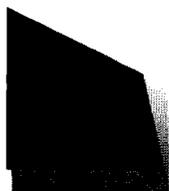


Long-term earnings losses of high-seniority displaced workers

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The recent recession and continuing slow employment growth have focused renewed attention on the plight of displaced workers—workers whose job loss results from the plant closings and mass layoffs associated with economic restructuring. It has long been clear that such workers suffer short-term earnings losses if they are forced into unemployment while searching for new jobs.¹ What has been less clear, however, is the magnitude of any long-term losses from reduced earnings on these new jobs. This article provides evidence that for displaced workers who had substantial seniority with their former employers, these long-term earnings losses are highly significant and, in fact, cumulatively much larger than the earnings losses they suffer while unemployed.

Displacement is, of course, not limited to recessions. Rather, displacement is a normal feature of a dynamic economy in which technological progress and changing consumer tastes constantly necessitate economic restructuring. The Congressional Budget Office recently estimated that during the 1980s, 20 million workers lost jobs because of plant closings and permanent layoffs. Even in the relatively strong labor market that prevailed in 1988, 1.5 million workers lost jobs in this way.² The aggregate economy benefits from this frequent restructuring. Nevertheless, many have shown a concern for the losses suffered by some of those who do not benefit—the displaced workers.

Concern has been especially great for workers who are displaced as a result of changes in

government policy. For instance, trade liberalization is almost certainly good for the country as a whole. In addition to lowering prices for consumers, it increases opportunities for export-producing sectors of the economy and is likely to result in a net increase in jobs for U.S. workers. Despite these benefits, however, some workers are likely to be displaced as a result of increased imports.³ Policymakers have tried to help such workers, either because they believe fairness requires it or because they believe such assistance is the only way to win enough political support for freer trade. In either case, they have an interest in knowing the full losses suffered by job losers.

Assessing the full costs borne by displaced workers is even more important when the net benefits of policy changes that lead to displacement are less clearly positive than those of freer trade. In such cases, policymakers need to be concerned not only with compensating the losers, but also with determining whether the policy change should be made at all. For instance, from an economic perspective, additional environmental regulations should only be imposed if the benefits of such regulations exceed their full costs, including the costs borne by any workers who lose their jobs. Similarly, much debate over appropriate monetary and fiscal policy can be cast in terms of a trade-off between inflation and

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unemployment. If some of this unemployment takes the form of permanent job loss, then the net benefits of further reductions in inflation depend on the magnitude of any long-term earnings losses experienced by affected workers.

If workers' skills were perfectly general in the sense that they were equally valuable to all employers and if earnings only reflected workers' accumulated skills, then displacement might not have any long-term consequences. However, workers possessing skills that were especially well-suited to their old positions are likely to be less productive, at least initially, on their subsequent jobs. Such a fit between workers' skills and the requirements of their old jobs could have resulted from on-the-job investment in firm-specific human capital or from costly search resulting in particularly good matches with their old firms.⁴

Moreover, workers losing jobs that paid wage premiums that didn't merely depend on their accumulated skills are likely to have long-term losses if their subsequent jobs pay standard wages. Such wage premiums could have arisen because of direct or threatened effects of unions, or because employers voluntarily chose to pay higher wages because doing so directly raised workers' productivity.⁵

Finally, displaced workers' long-term earnings will be lower if, on their previous jobs, they had accepted wages below their level of productivity in return for higher earnings later in their careers. Economists have interpreted internal labor market phenomena and promotion-from-within policies as attempts by firms to implement such deferred compensation schemes. Workers might have accepted such earnings paths in order to enhance their employers' incentive to invest in their human capital.⁶

These theoretical considerations suggest that displaced workers could suffer earnings losses after they find new jobs. They do not, however, tell us how large those losses are likely to be or how long the losses might persist. Empirical analysis is required to determine whether displacement is a relatively temporary setback from which workers quickly recover once they find new jobs or, alternatively, whether it is an essentially permanent blow to workers' living standards.

In this article, we examine the long-term consequences of displacement for workers who had accumulated substantial seniority with their former employers. Using newly developed data

from the administrative records of the state of Pennsylvania, we study the earnings histories of a group of workers who left declining firms between 1980 and 1986 after working for those firms since at least 1974. By observing these workers' earnings for several years before and after their separations, as well as the earnings of workers whose employment relationships endured throughout our sample period, we are able to assess displaced workers' long-term earnings losses much better than has previously been possible.

Workers with seniority as high as those we study make up only a small portion of all layoffs. Nationally, we estimate that during the period 1980-86, approximately 350,000 such workers were displaced per year, about 18 percent of all displacements. Nevertheless, high-seniority workers are likely to account for a significant fraction of earnings losses because they are more likely to have accumulated firm-specific skills or to have been particularly well matched to their former employers. Likewise, because earnings premiums and deferred compensation decrease quit rates, high-seniority workers are more likely than others to experience earnings losses due to displacement for these reasons as well.

Our principal finding is that high-seniority workers suffer large, seemingly permanent earnings losses as the result of displacement. Even five years after their separations, the average annual losses of the workers we studied were approximately 25 percent of their 1979 earnings. We also observe several important patterns to the earnings losses. For instance, workers losing jobs in depressed labor markets and those formerly employed in highly unionized durable goods industries experience especially large losses. Nevertheless, we find that workers of nearly every description experienced significant losses. Even workers who found new jobs in the same industry had major earnings losses, a finding that suggests the importance of highly firm-specific features in workers' employment relationships.

In the next section we describe the data that underlie our analysis. Next we discuss the specific definition of earnings losses due to displacement that is adopted in this article and present some simple estimates of those losses for the cohort of displaced workers who separated from their former firms in the fourth quarter of 1981. The subsequent section

presents results derived from our full data set showing how losses vary over time and across workers. This is followed by a discussion of some of the steps policymakers have taken to assist displaced workers. Finally, we offer some brief conclusions.

The Pennsylvania data

The empirical work described in this article assesses the magnitude and temporal pattern of earnings losses suffered by workers displaced in Pennsylvania between 1980 and 1986. We have limited our analysis to these workers in order to take advantage of a rich set of administrative data on Pennsylvanian workers and their firms. By combining quarterly earnings histories for a 5 percent sample of the state's workers with their firms' employment data, we have created a data set that contains workers' quarterly earnings from 1974 through 1986 as well as information about their firms, including employment levels and growth, geographic location, and four-digit SIC industry.⁷ By observing changes in the sources of earnings, we were able to date with high accuracy the quarter in which some workers separated from firms experiencing substantial employment declines. We also identified other workers who remained continuously employed by a single firm.

These administrative data have several advantages for assessing the losses suffered by displaced workers. First, they track workers' earnings over a relatively long period of time. This allows us to distinguish short-term from long-term losses and also to be more confident that our results are free of statistical biases.⁸ Second, they contain information on a large number of displaced workers. This allows us to provide useful results for relatively narrowly defined groups of workers. Third, they include information on employment changes in workers' firms. This allows us to identify workers who separated from distressed firms. Such workers are likely to have been displaced rather than to have quit or been dismissed for cause. Finally, they contain information on a large number of nondisplaced workers. This allows us to borrow statistical techniques from the program evaluation literature in order to obtain more reliable estimates of the cost of displacement, including the loss of earnings growth that would have occurred in the absence of job loss.

Our Pennsylvania data set also allows us to avoid two problems inherent in the use of stan-

dard survey-based data sets. First, earnings in data such as the Current Population Survey (CPS) and Panel Study of Income Dynamics (PSID) are reported by workers with significant error, while our data are based on firms' reports that are used to calculate tax liabilities and are presumably virtually free of measurement error.⁹ Second, workers in data sets such as the Displaced Worker Supplements (DWS) to the CPS are less likely to report instances of job loss the longer ago the displacement occurred. If, as seems likely, the less severe setbacks are the ones not reported, it becomes difficult to use this data to determine the rate of recovery from job loss. By contrast, our administrative data allow us to identify all of workers' separations.

There are also some disadvantages to using these data. Most obviously, they report only on Pennsylvanian workers. Although we cannot be sure that their experiences reflect the experiences of displaced workers generally, it is worth noting that Pennsylvania is a large state with a diverse industrial base. Further, during the period covered by this study, the economic performance of the eastern half of the state, which shared in the growth experienced by the other Middle Atlantic states and New England, was considerably better than that of the western half, which experienced double-digit unemployment rates.¹⁰ This variation in labor market conditions allows us to assess the impact of such conditions on earnings losses, which in turn helps us assess the importance of our restriction to Pennsylvanian workers.

Another disadvantage of our data is that demographic information on workers is limited to their sex and year of birth. By comparison, data sets such as the CPS and the PSID include a wider array of characteristics including workers' educational attainments, occupations, and marital and union statuses. The statistical techniques that we employ account for unobserved heterogeneity in ways that ensure that our lack of such information does not lead to any biases in our estimates of average earnings losses.¹¹ However, lack of data does limit our ability to measure differences in earnings losses across demographic groups. Similarly, lack of data prevents us from decomposing earnings losses into those due to lower wages and those due to reduced hours. However, even given these limitations, we are able to provide a substantially more complete assessment of the determinants

of long-term earnings losses than has previously been possible.

Another possible shortcoming of our data is that they do not explicitly identify whether workers' separations resulted from quits, discharges for cause, or displacements.¹² The fact that the former two reasons for separation are likely to have quite different consequences for workers' earnings motivates our focus on workers separating from distressed firms. Specifically, we limited our analysis to a mass-layoff sample that includes separators whose firms' employment in the year following their departure was 30 percent or more below their maximum levels during the late 1970s.¹³ This definition encompasses firms that closed around the time of workers' separations as well as firms with large employment declines. Although some workers from this sample may have quit or been discharged for cause, the vast majority probably were displaced from their firms for economic reasons.

Finally, our data's most important disadvantage is that they do not allow us to distinguish between workers who left Pennsylvania's wage and salary work force and those who remained unemployed for long periods of time.¹⁴ In these data, both groups of workers have zero earnings. For the unemployed, those earnings are their actual earnings. But for workers who moved out of state, became self-employed, or worked under a different Social Security number, zero clearly understates their actual earnings.¹⁵ Therefore, to avoid overstating workers' earnings losses, we have eliminated from our sample the approximately 25 percent of high-tenure separators who subsequently never showed positive earnings in our data.

Because some of the workers we eliminate probably were unemployed, we believe that this decision biases downward our displacement cost estimates. Without this sample restriction, our estimates of losses would be approximately 15 percentage points larger. Alternatively, with this sample restriction, we might overstate losses if the most resilient workers are significantly more likely to move out of state. However, we discount this possibility because before their separations, the excluded workers had characteristics similar to the rest of the sample. Moreover, in results not reported in this article, we find that displaced workers who move within Pennsylvania actually experience somewhat larger-than-average losses.

To summarize, to construct the specific sample analyzed in this article, we first included only those workers with six or more years of tenure by the beginning of 1980. Second, we restricted our sample to workers for whom we had information on age and sex and, to avoid complications associated with early retirement, to workers born between 1930 and 1959. Third, we selected those workers who separated from firms that had experienced employment declines of 30 percent or more from their 1974-79 peaks, as well as those workers who maintained a stable employment relationship through at least 1986.¹⁶ Finally, to reduce biases due to workers' disappearing from the sample, we included only workers who had received some wage or salary earnings during each calendar year.

Table 1 displays some characteristics of the age and earnings distributions of the displaced workers that we study, as well as of workers who continued working for a single employer through at least 1986. The median displaced worker was 37 years old in 1979, only one year less than the median nondisplaced worker. In addition, 80 percent of all workers were within ten years of the median age for their group.

The earnings figures in table 1 indicate that the median displaced worker earned \$23,593 (1987 dollars) in 1979, about 5 percent less than the median stably employed worker's earnings of \$24,867. A similar gap between displaced and nondisplaced workers' 1979 earnings holds within each of the groups displayed in the table. It is also worth noting that, on the one hand, displaced workers were more likely to be male, to come from the manufacturing sector, and to work in western Pennsylvania, characteristics associated with higher earnings. On the other hand, they were somewhat more likely to work for smaller firms, a characteristic associated with lower earnings.

The nature of earnings losses

Our concept of the losses caused by displacement focuses on the consequences to the worker. Specifically, we define the loss as the difference between workers' actual earnings and their expected earnings in the absence of the events that led to their job loss. We derive estimates of this quantity from a statistical model (see box) that represents the dependence of workers' earnings on a number of factors including the event of displacement.

TABLE 1

Sample characteristics

	Displaced workers				Stably employed workers					
	%	10th percentile ^a	Mean	Median ^a	90th percentile ^a	%	10th percentile ^a	Mean	Median ^a	90th percentile ^a
1979 age		27	37.1	37	47		28	37.7	38	48
1979 earnings^b										
Total		\$12,037	\$24,461	\$23,593	\$36,805		\$13,643	\$26,321	\$24,867	\$38,879
Males	77.3	16,658	27,253	26,201	38,207	75.1	17,956	29,349	27,594	40,960
Females	22.7	7,827	14,975	14,282	22,834	24.9	9,005	17,199	16,435	26,045
Manufacturing	76.3	12,386	24,346	23,774	36,250	60.1	14,047	26,197	24,768	38,361
Nonmanufacturing	23.7	10,203	24,834	22,665	39,624	39.9	13,080	26,509	25,033	39,599
Eastern Pennsylvania	53.4	11,477	23,354	22,329	35,474	59.5	13,071	25,994	24,352	39,037
Western Pennsylvania	46.6	12,859	25,733	25,226	37,950	40.5	14,742	26,803	25,524	38,762
1979 firm size ≤ 2,000	49.7	10,047	22,085	20,621	34,149	47.1	11,942	24,459	22,552	37,304
1979 firm size > 2,000	50.3	15,544	26,814	26,617	38,027	52.9	16,564	27,982	27,188	39,975

^aValues represent the level below which 10%, 50%, or 90% of the respective group falls.
^bIn 1987 dollars.

Before examining such estimates, however, it is useful to discuss a number of subtleties in our definition of earnings losses that can be more easily appreciated in the context of the simple earnings history data displayed in figure 1. That figure shows the mean earnings over the sample period of the group of displaced workers that separated from their former employers in the fourth quarter of 1981 as well as the mean earnings of workers who remained stably employed throughout the sample period.

Figure 1 illustrates a number of characteristics that proved to be general features of the experience of displaced workers:

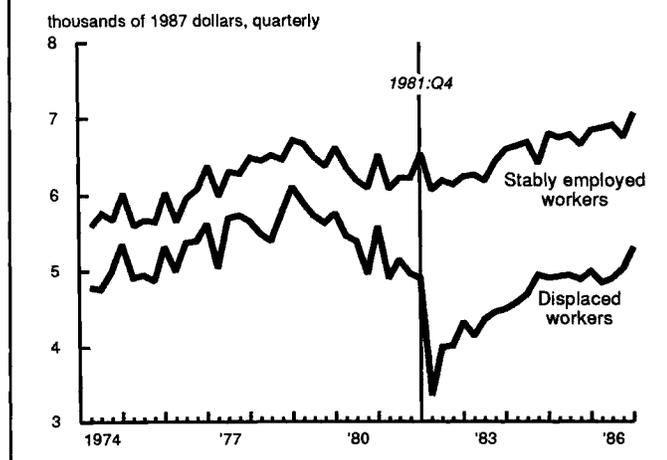
- 1) From the beginning of the sample period until a year or two before workers' separations, there was a relatively constant gap between the earnings of displaced and nondisplaced workers.
- 2) During the year or two immediately prior to workers' separations, this gap began to widen.
- 3) Displaced workers' earnings took a sharp drop when they separated from their former firms.
- 4) During the next few quarters, displaced workers' earnings recovered somewhat relative to nondisplaced workers.
- 5) Finally, for the rest of the sample period, the earnings gap remained

relatively constant, but larger than at the beginning of the sample period.

To estimate the losses suffered by displaced workers, we track the earnings growth of nondisplaced workers to infer by how much displaced workers' earnings would have changed if they had not been displaced. Because the gap between the two groups' earnings was relatively constant for several years prior to the period surrounding separation, it is reasonable to assume that gap would have remained constant throughout the sample period if the one group of workers had not been displaced. This assump-

FIGURE 1

Earnings histories of workers displaced in 1981:Q4 and workers stably employed through 1986



tion in turn implies that the increase in the earnings gap is a reasonable estimate of the effect of displacement on earnings.

For example, the losses suffered during 1986 by the workers displaced in the fourth quarter of 1981 (1981:Q4) could be estimated by

$$(y_{86D} - y_{86S}) - (y_{baseD} - y_{baseS}) = (y_{86D} - y_{baseD}) - (y_{86S} - y_{baseS})$$

where

y_{86D} = mean earnings of displaced workers in 1986,

y_{86S} = mean earnings of stably employed workers in 1986,

y_{baseD} = mean earnings of displaced workers in the base period, and

y_{baseS} = mean earnings of stably employed workers in the base period.

Table 2 presents such difference-in-differences estimates.¹⁷

Over the period 1974-79, the displaced workers who separated in 1981:Q4 had average annual earnings of \$21,868. This was \$2,804 less than the average earnings of the nondisplaced workers. By contrast, in 1986 the displaced workers earned an average of \$19,759, which was \$8,008 less than the average for nondisplaced workers. Thus the gap between the two groups' earnings increased by \$5,203. Alternatively, this estimate of the earnings loss caused by displacement is equal to the difference between displaced and nondisplaced workers' earnings growth from the base period (1974-79) to 1986. For the displaced workers, earnings growth was -\$2,108 and, for the nondisplaced workers, it was \$3,095. Again, the difference was \$5,203. Similar calculations yield an estimated loss during the first year after separation (1982) of \$6,275.

Some studies define the losses due to displacement as the decline in workers' earnings from levels im-

mediately prior to separation. Table 2 suggests that such a measure could misrepresent the importance of displacement to workers in two ways. First, the events that eventually lead to job loss may decrease workers' earnings even before their final separations. This can occur through reduction in overtime hours, temporary layoffs, or real wage decreases. Table 2 presents evidence of such pre-separation earnings declines for the 1981:Q4 cohort. In particular, the difference-in-differences estimator of losses in 1981 is \$2,138. Using 1981 earnings as the base in a calculation of earnings losses would decrease loss estimates for subsequent years by this same amount.

The second reason why the simple change in displaced workers' earnings from levels immediately prior to separation may fail to capture the importance of displacement to workers is that it does not account for the loss of earnings growth that would have occurred in the absence of displacement. Such losses of potential earnings reduce workers' welfare just as meaningfully as do actual declines in earnings, and thus ought to be included in any measure of lost earnings. Lost earnings growth is not a significant factor in the estimation of losses in the first

TABLE 2

Earnings means for workers displaced in 1981:Q4 and stably employed workers
(in 1987 dollars)

	Workers displaced in 1981:Q4	Stably employed workers	Difference: displaced - stable
Earnings level			
Annual average in base period (1974-79)	\$21,868 (505)	\$24,672 (98)	-\$2,804 (514)
1981	20,258 (649)	25,200 (106)	-4,942 (658)
1982	15,669 (684)	24,748 (111)	-9,079 (693)
1986	19,759 (761)	27,767 (139)	-8,008 (774)
Earnings changes			
1981-base	-1,609 (474)	529 (51)	-2,138 (477)
1982-base	-6,199 (540)	76 (59)	-6,275 (543)
1986-base	-2,108 (612)	3,095 (87)	-5,203 (618)

Note: Numbers in parentheses are standard errors.

year after the 1981:Q4 cohort's separation because the annual earnings of nondisplaced workers' had grown by only \$76 dollars from the base period. Over the five years following separation, however, the picture changes considerably. Ignoring the \$3,095 earnings growth experienced by nondisplaced workers for the period ending five years after the 1981:Q4 cohort's

separation reduces the estimated losses of the latter group by more than half.

A final point to note is that we have inferred the growth in displaced workers' earnings that would have occurred in the absence of displacement from the average experience of all nondisplaced workers. An alternative would be to make this inference only on the basis of the

BOX 1

Statistical models for estimating earnings losses

Our estimates of earnings losses are derived from a statistical model that represents the dependence of workers' earnings histories on displacement and other factors.¹ This model exploits two of the principal strengths of our data set—that it covers a long period of time and that it contains data on many individuals—so as to yield a detailed picture of the pattern of earnings losses across time and across workers.

To produce such a detailed picture, we pool information for all workers displaced between 1980 and 1986. A convenient way to do this is by introducing a series of dummy variables for the number of quarters before or after workers' separations. We let $D_{it}^k = 1$ if, in period t , worker i had been displaced k quarters earlier (or, if k is negative, worker i was displaced $-k$ quarters later). Otherwise, $D_{it}^k = 0$. By restricting attention to these dummy variables, we formalize the idea that a worker displaced in 1982 was in much the same position in 1985 as a worker displaced in 1981 was in 1984.

Our specification assumes that workers' earnings at a given date depend on displacement through the set of previously defined dummy variables and on some controls for fixed and time varying characteristics:

$$(1) \quad y_{it} = \alpha_i + \gamma_t + x_{it} \beta + \sum_{k \geq -m} D_{it}^k \delta_k + \varepsilon_{it}.$$

In this equation, the dummy variables D_{it}^k , $k = -m, -(m-1), \dots, 0, 1, 2, \dots$ jointly represent the event of displacement. In particular, δ_k is the effect of displacement on a worker's earnings k quarters after its occurrence. In the empirical work described in this article, we allow displacement to affect earnings up to 20 quarters before separation.² The vector x_{it} consists of the observed time-varying characteristics of the worker, which in this article are limited to the interactions among sex, age, and age squared. The parameter γ_t is the coefficient of a dummy variable for the quarter t in the sample period; these quarter dummies jointly capture the general time pattern of earnings in the economy. The "fixed effect," α_i , summarizes the impact of permanent differences among workers in observed and unobserved characteristics. Finally, the error term ε_{it} is assumed to have constant variance and to be uncorrelated across individuals and time.

We estimate the parameters of equation 1, including the fixed effects, by least squares. Thus, no matter how workers' permanent characteristics are related to their displacement status, our estimates of the displacement effects are unbiased. This estimation approach generalizes the "difference-in-differences" technique which uses a comparison group to estimate the earnings changes that would have occurred in the absence of displacement, by accounting for the effects of time-varying variables and by allowing the effects of displacement to vary by the number of quarters relative to separation.

The foregoing model describes the temporal pattern of displaced workers' earnings losses in a highly flexible manner. It must, however, be modified to summarize how this pattern varies among different groups of workers. The most straightforward such modification interacts each displacement dummy variable, D_{it}^k , with variables indicating workers' sex, age, industry, or region. The problem with this approach is that it leads to a very large number of parameters. Fortunately, after examining such estimates, we observed that differences among groups in the time pattern of earnings losses occurred

experiences of nondisplaced workers who were highly similar to the displaced workers. In fact, the estimates presented in the next section do allow workers' expected earnings growth to depend on their age and sex. It is possible to go still further and compare displaced workers only to others who kept jobs in their former industries

or firms. But our interest is in the full effects of the events that lead to displacement. A comparison of displaced workers' earnings only to those of workers retaining jobs in firms or industries affected by displacement does not capture these full effects if those same events cause those who retain their jobs in affected firms or industries to

mainly along just three dimensions: the rate at which earnings dip in the period before separation, the size of the drop that occurs at the time of separation, and the rate of recovery in the period following separation.

To construct a more parsimonious representation of losses across time and workers, we use the fact that differences in the losses among groups can be summarized by three magnitudes. Specifically we define

$$\begin{aligned} F_{it}^1 &= t - (s - 13), \text{ if worker } i \text{ is displaced at time } s \text{ and } s - 12 \leq t \leq s, \text{ and } F_{it}^1 = 0 \text{ otherwise;} \\ F_{it}^2 &= 1, \text{ if worker } i \text{ is displaced at time } s \text{ and } t \geq s + 1, \text{ and } F_{it}^2 = 0 \text{ otherwise;} \text{ and} \\ F_{it}^3 &= t - (s + 6), \text{ if worker } i \text{ is displaced at time } s \text{ and } t \geq s + 7, \text{ and } F_{it}^3 = 0 \text{ otherwise.} \end{aligned}$$

Then, if c_i is a vector of characteristics of individual i , our parsimonious model takes the form

$$(2) \quad y_{it} = \alpha_i + \gamma_t + x_{it} \beta + \sum_{k \geq -m} D_{it}^k \delta_k + F_{it}^1 c_i \phi_1 + F_{it}^2 c_i \phi_2 + F_{it}^3 c_i \phi_3 + \epsilon_{it},$$

where ϕ_1 , ϕ_2 , and ϕ_3 are parameter vectors giving the effect of workers' characteristics on the dip, the drop, and the recovery, respectively. To implement this specification we include the full set of displacement dummies but only allow for interactions between worker characteristics and the three variables F_{it}^1 , F_{it}^2 , and F_{it}^3 . Specification 2 forces the gap between the estimated losses of two workers to 1) be zero in the period more than three years before separation, 2) grow or decline linearly during the period from three years before separation until the quarter of separation, 3) be constant during the period from one to six quarters after displacement, and 4) grow or decline linearly from its value six quarters after separation until the end of the sample period. Accordingly, the losses k quarters after separation for a worker with characteristics c_i take the following form:

$$\begin{aligned} &\delta_k \text{ if } k \leq -13; \\ &\delta_k + c_i \phi_1 (k + 13) \text{ if } -12 \leq k \leq 0; \\ &\delta_k + c_i \phi_2 \text{ if } 1 \leq k \leq 6; \text{ and} \\ &\delta_k + c_i \phi_2 + c_i \phi_3 (k - 6) \text{ if } k \geq 7. \end{aligned}$$

The loss estimates presented in table 3 are derived from model 2 for the cases in which c_i consists of dummy variables for sex, birth cohort, industry, and firm size, and for the case in which c_i summarizes local labor market conditions by including a region's unemployment rate, its trend growth rate of employment growth, and the deviation of its employment from trend in the quarter in which the worker was displaced.

¹Similar statistical models are often used to evaluate the earnings impact of public sector training programs. See Ashenfelter (1978), Heckman and Robb (1985), and LaLonde (1986).

²To identify the parameters of model 1, we must observe the earnings of at least some displaced workers more than m quarters prior to their displacement. The choice of $m = 20$ presents us with no problems of identification, for even our first cohort of displaced workers, who separated from their firms in the first quarter of 1980, have six years of pre-displacement data.

³Elsewhere we consider models that allow for a worker-specific time trend in addition to the worker-specific constant in model 1. (See Jacobson, LaLonde, and Sullivan [1993a].) Estimated displacement costs are slightly higher under this alternative specification.

suffer their own earnings declines. Instead, it captures only the effects specifically associated with the separation.

We have chosen to focus here on the workers most affected by their firms' distress—the workers who actually lost jobs. Yet workers who kept jobs in distressed firms and whose earnings declined relative to those who kept jobs in nondistressed firms suffered meaningful losses too. Elsewhere we estimate that these earnings losses are about 20 percent as large as those suffered by workers who lost their jobs.¹⁸ Thus the choice of comparison group, while significant, is not crucial; even when it is limited to workers who remained employed in distressed firms, the estimated earnings losses due to displacement are still 80 percent of those reported here.

Estimated earnings losses

In this section we present our estimates of the earnings losses associated with displacement as derived from the statistical model described in the box. Like the difference-in-differences estimates computed in the previous section, these estimates account for the loss of earnings growth that displaced workers experience and allow for permanent differences in the level of earnings across workers. They extend the difference-in-differences estimates by

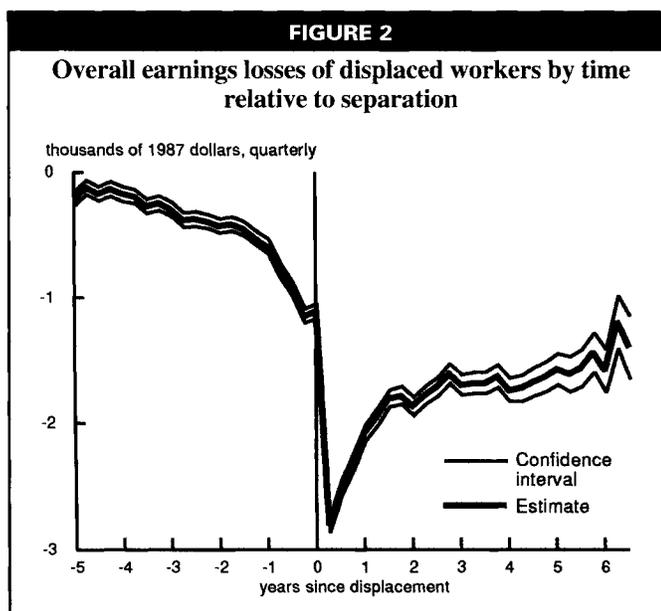
- 1) pooling information from all cohorts of workers displaced from 1980 to 1986;
- 2) allowing individual workers' earnings growth to vary by age and sex;
- 3) making the base period, in which displacement effects are assumed to be absent, end five years before workers' actual separations;
- 4) allowing the effects of displacement to vary by length of time since separation; and
- 5) allowing the magnitude of workers' losses to vary by sex, birth cohort, former industry, former firm size, and conditions of the local labor market at the time of their separation.

We begin by reporting estimates of the average effect of displacement on displaced workers' earnings for each quarter beginning with the twentieth quarter prior to, and ending with the twenty-sixth quarter

after their separations. To facilitate the exposition, we plot these estimated effects against the number of quarters before or after workers' separations. We also show 95 percent confidence bounds for each quarter's estimate.

As figure 2 shows, high-tenure prime-age workers endured substantial and persistent earnings losses when they were displaced from firms with substantial employment declines. Even in the fifth year after separation, their quarterly earnings remained \$1,600 below expected levels. This loss corresponds to approximately 25 percent of their 1979 earnings.¹⁹ Further, because the estimated losses do not decline significantly following the third year after separation, there is little evidence that displaced workers' earnings will ever return to expected levels. Clearly, displacement is a major setback for experienced workers.

We also found evidence that the events which led to job loss caused workers' earnings to depart from their expected levels well before these workers actually left their firms. In fact, their quarterly earnings began to diverge meaningfully from expected levels approximately three years before separation. That divergence accelerated as separation approached, so that by the quarter immediately before separation, these workers' quarterly earnings were approximately \$1,000 below expected levels. Although we cannot determine from our data whether these pre-separation earnings losses resulted from cuts in real wages or in weekly hours, elsewhere we



present evidence that temporary layoffs for which workers received unemployment insurance benefits can account for about half of these pre-separation losses.²⁰

The average present discounted value of workers' earnings losses during the period from three years before to six years after their separations amounted to approximately \$50,000.²¹ If, as seems likely, these workers' earnings losses remain at about \$6,000 per year until their retirement at age 65, their losses' present value rises to approximately \$80,000. Workers' average earnings losses during the period up to six quarters after their separations were approximately \$20,000. Virtually all workers had found stable employment by this time. Even during this period, far from all of these losses are attributable to workers' unemployment. But, even if unemployment was responsible for all of these losses, it would still account for only about 25 percent of workers' cumulative earnings losses.

Table 3 displays estimates of earnings losses for several categories of workers. Each group of estimates corresponds to a version of model (2) of the box for a particular choice of the vector c_i .²² Losses are shown for the first and fifth years after separation. The former reflect both lower earnings on workers' initial jobs after separation and earnings losses due to unemployment. By the fifth year after separation, however, workers have had a significant amount of time to adjust to their displacement. Losses at that time reflect almost exclusively lower earnings on jobs that those workers are likely to hold for some time. To aid interpretation, losses are presented in 1987 dollars and as a percentage of workers' 1979 earnings.

Table 3 indicates that men had larger dollar losses than women. However, because their pre-displacement earnings were much less than those of men, women's smaller dollar losses actually were larger percentages of their pre-displacement earnings. In the first year after job loss, men's earnings were more than \$10,500 less than expected and even in the fifth year were still \$7,100 less than expected. These figures are 39 percent and 26 percent, respectively, of their 1979 earnings. For women, the losses were \$6,700 and \$4,700 in the first and fifth years after job loss, or 45 percent and 32 percent of 1979 earnings. On the one hand, the lower dollar losses for women suggest that before displacement, they possessed fewer firm-specific skills or were less likely to have been receiving

wage premiums. On the other hand, their higher percentage losses suggest that a greater fraction of women's earnings were attributable to firm-specific skills or wage premiums.

The birth cohort estimates in table 3 indicate that workers of widely different ages had remarkably similar long-term losses. In the first year after separation, workers born in the 1950s had losses more than \$1,000 higher than those of workers born earlier. By the fifth year after separation, however, their losses were less than \$600 higher than those of the older workers. The modest narrowing of the differences in losses across age cohorts may reflect a greater willingness of younger workers and their new employers to invest in obtaining new skills. This greater willingness, in turn, is consistent with the longer time they will have to recoup the benefits of such investments.

Table 3 also indicates that long-term losses due to displacement are substantial for workers in almost every industry. However, losses were especially large in the primary metals industries. In the first year after separation, workers in these industries were earning \$17,600 less than expected. Five years after separation their losses were still \$12,100, or 40 percent of their 1979 earnings. These workers' large losses may reflect the loss of union wage premiums that kept earnings on their old jobs especially high. However, loss of union premiums cannot be the whole explanation of earnings losses among displaced workers. Even workers in the wholesale and retail trade industries, where unionization rates are relatively low, experienced long-term losses equal to approximately 29 percent of their 1979 earnings.

The only industry group for which long-term losses were not a significant fraction of previous earnings was finance, insurance, and real estate, where losses five years after separation averaged only 3.5 percent of 1979 earnings.²³ Experienced workers in these industries may have skills that are more easily transferred from one employer to another. Another possibility is that because employment in these industries was growing relatively rapidly, displaced workers may have found it easier to find new jobs with similar firms. However, we show below that returning to the same industry did not, in general, shield workers from losses.

Another indication that losses are somewhat higher for unionized workers is the larger losses experienced by workers displaced from very

TABLE 3
Earnings losses by worker characteristics
 (in 1987 dollars)

	Number	1979 earnings	First year after separation		Fifth year after separation	
			Loss	Percent*	Loss	Percent*
Overall	6,435	\$24,461	\$9,676 (70)	39.6 (0.3)	\$6,575 (125)	26.9 (0.5)
Sex						
Male	4,972	27,253	10,555 (76)	38.7 (0.3)	7,143 (132)	26.2 (0.5)
Female	1,463	14,975	6,734 (118)	45.0 (0.8)	4,744 (184)	31.7 (1.2)
Decade of birth						
1930s	2,599	25,605	9,209 (94)	36.0 (0.4)	6,672 (159)	26.1 (0.6)
1940s	2,584	24,742	9,662 (92)	39.0 (0.4)	6,352 (151)	25.7 (0.6)
1950s	1,252	21,509	10,663 (121)	49.6 (0.6)	6,927 (188)	32.2 (0.9)
Industry						
Mining and construction	247	31,570	11,589 (243)	36.7 (0.8)	8,434 (352)	26.7 (1.1)
Nondurable manufacturing	1,206	18,989	7,104 (124)	37.4 (0.7)	5,052 (188)	26.6 (1.0)
Primary metals	1,354	30,160	17,562 (117)	58.2 (0.4)	12,074 (210)	40.0 (0.7)
Fabricated metals	436	23,653	7,156 (189)	30.3 (0.8)	4,936 (301)	20.9 (1.3)
Nonelectrical machinery	632	25,489	5,577 (168)	21.9 (0.7)	4,644 (284)	18.2 (1.1)
Electrical machinery	421	21,368	8,447 (197)	39.5 (0.9)	5,318 (300)	24.9 (1.4)
Transportation equipment	419	25,320	7,912 (196)	31.2 (0.8)	6,508 (291)	25.7 (1.1)
Other durable manufacturing	441	22,108	7,499 (184)	33.9 (0.8)	4,570 (262)	20.7 (1.2)
Transportation, communication, and public utilities	348	28,666	9,000 (206)	31.4 (0.7)	9,392 (321)	32.8 (1.1)
Wholesale and retail trade	545	20,604	8,809 (167)	42.8 (0.8)	5,927 (235)	28.8 (1.1)
Finance, insurance, and real estate	183	24,604	4,352 (291)	17.7 (1.2)	855 (369)	3.5 (1.5)
Professional, business, and entertainment services	203	21,635	2,184 (282)	10.1 (1.3)	3,093 (378)	14.3 (1.7)
Firm size						
50-500	1,704	21,284	8,238 (107)	38.7 (0.5)	5,404 (163)	25.4 (0.8)
501-2,000	1,497	22,997	7,635 (112)	33.2 (0.5)	5,540 (176)	24.1 (0.8)
2,001-5,000	1,381	24,378	6,760 (115)	27.7 (0.5)	5,571 (179)	22.9 (0.7)
>5,000	1,853	28,630	11,896 (147)	41.5 (0.5)	10,151 (190)	35.5 (0.7)
Local labor market						
Pittsburgh-1982	214	26,232	13,075 (116)	49.8 (0.4)	8,889 (267)	33.9 (1.0)
Philadelphia-1985	189	25,859	7,349 (89)	28.4 (0.4)	4,947 (158)	19.1 (0.6)

*Loss as a percentage of 1979 earnings.

Note: Numbers in parentheses are standard errors.

large firms. Workers from firms with over 5,000 employees in 1979 had fifth year losses of 36 percent of their 1979 earnings. By contrast, average losses of workers in smaller firms were at most 25.4 percent.²⁴

Finally, table 3 indicates that the size of earnings losses depended substantially on the state of the local labor market when workers were displaced. We divide Pennsylvania into 13 distinct regions and summarize local labor market conditions in those regions with three variables: 1) the trend rate of employment growth over the sample period, 2) the deviation of employment growth from that trend in the quarter in which the worker separated, and 3) the unemployment rate in the quarter in which the worker separated.

We further summarize these effects by presenting estimates of losses for a particularly weak labor market (Pittsburgh in 1982) and a particularly robust labor market (Philadelphia in 1985). Losses were 13 percentage points higher in the weaker labor market. Even in the robust market, however, losses still averaged over 19 percent of 1979 earnings. Therefore, while labor market conditions are a significant determinant of displaced workers' losses, even those who separate from distressed firms in prosperous times experience large losses.

Our data also allow us to assess the importance of the sector of workers' post-displacement jobs for the size of their losses.²⁵ If the skills required on two jobs are more similar when the jobs are in the same industry, and if the loss of specialized skills is an important determinant of workers' losses, then displaced workers returning to the same industry should experience smaller losses than those whose new jobs lie in a different industry. Accordingly, we examined the earnings losses of workers whose new jobs were 1) in the same four-digit SIC industry as their old job, 2) in the same sector (manufacturing or nonmanufacturing) but in a different four-digit SIC industry, or 3) in a different sector.

The earnings losses of manufacturing workers depended crucially on whether those workers obtained new jobs in the manufacturing sector.

	First year after separation		Fifth year after separation	
	Loss	Percent*	Loss	Percent*
Manufacturing workers				
Same SIC	\$6,700 (212)	27.5 (0.1)	\$4,020 (281)	16.5 (0.1)
Same sector	8,188 (186)	33.6 (0.1)	4,702 (258)	19.3 (0.1)
Different sector	12,538 (168)	51.5 (0.1)	9,280 (239)	37.8 (0.1)
Nonmanufacturing workers				
Same SIC	5,214 (276)	21.0 (0.1)	5,098 (416)	20.5 (0.2)
Same sector	8,288 (243)	33.4 (0.1)	6,510 (305)	26.2 (0.1)
Different sector	10,436 (549)	42.0 (0.2)	7,791 (694)	31.4 (0.3)

*Loss as a percentage of 1979 earnings.
Note: Numbers in parentheses are standard errors.

As table 4 shows, in the fifth year after separation, the losses of those who left the manufacturing sector were 38 percent of their 1979 earnings.²⁶ However, for those who found new jobs in the manufacturing sector, it did not matter as critically whether they found a job in their old four-digit SIC industry. In the fifth year after their separations, manufacturing workers' losses were 17 percent of 1979 earnings if they found new jobs in the same four-digit SIC industry, compared with 19 percent if they found new manufacturing jobs in different four-digit SIC industries.

The findings for displaced nonmanufacturing workers are similar, though the dependence on new industry is less pronounced. For those who found new jobs in the same four-digit SIC industry, earnings losses in the fifth year after separation were 21 percent of 1979 earnings. That figure rose to 26 percent when the new jobs were in different four-digit SIC industries but still in the same sector. For those who found new jobs in the manufacturing sector, fifth-year earnings losses were 31 percent of 1979 earnings.

It is clear, then, that among both manufacturing and nonmanufacturing workers, even those who found jobs in the same four-digit SIC industry experienced large and persistent losses. This finding suggests that something intrinsic to the

employment relationship itself is lost when workers are displaced. If it is workers' skills that are lost, these skills must be firm-specific, not merely industry-specific. Alternatively, such earnings losses may result from the workings of internal labor markets.

Though a number of interesting patterns appear in tables 3 and 4, workers' earnings losses appear to be more similar than different. Large long-term losses appear to be the rule when experienced workers are forced to leave declining firms.

Public policies to assist displaced workers

Assistance for displaced workers comes in several forms.²⁷ Unemployment insurance (UI) provides income replacement while workers are unemployed. For some workers, these benefits are supplemented by Trade Adjustment Assistance (TAA), which provides additional benefits to workers whose job loss is the result of import competition. Other programs aim to speed displaced workers' return to work and raise their skills so that they will have higher earnings in the future. For instance, the Economic Dislocation and Worker Adjustment Act (EDWAA) provides certain displaced workers with extensive job search assistance, counseling, and classroom training. Unfortunately, as we shall argue, the existing assistance programs do not and probably cannot eliminate more than a small fraction of the losses suffered by workers such as those we report on here.

In the previous section we observed that most of the cumulative losses experienced by displaced workers occurred after they had become re-employed. This finding obviously implies that a benefit such as UI, whose receipt is tied to being unemployed, cannot eliminate a large fraction of workers' losses. In any case, only a little over 40 percent of the displaced workers we study in this article received any UI payments in the quarter of their separation or the one thereafter.²⁸ Thus it is not surprising that, as

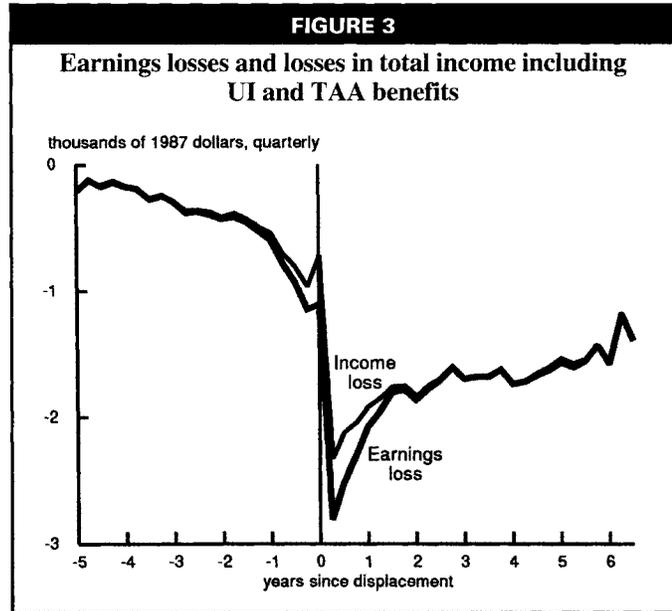


figure 3 demonstrates, UI and TAA do relatively little to reduce displaced workers' cumulative losses. Figure 3 compares losses in earnings as shown in figure 2 with a measure of displaced workers' losses in income including UI and TAA benefits. Clearly, UI significantly reduces losses in the period when they are most severe but has no impact on workers' long-term welfare.

Of the displaced workers we study who did receive UI benefits, many received them for long periods. Nearly two-thirds received 26 or

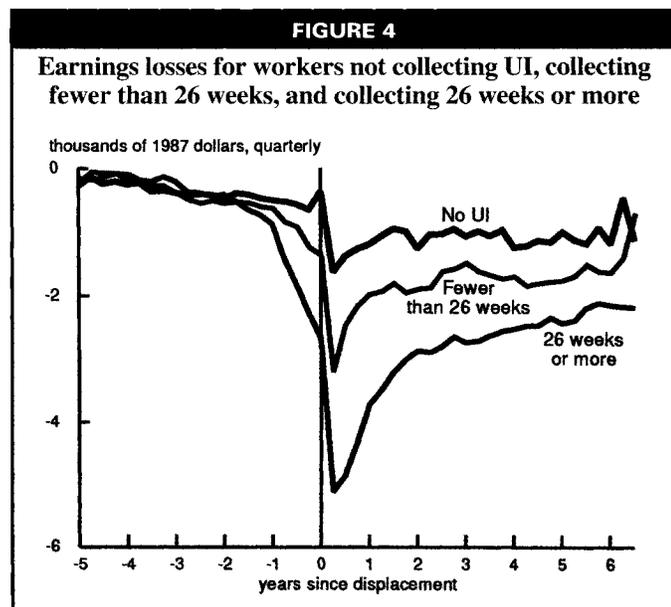


TABLE 5

Distribution of weekly UI benefits relative to weekly earnings before and after displacement
(in 1987 dollars)

	25th percentile ^a	Median ^a	75th percentile ^a
Did not collect UI			
Previous weekly earnings	\$314	\$433	\$575
Subsequent weekly earnings	277	411	560
Percentage change ^b	-17.1%	-1.5%	15.5%
Less than 26 weeks of UI			
Previous weekly earnings	\$264	\$382	\$520
Subsequent weekly earnings	197	321	447
Percentage change ^b	-36.6%	-11.5%	9.6%
UI weekly benefit	\$121	\$185	\$201
Benefit relative to previous earnings ^c	31.6%	41.6%	51.6%
Benefit relative to subsequent earnings ^c	35.3%	48.5%	67.8%
26 or more weeks of UI			
Previous weekly earnings	\$293	\$414	\$522
Subsequent weekly earnings	122	211	330
Percentage change ^b	-67.3%	-41%	-12.5%
UI weekly benefit	\$167	\$190	\$199
Benefit relative to previous earnings ^c	35.8%	44.7%	53.0%
Benefit relative to subsequent earnings ^c	53.5%	77.4%	135.2%

^aValues represent the level below which 25%, 50%, or 75% of the respective group falls.

^bEntries are the respective percentiles of the distribution of individual percentage changes, not the percentage difference between the corresponding percentiles of the distributions of previous and subsequent earnings.

^cEntries are the respective percentiles of the distributions of individual benefit-to-earnings ratios, not the ratio of the percentiles.

more weeks of UI in the four years surrounding their separations. This finding is not unique to our data. Other researchers have noted an increased tendency for certain groups of workers to exhaust 26 weeks of UI eligibility. This fact has prompted a number of policymakers and analysts to advocate substantially lengthening the standard maximum duration of benefits.²⁹

Figure 4 displays estimates of losses separately for workers who

- 1) received no UI benefits,
- 2) received fewer than 26 weeks of benefits, and
- 3) received 26 or more weeks of benefits.³⁰

As can be seen, workers who collected many weeks of UI had especially large earnings losses. Indeed, in the fifth year after separation their losses averaged nearly \$10,000. Clearly, workers who collect many weeks of UI are among those who policymakers should most want to help.

The fact that these workers' losses are so large and persistent, however, makes providing that help in the form of longer maximum benefit durations potentially costly to the economy because doing so may substantially delay the beneficiaries' return to work. In order to give unemployed workers strong incentives to find new jobs, policymakers have limited UI benefits to a little less than half their previous earnings. Yet even such benefit levels may represent a substantial fraction of the earnings that workers can eventually expect to get on their new jobs, since new jobs tend to be lower-paying than previous ones.

Table 5 compares estimates of workers' weekly earnings on pre- and post-displacement jobs with their weekly UI benefits. We estimated weekly earnings on new jobs by dividing by 13 workers' earnings in the second quarter after their separations in which they had positive earnings and received no UI benefits. We estimated weekly earnings on old jobs in the same manner from workers' earnings in the last quarter before their separations in

which they received no UI payments.

The table shows that workers who collected 26 or more weeks of UI generally had much larger drops in weekly earnings than other workers and that UI benefits were a significantly larger fraction of subsequent than of previous earnings. For workers collecting fewer than 26 weeks of UI, the median ratio of benefits to earnings was 42 percent for previous earnings and 49 percent for subsequent earnings. For workers collecting at least 26 weeks of benefits, however, the two median ratios were 45 percent and 78 percent. Indeed, for more than a third of the latter group, benefits exceeded their earnings on post-displacement jobs.³¹

It seems possible, then, that providing longer periods of eligibility for UI benefits will increase unemployment durations not only because appropriate jobs for such workers are scarce, but also because many workers will have

relatively little incentive to take those jobs. For many displaced workers, lengthening the duration of benefits might simply postpone the inevitable—taking a job at substantially lower earnings. Elsewhere, we suggest that assistance could be better provided to such workers by offering an earnings subsidy that would replace a fraction of the difference between earnings on their pre- and post-separation jobs. Such a subsidy would direct the most assistance to those suffering the largest losses without at the same time eliminating displaced workers' incentives to return to work.³²

Because UI has an obviously limited capacity to reduce displaced workers' long-term losses, policymakers have also designed programs to raise these workers' earnings once they are re-employed. These include training programs that upgrade workers' skills and job search assistance programs that better match workers' existing skills with the needs of employers. Unfortunately, a good deal of research suggests that these efforts historically have not raised workers' earnings by enough to come close to compensating for losses of the size we estimated.³³ This lack of success in raising workers' earnings may reflect the relatively modest duration and intensity of traditional subsidized training programs.³⁴

There is also reason to question whether the resources that are available for assisting displaced workers are allocated wisely. Eligibility for EDWAA services theoretically extends to millions of workers per year. In reality, however, funding constraints have limited participation to about 120,000 workers annually.³⁵ Thus in determining the mix of services provided under this program, policymakers face an inevitable choice between breadth and depth. More specifically, they can provide large numbers of workers with relatively basic and inexpensive job search assistance, or they can provide a smaller number of workers with job training which, while relatively modest in duration and intensity, is still several times more expensive. Presumably, the decision should depend on two considerations: 1) the respective rates of return that these two choices offer in the form of increased earnings on workers' subsequent jobs, and 2) their respective implications for equity among workers.

Our reading of the available evidence suggests that job search assistance has a substantially higher rate of return than the kind of training

that has been traditionally provided to displaced workers. In a recent survey of research on training and job search assistance programs for the displaced, Leigh (1990) concluded that job search assistance strongly improves a variety of labor market outcomes, including earnings. Given its low cost per worker, it also appears to be cost effective.³⁶ Later, however, Leigh notes that "classroom training fails to have a sizable incremental effect on earnings and employment above that of job search assistance only. In particular, it certainly does not appear that the additional affect of classroom training is large enough to offset the higher cost of these services."³⁷ Concentration on job search assistance would also allow more workers to be served and hence seems more equitable as well. Thus, the stipulation in EDWAA's enabling legislation that half of all funds be spent on classroom training may be unfortunate.

The results of the recent New Jersey Unemployment Insurance Re-employment Demonstration are typical of the evidence on the relative rates of return to training and job search assistance.³⁸ This demonstration used an experimental design to study whether mandatory job search assistance and referrals for retraining raised displaced workers' earnings. The demonstration targeted UI claimants over 25 years old, with at least three years' tenure with their former employer, and who had been laid off without a recall date for more than four weeks. A random sample of this group was required to participate in a two-week job search assistance workshop. Afterwards, a random sample of these participants was referred to training.

The evaluation indicated that job search assistance raised participants' earnings by \$450 during a one-year period some months after the programs ended. However, the earnings gains of those who received both job search assistance and retraining referrals were not significantly larger than the gains of those who received job search assistance alone. To make the case for retraining even worse, job search assistance cost only a few hundred dollars per participant, whereas training cost at least \$2,300 per participant.

As we noted, the evidence suggests that traditional subsidized training programs have not significantly reduced displaced workers' earnings losses. Nevertheless, it is instructive to ask how much it might cost for a hypothetical, well-

functioning training program to eliminate displaced workers' \$6,000 annual long-term earnings losses. Suppose that such a program were able to generate a 12 percent rate of return on its investment—a high rate compared to investments in other forms of human capital such as schooling. Even such a program could generate a permanent earnings gain of \$6,000 per year only at a cost of \$50,000. For this price, one could allow participants to spend two years out of the labor force and forego \$15,000-\$19,000 per year in earnings in a full-time retraining program with direct costs of \$6,000-\$10,000 per year. This would be equivalent to paying the tuition, books, and other expenses for a displaced worker with a high school diploma to go back to school full time to acquire an associates degree. To date, policymakers have not been willing to commit this level of resources to retraining displaced workers; typical programs last only a few months and cost a few thousand dollars.

In summary, the existing programs designed to aid displaced workers provide modest short-term relief but do little to reduce long-term losses. No existing program provides the costly, long-lasting assistance that might come close to offsetting these losses fully. Although current programs could probably be substantially improved through reorganization and in some cases additional funding, it is doubtful whether they could ever fully restore workers' lost earnings potential. It may be more efficient to introduce some form of earnings subsidy that would replace a fraction of the difference between workers' earnings on their pre- and post-displacement jobs. Such a program might effectively provide substantial assistance to those most severely affected by job loss without at the same time creating strong disincentives to work.

Conclusion

Displacement clearly has substantial long-term consequences for high-seniority workers. Even several years after separation, such workers' losses are still approximately 25 percent of their pre-displacement earnings. Losses vary in important ways across groups of workers; they are larger for workers in highly unionized durable goods manufacturing industries and for those losing jobs in depressed labor markets. But workers from almost every industrial sector and in every labor market condition appear to suffer

significant losses. Even workers returning to the same industry experience significant losses.

Current programs to assist displaced workers offset only a small fraction of the losses of high-seniority workers. Even so, the current structure of the UI system may delay significantly displaced workers' return to work, since benefit levels for those most adversely affected by job loss are often relatively close to earnings on post-displacement jobs. Job search assistance appears to be highly cost effective, but our finding that even workers who return to the same industry suffer large losses suggests that these programs are limited in their capacity to aid workers. The job training traditionally offered to displaced workers does not appear to come close to eliminating their losses and may not even be cost effective. Whether more ambitious training programs would have larger effects is an open question. Given the current resources devoted to assisting displaced workers, however, shifting resources from training to job search assistance would probably contribute to both greater equity and greater efficiency.

If policymakers wish to offset a substantial portion of displaced workers' losses, they will almost certainly have to commit substantially more resources than they have done heretofore. Whether they should make this commitment is obviously a political question. But when displacement is the result of policies such as trade liberalization, whose net benefits to society are likely to be large, it may be worth insuring that those who suffer losses receive assistance if for no other reason than to insure the political viability of the policy.

When policies that entail job loss are less clearly beneficial, as in some cases of proposed environmental regulation, policymakers will need to weigh carefully the full consequences of the resulting dislocation. Similarly, if lower inflation can be achieved only at the cost of permanently displacing workers, then the magnitude of the long-term losses documented in this article suggests caution in evaluating the net gains from further reductions in inflation. Only a small fraction of workers' total losses occur while they are actually unemployed. The majority of their losses occur in the form of lower earnings on subsequent jobs. Thus the trade-off is not strictly between inflation and unemployment, but between inflation and a more comprehensive measure of labor market disruption that includes the long-term effects of displacement.

FOOTNOTES

¹See Chapter 2 of Jacobson, LaLonde, and Sullivan (1993b) for a review of some of the previous empirical literature documenting displaced workers' earnings losses.

²See Congressional Budget Office (1993).

³In the case of the North American Free Trade Agreement (NAFTA), a widely quoted estimate from the Institute for International Economics is that 150,000 jobs will be lost in the ten years after ratification. This figure is easily offset by the 325,000 new jobs predicted to be created as the result of the treaty. See Congressional Budget Office (1993).

⁴For example, on the former possibility see Becker (1975) and on the latter possibility see Jovanovic (1979).

⁵For example, on the former possibility see Lewis (1986) and on the latter possibility see Stiglitz (1974).

⁶See, for example, Lazear (1981).

⁷For details on how we constructed our data, see Jacobson, LaLonde, and Sullivan (1993b).

⁸The statistical issues associated with estimating earnings losses due to displacement are similar to those involved in the estimation of the impact of programs such as those providing subsidized training to workers. One interpretation of the exchange between LaLonde (1986) and Heckman and Hotz (1989) is that reliable nonexperimental estimation of such programs' impacts requires data on workers well before the time of their participation.

⁹See Duncan and Hill (1985) and Bound and Krueger (1991).

¹⁰See Jacobson (1988).

¹¹See Jacobson, LaLonde, and Sullivan (1993a) and Chapter 4 of Jacobson, LaLonde, and Sullivan (1993b) for discussion of statistical issues in the estimation of earnings losses, including a description of circumstances under which our earnings loss estimators could possibly be biased.

¹²In related research, Jacobson (1991) found that between 1977 and 1987, the rate of separations for workers from Allegheny County (Pittsburgh) was 80 percent for workers with less than one year of tenure, 43 percent for workers with one year of tenure, 24 percent for workers with two to three years of tenure, and 13 percent for workers with four or more years of tenure. For those with four or more years of tenure, he estimated that one-half were retirements and one-third were displacements. Thus the quit rate for that group would be about 2 percent per year.

¹³This categorization is less sensible for workers in small firms. Accordingly, we further restricted our sample to workers whose firms had at least 50 employees in 1979. We have experimented with other, similar definitions of mass layoff and obtained results similar to those presented here.

¹⁴The wage and salary work force consists of those covered by the unemployment insurance system. The primary group of workers excluded are those that are self-employed. Potential sample selection problems are not unique to studies using administrative data. For example, in the 1984 DWS, wage data were unavailable for the approximately 40 percent of the sample that was not employed at the survey date. See Flaim and Seghal (1985).

¹⁵Tannery (1991) used U.S. Social Security Administration data to study the rates at which workers left the Pennsylvania wage and salary work force between 1979 and 1987. Although his sample is not restricted to high-tenure workers, he found that among those who left the Pennsylvania wage and salary labor force for reasons other than retirement, 60 percent had earnings outside the state. However, among those who left the state by 1987, over one-half had 1979 earnings less than \$3,000 and less than 8 percent had earnings above \$20,000.

¹⁶Workers who separated from firms that did not experience large employment declines or who worked for firms with fewer than 50 employees in 1979 were not used in the analysis described in this article.

¹⁷The difference-in-differences technique has been frequently employed in the program evaluation literature. See, for example, Ashenfelter (1978), Ashenfelter and Card (1985), Heckman and Robb (1985), LaLonde (1986), and Card and Sullivan (1988).

¹⁸See Jacobson, LaLonde, and Sullivan (1993b).

¹⁹Although not shown, the quarterly employment rates of the displaced workers in our sample differ only slightly from their expected levels except in the year after separation. This is not surprising because our sample excludes workers with extremely long spells without wage and salary earnings. Thus the substantial earnings losses shown in figure 2 are largely due to lower earnings for those who work, rather than to an increase in the number of workers without quarterly earnings.

²⁰See Jacobson, LaLonde, and Sullivan (1993b).

²¹This assumes a 4 percent real discount rate.

²²Elsewhere we explore the relative importance of the various factors displayed in table 3 in determining workers' losses, for instance, the extent to which the differences in men's and women's earnings losses are explained by differences in the industries in which they work. See Jacobson, LaLonde, and Sullivan (1993a).

²³The variation in losses across industries is significantly less when the alternative comparison group discussed at the end of the previous section is used to estimate losses. For instance, the earnings losses of displaced primary metals workers and displaced finance, insurance, and real estate

workers are both about 25 percent when the comparison group is limited to workers in the displaced workers' former industries. This convergence in loss estimates reflects the relatively rapid earnings growth of workers who remained employed in finance, insurance, and real estate and the significant earnings reductions experienced by workers who remained employed in primary metals. See Chapter 6 of Jacobson, LaLonde, and Sullivan (1993b).

²⁴In Jacobson, LaLonde, and Sullivan (1993a) we show that the large losses of workers from large firms remain even after we control for other factors such as the industrial makeup of these firms.

²⁵In keeping with this study's focus on displacement's long-term impact, we would like to assess the relationship between earnings losses and the industry of workers' new jobs several years after separation. For workers displaced in 1985 and 1986, however, such an assessment is impossible because we have post-separation data for only a few quarters. Accordingly, we examined the relationship between earnings losses and industry of new job for workers separating from distressed firms between 1980 and 1983. Industry of new job refers to the workers' primary employer in 1986, or three to six years after separation.

²⁶This finding showing greater losses when displaced workers switch sectors does not result because workers with jobs in the nonmanufacturing sector have been displaced for a shorter period of time. The mean quarter of separation for those who switch sectors is the same as for those who remain in the manufacturing sector.

²⁷For a fuller discussion of assistance policies see Jacobson, LaLonde, and Sullivan (1993b).

²⁸Most of these workers appear to have found new (lower-paying) jobs relatively quickly. Very few of them had even a single quarter without earnings.

²⁹See, for example, Topel (1991).

³⁰The estimates in figure 4 were obtained from a model that interacted dummy variables for the three categories of workers with dummies for the number of quarters relative to separation and thus do not satisfy the constraints imposed by the parsimonious model described in the box.

³¹Moreover, for most of the period covered by our study, unemployment insurance benefits received favorable tax treatment. Note that the figures given are medians of the distributions of the ratio of benefits to earnings. This is not necessarily the same as the ratio of the medians.

³²See Jacobson, LaLonde, and Sullivan (1993b).

³³See Leigh (1990) for a comprehensive survey of research on the effectiveness of training programs for displaced workers.

³⁴Such programs, which are often run through community colleges, seldom last more than six months.

³⁵A recent Congressional Budget Office study (1993) notes that funding levels have recently risen to levels consistent with participation of around 200,000 workers per year.

³⁶Leigh (1990), p. 102.

³⁷Leigh (1990), p. 103.

³⁸See Corson et al. (1989).

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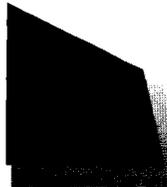
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Cost effective control of urban smog: a report of a conference held at the Federal Reserve Bank of Chicago, June 7-8, 1993

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The new environmental mandates set forth in the Clean Air Act Amendments of 1990 (CAAA '90) are expected to cost the nation \$20 to \$30 billion annually through the end of the decade. These costs will fall particularly hard on Seventh District metropolitan areas such as Chicago, Milwaukee, and Muskegon, Michigan, which are classified as severe nonattainment areas.

Responding to these expectations, a group of academics, business people, government regulators, and environmentalists gathered on June 7 and 8, 1993, for a conference at the Federal Reserve Bank of Chicago sponsored by the Chicago Fed, the Workshop on Market-Based Approaches to Environmental Policy of the University of Illinois at Chicago, and the Chicago Council on Foreign Relations. The conference was designed to evaluate the promise and the potential shortcomings of urban smog control strategies from various perspectives, ranging from the impact on human health to the potential effects on regional economies. The conference proceedings reflect this diversity of topics and explore ways of crafting environmental policy that will improve air quality while minimizing the extent of economic disruption.

During the past twenty-five years, most regions of the United States have experienced both growing per capita standards of living (as measured by national income) and improved air quality. Environmental policy measures have brought about reduced atmospheric concentrations of lead, particulate matter, and sulfur dioxide. In contrast to this improvement, however,

recent years have seen the emergence of two apparently opposing trends: a heightened interest in reducing urban smog concentrations, which remain high, and a growing apprehension that improved air quality will require increasing costs per unit of improvement.

What explains this shift from optimism about having achieved certain environmental goals to the more recent apprehension of an environment-prosperity trade-off? Perhaps some of the more tractable environmental problems have been solved and the less costly pollution abatements have been achieved, leaving those complex environmental problems that will be very costly to remedy. One of the remaining problems is the quantity of low-level airborne ozone, perhaps the most important component of urban smog. After twenty years of efforts such as modifications to automobiles, many urban areas still fail to meet national standards for ambient ozone.

Given the difficulties in attaining national ozone standards, it is natural to ask whether the goals of current ozone legislation can be justified within a cost-benefit framework. In the minds of many of the conference participants was an earlier and influential study by the economists Alan Krupnick and Paul Portney (1991), which estimated that the costs of a one-third reduction

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of volatile organic compounds, a precursor of ground-level ozone, far exceeded the benefits associated with this reduction—by a factor of eight or more.¹ Calculations for the Los Angeles area, that “superbowl” of smog, reduced the factor but left the ratio above three. These findings were consistent with those of earlier research. Yet the Clean Air Act Amendments of 1990 (CAAA ‘90) set new and even more stringent goals for the nation that could require more expensive control measures.

Recent research suggests that the benefits of reducing smog are greater than previously estimated. This shift in thinking is due to new discoveries about the health impacts of ozone, as well as its adverse effects on agriculture and material contamination—primarily vehicle tires. Moreover, as new market-based approaches to controlling emissions are tried, the smog cleanup costs, both for volatile organic compounds and nitrogen oxides, appear to be decreasing or increasing less rapidly per unit of improvement. If this is true, the new legislation might be even closer to the mark than previously thought.

Some observers view Title I of CAAA ‘90 as a renewed effort by the federal government to attain cleaner urban air, but in the most cost-efficient fashion so as to allow continued improvement in both living standards and air quality. The legislation sets more stringent requirements for reducing ozone concentrations, yet it provides for new, flexible, market-based approaches to controlling those ozone precursors generated by human activity. Such approaches hold out the promise of more cost effective and innovative control of air pollution. Among the responses to the legislation are programs that allow firms to trade rights to emit prescribed levels of the precursors of urban ozone, and “cash-for-clunkers” programs that offer bounties to car owners who scrap their high-emitting, often older, automobiles.

Incentive systems such as these have long appealed to economists. In theory, given cost variability within and among firms, market incentives allow firms to realize significant cost savings by choosing the cheapest, most efficient methods of reducing their own emissions. In addition, programs of tradeable emission credits give firms an incentive to search out-of-house for the most cheaply reduceable emission sources to control first, such as motor vehicles. But perhaps the most significant benefit of incentive systems is that they stimulate advances in en-

vironmental control technologies and promote practices that lead to additional cost savings and emissions reduction.

Clearly, incentive systems hold out the promise of substantial savings in resources that would be welcome in an era of increasing demands. The only hitch is that they are relatively untried and untested. A heavy load of program design, institution creation, monitoring, and enforcement problems remains to be resolved before the promise of incentive systems can be fulfilled. Additionally, many of the parties concerned with environmental policy are uneasy with market-based approaches. This includes not only some environmental groups, but also segments of the business and government regulatory communities.

An important objective of the June conference, therefore, was to contribute to a full airing of these disparate views. Several contributions to the conference bear on this point. The director of the Illinois Environmental Protection Agency and the president of Commonwealth Edison Company announced the initiation of a new market-based program whereby emitters in the Chicago region can trade nitrogen oxide emission credits. A senior economist with the Environmental Defense Fund voiced support for this program, illustrating the potential for cooperation among groups previously in opposing environmental camps.

Such signs of cooperation are welcome at this time. The debate leading up to CAAA ‘90, both inside and outside Congress, revealed a dramatic widening of the range of interest groups demanding a say in the legislative process. Groups with differing points of view and conflicting historical positions on environmental policy—particularly, the business and environmental communities—seemed to be modifying previous positions and opening up tentative new lines of communication and cooperation. At the local and regional level, such cooperation will be needed if these innovative policies are to be successfully designed and implemented. The conference aimed to nurture the development of these new cooperative relationships, which can ultimately fashion the most cost effective policies for solving the ozone abatement problem.

FOOTNOTE

¹Alan J. Krupnick and Paul R. Portney, “Controlling urban air pollution: a benefit-cost assessment,” *Science*, Vol. 252, 1991, pp. 522-28.

Proceedings of the Conference on Cost Effective Control of Urban Smog

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