Can sectoral reallocation explain the jobless recovery?

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Introduction and summary

Recent employment trends are puzzling.[1] Historically, the number of nonfarm jobs has grown rapidly following the end of a recession. For instance, during each of the five recessions of the 1960s, 1970s, and 1980s, it took less than four months for employment to exceed its level at the end of the recession ("the trough"). On average, 26 months into those recoveries, employment was 5.4 percent higher than at the end of the recession and 3.6 percent higher than at the previous expansion's peak.

Employment growth was much weaker after the recession of the early 1990s, when it took 14 months for the number of jobs to return to the level reached at the trough and an additional nine months before it exceeded the previous expansion's peak. Even 26 months into that recovery, employment was only 1.8 percent above the trough. Moreover, job growth has been even more disappointing since the most recent recession. As of January 2004, 26 months into this recovery, nonfarm payrolls are actually 0.5 percent *below* those of November 2001, the date the National Bureau of Economic Research says the recession ended.

Many analysts have attributed this surprisingly weak employment performance to an increased need for sectoral reallocation. According to this theory, an accelerating pace of structural change has greatly increased the number of workers forced by job loss to make major career transitions. Because securing a new job in a different economic sector often takes a significant amount of time, the theorized increase in the need for sectoral reallocation is thought to have temporarily raised unemployment and restrained employment growth.

It is important to note that sectoral reallocation is not new, nor in the long run is it a bad thing. In a well-functioning economy, the growth in international trade, shifts in product demand, and productivity growth that varies across sectors all imply that resources constantly need to be reallocated from one part of the economy to another. Recent research shows that such reallocation is an important contributor to overall productivity growth and, thus, to rising living standards.[2] Consequently, in the long run, reallocating workers to their most productive use greatly benefits the economy.

However, in the short run, reallocation is costly.[3] Workers displaced from contracting sectors of the economy need to spend time searching for new jobs. This can take substantial time and resources, especially if workers' old skills do not match those demanded by firms in expanding sectors. Thus, an increased need for sectoral reallocation may temporarily increase the economy's natural rate of unemployment and lower its rate of employment growth.

The notion that the U.S. is currently experiencing an increased need for sectoral reallocation is at least superficially consistent with a number of recent developments. In particular, certain segments of the economy, most notably manufacturing, have seen particularly large declines in employment.[4] In addition, there has also been much discussion of possible increases in "outsourcing," "offshoring," and other employment practices that could increase worker displacement. Especially prominent have been claims, largely undocumented to date, that, because of the development of the Internet, workers in many service and technical occupations that were formerly relatively isolated from international competition are now being replaced by workers in countries such as India or China.

It is not clear, however, that the need for sectoral labor reallocation is especially great right now. As we have noted, reallocation is always occurring in a dynamic economy, and while it is true that manufacturing has been hit hard recently, this sector is always severely impacted by recession.[5] Moreover, the loss of jobs to foreign competition is hardly new. There has been a long history of concern over job losses to Japan, Korea, Mexico, and a host of other countries, even while employment has continued to expand.

In this article, we reconsider the case for sectoral reallocation's role in the "jobless recovery." We begin by reviewing previous work on measures of sectoral reallocation. This includes evidence on the extent of worker displacement, reasons for unemployment, and job creation and job destruction, as well as statistical models of reallocation based on readily available industry-level employment data. We offer a critique of these measures, with a particular emphasis on the recent contribution of Erica Groshen and Simon Potter (2003), the study most often cited by those who identify sectoral reallocation as the cause of the recent "jobless recovery." Finally, we offer new evidence of the extent of sectoral reallocation based on the methodology of Rissman (1997).

Our conclusion is that there is little evidence of an increase in sectoral reallocation. Groshen and Potter have unearthed some interesting clues about what factors may be leading to jobless recoveries, but we do not believe that the statistic that they identify—the correlation between employment growth rates during and after recessions—is a particularly close proxy for sectoral reallocation. In addition, we find that other, more traditional measures of sectoral reallocation based on changes in industry employment shares actually rose less during the most recent two recessions than in previous recessions. Moreover, those measures declined to normal levels relatively promptly once the recent recessions ended. These results hold even after appropriate adjustments for business cyclical effects and are not particularly sensitive to the treatment of such factors as long-run trends in industry employment shares.

This negative result for reallocation across industries does not necessarily imply that other forms of reallocation have not been more significant recently. It is possible, for example, that there has been an increase in the number of workers forced to make major career transitions, but that those transitions have involved changing occupations or geographic regions, rather than industries. However, it would be somewhat surprising if there were a major increase in labor reallocation that did not result in a marked increase in industrial reallocation, and there is some limited evidence that the level of overall reallocation of workers across firms is currently relatively low. Thus, economists should continue to look for other explanations for the disappointing employment growth of the last two years.

Measures of sectoral reallocation

Although the concept of sectoral reallocation is easily stated, measuring its extent is very difficult in practice. Ideally, one would like to identify those workers or categories of workers who have lost their jobs because of structural change and to know to what extent those workers' skills differ from those necessary to fill available openings. Unfortunately, such ideal data do not exist and economists have been forced to rely on proxy measures that they hope are proportional to the amount of unemployment caused by sectoral reallocation. These have most often been based on transformations of industry-level employment totals. Such is the case with the measure proposed by Groshen and Potter (2003), as well as those of Lilien (1982) and Rissman (1997). Before turning to such measures, however, we briefly discuss some other data that might shed light on how the extent of necessary structural reallocation has varied over time.

Displacement rates

Perhaps the best source of data on the number of workers negatively impacted by structural change in recent years is the *Displaced Worker Survey* (DWS), a biennial supplement to the Bureau of Labor Statistics' (BLS) *Current Population Survey* that asks respondents if they have lost a job in the past three years.[6] Job losses are assigned to six possible reasons. In most cases, job loss is attributable to one of the three standard reasons—plant or company closing down or moving, position or shift being abolished, and insufficient work—and therefore may be the consequence of structural change.

Aaronson and Sullivan's (1998 and 2003) analysis of the DWS shows that the fraction of high-tenured workers suffering job loss was relatively high in the late 1990s, especially given what were otherwise very favorable labor market conditions. This finding is suggestive of a relatively high degree of sectoral reallocation during that period. Unfortunately, the DWS data are only available through 2001. Moreover, available tabulations only provide displacement rates for the combined 1999–2001 time period and, thus, do not permit an analysis at the shorter time horizons that would be necessary to evaluate the role of displacement in contributing to weak employment growth following the recession.[7]

Reasons for unemployment

Figure 1 shows the percentage of the labor force reported unemployed due to temporary and permanent layoffs. As Groshen and Potter (2003) note, the last two recessions did not see the kind of significant increase in temporary layoffs that was typical of previous recessions. They interpret this finding as being consistent with structural change having played a more prominent role in the last two recessions.

The declining usage of temporary layoffs, from which workers can be quickly recalled, may have played some part in reducing the speed with which employment declines are reversed after recessions. But, even in earlier recessions, only a minority of unemployed workers were on temporary layoff and the fall in the proportion of the unemployed on temporary layoff isn't large enough to explain a major portion of the decline in post-recession employment growth. For instance, the number of workers on temporary layoff fell by the equivalent of 1.3 percent of total household employment in the two years after the 1982 trough, compared with drops of only 0.3 percent and 0.1 percent, respectively, following the 1991 and 2001 recessions. While that is a substantial change, it is not large compared with the difference in overall employment growth following the 1982 and subsequent recessions, which was roughly 8 percent in the two years after the 1982 trough but only 1.3 percent after the 1991 trough and only –0.6 percent after the 2001 trough.

Moreover, it seems more reasonable to identify sectoral reallocation not with a low level of temporary layoffs, but rather with a high level of permanent layoffs. And, as figure 1 shows, during the last two recessions, the fraction of the labor force unemployed due to permanent layoffs did not rise to historically high levels. In fact, the peak in permanent layoffs during the early 1990s recession was far below that of the 1981–82 recession, and the peak of permanent layoffs during the most recent recession was also below that of the 1975 recession. Thus, we do not view the data on reasons for unemployment as offering support for the theory that sectoral reallocation is the cause of the jobless recoveries

Job reallocation data

The Bureau of Labor Statistics' new Business Employment Dynamics data offer another perspective on sectoral reallocation. These data build on previous work by Davis and Haltiwanger (1990) and Davis, Haltiwanger, and Schuh (1996) quantifying the extent of "job creation" and "job destruction" in the manufacturing sector using data from the Longitudinal Research Database of the Center for Economic Studies of the Census Bureau. In this work, job creation refers to the total increase in quarterly employment at manufacturing establishments that increase their employment or are newly opened, and job destruction refers to the total decline in quarterly employment at establishments that decrease employment or close. The net increase in employment is the difference between job creation and job destruction, while the sum of job creation and job destruction is referred to as total job reallocation.

Davis and Haltiwanger (1990) and Davis, Haltiwanger, and Schuh (1996) examine job creation and job destruction over the business cycle. They find that manufacturing job destruction is strongly countercyclical but that manufacturing job creation is only mildly procyclical. Unfortunately, their data do not seem to have been updated past 1993. Moreover, the data's narrow focus on manufacturing does not allow an assessment of reallocation across all industrial sectors.[8]

Recently, however, the Bureau of Labor Statistics began releasing quarterly statistics on job creation and job destruction for the entire economy. A weakness of this important new data source is that it only begins in 1992, so it covers only the most recent recession. While this means we cannot use it to determine whether the behavior of job creation or destruction during the current cycle is unusual, the new Business Economic Dynamics data

FIGURE 1

Percent of labor force unemployed because of permanent and temporary layoff

Note: NBER dated recessions are shaded in gray.
Source: Bureau of Labor Statistics.
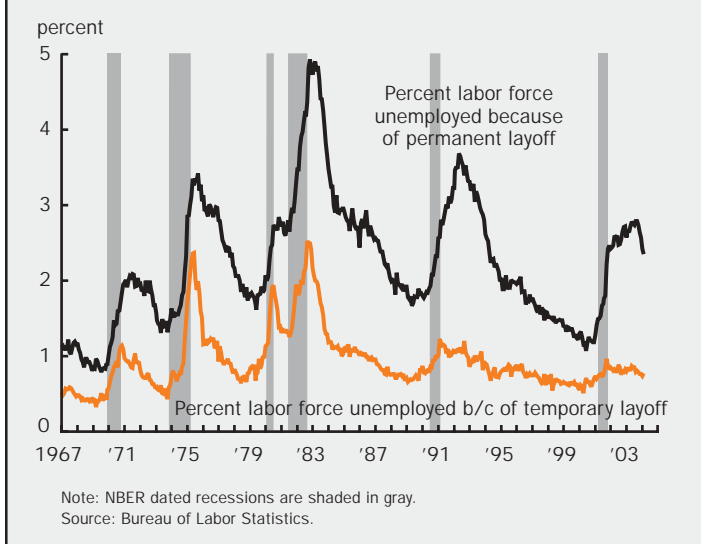
offers some important clues about the nature of the current period of weak employment growth.

As figure 2 displays, the rate of job destruction (as a share of employment) surged during the recession, but the most recent data, for the second quarter of 2003, show that job destruction has fallen to the lowest level since 1994. What has prevented net employment growth from being more robust is a continuing low level of job creation.[9] This finding seems at odds with the hypothesis that the current period is one of extensive job reallocation. Indeed, total job reallocation, as measured by the sum of job creation and job destruction is at its lowest level in the ten-year history of the series. To square the results in figure 2 with an important role for sectoral reallocation in the post-recession period, one could argue that the job destruction that occurred during the recession created an unusual degree of mismatch between the skills of those out of work and those required in expanding firms and that, consequently, the economy is still heavily affected by those job losses. This is possible, but there is little evidence to support it.[10]

Dispersion in industry growth rates

As we have noted, most previous research over the last twenty years has utilized readily available industry-level employment data to attempt to identify the extent of sectoral reallocation. The seminal paper is Lilien (1982). Lilien reasons that in the absence of sectoral reallocation, all industries' employment will grow at the same rate. By contrast, when labor is being reallocated across industries, expanding industries will grow faster than average and contracting industries will grow more slowly.

This reasoning leads Lilien to propose a measure of sectoral reallocation based on the standard deviation across industries in employment growth rates:

$$\sigma_t^L = \left[\sum_{i=1}^{I} s_{it}(g_{it} - g_t)^2 \right]^{1/2},$$

where g_{it} is employment growth in industry i at time t, g_t is aggregate employment growth, and s_{it} is the share of total employment in industry i at time t. [11] If all sectors grew at the same rate, Lilien's measure would be zero. The measure is always positive and larger when individual industry employment growth rates diverge more from the average. The idea is that changing shares of workers in industries should closely parallel the need for reallocation.

Figure 3 shows the Lilien measure of sectoral reallocation from the first quarter of 1960 through the third quarter of 2003.[12] Clearly, Lilien's measure of sectoral reallocation is countercyclical; there is more movement of employment across industries during recessions than expansions. This is consistent with the notion that the need to reallocate workers implies an increase in costly search that reduces output and raises unemployment.

The figure also shows that Lilien's measure of sectoral reallocation rose during the most recent recession, as well as the previous one that occurred in the early 1990s. However, the increase in his measure of reallocation was not nearly as great as in the previous five recessions. Moreover, the reallocation measure declined relatively quickly after the last recession and has been at quite a low level over much of the most recent jobless recovery.[13] These results clearly run counter to the idea that the jobless recovery is the result of extensive sectoral reallocation.

Abraham and Katz (1986) criticize the Lilien measure of sectoral reallocation as confounding cyclical with sectoral changes. They note that business cycles exert a predictable pattern of effects on the distribution of employment across industries. In particular, employment growth in goods-producing industries typically declines more during economic downturns than employment growth in service-producing sectors. This pattern implies increased dispersion in industry employment growth during contractions and reduced dispersion during expansions, even if there is no actual impact of reallocation on total employment. Consequently, sectoral reallocation
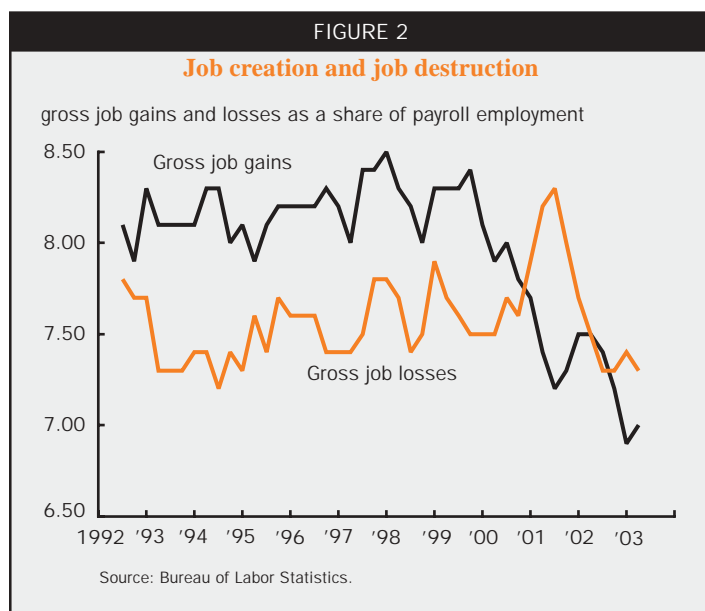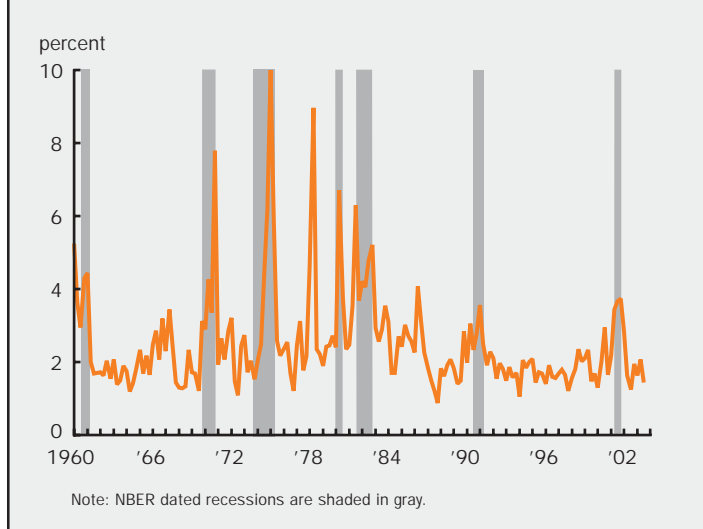

FIGURE 2

Job creation and job destruction

gross job gains and losses as a share of payroll employment

FIGURE 3

Lilien measure of sectoral reallocation

Note: NBER dated recessions are shaded in gray.

as measured by Lilien captures both the process of sectoral reallocation and the normal employment flows of the business cycle. Hence, we cannot be certain that a high measured value of dispersion in employment growth is a signal of anything other than low economic activity.

Some authors, including Loungani, Rush, and Tave (1990) and Rissman (1993), have attempted to control for the cyclicality of industry employment growth in order to create a measure that reflects only sectoral reallocation. The essential notion is that cyclical effects are temporary, whereas structural change is permanent.[14] Loungani et al. focus on dispersion in stock prices with the belief that stock prices are forward looking and are good predictors of industries that are waning or waxing. Furthermore, stock prices are assumed to be unaffected by short-term factors. Rissman instead decomposes changes in employment shares into temporary or short-term movements versus permanent or long-term movements. Even after controlling for cyclical variation in this way, Rissman notes that sectoral reallocation seems to increase around the time of business cycle contractions.

Groshen and Potter's measure of industrial reallocation

The study most often cited by those who identify sectoral reallocation as the cause of this jobless recovery is that of Groshen and Potter (2003), henceforward GP.[15] Their measure uses data similar to that employed by Lilien, but it differs from previous measures in several respects. One distinction is in its utilization of data at the higher, two-digit, degree of disaggregation, for

which there are 70 industries.[16] However, the bigger difference is in how the industry data are used. Rather than measuring *dispersion* in industry growth rates, GP measures the *correlation* across industries in growth rates over two periods of time—during a recession and during the year following a recession.

Let g_i^r be employment growth in industry *i* during a particular recession and let g_i^e be the industry's employment growth rate in the year following the recession.[17] Also let g^r and g^e be the corresponding aggregate employment growth rates. GP's measure of sectoral reallocation is the proportion of employment accounted for by industries with either $g_i^r > g^r$ and $g_i^e > g^e$ or $g_i^r < g^r$ and $g_i^e < g^e$.[18] That is, they measure the proportion of employment that is accounted for by industries that are either growing faster than average in both periods or growing more slowly than average in both periods.[19] As shown in table 1, GP identify sectoral reallocation with an industry's presence in quadrant 1 (greater than average job growth during both the recession and early recovery) or quadrant 4 (less than average job growth during both the recession and early recovery). If, across industries, the correlation between growth in the two periods is higher, then their measure will tend to be higher. Indeed, their measure is sometimes called the "quadrant correlation," because it is based on the proportion of observations in the various quadrants in table 1.

GP motivate the quadrant correlation as a measure of structural change by noting that structural changes tend to be long-lived phenomena that are not quickly reversed. Thus, in industries in which structural adjustments are especially significant, $g_i^r - g^r$ and $g_i^e - g^e$ will tend to have the same sign. That is, if structural change is positively impacting an industry, it will tend to experience above-average employment growth in both periods. Conversely, if structural change is negatively impacting an industry, it will tend to experience below-average employment growth in both periods. Thus, intuitively, if the proportion of industries in which $g_i^r - g^r$ and $g_i^e - g^e$ have the same sign is high (quadrants 1 and 4), then employment fluctuations may be dominated by structural influences.

The first row of table 2 shows the values of the GP measure for the last four recessions, where the "double dip" recessions of 1980 and 1981–82 are combined into one long recession.[20] Clearly, during the last two cycles, a higher fraction of workers were in industries

TABLE 1		
Groshen and Potter sectoral reallocation		
Job growth in year after recession	**Job growth in recession**	
	Less than average $(g_i^r < g^r)$	Greater than average $(g_i^r > g^r)$
Greater than average $(g_i^e > g^e)$	*Quadrant 2*	*Quadrant 1* G&P sectoral reallocation
Less than average $(g_i^e < g^e)$	*Quadrant 4* G&P sectoral reallocation	*Quadrant 3*

in which employment growth was either above average in both the recession and recovery or below average in both periods. For the 1975 and 1980–82 recessions, the proportions were 42 percent and 44 percent, respectively, while for the 1990–91 and 2001 recessions, the figures were 67 percent and 70 percent, respectively.

Are differences of the above magnitude statistically meaningful or could they be the result of random fluctuations?[21] One very rough way to gain an appreciation of the uncertainty in the GP measure is to compute the statistic for slightly different periods. Thus, row 2 of the table shows the same statistic computed using the business cycle peak for the start of the recession and the business cycle trough for the start of the expansion, rather than the month after these two dates as in GP.[22] Making this small change to the definition of the statistic changes the values for the various recessions by between two and ten percentage points. Clearly, the GP statistics are subject to substantial variability. However, the difference in the GP statistic between the recessions of the 1970s and the 1980s and those of the 1990s and 2000s is of a somewhat larger magnitude. Thus, the increase in table 2 does likely represent an actual change rather than a purely random fluctuation.

While the GP statistic has some intuitive appeal, there are reasons why it is not likely to be a close proxy for sectoral reallocation. In particular, it is not sensitive to the magnitude of the across-industry variability of employment growth. That is, the value of the statistic does not depend on *how far* above or below average the various industry growth rates are. This is a major weakness because the need for sectoral adjustments is likely to be greater when individual industries are growing at rates that differ more from average.

To see the significance of the GP statistic's insensitivity to scale, consider two scenarios for an economy with three industries, called A, B, and C. In the first scenario, industry A's employment growth during the recession is –2.1 percent, while its growth during the following year is 1.9 percent. For industry B, the figures are –2.0 percent and 2.0 percent, respectively, and for industry C, they are –1.9 percent and 2.1 percent, respectively. If the industries each start with one-third of the employment, then the total growth rates would be –2.0 percent and 2.0 percent (approximately) and the GP statistic would be equal to two-thirds.[23] In the second scenario, the three industries again start with employment shares of one-third, but the growth rates are –12 percent and –8 percent for industry A, –2 percent and 2 percent for industry B, and 8 percent and 12 percent for industry C. In the second scenario, average growth rates are still –2.0 percent and 2.0 percent (approximately) and the GP statistic is again two-thirds. However, the amount of sectoral reallocation is likely to be much greater in the second scenario, in which more than 6 percent of total employment has shifted from industry A to industry C, than in the first scenario in which the shift in employment is only about one-tenth of a percent. Thus, the GP statistic misses

TABLE 2				
Groshen–Potter and related statistics for recent recessions				
	Mid-1970s	**Early 1980s**	**Early 1990s**	**2001**
Groshen–Potter statistic	42%	44%	67%	70%
Standard recession and expansion dating	52%	46%	65%	75%
GP12 statistic (quadrant correlation for 12-month forward and backward growth rates) at recession trough	52%	36%	66%	66%

an aspect of industry growth rates that can be important for assessing sectoral reallocation.

Empirically, differences over time in the variability of employment growth rates are likely a very significant concern. Indeed, the Lilien measure, shown in figure 3, showed that the across-industry standard deviation in employment growth rates was much higher during the early recessions than the later ones. Thus, the GP statistic, which is insensitive to this kind of variation, does not accurately reflect the relative degree of sectoral reallocation in the earlier and later recessions.

Neither can one point to a historical track record in which the GP statistic is highly correlated with employment growth. Of course, employment growth in the expansions following the last two recessions was much lower than employment growth in the previous recessions. So, the fact that the GP statistic was higher in the latter two recessions is suggestive of a negative relationship between it and employment growth in the early part of expansions. However, four data points do not seem adequate to judge the relationship between the GP statistic and employment growth.

In order to get a clearer picture of the relationship between the GP statistic and employment growth, we computed a version of the GP statistic for each date, regardless of whether it corresponded to a recession trough. Specifically, for each month t, let g_i^b be employment growth in industry i between t and $t-12$ and let g_i^f be the industry's employment growth from t to $t+12$. Also let g^b and g^f be the corresponding aggregate growth rates. Then, we computed $GP12_t$, the percentage of employment in industries in which either $g_i^b > g^b$ and $g_i^f > g^f$ or $g_i^b < g^b$ and $g_i^f < g^f$. Values of $GP12_t$ for the months corresponding to the recession troughs are shown in the third row of table 1. Because recessions typically last about 12 months, these values are similar to those in the other rows.[24]
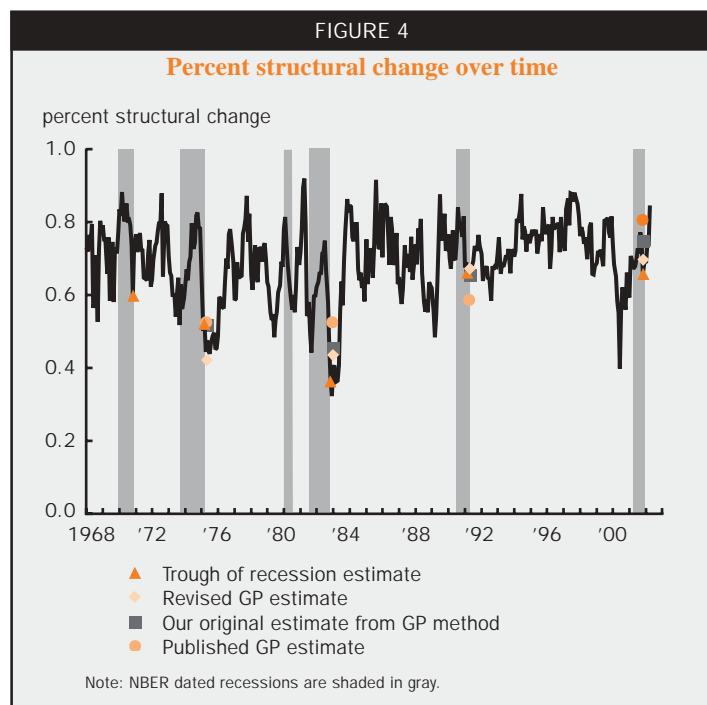
Figure 4 shows the value of the $GP12$ statistic since 1968. In addition, the versions of the GP statistic shown in table 1 are marked with squares at the dates of recession troughs. Several points are clear from figure 4. First, 70 percent is a fairly typical value for $GP12$. Thus the values recorded for the trough of the last two recessions are not unusual when judged relative to the full history of data. Second, high values of the $GP12$ statistic often occur during periods of rapid employment growth such as the late 1990s. Thus a high value of $GP12$ in recent months would not necessarily have

led one to expect poor employment growth. Third, the $GP12$ statistic typically increases fairly sharply during the first several months of an expansion. The current expansion does not seem to an exception to that rule. Finally, in addition to dropping around the time of a recessionary trough, the statistic tends to drop some time near the peak of the business cycle, often a few months before. The drop that occurred before the most recent recession is reasonably comparable to previous pre-recession drops. Thus, if we were to use the $GP12$ statistic to judge sectoral reallocation near the peak, we would find no difference in this recession.

To conclude, our analysis of the GP statistic suggests that, while it may have identified some intriguing differences between the two most recent recessions and those that preceded them, there are several reasons why it is unlikely to provide an accurate assessment of the extent of sectoral adjustment in the economy.

A better measure of sectoral reallocation

Rissman (1997) develops an alternative methodology for assessing the extent of sectoral reallocation that is similar to the Lilien measure, but with an allowance for cyclical fluctuations that addresses the criticism of Abraham and Katz. Her measure is based on a decomposition of the time series of industry employment share growth rates into three components. Figure 5 illustrates this decomposition for a particular industry, durable manufacturing. This chart shows

FIGURE 4

Percent structural change over time

percent structural change

Note: NBER dated recessions are shaded in gray.

Legend:
▲ Trough of recession estimate
◆ Revised GP estimate
■ Our original estimate from GP method
● Published GP estimate

employment growth in durable manufacturing less aggregate nonfarm employment growth for 1961 to the present.[25] Negative numbers indicate that the industry's employment share is falling, while positive numbers indicate that its employment share is rising.

The first factor in the decomposition reflects the long-term trend of employment into growing sectors and out of declining sectors. In durable manufacturing, there is a clear long-run decline in employment share. This is shown by the black line, which indicates that on average over the last 43 years employment growth in durable manufacturing was 2 percent per year lower than aggregate employment growth. Both technological progress and increased imports have contributed to this trend. The movement of employment out of durable manufacturing is structural in the sense that reallocation is occurring. However, given its predictability and relatively slow pace, the trend loss of jobs is perhaps not as disruptive to employment or output growth as are unpredictable, idiosyncratic changes in employment share.

Second, as noted by Abraham and Katz (1986), there are predictable movements of employment into and out of certain industries over the business cycle. For example, in durable manufacturing, there is a clear procyclical pattern to growth in the industry's share of employment. Due to a lull in demand for durable goods, employment falls sharply during recessions and, once demand picks up, increases during recoveries. A similar procyclical pattern occurs in the other goods-producing sectors of the economy. In the service-producing sectors, the opposite occurs.

Again, arguably, fluctuations in employment shares due to the business cycle may not be overly disruptive because they are reversed fairly quickly as the economy recovers. While job matches are destroyed, similar ones are recreated within a fairly short period. During the interim, the unemployment rate rises because workers are laid off. However, as the economy improves and conditions return to "normal," the unemployed are able to locate new work relatively quickly without having to invest in the acquisition of new skills or to move in search of work.
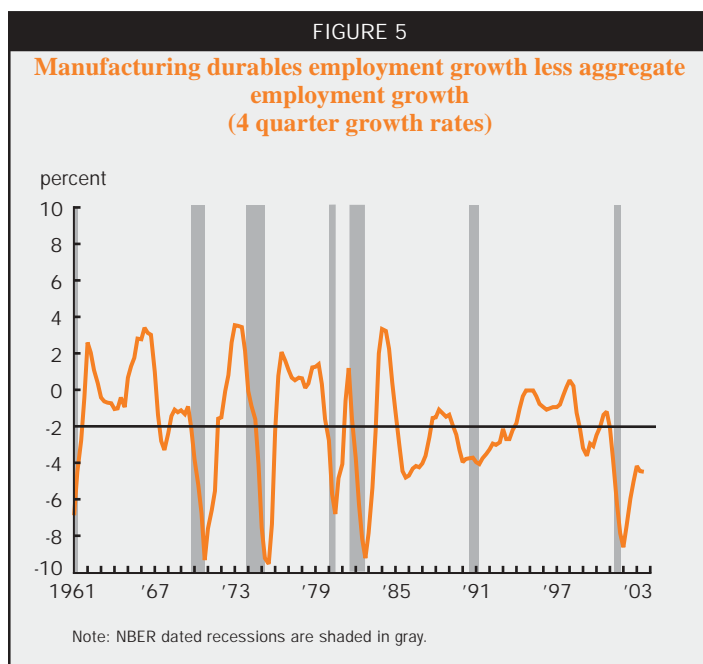
The third general basis for sectoral reallocation, and likely the most disruptive for labor markets, is *unanticipated* movement of workers across industries. That is, reallocation across sectors that occurs for reasons unrelated to the

business cycle or long-term secular reasons. These movements could be thought of as transformational changes to a firm or industry due to restructuring, reorganizations, or other factors that might shift inputs to more valuable sources. Employment changes like these are likely to be the most disruptive to the labor market because they are not predicable (unlike long-term trends) but are permanent features of the landscape (unlike cyclical trends).

The above discussion suggests a general model of industry employment growth net of aggregate employment growth given by the following:

1) $\Delta \ln s_{it} \equiv g_{it} - g_t = a_i + C_{it} + e_{it}$,

where the share of employment in industry i at time t is given by S_{it} and there are $i = 1, \ldots, I$ industries in the economy. According to this specification, net industry employment growth depends upon a long-term trend captured by the term a_i. (For durable manufacturing, we would expect this term to be around –2.0, reflecting the sector's long-term employment decline.) For expanding industries, a_i is positive. The cyclical component for the ith industry is given by the term C_{it}. We more formally describe the procedure used to generate estimates of C_{it} below. Finally, the idiosyncratic movement in employment growth in industry i relative to aggregate employment growth is captured by the term e_{it}. These idiosyncratic shocks reflect unanticipated permanent changes in the industry's employment share that are unaccounted for by either the industry's

FIGURE 5

Manufacturing durables employment growth less aggregate employment growth
(4 quarter growth rates)

Note: NBER dated recessions are shaded in gray.

long-term trend or the business cycle. The idiosyncratic shocks are assumed to be serially uncorrelated and uncorrelated with each other, have mean 0, and constant variance of σ_i^2.

By ignoring the cyclical component, as Lilien (1982) does, we would overstate the importance of the idiosyncratic term. Put more simply, if we disregard the effect of the business cycle on durable manufacturing, for example, we interpret all variation in durable manufacturing's employment share as sectoral reallocation—even if some of it is clearly related to the business cycle and is temporary. By carefully modeling the effect of the business cycle on industry employment growth, we are able to address the Abraham and Katz (1986) critique and control for the effect of the cycle on the industrial composition of employment. This does not mean that sectoral reallocation will not be correlated with the business cycle. In fact, sectoral reallocation may occur when the opportunity cost is lowest, that is, during recessions. However, it is important to first obtain a good measure of the cycle C_{it} and its effect upon the industry.

There are many possible ways to measure the business cycle, C_{it}. One possibility is to let the cyclical component be measured by deviations of real gross domestic product (GDP) growth from trend. This measure is easily calculated and would be appropriate if the employment cycle were coincidental with this measure. However, as documented earlier, employment growth has been slow to recover, unlike other measures of cyclical activity.[26]

By using an output-based measure of economic activity such as detrended real GDP growth to capture the cycle, we may mismeasure the cycle and misinterpret the results. For example, suppose that the most appropriate measure of the cycle for analyzing changes in industry employment growth is an activity-based measure, but instead an output-based measure is employed. Now suppose that the two measures coincide for much of the period with the exception of the most recent expansion, during which the two diverge. For an industry like durable manufacturing that is countercyclical, the output-based measure would attribute current low net employment growth to negative shocks e_{it}. In contrast, the activity-based measure would attribute the same low net employment growth in durable manufacturing to low economic activity. Which of these measures to use becomes a difficult and pivotal question.

Rissman notes that business cycles—however defined—are characterized by comovements in economic activity across industries.[27] Thus, during a recession goods-producing industries tend to shrink

and service-producing industries to grow in employment share. She uses these comovements across industries to identify and calculate an alternative measure of the cycle. This measure does not rely on information about output, such as real GDP, nor does it depend upon aggregate employment growth. Instead, it depends upon the distribution of employment shares across industries and how these employment shares shift relative to one another over time. The idea is to let the cycle be described by certain consistent patterns of shifts in the distribution of employment across industries.

As currently specified, equation 1 cannot be estimated without further restrictions. Rissman (1997) suggests the following, which is based upon work by Stock and Watson (1989):

2) $C_{it} = b_i(L)C_t$

3) $C_t = \phi_1 C_{t-1} + \phi_2 C_{t-2} + u_t.$

There is a common cycle C_t that follows an AR(2) process. The cycle is permitted to affect each industry differently through the parameters of $b_i(L)$, which is a polynomial in the lag operator. This specification offers a great deal of flexibility in characterizing the effect of the cycle on an industry's net employment growth. The cycle is permitted to have a leading effect in some industries while it lags in others. The magnitude of the effect of the cycle on an industry's employment growth is also permitted to vary. The Kalman filter is used to obtain estimates of the parameters of the model.[28] Estimates of the cycle can be constructed easily from the parameter estimates. Details of the estimation can be found in Rissman (1997).[29]

Sectoral reallocation is the result of both long-term trends (the a_i's) and unanticipated shocks (the ε_{it}'s). Yet, these long-term trends have been occurring for many, many years. For example, the share of employment in goods-producing industries has been falling steadily since the 1950s. So sectoral reallocation has been a feature of the economic landscape for decades. For sectoral reallocation to explain the unusually low current employment growth, it must be that currently the idiosyncratic shocks are abnormally large.

Analogous to Lilien (1982), Rissman proposes a measure of sectoral reallocation based on the estimates of e_{it}. Specifically,

4) $\sigma_t^* = \left(\sum_i s_{it-1}^* \hat{\varepsilon}_{it}^2 \right)^{1/2}.$

The term s_{it-1}^* is industry i's acyclic employment share at time $t–1$. These employment shares are hypothetically what the industry's employment share would have been if the employment cycle was held constant at a value of 0, implying neutral growth. These acyclic employment shares would depend only on the industry's long-term trend and idiosyncratic shocks. The $\hat{\varepsilon}_{it}$'s are estimates of the idiosyncratic shocks for each of the i industries obtained from the Kalman filter estimation exercise. The dispersion measure includes services.[30] The calculation relies upon unanticipated variation in the composition of industry employment growth. Long-term structural change affects the measure only through its effect on the acyclical employment shares. Because of its construction, the measure directly addresses the Abraham and Katz critique of Lilien's construct.

An alternative measure that is somewhat in between those proposed by Lilien and Rissman is given by:

$$5) \quad \sigma_t^+ = \left(\sum_i s_{it-1}^* (\hat{a}_i + \hat{\varepsilon}_{it})^2 \right)^{1/2}.$$

This measure calculates variation in the composition of industry employment growth that is unrelated to the normal shifts that occur as the result of the cycle. It is a broader measure of sectoral reallocation in that it includes long-term change in industry employment shares as a sectoral shift. This is reflected both in the weight and in the inclusion of a_i separately.[31]
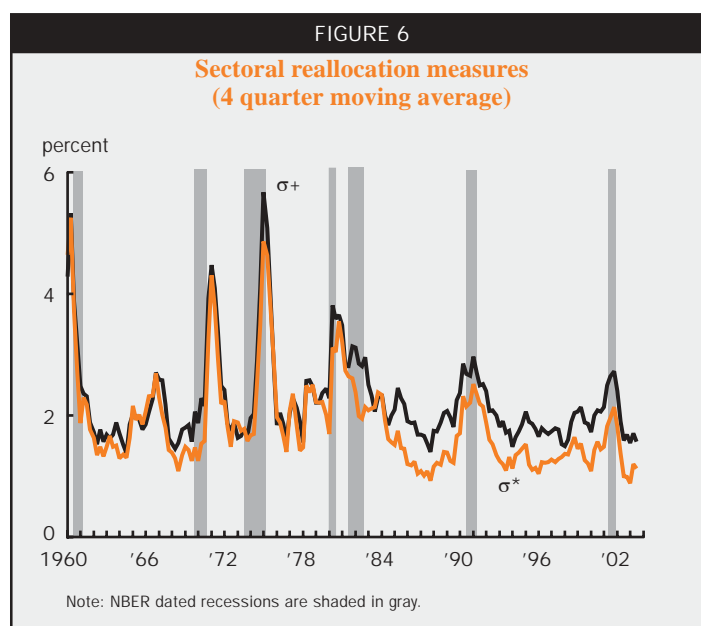
Figure 6 shows these two different summary measures of sectoral reallocation. The first, the orange line in figure 6, is a four-quarter moving average of the σ_t^*, where the weights are smoothly declining and sum to one.[32] First, note that sectoral reallocation coincides with the business cycle (even after netting out typical cyclical movements across industries), suggesting that restructuring and reorganization is more common during bad times when it may be less costly or that worker reallocation actually contributes to aggregate downturns. The last recession was not an exception. The structural component of sectoral reallocation rose from an average of 1.38 in 2000 to 2.14 during the trough quarter. But the level of sectoral reallocation fell back to pre-recession levels within two quarters of the end of the recession. Furthermore, the peak was significantly lower than it has been in

previous recessions.[33] In fact, this measure has been in decline since the mid-1980s. This is consistent with other research suggesting a fall in economic volatility starting from the mid-1980s.[34]

The black line in figure 6 plots a more comprehensive measure of sectoral reallocation by including the long-term trend components along with the idiosyncratic shocks. This measure is found in equation 5. The line shown is again a four-quarter moving average. While this measure peaks during the most recent recession, the level of sectoral reallocation suggests no unusually large increase during either of the two recent jobless recoveries, at least relative to the 1970s and 1980s.

Conclusion

Our findings do not support the theory that the need to reallocate labor across industrial sectors has been particularly great during the last two recessions or the jobless recoveries that followed. We base this conclusion primarily on two pieces of evidence. First, we do not believe that the widely cited statistic that Groshen and Potter identify provides an accurate assessment of the extent of sectoral adjustment in the economy. Conceptually, their proposed measure does not capture the cyclical element of industry employment dynamics that is likely to be an important component of sectoral reallocation. Moreover, empirically, their measure is subject to substantial variability, depending on the exact period over which it is computed. Small changes in the length of the window, the dating of business cycle turning points, or the weighting of the industries may lead to different

FIGURE 6

**Sectoral reallocation measures
(4 quarter moving average)**

percent

Note: NBER dated recessions are shaded in gray.

results. The second piece of evidence comes from expanding the work of Rissman (1997). After controlling for cyclical variation in industry employment growth, we find that reallocation of employment across industries has declined, not increased, over the past two business cycles.

That, of course, does not necessarily imply that other forms of sectoral reallocation have not been more significant. It is possible, for example, that there has been an increase in the number of workers forced to make major career transitions, but that those transitions have involved changing occupations or geographic regions, rather than industries. However, it would be somewhat surprising if there were a major increase in a form of labor reallocation that did not result in a marked increase in industrial reallocation. For example, suppose that the occupational mix has

shifted to favor more highly skilled workers. By focusing on the industrial mix rather than the occupational mix, the analysis may miss an important aspect of the reallocation picture. However, to the extent that industries differ in their occupational mix, echoes of occupational reallocation would be found in the industrial composition of employment as well. Finally, the fact that job destruction and creation as measured in the Business Employment Dynamics data are both at low levels seems inconsistent with a major role for any form of labor reallocation. Whatever forces are depressing hiring at this stage of the business cycle are felt across a broad spectrum of industries, occupations, and geographic areas. Thus, the lack of more significant employment growth since the end of the last recession remains a puzzle, and economists should continue to look for other explanations.[35]

NOTES

[1]See Aaronson, Rissman, and Sullivan (2004), also in this issue, for a more extensive discussion of the jobless recovery.

[2]Bartelsman and Doms' (2000) extensive review of recent productivity studies notes that a large part of aggregate productivity growth is due to worker reallocation.

[3]For estimates of the effects of displacement on individual workers' earnings, see, for example, Jacobson, LaLonde, and Sullivan (1993a and 1993b).

[4]Employment in the manufacturing sector has fallen by approximately 15.5 percent since the start of the recession, including a 9.5 percent fall since the recession ended. This compares with declines of 1.8 percent and 0.6 percent, respectively, for the economy as a whole.

[5]The recession of the early 1990s is sometimes referred to as the service sector recession, but even in that downturn, manufacturing was disproportionately affected. Manufacturing employment fell by 3.2 percent, while employment in the nonmanufacturing sectors fell by 0.7 percent. During the first two years of that jobless recovery, total nonmanufacturing employment grew by 1.9 percent but manufacturing employment fell by 2.0 percent. Manufacturing fared even worse in earlier recessions.

[6]The 1984 to 1992 surveys ask about the prior five years.

[7]Aaronson and Sullivan construct annual measures of displacement for the period 1984–99. This requires some additional assumptions about the rate at which workers "forget" instances of displacement. See Aaronson and Sullivan (2003) for more details.

[8]Foote (1998) constructs data on job creation and destruction for the state of Michigan and finds that Davis and Haltiwanger's conclusion may not generalize beyond the manufacturing sector. In particular, he finds that for industries that are growing as a share of employment job creation varies more than destruction over the business cycle.

[9]The finding that the weak employment growth of the recent period is due more to weak hiring than high levels of layoffs is supported by another new data source, the *Job Openings and Labor Turnover Survey*, which began only in December 2000. These data show a fall in hiring and layoffs since that date. On a positive note, hiring rates have improved recently, with the year-over-year hiring rate turning positive during fall 2003 for the first time since the beginning of the survey.

[10]To some extent, unusually high unemployment duration over the last two years is consistent with increased mismatch. The median spell of unemployment was over ten weeks during much of 2003, its highest level since 1983. One mitigating factor to the matching story is the increased use of the Internet for job search, which likely has improved matching efficiency. See Autor (2001) for a discussion. However, see Kuhn and Skuterud (2004) for empirical evidence to the contrary.

[11]Industry employment growth is related to its share of employment by the following mathematical relationship: $\Delta\ln(s_{it}) = \Delta\ln(e_{it} / e_t) = g_{it} - g_t$.

[12]This measure identifies sectors at the one-digit standard industrial classification (SIC) level. There are ten such industries: mining; construction; durables manufacturing; nondurables manufacturing; transportation and public utilities; finance, insurance, and real estate; retail trade; wholesale trade; services; and government.

[13]This description of the reduction in variability has been noted by other researchers as well (for example, McConnell and Perez-Quiros, 2000, and Stock and Watson, 2003). Stock and Watson (2003) note that the standard deviation of the growth rate of GDP, averaged over four quarters, was one-third less during 1984 to 2002 than it was during 1960 to 1983. This decline in volatility is widespread across sectors within the U.S. It is also found in the other Group of 7 economies, although the timing and details differ from one country to the next.

[14]Figura (2002) surveys the research and proposes an alternative way to measure reallocation, employing the same data that Davis and Haltiwanger use to examine job creation and destruction. He uses a low-pass filter to identify permanent employment movements and concludes that permanent reallocation of jobs across plants accounts for about 30 percent of the cyclical fluctuations in aggregate employment.

[15]A Google search of "Groshen and Potter" show well over a hundred references to their paper, including the *Atlantic Magazine*, *Christian Science Monitor*, CNN, *The Economist Magazine*, *The Times of London*, *Miami Herald*, *San Francisco Chronicle*, *Seattle Times*, *USA Today*, *Wall Street Journal*, *Washington Post*, and the *Weekly Standard*.

[16]GP include 67 two-digit SIC private sector industries and three government sectors. Private industries excluded from the analysis are agricultural production (SIC codes 1 and 2), agricultural services (7), forestry (8), fishing (9), postal service (43), miscellaneous services not elsewhere classified (89), and nonclassified establishments (99). Data from the three government sectors—federal, state, and local—are taken from the monthly payroll survey. In earlier years (pre-1988), there are eight fewer industry groupings. We have computed versions of the Lilien measure using the set of industries tracked by GP. Qualitatively, the results look very similar to those in figure 3. Moreover, computing the GP measure using data at the one-digit level of aggregation yields results similar to those GP obtain with two-digit disaggregation. Thus, the level of disaggregation is not the primary difference between GP's results and the dispersion-based measures of sectoral reallocation that we have previously discussed.

[17]GP's measure is actually based on a recession period that starts one month after the business cycle peak and an 11-month post-recession period that begins the month after the business cycle trough. Thus, period *r* does not include the first month of the recession and period *e* does not include the first month of the expansion.

[18]Employment is measured at the peak.

[19]Some reports on their work incorrectly describe their measure of the fraction of industries in the structural category as consisting entirely of industries that are shrinking in both periods. In fact, on average from 1970 to 2003, roughly half of the employment in this category is accounted for by industries in which employment growth is above average in both periods; and growth that is positive, but below average, is treated the same as outright employment declines.

[20]The numbers in table 2 reflect corrections made after the publication of their article. The largest difference between the corrected numbers and the numbers actually published in their paper is for the 1990–91 recession. As published, the figure for the first jobless recovery was 57 percent, closer to those of early recessions than to the recession of 2001. In the corrected data, it is much closer to the latter. The 2001 figure published in GP is 79 percent, a bit higher than the corrected figure of 70 percent reported in table 2.

[21]It is not immediately obvious how best to compute a "standard error" for the GP statistic. We have done some simulations in which we generate random data similar to that underlying the GP statistic under the assumption that employment growth in the two periods is jointly normally distributed with variances and covariances that match the actual data. We find that the standard deviation of the randomly generated GP statistics is between 8.1 percentage points and 9.4 percentage points, depending on the period. Assuming the figures for the different periods are independent, the t-statistic for a comparison of one of the early recessions to one of the late recessions is typically about 2.5. This seems to accord reasonably well with the highly informal discussion of this paragraph.

[22]As noted in footnote 17, GP's statistic is computed for periods that leave out the first month of the recession and recovery.

[23]The two-thirds figure arises because industry A grows slightly less than average during the recession and recovery (quadrant 4) and industry C grows slightly faster than average during both periods (quadrant 1), but industry B grows at the average rate in both periods. Since they all have equal employment shares, the GP statistic is equal to two-thirds.

[24]The biggest difference is for the 1980–82 combined recession, which is the one whose length differs the most from 12 months.

[25]Recall that $\Delta\ln(s_{it}) = g_{it} - g_t$.

[26]In fact, the NBER notes that in defining an expansion or recession it focuses on aggregate economic activity, which is captured well by real GDP. However, definitions that emphasize the fraction of productive resources that are being used are also valid. Such definitions would place more weight on employment numbers and the unemployment rate and give a different view of the current state of the economy.

[27]The term "comovement" as used here is taken to mean that two or more variables move together but not necessarily in the same direction.

[28]Rissman (1997) provides details.

[29]Identifying restrictions are needed to obtain estimates. The results presented here set the variance of the business cycle shock to unity, thereby setting the scale of the measure of the cycle. To set the timing of the cycle and its sign, the cycle is assumed to enter the durable manufacturing equation only contemporaneously. All other industries have current and two lags of the cycle in their specification. We drop services to avoid the constraint that employment shares sum to one. (This is analogous to the dummy variable problem.) We also drop mining because it is quite small in terms of total share but, due to strike activity, highly volatile. To check whether results are dependent upon the use of durable manufacturing to determine the timing of the cycle, we carried out the same analysis using retail trade instead of durable manufacturing to identify the cycle. Results were similar. Therefore, only results that employ durable manufacturing parameter restrictions in the identification scheme are reported in the text.

[30]Although we omitted services from the original estimation procedure, we generated an estimate for services from a linear regression of the same form as for the other industries.

[31]Generally, $\sigma_t^+ > \sigma_t^*$, although it is possible that the opposite occurs if, for example, expanding industries have large negative shocks and declining industries have large positive ones.

[32]The smoothed value $\sigma_t^*(S)$ is given by $\sigma_t^* = 0.4 * \sigma_t^* + 0.3 * \sigma_{t-1}^* + 0.2 * \sigma_{t-2}^* + 0.1 * \sigma_{t-3}^*$.

[33]The contraction and expansion quarters are 25 percent and 53 percent lower in the two most recent recessions. When we take into account the lagging nature of this measure, particularly in the earlier years, by assigning the first year of expansions as contracting periods, the difference between pre- and post-1985 is roughly 40 in both expansion and contraction periods.

[34]See, for example, McConnell and Perez-Quiros (2000) and Stock and Watson (2003).

[35]The Aaronson, Rissman, and Sullivan (2004) article, also in this issue, briefly reviews some alternative theories of the jobless recovery.

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