SECTORAL SHIFTS AND CYCLICAL UNEMPLOYMENT RECONSIDERED*

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This paper develops a new measure of reallocation shocks based on the variance of industry stock market excess returns to assess the contribution of sectoral reallocation to unemployment in the postwar U. S. economy. The Beveridge Curve relationship is used to establish that this series isolates reallocation shocks. Reallocation shocks are found to explain only a moderate share of the fluctuations in aggregate unemployment on average over the period. However, reallocation accounted for a substantial share of increases in unemployment in several episodes, particularly the mid-1970s. Reallocation shocks also account for a larger share of fluctuations in unemployment of longer durations than of shorter durations.

The importance of sectoral reallocation as a source of aggregate unemployment is the subject of ongoing debate. While Keynesian explanations of unemployment tend to emphasize aggregate disturbances as the cause of business cycles, many real business cycle theories attribute unemployment primarily to sectoral shocks that are propagated through imperfect labor market adjustment. Indeed, some economists have argued that sectoral shifts bear primary responsibility for the high levels of unemployment in the United States in the 1970s and 1980s. For instance, Lilien [1982a, p. 777] concludes that "most of the unemployment fluctuations of the seventies (unlike those in the sixties) were induced by unusual structural shifts within the U. S. economy."

The debate over the causes of unemployment persists in large part because it is difficult to distinguish empirically between unemployment associated with reallocation and aggregate shocks. An increase in unemployment may reflect a contraction in aggregate demand that induces firms in most sectors to lay off workers temporarily. Alternatively, it may reflect sector-specific shocks that change the pattern of demand among sectors. If workers must undergo a time-consuming process of retraining or relocation in order to move between sectors, sectoral shocks will raise aggregate unemployment even if the contractionary effects on some sectors are offset by expansionary effects on others.

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It is thus difficult to make inferences about the type of shock from ex post changes in unemployment. Lilien [1982a, 1982b] attempts to circumvent this problem by using an index of the sectoral dispersion of employment growth to capture reallocation unemployment. Abraham and Katz [1986] point out, however, that this employment dispersion measure may reflect cyclical as well as reallocation shocks if industries differ in their cyclical sensitivities and trend growth rates. They provide empirical evidence that this is the case for the period Lilien considers.

In this paper we develop a new series to measure the importance of reallocation shocks.[1] Rather than inferring reallocation shocks from labor market flows, we attempt to measure these shocks directly. To this end, we construct a time series of the variance of sectoral stock market excess returns, termed cross-section volatility. Stock returns are useful in this regard since the capital asset pricing model provides a theoretical method for separating cyclical and reallocation movements in stock prices; there is no corresponding theory for movements in employment growth rates. Using stock return data, we form a measure of cross-section volatility based on the variance of one-quarter excess returns.

After confirming that excess returns predict subsequent increases in employment within industries, we examine the relation between cross-section volatility and unemployment. We find a positive and statistically significant correlation between cross-section volatility and subsequent unemployment, which is not explicable by alternative macroeconomic variables such as changes in the money supply, the price of oil, or the aggregate market return. Overall, we conclude that the reallocation shocks captured by cross-section volatility account for a moderate share of the variation in unemployment on average. However, reallocation accounted for a particularly high share of the increases in unemployment during particular episodes, such as the mid-1970s and late 1960s. In contrast, it accounted for very little of the increases in unemployment in the late 1950s and the early 1980s.

Apart from using variables such as changes in the money

1. Brainard [1987] creates a sectoral cross-section volatility series to test for reallocation unemployment in interwar Britain. Cutler [1989] develops a firm cross-section volatility series to test the importance of diversifiable and nondiversifiable risk for asset pricing. Topel and Weiss [1988] develop a related sectoral series as a proxy for workers' expectations about relative wage uncertainty. In work closely related to ours, Loungani, Rush, and Tave [1990] develop a similar series based on industry total returns. We discuss their research in greater depth below.

supply and the market return to control for aggregate shocks, we also use data on job vacancies jointly with unemployment to examine whether cross-section volatility accurately captures reallocation shocks. The Beveridge Curve posits a negative relationship between unemployment and vacancies in response to aggregate shocks: adverse aggregate shocks temporarily reduce the demand for workers across many sectors, generating aggregate reductions in job vacancies along with increases in unemployment.[2] Reallocation shocks, in contrast, raise job vacancies in some sectors and lower them in others, so that the net effect on aggregate vacancies may be positive, or small in either direction. We estimate Beveridge Curve equations to test whether cross-section volatility isolates reallocation shocks, and conclude that it does.

In addition, we find support for the reallocation interpretation of cross-section volatility in examining unemployment of different durations. The cross-section volatility measure explains a relatively larger share of fluctuations in longer duration unemployment, suggesting that unemployment spells associated with intersectoral movements persist longer than intrasectoral unemployment spells. In contrast, an employment dispersion measure achieves higher significance in explaining unemployment of shorter duration.

Our work is close in spirit and approach to that of Loungani, Rush, and Tave [1990], who develop a series based on the sectoral dispersion in stock market total returns to capture sectoral shocks. However, our research diverges in a number of ways. First, while Loungani et al. use total returns in formulating the dispersion series, we use excess returns in order to control for idiosyncratic sectoral responsiveness to aggregate shocks. Second, we attempt to measure the explanatory power of cross-section volatility independent of oil price shocks. In addition, we provide evidence for a reallocation interpretation of cross-section volatility by using data on vacancies, and on different duration classes of unemployment. Our results from the aggregate unemployment equations are broadly consistent with Loungani et al. (covering a longer period, stretching from 1933 to 1987), but our results differ in finding that more lags of cross-section volatility are significant in explaining unemployment. We also find that cross-section volatility explains little of the increase in unemployment associated with the 1981–1982 recession.

2. This point is emphasized in Abraham and Medoff [1982] and Jackman, Layard, and Pissarides [1984], among others.

The plan of the paper is as follows. In the next section we develop the conceptual basis for the cross-section volatility measure, and distinguish it from alternative candidates. Section II describes the construction of the cross-section volatility series and its path over time. Section III presents empirical results explaining unemployment with cross-section volatility and a variety of aggregate variables. Section IV examines whether cross-section volatility isolates reallocation shocks by providing evidence on vacancies and on unemployment of different durations, and Section V concludes.

I. Reallocation and Aggregate Shocks

Stochastic shocks that change sectoral returns and induce changes in resource utilization can be divided broadly into two categories. Reallocation shocks, such as changes in tastes or technologies, cause changes in the sectoral pattern of returns that are sufficiently large and persistent to induce shifts in the equilibrium distribution of capital among sectors. Aggregate shocks, in contrast, cause only transitory changes in the profitability of capital across sectors that have no lasting effect on the distribution of capital. Aggregate shocks are frequently associated with cyclical fluctuations.

Consider a multisector economy where the value of output is subject to stochastic shocks, where it is possible to lay off workers and close job openings on short notice, and where capital and labor are partly sectoral specific, so that movement between sectors takes time.[3] Starting in an equilibrium with equal returns to capital across sectors, a change in technology or tastes that raises the marginal productivity of capital in some sectors and lowers it in others will register first in an increase in the sectoral dispersion of returns to capital. The capital stock will be drawn down in adversely affected industries, causing increased unemployment and reduced vacancies in those sectors. Conversely, investment will rise in positively affected industries, leading to increased job vacancies. Over time, the dispersion in returns will narrow progressively, as capital and labor move to more productive sectors.

If firms in the high profitability industries expand gradually, or if workers laid off in the contracting sectors only gradually find jobs in the expanding sectors, aggregate output will fall, and

3. See Brainard and Cutler [1990] for a formal model relating unemployment and vacancies to reallocation and aggregate shocks.

resources will be temporarily unemployed during the transition. The relative responses of aggregate unemployment and vacancies will depend on the technologies of creating and closing job openings, of moving resources between sectors, and of matching jobs to workers. If the creation of new jobs depends in part on new physical capital investment, the increase in unemployment will be more immediate and more severe than the increase in vacancies. Indeed, vacancies may rise or fall initially, depending on differences across sectors in the ability of firms to alter job openings.[4]

Now consider the arrival of an adverse aggregate shock that temporarily lowers returns across all sectors. In this case, firms in all sectors will reduce their utilization of capital in response to the decline in the marginal product of capital, and labor demand will fall as well, if labor and capital are gross complements in production. On aggregate, unemployment will rise if wages do not fully adjust, and vacancies will fall. Over time, as the marginal product of capital returns to its equilibrium value, capital utilization and labor demand will increase, raising vacancies and lowering unemployment. Since all sectors respond similarly in this case and there is no change in the equilibrium distribution of capital, the dispersion of sectoral returns to capital should not increase significantly following an aggregate shock.

Suppose that we want to measure the amounts of vacancies and unemployment that are caused by reallocation as opposed to aggregate shocks, and the shocks themselves are unobservable. One approach, proposed by Lilien [1982a], is to use the variance each period of employment growth in different sectors as a measure of reallocation shocks. The sectoral dispersion of employment growth should rise in response to a reallocation shock, as workers are laid off in some industries and hired in others.

There are two problems with this measure. The first is that the dispersion in net employment growth may rise by as much as or more in response to an aggregate shock, if sectors vary in their aggregate sensitivities and trend growth rates [Abraham and Katz, 1986]. Even if the aggregate sensitivities of all sectors are equal, however, the temporal relationship between the arrival of a reallocation shock and the employment response may differ among sectors, yielding an ambiguous reallocation signal.

A more promising approach to isolating reallocation shocks is

4. Hosios [1990] shows that the response of aggregate vacancies to a reallocation shock depends on the degree of capital mobility.

to measure the dispersion in the returns to human capital across sectors. Since such returns are unobservable, we use a natural alternative: the dispersion in returns to physical capital. A reallocation shock should register immediately in an increase in the sectoral dispersion of returns to capital; in contrast, an aggregate shock should have little or no effect on the intersectoral pattern of returns to capital.

The stock market is thus a natural place to look for evidence of reallocation shocks. Although stock prices respond to both aggregate and sectoral shocks, and aggregate sensitivities may differ substantially across sectors, the capital asset pricing model provides a theoretical basis for separating aggregate movements in stock prices from idiosyncratic movements. In addition, the efficient markets hypothesis suggests that the arrival of information about the future profitability of a firm is captured in a single and immediate movement in its stock price, thus ensuring a tight temporal correspondence between the arrival of a shock and the response of stock market dispersion. For these reasons, a measure of the dispersion in sectoral excess returns should provide a good measure of reallocation shocks.

II. Data and Methodology

We construct the cross-section volatility series using industry data on stock market excess returns. Excess returns for each industry through time, $\epsilon_{j,t}$, are formed as the residual from the market model:[5]

$$R_{j,t} = \beta_{0j} + \beta_{1j} R_{m,t} + \epsilon_{j,t}, \tag{1}$$

where $R_{m,t}$ is the return on the market portfolio at time t (the Standard and Poors Composite Index), and $R_{j,t}$ is industry j's return at time t.[6] We form excess returns from the industry-specific

5. We also formed the cross-section volatility series using multifactor models of stock prices, which would be appropriate if there were aggregate shocks not captured in the market return. We used the dividend-price ratio, the three-month and one-year Treasury bill rates, a measure of volatility formed from the variance in daily returns, and the market return as factors in one equation, and also included oil price changes in a second equation. In both cases, almost all of the explanatory power was in the market return. The series formed from the residuals of these equations were virtually identical to the CAPM formulation, with a cross correlation of 0.97 in both cases.

6. Industry returns are formed by matching S&P industry indices to conventional two- or three-digit SIC codes, yielding excess returns for 49 industries. When more than one S&P classification is included in a single industry, we average their returns to form the industry return.

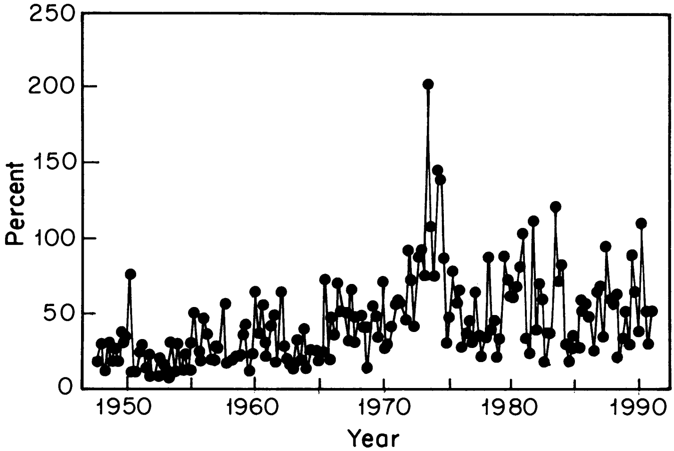

FIGURE I
Cross-Section Volatility
Note. Cross-section volatility is defined as the weighted variance of quarterly excess returns as given in equation (3).

components of return variation:

$$\eta_{j,t} = \hat{\beta}_{0j} + \hat{\epsilon}_{j,t}. \tag{2}$$

The excess returns include the time-invariant component of the industry-specific response in order to capture trend movements within industries.[7]

We form the measure of cross-section volatility as the weighted variance of one-quarter excess returns (CSV):

$$CSV_t = \sum_{j=1}^{N_t} w_{j,t}(\eta_{j,t} - \bar{\eta}_t)^2. \tag{3}$$

Employment weights adjust for the differential impact of a change in a sector's employment on aggregate employment:[8] $w_{jt} = E_{j,t}/E_t$.

The cross-section volatility series is graphed in Figure I, and presented in the Appendix. Summary statistics are reported in the

7. Alternatively, if industry trends in excess returns have different implications for unemployment than for short-term fluctuations, it would be more appropriate to form the dispersion series from the error terms alone. The correlation between the cross-section volatility series including both the time-invariant component and the error term, and a series formed from the error terms alone is, however, 0.99, suggesting that this distinction is immaterial in practice.

8. The number of industries (N_t) ranges from 18 to 44, reflecting the availability of corresponding return and employment data.

TABLE I
CHARACTERISTICS OF DATA

A. Univariate statistics

Series	Mean	Standard deviation
Cross-section volatility (CSV)	46.0	29.3
Employment dispersion (ED)	2.8	1.4
Money growth (DM)	0.013	0.008
Real price of oil (POIL)	0.525	0.187
Real market return (MRET)	0.096	0.243
Unemployment rate (UN)	5.7	1.7
Vacancy rate (VAC)	2.1	0.2

B. Cross correlations

	CSV	ED	DM	POIL	MRET	UN	VAC
CSV	1.000						
ED	0.051	1.000					
DM	0.363	0.022	1.000				
POIL	0.249	0.072	0.360	1.000			
MRET	−0.400	−0.038	−0.337	−0.190	1.000		
UN	0.216	0.045	0.405	0.721	−0.324	1.000	
VAC	−0.032	−0.015	−0.056	−0.403	0.065	−0.737	1.000

Note. The table shows summary statistics for all of the series used in the equations. The sample is 1948.1 to 1991.2.

first row of Table I. The mean of cross-section volatility is 46 percentage points, with a standard deviation of 29 percentage points. The cross-section volatility measure displays moderate serial correlation (0.45 in the first quarter) and is positively contemporaneously correlated with unemployment.

The cross-section volatility series is particularly high between 1972.2 and 1975.1, and in isolated quarters in the early 1950s, the late 1960s, the early and late 1980s, and the early 1990s. The highest peak of cross-section volatility occurs in the third quarter of 1973, coinciding with the embargo on oil sales to the United States and the Netherlands by most of the OPEC countries. Cross-section volatility is also high in the fourth quarter of 1979, when the U. S. embassy in Tehran was seized and Iran suspended oil exports to the United States. Although oil prices had risen prior to each of these quarters, the sharp increases in cross-section volatility coincide with the arrival of news auguring a substantial deepening of the oil crisis. During the past decade, the largest increases in cross-section volatility occur in the first quarter of 1982, the fourth quarter of 1983, and the third quarter of 1990; in all cases, the increases are less persistent and less extreme than those in the mid-1970s. Interestingly, the 1987 stock market crash registers as only a moderate and short-lived increase in cross-section volatility.[9]

In the 1970s the industries with the largest excess returns are roughly similar at each of the peaks of the cross-section volatility series. In both 1973–1974 and 1979, petroleum, oil and gas, and other mining industries had large positive excess returns; while the tire and rubber, housebuilding, and air transportation industries fared particularly poorly. At the peaks of the 1980s, there is less uniformity among the dominant industries. While petroleum and oil and gas companies did poorly, financial services industries had positive returns in 1981, and retail and other service stores did well in early 1982.

Although the peaks in cross-section volatility do not coincide precisely with large returns in industries commonly thought to be important contributors to reallocation unemployment, such as steel production and transportation equipment, the pattern of returns in these industries is closely related to movements in cross-section volatility. The transportation equipment industry had large positive returns in the quarter preceding the 1967 peak, and fared poorly just before the 1981 peak. Similarly, the steel industry had large negative returns just prior to the 1979 and 1982 peaks, and large positive returns throughout 1987. Thus, the shape of the series is roughly consistent with traditional views about reallocation shocks.

In addition to the industry measure of cross-section volatility, we constructed a firm cross-section volatility measure, using firm excess returns in place of industry excess returns, and weighting by market values instead of employment shares. Since the firm series performs similarly to the industry series in all the equations we estimate, we report results only for the industry series.

Further, we constructed two alternative measures of cross-section volatility to control for any bias associated with changes in

9. The cross-section volatility series is highly correlated with a series constructed from industry total returns, such as that used by Loungani et al. However, the two series differ in particular periods, such as the second quarter of 1970, and the third and fourth quarters of 1980 and 1990, when the series constructed from total returns increases sharply.

the sample of industries over time. The first alternative series uses excess returns for only those industries that have both employment and stock price data continuously throughout the sample period (sixteen in all). The second series uses the full set of industries, but adjusts the mean of the series each time industries are added or deleted. The adjustment factor for each subperiod with a different number of firms is the ratio of the mean of the series formed from the continuously sampled industries to the mean of the series with the full set of industries. The results using both alternative series are similar to those with the unadjusted series, so we report only the unadjusted series in the text.

A potential weakness of the cross-section volatility measure is that it may reflect changes in firms' leverage ratios. A firm's stock market price will be more volatile the greater is its debt-equity ratio, because high leverage is associated with a greater concentration of risk per share [Black, 1976; Christie, 1982]. Since there are no long time-series data on industry debt-equity ratios, we are unable to control for leverage in the industry series directly. For a sample of firms, however, we adjusted the cross-section volatility series to control for leverage effects by weighting returns with annual debt-equity ratios, both from COMPUSTAT. The leverage-adjusted series and the unadjusted series did not differ materially.

Another potential weakness of the cross-section volatility measure is that excess returns may reflect changes in the expected value of physical capital that are unrelated or inversely related to the expected value of human capital. An inverse relationship would result, for example, if the bargaining power of firms were to increase relative to that of labor in a rent-sharing context.

We test this hypothesis by pooling the industry time series and regressing excess net employment changes in each industry on the industry's excess return. The excess employment change in industry j, $\xi_{j,t}$, is formed analogously to its excess stock return:

$$\Delta \log (E_{j,t}) = \gamma_{0j} + \gamma_{1j} \Delta \log (E_t) + \xi_{j,t}. \tag{4}$$

The residuals are summed over different time horizons ranging from one quarter to five years:

$$\hat{\xi}^q_{j,t} = \sum_{i=1}^{q} \hat{\xi}_{j,t+i-1} \tag{5}$$

and regressed against the one-quarter excess return:

$$\hat{\xi}^q_{j,t} = \tau_q + \delta_q \eta_{j,t} + \nu^q_{j,t}. \tag{6}$$

Estimates of equation (6) are reported in the first column of Table II. The estimated coefficients indicate that excess returns significantly predict employment growth, although the effect is small. An industry with a 10 percent excess return is predicted to have additional employment growth of roughly 0.8 percentage points after two years. There is no incremental effect beyond four years, although the initial effect persists.

To examine the importance of permanent changes in returns, we also estimate an equation relating excess employment changes over various horizons to persistent movements in excess returns:

$$(6') \qquad \hat{\xi}^q_{j,t} = \tau_q + \left[\delta_{1q} + \delta_{2q}\left|\sum_{k=0}^{7} \eta_{j,t-k}\right|\right]\eta_{j,t-k} + \nu^q_{j,t}.$$

If the predictive power of the excess return for subsequent employment changes is independent of the path of past returns, the estimated coefficient on δ_{1q} should be unchanged from equation

TABLE II
EMPLOYMENT CHANGES AND EXCESS RETURNS

Quarters (q)	δ	R^2	δ_1	δ_2	R^2	N
1	0.0061	0.001	−0.0064	0.299	0.002	5398
	(0.0034)		(0.0051)	(0.094)		
4	0.0523	0.007	0.0313	0.546	0.009	5145
	(0.0108)		(0.0142)	(0.279)		
8	0.0815	0.006	0.0357	1.208	0.007	4866
	(0.0200)		(0.0237)	(0.475)		
12	0.0964	0.004	0.0368	1.589	0.006	4601
	(0.0281)		(0.0332)	(0.739)		
16	0.1165	0.004	0.0418	1.962	0.005	4371
	(0.0365)		(0.0429)	(1.018)		
20	0.1340	0.003	0.0302	2.778	0.005	4143
	(0.0457)		(0.0530)	(1.370)		

Note. The table shows regressions of the idiosyncratic change in each industry's employment over different horizons on a constant (not reported) and the industry's excess return. The specifications for the two regressions are

$$\xi^q_{j,t} = \tau_q + \delta_q \eta_{j,t} + \nu^q_{j,t}$$

$$\xi^q_{j,t} = \tau_q + \left[\delta_{1,q} + \delta_{2,q}\left|\sum_{k=0}^{7} \eta_{j,t-k}\right|\right]\eta_{j,t} + \nu^q_{j,t},$$

where $\xi_{j,t}$ is net excess employment growth in industry j in quarter t and $\eta_{j,t}$ is the industry's excess return. The first column shows the value for q. The data are quarterly from 1948–1987. Standard errors for the multiperiod regressions are corrected for moving average residuals, using the procedure in Newey and West [1987].

(6) and that on δ_{2q} should be small. If instead the impact of excess returns is more pronounced the more persistent is their movement, the coefficient on δ_{2q} should be more important.

The estimated coefficients are reported in the latter columns of Table II. The equations indicate that the persistence of excess returns is an important factor in predicting employment changes. The coefficients on δ_{2q} are positive and statistically significant at all horizons; the coefficients on δ_{1q} are generally small and statistically insignificant. The results suggest the value of allowing the cross-section volatility series to affect unemployment with long lags, and confirm the appropriateness of excess returns as predictors of employment flows.

We also form an employment dispersion measure along the lines of Lilien [1982b], to examine its relationship to cross-section volatility. The specification we report in Section IV is the employment-weighted variance of the industry-specific changes in employment from equation (6):

$$ED_t = \sum_{j=1}^{N_t} w_{j,t}(\hat{\xi}_{j,t} - \bar{\hat{\xi}}_t)^2. \tag{7}$$

Summary statistics for employment dispersion are given in the second row of Table I. The mean is 2.8 percentage points per quarter, with a standard deviation of 1.4 percent.[10]

The empirical tests on unemployment and vacancies use U. S. quarterly data from 1948.1 to 1991.2. The unemployment rate is the rate for the civilian population. Since no series of true job vacancies exists, vacancies are formed by adjusting the help wanted index, following Abraham [1987] and Blanchard and Diamond [1989].[11]

To isolate the effects of reallocation, we use two sets of controls in our regressions. The first uses the change in the money supply (DM), and the relative price of oil (POIL) as aggregate proxies.[12]

10. We adjust the employment dispersion series to control for extreme changes in employment related to strikes by removing employment changes of over 10 percent in a quarter.

11. We begin with the quarterly index of help wanted advertising, scaled by nonagricultural employment. We then fit Abraham's [1987] adjustment factor for the period 1968 to 1981 to a quadratic in time and predict the series out of sample from 1948 to 1991. The vacancy rate is the product of the normalized help wanted index and the adjustment factor, where the annual adjustment factor is used for each of the associated four quarters. The resulting series is then fitted to the mean of the known Minnesota vacancy data.

12. We experimented with different formulations of the oil price series, including log changes. Although variations in the formulation of the oil price series affect the relative significance of individual lags of the oil price variable, they do not change the results on cross-section volatility, or on the joint significance of the oil price variables.

There is considerable evidence linking both variables to aggregate activity. Shocks to the price of oil may have sectoral as well as aggregate effects; since movements in cross-section volatility are strongly associated with oil price shocks in the 1970s, the inclusion of the oil price series is important in determining whether cross-section volatility has any independent explanatory power. Statistics on the growth rate of the money supply and the relative price of oil are shown in the third and fourth rows of Table I.

Our second cyclical control uses the three-year return on the market index (MRET).[13] While the market return clearly reflects aggregate news, it may also reflect sectoral shocks insofar as it anticipates their effect on aggregate variables. For this reason, the estimated coefficients on cross-section volatility in equations containing the market returns are lower bounds on the true effects of reallocation shocks.

III. Cross-Section Volatility and Unemployment

We begin by presenting equations relating unemployment to cross-section volatility and the other shock variables. Both contemporaneous and lagged values of the independent variables are included to allow for long-run responses to the shocks. Since the correct specification of the unemployment equation is an unresolved issue, we estimate two variants. The first equation explains the level of unemployment:

$$\text{(8a)} \qquad \text{Level: } U_t = \beta_0 + \sum_{k=0}^{15} \beta_{1k} CSV_{t-k} + \epsilon_t;$$

and the second includes lagged values of unemployment to correct for serial correlation:

$$\text{(8b)} \qquad \text{Lag: } U_t = \beta_0 + \sum_{k=0}^{7} \beta_{1k} CSV_{t-k} + \sum_{k=1}^{4} \rho_k U_{t-k} + \epsilon_t.$$

The level specification includes four years of lagged independent variables, while the lag equation includes only two years, since past unemployment controls for the propagation of shocks.

Panel A of Table III reports the point estimates for regressions of aggregate unemployment on cross-section volatility and various controls. Each entry is the sum of the coefficients for the four

13. We experimented with one-quarter market returns but found that returns at longer horizons had greater predictive power for unemployment.

TABLE III
CROSS-SECTION VOLATILITY AND UNEMPLOYMENT

A. Coefficient estimates

Variable	Level (1)	Lag (2)	Level (3)	Lag (4)	Level (5)	Lag (6)
Cross-section volatility						
1 year	−0.0020	0.0030	0.0146	0.0038	0.0010	0.0023
	(0.0064)	(0.0016)	(0.0061)	(0.0017)	(0.0066)	(0.0016)
2 years	0.0190	0.0008	0.0127	0.0024	0.0209	0.0000
	(0.0075)	(0.0017)	(0.0060)	(0.0018)	(0.0075)	(0.0018)
3 years	0.0196		0.0105		0.0230	
	(0.0076)		(0.0062)		(0.0078)	
4 years	0.0118		0.0169		0.0111	
	(0.0064)		(0.0058)		(0.0064)	
Money growth						
1 year			17.6	−1.4		
			(23.9)	(7.0)		
2 years			−86.4	−11.4		
			(25.4)	(7.1)		
3 years			−7.6			
			(28.2)			
4 years			−32.3			
			(24.5)			
Price of oil						
1 year			2.12	1.16		
			(2.52)	(0.77)		
2 years			4.41	−0.27		
			(3.68)	(0.78)		
3 years			1.28			
			(3.85)			
4 years			−1.49			
			(2.96)			
Market return						
1–3 years					0.96	−0.20
					(0.56)	(0.13)
Lagged unemployment						
1 year		0.935		0.862		0.939
		(0.019)		(0.032)		(0.019)
F-test $CSV_i = 0$	0.000	0.043	0.000	0.016	0.000	0.255
$\bar{R}^2$	0.400	0.965	0.793	0.972	0.413	0.966

quarters in that year, with the standard error of the sum reported in parentheses. The penultimate row reports the p-value for the null hypothesis that the cross-section volatility coefficients have no effect on unemployment. Since the coefficients from different

TABLE III
(CONTINUED)

B. Impulse response functions for cross-section volatility

Quarter	Level (1)	Lag (2)	Level (3)	Lag (4)	Level (5)	Lag (6)
4	0.063	0.201	0.222	0.210	0.097	0.162
	(0.112)	(0.091)	(0.087)	(0.091)	(0.110)	(0.094)
8	0.217	0.253	0.190	0.261	0.254	0.156
	(0.104)	(0.100)	(0.081)	(0.091)	(0.120)	(0.112)
12	0.322	0.241	0.228	0.195	0.362	0.136
	(0.109)	(0.092)	(0.087)	(0.079)	(0.111)	(0.116)
16	0.270	0.172	0.298	0.095	0.278	0.099
	(0.099)	(0.076)	(0.082)	(0.056)	(0.098)	(0.094)
20	0.108	0.112	0.113	0.048	0.115	0.067
	(0.022)	(0.061)	(0.022)	(0.037)	(0.022)	(0.072)
24	0.053	0.069	0.055	0.024	0.056	0.043
	(0.010)	(0.048)	(0.010)	(0.023)	(0.010)	(0.055)
28	0.026	0.041	0.027	0.012	0.028	0.027
	(0.005)	(0.038)	(0.005)	(0.015)	(0.005)	(0.042)

Note. Data are quarterly from 1948–1991. The coefficients in Panel A are the sum of the coefficients for the quarters in that year; the standard errors are for the sum. Each column in Panel B shows the response of unemployment for a one-standard deviation shock in the error term in an autoregression of cross-section volatility. Standard errors for the impulse response functions are based on 1000 simulated impulse response functions, as described in the text.

specifications are not directly comparable, Panel B reports the associated impulse response functions for unemployment.[14]

The first pair of columns reports the results with cross-section volatility alone; the first column is the level equation (8a), and the second is the lag equation (8b). In both equations cross-section volatility raises subsequent unemployment, although the response is slightly larger in the level equation. The impulse response functions rise for two to three years and then decline. At three years the effect on unemployment of a one-standard deviation shock to cross-section volatility is about 0.3 percentage points; we return later to the quantitative importance of this estimate. The response is statistically significant for much of the first six years.

The second pair of columns adds money growth and the relative price of oil to the equations. The inclusion of these

14. We allow cross-section volatility to follow an AR(4), and compute the response of unemployment to a one-standard-deviation shock in the error term of this autoregression. The standard errors for the impulse response functions are the empirical standard deviations from 1000 simulated responses. Each simulation draws a coefficient vector for the unemployment equation from a multivariate normal distribution, with the estimated coefficients and variance-covariance matrix as the true parameters of the distribution.

variables improves the fit of the equation dramatically. The coefficients on the growth rate of money are generally negative, suggesting that unemployment declines in response to increases in the money supply. The coefficients on the price of oil are positive except at very long lags. They are individually insignificant but jointly significant.

Their inclusion does not alter the conclusions about cross-section volatility, however. The impulse response functions still suggest positive and significant effects of cross-section volatility on unemployment, although the decay in the unemployment response is more rapid. Figure II shows the impulse response function from column (4). The unemployment response is about 0.2 percentage points after one year and continues to rise, peaking after about two years. The response is statistically significant in the three years surrounding the peak unemployment response. Importantly, these results suggest that cross-section volatility measures reallocation shocks in addition to those captured by the price of oil.

The final pair of columns in Table III reports equations including the market return as a cyclical control. Including the market return changes the results more substantially. While the equations for the level of unemployment are similar to those without the market return, the lag equation suggests a much

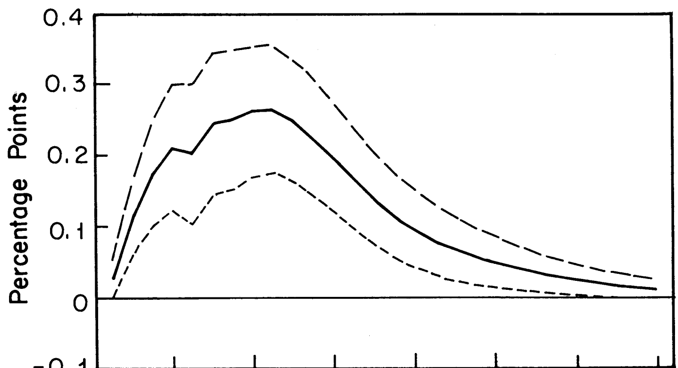

FIGURE II
Response of Unemployment to Cross-Section Volatility

Note. Figure II shows the response of unemployment to a one-standard deviation shock to cross-section volatility, along with the one-standard deviation confidence interval for the response. The confidence interval is based on 1000 simulations of the unemployment response.

smaller role for cross-section volatility, at a lower level of significance. The coefficient on the market return variable is positive in the level equation and negative in the lag equation, and its significance is low in both.

It is difficult to interpret these findings. As Table I indicates, there is a large negative correlation between one-quarter cross-section volatility and the market return (−0.4). Indeed, when cross-section volatility is omitted from the equations (not reported), there is a much larger negative effect of market returns on subsequent unemployment. As indicated above, this is exactly the prediction if market returns anticipate the response of aggregate activity to reallocation shocks. Unfortunately, there is no way to differentiate this interpretation of the market return coefficients from one stressing large and unmeasured aggregate shocks. Future research could usefully address this problem.

Overall, it appears that although cross-section volatility has a significant effect on unemployment, the magnitude of the response to cross-section volatility shocks is not large, suggesting that very large shocks would be needed to account for the increases in unemployment that are characteristic of recessions. Taken together, the point estimates and the impulse response functions lead us to conclude that for most of the postwar period, reallocation shocks played a moderate role in generating fluctuations in unemployment. Movements in cross-section volatility appear to explain on average one-quarter of the variance of total unemployment. These results are consistent with those of Murphy and Topel [1987], who find that about 25 percent of unemployment is accounted for by people who switch jobs after an unemployment spell, and that the cyclical variance of this flow is relatively small.

However, there have been several periods in which the reallocation shocks captured by cross-section volatility have generated substantial increases in unemployment. For instance, reallocation shocks accounted for 60 percent of the 4.0 percentage point increase in aggregate unemployment between 1973 and 1975. In the second half of the 1960s, reallocation unemployment rose 0.7 percentage points, despite a strong macroeconomy and a net decline in aggregate unemployment. In contrast, reallocation shocks appear to have played a marginal role in the recessions of the early 1980s and 1990s: reallocation unemployment accounted for only one-fifth of the 4.7 percentage point increase in aggregate unemployment between 1979 and 1982, and one-third of the 1.5 percentage point increase in aggregate unemployment between 1989 and the first half of 1991.

IV. Cross-Section Volatility, Employment Dispersion, and Reallocation Shocks

Having established the role of cross-section volatility in explaining movements in aggregate unemployment, we next compare cross-section volatility with the employment dispersion variable proposed by Lilien [1982a], to examine their relative power in isolating reallocation shocks. Table IV reports univariate unemployment equations similar to Table III, with the level equation in the first column and the lag equation in the second.

TABLE IV
Cross-Section Volatility, Employment Dispersion, and Unemployment

Variable	Level (1)	Lag (2)
Cross-section volatility		
1 year	−0.0042	0.0029
	(0.0066)	(0.0016)
2 years	0.0107	0.0005
	(0.0080)	(0.0017)
3 years	0.0165	
	(0.0079)	
4 years	0.0157	
	(0.0067)	
Employment dispersion		
1 year	0.708	0.007
	(0.215)	(0.049)
2 years	0.467	0.094
	(0.200)	(0.044)
3 years	−0.136	
	(0.184)	
4 years	−0.123	
	(0.178)	
Lagged unemployment		
1 year	0.927	
	(0.020)	
F-test $CSV_i = 0$	0.000	0.119
$\bar{R}^2$	0.475	0.967

Note. Data are quarterly from 1948–1991. The coefficients are the sum of the coefficients for the quarters in that year; the standard errors are for the sum. The specifications are described in the text.

Table IV suggests that both cross-section volatility and employment dispersion have positive effects on unemployment, and that the two effects are largely independent. The coefficients on cross-section volatility are smaller in magnitude but similar to those without employment dispersion. Both specifications reject the null hypothesis that cross-section volatility has no effect on unemployment. The level equation suggests that the response to employment dispersion is more immediate than the response to cross-section volatility. Unemployment increases in the first and second years following employment dispersion shocks, compared with the third and fourth years for cross-section volatility. The coefficients on employment dispersion in subsequent years are negative, but small and statistically insignificant. Both equations suggest that the shocks captured by cross-section volatility are distinct from those captured by employment dispersion.

While the positive relationship between either or both dispersion measures and unemployment could be attributable to reallocation shocks, so far we have provided no evidence ruling out an aggregate interpretation. Thus, we turn to the Beveridge Curve relationship between unemployment and vacancies to distinguish between reallocation and aggregate interpretations of the dispersion measures. Reallocation variables should shift out the Beveridge Curve; with time-consuming intersectoral reallocation, greater unemployment in some sectors will be accompanied by increased labor demand and vacancies in others. Aggregate shocks, in contrast, should move the economy along a given Beveridge Curve.

Table V presents Beveridge Curve estimates.[15] The logarithm of the vacancy rate is regressed against contemporaneous and lagged values of cross-section volatility and employment dispersion, with the logarithm of the unemployment rate as a control:

$$(9)\quad \log(VAC_t) = \beta_0 + \sum_{k=0}^{15} \beta_{1k} CSV_{t-k} + \sum_{k=0}^{15} \beta_{2k} ED_{t-k} + \beta_3 \log(UN_t) + \epsilon_t.$$

The results suggest that cross-section volatility is indeed a reallocation measure. Increases in cross-section volatility shift out the Beveridge Curve, in specifications both including and excluding

15. Pissarides [1986] discusses the appropriate specification of the Beveridge Curve equation.

TABLE V
BEVERIDGE CURVE ESTIMATES

Variable	(1)	(2)
Cross-section volatility		
1 year	0.00057	0.00054
	(0.00028)	(0.00030)
2 years	0.00010	−0.00009
	(0.00034)	(0.00037)
3 years	0.00002	−0.00006
	(0.00034)	(0.00036)
4 years	0.00103	0.00133
	(0.00029)	(0.00032)
Employment dispersion		
1 year	0.0153	
	(0.0102)	
2 years	0.0097	
	(0.0093)	
3 years	−0.0125	
	(0.0084)	
4 years	−0.0152	
	(0.0081)	
Log of unemployment	−0.294	−0.310
	(0.022)	(0.024)
F-test $CSV_i = 0$	0.012	0.006
F-test $ED_i = 0$	—	0.977
$\overline{R}^2$	0.618	0.649

Note. Data are quarterly from 1948–1991. The coefficients are the sum of the coefficients for the quarters in that year; the standard errors are for the sum. The specifications are described in the text.

employment dispersion. The magnitude is relatively small, however, with an increase in vacancies of about 1 percent (0.02 percentage points). This result is consistent with the estimates of reallocation shocks in Blanchard and Diamond [1989]. Their decomposition of the Beveridge Curve [Figure IX, p. 42] suggests that typical reallocation shocks first raise unemployment by about 0.15 percentage points, with only a negligible effect on vacancies, and then raise vacancies slightly (0.05 percentage points), as unemployment declines. This description matches our empirical results quite closely.

The coefficients on employment dispersion are more ambiguous. The coefficients on the first two lagged values are positive and insignificant, while the coefficients on the third and fourth lags are negative and close to significant. Overall, the regression fails to reject the hypothesis that employment dispersion is consistent with an aggregate relationship between unemployment and vacancies. Even though our formulation of employment dispersion attempts to control for cyclical responsiveness by excluding movements correlated with aggregate employment fluctuations, the results suggest that the employment dispersion measure predominantly reflects aggregate shocks. The cross-section volatility series, on the other hand, appears more effective at isolating reallocation shocks.

An alternative means of assessing whether the dispersion measures capture reallocation shocks is to compare their predictive power for different duration classes of unemployment. The duration of unemployment spells associated with reallocation shocks should be longer than that associated with aggregate shocks, since movement between sectors is more likely to require time-consuming development of new skills or geographic reallocation than intrasectoral movements. In addition, temporary layoffs should comprise a larger share of aggregate unemployment than of reallocation unemployment.

To examine this issue, we estimate equations similar to equation (8b), disaggregating unemployment by duration: 0–4 weeks, 5–14 weeks, 15–26 weeks, and 27+ weeks. Table VI reports results from these equations; for simplicity, we present the p-value

TABLE VI
EXPLAINING UNEMPLOYMENT BY DURATION

Unemployment Duration	Cross-section volatility	Employment dispersion
0–4 weeks	0.274	0.108
5–14 weeks	0.037	0.538
15–26 weeks	0.003	0.518
27+ weeks	0.059	0.716

Note. Each cell of the table shows the p-value for the null hypothesis that the shock variable (given in the columns) has no incremental effect on unemployment of the corresponding duration (given in the rows). A small value indicates that the null hypothesis of no effect can be rejected. The specification is

$$U_t^a = \beta_0 + \sum_{k=0}^{7} \beta_{1k} CSV_{t-k} + \sum_{k=0}^{7} \beta_{2k} ED_{t-k} + \sum_{k=1}^{4} \rho_k U_{t-k}^a + \epsilon_t,$$

where U^a is unemployment of duration a. The data are quarterly from 1948–1991.

associated with the hypothesis that the dispersion variable has no incremental effect on unemployment of each duration. Smaller *p*-values indicate that we can reject the hypothesis of no effect on unemployment at a higher level of significance.

The results suggest that cross-section volatility has greater explanatory power for longer duration unemployment. The effect of cross-section volatility on short-term unemployment (0–4 weeks) is statistically insignificant; however, for durations exceeding four weeks, it is highly significant. Employment dispersion, in contrast, is significant only in explaining short-term unemployment; the *p*-values suggest that there is no effect beyond four weeks. Again, these results are consistent with an interpretation of cross-section volatility as a reallocation variable, and of employment dispersion as an aggregate variable.

V. Conclusion

In this paper we develop a measure of reallocation shocks from the variance of stock market excess returns over time, and use it to test for the significance of reallocation unemployment in the postwar United States. Using data on both vacancies and unemployment, we confirm that cross-section volatility is reallocational as opposed to cyclical in nature. Increases in cross-section volatility shift out the Beveridge Curve, appearing as an increase in unemployment for a given level of vacancies rather than through increases in both. On average over the postwar period, the reallocation shocks captured by cross-section volatility accounted for only a moderate share of the fluctuations in aggregate unemployment. The importance of reallocation shocks varied considerably, however; reallocation shocks explain a large share of the fluctuations in unemployment in the mid-1970s and late 1960s, a moderate share in the recession of the early 1990s, and a negligible share in the recession of the early 1980s.

On the other hand, tests on disaggregated data show that reallocation shocks account for a larger share of fluctuations in long duration unemployment. Since the social cost of long duration unemployment is more severe than that of short duration unemployment, the economic importance of reallocation unemployment may be larger than its contribution to total unemployment would suggest.

Our results suggest several areas for future research. The results suggesting that reallocation and cyclical shocks have differential impacts on the unemployment rates of various subgroups within the labor force are worth exploring in greater depth. Further, while we have assumed that industry or firm affiliation is the natural source of labor market specificity, geographic or occupational attachments might be more important in explaining slow adjustment to reallocation shocks. Evidence on the relative importance of alternative sources of specificity would be useful. Finally, the hypothesis that we have advanced relating sectoral excess returns to expected changes in returns to human and physical capital investment suggests a connection between the cross-section volatility series and wages, which is also worth exploring.

APPENDIX:
CROSS-SECTION VOLATILITY

Quarter	CSV	Quarter	CSV	Quarter	CSV
1948.1	17.07	1963.1	17.08	1978.1	22.41
1948.2	28.99	1963.2	14.87	1978.2	35.40
1948.3	11.35	1963.3	33.09	1978.3	88.17
1948.4	30.63	1963.4	18.47	1978.4	39.11
1949.1	20.26	1964.1	40.13	1979.1	45.76
1949.2	26.30	1964.2	13.65	1979.2	21.05
1949.3	19.39	1964.3	26.42	1979.3	32.97
1949.4	36.86	1964.4	25.45	1979.4	89.07
1950.1	30.91	1965.1	26.42	1980.1	74.43
1950.2	34.92	1965.2	18.50	1980.2	62.32
1950.3	76.99	1965.3	25.25	1980.3	62.22
1950.4	11.16	1965.4	73.90	1980.4	68.87
1951.1	11.27	1966.1	19.97	1981.1	82.35
1951.2	25.66	1966.2	48.27	1981.2	104.03
1951.3	29.43	1966.3	35.98	1981.3	35.13
1951.4	13.31	1966.4	71.14	1981.4	24.32
1952.1	21.98	1967.1	52.01	1982.1	112.13
1952.2	8.64	1967.2	52.57	1982.2	40.46
1952.3	9.11	1967.3	32.77	1982.3	70.83
1952.4	20.24	1967.4	66.36	1982.4	59.55
1953.1	16.66	1968.1	31.54	1983.1	16.75
1953.2	12.42	1968.2	47.79	1983.2	36.69
1953.3	7.19	1968.3	49.50	1983.3	38.61
1953.4	31.95	1968.4	42.74	1983.4	122.64
1954.1	11.28	1969.1	14.88	1984.1	73.14
1954.2	30.07	1969.2	40.82	1984.2	84.12
1954.3	14.32	1969.3	55.29	1984.3	30.16
1954.4	25.11	1969.4	49.68	1984.4	18.58
1955.1	13.83	1970.1	34.48	1985.1	27.44

APPENDIX:
CONTINUED

Quarter	CSV	Quarter	CSV	Quarter	CSV
1955.2	29.89	1970.2	72.13	1985.2	35.36
1955.3	50.27	1970.3	28.22	1985.3	27.55
1955.4	24.80	1970.4	30.06	1985.4	59.18
1956.1	18.12	1971.1	42.15	1986.1	52.70
1956.2	47.30	1971.2	56.43	1986.2	56.79
1956.3	37.33	1971.3	58.98	1986.3	49.18
1956.4	19.86	1971.4	58.52	1986.4	25.88
1957.1	19.91	1972.1	45.98	1987.1	64.96
1957.2	29.07	1972.2	91.34	1987.2	68.42
1957.3	28.33	1972.3	73.67	1987.3	34.83
1957.4	57.73	1972.4	41.69	1987.4	95.65
1958.1	17.37	1973.1	87.16	1988.1	59.11
1958.2	19.35	1973.2	93.21	1988.2	57.47
1958.3	21.01	1973.3	74.68	1988.3	63.23
1958.4	21.69	1973.4	202.54	1988.4	22.11
1959.1	20.88	1974.1	107.64	1989.1	33.68
1959.2	37.16	1974.2	74.89	1989.2	51.98
1959.3	43.20	1974.3	145.92	1989.3	30.73
1959.4	12.35	1974.4	139.37	1989.4	90.75
1960.1	23.93	1975.1	87.08	1990.1	64.40
1960.2	65.94	1975.2	30.33	1990.2	39.15
1960.3	35.70	1975.3	48.75	1990.3	110.90
1960.4	55.78	1975.4	79.06	1990.4	53.09
1961.1	31.64	1976.1	58.68	1991.1	30.68
1961.2	21.50	1976.2	66.82	1991.2	54.10
1961.3	42.00	1976.3	28.54		
1961.4	48.81	1976.4	37.20		
1962.1	17.39	1977.1	46.84		
1962.2	64.46	1977.2	32.11		
1962.3	28.17	1977.3	64.49		
1962.4	19.84	1977.4	35.99		

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