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OIL PRICE SHOCKS AND THE DISPERSION HYPOTHESIS, 1900 - 1980

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Abstract

Recent research by David Lilien shows that a significant fraction of aggregate unemployment can be 'explained' by the dispersion of employment growth across industries. This paper presents two new results in this area. First, it is shown that a significant fraction of the variation in Lilien's dispersion index is due to the differential impact of oil shocks across industries. Second, and more important, it is shown that, once the dispersion in employment growth due to oil shocks is accounted for, the residual dispersion has no explanatory power for unemployment.

I. Introduction

Macroeconomic models typically assign primary importance to aggregate demand shocks in the determination of the unemployment rate. This reflects the belief that shocks to the composition of demand merely lead to a reallocation of labor resources across industries. While this process may generate unemployment, the amount of such unemployment is thought of as small and fairly stable over time. This sanguine view of the labor reallocation process has been challenged by Lilien(1982) who contends that "as much as half" of the cyclical variation in unemployment is due to the slow adjustment of labor to shifts in demand from some industries to others. In a recent contribution, Sheffrin(1984) further challenges "the prevailing fiction of macroeconomics that relationships between the individual markets can be safely ignored".

This paper presents new results in this line of research. We follow Lilien in constructing a dispersion index to measure the amount of labor reallocation required each period; this variable turns out to bear a significant positive correlation with unemployment. The point of departure is in decomposing the dispersion index into two parts : (i) dispersion caused by the differential impact of oil price shocks across industries, and, (ii) residual dispersion. It is then demonstrated that, once the dispersion in employment growth due to oil shocks is accounted for, the residual dispersion bears no correlation with unemployment.

The results suggest that, were it not for the disruptions in the world oil market, the process of labor reallocation would have been carried out without generating significant unemployment. Moreover, for reasons discussed later, the view that oil prices affect the economy through a channel other than the process of labor reallocation cannot be rejected.

Section II describes the construction of the dispersion index. The decomposition of the index is carried out in Section III. This section also presents the unemployment rate equations, using annual data for the post-war period 1948 to 1980. In Section IV the results are extended to the pre-Depression period from 1900 to 1929. A similar analysis using quarterly data for the period 1947-1982 is presented in the appendix. [1]

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[1] forthcoming, The Review of Economics and Statistics

II. Sectoral Dispersion and Unemployment

Consider an economy with n industries. Let E_{it} denote employment in industry i in period t and let e_{it} denote the corresponding growth rate. Each industry's growth can be regarded as partly stemming from shifts in aggregate demand and partly from industry-specific factors :

$$e_{it} = \alpha_i X_t + S_{it} \qquad \text{...(1)}$$

where, X_t, is a matrix of variables capturing changes in aggregate demand, α_i measures industry i's sensitivity to aggregate demand shocks, and S_{it} is the sectoral or industry-specific component of employment growth. Averaging across industries, aggregate employment growth can be written as, [2]

$$e_t = (\Sigma\, \alpha_i/n)X_t + (\Sigma S_{it}/n) = \alpha X_t + S_t \qquad \text{...(2)}$$

The dispersion index, $(\sigma_t)^2$, is then defined as the variance of the sectoral components around their mean, S_t :

$$(\sigma_t)^2 = [\Sigma E_{it}/E_t(S_{it} - S_t)^2] \qquad \text{...(3)}$$

Under the dispersion hypothesis, the index must have a positive impact on the aggregate unemployment rate. Lilien's argument is a simple and appealing one. Shocks that have differing impacts across industries lead to a rise in $(\sigma_t)^2$. Such 'reallocative' shocks necessitate a movement of labor out of adversely affected industries. However, due to, say, workers having industry-specific skills or simply due to the time-consuming nature of job search, the

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[2] For the data considered here, aggregate employment growth can be approximated very well by the simple arithmetic mean of industry growth rates.

process of labor absorbtion tends to be slow and involves considerable unemployment in the interim. A higher dispersion of sectoral shocks leads to higher unemployment by increasing the amount of labor reallocation required.

To construct an empirical analog to (3), annual employment data for 26 industries over the period 1948-80 is used. The aggregate demand shocks are represented by Barro's (1981) series of unanticipated money growth, DMR. Each industry's employment growth is then regressed on the current and one lagged value of the change in DMR. [3] The residuals from these regressions serve as measures of the S_{it}'s and are used in the construction of $(\sigma_t)^2$.

[3] These regressions are contained in an appendix available from the author.

III. Oil Shocks, Dispersion and Unemployment, 1948 - 1980

A. Decompositon of the Dispersion Index :

In this section we decompose the index into two components, one which is influenced solely by oil price shocks while the other captures the effects of the remaining reallocative shocks.

The motivation for this preferential treatment of oil shocks is two-fold. First, Hamilton(1983) has shown that oil prices have Granger-caused unemployment in both the pre-OPEC and the post-OPEC periods. The extent of this correlation cannot be easily explained through conventional macroeconomic channels. [3] Second, these shocks clearly have both aggregate and reallocative effects. Their impact is greater on industries that use a lot of energy inputs in their production process - the steel industry is an example - and in which energy cannot be easily substituted by other inputs. On the other hand, industries such as coal mining, electric and gas utilities, and petroleum refining, which constitute the domestic energy sector enjoy a boom. Between 1973 and 1980, investment in the energy sector grew at an annual rate of 5.8% compared with a rate of 2.7% for the economy as a whole. Over the same period, the share of the energy sector in total investment rose from 19% to 24% and its share of total profits from 8% to 21%. At a casual level, it seems that sectoral shifts of this magnitude can be a source of significant unem-

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[3] Hamilton states that "we were unable to account for this correlation as a pure supply-side effect in a frictionless neoclassical economy; unemployment of men and machines in excess of the natural rate seems to have been an integral part of the U.S. business cycle. On the other hand, we also had little success with a pure demand-side interpretation; the historical magnitudes of income transfers and erosion of real balances associated with these oil shocks does not seem large enough to have accounted for more than a small part of the business downturn".(pgs.238-39)

ployment.

To carry out the decomposition, the sectoral component is re-written as,

$$S_{it} = \beta_i P_t + R_{it} \qquad \text{...(4)}$$

P_t measures changes in oil prices, β_i is the industry-specific response, and R_{it} is the residual component of sectoral employment growth. Correspondingly,

$$S_t = \beta P_t + R_t \qquad \text{...(5)}$$

By substituting (4) and (5) in (3), and by neglecting a cross-product term, we can approximate the dispersion index by,

$$(\sigma_t)^2 = (\sigma_{pt})^2 + (\sigma_{rt})^2 \qquad \text{...(6)}$$

where,

$$(\sigma_{pt})^2 = \{\Sigma E_{it}/E_t\ [(\beta_i - \beta)P_t]^2\} \qquad \text{...(7)}$$

and,

$$(\sigma_{rt})^2 = [\Sigma E_{it}/E_t\ (R_{it} - R_t)^2] \qquad \text{...(8)}$$

To consruct the empirical analogs to $(\sigma_{pt})^2$ and $(\sigma_{rt})^2$, the industry employment growth equations have to be re-estimated. From (1) and (4), these equations now take the form,

$$e_{it} = \alpha_i X_t + \beta_i P_t + R_{it} \qquad \text{...(9)}$$

Though many variables could potentially be included in X_t, only changes in unanticipated money growth (DDMR) proved helpful in explaining both the aggregate and the cross-industry variation in employment. [5] The series for unanticipated money growth is the one constructed in Barro (1981). The oil price variable is measured as the producer price index for crude petroleum deflated by the index for all industrial commodities (DRP). The employment data is from the BLS establishments survey.

The specification of X_t assumes that only the unanticipated part of money growth influences employment. As in Barro (1981), this hypothesis was tested by regressing employment simultaneously on actual and unanticipated money growth and then seeing if deleting actual money growth significantly worsens the fit. The hypothesis that only DMR's were relevant was accepted for the aggregate employment equation and for most industry equations. [6]

Tables 1-3 contain the estimated equations for a 26-industry decomposition of aggregate employment. [7] The coefficients on the DMR variables are broadly in accord with the two-year expansionary impact on aggregate output and the rising response to monetary disturbances reported in Barro(1981). Changes in

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5 Various transformations of temporary and permanent government purchases, government debt, and a time trend were included in alternate specifications of X_t. These variables were, at best, marginally significant in the aggregate equation. Retaining them in the estimated equations does not alter any of the conclusions.

6 Many researchers, most recently Trehan (1984), have shown the results of such tests to be sensitive to the specification of the money growth equation. The 'solution' employed here is to experiment with other ways of capturing monetary influences. In one specification actual money growth was used instead of DMR's; in another, employment was restricted to be correlated only with the growth rate of real demand deposits. While the estimated equations differ substantially from the ones reported here, the conclusion regarding the insignificance of residual dispersion remains unaltered.

7 This is three short of the customary 29-industry decomposition. I have excluded the federal and state government 'industries' - which seem to be driven by forces other than those captured here - and miscellaneous manufacturing.

Table 1: Employment Growth Equations, 1948-80

Industry	Dependent Variable					
	Intercept	$DDMR_t$	$DDMR_{t-1}$	DRP_{t-1}	R^2	D·W
Mining	.000 (.008)	-0.53 (0.52)	0.76 (0.53)	0.20 (0.10)	.23	1.1
Construction	.026 (.005) *	1.17 (0.34) *	1.77 (0.35) *	-0.25 (0.07)	.68	1.4
Durable Manufacturing	.020 (.007) *	0.29 (0.49)	1.70 (0.50) *	-0.30 (0.10) *	.51	1.9
Nondurable Manufacturing	.007 (.003) *	0.29 (0.19)	0.65 (0.19) *	-0.13 (0.04) *	.55	2.2
Transportation & Public Utilities	.010 (.004) *	-0.10 (0.23)	0.67 (0.24) *	-0.11 (0.05) *	.44	1.3
Services	.039 (.002) *	0.05 (0.13)	0.35 (0.13) *	-0.01 (0.02)	.25	1.0
Finance, Insurance, Real Estate	.034 (.002) *	0.07 (0.12)	0.18 (0.12)	-0.05 (0.02) *	.25	0.5
Retail Trade	.027 (.002) *	0.10 (0.16)	0.57 (0.16) *	-0.04 (0.03)	.42	1.2
Wholesale Trade	.023 (.002) *	-0.05 (0.15)	0.45 (0.15) *	-0.06 (0.03) *	.41	1.3

Notes:

1) Standard errors are in parentheses

2) An asterisk denotes a marginal significance level $\leqq .05$

3) DDMR is the change in unanticipated money growth

4) DRP is the change in the relative price of crude petroleum

Table 2: Durable Manufacturing

Industry	Intercept	$DDMR_t$	$DDMR_{t-1}$	DRP_{t-1}	R^2	D·W
	Dependent Variable					
Lumber	-.001 (.008)	1.91 (0.51) *	2.27 (0.52) *	-0.20 (0.10) *	.57	1.9
Furniture	.018 (.008) *	1.31 (0.49) *	1.59 (0.50) *	-0.30 (0.10) *	.54	2.4
Stone, Clay & Glass	.012 (.005) *	0.75 (0.34) *	1.54 (0.34) *	-0.22 (0.07) *	.62	2.4
Primary Metals	.006 (.010)	-0.06 (0.61)	1.80 (0.62) *	-0.31 (0.12) *	.44	2.2
Fabricated Metals	.022 (.007) *	0.51 (0.49)	1.69 (0.50) *	-0.30 (0.10) *	.52	1.9
Machinery	.028 (.009) *	-0.36 (0.59)	1.87 (0.60) *	-0.26 (0.12) *	.47	1.7
Electrical Machinery	.036 (.010) *	0.03 (0.65)	1.41 (0.67) *	-0.41 (0.13) *	.42	1.7
Transp. Equipment	.020 (.013)	0.35 (0.84)	1.85 (0.85) *	-0.37 (0.17) *	.33	1.7
Instruments	.035 (.008) *	-0.34 (0.54)	1.25 (0.55) *	-0.28 (0.11) *	.41	1.1

Table 3: Nondurable Manufacturing

Industry	Intercept	$DDMR_t$	$DDMR_{t-1}$	DRP_{t-1}	R^2	D·W
	Dependent Variable					
Food	.000 (.002)	0.07 (0.12)	0.27 (0.12) *	-0.06 (0.02) *	.40	1.4
Tobacco	-.014 (.004) *	-0.64 (0.29) *	-0.03 (0.29)	-0.02 (0.06)	.18	2.5
Textiles	-.008 (.006)	0.82 (0.41) *	1.07 (0.42) *	-0.13 (0.08)	.34	2.1
Apparel	.006 (.005)	0.40 (0.31)	0.71 (0.32) *	-0.18 (0.06) *	.40	2.5
Paper	.017 (.004) *	0.20 (0.28)	0.59 (0.28) *	-0.20 (0.05) *	.46	2.0
Printing	.018 (.002) *	-0.07 (0.16)	0.34 (0.16) *	-0.07 (0.03) *	.36	0.7
Chemicals	.021 (.004) *	-0.08 (0.26)	0.61 (0.26) *	-0.15 (0.05) *	.44	1.2
Petroleum & Coal	-.002 (.005)	-0.29 (0.33)	0.16 (0.33)	-0.08 (0.07)	.11	1.2
Rubber	.034 (.008) *	1.00 (0.54)	2.44 (0.55) *	-0.33 (0.11) *	.60	2.4
Leather	-.014 (.006) *	0.61 (0.37)	0.62 (0.38)	-0.10 (0.07)	.22	2.2

the relative price of oil are estimated to have had a significant contractionary effect on employment growth. It turns out that the lagged, rather than the contemporaneous change in relative prices is important for employment; though this is in line with Hamilton's findings, the reason for such a lag is not clear.

For my purposes there are two important features of these equations. First, lagged DMR's have a significant positive impact in 23 of the 26 industries and the oil price variable has a significant negative impact in 20 industries; this justifies their treatment as common factors which underlie the cross-industry variation in employment. Second, the equations show the uneven impact of aggregate shocks across industries. In general, service-producing industries display substantially higher mean growth and lower responsiveness to aggregate shocks than goods-producing industries (see Table 1). Within the latter category, durable goods industries exhibit both higher mean growth and greater responsiveness to aggregate shocks than nondurable goods industries (see Tables 2 and 3).

The dispersion index, $(\sigma_t)^2$, and the sum of its components [$(\sigma_{pt})^2 + (\sigma_{rt})^2$] turn out to be highly collinear, with a simple correlation coefficient of 0.92. The mean of the index - .000498 - is virtually identical to the mean of the approximation,.000500, which shows that the omitted cross-product term is of very small magnitude. The standard deviation of the two variables is also not substantially different.

B. Unemployment Equations :

Finally, the dispersion indices are included in an equation explaining the aggregate unemployment rate, U_t. The estimated equations are reported in Table 4. In addition to the DMR's, measures of temporary government defense purchases, $TGOV_t$, and permanent defense purchases, $PGOV_t$ - as constructed in Barro(1981) - are included as explanatory variables. With the exception of the current DMR, all these variables have significant expansionary effects. The first regression in Table 4 is similar to the ones reported by Lilien. It supports the hypothesized positive relationship $(\sigma_t)^2$ and the unemployment rate. [8]

The next three regressions constitute the value-added of this paper. Of the two components of the index, the measure of residual dispersion, $(\sigma_{rt})^2$, has no explanatory power for unemployment (see row 2 of the table). This suggests that, were it not for the exogenous disruptions in the world oil market, the process of labor reallocation would have been accomplished without involving substantial unemployment. On the other hand, the impact of $(\sigma_{pt})^2$ on U_t is both positive and highly significant (see row 3). Including both components simultaneously does not alter the results.

At first sight, the significance of $(\sigma_{pt})^2$ suggests that the process of labor reallocation in response to the oil shocks has been a source of considerable unemployment over the post-war period. However, further empirical work is required to substantiate this claim. The reason for this is as follows.

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8 The form of Lilien's unemployment equations differs slightly from the one used here. In his work, the dispersion index is transformed by taking the square root. Lagged unemployment and a time trend are included as explanatory variables. Carrying out these modifications does not alter any of my conclusions.

Table 4: Unemployment Equations, 1948-80

No.	Dependent Variable									R^2	MSE	D.W.
	Intercept	DMR_t	DMR_{t-1}	$TGOV_t$	$PGOV_t$	$(\sigma_t)^2$	$(\sigma_{rt})^2$	$(\sigma_{pt})^2$	DP_{t-1}			
1	7.32 (0.67) *	-20.4 (12.0)	-46.5 (11.4) *	-45.7 (12.5) *	-29.9 (6.0) *	744.2 (330.4) *	...	...	...	.79	.49	1.53
2	7.69 (0.70) *	-24.6 (12.9)	-49.2 (12.4) *	-39.1 (13.8) *	-30.7 (6.8) *	...	368.7 (394.5)	...	...	.75	.58	1.76
3	6.58 (0.72) *	-10.6 (12.3)	-40.2 (11.0) *	-39.4 (10.6) *	-19.8 (6.4) *	...	...	1641.6 (554.6) *	...	.81	.44	1.57
4	6.59 (0.72) *	-9.1 (12.5)	-41.6 (11.2) *	-44.3 (12.2) *	-21.4 (6.8) *	...	295.7 (345.0)	1606.3 (559.3) *	...	.82	.44	1.79
5	6.93 (0.64) *	-13.4 (11.5)	-40.7 (10.7) *	-33.5 (10.1) *	-21.6 (6.0) *	...	...	...	6.46 (2.01) *	.82	.42	1.00

Note: All equations are estimated by ordinary least squares. Standard errors are in parentheses; an asterisk denotes a marginal significance level ≦ .05.

What distinguishes the dispersion hypothesis from other hypotheses is the way the oil price variable, P_t, enters the unemployment equation. In conventional macro models, both the magnitude and the direction of oil price changes are important. Hence, unemployment depends positively on P_t. On the other hand, under the dispersion hypothesis, the direction of the change in oil prices is not important. Both positive and negative changes increase the amount of labor reallocation required. Hence, unemployment depends positively on $(P_t)^2$ or, from equation (7), on $(\sigma_{pt})^2$. This theoretical distinction becomes blurred in the empirical work due to the nature of the oil price series. This series hovers around zero for most of the sample period except for sharp blips, all of them positive, in 1953, 1957, 1969-70, 1974, and 1979-80. Consequently, the empirical counterparts of P_t and $(P_t)^2$ have a high positive correlation. For instance, the simple correlation coefficient between the lagged change in the relative price of oil, P_{t-1}, and $(\sigma_{pt})^2$ is 0.82. The final regression shows that P_{t-1} performs just as well as $(\sigma_{pt})^2$ in explaining unemployment.

IV : Oil Shocks, Dispersion and Unemployment, 1900 - 1929

In the previous section it was demonstrated that the ability of the dispersion index to 'explain' unemployment stems largely from its collinearity with oil price shocks. This section tests whether a similar result holds over the period 1900 to 1929. The main conclusions obtained from this exercise are (i) that the correlation between the aggregate unemployment rate, U_t, and the dispersion index, σ_t, is positive, and, (ii) that this positive correlation is attributable almost entirely to the oil price shock of 1920.

The proximate source of all the data used in this section is "Historical Statistics of the United States : Colonial Times to 1970". The key variables are plotted in Figures 1 and 2. The dispersion index is constructed from a eight industry decomposition of employment. [9] U_t is the civilian unemployment rate. The relative price of oil, P_t, is measured as the wholesale price index for fuels and power divided by the wholesale price index for all commodities. Figure 1 suggests that, except for the peak in 1921, the coincident movement in U_t and σ_t is fairly modest.

The contraction in 1921 is preceeded by a sharp rise in the relative price of fuels and power. While the fuels and power index has many components, by going through the records of the period it can be established that it is movements in the price of crude petroleum that were particularly important in 1920. For instance, Pogue(1921, pg.240) writes : "...partly as a result of a demand for fuel oil which had been actively stimulated by the efforts of the oil industry as well as by the circumstances of a disastrous coal strike, the

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[9] The sectors are mining, construction, manufacturing, transportation & public utilities, finance, insurance & real estate, trade, services and the government.

FIGURE 1

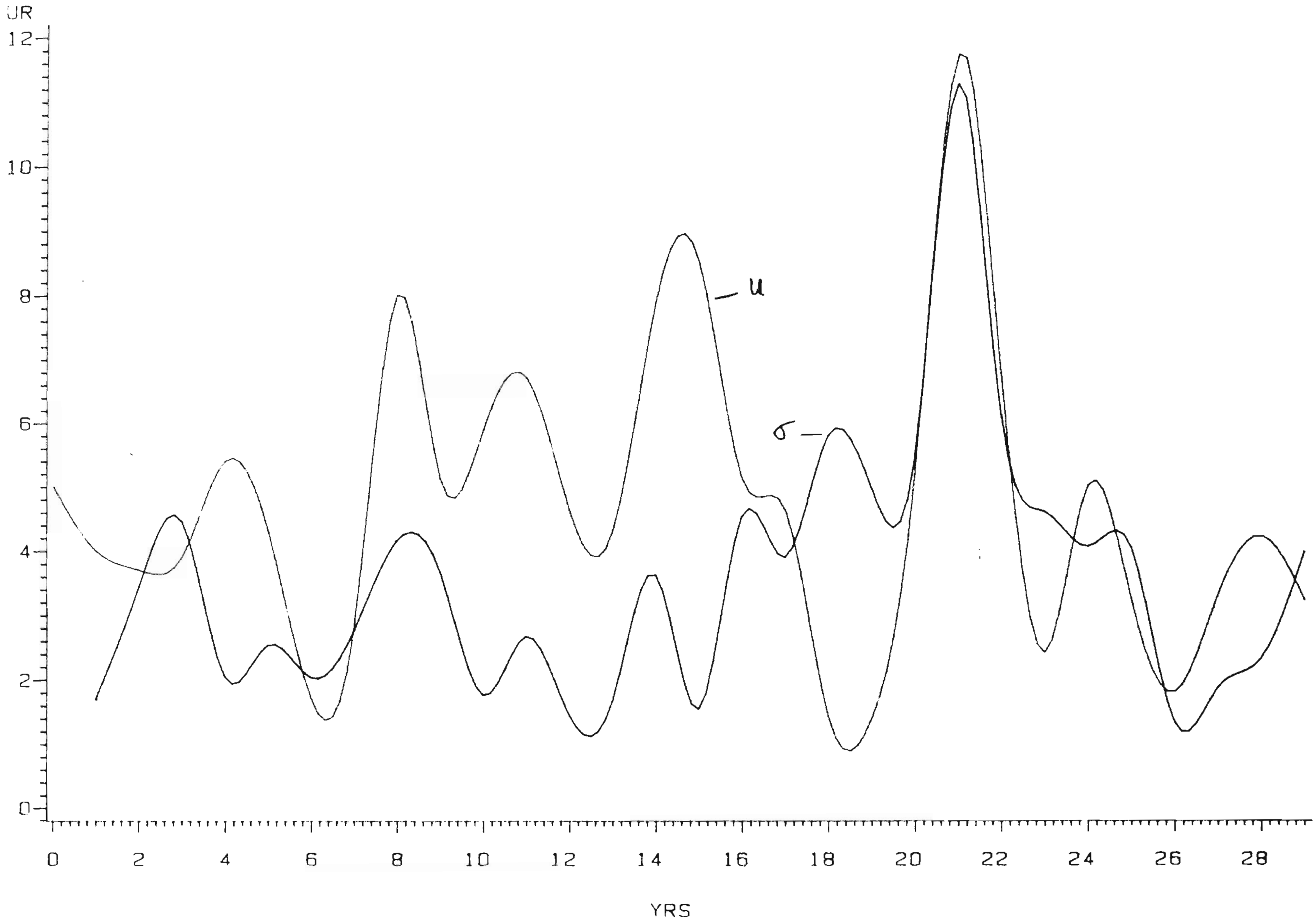

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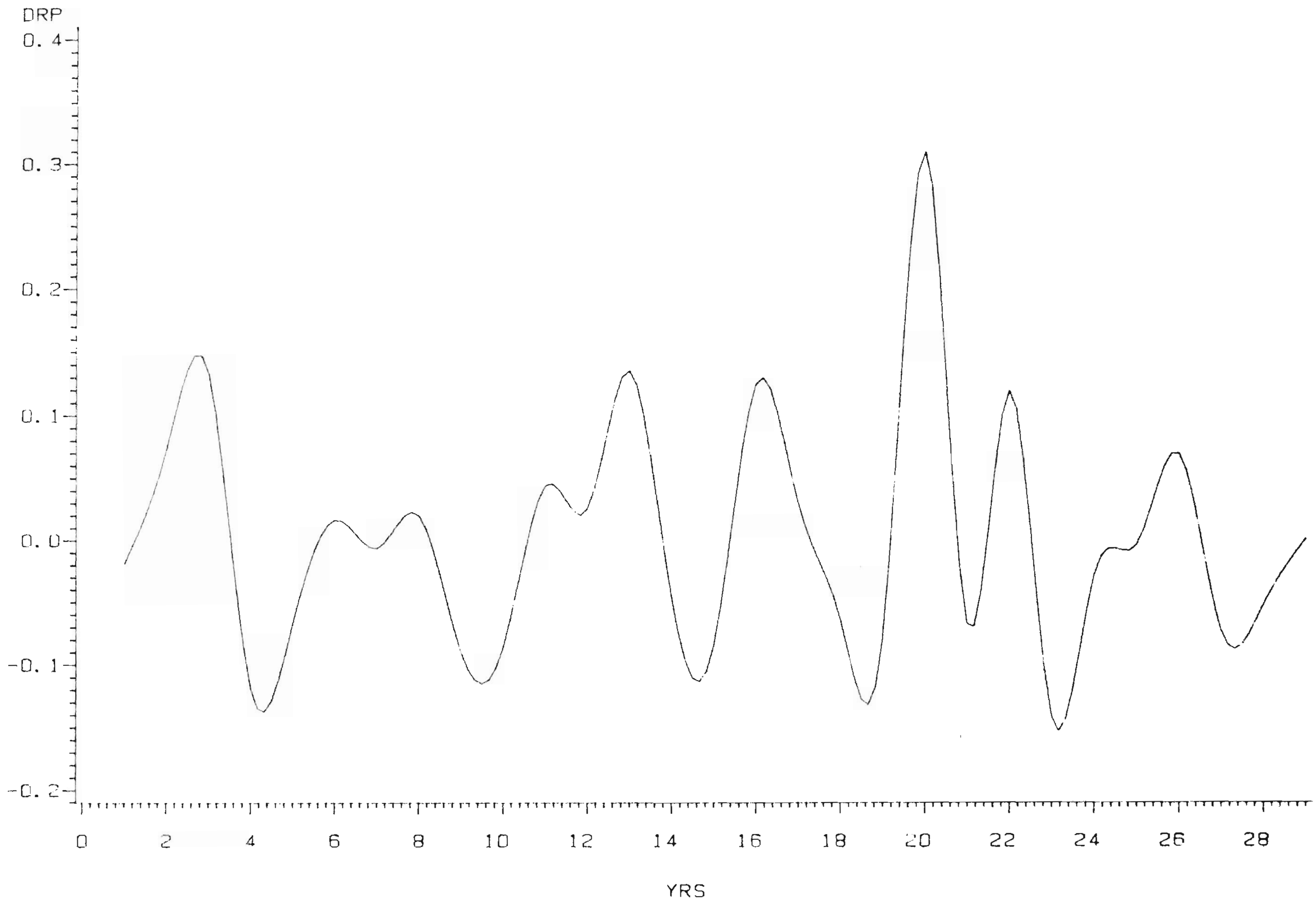
FIGURE 2



OIL PRICE SHOCKS, 1900-1929

crude oil market showed a gathering strength which culminated in a sharp and almost unprecedented rise during the first quarter of 1920...Then came deflation and the liquidation of the industrial structure of the entire country. But oil persisted as if immune. The highest levels of crude oil prices were not attained until July..." [10]

A possible explanation for the price rise is that U.S. producers were trying to exploit fears of an oil shortage; such fears were engendered largely by the higher consumption of oil during World War I. To quote Nash(1964,pg.43) "The suddenness with which the Wilson administration abolished federal controls between 1918 and 1919 left the oil industry entirely to its own devices...For those engaged in the petroleum industry, the most immediate peacetime problem was fear of an impending oil shortage....The drain of increased consumption of petroleum products on limited and dwindling domestic supplies aroused fears of depletion...Although scientific instruments were largely inaccurate during those years, G. O. Smith, the highly respected director of the U.S. Geological Survey, in 1919 predicted the exhaustion of American petroleum reserves within ten years".

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[10] The manner in which the U.S. Navy obtained oil at discounted prices is interesting. "The petroleum shortage of 1919 aroused dire fears in the mind of Secretary of the Navy Josephus Daniels. He was concerned with obtaining fuel oil at what he considered reasonable prices. To meet the crisis he ordered Navy officers to seize fuel, if confronted by rapidly rising oil prices, they failed to receive reasonable bids from suppliers. When the Union Oil Company refused to deliver fuel at $1.60 a barrel, as the Navy desired, six destroyers drew up at the San Francisco plant a few weeks later with orders to seize as much oil as they required. This action had the desired effect, for in the month thereafter the Navy was able to sign contracts with suppliers".[Nash(1964),pgs.44-45]

In future work, I hope to investigate the causes and consequences of this oil price shock in greater detail; for present purposes, it is only necessary to show that the positive correlation between unemployment and dispersion is largely attributable to this episode. Table 5 reports simple correlation coefficients between the key variables. Over the period 1901 - 1929, the simple correlation between the lagged change in oil prices and σ_t is 0.42 the correlation between P_{t-1} and U_t is 0.32. The dispersion index and unemployment are also positively correlated over this period. When the last ten observations are dropped, oil price changes are no longer significantly correlated with either U_t and σ_t correspondingly, the positive correlation between dispersion and unemployment also vanishes.

Results of a similar nature are presented in Table 6. The unemployment rate is regressed on the dispersion index, the lagged unemployment rate, a time trend and the growth rate of M2. [11] The first equation is estimated over the period 1901-1929. [12] The coefficient on the dispersion index is positive and significant at about a 5% level. The specification of the second equation is identical to that of the first; however the observation for 1920 is dropped from the sample. This change causes a dramatic drop in the coefficient on the

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[11] Mark Rush(1984, 1985) has presented some evidence on the effect of different monetary standards on the money - output correrlation. During the gold standard era, 1880-1913, movements in real activity were correlated largely with changes in the money multiplier; neither unanticipated nor anticipated shocks to the money base were important over this period. Over a later period, beginning in 1920, unanticipated (rather than anticipated) shocks to the base are related to output. Since my sample period has some overlap with both these regimes, it is not apparent how the money variable should be specified. Including the growth rate of the base and the growth rate of the multiplier as separate variables had no effect on the magnitudes of the remaining coefficients.

[12] Over a longer period, 1901-1947, σ_t has no explanatory power for U_t. My preliminary investigations indicate that the correlation breaks down during the Depression.

Table 5: Correlation Coefficients

Period: 1901-1929

	U_t	σ_t	P_{t-1}
σ_t	0.39*	..	..
P_{t-1}	0.32*	0.42*	..

Period: 1901-1919

	U_t	σ_t	P_{t-1}
σ_t	-0.28	..	..
P_{t-1}	0.10	0.12	..

Note: An asterisk indicates that the null hypothesis of zero correlation can be rejected at a 10% level of significance.

Table 6: Unemployment Equations

No.	Period	Intercept	DM2	σ	U_{t-1}	t	R^2	D.W.
1	1901-1929	4.37* (1.24)	-22.44* (7.19)	36.72* (18.15)	0.33* (0.15)	-0.07 (0.04)	0.48	1.60
2	1901-1920 1922-1929	4.64* (1.22)	-15.96* (8.08)	6.19 (26.06)	0.33* (0.15)	-0.06 (0.04)	0.29	1.79

Note: Standard errors are in parentheses; an asterisk denotes a marginal significance level $\leqq .10$.

dispersion index, accompanied by a rise in its standard error, so that it is no longer significant at conventional levels.

V. Conclusions

Some recent research has propagated the view that reallocative shocks significantly affect aggregate unemployment by increasing the amount of labor reallocation required. The evidence for this view rests on the finding of a positive correlation between the aggregate unemployment rate and the cross-industry dispersion of employment growth. This paper shows that this correlation largely vanishes once oil price shocks are controlled for. The 'dispersion hypothesis' could still be true if it were shown that oil price shocks have strong reallocative effects. A key prediction of the hypothesis is that both increases and decreases in oil prices lead to increases in unemployment. Hence, one test of the dispersion hypothesis is whether the square of oil price changes, and not just the change, has a positive correlation with unemployment. Unfortunately, the data do not permit such a distinction because almost all the changes were positive and abrupt. In the absence of a deeper structural analysis, a parsimonious interpretation of the evidence thus far is that the dispersion hypothesis is incorrect and that oil prices affect the economy through some other channel.

REFERENCES

Barro, Robert J., Money, Expectations and Business Cycles, (New York : Academic Press, 1981).

Barro, Robert J., "Output Effects of Government Purchases," Journal of Political Economy 89 (Dec. 1981), 1086-1121.

Hamilton, James D., "The Macroeconomic Effects of Petroleum Supply Disruptions", dissertation, University of California, Berkeley (June 1983).

Lilien, David M., "Sectoral Shifts and Cyclical Unemployment", Journal of Political Economy 90 (Aug. 1982), 777-793.

Nash, Gerald D., United States Oil Policy 1890 - 1964, (Pittsburgh : University of Pittsburgh Press, 1968).

Pogue, Joseph E., The Economics of Petroleum, (New York : John Wiley and Sons, 1921).

Rush, Mark, "Unexpected Monetary Shocks from 1920 to 1983", mimeo, 1984, University of Florida, Gainesville.

Rush, Mark, "Unexpected Monetary Disturbances during the Gold Standard Era", Journal of Monetary Economics 15 (1985) 309-321.

Sheffrin, Steven M., "The Dispersion Hypothesis in Macroeconomics", Review of Economics and Statistics 66 (Aug. 1984) 482-485

Trehan, Bharat, "Essays on Money and Business Cycles", dissertation, University of Rochester (Sep. 1984).

Appendix : Extension to Quarterly Data

This appendix extends the analysis to quarterly data; this serves as a test of the robustness of the results presented in the main text of the paper. Some modifications are made - largely to make the results of this section comparable to those in Lilien (1982b) - to the structure described previously. Using the same notation as before, employment growth is written as,

$$e_{it} = X_t \alpha_i + Z_t \omega_i + S_{it} \qquad \ldots(1)$$

X_t contains a time trend and the current and eight lagged values of the change in DMR. Z_t is the unobservable component of aggregate demand; it is estimated as a factor score using common factor analysis. [13] The sectoral component is assumed to follow a first-order autoregressive process :

$$S_{it} = \rho_i S_{it-1} + \varepsilon_{it} \qquad \ldots(2)$$

The dispersion index, $(\sigma_t)^2$, is then defined as,

$$(\sigma_t)^2 = \sum_{i=1}^{n} c_i [(\varepsilon_{it})^2] / \sigma_i \qquad \ldots(3)$$

This definition of the index differs from the earlier one in two respects. First, each industry's residuals are weighted by c_i, with c_i being the share of industry i in total employment in 1969. Second, σ_i denotes the variance over time of an industry's residual, i.e., $\sigma_i = \sum_{t=1}^{T}(\varepsilon_{it})^2/T$, where T is the length of the sample period. The residuals are deflated by σ_i to capture scale differences in the variance of ε_{it}. To isolate the effects of oil price shocks, the employment growth equation is re-specified as,

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[13] The use of factor analysis as an estimation procedure for models containing unobserved variables is discussed in Judge, et. al. (1980, pgs.550-555). See also Harman(1976, pgs.363-87).

$$e_{it} = X_t\ \alpha_i + P_t\ \beta_i + Z_t^*\ \omega_i + R_{it} \qquad \ldots(4)$$

P_t is a matrix of current and lagged changes in the relative price of crude petroleum The unobservable component, Z_t^* is again estimated as a factor score; it is restricted to be orthogonal to X_t and P_t. are related to the structural characteristics of each industry. R_{it} has the following autoregressive structure :

$$R_{it} = \rho_1^* R_{it-1} + \eta_{it} \qquad \ldots(5)$$

The components of the dispersion index are defined as,

$$(\sigma_{pt})^2 = \{\sum_{i=1}^{n} c_i\ [(\beta_i - \beta)P_t]^2\} \qquad \ldots(6)$$

and,

$$(\sigma_{rt})^2 = \sum_{i=1}^{n} c_i[(\ \eta_{it})^2]/\ \sigma_i \qquad \ldots(7)$$

where, $\beta = \sum_{i=1}^{n} c_i\ \beta_i$. and σ_i is now $\sum_{t=1}^{T}(\ \eta_{it})^2/T$.

The estimated employment growth regressions are contained in unpublished tables available from the author. The unemployment rate equations are reported in Table A-1. A time trend and the current and eight lagged values of unanticipated money growth are included as additional explanatory variables. The first regression - similar to the ones reported by Lilien(1982b) - supports the hypothesized positive relationship σ_t and the unemployment rate. [14]

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[14] Following Lilien, the dispersion indices are included in the unemployment equations in standard deviation form. The simple correlation between σ_t and Lilien's measure of dispersion is .843.

Table A-1

Unemployment Equations, 1947-I-1982-IV

No.	Dispersion Index	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7	Lag 8	Intercept	Time	Sum of DMR	Sum of DRP	Root MSE
1	σ	.29*	.40*	.16	-.03	.15	.39*	.36*	.46*	.20	0.24	.038*	-392*	-	.338
		(.13)	(.16)	(.17)	(.17)	(.17)	(.17)	(.16)	(.14)	(.12)	(1.16)	(.006)	(24)		
2	σ_p	.60*	.83*	.49*	.47*	.34*	-.19	-.12	.07	.09	2.43*	.019*	-382*	-	.327
		(.16)	(.16)	(.17)	(.17)	(.16)	(.20)	(.21)	(.21)	(.20)	(0.91)	.005	(26)		
	σ_r	.24	.38*	.10	-.23	-.20	.06	.08	.28*	.17					
		(.13)	(.15)	(.15)	(.15)	(.15)	(.15)	(.14)	(.14)	(.12)					
3	σ_p	.62*	.83*	.53*	.46*	.26	-.24	-.10	.17	.10	3.61*	.015*	-382*	-	.340
		(.16)	(.17)	(.17)	(.17)	(.17)	(.19)	(.20)	(.20)	(.19)	(0.32)	(.004)	(18)		
4	σ_r	.15	.26	.02	-.30	-.23	.06	.11	.28	.16	2.31	.034*	-355*	-	.364
		(.14)	(.17)	(.17)	(.18)	(.17)	(.18)	(.17)	(.16)	(.13)	(1.22)	(.006)	(18)		
5	-	-	-	-	-	-	-	-	-	-	4.20*	.011	-329*	46.7*	.296
											(0.56)	(.007)	(23)	(3.4)	

Note: All equations are estimated with a correction for fourth-order autocorrelation.

Standard errors are in parentheses; an asterisk denotes a marginal significance level ≦ .05.

DMR is a measure of unanticipated money growth.

DRP is the change in the relative price of crude petroleum.

Regressing unemployment on the two components separately - rather than on the composite index, σ_t - enhances the explanatory power of the equation (see row 2 of the table). The coefficients on σ_{pt} are positive and highly significant upto lag four. On the other hand, very few of the coefficients on σ_{rt} are individually significant. The estimates of the coefficients are not appreciably altered when the dispersion indices are included separately (see rows 3 and 4).

To further assess the relative importance of the two components, it is useful to construct the following measures of the 'natural rate' of unemployment :

$$U_{pt}^* = a + \sum_{j=0}^{8} b_j \sigma_{pt-j} \quad \text{...(8)}$$

and

$$U_{rt}^* = a + \sum_{j=0}^{8} f_j \sigma_{rt-j} \quad \text{...(9)}$$

where, a is the estimate of the intercept from equation 2 in Table A-1, and b_j and f_j are the estimated coefficients attached to the σ_{pt} and σ_{rt} variables. The two measures of the natural rate reflect the amount of unemployment attributable to movements in the respective dispersion indices. Over the period 1947-1982, U_{pt}^* accounts for roughly 20% of the variance of detrended unemployment; less than 5% of it is explained by U_{rt}^*.

References :

Harman, Harry H., Modern Factor Analysis, (Chicago : The University of Chicago Press, 1976).

Judge, George G., Griffiths, Hill and Lee, The Theory and Practice of Econometrics, (New York : John Wiley & Sons, 1980).

Lilien, David M., "A Sectoral Model of the Business Cycle", MRG working paper no. 8231, University of Southern California, (Dec. 1982).

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