simulation were affected in any significant way by whether we worked with $\ln E_{it}$ or $\Delta \ln E_{it}$ parameter estimates. There is a time trend in the $\Delta \ln E_{it}$ equations because we had included both t and t^2 in the underlying $\ln E_{it}$ equations.

7. For theoretical models which produce this inverse relationship between U_t and V_t (commonly referred to as the Beveridge curve), see Holt and David (1966), Hansen (1970), and Jackman, Layard and Pissarides (1983).

8. Secular increases in the U.S. unemployment rate have been linked to outward shifts in the Beveridge curve; see, for example, Abraham (1982), Medoff and Abraham (1982) and Medoff (1983). Katz (1983) discusses the likely consequences of mean preserving spreads in desired employment growth rates for movements in both unemployment rates and job vacancy rates, with particular reference to sorting out among possible causes of cyclical fluctuations in unemployment.

9. The increased unemployment caused by a mean preserving spread in desired employment growth rates could generate feedbacks reducing aggregate demand. Absent such feedbacks, a mean-preserving spread would cause vacancies to rise one-for-one with unemployment; with feedbacks, the short run increase in the number of vacancies might be less than the short run increase in unemployment. Increases in unemployment attributable to the feedback following a mean preserving spread should not be considered increases in the natural rate in the sense of Lilien (1982a), since they could be reversed by aggregate demand policy in the same way as unemployment caused directly by a negative shock to aggregate demand.

10. Preston (1977) discusses the data and methodology used in creating the help wanted index in considerable detail.

11. We also estimated models like those reported in Table 2 with all the different specifications reported in Lilien (1982b); with an AR(1) error structure rather than a lagged dependent variable; and with data for several different time periods. Our qualitative conclusions appear to be very robust.

12. Johnson and Layard (1983) present a similar model with σ_t specified as a function of current and lagged unemployment. Using annual data for the period 1949 to 1980, they obtain coefficients on U_t and U_{t-1} that are essentially equal but opposite in sign. They interpret this result as evidence that σ_t is related to the change in unemployment, not to unemployment itself.

13. This basic specification, which we have arrived at using fairly ad hoc reasoning, can be more formally justified. Lilien (1982b) derives this structure from a model of a multisectoral labor market with limited labor mobility across sectors and a gradual process of adjustment of sector-specific labor forces to permanent sector-specific shocks. A major problem with this model is that it allows no role for vacancies.

14. When we estimated our own fixed effects model using a maximum likelihood approach, the fixed effect estimates were completely dominated by the residuals from the mining sector equation.

15. These 29 sectors are the same sectors utilized in Table 1 except that durable goods and nondurable goods manufacturing are broken into their 20 two-digit SIC component industries. The employment data are from the BLS establishment payroll survey.

16. We were not able to ascertain precisely what money equation generated the DMR series used in Lilien (1982b). Our money equation used M1 as the dependent variable, with pre-1959 M1 data taken from Barro and Rush (1980); and the post-1959 M1 data from the <u>Federal Reserve Bulletin</u>; the

equation was fit for the sample period 1948:Q4 to 1982:Q4 and included four lagged values of M1, four lagged values of the interest rate on three month treasury bills, and a time trend. We fit models with detrended values of the dependent variables because when we simply included a time trend in the estimating equations, the coefficients it assumed seemed unreasonably large. This specification decision had virtually no effect on the coefficients of the sectoral shift proxies or of unanticipated money.

17. Another way of assessing how much of the variation in UDT is accounted for by movements in UDT^* would be to look at the R^2 from a regression of UDT on UDT^*. However, this produces misleading results; the coefficient on UDT^* in this model is in the present case 1.830, which means that any swings in UDT^* are exaggerated in terms of their effect on UDT.

18. In addition to the models reported here, we also experimented with a variety of alternative specifications. These included: creating SIGRESA and SIGRESB variables calculated using non-normalized residuals; including eight lags rather than only four lags of ΔDMR in the employment growth equations used to produce SIGRESA and SIGRESB (for consistency with the inclusion of eight lags of DMR in the unemployment and help wanted index equations); and estimating the unemployment and help wanted index equations for time periods including earlier years. In most of these alternative specifications, the conclusions concerning the effect of the residual dispersion measures on unemployment and on the help wanted index were even less favorable to the sectoral shift hypothesis than those reported here.

19. If AVERES, a measure of the change in aggregate demand conditions, belongs in the employment growth equations used to create SIGRESB, then for consistency some comparable level of aggregate demand conditions variable belongs in the unemployment and help wanted index equations which include SIGRESB. A reasonable approach to constructing such a variable would be to cumulate the values of $AVERES_t$ over time; including this cumulative AVERES variable in the column (3) and column (4) models of Table 3 actually reduced the estimated effect of SIGRESB still further.

Table 1: Sectoral Change in Employment Equations Including the Deviation of Log (GNP) From Trend as an Explanatory Variable[a/]

	Mean [Standard Deviation] of Dependent Variable[b/]	Coefficient on: Constant/10	Coefficient on: Time Trend/10,000	Estimated value of $\frac{d \ln E_{it}}{dt}$, $t = \bar{t}$	Sum of coefficients on current and four lagged values of deviation of log (GNP) from trend[c/]	D.W.	S.E.E.
Mining	.0010	− .135	2.344	.0015	1.113	1.995	.0328
	[.0346]	(.061)	(.687)		(.415)		
Construction	.0033	.056	−.220	.0042	1.549	1.983	.0147
	[.0189]	(.040)	(.449)		(.247)		
Durables	.0015	.045	−.247	.0030	2.345	1.953	.0112
	[.0209]	(.030)	(.345)		(.189)		
Nondurables	.0004	.014	−.078	.0009	.830	1.849	.0057
	[.0091]	(.018)	(.203)		(.106)		
Transportation/Util.	.0015	− .014	.514	.0019	.980	2.031	.0060
	[.0089]	(.016)	(.186)		(.102)		
Wholesale trade	.0052	.041	.188	.0053	.566	1.967	.0036
	[.0057]	(.014)	(.161)		(.077)		
Retail trade	.0062	.052	.205	.0065	.690	2.029	.0038
	[.0062]	(.012)	(.133)		(.070)		
FIRE	.0080	.081	−.029	.0079	.139	2.097	.0022
	[.0036]	(.018)	(.205)		(.061)		
Services	.0099	.080	.316	.0100	.364	1.931	.0032
	[.0043]	(.011)	(.121)		(.062)		
Federal Government	.0024	.049	−.333	.0028	.579	1.938	.0131
	[.0141]	(.038)	(.431)		(.232)		
State Government	.0090	.128	−.626	.0089	−.187	2.068	.0057
	[.0063]	(.024)	(.269)		(.126)		

a/ All equations were estimated with seasonally adjusted quarterly data for the period 1951:Q1 through 1982:Q4. Maximum likelihood correction was made for first order serial correlation in the error terms. Standard errors are reported in parentheses.

b/ The dependent variables are equal to $\ln E_{it} - \ln E_{it-1}$, where E represents employment and i indexes the sectors. The underlying employment data came from the establishment payroll survey.

c/ The trend values of log (GNP) were the fitted values from a regression including t and t^2 estimated using data for 1948:Q4 through 1982:Q4.

Table 2: Unemployment and Normalized Help Wanted Index Equations Estimated With Annual Data[a]

	Dependent Variable U_t (1)	Dependent Variable $NHWI_t$ (2)
Constant	0.157 (0.602)	1.085 (0.231)
σ_t	56.0 (9.2)	-8.7 (2.0)
σ_{t-1}	21.8 (11.3)	-2.9 (2.3)
DMR_t	-19.8 (8.0	4.1 (1.7)
DMR_{t-1}	-22.9 (8.2)	5.4 (1.8)
DMR_{t-2}	-7.7 (10.3)	0.5 (2.3)
U_{t-1}	0.352 (0.144)	--
$NHWI_{t-1}$	--	0.292 (0.164)
Time trend	0.078 (0.018)	0.007 (0.003)
R^2	0.869	0.838
SEE	0.566	0.012
DW	2.231	1.604

[a] Both models were estimated with annual data for the sample period 1949 to 1980 using ordinary least squares. U is the civilian unemployment rate (mean [standard deviation] 5.3 [1.4]); NHWI is the Conference Board help wanted index divided by total nonagricultural payroll employment (1.3 [0.3]); σ is the dispersion in annual employment growth rates across the eleven major sectors listed in Table 1 (0.025 [0.013]); and DMR is the unanticipated growth in the money supply (-0.002 [0.016]). Standard errors are reported in parentheses. The DMR variable used in these models was supplied by David Lilien. The time trend equals 1 in 1949, 2 in 1950, and so on.

Table 3: Quarterly Unemployment and Normalized Help Wanted Index Equations Including a Measure of Residual Dispersion in Employment Growth Rates[a]

	Dependent Variable = Detrended U_t		Dependent Variable = Detrended $NHWI_t$	
	(1)	(2)	(3)	(4)
Constant	2.150 (1.303)	3.950 (1.497)	1.146 (0.245)	1.140 (0.296)
Sum of coefficients on current and eight lagged values of SIGRESA[b]	3.135 (1.445)	--	-0.061 (0.276)	--
Sum of coefficients on current and eight lagged values of SIGRESB[c]	--	1.121 (1.627)	--	-0.055 (0.334)
Sum of coefficients on current and eight lagged values of DMR[d]	-157.6 (91.8)	-232.2 (101.0)	43.1 (18.4)	49.9 (18.0)
DW	1.984	1.990	1.969	2.035
SEE	0.300	0.308	0.058	0.059

a/ All equations were estimated with seasonally adjusted quarterly data for the 1958:Q1 to 1982:Q1 sample period. Detrended U_t, the civilian unemployment rate with a linear trend removed, has mean [standard deviation] 4.769 [1.267]; detrended $NHWI_t$, the normalized help wanted index with a linear trend removed, has mean [standard deviation] 1.075 [0.237]. All models were fit allowing for an AR(4) error structure; the TSP LSQ procedure was used to specify the estimating equations. Standard errors are reported in parentheses.

b/ $SIGRESA_t$ equals $\sum_{i=1}^{29} (E_{it}/E_t)(\hat{e}_{it}^2/\hat{v}_{e_i})$, where E_{it} is period t employment is sector i; E_t is period t total employment, $\hat{e}_{it}$ is the period t innovation to the error term from an AR(1) sector i employment growth equation estimated for the sample period 1953:Q1 to 1982:Q1 which includes a constant, a time trend and the current plus four lagged values of the change in unanticipated money as explanatory variables; and $\hat{v}_{e_i}$ is the variance of the $\hat{e}_{it}$'s over the 1953:Q1 to 1982:Q1 period.

SIGRESA has a mean [standard deviation] of 0.878 [0.307] over the sample period for the models presented here.

c/ $SIGRESB_t$ is defined analogously to $SIGRESA_t$, except that the employment growth equations which yield $SIGRESB_t$ also include $SRES_t$, the employmented-weighted period t average of the errors from OLS employment growth equations like the AR(1) models described in footnote b, as an explanatory variable. SIGRESB has a mean [standard deviation] of 0.882[0.248] over the sample period for the models presented here.

d/ The pre-1959 money supply data (M1) used to create DMR came from Barro and Rush (1980) and the post 1959 data from the Federal Reserve Bulletin. The money equation which generated DMR was fit over the sample period 1948:Q4 to 1982:Q4 and included four lagged values of M1, four lagged values of the interest rate on three month treasury bills and a time trend. DMR has a mean [standard deviation] of 0.000 [0.006] over the sample period for the models presented here.

Figure 1: Movements of Several Series Over a Hypothetical Aggregate Demand Driven Business Cycle

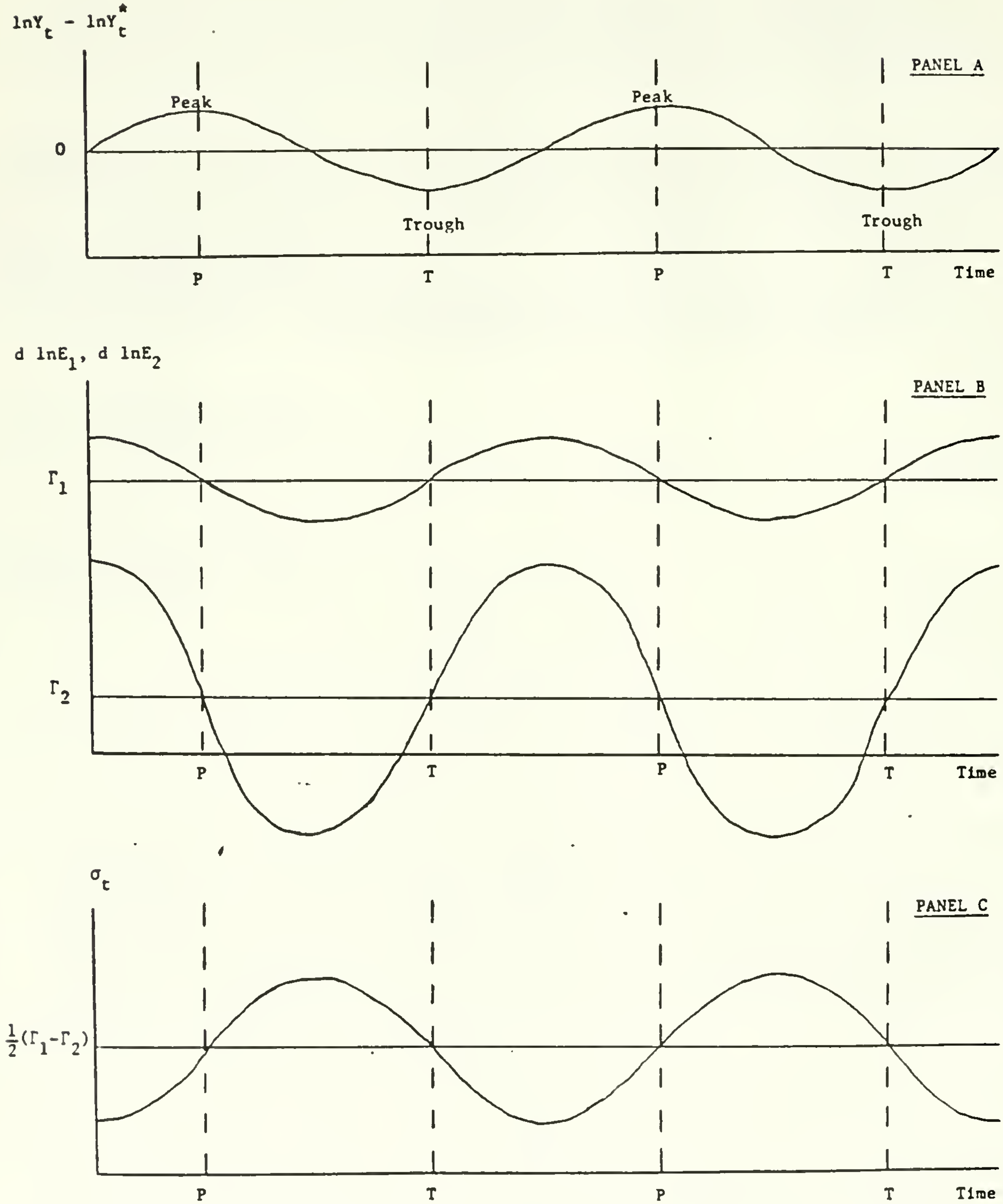


Figure 2: Movements Along and Shifts of the Beveridge Curve

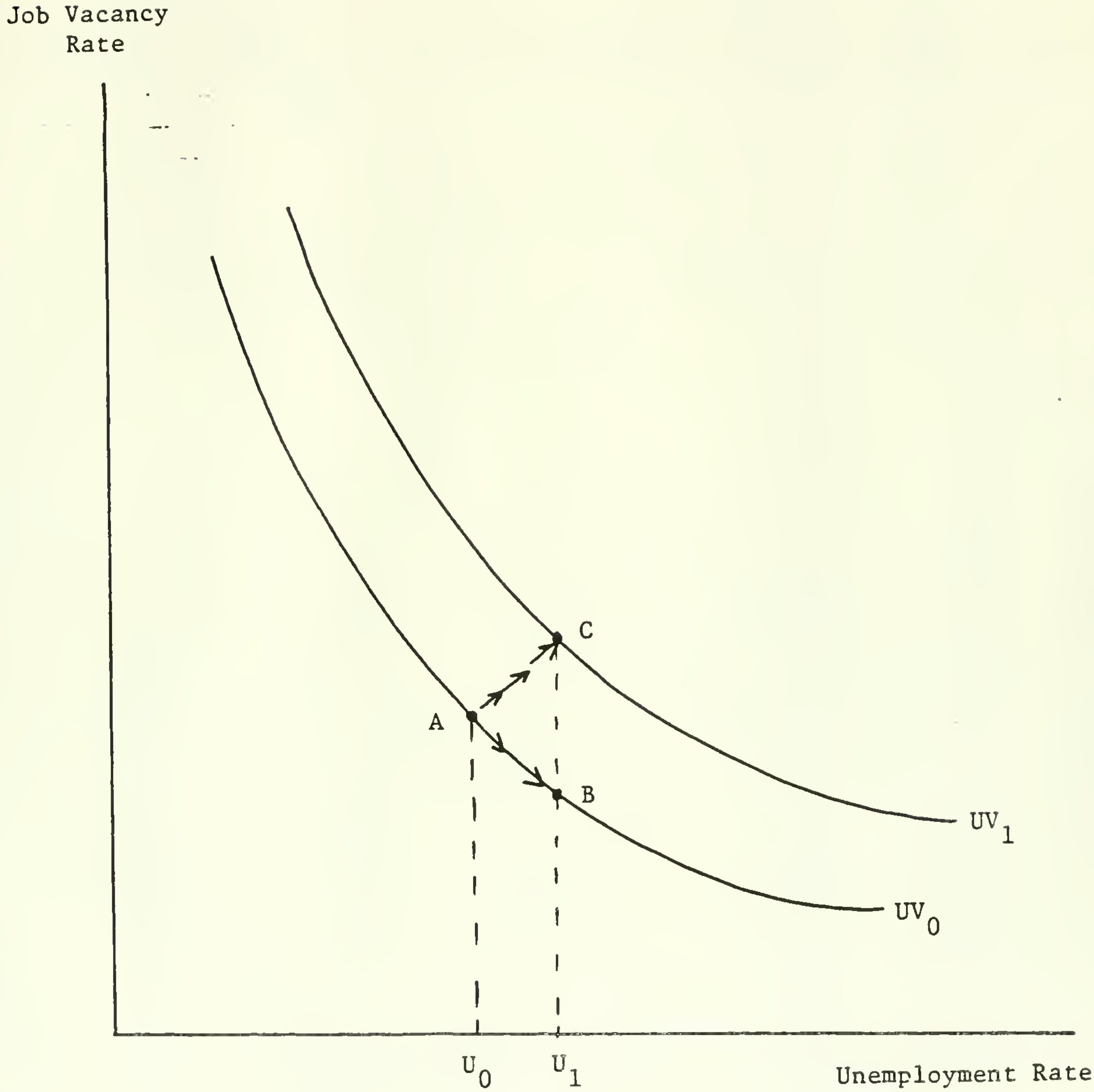
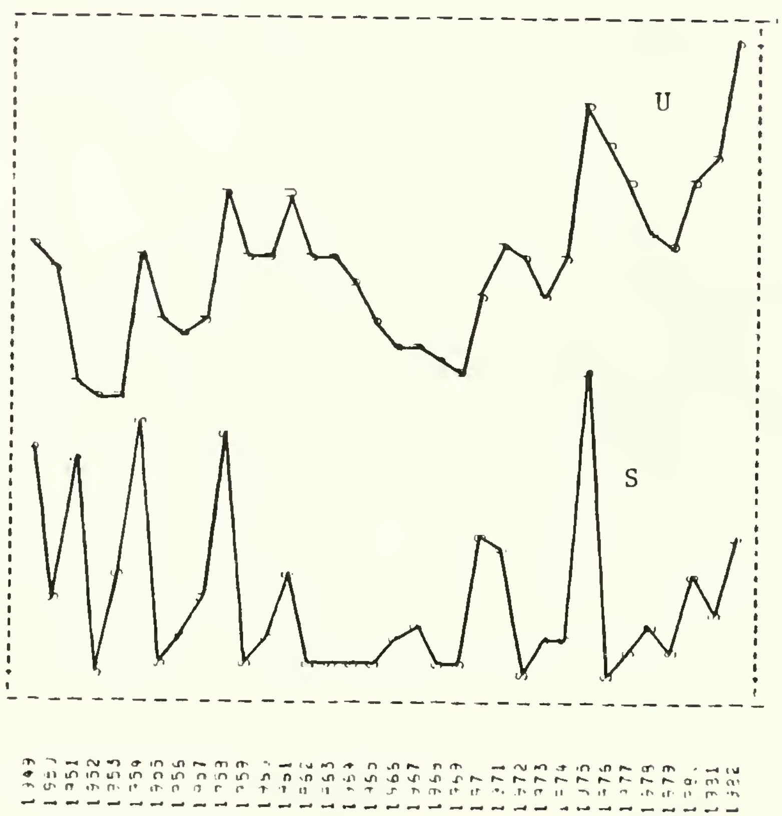


Figure 3: Unemployment Rate, Normalized Help Wanted Index, and Sigma in Annual Data

Unemployment Rate (U) vs. Sigma (S)



Normalized Help Wanted Index (N) vs. Sigma (S)

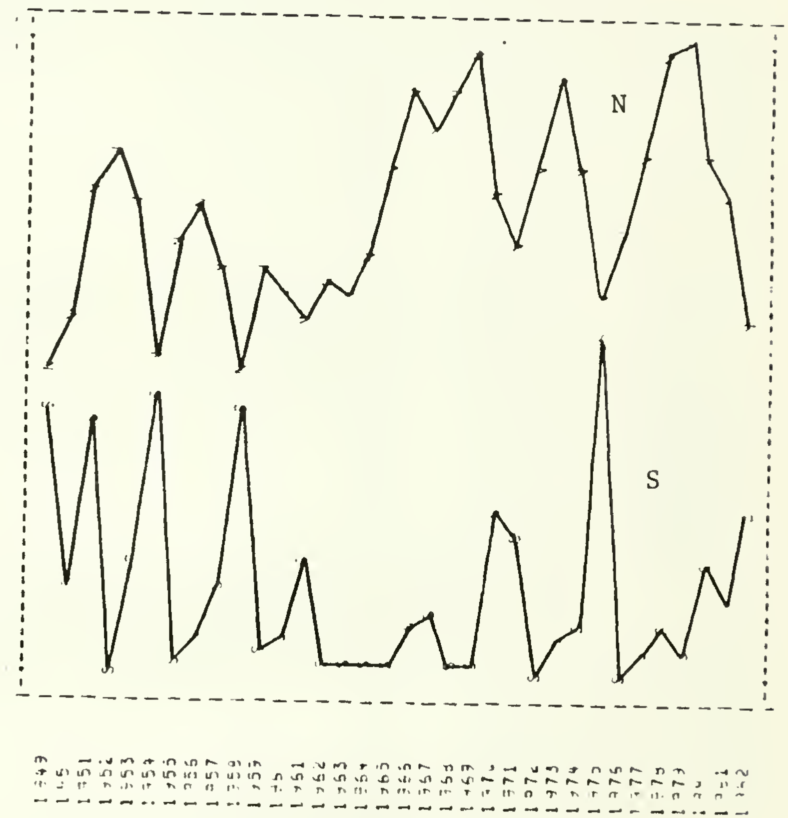
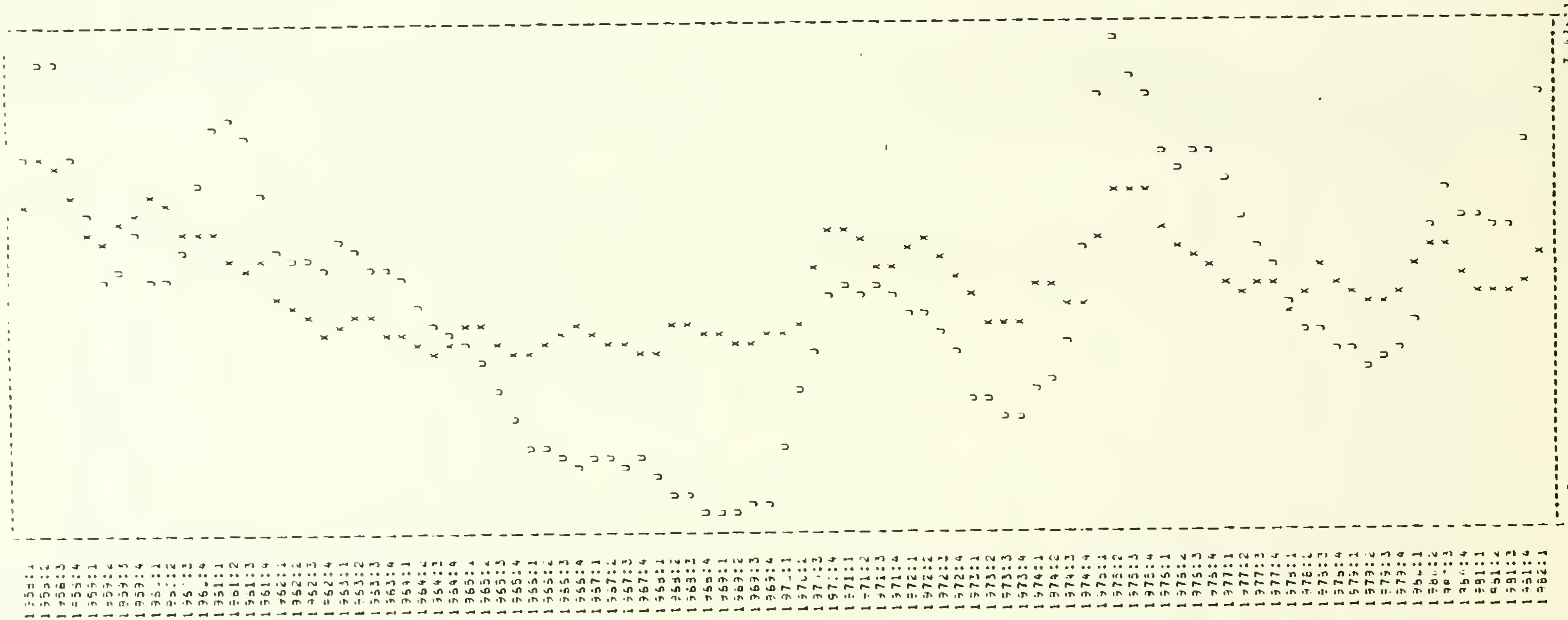
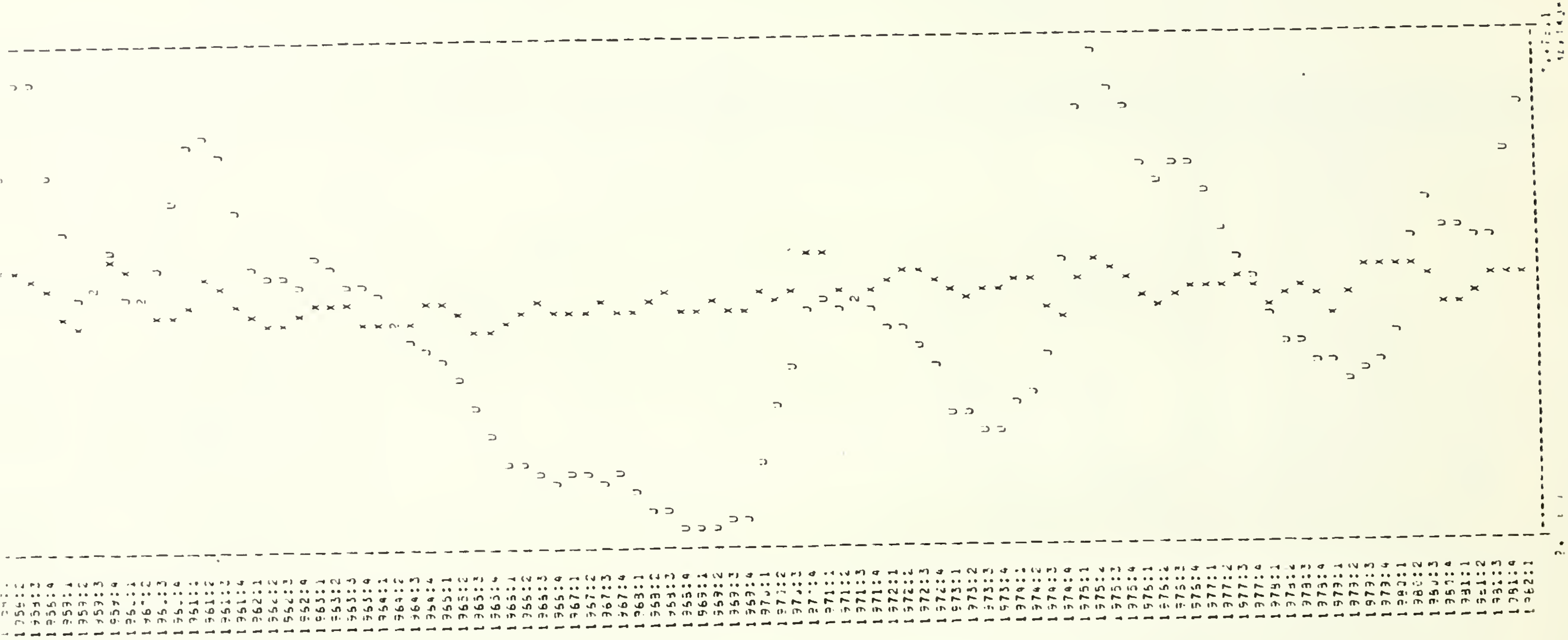


Figure 4a: Detrended Actual Unemployment Rate and Detrended Natural Unemployment Rate Based on SIGRESA



Detrended actual unemployment rate plotted with U.
Detrended natural unemployment rate based on SIGRESA plotted with X.

Figure 4b: Detrended Actual Unemployment Rate and Detrended Natural Unemployment Rate Based on SIGRESB



Detrended actual unemployment rate plotted with U.
Detrended natural unemployment rate based on SIGRESB plotted with X.

Appendix A: Short Term Movements in Help Wanted Advertising Versus Short Term Movements in Job Vacancies

Some insight into how well cyclical swings in help wanted advertising track cyclical swings in job vacancies can be obtained using job openings data collected monthly in Minnesota from January 1972 to December 1981. Monthly help wanted index data are available for Minneapolis/St. Paul for the same time period. Thus, we are able to compare month to month movements in help wanted advertising and job vacancies.[1/]

We estimated equations of the following form:

$$\text{(A-1)} \qquad \ln NHWIA = \beta_0 + \beta_1 \ln VR + \tilde{\gamma}\tilde{S} + \beta_3 \cdot T + u$$

where NHWI represents the city help wanted index divided by metropolitan area nonagricultural payroll employment, VR represents the metropolitan area vacancy rate, S is a vector of eleven month dummies, T is a time trend, the γ's and β's are coefficients to be estimated, and u is an error term. The published help wanted index data are seasonally adjusted; the available job vacancy data are not. Rather than seasonally adjust the job vacancy data, we deseasonalized the help wanted index numbers. A vector of month dummies was then included in the estimating equation to correct for possible differences in the pattern of seasonality in the two series. Since we are interested in how short term movements in the two series compare, not in any possible trend divergences between the two series, we also included a time trend in the estimating equations. The estimated coefficient on the lnVR term is equal to 0.884 with a standard error of 0.051. This coefficient estimate is significantly less than 1.0, which suggests that help wanted advertising may be somewhat less cyclically responsive than job vacancies. Our main concern is how closely the two series track each other once trend and cycle have been controlled for; the equation R^2 is a respectable 0.800.

The limited pertinent evidence we have available thus suggests that short term movements in help wanted advertising track short term movements in job vacancies reasonably well.[2/] The fact that the fluctuations in the two series seem to have somewhat different amplitudes relative to their mean values does not in and of itself cause any problems with using the normalized help wanted index as a vacancy rate proxy. Given the deficiencies of the available job vacancy data, the imperfect correlation between movements in the two series may be as much attributable to noise in the vacancy data as to noise in the help wanted index data.

Footnotes to Appendix A

1. See Abraham (1983) for a more detailed discussion of the Minnesota job vacancy data. These Minnesota statistics are the only available vacancy data which cover the entire nonagricultural economy of some geographic region; were collected for a time period long enough for the economy to pass through a complete business cycle; and could be matched with help wanted index numbers based on a count of number of help wanted advertisements. Thus, they are the only vacancy data which we could use for the purpose at hand.

2. Abraham (in progress) considers the separate issue of whether the normalized help wanted index and the job vacancy rate have moved together over longer periods of time.

References to Appendix A

Abraham, Katharine G., "Structural/Frictional versus Deficient Demand Unemployment: Some New Evidence," American Economic Review, September 1983, pp. 708-724.

Abraham, Katharine G., "What Does the Help Wanted Index Measure?" in progress.

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