NBER WORKING PAPERS SERIES

SECTORAL SHIFTS AND CYCLICAL UNEMPLOYMENT RECONSIDERED

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Working Paper No.3491

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 1990

We are grateful to Olivier Blanchard, Peter Diamond, Greg Duffee, Kala Krishna, Paul Krugman, Chris Pissarides, Jim Poterba, Julio Rotemberg, Louise Sheiner, David Weil, and especially Larry Katz and Larry Summers for useful discussions, and to the National Science Foundation and Sloan Foundation for research support. This paper is part of NBER's research program in Labor Studies. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

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ABSTRACT

This paper examines the importance of sectoral reallocation and cyclical unemployment in the postwar US economy. It develops a new measure of reallocation shocks based on the variance of industry stock market excess returns over time, termed cross section volatility. Data on unemployment and vacancies is used to establish that the cross section volatility series is effective in isolating reallocation shocks. The series is then used to measure the contribution of reallocation shocks to aggregate unemployment and to unemployment of varying durations. On average, about 40 percent of aggregate unemployment is explained by reallocation, but much of the variance of unemployment through time is better explained by cyclical shocks. Reallocation shocks account for a relatively larger share of long duration unemployment.

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Introduction

The importance of sectoral reallocation as a source of aggregate unemployment is the subject of ongoing debate. While Keynesian explanations of unemployment have tended 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.[1] Indeed, some economists have argued that sectoral shifts were primarily responsible for the high levels of unemployment in the US in the 1970's and 1980's, although the empirical evidence is by no means conclusive.[2]

The debate over the causes of unemployment persists in large part because it is difficult to distinguish empirically between unemployment associated with reallocation versus aggregate shocks.[3] An increase in unemployment may reflect a contraction in aggregate demand that causes firms in all sectors to lay off workers temporarily. Alternatively, it may reflect sector-specific shocks that change the pattern of demand among sectors if workers laid off in one sector must undergo a time-consuming

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[1] Notable examples of real business cycle explanations include Black (1982) and Lucas and Prescott (1974), while more "Keynesian" explanations include Fischer (1977), Taylor (1980), and Mankiw (1985).

[2] Lilien (1982a) 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." (p. 777) The issue has also been examined by Davis (1987) and Newman and Topel (1984).

[3] The term "reallocation unemployment" refers to unemployment associated with adjustment to a long-term shift in the equilibrium distribution of human capital. Both aggregate and reallocation shocks may be associated with unemployment caused by short term frictions in the matching of otherwise suited workers to jobs; this type of unemployment is not considered here.

process of retraining or relocation before being employed in another sector. As long as labor reallocation takes time, sectoral shocks will raise aggregate unemployment even if the contractionary effects on some sectors are offset by expansionary effects on others.[4]

It is thus difficult to make inferences about the type of shock from ex post changes in unemployment. Lilien (1982a,b) attempts to circumvent this problem by using measures of the sectoral dispersion of employment growth to capture reallocation unemployment. Abraham and Katz (1986) point out, however, that employment dispersion measures may reflect both cyclical and reallocation shocks if industries differ in their cyclical sensitivities and trend growth rates, and they provide empirical evidence that this is the case.

In this paper we reconsider the importance of reallocation shocks. Rather than trying to infer 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 stock market excess returns, termed cross section volatility.[5] Under the capital asset pricing model (CAPM), a sector's excess return reflects the arrival of idiosyncratic information about the

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[4] Even "micro" measures of the unemployment rate of workers who change sectors may not effectively isolate reallocation shocks, since the costs of moving and reemployment probabilities may vary over the business cycle. Rogerson (1987) considers this issue from a theoretical perspective, while Murphy and Topel (1987) and Loungani and Rogerson (1989) examine this issue empirically.

[5] Brainard (1987) develops such a series to test for the importance of sectoral reallocation unemployment in interwar Britain. Cutler (1989) develops a firm cross-section volatility series to test the importance of diversifiable and non-diversifiable risk for asset pricing. Topel and Weiss (1985) develop a similar industry series as a proxy for workers' expectations about future relative wage uncertainty. Loungani, Rush, and Tave (1989) have undertaken research along similar lines; their findings are consistent with ours, although the focus of their work is different.

sector's future profitability. The cross section volatility series is thus a measure of the variance of sector-specific shocks over time.

After constructing the cross section volatility series, we use data on both labor supply and demand to test whether it truly captures reallocation news. As has been noted by Solow (1964) and Blanchard and Diamond (1989a,b), among others, although aggregate and reallocation shocks have similar effects on unemployment, they have quite different effects on job vacancies.[6] Adverse aggregate shocks reduce the demand for new workers across many sectors, thus lowering job vacancies; this is the basis for the negative relationship between unemployment and vacancies embodied in the Beveridge curve. In contrast, reallocation shocks raise vacancies in some sectors, so that the net effect on aggregate vacancies may be positive, or small in either direction if there are offsetting reductions in other sectors.

We use the Beveridge Curve relationship to test whether the cross section volatility series captures reallocation shocks and conclude that it does. An increase in cross section volatility shifts the Beveridge Curve outwards rather than moving along it, working almost entirely through an increase in unemployment for a given level of vacancies. This finding is robust to the inclusion of variables measuring other supply and demand shocks, including the relative price of oil. We also confirm the Abraham and Katz (1986) finding that the variance of employment growth rates predominantly reflects aggregate shocks.

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[6] This point is also emphasized in Jackman, Layard, and Pissarides (1984), Abraham and Medoff (1982), and Abraham (1987).

We then use the cross section volatility series to gauge the importance of reallocation shocks for postwar US unemployment. We conclude that reallocation shocks account for roughly 40 percent of total unemployment, but for much less of the variation in unemployment. Several periods of high unemployment, such as the late 1960's and mid 1970's, had particularly high reallocation components. Reallocation accounted for a very small share of the total in some other periods of high unemployment, however, such as the 1982 recession. We also examine the importance of reallocation shocks for different duration classes of unemployment, and find that reallocation accounts for a relatively larger share of longer duration unemployment.

The plan of the paper is as follows. In the first section we develop a simple, two-sector model relating unemployment and vacancies to reallocation and aggregate shocks, and the rationale for using cross section volatility as a measure of reallocation shocks. Section two describes the construction of the cross section volatility series and its path over time. Section three presents empirical tests of cross section volatility as a measure of reallocation, as distinct from cyclical shocks. Section four analyzes the importance of reallocation for aggregate unemployment and vacancies, and for different duration classes of unemployment. Section five summarizes and lays out an agenda for future research.

I. Reallocation Shocks and Aggregate Shocks

Resources move within and between sectors in response to stochastic shocks that change the pattern of sectoral returns. These shocks can be grouped broadly into two categories. Reallocation shocks cause permanent changes in the sectoral pattern of returns, sufficient to induce shifts in the distribution of capital across sectors. Reallocation shocks are commonly associated with changes in tastes and technology. Aggregate shocks, in contrast, cause transitory changes in the profitability of capital across many sectors that have no long-run effect on the distribution of capital. Aggregate shocks are commonly associated with business cycle fluctuations.

Adverse aggregate shocks temporarily depress labor demand and thus total employment and vacancies. Consider an economy in which the value of output is subject to transitory shocks, and in which it is possible to lay off workers and close job openings on short notice. If the marginal product of capital falls, firms will reduce their utilization of capital. Provided that labor and capital are gross complements in production, labor demand will fall as well. Firms will close job openings and lay off workers. Over time, as the marginal product of capital increases, capital utilization and job vacancies will increase, and unemployment will decline.

Reallocation shocks also induce systematic changes in job vacancy and unemployment rates, although for different reasons. If capital or labor is imperfectly mobile across sectors, unexpected changes in the pattern of returns across sectors will result in transitory unemployment of resources, reflecting a mismatch of demands and supplies within sectors.[7]

Starting from an equilibrium with full employment, a shock that permanently changes the relative product of capital across sectors will cause firms in less profitable industries to close job openings, lay off

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[7] Mismatch arises in models with convex adjustment costs, or with fixed hiring and firing costs (such as Caplin and Krishna (1986)).

workers, and draw down capital. If firms in the high profitability industries can only gradually create job openings and hire new workers, however, output will fall, and resources will be unemployed. How the adjustment to the reallocation shock is distributed between 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.

In this section, we develop a model to examine the response of aggregate unemployment and vacancies to these two types of shocks, and to consider alternative measures of the shocks. In subsequent sections, we employ a measure of the sectoral dispersion of asset returns to test for the importance of reallocation and aggregate shocks.

I.1 Assumptions

The economy is disaggregated into two sectors (called 1 and 2). Each sector is characterized by a Leontief production function, with each filled job producing one unit of output and each unfilled job producing nothing. Workers are assumed to earn a constant fraction of the rents from their output, so that both firms and workers benefit from a match. This fraction, w, can be thought of as the standard Nash bargaining solution, following Mortenson (1982) or Diamond (1982).

The aggregate stocks of capital, K_{∞}, and labor, L_{∞}, are fixed. Both capital and labor are assumed to have a sector-specific component, however, so that new hires and new investment in each sector must be drawn from the pools of labor and capital specific to that sector. Further, resources can only move between sectors by undertaking time-consuming adjustment, such as skills retraining or geographic relocation. We model this adjustment explicitly in the next subsection. Costly mobility implies that the "effective labor force" ($L_{i,t}$) and "effective stock of capital" ($K_{i,t}$) -- the pools of labor and capital in each sector that are available to be employed at that time -- may be smaller than the total supply of the factors: $L_t = L_{1t} + L_{2t} \leq L_\infty$, and $K_t = K_{1t} + K_{2t} \leq K_\infty$.

To allow for transitory changes in productive capital within each sector, as are caused by aggregate shocks, we further distinguish between the effective supply of capital and the amount that is productive at any time ($\tilde{K}_{i,t}$) where $\tilde{K}_{i,t} \leq K_{i,t}$. In the long run, all capital will be productive, and the two will be equal. In the short run, however, fluctuations in the return to capital may lower the amount of productive capital relative to its effective supply.

We start in an initial steady state at time $t=-\infty$, and examine the response of capital, labor, employment and vacancies to a one-time shock at $t = 0$, and their transition paths to the new steady state at time $t=\infty$. Denote $K_{i,-\infty}$ as the initial amount of capital in sector i (= $\tilde{K}_{i,-\infty}$ assuming the economy was in steady state), $K_{i,0}$ and $\tilde{K}_{i,0}$ as the effective supply of capital and stock of productive capital immediately following a shock, and $K_{i,\infty}$ ($=\tilde{K}_{i,\infty}$) as the new steady state stock. We define similar measures for the effective labor force.

These constructs lend themselves to straightforward definitions of aggregate and reallocation shocks. An adverse aggregate shock ($c>0$) is defined as a shock that lowers the productivity of capital in both sectors, and a reallocation shock (s>0) is defined as a shock that lowers the marginal productivity of capital in sector 1 relative to sector 2.[8] Then:

(1a)	Effective Supplies of Capital and Labor	$K_{1,0} = K_{1,-\infty} - s;\quad K_{2,0} = K_{2,-\infty}$ $L_{1,0} = L_{1,-\infty} - s;\quad L_{2,0} = L_{2,-\infty}$
(1b)	Stock of Productive Capital	$\tilde{K}_{1,0} = K_{1,0} - c;\quad \tilde{K}_{2,0} = K_{2,0} - c$
(1c)	Long Run Distribution of Capital and Labor	$K_{1,\infty} = K_{1,-\infty} - s;\quad K_{2,\infty} = K_{2,-\infty} + s$ $L_{1,\infty} = L_{1,-\infty} - s;\quad L_{2,\infty} = L_{2,-\infty} + s$

Firms react to an adverse aggregate shock by lowering the utilization of capital and laying off workers. Thus, the initial impact is to make part of the productive stock of capital in each sector unproductive[9] ($\Delta\tilde{K} = \tilde{K}_{1,0}-\tilde{K}_{1,\infty} = -2c$). Since an aggregate shock does not change the long run pattern of production, it has no effect on the effective supplies of capital and labor.

In contrast, the effective supplies of both capital and labor decline after a reallocation shock. Since a reallocation shock permanently raises the value of output in sector 2 relative to sector 1, and since capacity reduction and layoffs are assumed costless, firms in sector 1 immediately shut down capacity and labor is displaced ($\Delta K = K_0-K_{-\infty} = -s$, and $\Delta L = L_0-L_{-\infty} = -s$). The stock of productive capital in sector 1 falls correspondingly ($\Delta\tilde{K}_1 = -s$). The stocks of capital and labor in sector 2 rise only gradually

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[8]Reallocation shocks are modelled asymmetrically in the interest of simplicity: s is assumed nonnegative, so that a reallocation shock raises the marginal productivity of capital in sector 2 relative to sector 1. Reallocation shocks in the opposite direction can be incorporated easily by making equation (2) symmetric.

[9]The specification in equation (1) assumes that the effect of aggregate shocks is of the same magnitude in both sectors. We introduce a more general specification in section I.4. Abraham and Katz (1986) stress the practical importance of allowing for differential aggregate sensitivities.

to offset the decrease in sector 1, however, since mobility across sectors takes time.

Both aggregate and reallocation shocks initially raise unemployment, as workers in jobs that have become unproductive are laid off. We assume that the change in unemployment is proportional to the loss in potentially productive jobs, by a factor ϕ: $\Delta U = -\phi\Delta\tilde{K} = \phi(2c+s)$, where $U_t = L_\infty - E_t$.

We assume there are frictions in the matching of workers to jobs within sectors, but that the cost to posting vacancies is negligible, so that there are vacancies in equilibrium, $V_{i,t} = \tilde{K}_{i,t} - E_{i,t}$, even in the presence of unemployment. Thus, both types of shocks cause an initial drop in the level of vacancies that is proportional to the decline in productive capital, since job mobility and matching are not instantaneous: $\Delta V = \Delta\tilde{K} - \Delta E = -(1-\phi)(2c+s)$.

I.2. Dynamics

Although the initial impact of reallocation and aggregate shocks on unemployment and vacancies are the same, the paths of both variables in response to the two shocks will depend on the relative rates of labor and capital mobility. To simplify the derivations, we express the movement of capital and labor as linear flow equations.[10] These equations can be interpreted as reduced forms for investment and mobility decisions based on anticipated sectoral returns. The linearity would be exact for quadratic adjustment costs. The equations for resource mobility are then:

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[10] If the arrival of shocks were assumed continuous, the inter-sectoral mobility decision could not be expressed as a linear flow equation. An additional term would be necessary to account for the option value of remaining in the original sector.

(2a) Intrasectoral Mobility $\dot{\tilde{K}}_{i,t} = \lambda_c(K_{i,t} - \bar{K}_{i,t})$

(2b) Intersectoral Mobility Capital $\dot{K}_{2,t} = \lambda_s(K_{2,\infty} - K_{2,t})$

Labor $\dot{L}_{2,t} = \lambda_u(L_{2,\infty} - L_{2,t})$

where λ_c, λ_s, and λ_u are constant speeds of adjustment. The rate at which unproductive capital becomes productive, λ_c, is the same in both sectors, and is distinct from the rates of labor reallocation, λ_u, and of capital reallocation across sectors, λ_s.

To complete the dynamics, we specify the process for employment creation in each sector. Employment growth is the sum of two parts: a flow of new matches, which is an increasing function of the number of vacant jobs and the number of unemployed workers in each sector; and an exogenous separation rate. Assuming a linear, constant returns to scale matching function yields a flow equation for sector i employment growth:[11]

(3) $\dot{E}_{i,t} = -\delta E_{i,t} + \omega[V_{i,t} + U_{i,t}]$

where ω is the matching rate.

Equations (2) and (3) can be solved for steady state employment in each sector:

(4) $E_{i,\infty} = \omega(K_{i,\infty} + L_{i,\infty})/(\delta+2\omega)$

Employment in each sector depends positively on the effective supplies of capital and labor in the sector. Total employment will depend only on the aggregate stock of capital and labor, independent of its distribution across sectors, however, since employment is linear in capital and labor. This, in

[11]Because there are workers in transition between sectors, the unemployment rates in each sector, $U_{i,t} = L_{i,t}-E_{i,t}$, do not sum to total unemployment.

turn, implies that the steady state level of unemployment and vacancies will be independent of the distribution of resources between sectors.

I.3 Solution

The flow equations for employment, capital and labor can be solved as a system with four eigenvalues, all of which are stable. The solution is given by:

$$(7a)\quad K_t = -2ce^{-\lambda ct} - se^{-\lambda st} + K_\infty$$

$$(7b)\quad L_t = -se^{-\lambda ut} + L_\infty$$

$$(7c)\quad U_t = 2c[\phi e^{-(\delta+2\omega)t} + \omega\mu_{c,t}] + s[\phi e^{-(\delta+2\omega)t} + \omega\mu_{s,t} + \omega\mu_{u,t}] + U_\infty$$

$$(7d)\quad V_t = 2c[(\phi-1)e^{-(\delta+2\omega)t} + (\lambda_c-\delta-\omega)\mu_{c,t}] + s[(\phi-1)e^{-(\delta+2\omega)t} + (\lambda_s-\delta-\omega)\mu_{s,t} + \mu_{u,t}] + V_\infty$$

where

$$\mu_{i,t} = \frac{e^{-(\delta+2\omega)t} - e^{-\lambda it}}{\lambda_i-(\delta+2\omega)} \quad \begin{matrix} > 0 & 0 < t < \infty \\ = 0 & t = 0,\ t = \infty \end{matrix}$$

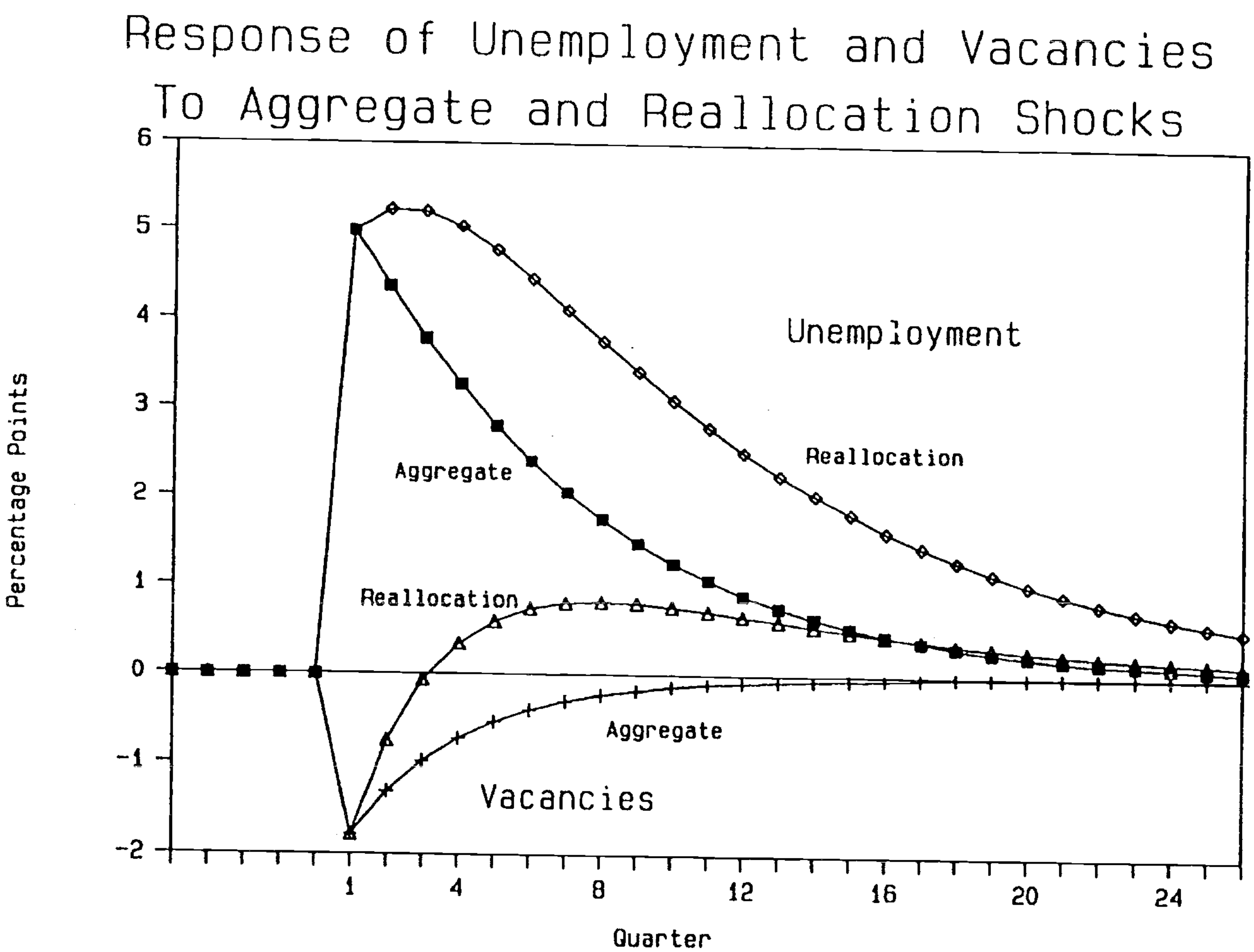
for i = c,s,u.

Equations (7a) and (7b) describe the paths of capital and labor following both types of shocks. Capital adjusts to reallocation shocks and aggregate shocks at different rates, while labor responds only to reallocation shocks.

Equation (7c) gives aggregate unemployment. Unemployment along the transition path lies above its steady state level following both types of shocks because matching is not instantaneous (the terms multiplying ϕ), and because the slow adjustment of capital delays job creation ($\mu_{c,t}$ and $\mu_{s,t}$). There is an additional increase in unemployment following a reallocation shock ($\mu_{u,t}$) caused by the slow reallocation of labor between sectors.

Equation (7d) is the path of aggregate vacancies. Movements of vacancies have three components. First, the initial reduction in vacancies is offset

Figure 1


Response of Unemployment and Vacancies
To Aggregate and Reallocation Shocks
Percentage Points
6
5
4
3
2
1
0
-1
-2
1
4
8
12
16
20
24
Quarter
Unemployment
Reallocation
Aggregate
Reallocation
Aggregate
Vacancies

only gradually for both types of shocks, due to frictions in matching (the terms multiplying ϕ). Second, there is an ambiguous effect on vacancies from slow capital mobility, depending on whether the flow of new jobs (λ_c and λ_s) is greater than or less than the net flow of workers out of employment ($\delta+\omega$). Third, slow labor mobility across sectors in response to a reallocation shock slows the filling of vacancies in expanding sectors (the $\mu_{u,t}$ term).

To demonstrate the various effects, Figure 1 shows the response of unemployment and vacancies to typical aggregate and reallocation shocks.[12] The shocks are scaled to generate the same initial increase in unemployment (five percentage points) in both cases.

Three aspects of Figure 1 are worth noting. First, vacancies are higher after reallocation shocks than after aggregate shocks. Following their initial fall in response to a reallocation shock, vacancies actually increase relative to their steady state value, while they remain low all along the transition path following an aggregate shock. Although this pattern does not hold for all parameter values, it becomes more pronounced as mobility across sectors becomes more costly.[13]

Second, the response of unemployment to a reallocation shock is more persistent than to an aggregate shock. The greater persistence of

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[12] The exogenous separation rate (δ) is set at 2.5 percent per quarter, and the matching rate (ω) is chosen to achieve a steady state unemployment rate of 5 percentage points. The share of lost jobs resulting in unemployment (ϕ) is set at 0.75. Intra-sectoral capital movement is assumed to have a half life of 4 quarters, while the half lives of inter-sectoral capital and labor movement are asumed equal at 6 quarters.

[13] Hosios (1987) shows that the response of aggregate vacancies to a reallocation shock depends on the degree of capital mobility.

reallocation-induced unemployment reflects slower capital adjustment between sectors than within sectors, and the additional effect of slow labor adjustment between sectors.

Lastly, unemployment reacts more strongly to both shocks than do vacancies. Vacancies return to their steady state value rapidly; unemployment, however, remains high for up to 3 or 4 years. This suggests that it may be more difficult to gauge the effect of the different shocks on vacancies than on unemployment.

I.4 Measuring Reallocation Shocks

Now suppose we want to measure the amount of vacancies and unemployment that is caused by reallocation as opposed to aggregate shocks, and the shocks themselves are unobservable. One strategy, first proposed by Lilien (1982), is to use the variance each period of employment growth in different sectors as a measure of reallocation shocks. The dispersion of sectoral 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 potential problems with this measure. The first is the observation made by Abraham and Katz (1986) that the dispersion in net employment growth may rise by as much or more in response to aggregate shocks, if sectors vary in their aggregate sensitivities and trend growth rates. Second, even if the aggregate sensitivities of the two sectors are equal, so that employment dispersion responds only to reallocation shocks, there need be no clear temporal relationship between employment dispersion and unemployment.

To see this, start by allowing for different sectoral sensitivities to aggregate shocks, β_i. Solving for sectoral employment yields:

(8a) $$E_{1,t} = -\beta_1 c[\phi e^{-(\delta+2\omega)t} + \omega\mu_{c,t}] + E_{1,\infty}$$

(8b) $$E_{2,t} = -\beta_2 c[\phi e^{-(\delta+2\omega)t} + \omega\mu_{c,t}] - s[\phi e^{-(\delta+2\omega)t} + \omega(\mu_{s,t} + \mu_{u,t})] + E_{2,\infty}$$

The variance of employment growth rates, which we term employment dispersion (ED_t), is given by:

(9) $$ED_t = \Sigma\{(\dot{E}_{i,t} - \dot{E}_t/2)^2\}$$

$$= (1/2)\{(\beta_1-\beta_2)c[\phi(\delta+2\omega)e^{-(\delta+2\omega)t} + \omega T_{ct}] - s[\phi(\delta+2\omega)e^{-(\delta+2\omega)t} + \omega(T_{st}+T_{ut})]\}^2$$

where

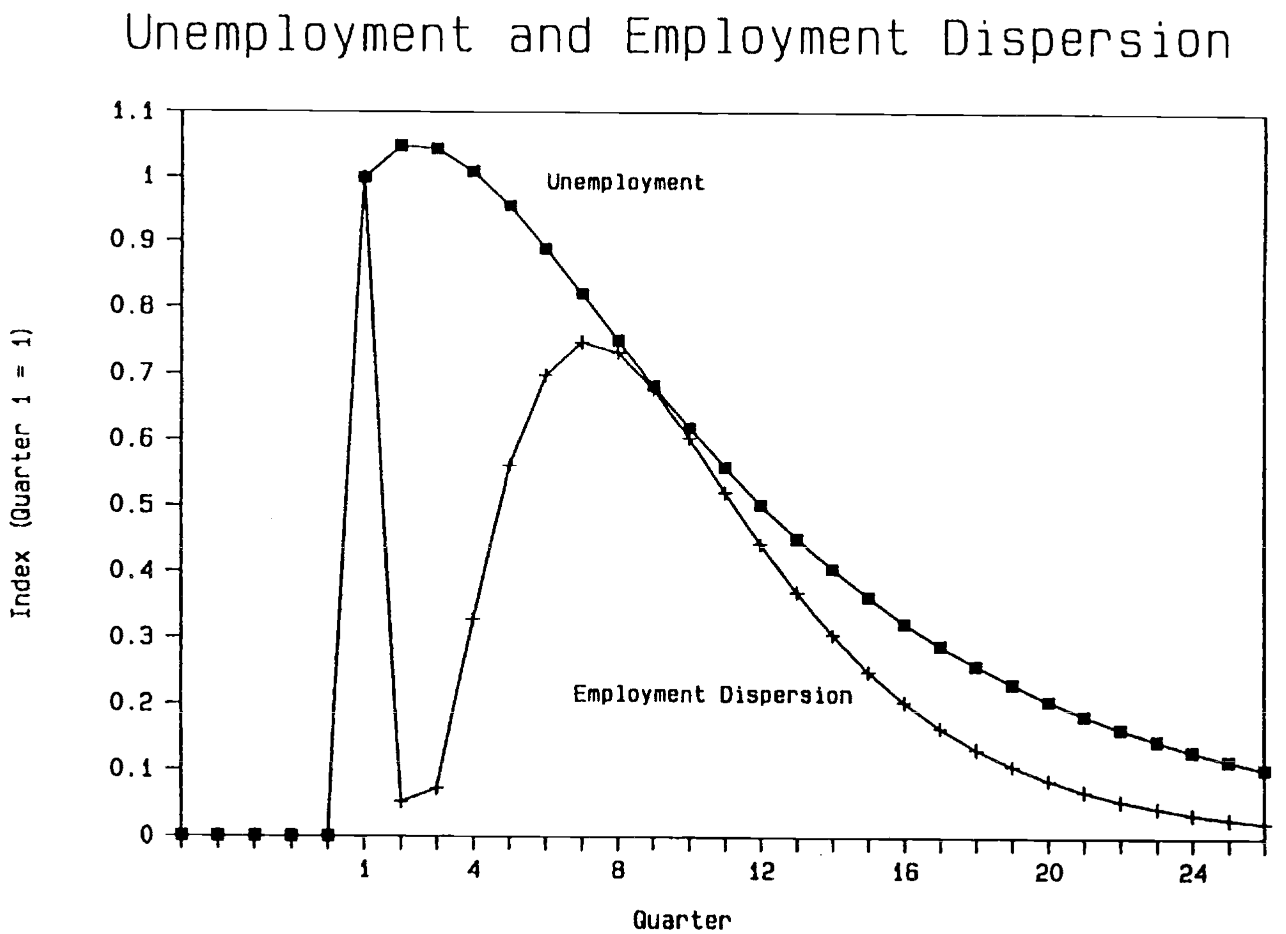
$$T_{i,t} = \frac{(\delta+2\omega)e^{-(\delta+2\omega)t} - \lambda_i e^{-\lambda_i t}}{\lambda_i-(\delta+2\omega)} \qquad \begin{array}{ll} = 0 & t = \infty \\ = -1 & t = 0 \end{array}$$

for i = c,s,u.

The first term in equation (9) reflects the response of employment dispersion to an aggregate shock. If aggregate sensititives differ ($\beta_1 \neq \beta_2$), employment dispersion will respond to both aggregate and reallocation shocks, with the relative size of the two components indeterminate. Although in theory it is possible to allow for different aggregate sensitivities before forming employment dispersion, in practice there is little theoretical basis for estimating β_1 and β_2.

Even if the aggregate sensitivities of the sectors are equal, so that employment dispersion responds solely to reallocation shocks, there is no clear, predictive relationship between the level of employment dispersion and unemployment and vacancies. This point is clear from Figure 2, which shows the paths of employment dispersion and unemployment for a typical reallocation shock for the case $\beta_1=\beta_2$. The series are normalized to unity in the first period.

Figure 2



Unemployment and Employment Dispersion
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Index (Quarter 1 = 1)
Unemployment
Employment Dispersion
1
4
8
12
16
20
24
Quarter

Both series display complicated dynamics. Employment dispersion is high initially, reflecting rapid initial growth in employment in sector 1 caused by the large increase in unemployment there. As labor and capital begin to move across sectors, employment growth rises in sector 2, reducing the rate of employment dispersion. As this continues, employment growth in sector 2 surpasses the rate in sector 1, leading to the second peak in employment dispersion. Employment dispersion does not begin a sustained decline until nearly two years out. The disparate patterns followed by employment dispersion and unemployment suggest the difficulty in using employment dispersion as a shock variable. Indeed, in the illustrated case, high unemployment more accurately predicts high employment dispersion than the reverse.[14]

A more promising approach to isolating reallocation shocks would be to measure the dispersion in the returns to human capital across sectors. Since such returns are unobservable,[15] the model above suggests a natural alternative: the dispersion in returns to physical capital. The model predicts that a reallocation shock shows up immediately in an increase in the sectoral dispersion of returns to capital, signalling the value of reallocating capital from sector 1 to sector 2. In contrast, an aggregate shock leaves the intersectoral pattern of returns to capital largely

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[14] The empirical results in Lilien (1989) suggesting that Granger causality between unemployment and employment dispersion runs in both directions are consistent with this finding. We find similar results in bivariate systems of unemployment and employment dispersion, although the inclusion of other variables reduces the statistical significance of these results.

[15] Average wages primarily reflect the average marginal product of the employed, and thus may not correspond to the marginal returns to human capital investment among the unemployed.

unaffected, the more so the more transitory is the expected duration of the shock.

The stock market is thus a natural place to look for evidence of a reallocation shock, since stock market returns reflect changes in the present discounted value of capital returns. A measure based on stock market returns has two advantages. The first advantage is that stock prices move immediately and only once in response to new information about capital returns, given efficient markets. This yields a clear, predictive relationship: movements in stock prices unambiguously precede changes in unemployment and vacancies. Second, the capital asset pricing model (CAPM) provides a firm theoretical basis for separating aggregate and idiosyncratic movements in stock returns.

To see these points, start by defining the value of firms in each sector. Assuming a constant wage share,[16] the stock market value of the capital in sector i is:

(10) $$P_{i,0} = \int_0^\infty (1-w)e^{-rs} E_{i,s}\, ds,$$

where r is the real interest rate. The arrival of a shock causes a jump in the value of capital in both sectors. Integrating the equations for employment growth in each sector yields:

(11a) $$dP_{1,0} = (1-w)\{(\frac{-\beta_1 c}{r+\delta+2\omega})[\phi + \frac{\omega}{\lambda_c+r}] - s\phi/r\}$$

(11b) $$dP_{2,0} = (1-w)\{(\frac{-\beta_2 c}{r+\delta+2\omega})[\phi + \frac{\omega}{\lambda_c+r}] - (\frac{s}{r+\delta+2\omega})[\phi + \frac{\omega}{\lambda_s+r} + \frac{\omega}{\lambda_u+r}] + s\phi/r\}$$

The variance of price changes, which we term cross section volatility, is:

[16] Since total employment does not change across steady states, it is natural to assume that the rent sharing rule does not either.

$$(12)\quad CSV_0 = \Sigma\{(dP_{1,0} - dP_0/2)^2\}$$

$$= (1/2)\left(\frac{1-w}{r+\delta+2\omega}\right)^2\{-(\beta_1-\beta_2)c[\phi + \frac{\omega}{\lambda_c+r}] + s[\phi + \frac{\omega}{\lambda_s+r} + \frac{\omega}{\lambda_u+r}] - 2s\phi/r\}^2$$

From (12), it is clear that the arrival of a reallocation shock is reflected in an immediate and one-time jump in cross section volatility, in contrast with the complicated and protracted response of employment dispersion. The jump is greater the greater are the magnitude of the shock (s,c) and the rate of matching (ω), and the lower are intersectoral mobility and the discount rate.

Even when the sectors differ substantially in their aggregate sensitivities, however, the CAPM provides a natural way to control for aggregate effects in stock prices, by controlling for stock price movements that are perfectly correlated across sectors. In effect, the CAPM provides a theoretical basis for estimating β_1 and β_2.

For these reasons, a measure of the dispersion in sectoral excess returns should provide a good measure of reallocation shocks. In the next section, we move to the construction of this series.

II. Data and Methodology

We construct the cross section volatility series using industry data on stock market excess returns.[17] Excess returns for each industry through time, ϵ_{jt}, are formed as the residual from the market model:[18]

$$R_{jt} = \beta_{0,j} + \beta_{1,j}R_{mt} + \epsilon_{jt} \tag{13}$$

where R_{mt} is the return on the market portfolio at time t (the Standard and Poors Composite Index), and R_{jt} is industry j's return at time t.[19] Cross section volatility is then formed as the weighted variance of industry excess returns:

$$CSV_t = \sum_{i=1}^{n_t} w_{it}(\epsilon_{it}-\bar{\epsilon}_t)^2 \tag{14}$$

where the weight for industry i is its share in total employment, $w_{it} = E_{it}/E_t$, and n_t is the number of industries with both employment and return data.[20] Employment weights adjust for the magnitude of the effect of changes in an industry's returns on aggregate employment.

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[17] In this paper we focus on specificities at the industry and firm levels. In future research we will investigate alternative sources of specificity, such as geographical and occupational attachments.

[18] We also formed the cross section volatility series using multifactor models of stock prices, which would be appropriate if there are 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 .97 in both cases.

[19] Industry returns are formed by matching S&P industry indices to conventional two-digit SIC codes, yielding excess returns for 42 two-digit SIC industries. When more than one S&P classification is included in a single two-digit SIC code, we average their returns to form the industry return.

[20] The number of industries in the sample ranges from 28 to 42.

In addition to the measure in equation (14), we also 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 two series perform similarly in all the equations we estimate, we report results only for the industry series.

The industry cross section volatility series is shown in Figure 3, and presented in the Appendix. Summary statistics are in the first row of Table 1. The mean of the series is 45 percentage points, with a standard deviation of 29 percentage points. The first order autocorrelation is 0.43, although subsequent autocorrelations are much lower. Cross section volatility is positively contemporaneously correlated with unemployment, and less so with vacancies.

As Figure 3 shows, cross section volatility is particularly high in the late 1960's, in the mid and late 1970's, and in the early 1980's. The peak of the series is in the fourth 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 US embassy in Teheran was seized and Iran suspended oil exports to the United States. Although oil prices had been increasing before both of these quarters, the increase in cross section volatility in these quarters reflects a substantial deepening of the oil crisis.

At the peaks of cross section volatility in the 1970's, the industries with the largest excess returns are roughly similar. In both 1973-4 and 1979, petroleum, oil and gas, and other mining industries had large positive excess returns. The tire/rubber, housebuilding, and air transportation industries fared particularly poorly. In the peaks of the early 1980's, the

Figure 3

Cross Section Volatility (1948-87)

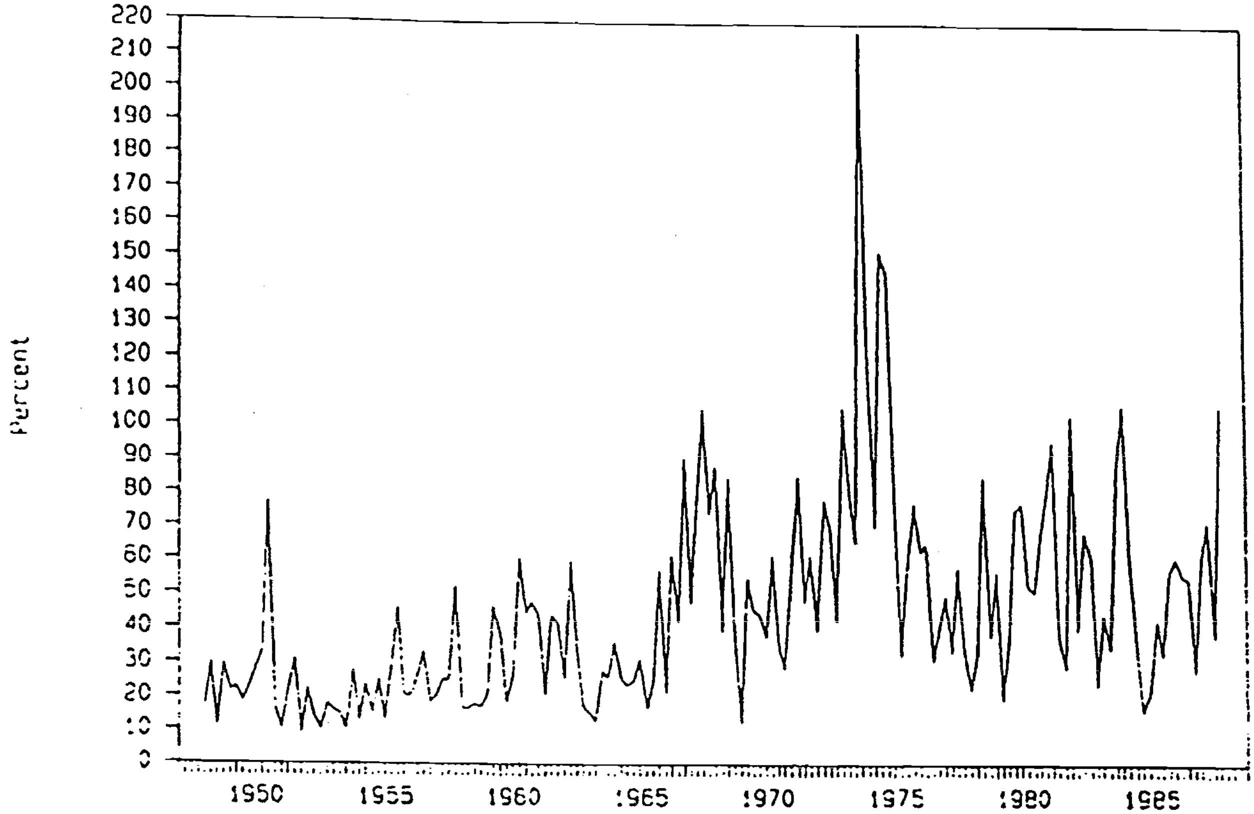

Table 1: Characteristics of Data

A. Univariate Statistics

Series	Mean	Standard Deviation	Autocorrelations ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6
CSV	45.2	28.7	.427	.324	.400	.281	.261	.159
ED	1.9	1.3	.605	.368	.292	.304	.263	.200
POIL	0.5	0.2	.988	.965	.940	.913	.886	.859
U	5.0	2.4	.982	.949	.910	.869	.833	.804
V	2.1	0.2	.937	.802	.623	.431	.260	.126

B. Cross Correlations

	CSV	ED	POIL	U	V
CSV	1.000				
ED	-.239	1.000			
POIL	.158	-.158	1.000		
U	.214	-.231	.824	1.000	
V	.098	-.156	-.353	-.582	1.000

Note: Data are quarterly from 1948-1987. Variables are defined in text.

dominant industries are less uniform. 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 are not precisely associated with large returns in the industries commonly thought to be large contributors to reallocation unemployment, such as steel production and transportation equipment, changes in the returns in these industries support the pattern in cross section volatility. The transportation equipment industry was marked by large positive returns in the quarter preceding the 1967 peak, and it 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.

One potential weakness of the cross section volatility measure is that it may reflect changes in firms' leverage ratios. A firm's returns 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)). We examined the sensitivity of the firm cross section volatility series to leverage effects by weighting the firms' excess returns by the inverse of their debt-equity ratios, using annual prices and debt-equity ratios from COMPUSTAT. The leverage-adjusted series and the unadjusted series did not differ materially.

Since there is no long time-series data on industry debt-equity ratios, we were unable to control for leverage in the industry series in the same way. Instead, we correct for leverage by taking the residuals from a regression of cross section volatility on the three-year return on the market.[21] The market return should be inversely related to the leverage ratio since equities comprise a larger proportion of the value of total assets when the market return is high. Although imperfect as a correction for leverage, this adjustment has the advantage that it corrects for correlation between unemployment and market volatility.

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. Such a correlation would result, for example, if the bargaining power of firms increases 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. Excess employment changes, ξ_{jt}, are formed analogously to the excess stock returns:[22]

$$(15) \qquad \Delta E_{j,t} = \gamma_{0,j} + \gamma_{1,j}\Delta E_t + \xi_{j,t}.$$

We take the estimated residuals, $\hat{\xi}_{jt}$, and estimate equations of the form:

$$(16) \qquad \sum_{i=1}^{q} \hat{\xi}_{j,t+i-1} = \delta_{0,t} + \delta_{1,t}\hat{\epsilon}_{j,t} + \upsilon_t.$$

for employment changes (q) of one quarter and annually up to five years.

The results are shown in Table 2. The first column of the table reports estimates of equation (16). The estimated coefficients indicate that market

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[21] We then add a constant to equate the mean of the adjusted residuals to that of the original series. We experimented with 1, 3, and 5 year returns, and concluded they are not significantly different.

[22] The employment dispersion series includes the same 42 two-digit industries used in forming cross section volatility.

Table 2: Employment Changes and Returns

Quarters (q)	Equation (1) δ_1	R^2	Equation (2) δ_1	δ_2	R^2	N
1	0.0109 (0.0028)	.003	-0.002 (0.004)	0.318 (0.077)	.006	5121
4	0.0443 (0.0083)	.010	0.027 (0.011)	0.443 (0.212)	.012	4888
8	0.0586 (0.0132)	.008	0.029 (0.016)	0.791 (0.317)	.010	4597
12	0.0621 (0.0173)	.006	0.024 (0.021)	1.039 (0.480)	.008	4344
16	0.0548 (0.0204)	.003	0.011 (0.024)	1.167 (0.558)	.005	4123
20	0.0596 (0.0232)	.003	0.002 (0.027)	1.456 (0.578)	.005	3915

Note: The table shows regressions of the excess 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:

(1) $$\sum_{i=1}^{q} \hat{\xi}_{j,t+i-1} = \delta_{0,t} + \delta_{1,t}\hat{\epsilon}_{j,t} + \upsilon_t$$

(2) $$\sum_{i=1}^{q} \hat{\xi}_{j,t+i-1} = \delta_{0,t} + (\delta_{1,t} + \delta_{2,t}\left|\sum_{i=0}^{7}\hat{\epsilon}_{j,t-i}\right|)\hat{\epsilon}_{j,t} + \upsilon_t$$

where $\hat{\xi}_{j,t}$ is net excess employment growth in industry j in quarter t and $\hat{\epsilon}_{j,t}$ 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 multi-period regressions are corrected for moving average residuals, using the procedure in Newey and West (1987).

returns significantly predict employment changes, although the estimated effect is small. An industry with a ten percent excess return is predicted to have additional employment growth of roughly 0.6 percentage points after two years. There is no incremental effect beyond three years, although the initial effect is persistent.

The second set of columns examines whether the effect of the excess return, $\delta_{1,t}$, varies with the magnitude and consistency of past excess returns. The estimates derive from a modified version of equation (16):

$$(16') \qquad \sum_{i=1}^{q} \hat{\xi}_{j,t+i-1} = \delta_{0,t} + [\delta_{1,t} + \delta_{2,t}|\sum_{i=0}^{7}\hat{\epsilon}_{j,t}|]\hat{\epsilon}_{j,t} + \upsilon_t .$$

If the predictive power of the excess returns for subsequent employment changes is independent of the path of past excess returns, the coefficient on $\delta_{1,t}$ should be unchanged and that on $\delta_{2,t}$ should be small. If the effect is instead proportional to the past accumulation of similar shocks, however, the coefficient on $\delta_{2,t}$ should be more important. The estimated values for $\delta_{1,t}$ and $\delta_{2,t}$, reported in Table 2, indicate that the consistency of the excess returns is an important factor in the predictive relationship. The coefficients on $\delta_{2,t}$ are positive and statistically significant at all horizons; the coefficients on $\delta_{1,t}$ are generally small and statistically insignificant. The results confirm the usefulness of excess returns as predictors of employment flows. They also suggest that it will be important to allow for lags of the return variances to affect current unemployment, in addition to the contemporaneous values.

We also form an employment dispersion series along the lines proposed by Lilien (1982b) to examine its relationship to the cross section volatility series. The specification we report in Section III is the employment-weighted variance of the industry-specific changes in employment from equation (15):

$$(17) \quad ED_t = \sum_{i=1}^{n_t} w_{it}(\xi_{it}-\bar{\xi}_t)^2$$

Summary statistics for employment dispersion are given in the second row of Table 1. The mean is 2 percentage points per quarter, and the first order serial correlation is much higher than cross section volatility. Suggestive of the empirical results reported below, employment dispersion is negatively contemporaneously related to the level of unemployment and vacancies.[23]

The empirical tests on unemployment and vacancies use US quarterly data from 1948-1987. The unemployment rate is the rate for the total 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 (1989a and b).[24]

To isolate the effects of reallocation, we also include various controls for cyclical activity in our regressions.[25] The first control is the

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

[24] We begin with the quarterly index of help wanted advertising, scaled by non-agricultural 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 1987. 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 used by Abraham in the construction of the adjustment factor.

[25] We experimented with various measures of government spending. These variables generally appeared with the "incorrect" sign, suggesting an endogeneity problem, although the inclusion of federal spending did increase the explanatory power of government cross section volatility. Since we were unable to find good instruments for government spending, we do not present these results.

change in of the money supply (DM). We report results using the growth rate of the monetary base as the monetary measure, but the results are robust to alternative measures.

We also include the relative price of oil (POIL), because of the considerable evidence linking this variable to aggregate economic activity in the postwar period.[26] Since movements in cross section volatility are strongly associated with the oil price increases in the 1970's, the inclusion of the relative price of oil is important in determining whether cross section volatility has any independent explanatory power. Statistics on the relative price of oil are shown in the third row of Table 1; shocks to the relative price of oil are highly persistent.

III. Testing Reallocation

In this section, we present empirical findings on the relationship between cross section volatility, unemployment and vacancies. We find that cross section volatility is a reallocation variable. Increases in cross section volatility shift the Beveridge curve outward, although the response is almost entirely in unemployment, rather than in both unemployment and vacancies. Employment dispersion, in contrast, has opposite effects on unemployment and vacancies, suggesting that it principally reflects aggregate shocks.

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[26] The importance of oil price shocks in aggregate activity is discussed in Hamilton (1983) and Loungani (1986).

III.1 The Response of Unemployment

We begin by presenting equations relating unemployment by itself to cross section volatility and the other shock variables. This is both to permit comparison with earlier research, and because these tests in themselves are quite suggestive. The estimated unemployment equations include contemporaneous and lagged values of the independent variables, to allow for long run responses to the shocks. Since the correct specification of the unemployment equation is an open issue, we estimate several variants.

The first specification is for the level of unemployment. Since the residuals from this equation are serially correlated, we estimate consistent standard errors using the procedure in Newey and West (1987).[27] The second specification is an autoregression for unemployment, including 4 quarters of lagged unemployment along with the independent variables. This form of the equation is close to that preferred by Lilien (1982a). While these two equations are appropriate if the unemployment rate is stationary in levels, they are not appropriate if it is a random walk.[28] Accordingly, the third specification is for the difference in unemployment, including 4 quarters of lagged differences in unemployment. The three equations are as follows:

(18a) Level $$U_t = \beta_0 + \sum_{i=0}^{15} \beta_{1,i} CSV_{t-i} + \epsilon_t$$

(18b) Lag $$U_t = \beta_0 + \sum_{i=0}^{7} \beta_{1,i} CSV_{t-i} + \sum_{i=1}^{4} \rho_i U_{t-i} + \epsilon_t$$

---

[27] We use eight lags in forming the residual matrix; the results are insensitive to the number of lags.

[28] Blanchard and Diamond (1989a) fail to reject the hypothesis that monthly unemployment has a unit root.

(18c) Difference $$\Delta U_t = \beta_0 + \sum_{i=0}^{7} \beta_{1,i} CSV_{t-i} + \sum_{i=1}^{4} \rho_i \Delta U_{t-i} + \epsilon_t$$

We include four years of lagged independent variables in the level specification, but only two years in the lag and difference specifications, since these already control for the propagation of shocks.[29]

Table 3(a) reports the point estimates for regressions with cross section volatility as an independent variable. Each entry is the sum of the coefficients for the four quarters in that year, with the standard error of the sum reported in parentheses. Since the coefficients from different specifications are not directly comparable, Table 3(b) reports the associated impulse response functions for the level of unemployment. We allow cross section volatility to follow an AR(4),[30] and compute the response of unemployment to a one standard deviation shock in the error term of this autoregression.[31]

The first three columns report the results of estimating equations (18a) through (18c). In all three equations, cross section volatility raises the unemployment rate. The impulse response functions rise for 3 to 4 years and then decline. The qualitative response is similar across specifications,

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[29] In the equations with the change in the money supply, we include only three years of monetary growth, to maintain consistency with earlier work. The qualitative results are insensitive to the lag structure employed for the independent variables.

[30] The patterns are similar with different specifications for the decay of the shock, although the effect on unemployment at longer horizons is smaller with fewer lags.

[31] 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.

Table 3: Cross Section Volatility and Unemployment

Equation	(1) Level	(2) Lag	(3) Diff.	(4) Lag	(5) Diff.
	A. Coefficient Estimates				
CSV_{t-1}	.018	.0011	.0006	.0014	.0016
	(.016)	(.0012)	(.0011)	(.0015)	(.0015)
CSV_{t-2}	.019	.0019	.0016	.0016	.0017
	(.013)	(.0012)	(.0012)	(.0015)	(.0016)
$CSV_{t-3,4}$	.055	---	---	---	---
	(.015)				
DM_{t-1}	---	---	---	-0.15	-0.16
				(0.12)	(0.07)
DM_{t-2}	---	---	---	-0.03	-0.04
				(0.09)	(0.09)
DM_{t-3}	---	---	---	0.18	0.16
				(0.08)	(0.08)
Sum of ρ_i	---	.976	.396	.982	.373
		(.011)	(.097)	(.013)	(.116)
F-test: $CSV_i=0$	.001	.192	.133	.052	.035
$\bar{R}^2$	.178	.987	.430	.988	.483
	B. Impulse Response Function for Cross Section Volatility				
Quarter					
4	.188	.092	.092	.102	.126
	(.190)	(.094)	(.097)	(.095)	(.091)
8	.306	.215	.149	.223	.254
	(.198)	(.124)	(.135)	(.131)	(.131)
12	.335	.285	.236	.268	.327
	(.196)	(.138)	(.152)	(.159)	(.164)
16	.573	.272	.244	.264	.352
	(.165)	(.133)	(.165)	(.167)	(.180)
24	.089	.207	.262	.221	.372
	(.017)	(.111)	(.174)	(.172)	(.192)

Note: Data are quarterly from 1948-1987. The coefficients are the sum of the coefficients for the quarters in that year; the standard errors are the standard error of the sum. The specifications are described in the text. For the levels equation, the standard errors are corrected for serial correlation using the procedure in Newey and West (1987), with eight lags in the correction matrix. The impulse response function for the difference specifications are cumulated to give the effect on the level of unemployment. Standard errors for the impulse response functions are based on 1000 simulated impulse response functions, as described in the text.

Table 4: Unemployment Response to Employment Dispersion and Oil Prices

Equation	Employment Dispersion (1) Level	(2) Lag	(3) Diff.	Price of Oil (4) Level	(5) Lag	(6) Diff.
Quarter						
4	.038	.042	.073	.163	.140	.108
	(.189)	(.093)	(.093)	(.101)	(.073)	(.080)
8	.042	.122	.204	.334	.362	.344
	(.185)	(.128)	(.116)	(.112)	(.088)	(.107)
12	-.204	.038	.112	.529	.391	.283
	(.172)	(.132)	(.117)	(.135)	(.073)	(.114)
16	-.442	.032	.123	.418	.374	.249
	(.133)	(.122)	(.117)	(.068)	(.065)	(.124)
20	-.026	.029	.129	.339	.347	.224
	(.008)	(.110)	(.116)	(.023)	(.064)	(.137)
24	-.002	.025	.123	.296	.315	.196
	(.005)	(.102)	(.115)	(.021)	(.062)	(.152)
28	.000	.022	.126	.260	.282	.174
	(.000)	(.097)	(.116)	(.018)	(.059)	(.167)
32	.000	.019	.125	.228	.251	.154
	(.000)	(.094)	(.115)	(.016)	(.056)	(.180)
$\bar{R}^2$	.115	.986	.430	.782	.989	.514

Note: Data are quarterly from 1948-1987. Each column shows the response of unemployment to a one standard deviation shock in the error term in an autoregression for the independent variable. Impulse response functions for the change in unemployment are cumulated to show the effect on the level. Standard errors are based on 1000 simulations.

although the magnitude in the level equation (0.57 percentage points at the peak) is larger than in the other two equations (0.29 to 0.24 percentage points at the peaks). For the level and lag equations, the response is statistically significant for a range of quarters around the peak.

The fourth and fifth columns add money growth to the lag and difference specifications. The coefficients on the growth rate of money are negative in the first year, about zero in the second year, and positive in the third year, suggesting a short duration for money supply shocks. Including money growth increases the explanatory power of cross section volatility in the difference equation, and improves the fit of the equation. The impulse response function is about the same in the lag specification, although the standard errors increase somewhat. Thus, controlling for at least some important aggregate shocks raises the importance of cross section volatility.

Table 4 presents univariate impulse response functions analogous to the first three columns in Table 3(b), with employment dispersion as the independent variable in columns 1-3 and the relative price of oil in columns 4-6. Both variables are assumed to follow an AR(4), and again the impulse is a one standard deviation shock to the error term in each autoregression.

The response to employment dispersion shocks differs substantially across specifications. In the level equation reported in column (1), the response is close to zero for two years, and then becomes significantly negative. In the lag and difference specifications, the response is positive and significant throughout. The magnitude of the response is larger in the difference specification. The timing of the maximum response of unemployment to employment dispersion (8 quarters in the lag specification) is earlier than the corresponding response to cross section volatility (13 quarters).[32]

The estimated response to oil price shocks is large and consistent across specifications. Oil price shocks increase unemployment by 0.3 to 0.5 percentage points at the peak. The effects are long-lasting, in part because of the high serial correlation in the oil price series. Most of the response of unemployment is statistically significant.

To examine the relative importance of each of these shocks, we estimate multivariate analogues of (18). Figure 4 shows the impulse response of unemployment to each of the shocks, based on the multivariate version of the lagged unemployment specification in equation (18b); the results are similar for the other specifications.[33] The multivariate estimates indicate strongly that cross section volatility has a significant effect on unemployment, even controlling for oil price shocks. They also confirm the differences between cross section volatility and employment dispersion.

As shown in Figure 4(a), unemployment rises for 10 quarters in response to a cross section volatility shock, peaking at over 0.2 percentage points, with much of the increase in unemployment statistically significant. While the magnitude of the peak response is about one-third lower than in the univariate equation, controlling for employment dispersion and the relative

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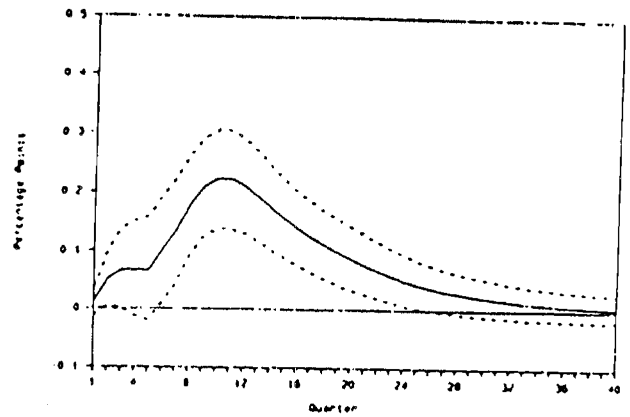
[32] The difference between employment dispersion here and in Lilien (1982a) is due to four factors. First, our data is more disaggregated data than Lilien's. Second, we control for aggregate employment growth in our measure of industry employment changes. Third, our estimates are quarterly, rather than annual. Since large annual variances may be spread more evenly across the quarters, this smooths the measure of employment dispersion. Lastly, Lilien generally includes a time trend while we do not.

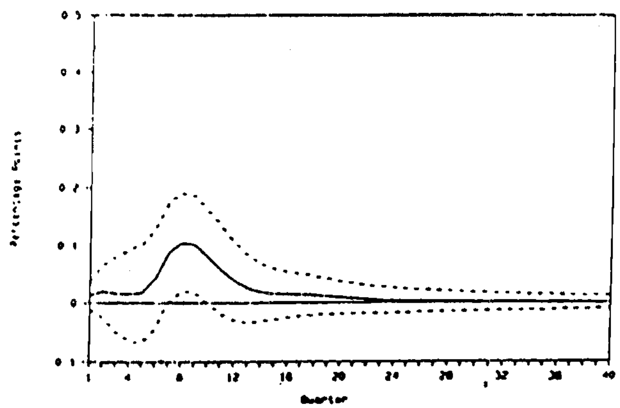
[33] We estimated these equations with and without controls for money growth. The differences are similar to those in Table 3, so we do not report them.

Figure 4

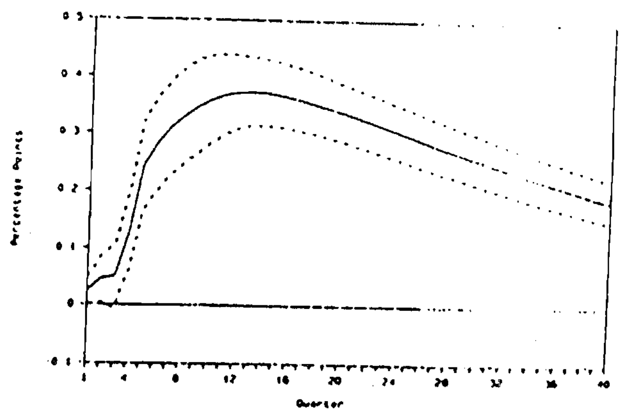
(a) Cross Section Volatility



(b) Employment Dispersion



(c) Price of Oil



Note: Figure shows impulse response functions for unemployment generated from:

$$U_t = \beta_0 + \sum_{i=0}^{7}\beta_{1,i}CSV_{t-i} + \sum_{i=0}^{7}\beta_{2,i}ED_{t-i} + \sum_{i=0}^{7}\beta_{3,i}POIL_{t-i} + \sum_{i=1}^{4}\rho_i U_{t-i} + \epsilon_t.$$

Each independent variable is assumed to follow an AR(4). The dashed lines are one standard error bands, calculated from 1000 simulated impulse response functions. The simulations assume the estimated coefficients and variance-covariance matrix are the true parameters.

price of oil increases the statistical significance of the response. Almost all of the difference in magnitude is due to the control for oil prices; the control for employment dispersion has little effect by itself on the response to cross section volatility. The peak response of unemployment (10 quarters) is also earlier than in the univariate equation (13 quarters).

The impulse response function for employment dispersion is essentially unchanged from the univariate estimate. Unemployment responds positively to increases in employment dispersion, but the coefficients are small in magnitude and statistically insignificant. The finding that the joint inclusion of cross section volatility and employment dispersion does not change the coefficients on either variable suggests that the two variables measure different shocks.

The response to an oil price shock is virtually unaffected by the inclusion of the other two shock variables. The response is large, long-lasting, and significant over most of the horizon.

III.2 Tests of Vacancies and Unemployment

The finding that unemployment responds positively to cross section volatility is suggestive, but not in it itself conclusive, since both aggregate and reallocation shocks raise unemployment. We thus turn to estimates of the Beveridge curve to distinguish between the shocks.[34] The theoretical results in Section I suggest that job vacancies fall in response

[34] See Abraham and Medoff (1982), Abraham (1987), and Medoff (1983) for evidence that the US Beveridge curve shifted out in the 1970's.

to aggregate shocks, while reallocation shocks may increase vacancies over a medium horizon, or have little discernible effect on net.

We first present estimates of static Beveridge curve equations; the vacancy rate is estimated against contemporaneous and lagged values of the three shock variables and the contemporaneous unemployment rate.[35] We use logarithms of vacancies and unemployment to allow for nonlinearities:[36]

$$(19)\quad \ln V_t = \beta_0 + \sum_{i=0}^{15} \beta_{1,i} CSV_{t-i} + \sum_{i=0}^{15} \beta_{2,i} ED_{t-i} + \sum_{i=0}^{15} \beta_{3,i} POIL_{t-i} + \beta_4 \ln U_t + \epsilon_t$$

Table 5 presents the results. The first column presents ordinary least squares estimates. The coefficients on cross section volatility are positive and significant, implying that it shifts the Beveridge curve outwards, even after controlling for oil price shocks. The relationship is especially strong at longer lags.

The coefficients on employment dispersion are negative at all horizons and significantly so for the first two years. This finding suggests that employment dispersion reflects primarily aggregate rather than reallocation disturbances, and indeed reflects disturbances that are not fully captured by the unemployment rate. Finally, none of the coefficients on the relative price of oil are statistically significant, suggesting that it reflects shocks that are fully captured in the aggregate unemployment-vacancy relation.

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[35]Since the residuals from the Beveridge curve are serially correlated, we estimate and report consistent standard errors using the Newey-West correction described above.

[36]Pissarides (1985) discusses in more detail the appropriate specification of the Beveridge curve equation.

Table 5: Beveridge Curves

Dependent Variable: $\ln(V_t)$

	(1)	(2)
CSV_{t-1}	.0009	.0008
	(.0005)	(.0007)
CSV_{t-2}	.0000	.0000
	(.0003)	(.0003)
$CSV_{t-3,4}$	.0017	.0015
	(.0005)	(.0013)
ED_{t-1}	-.063	-.063
	(.014)	(.018)
ED_{t-2}	-.044	-.045
	(.013)	(.014)
$ED_{t-3,4}$	-.013	-.011
	(.009)	(.017)
$POIL_{t-1}$	.089	.074
	(.124)	(.181)
$POIL_{t-2}$	.092	.083
	(.183)	(.186)
$POIL_{t-3,4}$	-.010	-.018
	(.115)	(.138)
$\ln(U_t)$	-.270	-.249
	(.040)	(.163)
$\bar{R}^2$	.729	---

Note: Equations use quarterly data from 1948-1987. The first column reports ordinary least squares estimates. The second column instruments for the unemployment rate with the return on the market over the past three years and contemporaneous and lagged money growth. The coefficients are the sum of the coefficients on the quarters in those years. Standard errors are in parentheses, and are estimated consistently using the procedure in Newey and West (1987), with eight lags in the correction matrix.

The coefficients from ordinary least squares are potentially biased if unemployment contemporaneously responds to unexpected shocks to vacancies, perhaps through changes in labor force participation. To correct for this, we estimate the equation instrumenting for the unemployment rate. We select instruments that capture cyclical fluctuations: the return on the market and the growth rate of the money supply. The second column reports these results.

The instrumental variables estimates are similar to those using ordinary least squares. The coefficients on cross section volatility are slightly larger, although the standard errors are larger as well, so that the estimates are no longer statistically significant. The coefficients on employment dispersion and the relative price of oil are also essentially unaffected. The similarity of the two sets of coefficients lends support to the ordinary least squares estimates.

The Beveridge curve estimates establish that vacancies rise in response to a cross section volatility shock, given the level of unemployment. They do not imply that cross section volatility raises the absolute level of vacancies, however, since cross section volatility also increases unemployment, which is negatively related to vacancies. To examine this set of dynamics, we turn to estimates of impulse response functions for a bivariate system of unemployment and vacancies. The equations are:[37]

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[37] This set of equations is similar to a vector autoregression, with two differences. First, we include contemporaneous values of some variables as regressors. Second, we impose restrictions on the shock variables. The restrictions cannot be rejected by the data, except for the exogeneity of the price of oil with respect to unemployment and cross-section volatility. The results from a formal VAR are similar to those reported.

(20)

$$U_t = \alpha_0 + \sum_{i=0}^{7}\alpha_{1,i}CSV_{t-i} + \sum_{i=0}^{7}\alpha_{2,i}ED_{t-i} + \sum_{i=0}^{7}\alpha_{3,i}POIL_{t-i} + \sum_{i=1}^{4}\rho_{1,i}U_{t-i} + \sum_{i=1}^{4}\rho_{2,i}V_{t-i} + \epsilon_{1,t}$$

$$V_t = \beta_0 + \sum_{i=0}^{7}\beta_{1,i}CSV_{t-i} + \sum_{i=0}^{7}\beta_{2,i}ED_{t-i} + \sum_{i=0}^{7}\beta_{3,i}POIL_{t-i} + \sum_{i=1}^{4}\phi_{1,i}U_{t-i} + \sum_{i=1}^{4}\phi_{2,i}V_{t-i} + \epsilon_{2,t}$$

Figure 5 shows the associated impulse response functions, which are computed similarly to those above.[38]

The impulse response functions confirm the interpretations of the Beveridge curve regressions developed above. Shocks to cross section volatility raise unemployment, peaking at just under 0.2 percentage points between 10 and 12 quarters; the response is statistically significant for much of the period. In contrast, the net effect on vacancies of cross section volatility shocks is effectively zero. The impulse response function changes signs, and none of the estimated coefficients are significant. Thus, the outward shift of the Beveridge curve in response to a cross section volatility shock works entirely through an increase in unemployment for a given level of vacancies.

In contrast, shocks to employment dispersion significantly lower vacancies, in addition to raising unemployment. The responses peak after 8 quarters, when unemployment is 0.14 percentage points higher, and vacancies are -0.06 percentage points lower. Both peaks are statistically significant. The negative response of vacancies confirms the interpretation that employment dispersion is driven primarily by aggregate disturbances.

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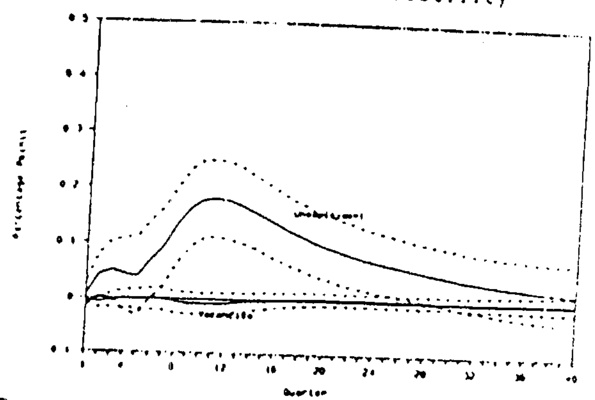
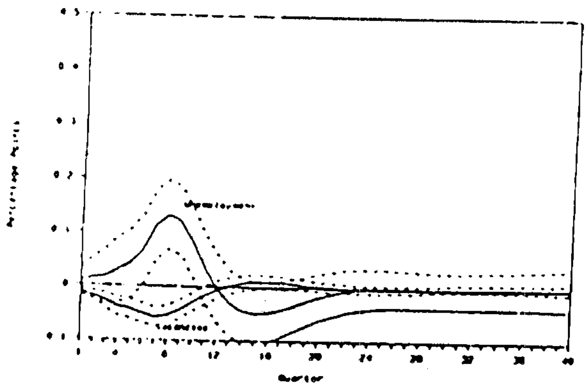
[38]In simulating the standard errors, we assume independence of the parameters across equations.

Figure 5

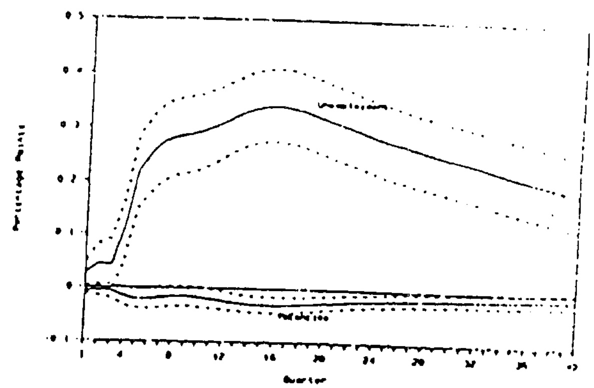
(a) Cross Section Volatility



(b) Employment Dispersion



(c) Price of Oil



Note: Figure shows impulse response functions for unemployment and vacancies generated from

$$U_t = \alpha_0 + \sum_{i=0}^{7}\alpha_{1,i}CSV_{t-i} + \sum_{i=0}^{7}\alpha_{2,i}ED_{t-i} + \sum_{i=0}^{7}\alpha_{3,i}POIL_{t-i} + \sum_{i=1}^{4}\rho_{1,i}U_{t-i} + \sum_{i=1}^{4}\rho_{2,i}V_{t-i} + \epsilon_{1,t}$$

$$V_t = \beta_0 + \sum_{i=0}^{7}\beta_{1,i}CSV_{t-i} + \sum_{i=0}^{7}\beta_{2,i}ED_{t-i} + \sum_{i=0}^{7}\beta_{3,i}POIL_{t-i} + \sum_{i=1}^{4}\phi_{1,i}U_{t-i} + \sum_{i=1}^{4}\phi_{2,i}V_{t-i} + \epsilon_{2,t}$$

Each independent variable is assumed to follow an AR(4). The dashed lines are one standard error bands, calculated from 1000 simulated impulse response functions. The simulations assume the estimated coefficients and variance-covariance matrix are the true parameters.

Shocks to the relative price of oil raise unemployment substantially; they also lower vacancies, although by less than employment dispersion. The response of unemployment rises sharply, to roughly 0.27 percentage points at 8 quarters, then rises more gradually to a peak of nearly 0.35 at 16 quarters, and declines very slowly. Vacancies fall in response to an increase in oil prices, to a low of -0.04 percentage points, although for much of the period the response is not statistically significant. The consistent negative response of vacancies corroborates the finding in Table 5 that oil price shocks move the economy along a Beveridge curve rather than shift the curve out, although the magnitude of the decrease in vacancies is relatively small.

The response to reallocation shocks implied by the coefficients on cross section volatility are strongly supportive of the findings in Blanchard and Diamond (1989a). Their decomposition of unemployment and vacancies (Figure 9, p. 42) suggests that typical reallocation shocks first raise unemployment by about 0.15 percentage points, with only a negligible affect on vacancies, and then raise vacancies slightly (0.05 percentage points), as unemployment declines.[39]

IV. Accounting for Aggregate Fluctuations

Having established that cross section volatility does measure reallocation shocks, in this section we examine the importance of

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[39]Their results suggest a faster response than our impulse response functions, but the findings are qualitatively similar.

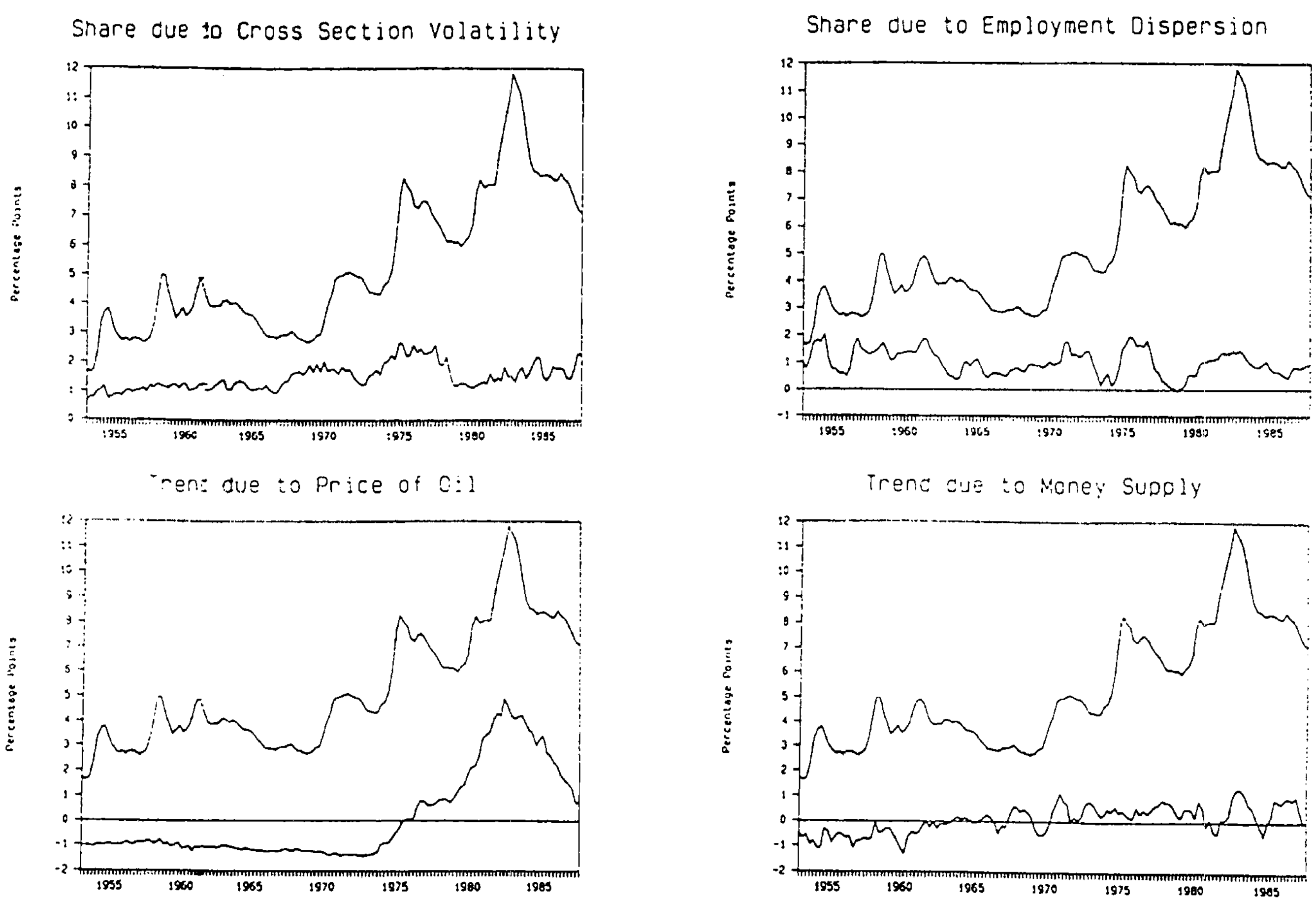
reallocation unemployment in aggregate unemployment. We conclude that on average, reallocation accounts for about 40 percent of unemployment. The reallocation unemployment rate has been fairly stable through time relative to the aggregate unemployment rate, with the exception of episodes such as the late 1960's and mid 1970's, when both the level and share of reallocation unemployment were substantial. Cross section volatility is more important in explaining long duration unemployment than shorter duration unemployment, however, consistent with the hypothesis that unemployment spells associated with intersectoral movement are longer lasting on average than those associated with aggregate fluctuations.

IV.1. Decomposing Movements in Unemployment

Although cross section volatility has a significant effect on unemployment, the magnitude of the response is not large. Very large shocks to cross section volatility would be needed to account for the 2-3 percentage point increases in unemployment that are characteristic of recessions.

Figure 6 decomposes the aggregate unemployment rate into four components: the shares due to cross section volatility and employment dispersion, and the trends due to changes in oil prices and in the money supply. The first two series are formed as the difference between the fitted value of unemployment and the value that would have resulted had the respective shock component been zero throughout the time period. The latter two series are the part of unemployment that is due to deviations of the variables from

Figure 6



Note: The figures show the share of unemployment due to Cross Section Volatility and Employment Dispersion, and the trend of unemployment due to Oil Price changes and Money Supply changes. The decomposition is based on the equation:

$$U_t = \beta_0 + \sum_{i=0}^{15} \beta_{1,i} * CSV_{t-i} + \sum_{i=0}^{15} \beta_{2,i} * ED_{t-i} + \sum_{i=0}^{15} \beta_{3,i} * POIL_{t-i} + \sum_{i=0}^{15} \beta_{4,i} * DM_{t-i} + \epsilon_t$$

The total unemployment rate is the fitted value.

trend.[40] The decomposition uses the level form of the unemployment equation, equation (18a), modified to include all of the independent variables.

For most of the post-war period, the level of reallocation unemployment is relatively stable and moderate in size. The mean rate of reallocation unemployment is 2.0 percentage points, about 38 percent of the mean total rate of 5.3 percentage points. This is consistent with the results using data on unemployed workers in Murphy and Topel (1987) and Loungani and Rogerson (1989). Those papers estimate that roughly 25 percent of unemployment is accounted for by people who switch jobs after an unemployment spell.

The standard deviation of reallocation unemployment is only 0.6 percentage points, however, one quarter of the standard deviation of total unemployment. Even in first differences, the standard deviation of the change in reallocation unemployment is only one-half that of the change in aggregate unemployment. Thus, only a small share of high frequency movements in unemployment can be explained by reallocation shocks.

Although the level of reallocation unemployment has been relatively constant, there have been several periods in which the share of reallocation unemployment has risen considerably. Reallocation unemployment was high in the late 1960's, exceeding 2.5 percentage points by late 1969. The share of reallocation unemployment rose above 80 percent, as the increase in reallocation unemployment preceded total unemployment by nearly two years.

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[40]The residual is the constant unemployment rate associated with the means of the oil price and unexpected money series.

Similarly, in 1975 over 3.4 percentage points of unemployment were attributable to reallocation. Reallocation unemployment started to fall several quarters after aggregate unemployment, so that in late 1976 the share of reallocation exceeded 50 percent. Interestingly, the share of unemployment associated with the direct effect of oil prices was relatively low during this period.

In sharp contrast, the decomposition attributes the 1982 recession almost entirely to the direct effect of oil price shocks - almost 5 percentage points of unemployment throughout 1982 and 1983 are attributed to oil price shocks. Almost none of the 1982 recession is attributed to the reallocation shocks captured by cross section volatility. And while the decomposition suggests a link between falling oil prices in the 1980's and the recovery from the recession, the amount of reallocation unemployment has also increased somewhat (to almost 3 percentage points) even as aggregate unemployment has fallen.

The unemployment attributed to employment dispersion is relatively low, and appears particularly cyclical. Almost all of the recessions in the post-war era are marked by an increase in unemployment associated with employment dispersion shocks, but the size of the increase (about 1.5 percentage points) is independent of the magnitude of the recession. The cyclicality of this series was stressed by Lilien (1982b, 1989).

IV.2. Disaggregation of Unemployment by Duration

The relatively modest size of the estimated unemployment fluctuations caused by reallocation may understate the economic significance of reallocation unemployment, and in particular the associated social costs.

If anecdotal evidence and theory are correct in linking reallocation to long duration unemployment, then layoffs caused by reallocation shocks would be associated with higher social costs than the shorter duration layoffs casued by aggregate fluctuations. In addition, standard monetary and fiscal policy would be ineffective in lessening the social impact, since they target aggregate rather than reallocation disturbances.

The empirical results above provide some evidence for this hypothesis. The lag in the initial response of unemployment is longer for cross section volatility shocks than for either employment dispersion or oil price shocks. Blanchard and Diamond (1989a) also find that reallocation shocks are most significant in explaining medium to long-term movements in unemployment. These findings are not conclusive, however, since long lags in unemployment could be explained equally well by cumulative increases in short average duration unemployment spells, as by a concentrated increase in long average duration spells.

To resolve this issue, we examine differences in unemployment disaggregated by duration. Figure 7 shows the movement in short-term (up to 5 weeks) and long-term (over 26 weeks) unemployment in the postwar period. Since the mid-1970's, long-term unemployment has significantly increased as a share of total unemployment; this trend is noted by Murphy and Topel (1987).[41]

To estimate the relation between the shock variables and the composition of unemployment, we estimate equations similar to equation (18b), with two modifications. First, we disaggregate unemployment by duration classes: 0-4

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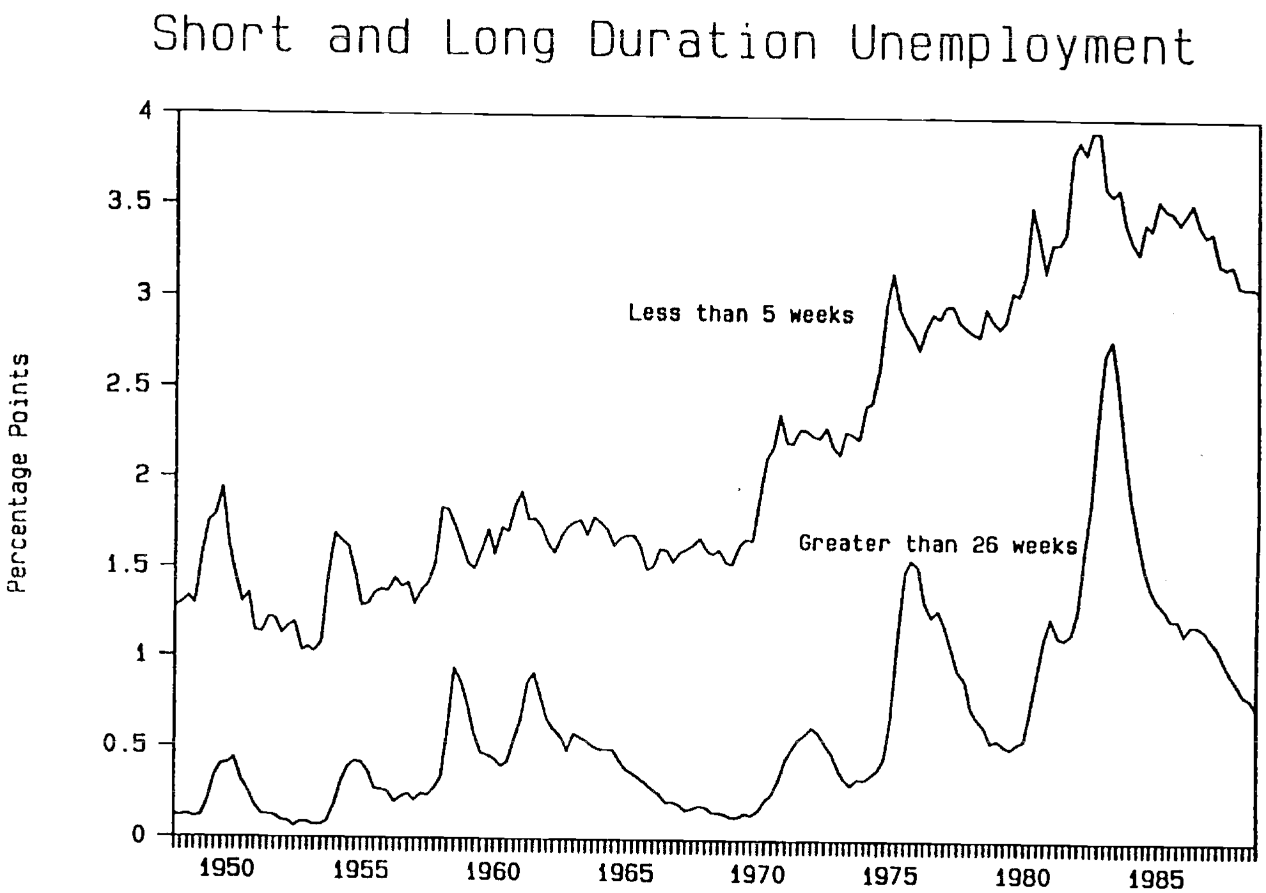
[41]The measured increase probably understates the true increase, since some portion of the long-term unemployed leave the labor force altogether.

Figure 7


Short and Long Duration Unemployment
Percentage Points
4
3.5
3
2.5
2
1.5
1
0.5
0
1950
1955
1960
1965
1970
1975
1980
1985
Less than 5 weeks
Greater than 26 weeks

weeks, 5-14 weeks, 15-26 weeks, and 27+ weeks. Second, in addition to lags of own duration unemployment, we include four lags of unemployment of the next shortest duration to control for variations in the flow of potential entrants. We then calculate impulse response functions as before.

Figure 8 shows the impulse responses of short term (0-4 week) and long term (27+ week) unemployment to each of the independent variables.[42] Movements in short term unemployment (Figure 8a) are dominated by shocks to oil prices and the money supply. Oil price shocks have a large, long-lasting, and significant effect on short term unemployment; money supply changes have a large but short-lived and statistically insignificant effect. Cross section volatility shocks, in contrast, have a small and statistically insignificant effect on short-term unemployment, and the effect of employment dispersion shocks is negligible.

Cross section volatility has a much larger effect on long term unemployment, and is statistically significant (Figure 8b). It is striking that the response to cross section volatility shocks is over twice as large at long durations as at short durations, despite the much smaller share of long duration unemployment in total unemployment. This finding is consistent with the modest importance of cross section volatility in the decomposition of total unemployment.

Employment dispersion also has a relatively greater effect on long-term unemployment, but the effect is smaller and less persistent than that of cross section volatility. Both oil price increases and money supply changes have large and significant effects on long duration unemployment.

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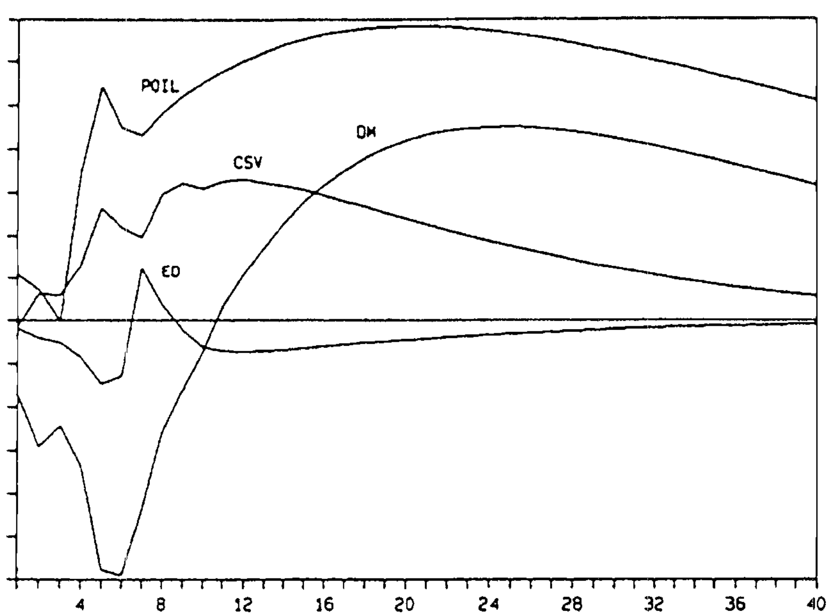
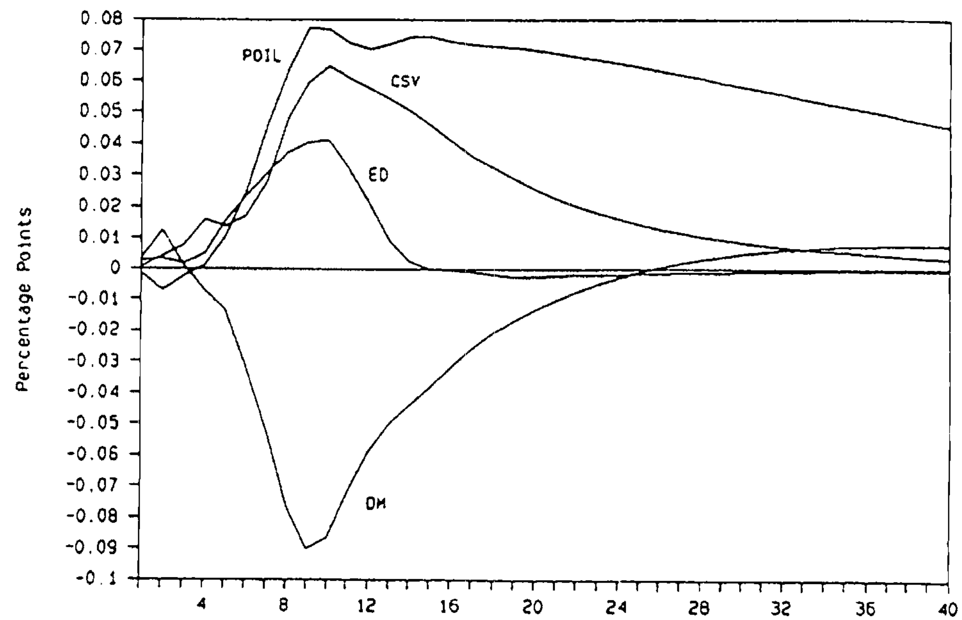
[42] The results for intermediate duration classes of 5 to 14 weeks and 15 to 26 weeks are consistent, so we do not report them.

Figure 8

Response of 0-4 Week Unemployment



Response of 27+ Week Unemployment



Note: Figure shows impulse response functions for unemployment generated from equation (18b), with lags of each duration unemployment and lags of unemployment of the next shortest duration included as indpendent variables. Each independent variable is assumed to follow an AR(4).

Table 6 explores the differences in the explanatory power of the shock variables for different duration unemployment in more detail. The table reports the p-value associated with the hypothesis that the shock variable has no incremental effect on unemployment of each duration, after controlling for lagged unemployment of the same duration and lags of shorter duration unemployment spells. Since the equations control for the flow of potential entrants, the estimated coefficients can be interpreted as changes in the probability of making the transition to the next higher unemployment duration class.

The table suggests that cross section volatility increases the transition probabilities at longer durations. The effect on both 15-26 week unemployment and 27+ week unemployment is positive and statistically significant at the ten percent level, while the effect at shorter durations is insignificant.

Employment dispersion, in contrast, significantly affects only 5-14 week unemployment. The responsiveness of long duration unemployment to employment dispersion noted in Figure 8(b) is primarily due to the continued impact of shocks to medium term unemployment. The effects of changes in the money supply are also most evident at medium durations, of 5-14 weeks and 15-26 weeks, while the relative price of oil is more significantly related to long term than short term unemployment.

Thus, cross section volatility shocks are more closely associated with longer duration unemployment, consistent with the theory. The overall economic impact of reallocation shocks may therefore be greater than is suggested by the moderate average share of reallocation unemployment in total unemployment.

Table 6: <u>Unemployment by Duration</u>

Unemployment Duration	Cross Section Volatility	Employment Dispersion	Relative Price of Oil	Change in Money Supply
0-4 weeks	.273	.777	.239	.485
5-14 weeks	.199	.028	.580	.019
15-26 weeks	.003	.145	.069	.044
27+ weeks	.085	.163	.049	.158

Note: The table shows the p-values for the null that the shock variable does not significantly affect the transition probability into the associated duration class. A small value means the null can be rejected.

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 US. 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.

The cross section volatility series is then used to assess the importance of reallocation shocks for aggregate fluctuations. We conclude that reallocation shocks accounted for about 40 percent of unemployment on average, but that much of the variation in unemployment is due to aggregate fluctuations. Reallocation shocks account for several episodes of high unemployment, particularly in the mid-1970's and late 1960's, but they were relatively unimportant for the high unemployment of the early 1980's.

Tests on disaggregated data show that reallocation shocks account for a larger share of long duration unemployment, however. This finding suggests that the economic importance of reallocation unemployment is understated by their moderate contribution to fluctuations in total unemployment.

Our results suggest several areas for future research. Preliminary research suggests that reallocation and cyclical shocks have differential impacts on the unemployment rates of various subgroups within the labor force. This area is worth exploring in more depth.

While in this work we have treated industry or firm affiliation as the source of specificity, sources other than these might be more important in explaining adjustment in response to reallocation shocks. In future research, we will investigate other sources of specificity.

And lastly, 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.

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Appendix: Industry Cross Section Volatility

1948:1	17.56	1962:1	25.55	1976:1	62.40
1948:2	30.16	1962:2	60.02	1976:2	64.87
1948:3	11.21	1962:3	33.12	1976:3	30.50
1948:4	29.91	1962:4	16.83	1976:4	40.21
1949:1	21.71	1963:1	15.47	1977:1	49.58
1949:2	22.81	1963:2	12.63	1977:2	32.92
1949:3	18.15	1963:3	28.11	1977:3	57.87
1949:4	23.29	1963:4	25.86	1977:4	33.73
1950:1	28.54	1964:1	36.37	1978:1	22.22
1950:2	33.37	1964:2	25.48	1978:2	32.83
1950:3	77.30	1964:3	23.44	1978:3	85.46
1950:4	16.10	1964:4	24.80	1978:4	37.51
1951:1	10.41	1965:1	31.68	1979:1	56.59
1951:2	21.57	1965:2	16.34	1979:2	18.74
1951:3	31.32	1965:3	24.67	1979:3	36.44
1951:4	8.75	1965:4	57.11	1979:4	75.23
1952:1	22.65	1966:1	21.09	1980:1	77.54
1952:2	14.27	1966:2	61.86	1980:2	52.46
1952:3	9.87	1966:3	42.05	1980:3	50.53
1952:4	17.88	1966:4	90.89	1980:4	66.96
1953:1	15.90	1967:1	47.64	1981:1	80.44
1953:2	14.80	1967:2	78.89	1981:2	95.97
1953:3	10.15	1967:3	105.49	1981:3	37.56
1953:4	28.12	1967:4	73.95	1981:4	28.67
1954:1	12.73	1968:1	88.09	1982:1	103.73
1954:2	23.85	1968:2	39.27	1982:2	39.94
1954:3	14.97	1968:3	85.05	1982:3	68.45
1954:4	25.36	1968:4	38.78	1982:4	61.36
1955:1	12.93	1969:1	11.99	1983:1	23.37
1955:2	28.79	1969:2	54.88	1983:2	44.32
1955:3	46.79	1969:3	45.54	1983:3	34.26
1955:4	20.71	1969:4	44.28	1983:4	88.10
1956:1	20.29	1970:1	37.43	1984:1	106.94
1956:2	26.55	1970:2	61.46	1984:2	59.87
1956:3	33.62	1970:3	34.95	1984:3	33.48
1956:4	18.29	1970:4	28.42	1984:4	15.86
1957:1	20.29	1971:1	52.01	1985:1	21.26
1957:2	25.25	1971:2	85.54	1985:2	42.72
1957:3	25.00	1971:3	47.51	1985:3	32.36
1957:4	53.06	1971:4	61.34	1985:4	56.49
1958:1	16.47	1972:1	39.36	1986:1	60.98
1958:2	16.53	1972:2	78.34	1986:2	55.68
1958:3	17.96	1972:3	70.08	1986:3	54.82
1958:4	16.93	1972:4	42.19	1986:4	27.79
1959:1	20.94	1973:1	106.07	1987:1	59.92
1959:2	46.89	1973:2	80.20	1987:2	71.82
1959:3	38.28	1973:3	65.11	1987:3	37.74
1959:4	17.98	1973:4	217.76	1987:4	106.52
1960:1	26.06	1974:1	115.94		
1960:2	60.96	1974:2	70.03		
1960:3	44.56	1974:3	152.10		
1960:4	47.78	1974:4	145.85		
1961:1	44.08	1975:1	80.18		
1961:2	20.20	1975:2	31.84		
1961:3	44.00	1975:3	56.97		
1961:4	41.59	1975:4	77.35		