Gross Job Flows Between Plants and Industries

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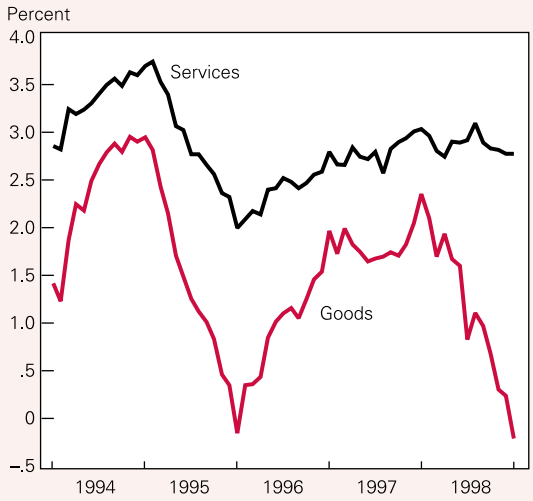
A remarkable feature of the current U.S. economic expansion has been its ability to shrug off the adverse effects of financial crises and economic slowdowns around the world for nearly two years. Employment has been expanding smartly and unemployment has continued to edge down. Recently, however, foreign-sector developments have triggered a sizable shift in the sectoral composition of U.S. employment. By early 1999, employment growth in the goods-producing sector—the sector most exposed to international trade—had stalled, while employment growth in the service-producing sector was still humming along (Figure 1). Indeed, many forecasters have been citing weakness in the industrial sector as a serious threat to the expansion.

Historically, substantial shifts in labor demand between sectors have been correlated with the business cycle. The gap between the rates of growth for goods and services employment, a cursory measure of these shifts, is closely correlated with GDP growth (Figure 2). A common view of this correlation is that some sectors, such as manufacturing, are more sensitive to the business cycle than others. Thus, shifts in labor demand are merely passive responses to fluctuations in aggregate demand (GDP) that temporarily alter relative employment growth rates among sectors. Another, complementary view is that these shifts are active, permanent responses to sector-specific events that generate increases in structural unemployment and reductions in aggregate demand.

Neither view fully explains current developments. In contrast to the first view, the decline in the employment gap has not been accompanied by the usual decline in GDP growth, although the deviation is historically moderate, so far. In contrast to the second view, the unemployment rate has shown no hint of rising as a result of labor demand shifts. These unusual developments highlight the inability of macroeconomists to completely understand the connection between shifts in labor demand and the business cycle, or to synthesize these two views.

Figure 1

U.S. Employment Growth, by Major Sector



Note: Rates are year-over-year percent changes calculated using seasonally adjusted monthly data from the BLS Establishment Survey.

Source: Haver Analytics, Inc.

This article provides new data and evidence on the connection between shifts in labor demand and the business cycle that may improve our understanding of episodes such as the current employment situation. We extend our recent analysis of job creation and destruction in U.S. manufacturing plants (Davis, Haltiwanger, and Schuh 1996). There, we documented that shifts in labor demand among plants are very large, persistent, and concentrated in a relatively small number of plants exhibiting unusually big employment changes. Perhaps more important, we found that this process, called job reallocation, intensifies during recessions.

Our earlier results led to a third, also complementary, view of labor demand shifts. Using plant-level employment data, we measured employment shifts between detailed sectors—such as industries and geographic regions—and controlled for different sensitivities of sectors to the business cycle. We found that neither sectoral differences in cyclical sensitivities nor between-sector shifts account for much of the magnitude or variation in job reallocation. Although these effects are present, most permanent job reallocation is idiosyncratic to plants and this idiosyncratic component accounts for the countercyclical nature of true job reallocation. From these findings we inferred that greater shifts in labor demand during recessions result from intensive restructuring of plants *within* industries, achieved through plant births and deaths, replacement of old capital with new technologies, and alteration of distribution networks.

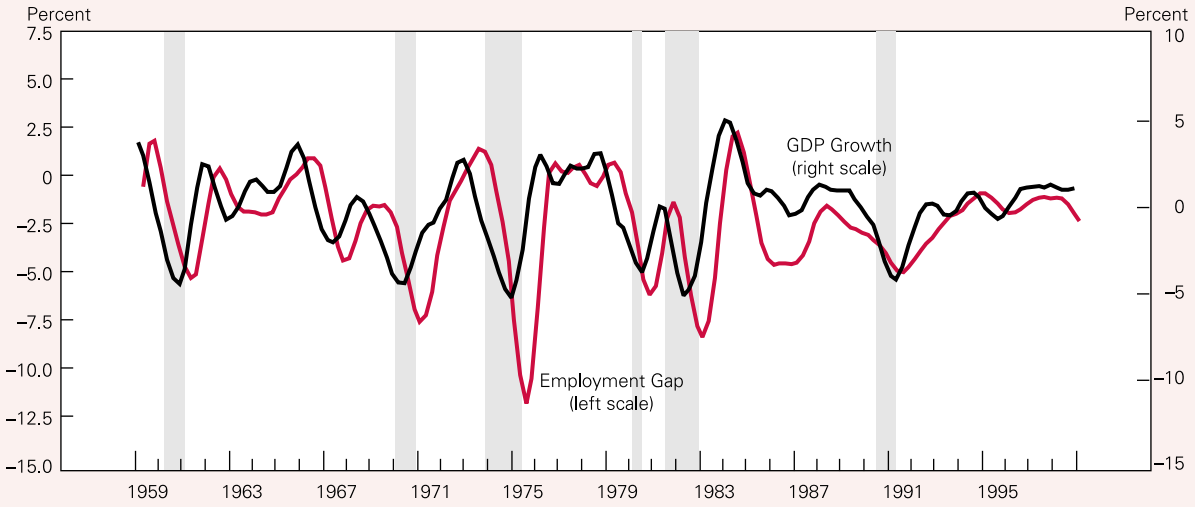
Here we reexamine the cyclical nature of job reallocation and demonstrate that reallocation between detailed manufacturing industries is remarkably similar to total reallocation among manufacturing plants. Like Ritter (1993), we observe a strong correlation between the two types of reallocation, but our deeper look uncovers many other important similarities, plus a few notable differences. Job reallocation between industries accounts for about one-third of total job reallocation; it is strongly countercyclical; and it closely mimics the cyclical behavior of total job reallocation between plants. Overall, we find here and in related work (Haltiwanger and Schuh 1998) that between-industry job reallocation is a robust proxy for total job reallocation in macroeconomic models, and also interesting in its own right.

The striking similarity between total and between-industry job reallocation has two important implications. First, it provides fresh support for the view that a significant fraction of the shifts in labor demand and increases in unemployment over the business cycle are attributable to sector-specific events. Critics of the so-called sectoral view of countercyclical shifts in labor demand, including the authors in earlier research, have advanced various theoretical and empirical criticisms of this view. However, the between-industry reallocation measures presented here control for these criticisms, yet still reveal significant countercyclical, permanent reallocation of employment between industries. Furthermore, we find evidence that fluctuations in between-industry

We demonstrate that reallocation of jobs between detailed manufacturing industries is remarkably similar to total reallocation among manufacturing plants.

Figure 2

Goods-Services Employment Gap and GDP Growth



Note: Rates are year-over-year and smoothed using a three-period centered moving average. The GDP growth rate is the deviation from the average over the 1958-73 and 1974-98 subperiods. Shaded areas shows periods of recession.

Source: Haver Analytics, Inc.

reallocation are at least partly attributable to sectoral changes in relative prices.

A second implication is that data on job reallocation between industries provide an opportunity to conduct broader investigations of the macroeconomic relationship between employment restructuring and the business cycle. U.S. data on total job reallocation among plants are only available for manufacturing, only extend back to 1972, and are now more than five years out of date (1993). In contrast, industry-level employment data from the U.S. Department of Labor can be used to construct up-to-date job reallocation data for the entire U.S. economy extending back at least to the 1950s (see Ritter 1994). These data can be used to develop and test macroeconomic models that include countercyclical job reallocation, which may improve our understanding of the economy and the conduct of government policy.

The article proceeds as follows. First we describe the historical development of the sectoral view of employment reallocation. Next we summarize our methodology for measuring job reallocation and related concepts. In the main contribution of the article, we provide evidence that countercyclical reallocation of jobs—between plants and between detailed manufacturing industries—is an important feature of the U.S. labor market and business cycle. We also explain briefly why our earlier results were incomplete. The article closes with some econometric evidence on the importance of job reallocation in macroeconomics.

Readers already familiar with our earlier work and the related literature may wish to skip directly to Section IV, "Four Basic Facts about Job Flows," which compares and contrasts the plant-level and industry-level results.

I. The Sectoral View of Labor Markets

Traditionally, most macroeconomic models have not included a role for compositional shifts in labor demand across sectors and firms in characterizing the labor market and the overall economy.[1] Instead, their

[1] This observation is not directed toward any particular ideological view within macroeconomics, rather it is a statement about macroeconomics in general. For example, neither Sargent (1987), Kydland (1995), nor Romer (1996), who espouse different ideologies, incorporate compositional shifts in labor demand. But Blanchard and Fischer (1989), Stokey and Lucas (1989), and Phelps (1994), who also differ, do incorporate them. The current trend, however, is that macroeconomists are more likely to incorporate heterogeneity in theoretical and empirical analyses as the availability of data and the ability to process them both expand rapidly.

focus has been primarily on explaining aggregate employment or the total unemployment rate, and their relationships with GDP growth, inflation, interest rates, and other macroeconomic variables. Fluctuations in aggregate demand or aggregate productivity play the central, if not only, role in generating business cycles in these models. As a result, macroeconomic analysis lacks broad evidence on shifts in labor demand across sectors and a well-established framework for evaluating their macroeconomic consequences.

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The economic turbulence of the 1970s and 1980s motivated some macroeconomists to begin studying compositional shifts in labor demand and hastened their incorporation into macroeconomic analysis. This period featured tremendous and, at that time, somewhat unusual compositional shifts: sharp changes in relative prices, increasingly open international trade, and big swings in defense expenditures. Often these shifts coincided with recessions and massive layoffs in certain industries and regions, raising the possibility that they might somehow be connected to business cycles. They also were suspected of contributing to secular increases in unemployment rates, the productivity slowdown, and sluggish real wage growth.

The sectoral view emerged from research on the microeconomic foundations of employment and inflation that began in the 1960s.[2] This research attempted to provide an economically sensible explanation for the existence of unemployment, even when the economy seemed, paradoxically, to be at full employment. One line of reasoning produced so-called theories of equilibrium unemployment. In these theories, firms and workers always behave optimally and there are no economic frictions such as rigid wages and prices. Instead, unemployment arises from sectoral changes and the inability to instantaneously match heterogeneous workers and jobs because the matching process is beset by frictions associated with search, incomplete information, and geographic separation.[3]

More specifically, the sectoral view is predicated on two tenets. First, sectors are continuously subject to economic factors that alter the desired allocation of jobs and workers across sectors. These factors are not aggregate but *sector-specific*: changes in relative productivity, relative prices, regional incomes, or consumer preferences, to give examples. Second, heterogeneity and certain immutable frictions prevent instantaneous allocation of jobs and workers to the right sectors. Because firms produce different products and use different technologies, jobs have different skill requirements and prospects for survival. Likewise, because people have different physical attributes and attain different levels of education, workers offer different skills. Furthermore, firms and workers are spatially separated, and neither firms nor workers have complete information about the characteristics, availability, and location of workers and jobs.

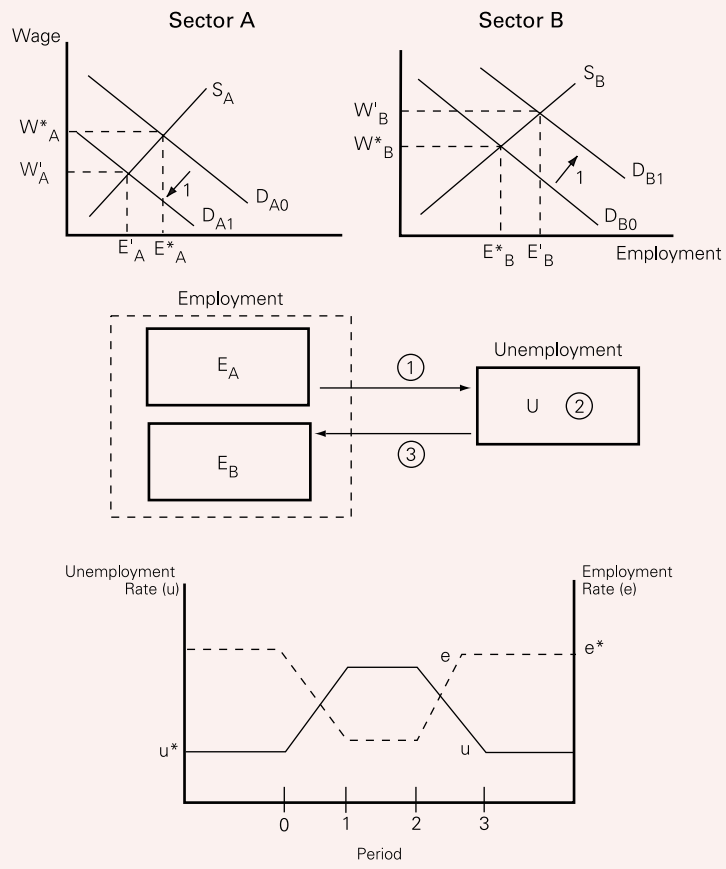
These tenets portray the labor market as composed of many distinct sectors, and employment as the outcome of a careful, time-intensive process of matching the location and skills of a worker to the location and requirements of a job. But worker-job matches are fragile. In addition to aggregate demand fluctuations, the economy is continuously subject to economic forces that destroy matches only in certain firms or sectors and require labor to be redistributed to other firms or sectors. Because it is costly and time-consuming to properly match workers and jobs, disruptions to worker-job matches involve spells of unemployment for dislocated workers.

Figure 3 depicts the sectoral view of the labor market. For simplicity, the labor market comprises two sectors, A and B (upper panel). Heterogeneity leads to different labor supply (S) and demand (D) curves, so equilibrium employment (E*) and the real wage (W*) differ as well. The first tenet of the sectoral

[2] This research was initiated by the critiques of the Phillips curve by Friedman (1968) and Phelps (1968). Some of the main contributions include Phelps (1970), Lucas and Prescott (1974), Lilien (1982), Davis (1987), Rogerson (1987), and Hamilton (1988).

[3] One interpretation of this sectoral view is that it is an explicit and more complex specification of the simple ambiguous frictions often incorporated in single-sector macroeconomic models to explain sluggish adjustment of aggregate variables. If so it offers many advantages, such as providing an alternative driving force behind business cycles (sectoral shocks) and the ability to quantify the impact of distributional developments on macroeconomic performance.

Figure 3



view is that some sector-specific economic event causes the relative demand for labor to change in *all* sectors. In this stylized example, the labor demand curve shifts inward in sector A—job destruction—and outward in sector B—job creation (arrow 1).[4] However, the aggregate demand for labor does not change.[5] These shifts cause the real wage to rise in sector B relative to sector A, inducing a desire to reallocate a certain number of jobs ($E^*_A - E'_A$) from sector A to sector B.

The second tenet of the sectoral view is that reallocation cannot occur instantly but must take place over several periods.[6] The inward shift of labor demand causes sector A to cut employment immediately (period 1). As a result, laid-off workers move from employment (E) to unemployment (U), reducing the employment rate (e) and raising the unemployment rate (u), as shown in Figure 3 (middle, lower panels). However, these unemployed workers must remain unemployed for a while (period 2) while they search for a new job, undergo job retraining, acquire additional education, or move to a different geographic region. Eventually, the unemployed workers are matched to unfilled jobs created in sector B (period 3).

The sectoral view also can be understood in terms of the standard decomposition of the unemployment rate into cyclical and natural rate components. Cyclical unemployment results from fluctuations in aggregate demand over the business cycle. Natural unemployment results from the kinds of heterogeneity and frictions described in the sectoral view, and it includes two components. One is frictional unemployment, which arises from delays in job search caused by imperfect information, geographic separation, and other barriers. The other is structural unemployment, which arises from mismatches in skills supplied and demanded in a labor market or the emergence of excess supply of or demand for labor in certain sectors. The sectoral view, then, is primarily about the determination of the natural rate of unemployment rather than cyclical unemployment.

Thus far, the discussion of the sectoral view does not necessarily connect compositional shifts in labor demand across sectors to the business cycle. In theory,

[4] Not all economic events affect both sectors simultaneously and in opposite directions. Some events might affect only one sector directly. Sector-specific, or "idiosyncratic," events are constantly buffeting sectors, with some sectors being positively affected and others adversely affected. Furthermore, sector-specific events also affect aggregate demand, which is then likely to affect employment in other sectors. The study of these complex interactions between sectoral and aggregate employment must be carried out within the context of an economic model that carefully defines and incorporates these concepts.

[5] In other words, $E^*_A + E^*_B$ equals full employment and $E'_A + E'_B$ also equals full employment.

[6] The length of each period in this stylized example is not important to the basic point, which is that some meaningful spell of unemployment occurs. The length of unemployment spells obviously varies across types of workers. The average unemployment spell is less than two months. But some dislocated workers experience spells of two years or more, especially those with long job tenure and high wages relative to other workers in their industries and occupations.

the unemployment generated by these shifts could be quite small relative to the unemployment generated by fluctuations in aggregate demand. Or the shifts could be evenly spread out over the business cycle so as not to cause significant fluctuations in the natural rate over time.

David Lilien (1982) explicitly argued for a business-cycle connection between shifts in labor demand and the unemployment rate. Lilien's theory, called the sectoral shifts hypothesis, suggests that changes in the desired allocation of jobs and workers across sectors may actually *cause* aggregate employment growth to fall and unemployment to rise. In fact, he concluded that "as much as half of the variance of unemployment over the postwar period can be attributed to fluctuations of the *natural rate* [emphasis added] brought about by the slow adjustment of labor to shifts of employment demand between sectors of the economy" (p. 778).

Empirically, Lilien claimed that his idea is manifest in the positive correlation between the unemployment rate and dispersion in employment growth rates across sectors. Lilien's dispersion measure is

$$\sigma = \left[\sum_s \left(\frac{E_{st}}{E_t} \right) (g_{st} - g_t)^2 \right]^{1/2}, \qquad (1)$$

where E denotes employment in about a dozen primary sectors, g denotes employment growth, and subscripts s and t denote sector and time, respectively.[7] The data continue to show a positive correlation of 0.32 between employment dispersion and the unemployment rate through 1998 (Figure 4), slightly higher than the one Lilien originally documented through 1980.

The sectoral shifts hypothesis was, and still is, controversial.[8] Part of the controversy stems from the unconventional suggestion that substantial fluctuations in the unemployment rate arise from fluctuations in the natural rate, which previously had been assumed to be uncorrelated with the business cycle. Another part of the controversy stems from the crudeness of Lilien's dispersion measure, which could be correlated with the business cycle for other reasons. Both concerns are eminently reasonable, as will be discussed in the next section.

But this hypothesis has endured two common misperceptions worth dispelling here. First, some view the sectoral shifts hypothesis as a *substitute* for traditional aggregate demand-based explanations of business cycles. In fact, it was proposed as a *complementary* hypothesis that could remedy "some of the limitations of aggregate models that do not *explicitly* [emphasis added] account for the multisectoral character of production and employment and the imperfect short-run mobility of resources between sectors" (Lilien 1982, p. 793). This misperception has led to an unnecessarily adversarial controversy between proponents of the two views.[9]

Worker-job matches are fragile. In addition to aggregate demand fluctuations, the economy is continuously subject to economic forces that destroy matches only in certain firms or sectors and require labor to be redistributed to other firms or sectors.

Second, some view the sectoral shifts hypothesis as solely about what *causes* business cycles. Although Lilien's article does indeed suggest that sectoral shifts can cause recessions, they were not promoted as the *sole* cause. Furthermore, the sectoral view on which this hypothesis is based has much broader macroeconomic implications. Even if aggregate demand fluctuations alone cause business cycles, the sectoral view provides an improved understanding of the macroeconomic implications of such fluctuations. As we show in this article, recessions have large, permanent, and disproportionate effects on employment in certain sectors and firms. Thus the mechanisms of the structural view still lead to cyclical increases in reallocation and the natural rate of unemployment, and to other related consequences of structural adjustment. These factors can enhance the workings of economic models

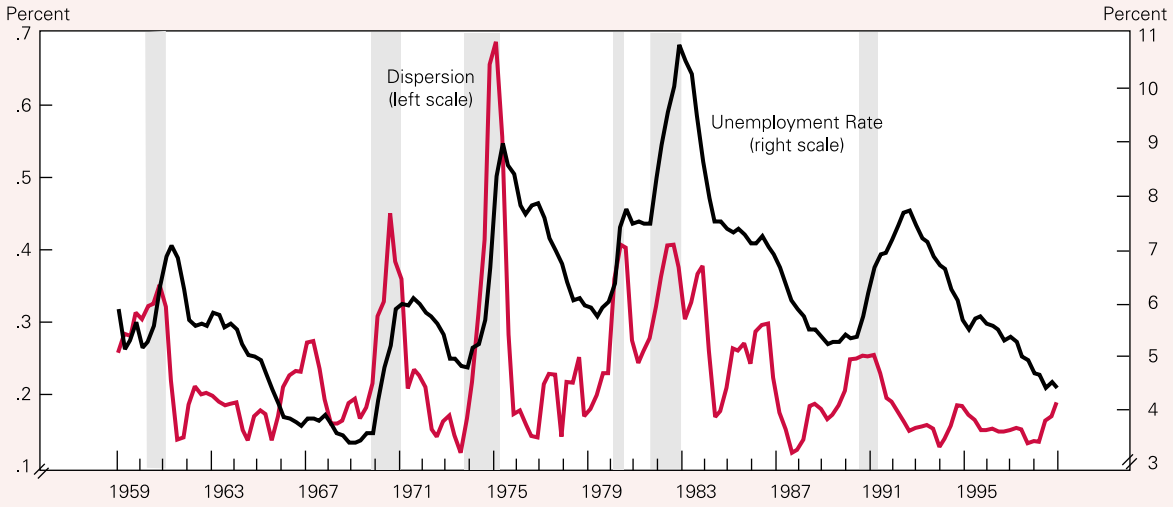
[7] Lilien's measure is the cross-sectional standard deviation of employment growth rates, weighted by sector employment size. If all sectors grow at the same rate, dispersion is zero; when sectors grow at very different rates, dispersion is high.

[8] See Schuh and Triest (1998), and the discussions by Caballero (1998) and Davis (1998), for more details.

[9] Recent research has steered away from such controversy and has incorporated roles for both aggregate and allocative forces. The empirical evidence indicates that both are at play, but estimates of their relative importance remain under considerable debate.

Figure 4

Employment Dispersion and the Unemployment Rate



Note: Rates are calculated with seasonally adjusted quarterly data. The dispersion rate is smoothed using a three-period centered moving average. Shaded areas show periods of recession.
Source: Haver Analytics, Inc.

and potentially alter the efficacy of macroeconomic as well as microeconomic government policies.[10]

II. Criticisms of the Sectoral View

Two primary criticisms of the sectoral view arose in response to Lilien's work. Abraham and Katz (1986) argued that dispersion in employment growth across sectors arises naturally in a multisector macroeconomic model that abstracts from sectoral shifts. If sectors vary in their sensitivities to the business cycle, then aggregate demand fluctuations can produce a positive correlation between employment dispersion and the unemployment rate. But this dispersion does not reflect greater intensity in true reallocation of labor across sectors; rather, it simply reflects transitory changes in the relative magnitudes of sectoral employment growth rates.

The idea here is that a reduction in some aggregate factor, such as aggregate demand, causes employment to decline in all sectors but by different amounts. Sectors such as manufacturing are very cyclically sensitive and experience larger declines in employment. Sectors such as services are less cyclically sensitive and experience smaller declines in employment. Together these differential shifts inherently cause measured employment dispersion to increase but the labor demand shifts are not permanent.

In this story, increased dispersion in employment growth is associated with transitory employment changes, both in sectors and in the aggregate, because aggregate demand fluctuations are ultimately transitory. Unemployed workers in each sector can return to their sector after aggregate demand rebounds. This idea underlies the common macroeconomic view that temporary layoffs of workers are a central source of cyclical fluctuations in unemployment.[11] Although aggregate demand fluctuations could generate structural unemployment via compositional shifts, especially through births and deaths of firms, traditional macroeconomic models do not explicitly provide such a channel.

[10] For example, Caballero (1998) does not believe that sectoral shifts cause business cycle fluctuations in the United States but nevertheless writes, "I find it difficult to consider questions such as: What is the natural rate of unemployment? or What are the cost and incidence of recessions? without thinking about the reallocation process and its obstacles" (p. 347).

[11] See, for example, Feldstein (1975) and Lilien (1980).

Aggregate employment changes are thought to be persistent because the rebound in aggregate demand and employment can be sluggish. When aggregate employment declines in a recession, typically it takes one to two years to return to its peak level of the previous expansion, and four to five years to return to its trend level. However, the employment changes are small in percentage terms (usually less than 5 percent in absolute value at an annual rate) and, more important, the decline in employment is clearly *temporary*. As the reader will see, plant-level employment changes are markedly different from these impressions conveyed by the aggregate data.

It turns out that both within-sector and between-sector reallocation play important roles in labor market dynamics, along with aggregate demand fluctuations.

To reiterate, the Abraham-Katz framework neither requires nor offers an avenue for substantial, permanent reallocation of jobs and workers across sectors and firms. Workers whose jobs are destroyed are not required to engage in the costly, time-consuming re-matching process that accompanies shifts in labor demand across sectors. No extended period of unemployment caused by labor market frictions and structural mismatches occurs over and above that caused by fluctuations in aggregate demand. That is, the natural rate of unemployment does not necessarily increase.

The other critique of the sectoral view comes from recent studies of highly disaggregated data. Partly in response to Abraham and Katz, we (in collaboration with Steven Davis) undertook an extensive study of employment growth at manufacturing plants rather than in broad industrial sectors. In some sense, measuring employment growth in plants is just a more highly disaggregated method than Lilien's dispersion measure. However, measuring plant-level employment growth allows one to control for the factors that could produce spurious cyclical fluctuations in employment dispersion. Thus, it allows us to construct measures of employment dispersion that are immune to the criticisms of Abraham and Katz.

We found overwhelming evidence that the intensity of shifts in labor demand across plants rises markedly during recessions. However, we found that the increased intensity was not caused either by differences in cyclical sensitivities of sectors to fluctuations in aggregate demand or by shifts in labor demand between sectors. Instead, we concluded that employment reallocation *within* sectors accounted for the vast majority of true plant-level employment restructuring. Furthermore, reallocation within sectors appeared to account for virtually all of the countercyclical movement of dispersion in employment growth rates—a finding robust to extremely detailed definitions of sectors.[12] By stressing the dominant role of within-sector reallocation, we argued against Lilien's hypothesis too, at least indirectly.

The evidence on employment reallocation between industries in the remainder of this article modifies our earlier conclusion somewhat. By focusing on within-sector reallocation, we overlooked the significant magnitude and countercyclical nature of between-sector reallocation. It turns out that *both* within-sector and between-sector reallocation play important roles in labor market dynamics, along with aggregate demand fluctuations.

III. Job Creation and Destruction

This section explains the measurement of firm-level employment changes and their interpretation as job creation and destruction; for more details see Davis, Haltiwanger, and Schuh (1996). We begin by defining basic concepts. A *job* is an employment position filled by a worker, so "job" and "employment" are synonymous.[13] Jobs are counted at a *plant*, which is a physical location where production takes place, such as a factory. In this study, the plants are all in the manufacturing industry. Plants differ from companies, which may include one or more plants in any region or industry. Measuring employment

[12] Davis and Haltiwanger (1992) report that when plants are divided into more than 14,000 sectors defined simultaneously by industry, geography, and plant characteristics, employment shifts between these sectors still account for only 39 percent of total variation in employment reallocation within these sectors.

[13] Unfortunately, the data do not provide information about the nature of the job except to distinguish between production and nonproduction, or supervisory, workers. Neither do they provide information about unfilled jobs. When a firm opens a new job it is not counted as job creation until a worker is hired.

changes in plants is appropriate because labor markets are geographically distinct, so the impact on workers and labor markets is more direct in plant-level changes.

Sometimes it is useful to assign plants to *sectors* defined by common plant characteristics. Here, sectors are *industries*: groups of plants that produce and sell the same product. The federal government classifies industries according to a detailed product code in the Standard Industrial Classification (SIC) system. Industries with four digits of code are the most detailed (about 450); this is the classification we use. Industries with one digit of code are the least detailed (about a dozen); this is the classification that Lilien used.

The basic building blocks of job creation and destruction are employment (E) changes (Δ) at the plant level, $\Delta E_{et} = E_{et} - E_{e,t-1}$, where subscripts e and t index plants (also known as establishments) and time, respectively. *Job creation* (C) is an increase in plant employment and *job destruction* (D) is a decrease in plant employment between two periods:

$$C_{et} = \begin{cases} \Delta E_{et} & \text{if } \Delta E_{et} > 0, \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

$$D_{et} = \begin{cases} |\Delta E_{et}| & \text{if } \Delta E_{et} > 0, \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

Note that job destruction is defined to be positive (absolute value) even though employment is declining. Because job creation and destruction are measures of employment *changes*, they are often referred to as *job flows*.[14]

Gross job creation (C_t) is the sum of all employment gains at expanding plants, and *gross job destruction* (D_t) is the sum of all employment losses at contracting plants, within manufacturing or within detailed industries, during a period.[15] *Net employment change* (N_t) is the difference between gross job creation and destruction,

$$N_t = C_t - D_t, \tag{4}$$

and also equals the change in aggregate employment (ΔE_t). Note that even when aggregate net employment does not change, gross job creation and destruction can be significant. In fact, *any* net employment change can result from high, moderate, or low job creation and destruction.

This last point is central to the study of employment adjustment because it suggests that net employment growth is an incomplete indicator of labor market developments. Some measure of the total reshuffling of jobs between plants is needed as well. *Gross job reallocation* (R_t) is the total number of jobs created and destroyed at plants during a period:

$$R_t = C_t + D_t. \tag{5}$$

Job reallocation is a measure of dispersion in employment changes across plants, similar in spirit to the Lilien dispersion measure.[16] A potential disadvantage of this measure is that it could reflect only fluctuations in net employment growth and not simultaneous job creation and destruction in plants. For example, if manufacturing employment increased by 1 percent and all plants within manufacturing experienced job creation rates of 1 percent and no job destruction occurs, then gross job reallocation would rise but no jobs or workers would necessarily shift across plants.

To determine the extent to which these spurious fluctuations in job reallocation are present in the data, we construct *excess job reallocation:*

$$X_t = R_t - |N_t|. \tag{6}$$

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[14] Employment changes at plants are actually the *net* result of all newly created and destroyed jobs *within* the plant. For example, a plant may destroy 10 assembler jobs and replace them with 5 computer technician jobs, but this methodology would indicate only that the plant destroyed 5 jobs. Unfortunately, the data do not reveal within-plant job flows, so our estimates of gross job creation and destruction actually *understate* the true magnitudes. Any effort to measure job changes is shaped by the level of disaggregation in the data.

[15] In practice, we focus on rates of job flows by building job flows from employment growth rates defined as

$$g_{et} = \Delta E_{et} / Z_{et},$$

where Z_{et} is a measure of plant size defined as the average of current and lagged employment

$$Z_{et} = (\tfrac{1}{2})(E_{et} + E_{e,t-1}).$$

This growth rate differs from the conventional rate, G_{et}, which only has lagged employment in the denominator. The conventional rate ranges from -1 to infinity, is asymmetric, and is infinite for plant start-ups. Our preferred rate ranges from -2 to $+2$, is symmetric, and is $+2$ for startups. The two rates are monotonically related by the formula

$$G \equiv 2g/(2 - g)$$

and are similar for small rates (less than 10 percent). Gross job flow *rates* are obtained from dividing gross job flow levels by aggregate size or from size-weighted plant growth rates.

[16] There is a technical, but important, difference between the dispersion measures. Lilien's measure is a standard variance statistic, but job reallocation is an absolute-deviation measure. Unlike the variance measure, job reallocation cannot provide an exact decomposition of its total fluctuations over time into fluctuations in its various components, a problem we discuss further below.

In the long run, this measure reflects the true reallocation occurring beyond the job creation or destruction required to accommodate trend changes in net employment.[17]

Job reallocation can aid our understanding of the aggregate labor market behavior for several reasons. When job reallocation intensifies, important compositional effects can arise if the jobs created are different from the jobs destroyed—even if net employment does not change much. For example, if the jobs that were destroyed paid high wages but the jobs created paid low wages, then reallocation would lower the average wage even though employment did not change.

When job reallocation intensifies, important compositional effects can arise if the jobs created are different from the jobs destroyed, even if net employment does not change much—for example, if jobs destroyed paid high wages but jobs created paid low wages.

The period around the mild 1980 recession looks a lot like this hypothetical example. From 1979:Q1 through 1980:Q3, total U.S. employment growth was relatively flat (0.6 percent annual rate), but job reallocation rose nearly 50 percent while real average hourly earnings dropped sharply (−4.5 percent annual rate) and never recovered. Such compositional effects on aggregate outcomes are not included in traditional macroeconomic models and tend to be downplayed by macroeconomists. But recent research with plant-level data suggests that they can be quite important.[18]

Another important effect is the impact of job reallocation on workers. Because workers are different, it matters whose job is destroyed. Economists use the term *human capital* to summarize a worker's education, experience, and skills. The wage paid to a worker depends primarily on human capital—more human capital means higher wages. Often, much of human capital is specific to a job, so when a plant destroys a job it also destroys human capital.

The literature on dislocated workers, meaning workers whose jobs were destroyed, indicates that the reallocation process is slow and costly for workers who lose a lot of human capital.[19] Dislocated workers usually earn significantly lower wages in their subsequent jobs—in some cases their wages are halved. When jobs are destroyed, it is not often the case that dislocated workers fill newly created jobs right away. More often, geographic and skill-match barriers prevent such worker reallocation, so dislocated workers tend to experience much longer than average spells of unemployment. These workers also face the additional problem of trying to find jobs that can fully replace their lost incomes in order to maintain their living standards. All of this means that job reallocation can raise the costs and duration of unemployment even when aggregate employment does not change much.

We also want to consider the component of total job flows between plants that is associated with job flows between industries. *Job flows between industries* are net employment changes at the industry level ($N_{it} = \Delta E_{it}$). Between-industry (superscript b) job creation and destruction are:

$$C_{it}^{b} = \begin{cases} N_{it} & \text{if } N_{it} > 0, \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

$$D_{it}^{b} = \begin{cases} |N_{it}| & \text{if } N_{it} < 0, \\ 0 & \text{otherwise.} \end{cases} \tag{8}$$

Gross job creation, destruction, and reallocation between industries are defined analogously to the plant-level measures. Manufacturing net employment change is identical for total and between-industry job flows.[20]

[17] In the short run (business cycle), however, excess reallocation fails to reflect legitimate reallocation that occurs solely through fluctuations in job creation or destruction. For example, suppose job creation is constant but job destruction rises above average for a period, falls below average the next period, and then returns to normal. In this case, true job reallocation could increase but excess reallocation would not. Thus, excess reallocation is less appropriate for business cycle analysis. For more details, see Haltiwanger and Schuh (1998).

[18] One prominent study is Olley and Pakes (1996), which shows that failure to properly take account of the plant-level dynamics such as plant births and deaths leads to significant misstatements of aggregate productivity growth.

[19] Data on this dislocated worker problem are limited. The surveys by Fallick (1996) and Kletzer (1998) summarize the available evidence.

[20] One could define job flows "within" industries as the difference between total and between-industry flows. However, this residual measure of within-industry reallocation is excess reallocation (sum of industry-level excess reallocation) whereas the between-industry reallocation is gross job reallocation, leading to an "apples and oranges" comparison. See Haltiwanger and Schuh (1998) for more details.

An important issue in understanding gross job flows is the degree to which job creation and destruction represent permanent versus transitory changes in plant employment. We quantify the permanence of job creation and destruction with plant-level *persistence* measures that reflect the fraction of jobs permanently created or destroyed in the current period that still exist or do not exist two years later.[21] The averages (across all plants) of these variables, denoted θ_{ct} and θ_{dt}, range between 0 and 100 in percentage terms.

Table 1
Illustration of Gross Job Flow Calculations

	Employment in:		Net	Job	Job	Job	Excess
	Year 1	Year 2	Change	Creation	Destruction	Reallocation	Reallocation
Industry A							
Plant #1	100	150	+50	50	0		
Plant #2	120	90	−30	0	30		
Total	220	240	+20	50	30	80	60
Industry B							
Plant #1	50	70	+20	20	0		
Plant #2	90	60	−30	0	30		
Total	140	130	−10	20	30	50	40
Total Economy							
All plants	360	370	10	70	60	130	120
Between industries				20	10	30	20

Note: A blank cell indicates concepts that are not meaningful or cannot be calculated.

Given these persistence rates, we define *permanent gross job flows* (subscript *P*) as the fractions of total job flows that persist two years:

$$C_{Pt} = \theta_{ct} C_t \tag{9}$$

$$D_{Pt} = \theta_{dt} D_t \tag{10}$$

$$R_{Pt} = C_{Pt} + D_{Pt}. \tag{11}$$

Transitory gross job flows are the differences between total and permanent job flows. Permanent and transitory job flows between industries are defined analogously.

Before turning to the actual empirical measurement of job flows, it may be instructive to review an example of the calculations implied by the equations above. Table 1 provides a stylized numerical illustration of gross job flow calculations for the interested reader.

Data for measuring total plant-level gross job flows come from the Longitudinal Research Database (LRD) at the U.S. Bureau of the Census. The LRD links data from the Census and Annual Survey of Manufactures of U.S. plants over the period from 1963 to 1993. Annual and quarterly employment data are available for the 1972–93 period for 50,000 to 70,000 plants per year, in five-year rotating panels. The annual data, which provide a better indication of permanent employment changes, are for total employees in March. The quarterly data, which provide a better indication of cyclical movements in employment changes, are for production workers at the midpoint of the quarter (payroll periods including the 12th of February, May, August, and November).

Data for between-industry job flows also come from the LRD. These data represent employment in detailed 4-digit SIC industries that have been summed across all plants in each of the approximately 450 industries. Data definitions, sample periods, and other features are the same as for the plant-level data, and we adjusted for the SIC change in 1987.[22] Between-industry job flows can be calculated using detailed employment data from other sources as well, such as the establishment survey published by the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor.[23]

[21] This choice of horizon is dictated largely by data limitations that prevent a longer horizon. However, two years is more than twice the length of a typical recession, a transitory event. From the point of view of the worker whose job was created or destroyed, two years is almost surely a permanent change.

[22] These industry-level employment data are in files RI4.DAT and RZI4.DAT released by Davis, Haltiwanger, and Schuh (1996) and the Census Bureau. The LRD employment *levels* do not exactly match the data in official Census publications for a variety of technical reasons, but the employment *growth rates* are very similar.

[23] We found that between-industry job flows calculated with BLS data (not reported in this article) are very similar to those calculated with the LRD data despite notable differences in sample composition and industry definitions. However, we use the LRD data to prevent sampling differences from affecting the analysis of relationships among types of job flows. An obvious advantage of the BLS data is that they can be used to construct between-industry job flows for nonmanufacturing industries, which Ritter (1994) has explored.

Table 2
Gross Job Flows in U.S. Manufacturing, 1972 to 1993: Basic Statistics
Percent

	Annual		Quarterly	
Mean (Standard Deviation)	Total	Between Industries	Total	Between Industries
Net Employment Growth	−1.5 (4.4)	−1.5 (4.4)	−.4 (2.0)	−.4 (2.0)
Job Creation	8.7 (2.0)	2.1 (1.8)	5.1 (.9)	1.7 (.9)
Job Destruction	10.2 (2.7)	3.6 (2.8)	5.5 (1.6)	2.1 (1.4)
Job Reallocation	18.9 (2.0)	5.7 (1.9)	10.5 (1.8)	3.8 (1.1)
Excess Job Reallocation	15.3 (2.0)	2.1 (1.3)	9.2 (1.1)	2.5 (.8)

Note: Annual data begin in 1973. Quarterly data begin in 1972:Q2 and are not seasonally adjusted.
Source: Longitudinal Research Database and authors' calculations.

IV. Four Basic Facts About Gross Job Flows

This section parallels Davis, Haltiwanger, and Schuh (1996) in describing four basic facts about gross job flows, extending the analysis to compare and contrast total (between-plant) and between-industry job flows. Our comparison overlaps slightly with Ritter (1993), who first noted the significant correlations between total and between-industry job flows.

Fact #1: Magnitude

Gross job flows are remarkably large. Table 2 shows that one in 11 jobs (8.7 percent) was newly created and one in 10 jobs (10.2 percent) was destroyed each year, on average, in U.S. manufacturing plants.[24] Thus, nearly one in five jobs in manufacturing was involved in job reallocation every year. Quarterly job flows, when expressed at annual rates, are even higher, but a large part of these flows is associated with seasonal and other transitory events. In contrast, net employment growth in manufacturing averaged only −1.5 percent annually and significantly masks the extent to which employment changed in typical expanding and contracting plants.

The picture painted by the gross job flows is one of tremendous churning and turnover, with simultaneous job creation and destruction even while aggregate employment is changing only modestly. But job reallocation goes far beyond what is required to accommodate net employment changes. On average, excess reallocation accounts for the vast majority of total gross job reallocation because net employment growth is small in absolute value (Table 2). So even when aggregate employment does not change, many workers move between jobs or exit the labor force. Davis and Haltiwanger (1992) calculated that job flows account for one-third to more than one-half of all worker flows in labor markets.[25] Because these worker movements may entail spells of unemployment, destruction of human capital, and significant wage loss, the sheer magnitude of job flows has important effects on the aggregate labor market.

The picture painted by the gross job flows is one of tremendous churning and turnover, with simultaneous job creation and destruction even while aggregate employment is changing only modestly. But job reallocation goes far beyond what is required to accommodate net employment changes.

Between-industry job flows account for roughly one-third of total job flows, on average. Although this fraction is economically significant, between-industry job flows greatly understate the magnitude of total job flows between plants. Thus, it would be unwise to

[24] Comparable data on U.S. job flows in nonmanufacturing are not readily available. However, the limited data available suggest that job flow rates are at least as large, if not significantly larger, in nonmanufacturing. See Leonard (1987), Anderson and Meyer (1994), and Foote (1998) for evidence from the United States, and Davis, Haltiwanger, and Schuh (1996) for evidence from foreign countries.

[25] Workers may leave a job for reasons other than job destruction. They may be fired, quit, retire, or temporarily withdraw from the labor market. More generally, workers flow among the three main states of the labor market—employment, unemployment, and not in the labor force—for many different reasons.

Figure 5

Gross Job Flows in U.S. Manufacturing

Note:Seasonally adjusted quarterly data are used. Shaded areas show periods of recession.
Source: Longitudinal Research Database and authors' calculations.

draw conclusions about the nature and consequences of total job flows from between-industry job flows. However, despite being only one-third as large as total job flows, between-industry job flows are about as variable as total flows, particularly in the annual data.

Fact #2: Cyclicality

Total job flows are closely correlated with the business cycle (Figure 5). Job destruction rises sharply during recessions—sometimes doubling in a short time—whereas job creation tends to fall, although not by as much as destruction rises. The cyclical nature of the job flows is summarized by their business cycle correlations, meaning their correlations with aggregate net employment growth (Table 3, top panel). Job creation is procyclical (positively correlated with net employment growth), whereas job destruction and reallocation are countercyclical. Job creation and destruction are negatively correlated, but far from per-

Table 3
Gross Job Flows in U.S. Manufacturing, 1972 to 1993: Correlations and Variance Ratios

	Annual		Quarterly	
	Total	Between Industries	Total	Between Industries
Business Cycle Correlations:				
Creation and Net Employment Growth	.89	.90	.72	.86
Destruction and Net Employment Growth	−.94	−.95	−.91	−.97
Reallocation and Net Employment Growth	−.39	−.54	−.51	−.76
Creation and Destruction	−.68	−.73	−.37	−.74
Variance Ratios:				
Destruction/Creation	1.86	2.41	2.83	3.97
Total and Between Correlations:				
Creation		.95		.85
Destruction		.97		.94
Reallocation		.79		.75

Note: Quarterly data are seasonally adjusted. A variance ratio is the ratio of the time series variance of job destruction to the time series variance of job creation.
Source: Longitudinal Research Database and authors' calculations.

fectly inversely correlated, especially in the quarterly data.

Another pertinent feature is that job destruction is two to three times more variable than job creation, as seen in Figure 5 and the variance ratios in Table 3.[26] During recessions, job destruction rises by much more than job creation declines. In fact, sometimes job creation hardly declines, if at all, during recessions. Understanding this cyclical asymmetry between job creation and destruction is the central focus of recent theories aimed at explaining countercyclical job reallocation.

Macroeconomic models that incorporate the sectoral view are better suited to explain the cyclical characteristics of job flows than models without it. In particular, it is hard to explain the asynchronous movements between job creation and destruction over time and the weak correlation (−0.37) between them without the aspects of job and worker reallocation embodied in the sectoral view. Moreover, the sectoral view can explain these characteristics regardless of whether the driving forces behind the business cycle are aggregate or sector-specific factors.

Here's how the sectoral view can explain the impact of adverse sector-specific events, such as those in the 1970s and 1980s. Job destruction rises first because it is costly for adversely affected firms to postpone necessary employment reductions. Job creation falls somewhat because job destruction reduces aggregate demand. But job creation associated with sectoral reallocation is delayed for two reasons: inherent reallocation frictions, and transitory reductions in expected future demand. As these barriers subside, job creation rises, but only after a lag (see Figure 5).[27] If sector-specific events affect some sectors favorably instead, job creation and destruction responses could still be asynchronous with job creation moving first if jobs are filled by new labor force entrants.

Aside from obvious differences in their average levels, total and between-industry job flows exhibit very similar cyclical movements. Like the total job flows, between-industry job destruction rises sharply during recessions and between-industry job creation tends to fall, but by less than destruction rises. Indeed, the business cycle correlations and variance ratios of the between industry job flows are very similar to those of the total job flows (Table 3, top and middle panels). Furthermore, the correlation between total job flows and between-industry job flows is high for each type of job flow (Table 3, bottom panel).

This result suggests the possibility of using between-industry job flows in macroeconomic modeling and policy analysis. The contrast in magnitudes of the two types of flows requires that we continue developing a deeper understanding of the relationship between the two types of job flows by looking at other characteristics.

[26] The limited evidence on job flows outside manufacturing suggests that this asymmetry may be unique to manufacturing or to goods-producing industries. See Ritter (1994) and Foote (1998) for details.

[27] Some observers mistakenly infer that the sectoral shifts hypothesis requires job creation and destruction to move in the *same* direction during recessions. Instead, the hypothesis assumes an inherent lag between creation and destruction.

Table 4
Persistence Rates for Gross Job Flows in U.S. Manufacturing, 1972 to 1993: Basic Statistics
Percent

Statistic	Type	Annual		Quarterly	
		One-Year	Two-Year	One-Year	Two-Year
Mean (Standard Deviation):					
Creation	Total	68.8	53.4	41.4	29.0
		(6.4)	(8.0)	(8.2)	(6.4)
	Between Industries	68.2	50.1	32.4	22.4
		(17.9)	(20.6)	(22.6)	(19.3)
Destruction	Total	81.7	74.3	51.4	44.0
		(4.5)	(5.3)	(9.5)	(8.5)
	Between Industries	82.3	74.0	41.2	35.3
		(12.9)	(15.4)	(19.7)	(19.0)
Business Cyclical Correlations:					
Creation	Total	.20	−.10	.37	.19
	Between Industries	.35	.09	.54	.37
Destruction	Total	−.06	.11	−.44	−.28
	Between Industries	−.22	−.09	−.69	−.56
Creation, Destruction	Total	−.69	−.53	−.33	−.29
	Between Industries	−.71	−.79	−.75	−.70

Note: Quarterly data for means and standard deviations are not seasonally adjusted; quarterly data for correlations are seasonally adjusted. The means and standard deviations are calculated across all plants for Total and across all industries for Between Industries.
Source: Longitudinal Research Database and authors' calculations.

Fact #3: Persistence

Gross job flows are primarily permanent. Three-fourths of annual job destruction and more than half of annual job creation lasts at least two years, on average, as shown in Table 4.[28] However, these average persistence rates do not fully reflect the permanence of plant-level employment changes. Most job flows at plants are actually permanent (85 to 100 percent persistence rates) while others are ultimately transitory, as demonstrated by Schuh and Triest (1998). Job flows of greater than 50 percent—including plant startups and shutdowns—tend to be especially permanent, not being reversed at all for up to five years.

The permanence of plant-level employment changes contrasts with aggregate net employment changes. Aggregate net employment changes are persistent, but ultimately the changes are temporary and do not necessarily involve permanent worker separations. For this reason, net employment changes provide little information about the permanence of shifts in plant-level or sectoral labor demand, or about the impact of these shifts on workers and unemployment.

Persistence of total job flows fluctuates only modestly over the business cycle (Figure 6). Job creation persistence is procyclical and job destruction persistence is countercyclical, so the two persistence rates are negatively correlated (Table 4, bottom panel). But the total persistence rates do not fluctuate much over the business cycle, as measured by standard deviations relative to means (Table 4, top panel). A notable development is that job destruction persistence has been increasing over time, rising roughly 1 percentage point per year. This trend may be contributing to the popular perception that "downsizing" has increased despite the fact that job destruction does not show a trend increase.

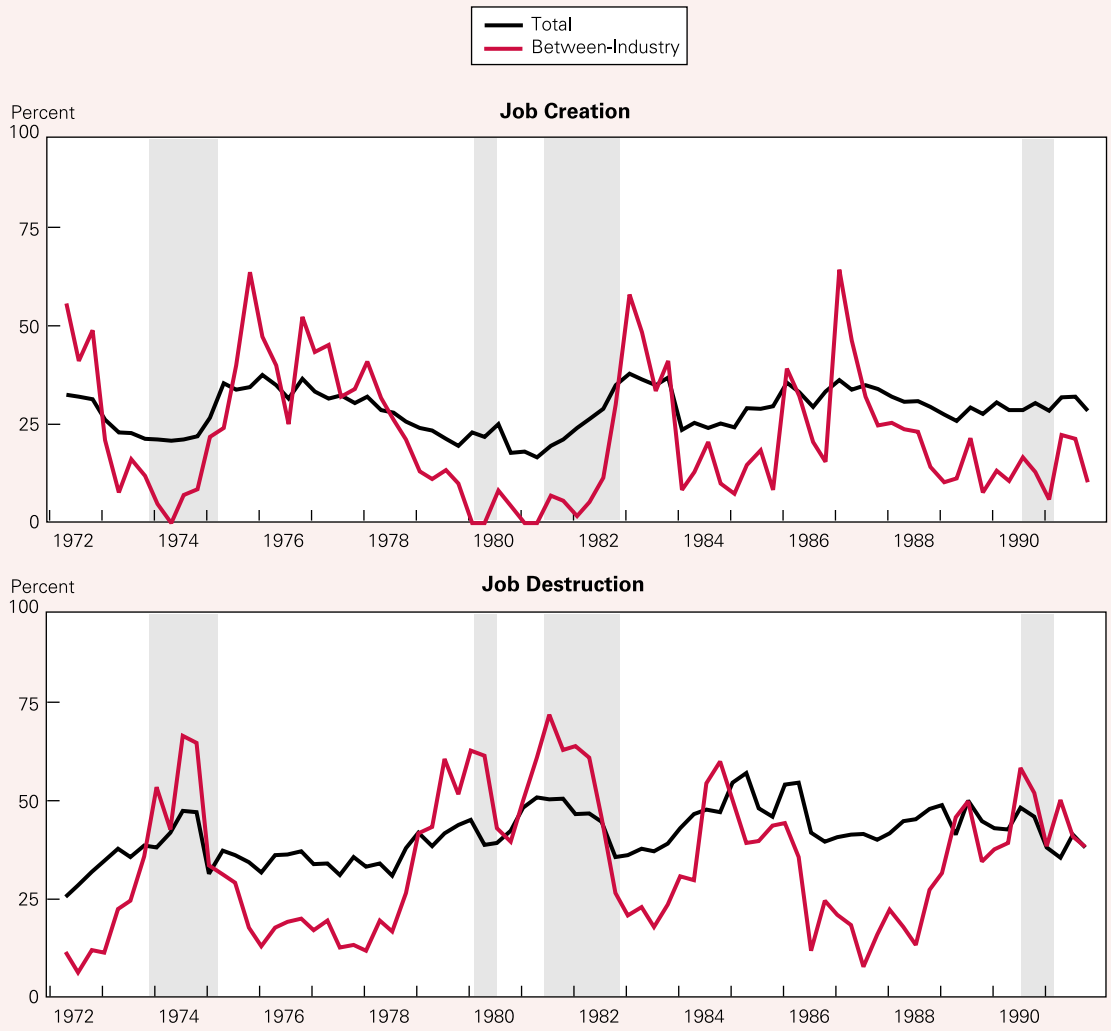
On average, the persistence rates of total and between-industry job flows are similar in magnitude (Table 4). This similarity suggests that employment changes in detailed industries, like employment changes in plants, tend to be primarily permanent. This finding contrasts with the conventional wisdom that industry employment changes during recessions are ultimately transitory in the same manner as aggregate net employment changes. A noteworthy difference is that the persistence rates of between-industry flows are two to three times more variable than those of total flows (Table 4, Figure 6). Nevertheless, the persistence rates of the two types of flows move together over time.

Because between-industry job reallocation is similar in spirit to a more disaggregated version of Lilien's dispersion measure, it is also subject to the Abraham-Katz criticism. One way to control for this

[28] Average persistence is higher for job destruction than job creation because, on average, manufacturing employment is shrinking over this period.

Figure 6

Two-Year Persistence Rates for Gross Job Flows



Note: Seasonally adjusted quarterly data are used. Shaded areas show periods of recession.

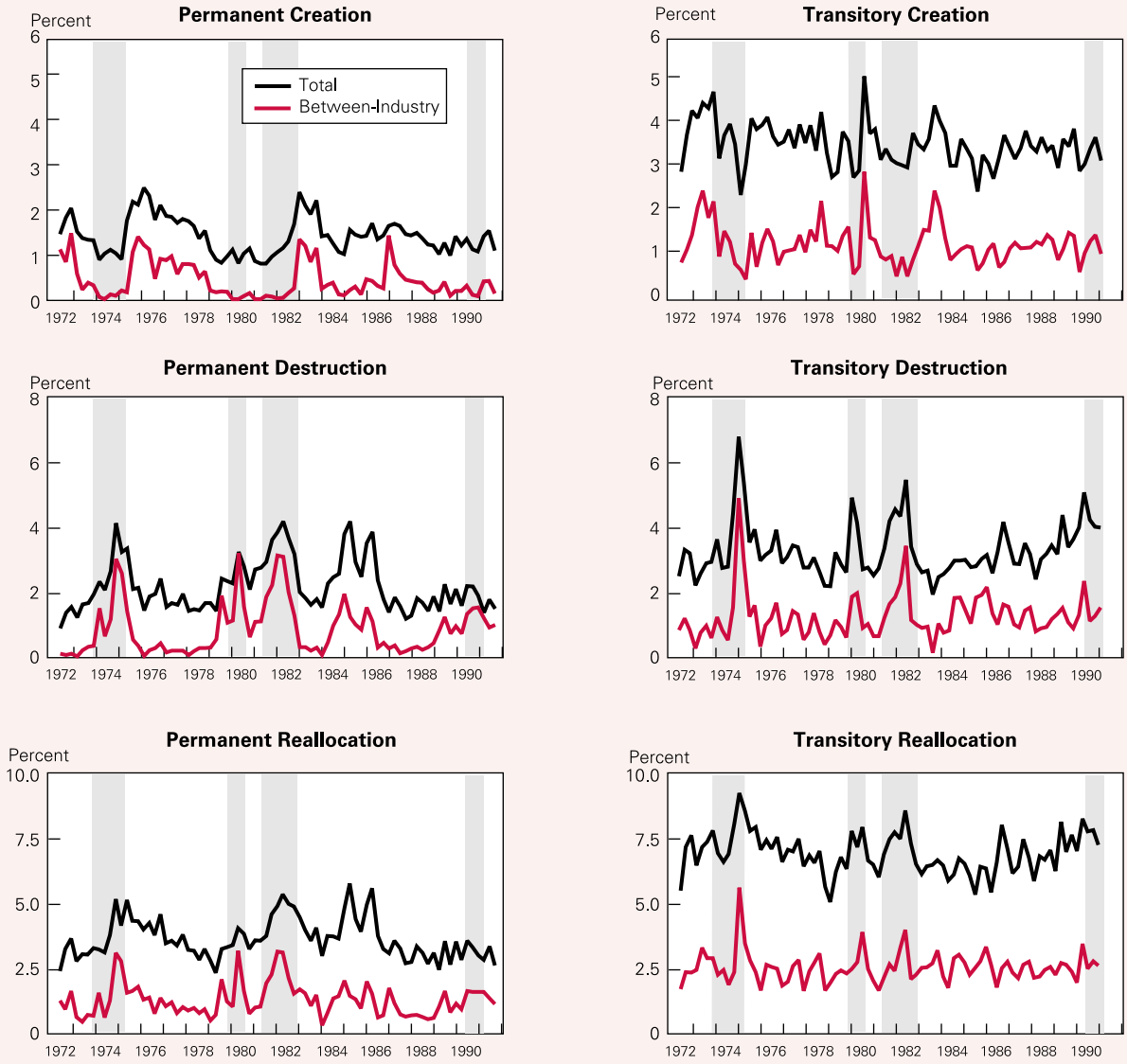
Source: Longitudinal Research Database and authors' calculations.

criticism is to focus on permanent job flows—job flows that last at least two years. If transitory shifts in labor demand associated with aggregate demand fluctuations, such as those envisioned by Abraham and Katz, do not last more than two years, then permanent job flows reflect true structural shifts in employment across plants and industries. Furthermore, if permanent job reallocation is countercyclical then true restructuring is connected to the business cycle.

Figure 7 plots the permanent components (persistence rate times job flow rate) of total and between-industry job flows. Permanent job flows exhibit time series characteristics very similar to the overall flows of jobs between plants and between industries shown in Figure 5. Permanent job reallocation is clearly countercyclical. However, transitory job reallocation is also clearly countercyclical. Apparently two phenomena are occurring. Countercyclical transitory job reallocation suggests that the Abraham-Katz effect is indeed at work. However, countercyclical permanent

Figure 7

Permanent-Transitory Decomposition of Job Flows



Note:Seasonally adjusted quarterly data are used. Shaded areas show periods of recession.

Source: Longitudinal Research Database and authors' calculations.

reallocation suggests that the elements of the sectoral view are also at work.

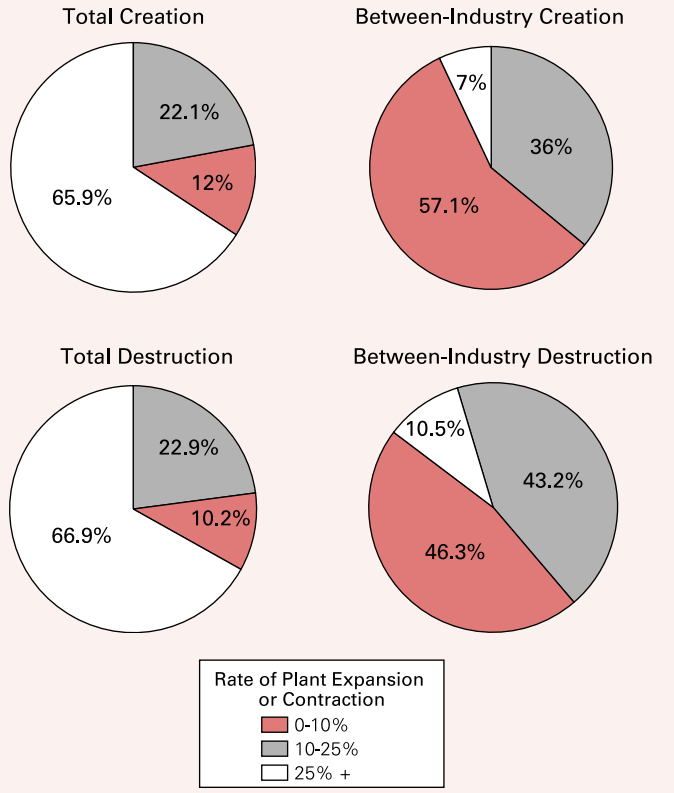
Once again, between-industry jobs flows prove to be generally reliable indicators of total job flows. In particular, the cyclical characteristics of permanent between-industry job flows are very similar to those of permanent total job flows, with the caveat that between-industry job flows are much smaller. Thus, both types of permanent job reallocation indicate that true employment restructuring is countercyclical.

Fact #4: Concentration

Gross job flows are concentrated in a relatively small number of plants with very large employment changes (Figure 8). Two-thirds of total jobs created

Figure 8

Concentration of Annual Gross Job Flows



Note: Total job flows are for 1973 to 1988, and between-industry job flows are for 1973 to1993.
Source: Longitudinal Research Database and authors' calculations.

and destroyed occur in plants that expand or contract by more than 25 percent in one year. Plants that start up (infinite growth rate) and completely shut down (100 percent decline) account for sizable portions of these job flows.

To appreciate the significance of this concentration, contrast plant-level employment changes with aggregate net employment changes. In every year from 1973 to 1993, annual net employment growth in manufacturing fell within the range of −10 percent to +10 percent. Thus *all* manufacturing net employment changes fall in the "small" category, whereas only one-tenth of total plant-level employment changes do. As with persistence, aggregate net employment data provide a misleading view of the concentration of employment changes among plants.

The existence of large, uneven job flows among plants implies that employment adjustment may affect some local labor markets disproportionately. If it is more difficult for workers to find new jobs as job destruction rises in a local labor market, then uneven job destruction will produce higher and more persistent unemployment than more even and moderate job destruction would. During recessions, the increase in job flows is concentrated in certain types of plants—large, old, and high-wage—that tend to employ certain types of workers—older, skilled, and high-wage. Because these plants are concentrated in particular industries and geographic regions, the cyclical effects are worse for some local labor markets and their workers. In sum, because of concentration, job destruction could potentially have a different impact on wage growth and expected unemployment duration during recessions than it does during expansions.

Predictably, job flows between industries are concentrated relative to aggregate net employment, but notably less concentrated than total job flows. About one-half of all job flows between industries occur in industries with "small" job flows—like net employment changes in manufacturing. The other half of between-industry job flows occur in industries with moderate and large job flows. But the magnitudes of these flows are much smaller than total job flows in these categories, so the concentration of job flows between industries greatly understates total concentration and the full impact of large, permanent employment changes in plants on local communities.

Summary of Facts

Gross job flows are large and permanent, occurring unevenly throughout the economy and fluctuating significantly over the business cycle. This portrait of gross job flows is essentially the same as what we reported in earlier research on total flows among plants, where we concluded that most of these job flows occur within industries. The new fact here is that gross job flows between detailed industries exhibit the same characteristics, by and large. Readers who are familiar with our earlier work or who want to understand how to reconcile these two results are referred to the discussion in the Box.

Comparison of Old and New Results

Despite some notable differences, between-industry job flows are very similar to total job flows. This conclusion contrasts with our earlier research, which attributed four-fifths of the variation in job reallocation to reallocation *within* detailed industries and categorically ruled out Lilien's theory. What explains this apparent contrast? The answer is that the measures of within-industry and between-industry job reallocation are not compatible, conceptually or empirically. We briefly explain why here but refer the reader to Haltiwanger and Schuh (1998) for more details.

Originally, Davis and Haltiwanger (1990, 1992) set out to construct a measure of job reallocation that abstracts from the criticisms of Abraham and Katz. Gross job reallocation is conceptually similar to Lilien's dispersion measure, except for the unit of measurement (plants versus industries), and empirically similar with a correlation of 0.49 in the raw data. (Figure 9 plots smoothed data.) Consequently, job reallocation may be subject to the Abraham and Katz criticism as well.

To control for the Abraham and Katz criticism, Davis and Haltiwanger proposed an adjusted measure of job reallocation based on the *idiosyncratic component* of a plant's employment growth rate,

$$\tilde{g}_{eit} = g_{eit} - \tilde{g}_{it} - g_t,$$

where g is employment growth and

$$\tilde{g}_{it} = g_{it} - g_t$$

is the idiosyncratic component of industry employment growth.[29] Subtracting aggregate growth (g_t) controls for the fact that aggregate employment changes during recessions are asymmetric, with short, sharp declines followed by relatively gradual increases. Subtracting idiosyncratic industry growth controls for variation in the cyclical sensitivities of industries.[30] If not controlled for, both of these effects would produce spurious countercyclical job reallocation.

It is immediately apparent from Figure 10 why we concluded that job reallocation within industries accounts for the vast majority of cyclical movements in total reallocation: Idiosyncratic plant-level job reallocation is very similar to total reallocation (top panel). In other words, the Abraham and Katz effects are not very important and employment restructuring is very countercyclical. Because idiosyncratic reallocation controls for industry effects, we interpreted it as "within-industry" reallocation. Yet between-industry reallocation and its idiosyncratic component are clearly very countercyclical as well (bottom panel).[31]

A second look at Figure 10 reveals the sources of tension in these two conclusions. First, interpreting idiosyncratic reallocation as "within" industries implies, inappropriately, that "other" reallocation (total minus idiosyncratic) is "between" industries. "Other" reallocation is tiny and acyclical, thus a poor reflection of true between-industry reallocation. Second, idiosyncratic and between-industry reallocation sum to more than total reallocation, so the two measures do not form an exact decomposition of total reallocation into compatible "between-industry" and "within-industry" components. The positive covariance between these measures further implies caution when interpreting the relationship between them.

What we conclude at this point is important: *All meaningful measures of job reallocation are significantly countercyclical*. We report in Haltiwanger and Schuh (1998) that all of the measures of between-industry job reallocation that might be trusted for macroeconomic and policy analysis are closely correlated with total

[29] Idiosyncratic job reallocation is the employment-weighted sum of absolute idiosyncratic growth rates:

$$\tilde{r}_t = \sum_e \left(\frac{E_{eit}}{E_t} \right) |\tilde{g}_{eit}|.$$

"Other" job reallocation is the residual

$$\hat{r}_t = r_t - \tilde{r}_t,$$

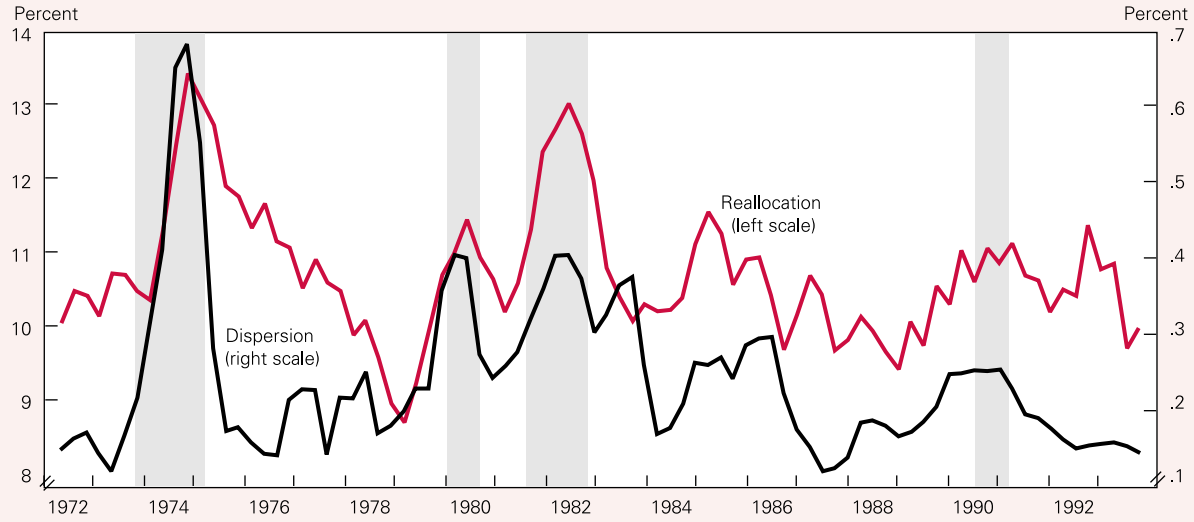
which differs substantially from between-industry reallocation.

[30] The idiosyncratic component does not control for the possibility that plants have different sensitivities to transitory industry effects, which is analogous to the differing sensitivities of industries to business cycles. This point merits further consideration, but it was not part of the Abraham and Katz criticism.

[31] The idiosyncratic component of between-industry job reallocation controls for the 2-digit industry employment growth rate common to the 4-digit industries.

Figure 9

Job Reallocation and Employment Dispersion



Note:Seasonally adjusted, smoothed, quarterly data are used. Shaded areas show periods of recession.
Source: Longitudinal Research Database and authors' calculations.

reallocation measures. Furthermore, between-industry job reallocation measures can account for as much as half of the variation in total job reallocation over the business cycle. For some reason, both total and between-industry job reallocation are connected to the business cycle—as a cause, a consequence, or both.

V. Aggregate Regression Evidence

Although we have established that job reallocation is significantly countercyclical, it remains to be seen whether it has a significant impact in macroeconomic models and, if so, whether it has any significant implications for the conduct of government policy. A complete investigation of these issues clearly goes well beyond the scope of this article, but we want to provide some suggestive evidence on the macroeconomic importance of job reallocation that we hope will stimulate further research.

The sectoral view and the job reallocation data suggest two primary hypotheses for macroeconomics. First, job reallocation may affect the natural rate of unemployment. Second, sector-specific factors may cause job reallocation (and unemployment) to increase. This section reports the results of two regression exercises aimed at providing evidence on these two hypotheses. Our regressions also provide another useful testing ground for evaluating the relationships among alternative measures of job reallocation.

To investigate the relationship between job reallocation and the unemployment rate, we estimated unemployment rate equations based on a simple Okun's Law model modified to include various measures of job reallocation. The estimating equation is

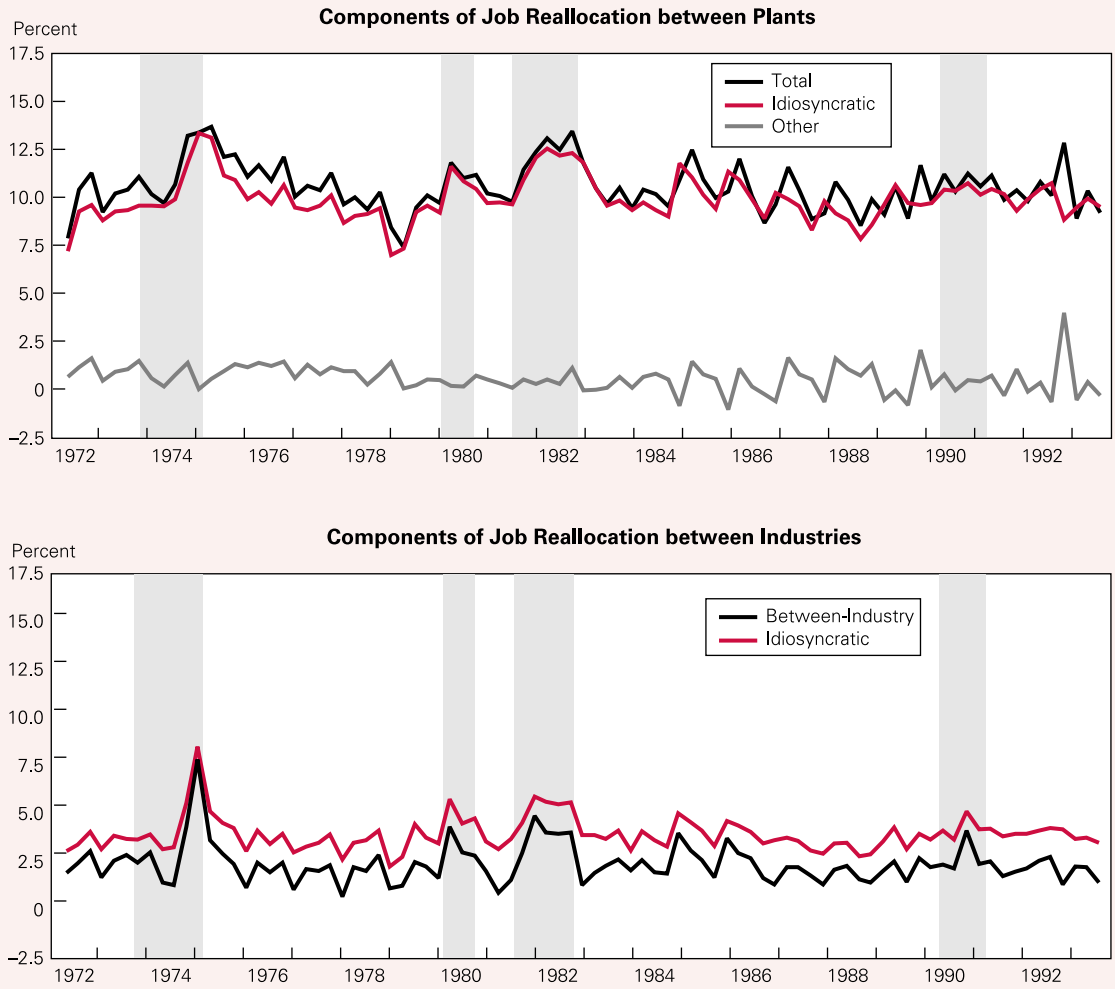
$$U_t = \alpha_0 + \alpha_1 U_{t-1} + \alpha_{2,0}(Y_t - \bar{Y}_t) + \alpha_{2,1}(Y_{t-1} - \bar{Y}_{t-1}) + \alpha_3 R_t + \alpha_4 DEMOG_t + \alpha_5 TREND_t, \quad (12)$$

where U_t is the manufacturing unemployment rate, $(Y_t - \bar{Y}_t)$ is the manufacturing output gap (in logs), R_t is job reallocation, $DEMOG_t$ is a demographic control defined as the labor force share (in percent) of workers aged 16 to 24, and $TREND_t$ is a linear time trend.[32] The lags of the unemployment rate and output gap control for economic factors that may cause serial correlation in the unemployment rate. Okun's Law predicts that $\alpha_2 = \alpha_{2,0} + \alpha_{2,1}$ should be negative, the sectoral view

[32] The unemployment rate and output (industrial production) gap are based on manufacturing data because the job reallocation data are for manufacturing only. However, the regression results are virtually the same using total U.S. unemployment and an output gap based on real GDP.

Figure 10

Decompositions of Job Reallocation



Note: Seasonally adjusted quarterly data are used. Shaded areas show periods of recession.
Source: Longitudinal Research Database and authors' calculations.

predicts that α_3 should be positive, and α_4 should be positive because young workers have above-average unemployment rates.[33]

Table 5 shows that job reallocation is a significant determinant of the unemployment rate even after controlling for conventional explanatory variables. All variables enter significantly and with the predicted signs. According to the gross job flow measures, the impact of job reallocation on the unemployment rate is roughly twice as large as the impact of the output gap (sum of current and lagged coefficients) and

[33] The model is estimated by ordinary least squares (OLS) even though the presence of the contemporaneous output gap and reallocation rate may cause simultaneity bias. Despite this potential problem, OLS estimation is common in this literature—see the regressions in Lilien (1982) and Abraham and Katz (1986) for examples. We estimated the model with a wide range of instrumental variables (IV) specifications and often found reallocation to be positive and significant. But the IV estimates were not very robust across specifications and we could not find one that yielded significant and correctly signed estimates for all parameters.

almost as large as the impact of demographic shifts. Because Okun's Law models are sometimes used to infer the natural rate of unemployment, these results imply that job reallocation would affect estimates of the natural rate.

The estimates in Table 5 also confirm our predictions about the various job reallocation measures. Gross job flows are more significant than the Lilien measure, and both idiosyncratic measures perform better overall than the total measures. Results for the between-industry job flows are very similar to those for total job flows—in fact, they are actually somewhat better.

To determine whether sector-specific factors may cause job reallocation to increase, we look for a relationship between changes in industries' relative prices and reallocation. An appropriate econometric model for this is a vector autoregression (VAR), in which the reallocation equation is

Table 5
Okun's Law Unemployment Rate Regressions

$$U_t = \alpha_0 + \alpha_1 U_{t-1} + \alpha_{2,0}(Y_t - \bar{Y}_t) + \alpha_{2,1}(Y_{t-1} - \bar{Y}_{t-1}) + \alpha_3 R_t + \alpha_4 DEMOG_t + \alpha_5 TREND_t$$

	Job Reallocation Measures					
			Between Plants		Between Industries	
Independent Variable	None	Lilien	Total	Idiosyncratic	Total	Idiosyncratic
U_{t-1}	.82**	.81**	.83**	.80**	.80**	.81**
	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)
$(Y_t - \bar{Y}_t)$	−.39**	−.35**	−.35**	−.34**	−.35**	−.32**
	(.02)	(.03)	(.03)	(.03)	(.03)	(.03)
$(Y_{t-1} - \bar{Y}_{t-1})$	.31**	.28**	.30**	.28**	.28**	.26**
	(.03)	(.04)	(.03)	(.03)	(.04)	(.04)
R_t		.85*	.11**	.14**	.12**	.17**
		(.44)	(.05)	(.05)	(.05)	(.05)
$DEMOG_t$	.19**	.17**	.18**	.19**	.19**	.21**
	(.08)	(.08)	(.08)	(.08)	(.08)	(.08)
$TREND_t$	.016*	.016*	.017**	.018**	.018**	.020**
	(.009)	(.009)	(.008)	(.008)	(.008)	(.008)
R-squared	.9714	.9727	.9734	.9738	.9733	.9748
Q (p-value)	.25	.46	.46	.28	.59	.82

Notes: The equation is estimated with ordinary least squares using quarterly data over the period 1972:Q3 to 1993:Q4. *U* is the manufacturing unemployment rate, *YGAP* is the industrial production output gap, *R* is job reallocation, *DEMOG* is the labor force share of workers aged 16 to 24, and *TREND* is a linear time trend. A constant is included in the estimation but not reported. Standard errors are in parentheses. ** indicates significant at the 5 percent level and * indicates significant at the 10 percent level. Q is the Ljung-Box statistic for a test of serial correlation in the residuals, and the p-value is the significance level of the test of the null hypothesis of no serial correlation.

$$R_t = \alpha + \sum_{i=1}^{4} (\beta_i R_{t-i} + \gamma_i N_{t-i} + \delta_i FFR_{t-i} + \phi_i RPD_{t-i}), \quad (13)$$

where N_t is net employment growth, FFR_t is the federal funds rate (a common measure of monetary policy), and RPD_t is relative price dispersion in output prices.[34] If job reallocation increases when aggregate demand declines, lags of N_t should be negative and lags of FFR_t positive. If job reallocation—particularly between industries—increases after relative prices change among industries, lags of RPD_t should be positive. This latter point does not prove that relative price dispersion causes reallocation, but if dispersion does cause reallocation, then this relationship would appear.

Table 6 shows that relative price dispersion tends to be the most significant determinant of job reallocation. The positive coefficient on lagged RPD_t means that increases in price dispersion during the preceding year lead to increases in current job reallocation. Lagged monetary policy also is a significant determinant of current job reallocation, as indicated by the positive coefficients on lags of FFR_t. Net employment growth is important only for between-plant reallocation, and reallocation lags are all insignificant. Again, both types of idiosyncratic reallocation perform better than total, and between-industry reallocation works as a good proxy for total between-plant reallocation.

VI. Conclusion

Dynamic market economies undergo tremendous and continual employment restructuring throughout

[34] See Schuh and Triest (1998) for definitions and discussions of this and related variables. In unreported regressions we find that dispersion in the relative price of raw materials works essentially the same way.

Table 6
Job Reallocation Regressions

$$R_t = \alpha + \sum_{i=1}^{4} (\beta_i R_{t-i} + \gamma_i N_{t-i} + \delta_i FFR_{t-i} + \phi_i RPD_{t-i})$$

Independent Variable	Job Reallocation Measures: Lilien (×10)	Between Plants: Total	Between Plants: Idiosyncratic	Between Industries: Total	Between Industries: Idiosyncratic
R	−.44	.16	.06	.01	−.54
	(2.19)	(.23)	(.24)	(.30)	(.34)
N	−.23	−.27*	−.42**	−.22	−.17
	(.15)	(.14)	(.14)	(.14)	(.17)
FFR	.13**	.03	.07*	.07*	.08*
	(.05)	(.04)	(.04)	(.04)	(.04)
RPD	.14**	.16**	.13**	.12**	.11**
	(.06)	(.06)	(.05)	(.06)	(.05)
R-squared	.60	.55	.62	.52	.42
Q (p-value)	.01	.96	.25	.14	.51

Notes: The equation is estimated with ordinary least squares using seasonally adjusted quarterly data over the period 1973:Q2 to 1993:Q4. *R* is job reallocation, *N* is manufacturing net employment growth, *FFR* is the federal funds rate, and *RPD* is relative price dispersion of industry output price changes in manufacturing. Parameter estimates are the sums of the four lagged coefficients with standard errors in parentheses. Parameters and standard errors in the first column (Lilien) are multiplied by 10. A constant is included in the estimation but not reported. ** indicates significant at the 5 percent level and * indicates significant at the 10 percent level. Q is the Ljung-Box statistic for a test of serial correlation in the residuals, and the p-value is the significance level of the test of the null hypothesis of no serial correlation.

the business cycle. In U.S. manufacturing, this process of job reallocation occurs at very high rates and affects a large fraction of jobs and workers each year. Most job reallocation represents large, permanent shifts in labor demand across plants and industries. As a result, it produces permanent separations of workers from their jobs and requires them to engage in a costly, time-consuming search for new jobs. Job reallocation between detailed industries accounts for about one-third of all job reallocation, and its time series properties are generally similar to those of total reallocation.

Job reallocation has important implications for macroeconomics because it intensifies markedly during recessions. After controlling for factors that could produce a spurious correlation between reallocation and the business cycle, we find that all meaningful measures of job reallocation are significantly countercyclical. We also find econometric evidence that job reallocation may be an important determinant of unemployment via the natural rate, and that at least one sector-specific factor—dispersion in relative prices—may be an important determinant of reallocation, and hence of some unemployment.

Taken all together, our findings motivate further development of macroeconomic models that explicitly incorporate elements of the sectoral view of reallocation and business cycles. Our previous research has spawned numerous interesting new theories to explain endogenous job flows and countercyclical job reallocation in macroeconomic models. However, perhaps because we did not draw out the evidence on job reallocation between industries, these theories generally have not incorporated intersectoral job reallocation. This article provides evidence that these theories should include both within-sector and between-sector reallocation.

Furthermore, the strong empirical similarities between job reallocation occurring between industries and between plants (total) bode well for testing of macroeconomic models containing elements of the sectoral view. Between-industry reallocation data can be constructed for the entire U.S. economy, can be extended further back in time, and are available much more frequently. Each of these possibilities overcomes serious disadvantages, from a macroeconomic perspective, of the manufacturing plant-level reallocation data from the LRD at the Census Bureau. Between-industry data appear to be valid for use in estimating many macroeconomic models, provided one keeps in mind their notable differences from the between-plant data.

Job reallocation has important implications for macroeconomics. We find that all meaningful measures of job reallocation are significantly countercyclical. We also find econometric evidence that job reallocation may be an important determinant of unemployment via the natural rate.

Finally, we close by pointing out that very little research or evidence exists on the implications of job

reallocation for macroeconomic and microeconomic government policies. By far, most macroeconomic analysis of government policy—monetary and fiscal policy—has been conducted with models that do not include explicitly the features of the sectoral view. Yet the theory and empirical evidence on the connections between job reallocation and the rest of the economy suggest that the design of optimal government policy may be affected by the sectoral view. Until macroeconomists develop more complete models with the sectoral view, however, it is not possible to identify the implications and recommendations for government policy.

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