LS/PPL
7/28/06
3:45 PM

Mortality, Mass-Layoffs, and Career Outcomes:

An Analysis using Administrative Data[1]

Daniel Sullivan

Chicago Federal Reserve

Till von Wachter

Columbia University

PRELIMINARY

COMMENTS WELCOME

To be Presented at NBER Summer Institute Labor Studies, Friday July 28th 2006

Abstract

Short-term labor market shocks, such as job displacements, can have persistent effects on workers' earnings, employment and job stability, consumption, and access to health insurance. A long literature suggests these changes in workers' socioeconomic conditions have potentially important effects on health outcomes, but existing studies associating job loss to health status face several problems of measurement and identification. This paper uses a large longitudinal administrative data set of quarterly earnings and employer records matched to information on individual mortality outcomes to estimate the long-term effect of a job loss during a mass layoff on mortality. We find that a job loss leads to a 15-20% increase in the probability of dying in the 20 years following a job loss. The initial and the long-run responses are particular pronounced. To examine the channels of the mass layoff effect, we exploit the panel nature of our data – covering over 15 years of earnings – to analyze the correlation of long-run career conditions, such as the average and the variance of earnings, with mortality, something not possible with typical data sets. A lasting decrease in earnings and a rise in earnings instability due to mass layoffs have the potential to explain a significant fraction of the effect of a job loss on mortality.

[1] Contact vw2112@columbia.edu. We would like to thank Marianne Bertrand, David Card, Claudio Lucifora, and participants at the Society of Labor Economics 2006 Meetings and the Mills Workshop for helpful comments. Alice Henriques provided excellent research assistance.

1. Introduction

Regular economic activity can expose workers to shocks to their career development. While for many workers these shocks may be short-lived, a growing literature shows that short-term career shocks – such as involuntary job losses or cyclical downturns – can have large and persistent effects for large groups of workers. For example, mature displaced workers tend to experience long-term earnings losses, reduced employment probabilities, early retirement, increased job instability, as well as reductions in consumption and a loss in health insurance coverage.[2] Similarly, cyclical shocks can lead to persistent earnings declines and long-term increases in the variance of career outcomes, especially for younger and lower educated workers.[3] This has been of continued concern to policy makers, partly because workers have been exposed to increasing instability in earnings, a decline in long-term employment relationships, and recently increases in displacement rates.[4]

The comprehensive effects of job loss and other career shocks on the socio-economic conditions of workers are particularly worrisome, since a large literature documents a strong correlation of income and health. Moreover, an increasing amount of research links stress from economic uncertainty and unemployment to unhappiness and mental health. A growing literature in epidemiology has also linked job losses to strokes and heart attacks and other detailed health measures, especially for older workers. While highly suggestive of an important relationship between career shocks and health outcomes, the existing empirical evidence linking economic status and job loss to health suffers from a variety of measurement and identification problems. At present, no comprehensive study of the relation of career outcomes and exogenous labor market shocks on health exists, partly due to a lack of data on detailed longitudinal career and health information for a large sample of workers.

We use a large administrative longitudinal data set of individual earnings and employment information matched to employer characteristics and individual mortality outcomes to study the

---

[2] See for example Ruhm (1991), Jacobson, Lalonde, and Sullivan (1993), Chan and Stevens (2001), Stevens (1997), Gruber (1997), Olson (1992).
[3] E.g., Oreopoulos, von Wachter, and Heisz (2006), Oyer (2006), Kahn (2005), Hines, Hoynes, and Krueger (2002), Okun (1973).
[4] E.g., Gottschalk and Moffitt (1994, 1998), Farber (2003), Stevens (2001), Aaronson and Sullivan (2005).

relationship between long-term career outcomes and mortality rates. Following Jacobson, Lalonde, and Sullivan (1993), we use our data, spanning over 15 years of quarterly earnings and employer records from the unemployment insurance system in Pennsylvania, to identify workers displaced at mass-layoffs occurring at the plant level. We then follow the incidence of mortality for these workers up until 20 years after a job loss and compare them to mortality of similar workers who stayed at their plant. To examine the multiple channels through which job loss can affect mortality, we first study the correlation of multiple long-term career outcomes – such as average earnings, employment mobility, and the variance of earnings – with death. We then use these results combined with additional estimates of mass-layoffs on our measures long-term career outcomes to interpret the alternative channels of the 'reduced form' effect of mass-layoffs on mortality.

The data we use is ideal for our purpose, since the longitudinal information on individual workers' earnings and employment allows us to construct detailed measures of long-term career outcomes; we are not aware of any other study of the socio-economic determinants of mortality using such detailed career information. Second, longitudinal information on establishment size enables us to identify large changes in employment at the establishment level that are plausibly exogenous to workers' own health developments. Thereby, we are able to overcome some of the problems existing studies of the effect of job loss on health. Third, reliable information on death from administrative sources for a long follow-up period allows us to estimate the effect of job loss on an objective health measure with sufficient precision.

We find that job displacements at mass-layoffs increase the long-term probability of dying by 15-20%. This result, robust to controls for average earnings, age, or cohort effects, follows a U-shape; mortality rates are particularly high in the years following a job loss and after a prolonged period of time. This is consistent with an initial increase in mortality from acute stress and a long-term increase in mortality from chronic stress resulting from permanently lower average earnings and persistent increases in the instability of earnings and employment. In fact, given our estimates of the correlation of permanent earnings and the variance of earnings with mortality, the strong effects of job displacements from mass-layoffs on these career outcomes could explain about 50-75% and

20% of the mass-layoff effects, respectively. Clearly, the stress caused by mass-layoff is likely to have additional direct effects on mortality not captured by our measures of career outcomes.

Our paper contributes to the existing literature in at least three ways. First, it is one of the first papers estimating the long-term effect of a plausibly exogenous labor market event – a job loss during mass-layoffs – on an objective measure of health for a large group of workers. It thereby helps to establish a true link between labor market outcomes, socio-economic variables, and health outcomes. Second, it is the first study to provide a comprehensive analysis of the correlation of permanent earnings and long-term instability in earnings and employment and mortality. Third, it provides estimates of the long-term effects of mass-layoffs on a range of career outcomes that are a contribution to the literature on the effects job displacements in their own right.

The next section gives a brief overview of the existing literature. The third section describes our approach and our data. The fourth section discussed the main results. First, it documents the correlation of mortality with permanent earnings and other career outcomes. Second, it analyzes the effects of mass-layoff on mortality. Third, it studies the effects of mass-layoff on other career outcomes and uses the results to interpret the sources of the effect of job loss on mortality. The last section concludes.

2. Literature Review: Why Should Job Losses Affect Mortality?

Job displacements and other negative economic events can have both direct and indirect impacts on health outcomes. Furthermost, job loss has strong effects on several economic channels that may influence health. A large literature has shown that job losers can experience substantial and long-lasting declines in earnings (e.g., Ruhm 1991, Jacobson, Lalonde, and Sullivan 1993, Schoeni and Dardia 2003, Couch 2006). The decline in earnings is larger for older and high tenured workers (e.g., Kletzer 1998), for workers in manufacturing, and for workers living in economically depressed areas. Job losses can also lead to substantial increases in earnings instability, by raising the propensity of non-employment and further job losses (e.g., Stevens 1997, Farber 2003). In addition, it has been shown that job losses affect consumption (Gruber 1997, Browning and Crossley 2001), and access to health insurance (Olson 1992).

Similarly, a growing literature shows that economic conditions in the local labor market and the firm have long term effects on workers' earnings and career instability. Cyclical swings have highly persistent effect on earnings (e.g., Oreopoulos, von Wachter, and Heisz 2006, Kahn 2006, Oyer 2006), and have lasting effects on job mobility and job quality, especially for less-advantaged workers (e.g., Oreopoulos et al. 2006). Economic conditions at the time of hiring can also have persistent effects within firms (e.g., Beaudry and DiNardo 1991, Baker, Gibbs and Holmstrom 1994). A growing number of papers suggest that these effects have become more pronounced since the mid-1980s. For example, the incidence of job loss and the variance of transitory and permanent earnings shocks has been increasing (e.g., Aaronson and Sullivan 1998, Farber 2003, Gottschalk and Moffitt 1994, 2002), possibly due to a rising importance in incentive pay (e.g., Lemieux, MacLeod, and Parent 2006).

A separate strand of literature documents a significant correlation between income and health and mortality. At face value, the existing estimates of the impact of income on health would imply a strong effect of job loss on, say, mortality (e.g., Deaton and Paxson 1999). However, such estimates may be biased due to reverse causality running from health to income, omitted worker characteristics, as well as measurement error.[5] These difficulties have led recent observers of the literature deemphasize the effect of income on health in favor of more lasting individual traits such as education (e.g., Cutler, Deaton, and Lleras-Muney 2006). There are indeed few studies of the effect of income on health with a research design that allow identification of a causal relationship. An exception is a recent experimental study analyzing lottery winners in Sweden that confirms a significant causal relationship running from income to health (Lindahl 2005).

[5] Another important question is regarding the source of any true income effects of health; these might arise from lack of access to health improving investments, or from effects through social-status and relative deprivation (e.g., Deaton 1999, Miller and Paxson 2001). Our analysis of rank confirms recent studies in showing that the relationship between a worker's rank in the baseline period either within county, industry, or initial employer is only weakly correlated with mortality.

Part of the difficulty in studying the effects of detailed career outcomes and exogenous career shocks on health is the lack of data. In particular, typical studies do not have good measures of permanent income and other long-term career outcomes such as earnings instability. This makes it impossible to assess the effect of, say, earnings instability on health. Similarly, most studies cannot measure economic shocks that could be used as plausibly exogenous events to measure the effect of career outcomes on health. For example, the best income data currently available for studies of health in the U.S. comes from the Current Population Surveys, which provide information only on income in the year prior to the survey with little longitudinal information on careers or employers.[6] This can lead to a downward bias in estimates of the impact of permanent income on mortality due to classical measurement error arising from respondents' inaccurate reporting (Bound and Krueger 1991) as well as an error in approximating permanent income by current income (e.g., Haider and Solon 2006). We will return to these issues below.

In addition to indirect effects running through income, earnings instability, or access to health insurance, job losses may also have direct effects on well-being. A large literature in economics and sociology has shown that unemployment correlates strongly with the incidence of depression, low self-esteem, unhappiness, and even suicide.[7] While some of these outcomes are conceivably due to lower income, some of them may derive from factors independent of the earnings situation. Similarly, several authors in sociology, social work, and epidemiology have analyzed the effect of job loss on mental and physical health. These studies use either longitudinal data with health and career information, such as the Health and Retirement Survey (HRS), or study the effect of single plant closures (see Burgard, Brand, and House 2005 for an excellent survey). Most prominently, a series of studies using the HRS has found increased incidence adverse health outcomes such as heart attacks or strokes among older job losers (e.g., Gallo et al. 2000, 2006). A smaller set of studies has analyzed randomized trials to study the effect of job loss, job search, and health outcomes (e.g., Price, Choi, and Vinokur 2002).

---

[6] Current Population Surveys for the 1980s and 1990s have been matched to mortality information to form the National Longitudinal Mortality Study (e.g., Johnson, Sorlie, and Backlund 1999). Note that the data has no panel component.
[7] E.g., see papers summarized in Darity and Goldsmith (1996) and Burgard, Brand, and House (2005).

Although the current estimates of job loss on health outcomes indicate that there are potentially significant effects on health even when controlling for detailed pre-job loss characteristics such as health and socio-economic status, they suffer from several potential drawbacks. Furthermost, since an important body of literature shows that job loss is in itself affected by poor health, special care has to be taken to avoid selection bias. While most studies focus on workers displaced by layoffs and plant closing and try to control for background characteristics, selection problems remain even for workers displaced in layoffs and plant closings.[8] Another concern is that recent studies typically focus on mature workers, possibly missing the effects of more long-lasting exposure to low income and chronic stress from earnings instability from job loss earlier in workers' careers. In addition, most studies do not have detailed longitudinal information on earnings and employment or employer characteristics.

Obtaining good career measures is particularly important since a small set of recent studies has suggested that economic activity and income might have conflicting effects on health outcomes. On the one hand, Ruhm (2000) reports that mortality declines in recessions, as workers have more time to invest in their health, face fewer work-related accidents, and experience no pressure at work. On the other hand, results from Evans and Snyder (2002) suggest that reduced economic activity may negatively affect health outcomes for older workers, perhaps due to a loss in social status or purpose. Thus, there are potentially contrasting effects of declines in earnings and employment caused by job losses. However, using aggregate shocks such as recessions or survey data with limited career information may make it more difficult to disentangle the health effects of various sources of economic activity.

3. Empirical Approach: Mortality, Career Outcomes, and Mass Layoffs

In the present paper, we merge two large administrative data sets to study the effects of career outcomes and exogenous labor market shocks on mortality. Specifically, panel data on

---

[8] This is because firms may selectively lay off their worse workers (Gibbons and Katz 1991), unstable firms attract worse workers (von Wachter and Bender 2005), and plant closings are more likely to occur in smaller firms that pay less and attract different employees (Krashinsky 2002).

individual earnings and employment information is merged with administrative data on the date of death. The former is derived from the unemployment insurance records of the state of Pennsylvania and covers the period from 1974 to 1991. The latter is derived from a database compiled by the Social Security Administration and covers deaths between 1974 and 2002. The combined data set has several attractive features. First, it allows us to identify large-scale lay-offs at the firm level that constitute plausibly exogenous shocks to workers' career development. Second, the long time period covered by the data allow us to better examine the effect of career outcomes such as permanent earnings or earnings stability on mortality. Third, an extended period of follow-up provides us with reliable and rich information on mortality patterns.

Our empirical analysis proceeds in three steps. In a first step, we use our data to examine the effect of measures of permanent income on mortality, to relate our results to other studies, and to examine the role of measurement error inherent in the use of short-term income measures. In addition, we provide what we believe to be the first estimates of the correlation of detailed measures of earnings instability and other long-term career outcomes with mortality. Second, we analyze the effect of job losses due to mass-layoffs on the probability of dying. Third, we estimate the long-term effects of job loss on a range of career outcomes and use these results to interpret the role of alternative channels underlying the effect of job loss on death.

To analyze the effect of career conditions and job loss on health, we divide our sample into a baseline period (1974-1979), a mass-layoff period (1980-1986), and a follow-up period (1987-2002). We then analyze the probability of dying in the follow-up period as a function of career outcomes in the baseline period and job loss in the mass-layoff period. This structure has several advantages. Among others, separating the baseline period and the job loss event from the follow up period reduces the bias from reverse causality running from health to income or job loss. In addition, it allows us to replicate existing studies of the effect of income on mortality (e.g., Deaton and Paxson 1999). It also replicates important features of the well-established research design of the paper on the effects of mass-layoff by Jacobson, Lalonde, and Sullivan (1993) further discussed below.

Using this timeline, we estimate several logistic models of the annual probability of dying as function of career information C_i^{74-79} measured over the horizon 1974 to 1979 (the baseline period), as well as controls for age and calendar year. In the logit-model the log-odds ratio of death is a linear function of included explanatory variables, such that the model we estimate can be represented as

$$\ln\left(\frac{p_{it}}{1-p_{it}}\right) = x_{it}'\beta = \pi C_i^{74-79} + \chi_a + \phi_t \qquad (1)$$

where the probability of dying in year t given survival until year t-1, $p_{it} = \Pr\{Death = 1\} = \Lambda(x'\beta)$, is measured over the interval 1987 to 2002 (the follow-up period).[9] All specifications include year dummies, and we alternatively model the role of age (χ_a) as a 4[th] order polynomial or as separate age dummies (with little difference in results). We consider several variations of model (1). For example, when we analyze the effect of the standard deviation of earnings on mortality, we also control for log average earnings and estimate

$$\ln\left(\frac{p_{it}}{1-p_{it}}\right) = \pi \ln\left(\overline{qearn_{it}}^{74-79}\right) + \gamma SD\left(\ln\left(qearn_{it}\right)\right)^{74-79} + \chi_a + \phi_t \qquad (2)$$

where *qearn* stands for quarterly earnings as measured by unemployment insurance records. As further discussed below, we also control for non-employment spells to take into account that the logarithm of earnings is not defined for zero.

Given that the probability of death is typically quite small, the log-odds ratio approximates the log of the death rate itself, and the coefficients have an approximate interpretation as percentage changes of the probability of dying. In addition, we will report the proper marginal effects on the probability of death that control for the curvature of the logistic distribution. The curvature implies that marginal effects on probabilities are highest for groups of workers who tend to have higher

[9] The cumulative distribution function of the extreme value distribution is $\Lambda(x'\beta) = \exp\{x'\beta\}/(1-\exp\{x'\beta\})$. Workers contribute one observation for each year that they are alive from 1986 to 2001.

mortality, such as older or low-income workers (i.e., the marginal effect is $d\,\Pr(D=1)/dx = \beta\Lambda'(x'\beta)$).

We first exploit the large sample sizes and limited degree of top-coding of quarterly earnings information in the unemployment insurance records to reexamine the proper functional form of the correlation of earnings and mortality; we also use our results to gauge the role of two important sources of measurement error afflicting estimates of the income-death correlation based only on survey measures of a single year of income – classical measurement error affecting surveyed earnings, and the mis-measurement of permanent earnings by current earnings.

We then analyze the effect of various measures of instability over worker's careers, among others the standard deviation of earnings, number of quarters worked, number of transitions between jobs and into non-employment, or the number of large earnings declines. In each of these cases we control for log average quarterly earnings to try to gauge the potential role of omitted variable bias (as in model (3)). We also limit the underlying heterogeneity of workers in our main samples by focusing on high-attachment male employees. Similarly, the correlations we obtain should not be afflicted by short term reverse causality or strong measurement error. However, as in any nonexperimental study, it is possible, that other biases still may impact our estimates. Thus we must be cautious in interpreting the results as a causal link between career earnings outcomes and mortality.

Instead, in our main estimates we analyze the effect on mortality of job losses due to mass layoffs. We define an involuntary job loss exactly as Jacobson, Lalonde, and Sullivan (1993), who focus on workers born between 1930 and 1959 who lost their job between 1980 and 1986 after having remained with the same employer in the period from 1974 to 1979. Specifically, we identify the workers who left their employer at the same time that the employer experienced a 30% or larger decline in employment. Initially, we follow JLS in focusing on workers who remained highly attached to the Pennsylvania labor force as evidenced by positive reported earnings in each year 1974 to 1986. As described below, we later extend our analysis to more broadly defined samples with weaker restrictions on age and labor force attachment after job loss.

Our main estimates are derived from a model of the form

$$\ln\left(\frac{p_{it}}{1-p_{it}}\right) = \pi \ln\left(\overline{qearn_{it}}^{74-79}\right) + \gamma MLF_i^{80-86} + \chi_a + \phi_t \tag{3}$$

where *MLF* is a dummy for whether a worker left his 1974-79 employer during a mass-layoff. The coefficient on the *MLF*-dummy measures the overall increase in the log odds of dying as a result of suffering job loss. To examine the source of this effect, we also examine interactions of the *MLF*-dummy with variables such as with age at layoff, years since layoff, initial industry or initial income.

Since the shock that triggers job loss in this analysis occurs at the firm level, it should be exogenous to the onset of workers' own health problems. It is still possible that the firm lays off its least productive workers, who may in turn be of low health. To ameliorate this potential problem we control for baseline average income, with very little difference in results. Perhaps the lack in strong differences in underlying productivity correlated with health is not surprising given our focus on workers with high-attachment to their employer and to the labor force. Clearly, these workers differ in health, but the differences are likely to be significantly reduced with respect to broader populations. We also consider the evolution of the mortality effect with years since layoff and find substantial non-linearities (a U-shape). This suggests that our effects are not driven by sample selection which would imply a constant or declining difference.

As discussed in Section 2, job loss is likely to affect mortality through a variety of channels. To gauge the effect of some of the likely channels, we estimate the effects of job loss due to mass layoff on some of the career outcomes whose correlation with mortality were analyzed in the first step. That is, we estimate the effect of mass-layoffs on average earnings, standard deviations of earnings, and non-employment. We do this by comparing the levels of these variables during the baseline period (1974-79) to their values during the portion of post-job loss period for which we have earnings information (1987-1991). That is, we estimate the following simple difference in differences model:

$$C_{it} = \theta_i + \delta MLF_i + \chi_a + \phi_t + \varepsilon_{it} \tag{4}$$

where *t* is either the pre-displacement period (1974-79) or the post-displacement period (1987-1991). The model includes worker and time-period fixed effects as well as a quadratic in age. The displacement effect is identified by the inclusion of workers staying at their employers throughout the period under study (the comparison group). The results can be combined with the correlations obtained from models as in equation (2) to interpret the sources of the effects estimated from the effects of mass-layoff on mortality (estimated in model (3)). Clearly, this does not allow an exact decomposition of the effect, since the correlations do not represent causal estimates, but it will allow us to obtain important insights regarding the potential magnitudes of the likely importance of alternative channels.

4. Career Outcomes, Mass Layoffs, and Mortality

4.1. Average Earnings and Mortality

This is one of the few studies of earnings and mortality that approximate permanent earnings with more than a single year of earnings data. Figure 1 shows various estimates of the correlation of average quarterly earnings in the period of 1974-1979 on mortality in 1986-2002. Since the natural logarithm turns out to be a good approximation to the declining correlation of average earnings and mortality, all our econometric specifications include the log of average quarterly baseline earnings.[10] The first three columns of Table 2 show various estimates of Model (1) for our main mass-layoff sample.[11] The effect of log average earnings is about -0.5 for the group of workers with high job attachment in the baseline period. Given that the probability of death is very small, the coefficient approximately implies a 10% decrease in mortality for a 20% increase in average quarterly earnings. For example, a two standard deviation increase in average quarterly earnings would lead to about a 4% decline in mortality. To properly assess the magnitudes of the estimated effects, the first

[10] For high and low earnings, a fourth order polynomial does a better job at approximating the 'non-parametric' dummy-variable estimates. We chose the more parsimonious specifications, but double-checked our results by including earnings-dummies. This is particularly important when non-linearities can matter, such as in the analysis of earnings ranks. The more fully non-parametric results in the lower panel of Figure 1 confirm that a smooth concave function is appropriate to capturing the relationship between earnings and mortality.
[11] Appendix Table 1 compares results across alternative samples, further discussed below.

panel in Table 3 and Figure 2 show the predicted values of the probability of dying by age- and income-group based on the estimates shown in Table 2 (1st column and 1st row). As expected, the earnings gradient rises with age – a comparison of differences in mortality rates at 25th and 75th earnings percentiles shows substantial differences across age-groups. Equivalently, the role of age decreases for high-income workers.

These results are robust for cohort controls, are similar across age groups, are unaffected by controls for other career measures such as quarters worked, and are not changed if the baseline period is extended to cover 13 instead of 6 years (1974-1986). Interestingly, the effect of income is significantly higher for workers who worked in manufacturing during the baseline period (see Appendix Table 1, Models 5 and 6). To replicate results in the existing literature, we also estimated models of 5 and 10 year follow-up (e.g., see Deaton and Paxson 1999). The results, shown in columns 4 to 9 in Table 2, essentially confirm our main estimates.[12] These estimates are bigger in absolute terms than the effects estimated by Deaton and Paxson (1999, Table 5) using CPS earnings data matched to mortality information. Even when we follow the literature by using a single year of earnings at beginning of the follow up period (row 3 of Table 2), our estimates are slightly larger, albeit weaker than the effects of average earnings. As shown in Bound and Krueger (1991, Table 6), the reliability ratio for men at single employers is about .8 in the case of classical measurement error, and .95-1 for mean-reverting measurement error. Thus classical measurement error could explain part of the difference of using annual earnings measures from survey data (CPS) and annual earnings information from administrative data (row 3).

The interpretation of the difference between the estimates in row 1 and row 3 is only slightly more involved. Consider a typical model of current earnings y_{it} as a function of persistent (θ_{it}) and transitory (u_{it}) components

$$y_{it} = \theta_{it} + u_{it}, \quad \text{where} \quad \theta_{it} = \theta_{it-1} + v_{it}, \quad u_{it} \sim ARMA, \quad v_{it} \sim WN. \tag{5}$$

---

[12] Changes in the fraction of older workers in our panel sample over time are likely to explain variation in the results across age groups for these models.

If both components affect health and longevity, when included as the sole explanatory variable current earnings captures the joint effect of the permanent and transitory earnings components. On the other hand, if only permanent earnings matter for long-term health outcomes, then current earnings is a noisy measure of permanent earnings. If so, then row 3 is downward biased by either classical (if u_{it} has short memory) or mean-reverting measurement error. Since we have measures of permanent earnings available in our data, we can check this directly by including them jointly into the model. If current earnings are simply a noisy measure of permanent earnings, its coefficient should drop to zero. This is shown in the last two rows of Table 2 (and Appendix Table 1 for other samples). In most cases, including a measure of average earnings indeed drives the effect of current earnings to zero.[13] This suggests that other studies having at disposition only measures of annual earnings should scale their coefficients up by a factor taking into account measurement error from survey responses as well as from transitory earnings disturbances. In separate calculations, we show that the combined reliability ratio can be as low as 0.6.

The current results are obtained from workers with a stable job from 1974 to 1979 who either continue to hold that job through the end of 1986 or who leave their baseline job at the time of a mass layoff. In both cases workers are required to have positive earnings in each year from 1979 to 1986. To assess to what extent our results are driven by the focus on high-attachment workers, Appendix Table 1 replicates our main specifications for a series of different samples. The second column shows results based on all workers who have a stable job in 1974 to 79 (i.e., with respect to column 1 it includes non-mass layoff job changers), and confirms the results from the mass-layoff sample for all specifications. The third column substantially weakens the restriction on labor force attachment by including all workers who where employed or received unemployment insurance at least half of the time in 1974-79. The effect of log average earnings is somewhat lower, but partly

[13] Since the relationship between permanent earnings and current earnings also differs by age, the measurement error might be more complicated (Haider and Solon 2006). This should be partially taken into account by the age controls included in our models.

due to correlation with quarters worked, which has a negative coefficient.[14] This somewhat surprising result is consistent with Ruhm (2000)'s analysis suggesting lower economic activity in recessions may be beneficial to health. However, it turns out that the beneficial effect of non-employment is not a very robust feature of our data.[15] The last two columns show the results for high and low attachment samples of older workers for whom we calculate average quarterly earnings with all quarters available from 1974 to 1986 (spanning the last 10 to 15 years of workers' earnings). The results confirm those in corresponding columns 2 and 3, and suggest that our main estimates are not driven by the choice of a particular time period or reference period within a workers' career as baseline.

4.2. Career Instability and Mortality

In addition to average quarterly earnings, other career outcomes such as the degree of employment or earnings stability may also be related to health and mortality. Table 4 shows statistics for different samples of various measures of career instability, including the standard deviation of log earnings, the number of quarters worked, the number of large declines in quarterly earnings (drops in earnings of more than two standard deviations), the number of transitions into non-employment, the number of job changes, and the number of long non-employment spells. Workers in the main mass-layoff sample experienced important variation in earnings over the baseline period, as shown by the standard deviation and the high fraction of workers with large drops in earnings. Although by construction this sample has very few transitions to non-employment or job changes, both earnings and employment instability become very relevant for the broader samples in the

---

[14] The fourth column shows the results for a very broad sample that includes all workers who were ever present in the UI system between 1974 and 1979. The effects of log average earnings are even lower for this sample. These results partly derive from the fact that the standard deviation of log average earnings is much higher in the broader samples (see Table 4); i.e., a two standard deviation increase in log average earnings is of much more similar magnitude across samples. This also hints at the fact that for the broader sample, on average fewer observations are used to calculate average quarterly earnings. Thus, part of the difference will be due to attenuation bias from classical measurement error, too. In addition, it may be that for low-income workers, average earnings are a worse approximation of the actual amount of resources due to greater importance of second earners, family ties, and government subsidy programs.

[15] The effects of quarters worked are positive for the sample of older high-attachment workers in column 5 and insignificant for more workers with some labor force attachment in column 6.

remaining columns.[16] For these samples, the standard deviation of log earnings is substantially higher and a larger fraction of workers experience job changes, transitions to non-employment, and longer non-employment spells.

To estimate the correlation of these measures with mortality, we present results from logit-models as shown in equation (2). These are shown for different samples and specifications in Table 5 and Appendix Table 2. All models include age dummies, year dummies, and log average earnings as controls, and all results are robust to inclusion of measures of the number of quarters worked. The main result of Table 5 is that the effect of the standard deviation of log earnings on mortality is positive, non-linear (the effect is positive and decreasing and well-captured by a log-specification, see Appendix Figure 2), and substantial. The results in column 1 of the first panel in Table 5 suggest that a 20% increase in the standard deviation of earnings leads to an increase in the risk of death of about 4%. In the pooled model, this corresponds to the effect of a 10% decline in average earnings. The estimates are also robust to inclusions of other measures career shocks such as quarters worked, non-employment transitions, or the presence and frequency of large earnings drops.

Given it is calculated over a relatively short period of time (six years), we interpret the standard deviation of log-earnings as a measure of the transitory component (u_{it}) of the earnings process in equation (5). We believe this to be a reasonable interpretation of the short-term earnings risk an individual faces. This interpretation is helped by the fact that the effect of the standard deviation is robust to the inclusion of indicators for the presence of large earnings shocks and non-employment transitions. Thus, we interpret the results in Table 5 to imply that the variability a worker faces in the labor market is negatively correlated with long-term health outcomes. Clearly, less healthy workers are likely to have higher standard deviations in earnings. However, the fact that the result also attains for very stable workers and is largely unaffected by the inclusion of log average earnings as additional control suggests it may not be fully explained by omitted variable bias. Reverse

[16] Note that some mobility is possible even for those workers due to temporary layoffs and short breaks in the employment spell.

causation is not an issue given that the follow up period begins seven years after the baseline period at which the standard deviation is calculated.

Table 5 also shows results for other measures of career instability and more broadly defined samples of workers. The effect of the standard deviation is present across all samples; it is smaller for the broader sample, partly due to the fact that the range of values the standard deviation takes is much higher (such that a change of two standard deviations would have a more similar effect; see Table 4). Similarly, its effect is essentially unaffected if it is calculated over a much longer time period (lower panel of Table 5). Not surprisingly, for the main high-attachment sample, the only other significant effect is the presence of large earnings declines. However, this effect fades for the sample with the long baseline in the bottom of the table. For the broader samples, transitions to non-employment tend to raise mortality even when controlling for the incidence of large earnings declines. This result stands in contrast to the sometimes beneficial effect of the amount of time spend in non-employment. Once we control for the number of times individuals transit to non-employment, the incidence of job changes has no effect for either sample.

Overall, we interpret these results to signify that the interaction between individual health and career outcomes is potentially complex, and goes beyond a simple correlation between earnings and mortality. In particular, it appears that various measures capturing the degree of earnings and employment stability have robust effect on mortality, too. It appears that workers with unstable careers die younger. To address part of the concerns of omitted variable bias afflicting these correlations, in the next section we study the short and long-term mortality effect of an explicit shock to workers careers – an involuntary job loss in the course of mass-layoffs at the plant level.

4.3. Mass-Layoff, Job Loss, and Mortality

Like the estimates of the effects of income level and variability, our estimates of the effect of job loss on mortality are based on a logistic regression model for death in a year given survival until the previous year and include controls for age and year of the sample. The first group of estimates is for those workers who were born between 1930 and 1959 and who had some recorded earnings every year through 1986. The coefficient shown in the first column indicates that suffering a job loss due to mass layoff between 1980 and 1986 was associated with an increase in the log odds of death each year of about 0.2. Because the probability of death is relatively low, this also implies about a 20% increase in the probability of death each year. When we include the log of average earnings in the 1974-79 period, the estimated increase declines, but only to about 17%.

Table 6 also shows how estimates of the impact of displacement on mortality vary over time and across different age groups of workers. Specifically, the third column is based on a model that interacts the displacement indicator with an indicator for whether the year in question was up to 10 years after job loss. The results in the fourth column show how the displacement results differ according to the age of the displaced worker. The estimates suggest a U-shaped pattern in which the increases in the log odds are lowest for displaced workers in their 50s. The fifth column allows estimates to differ according to the age at which workers were displaced. Those displaced when they were in their 30s have the largest increases in their mortality, but all three groups show substantial increases. The last 5 columns of the table are based on an enlarged sample that includes workers born as early as 1920 and dispenses with the restriction that workers have earnings every year between 1980 and 1986. This generally increases the estimated effects of displacement on mortality by about 20%.

The main mass layoff effect in Table 6 measures the overall increase in the probability of dying in the years from 1987-2002. Figure 4 explores the role of the time-pattern of the effects of job loss hinted at in Table 6 further. The upper panel shows the raw mortality rate by mass-layoff status over the period under study. The aging of the sample is apparent for both lines. In addition, it appears the difference in mortality rates is greater at the beginning and at the end of the sample period. To eliminate age and year effects, the lower panel of Figure 4 plots the coefficients of an interaction of a job loss dummy with annual dummies for years since 1987, the beginning of our follow up period.[17] The resulting U-shape suggests that the pattern of age found in Table 6 is likely to be driven by the duration since job loss. In particular, the pattern is suggestive of an initial

[17] The coefficients are smoothed using a moving-average.

response due to acute stress caused by the job loss, followed by a long-term impact of increased chronic stress due to lower earnings, higher earnings instability, and unstable employment.

4.4. Effects of Mass Layoffs on Career Outcomes

To better understand how displacement impacts mortality, we also studied the impact of displacement on workers' career earnings outcomes, both with respect to level and variability. As noted above, our estimates are based on a simple difference in differences specification that controls for a quadratic in age. Because in our Pennsylvania administrative data earnings may appear to be zero when workers have moved out of state, we further restrict the sample to workers who had positive earnings in every year through 1991.

As Table 7 shows, we estimate that displacement some time during the 1980-1986 time period reduces workers' earnings by approximately 22% in the 1987 to 1991 period. These estimates are quite similar to those reported in Jacobson, Lalonde, and Sullivan (1993) for a somewhat shorter follow up period. Thus the earnings losses associated with job displacement for workers with substantial job tenure appear to be extremely persistent.

Table 7 also shows that job displacement raises the standard deviation of the natural logarithm of annual earnings by about 16%, even in the post-displacement period. This increase in uncertainty represents another significant negative consequence of job loss. The portion of quarters with zero earnings rises by about one percentage point. Thus most of the reduction in earnings represents reductions in quarterly earnings in periods in which workers are employed.

4.5. Interpretation

Using the results in Table 7, one can gauge the potential order of magnitude of different channels through which mass-layoffs can affect mortality. To do so, we combine the mass-layoff results with the correlations estimated in Tables 2 and 5. Clearly, this does not yield a true decomposition of the effect as if these were causal parameters. Below, we will try to gauge our interpretation using parameters from other quasi-experimental studies.

The two main career outcomes that resulted most important are average quarterly earnings and the standard deviation of log quarterly earnings. From Table 7, job displacements at mass-layoffs persistently reduce earnings by about 25% for workers with continued high labor market attachment, and up to 50% for a broader sample including workers with more tenuous attachment to the labor market after job loss. Taken at face value, the estimated correlation of average earnings with mortality of -0.5 (Table 2) would imply that we expect an increase in mortality of about 12.5% for workers with high attachment (.25*.5). Thus about two-thirds of the main mass-layoff effect on mortality in Table 6, 0.17, could be explained by the observed declines in average earnings. Clearly, if frail workers die younger and have lower average earnings, this prediction overstates the potential effect of job loss through earnings. In his study of Swedish lottery winners, Lindahl (2005, Appendix Table 2) shows that the effect of controlling for initial health conditions tends to reduce the correlation between mortality and earnings by about a third to a half.[18] Were this to be the case, the predicted role of earnings in explaining the mass layoff effects is reduced to about half of the effect, which is still substantial. Note however that our high-attachment sample is likely to be of better health than the older sample used in Lindahl (2005).

The remaining effects could partially be driven by increases in the instability of earnings and other career outcomes. Table 7 shows that the standard deviation of log earnings increases on average by about 16% at a mass-layoff. At a coefficient of -0.2 (Table 5), this implies an increase in the probability of dying of about 3.2%. While the order of magnitude of this effect is much lower than the potential impact of earnings, it can still account for about 20% of the mass-layoff effect. Again, if frail people have higher earnings instability and higher death rates, this prediction is likely to be over stated. However, the fact that they also attain for workers with high job attachment and are robust to controls for baseline average income lends additional credibility to the results.

[18] The magnitudes of the OLS effect that Lindahl estimates are somewhat smaller but in the same ball-park as ours. He does not report logit estimates, so the comparison is based on approximate percentage effects derived from the results of linear probability models.

5. Conclusion

This paper uses administrative data covering over 15 years of quarterly earnings and employer records matched to individual mortality information to study the long-term effects of job loss on mortality. To measure an event plausibly exogenous to workers' own health outcomes, we analyze job losses occurring when employers experience mass layoffs affecting at least 30% of their work force. To further control for selection, we also control for workers' average earnings in the period before job loss. The results suggest an increase in 15-20% in the probability of dying in the 20 years after a job loss. This effect, robust across alternative samples and specifications, is particularly pronounced in the period following the job loss and in the long-run, consistent with stronger responses to acute and chronic stress.

To analyze the channels underlying the mass-layoff effect we also analyze the correlation of long-run career outcomes on the probability of dying. We show that the average and standard deviation of earnings during a baseline period have large and significant correlations with mortality in a later follow up period. The results on the role of earnings and employment instability are novel with respect to the existing literature on mortality that has had not access to long-run career outcomes. Together with estimates of the effects of mass-layoffs on long-run career outcomes we use these correlations to gauge the potential role of economic factors in driving the effects of job loss we find. The results suggest that an important fraction of the effect of job loss on mortality can be attributed to persistent losses in earnings. Similarly, increases in earnings instability appears to contribute to detrimental effects of layoffs on health.

These results suggest that events in the labor market shaping workers' careers also have long-run effects on health outcomes. While our results do not speak to the role of non-economic factors such as stress, self-worth, and happiness, they suggest that an important part of the negative health consequences of mass-layoffs can be prevented by providing assistance that stabilizes the level and variance of earnings.

References

Aaronson, Daniel and Daniel Sullivan (1998). 'The decline of job security in the 1990s: Displacement, anxiety, and their effect on wages.' Federal Reserve Bank of Chicago Economic Perspectives, Vol.22 No. 1.

Baker, George, Michael Gibbs, and Bengt Holmstrom (1994). 'The Internal Economics of the Firm: Evidence from Personnel Data.' *Quarterly Journal of Economics* 109: 881-919.

Beaudry, Paul and John DiNardo (1992). 'The Effect of Implicit Contracts on the Movements of Wages over the Business Cycle' *Journal of Political Economy*, 99(4).

Bound, John and Alan B. Krueger (1991). The Extent of Measurement Error in Longitudinal Earnings Data: Do Two Wrongs Make a Right?' *Journal of Labor Economics*, Vol. 9, No. 1 pp. 1-24

Browning, Martin and T.F. Crossley (2001). 'Unemployment Insurance Levels and Consumption Changes.' *Journal of Public Economics*. 80(1):1-23

Burgard, Sarah, Jennie Brand, and James House (2005). 'Causation and Selection in the Relationship of Job Loss to Health in the United States.' Mimeo. University of Michigan.

Chan, Sewin and Ann Huff Stevens (2001) "Job Loss and Employment Patterns of Older Workers," *Journal of Labor Economics* 19, 484-521.

Couch, Kenneth (2006). 'The Earnings Impact of Job Displacement Measured with Longitudinally Matched Individual and Firm Data.' Presented at 2006 SOLE Meetings.

Darity, William and Arthur Goldsmith (1996). 'Social Psychology, Unemployment, and Macroeconomics.' *Journal of Economic Perspectives* 10(1): 121-140.

Deaton, Angus (1999). "Inequalities in income and inequalities in health," Research Program in Development Studies, Princeton University, processed.

Deaton, Angus and Christina Paxson (1999). 'Mortality, education, income and inequality among American cohorts.' NBER Working Papers 7140.

Deaton, Angus, David Cutler, and Adriana Lleras-Muney (2006). 'The Determinants of Mortality.' Forthcoming *Journal of Economic Perspectives*.

William N. Evans and Steven Snyder, "The Impact of Income on Mortality: Evidence from the Social Security Notch," NBER working paper number 9197, *Review of Economics and Statistics*, Forthcoming.

Farber, Henry (2003). 'Job Loss in the United States, 1981-2001.' IRS Working Paper No. 471 Princeton University.

Gallo, W.T., H.M. Teng, T.A. Falba, S.V. Kasl, H.M. Krumholz, E.H. Bradley (2006). 'The Impact of a Late-Career Job Loss on Myocardial Infarction and Stroke: a 10-year Follow-Up Using the Health and Retirement Study.' *Occupational and Environmental Medicine*. July.

Gibbons, Robert and Lawrence Katz (1991). 'Layoffs and Lemons.' *Journal of Labor Economics* 9(4): 351-380.

Gottschalk, Peter and Robert Moffitt (1994). 'Growth in Earnings Instability in the U.S. Labor Market.' *Brookings Papers on Economic Activity*.

Gottschalk, Peter and Robert Moffitt (2002). 'Trends in the Transitory Variance of Earnings in the U.S.' *The Economic Journal*, Vol. 112 (478), C68-C73.

Gruber, Jonathan (1997). 'The consumption smoothing benefit of unemployment insurance.' *American Economic Review* 87 (1): 192–205.

Gruber, Jonathan, and Brigitte C. Madrian (2002) "Health Insurance, Labor Supply, and Job Mobility: A Critical Review of the Literature," NBER Working Paper No. 8817.

Haider, Steven J. and Solon, Gary, "Life-Cycle Variation in the Association between Current and Lifetime Earnings" (January 2006). NBER Working Paper No. W11943

Hildreth, Andrew, Till von Wachter, and Elizabeth Weber (2005). 'Estimating the 'True' Cost of Job Loss: Evidence Using Matched Data from California 1991-2000.' Mimeo, Columbia University.

Hines, James, Hilary Hoynes, and Alan Krueger (2002). 'Another Look at Whether a Rising Tide Lifts All Boats.' in Alan Krueger and Robert Solow. (Eds.), The Roaring Nineties: Can Full Employment Be Sustained? Russell Sage Foundation: New York.

Jacobson, Louis, Robert LaLonde and Daniel Sullivan (1993). 'Earnings Losses of Displaced Workers.' *American Economic Review* 83(4): 685-709.

Kahn, Lisa (2005). 'The Long-Term Labor Market Consequences of Graduating College in a Bad Economy.' Harvard University. Mimeo.

Johnson, Norman, Paul Sorlie, and Eric Backlund (1998). 'The Impact of Specific Occupation on Mortality in the U.S. National Longitudinal Mortality Study.' *Demography* 36(3): 355-67.

Kletzer, Lori (1989). 'Returns to Seniority after a Permanent Job Loss.' *American Economic Review* 79: 536-43.

Krashinsky, Harry (2002). 'Evidence on Adverse Selection and Establishment Size In the Labor Market.' *Industrial and Labor Relations Review* 56(1): 84-96.

Lemieux, Thomas, Bentley MacLeod, Daniel Parent (2006). 'Employment and Bonus Pay in the U.S.' Working Paper.

Lindahl, Mikael (2005). 'Estimating the Effect of Income on Health and Mortality using Lottery Prizes as an Exogenous Source of Variation in Income.' Forthcoming, *Journal of Human Resources*.

Miller, Doug and Christina Paxson (2006). 'Relative Income, Race, and Mortality.' Forthcoming, *Journal of Health Economics*.

Okun, Arthur M. (1973). 'Upward Mobility in a High-Pressure Economy.' *Brookings Papers of Economic Activity*, 1: 207-52.

Olson, Craig (1992). 'The Impact of Permanent Job Loss on Health Insurance Benefits.' Industrial Relations Section Working Paper No. 305. Princeton University.

Oreopoulos, Philip, Till von Wachter, and Andrew Heisz (2006). The Short- and Long-Term Career Effects of Graduating in a Recession: Hysteresis and Heterogeneity in the Market for College Graduates.' Mimeo Columbia University.

Paul Oyer, 2006. "The Making of an Investment Banker: Macroeconomic Shocks, Career Choice, and Lifetime Income," NBER Working Papers 12059

Price, Richard, Jin Nam Choi, and Amiram Vinokur (2002). 'Links in the Chain of Adversity Following Job Loss: How Financial Strain and Loss of Personal Control Lead to Depression, Impaired Functioning, and Poor Health.' *Journal of Occupational Health Psychology* 7(4): 302-312.

Schoeni, Robert and Michael Dardia (2003). "Estimates of Earnings Losses of Displaced Workers Using California Administrative Data." PSC Research Report No. 03-543.

Smith, James (1999). 'Healthy Bodies and Thick Wallets: The Dual Relation Between Health and Economic Status.' *Journal of Economic Perspectives 13(2):145–166.*

Stevens, Ann Huff (1997). 'Persistent Effects of Job Displacement: The Importance of Multiple Job Losses.' *Journal of Labor Economics*, Vol. 15, No. 1, Part 1, pp. 165-188

Stevens, Ann Huff (2001). 'Changes in Earnings Instability and Job Loss**.'** *Industrial and Labor Relations Review*, Vol. 55, No. 1, 60-78.

Ruhm, Christopher (1991). 'Are Workers Permanently Scarred by Job Displacements?' *American Economic Review* 81: 319-23.

Ruhm, Christopher (2000). „Are Recessions Good for Your Health?" *Quarterly Journal of Economics* 115 (2): 617-650.

von Wachter, Till and Stefan Bender (2005) 'At the Right Place at the Wrong Time: The Role of Firms and Luck in Young Workers' Careers.' Columbia University (forthcoming *American Economic Review*).

Table 1: Sample Statistics by Alternate Years - Mass-Layoff Sample

Panel B: Mass-Layoff Sample (Stable Job 1974-79, Some Earnings each Year 1980-86)

Year of Follow-Up	Average Age	Min. Age	Max. Age	Fraction Age >=60	Sample Size	Mortality Rate	Number Dead	Average Quart. Earnings 1974-79	Fraction Mass-Layoff
1987	46	28	57	0	15532	0.0034	53	6707	0.32
1989	47	30	59	0	15430	0.0034	53	6705	0.32
1991	49	32	61	0.08	15309	0.0037	57	6703	0.32
1993	51	34	63	0.16	15182	0.0057	87	6704	0.32
1995	53	36	65	0.24	15009	0.0074	111	6703	0.32
1997	55	38	67	0.32	14777	0.0079	116	6704	0.32
1999	57	40	69	0.40	14570	0.0082	119	6707	0.32
2001	59	42	71	0.47	14323	0.0103	147	6705	0.32

Panel B: Sample with Major Presence in Labor Force (50% Presence in 1974-1979)

Year of Follow-Up	Average Age	Min. Age	Max. Age	Fraction Age >=60	Sample Size	Mortality Rate	Number Dead	Average Quart. Earnings 1974-79	Fraction Mass-Layoff
1987	42	28	57	0	63872	0.0034	215	4784	-
1989	44	30	59	0	63442	0.0032	204	4784	-
1991	46	32	61	0.05	62996	0.0041	261	4780	-
1993	48	34	63	0.11	62465	0.0052	326	4779	-
1995	50	36	65	0.16	61793	0.0067	414	4777	-
1997	52	38	67	0.21	60940	0.0068	417	4773	-
1999	54	40	69	0.26	60116	0.0075	449	4770	-
2001	55	42	71	0.31	59134	0.0094	556	4764	-

Notes: The mass-layoff sample only includes workers that either experience a mass layoff in the period 1980-86 or who remain with the present employer for that period. It also includes only workers working at firms with at least 50 employees in 1974-1979. Further details on sample specifications in the text. Panel B only restricts workers to have positive earnings or unemployment insurance receipt for 12 out 24 quarters in 1974-1979. Both samples limit workers to birth cohorts 1930 to 1959.

Table 2: Correlation of Mortality and Average Earnings - Mass-Layoff Sample

	Hazard - Model			Deaton and Paxson Models					
	1986-2002			Death 0-5 Years post 1986			Death 5-10 Years post 1986		
	All	Age < 60	Age > 60	All	Age < 60	Age > 60	All	Age < 60	Age > 60
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Basic Model [Average 1974 - 1979 Quarterly Earnings]	**-0.509**	**-0.514**	**-0.506**	**-0.309**	**-0.591**	**-0.309**	**-0.515**	**0.093**	**-0.936**
	(0.075)	(0.105)	(0.108)	(0.179)	(0.096)	(0.179)	(0.099)	(0.990)	(0.195)
With Birth Cohort-Controls	**-0.508**	**-0.511**	**-0.506**	**-0.309**	**-0.591**	**-0.309**	**-0.515**	**0.093**	**-0.936**
	(0.075)	(0.105)	(0.108)	(0.179)	(0.096)	(0.179)	(0.099)	(0.990)	(0.195)
Single Year Earnings (1979)	***-0.388***	***-0.347***	***-0.433***	***-0.326***	***-0.437***	***-0.326***	***-0.377***	***0.057***	***-0.746***
	(0.066)	*(0.092)*	*(0.095)*	*(0.155)*	*(0.083)*	*(0.155)*	*(0.086)*	*(0.925)*	*(0.174)*
Average 1974-79 Earnings With 1979 Earnings	**-0.603**	**-0.806**	**-0.342**	**0.130**	**-0.752**	**0.130**	**-0.692**	**0.296**	**-1.090**
	(0.182)	(0.244)	(0.267)	(0.400)	(0.225)	(0.400)	(0.235)	(2.843)	(0.486)
1979 Earnings with Average 1974-79 Earnings	**0.092**	**0.289**	**-0.159**	**-0.428**	**0.159**	**-0.428**	**0.173**	**-0.201**	**0.154**
	(0.163)	(0.219)	(0.237)	(0.346)	(0.201)	(0.346)	(0.209)	(2.639)	(0.446)
Observations	238672	193261	45411	17642	17326	727	17316	15879	1437

Notes: Columns 1 to 3 show the coefficients of a logit model of the annual probability of dying from 1987 to 2002 on the natural logarithms of average quarterly income from 1974 to 1979. Columns 4-9 show the probability of dying within the indicated follow-up duration. All models include year and age effects. Standard errors are in parentheses.

Table 3: Fitted Probability of Death as Function of Age, Average Earnings, and Mass-Layoff Status

Panel A: Fitted Probability of Death by Age and Earnings Groups

	Mean Quarterly 1974-79 Earnings						25th minus 75th
	Average	10th	25th	50th	75th	90th	
Age	*6416*	*4314*	*5257*	*6451*	*7828*	*9370*	
40	**0.0015**	**0.0018**	**0.0017**	**0.0015**	**0.0014**	**0.0012**	**-0.0003**
50	**0.0035**	**0.0043**	**0.0039**	**0.0035**	**0.0031**	**0.0029**	**-0.0008**
60	**0.0099**	**0.0122**	**0.011**	**0.0099**	**0.009**	**0.0082**	**-0.002**
70	**0.0272**	**0.0331**	**0.03**	**0.0271**	**0.0246**	**0.0224**	**-0.0054**
70 minus 40	**0.0257**	**0.0313**	**0.0283**	**0.0256**	**0.0232**	**0.0212**	

Notes: Probabilities predicted using coefficients from the logit model of row 1 and column 1 in Table 2.

Panel B: Difference of Fitted Probabilities of Death by Mass-Layoff Status By Age and Earnings Groups

	Absolute Difference				*Percent Change to Baseline*			
Age	**Average**	**25th**	**50th**	**75th**	***Average***	***25th***	***50th***	***75th***
40	**0.0003**	**0.0003**	**0.0003**	**0.0002**	***0.20***	***0.18***	***0.20***	***0.14***
50	**0.0006**	**0.0006**	**0.0006**	**0.0005**	***0.17***	***0.15***	***0.17***	***0.16***
60	**0.0017**	**0.0018**	**0.0017**	**0.0015**	***0.17***	***0.16***	***0.17***	***0.17***
70	**0.0045**	**0.0049**	**0.0044**	**0.0041**	***0.17***	***0.16***	***0.16***	***0.17***

Notes: Probabilities predicted using coefficients from the logit model of row 1 and column 1 in Table 6.

Table 4: Statistics of Career Measures for Alternative Samples and Baseline

	Alternative Samples					
	Mass-Layoff Sample	Stable Job 1974-79	Major Presence 1974-79	Some Presence 74-79	Stable Job 1974-79	Major Presence 1974-79
Baseline Period, Cohorts	1974-79, Born 1930-59				1974-86, Born 1924-29	
Average Log Quarterly Earnings	8.82	8.81	8.52	8.11	8.71	8.39
(Standard Deviation)	(0.35)	(0.37)	(0.64)	(1.25)	(0.44)	(0.74)
Standard Deviation of Log Quarterly Earnings	0.22	0.23	0.37	0.42	0.38	0.46
(Standard Deviation)	(0.20)	(0.21)	(0.34)	(0.40)	(0.29)	(0.34)
Quarters Positive Earnings	23.62	23.60	21.53	18.72	47.08	42.03
(Median)	(24.00)	(24.00)	(23.00)	(23.00)	(51.00)	(48.00)
Number of Earnings Drops More Than 2 Std. Dev.	2.64	2.64	2.18	2.04	3.18	2.97
Fraction With More Than Two 2-SD Drops	0.44	0.45	0.35	0.31	0.51	0.47
Number of Transitions to Non-Employment	0.31	0.32	0.76	0.85	1.19	1.64
Fraction With More Than Two Non-Empl. Transitions	0.01	0.01	0.06	0.07	0.12	0.22
Number of Employer Changes	0.15	0.14	0.75	0.89	0.97	1.75
Fraction with More Than Two Employer Changes	0.002	0.002	0.081	0.093	0.095	0.263
Fraction with Long Non-Employmen Spells	0.11	0.10	0.43	0.53	0.57	0.72
Number of Workers	16602	25880	64876	78290	6006	12013

Notes: Sample statistics for career outcomes calculated for different samples and different baseline periods. The table only uses observations from the first year of the follow up period. Columns give details on sample specifications, the range of birth cohorts, and the length of the base-line period over which career outcomes are calculated.

Table 5: Correlation of Career Outcomes During Baseline Period and Mortality During for Different Samples and Baseline Periods (Cohorts 1930-1959)

	Mass-Layoff Sample			Major Presesence 1974-1979		
Baseline 1974-79	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log(Average Quarterly Earnings)	**-0.432**	**-0.457**	**-0.461**	**-0.299**	**-0.286**	**-0.289**
	(0.076)	(0.078)	(0.079)	(0.023)	(0.025)	(0.025)
Log(Standard Deviation of Log Quarterly Earnings)	**0.195**	**0.206**	**0.208**	**0.115**	**0.106**	**0.108**
	(0.038)	(0.039)	(0.038)	(0.018)	(0.020)	(0.020)
Number of Transitions to Non-Employment		**-0.066**	**-0.071**		**0.020**	**0.023**
		(0.045)	(0.045)		(0.015)	(0.016)
One Drop in Earnings More Than 2 Std. Dev.		**0.323**			**0.071**	
		(0.114)			(0.043)	
More Than One Drop in Earnings More Than 2 Std. Dev.		**0.165**			**0.039**	
		(0.101)			(0.038)	
Number of Job Changes			**-0.007**			**-0.007**
			(0.056)			(0.014)

	Stable Job 1974-79			Major Presesence 1974-1979		
Baseline 1974-86	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log(Average Quarterly Earnings)	**-0.535**	**-0.535**	**-0.541**	**-0.256**	**-0.228**	**-0.231**
	(0.054)	(0.057)	(0.057)	(0.017)	(0.017)	(0.018)
Log(Standard Deviation of Log Quarterly Earnings)	**0.180**	**0.183**	**0.185**	**0.155**	**0.095**	**0.099**
	(0.031)	(0.035)	(0.034)	(0.019)	(0.022)	(0.022)
Number of Transitions to Non-Employment		**-0.006**	**-0.006**		**0.053**	**0.054**
		(0.019)	(0.019)		(0.008)	(0.009)
One Drop in Earnings More Than 2 Std. Dev.		**-0.081**			**-0.035**	
		(0.085)			(0.044)	
More Than One Drop in Earnings More Than 2 Std. Dev.		**-0.052**			**-0.036**	
		(0.065)			(0.036)	
Number of Employer Changes			**-0.001**			**-0.004**
			(0.019)			(0.008)

Notes: Entries in table are coefficients from logit models of the annual probability of dying from 1987 to 2002. All models also include dummies for age and year. Standard errors are in parentheses. Columns give details on sample specifications and the length of the base-line period over which career outcomes are calculated. The range of birth cohorts is 1930 to 1959 for all columns. Different columns correspond to different models.

Table 6: Impact of Layoff During Mass-Layoff on Log-Odds of Death, Different Samples And Specifications

	stable job 1974-79; born 1930-59; earnings every year through 1986					stable job 1974-79; born 1920-59				
log avg earnings		**-0.488**	**-0.487**	**-0.489**	**-0.488**		**-0.425**	**-0.425**	**-0.425**	**-0.423**
		(0.075)	(0.076)	(0.075)	(0.075)		(0.040)	(0.040)	(0.040)	(0.040)
displacement	**0.203**	**0.171**				**0.253**	**0.231**			
	(0.055)	(0.056)				(0.032)	(0.032)			
LE 10 years post job loss			**0.163**					**0.230**		
			(0.068)					(0.034)		
GT 10 years post job loss			**0.184**					**0.234**		
			(0.088)					(0.047)		
displaced and age 30-39				**0.488**					**0.463**	
				(0.406)					(0.333)	
displaced and age 40-49				**0.309**					**0.442**	
				(0.145)					(0.119)	
displaced and age 50-59				**0.092**					**0.153**	
				(0.089)					(0.070)	
displaced and age 60-69				**0.178**					**0.223**	
				(0.080)					(0.044)	
displaced and age 70-79				**0.237**					**0.242**	
				(0.239)					(0.050)	
displaced and age 80-89									**0.238**	
									(0.147)	
displaced at age 30-39					**0.237**					**0.290**
					(0.129)					(0.103)
displaced at age 40-49					**0.145**					**0.236**
					(0.081)					(0.066)
displaced at age 50-59					**0.170**					**0.261**
					(0.078)					(0.041)
displaced at age 60-69										**0.173**
										(0.048)
Observations	239,521	239,521	239,521	239,521	239,521	379,428	379,428	379,428	379,428	379,428

Notes: Dependent variable is the log odds of death in a year between 1987 and 2002. All models include year effects and a quartic in age.

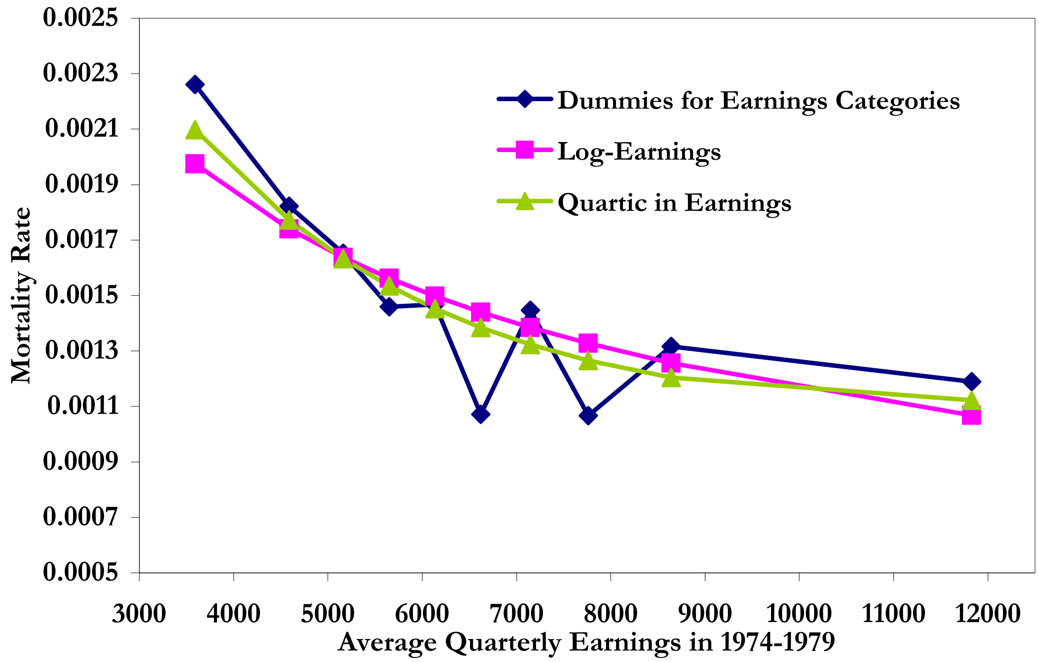
Table 7: Impact of Mass-Layoff on Career Earnings Outcomes: post-displacement versus pre-displacement

	stable job 1974-79; born 1930-59; earnings every year through 1991	stable job 1974-79; born 1920-59; earnings every year 1974-79 and 1987-91
Outcome Measure		
ln average earnings	**-0.215**	**-0.262**
	(0.006)	(0.006)
ln st dev ln earnings	**0.155**	**0.167**
	(0.016)	(0.013)
Percent quarters with zero earnings	**0.950**	**1.410**
	(0.110)	(0.100)
Transitions to nonemployment per year	**0.0050**	**0.0061**
	(0.0007)	(0.0006)
Job changes per year	**0.456**	**0.435**
	(0.011)	(0.009)
Observations	17,576	24,520

Notes: Difference in difference models with controls for quadratic in age.

Figure 1: Mortality Gradient in Average 1974-179 Earnings: Men in Stable Employment 1974-1986

Panel A: Alternative Specifications



Panel B: Non-Parametric Correlation between Average Earnings and Mortality

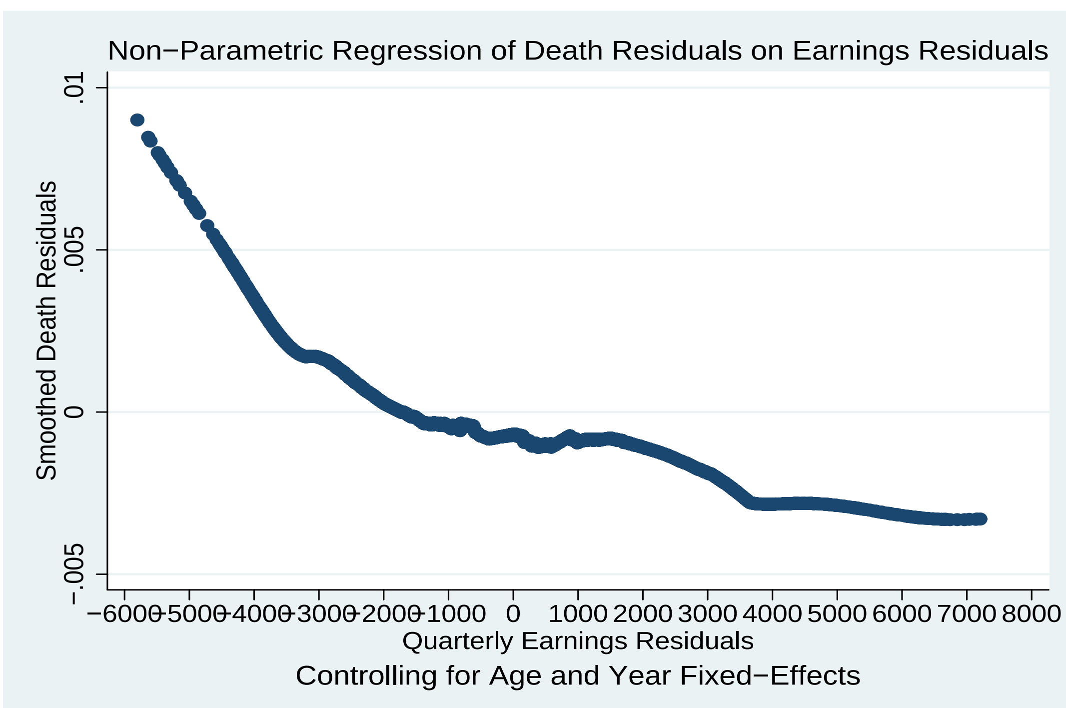
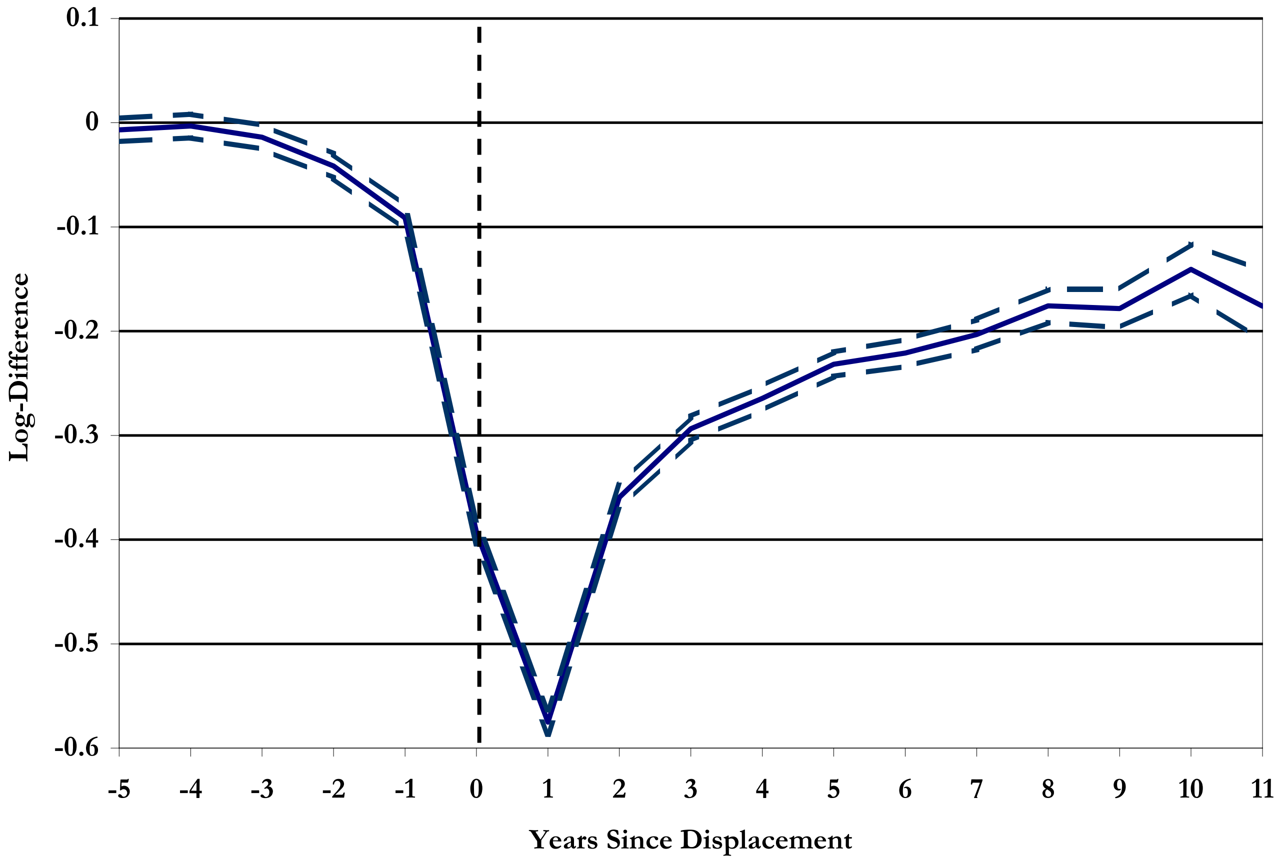


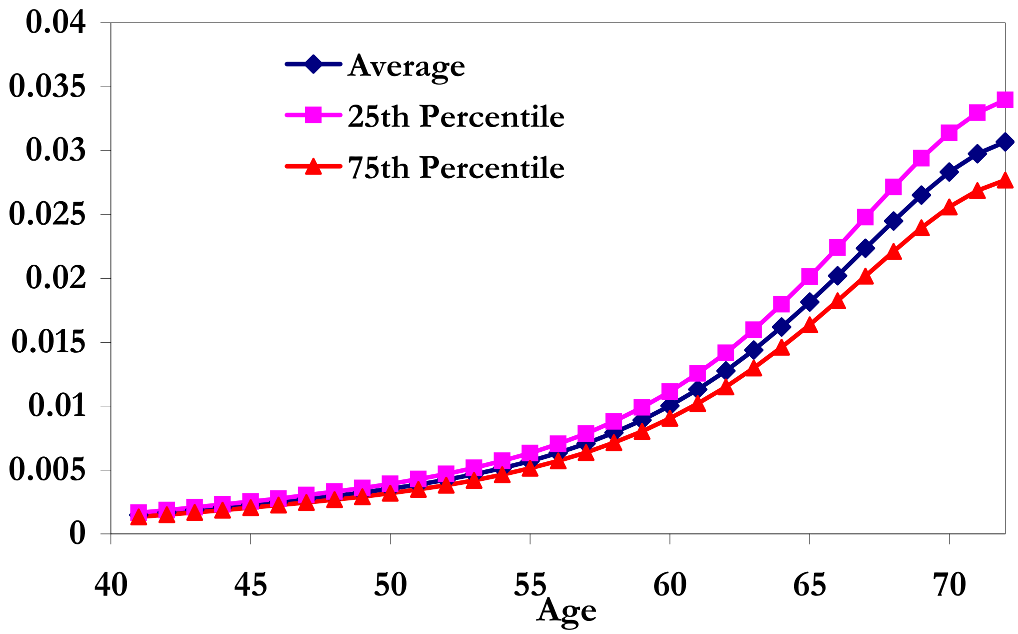
Figure 3: Estimate of the Long-term Earnings Decline Due to Mass-Layoffs Using Jacobson,Lalonde, and Sullivan (1993)'s Mass-Layoff Sample



Notes: Two standard error bands are drawn around main effects.

Figure 4: Predicted Effects of Average Earnings and Job Loss at Mass-Layoff on Mortality

Panel A: Mortality by Average, 25th, 75th Percentile of Mean 1974-19 79 Quarterly Earnings



Panel B: Mortality by Mass-Layoff Status [Average Mean 1974-1979 Quarterly Earnings]

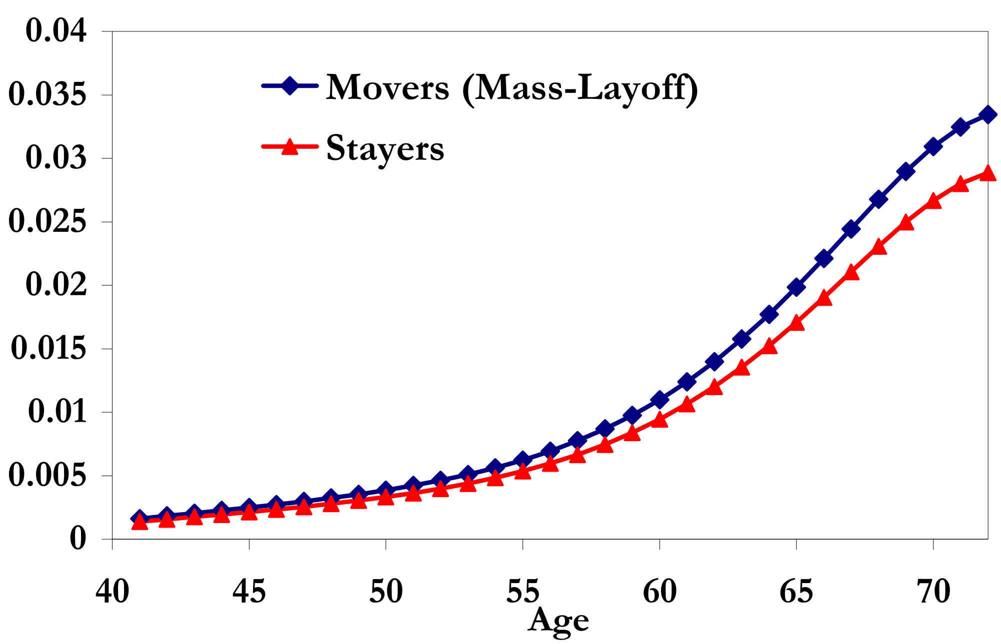
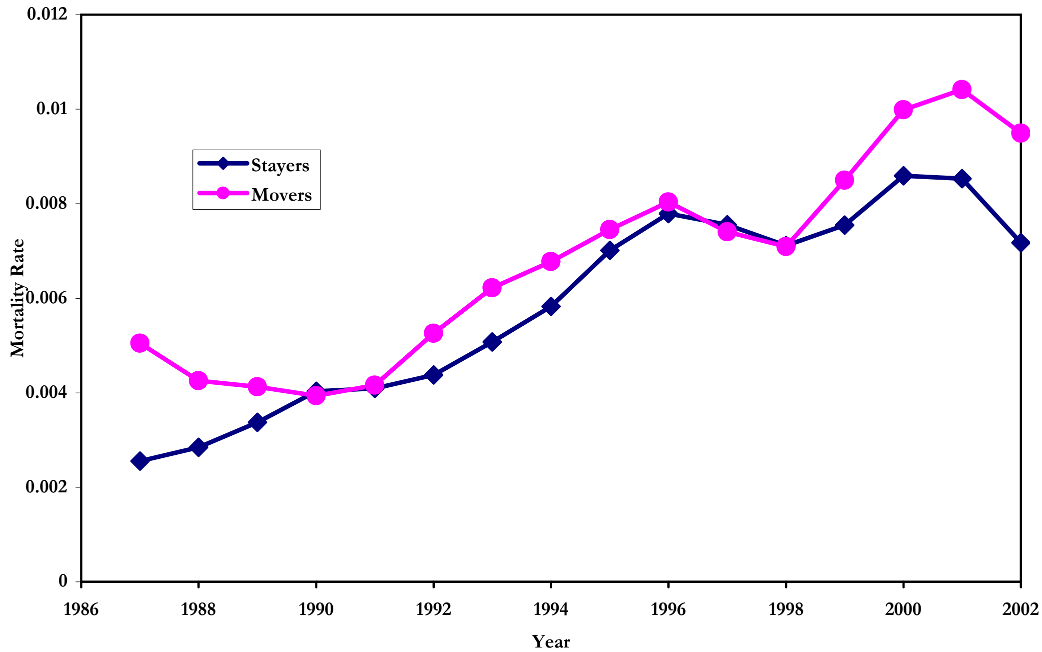
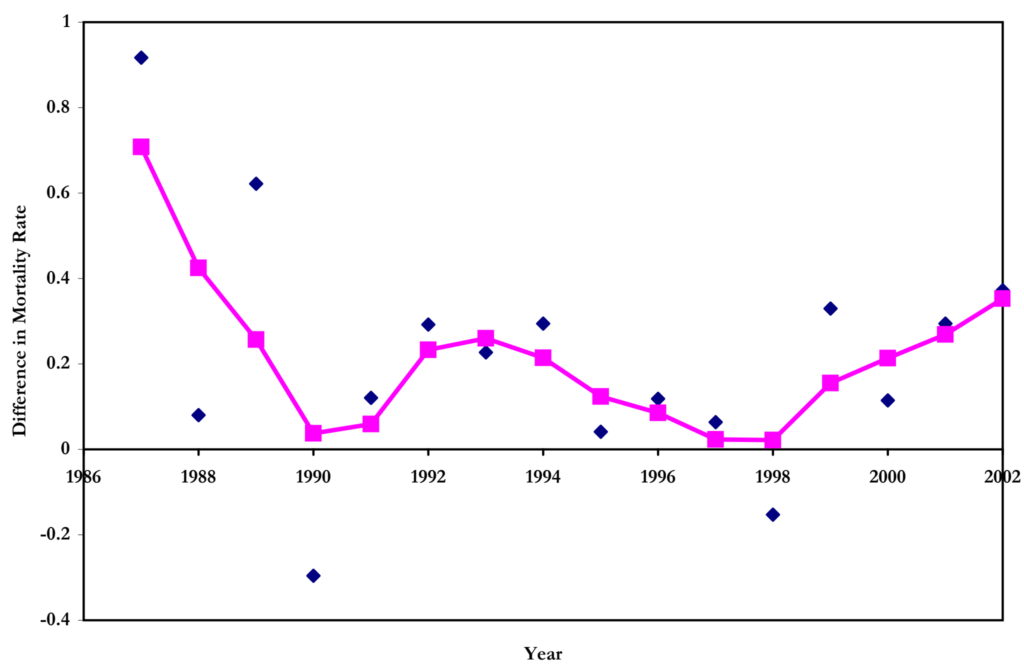


Figure 4: Effect of Mass-Layoffs during 1980 to 1986 on Mortality by Time Since Displacement

Panel A: Mortality Rate by Mass-Layoff Status



Panel B: Estimated Effect of Mass-Layoff on Mortality



Appendix Table 1: Correlation of Average Earnings and Mortality, Various Samples and Specifications

		Alternative Samples					
		Mass-Layoff Sample	Stable Job 1974-79	Major Presence 1974-79	Some Presence 74-79	Stable Job 1974-79	Major Presence 1974-79
(Model)	Baseline Period, Cohorts	1974-79, Born 1930-59				1974-86, Born 1924-29	
(1)	Log(Average Quarterly Earnings)	**-0.516**	**-0.537**	**-0.369**	**-0.111**	**-0.600**	**-0.296**
		(0.076)	(0.058)	(0.019)	(0.009)	(0.047)	(0.019)
(2)	Log(Average Quarterly Earnings)	**-0.537**	**-0.553**	**-0.414**	**-0.186**	**-0.517**	**-0.306**
		(0.079)	(0.061)	(0.027)	(0.017)	(0.054)	(0.029)
	Number of Quarters in Non-Employment	**-0.030**	**-0.022**	**-0.011**	**-0.016**	**0.011**	**-0.001**
		(0.032)	(0.025)	(0.005)	(0.003)	(0.003)	(0.002)
(3)	Log(Average Quarterly Earnings), Workers Age<=60	**-0.526**	**-0.531**	**-0.404**	**-0.118**	**-0.712**	**-0.422**
		(0.106)	(0.081)	(0.024)	(0.011)	(0.239)	(0.091)
(4)	Log(Average Quarterly Earnings), Workers Age>60	**-0.506**	**-0.542**	**-0.307**	**-0.095**	**-0.597**	**-0.290**
		(0.108)	(0.083)	(0.033)	(0.016)	(0.048)	(0.019)
(5)	Log(Average Quarterly Earnings), Workers Non-Manufacturing	**-0.362**	**-0.435**	**-0.339**	**-0.100**	**-0.602**	**-0.273**
		(0.126)	(0.088)	(0.023)	(0.010)	(0.055)	(0.021)
(6)	Log(Average Quarterly Earnings), Workers Manufacturing	**-0.594**	**-0.616**	**-0.507**	**-0.234**	**-0.564**	**-0.362**
		(0.099)	(0.080)	(0.041)	(0.026)	(0.100)	(0.061)
(7)	Log(Average Quarterly Earnings), With 1979 or 1986 Income	**-0.616**	**-0.437**	**-0.321**	**-0.075**	**-0.434**	**-0.225**
		(0.184)	(0.134)	(0.034)	(0.021)	(0.074)	(0.034)
	Log(1979 or 1986 Quarterly Earnings), With Log Average Quarterly Earn.	**0.099**	**-0.096**	**-0.074**	**-0.125**	**-0.043**	**-0.084**
		(0.164)	(0.115)	(0.023)	(0.019)	(0.029)	(0.019)

Notes: Entries in table are coefficients from logit models of the annual probability of dying from 1987 to 2002. All models also include dummies for age and year. Standard errors are in parentheses. Columns give details on sample specifications, the range of birth cohorts, and the length of the base-line period over which career outcomes are calculated. Different rows correspond to different models.

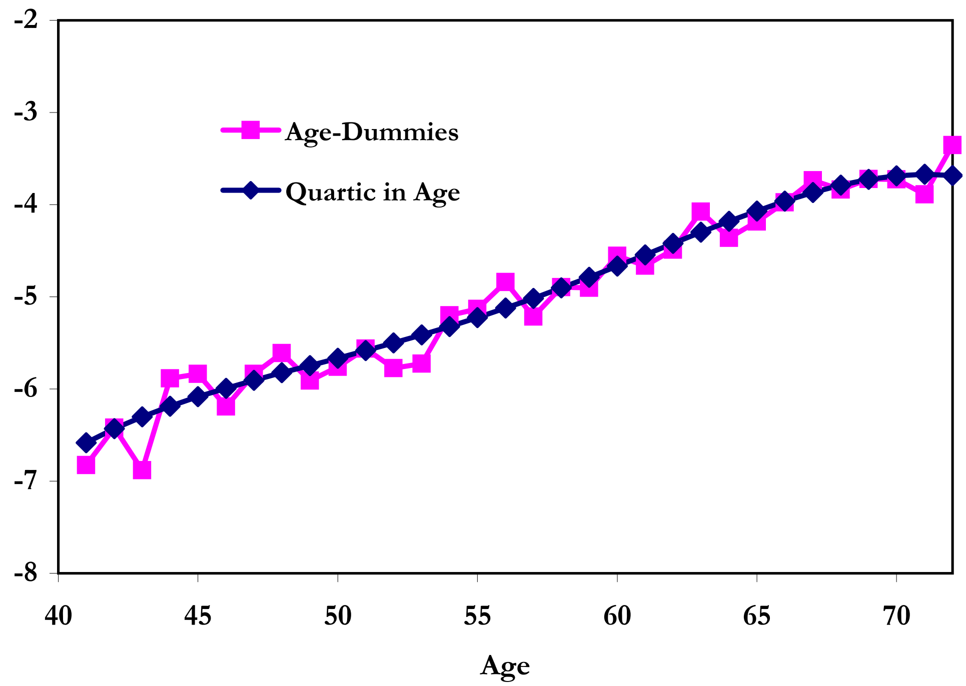
Appendix Table 2: Correlation of Average Earnings and Mortality, Various Samples and Specifications

		Alternative Samples					
		Mass-Layoff Sample	Stable Job 1974-79	Some Presence 74-79	Major Presence 1974-79	Stable Job 1974-79	Major Presence 1974-79
(Model)	Baseline Period, Cohorts	1974-79, Born 1930-59				1974-86, Born 1924-29	
(1)	Log(Average Quarterly Earnings)	**-0.380**	**-0.411**	**-0.091**	**-0.208**	**-0.555**	**-0.251**
		(0.049)	(0.034)	(0.006)	(0.011)	(0.050)	(0.021)
	Log(Standard Deviation of Log Quarterly Earnings)	**0.167**	**0.134**	**0.081**	**0.066**	**0.097**	**0.120**
		(0.026)	(0.018)	(0.008)	(0.009)	(0.032)	(0.022)
(2)	Log(Average Quarterly Earnings)	**-0.400**	**-0.426**	**-0.082**	**-0.199**	**-0.553**	**-0.235**
		(0.050)	(0.035)	(0.006)	(0.012)	(0.053)	(0.022)
	Log(Standard Deviation of Log Quarterly Earnings)	**0.176**	**0.141**	**0.061**	**0.057**	**0.096**	**0.084**
		(0.027)	(0.019)	(0.008)	(0.010)	(0.035)	(0.025)
	Number of Transitions to Non-Employment	**-0.053**	**-0.040**	**0.046**	**0.023**	**0.004**	**0.035**
		(0.031)	(0.022)	(0.007)	(0.008)	(0.020)	(0.011)
	One Drop in Earnings More Than 2 Std. Dev.	**0.221**	**0.161**	**-0.021**	**0.014**	**0.046**	**-0.042**
		(0.086)	(0.061)	(0.019)	(0.022)	(0.080)	(0.052)
	More Than One Drop in Earnings More Than 2 Std. Dev.	**0.140**	**0.103**	**-0.017**	**0.022**	**0.028**	**-0.041**
		(0.076)	(0.054)	(0.017)	(0.019)	(0.063)	(0.042)
(3)	Log(Average Quarterly Earnings)	**-0.443**	**-0.467**	**-0.066**	**-0.215**	**-0.572**	**-0.265**
		(0.051)	(0.035)	(0.005)	(0.012)	(0.052)	(0.021)
	Number of Employer Changes	**-0.063**	**-0.036**	**0.012**	**-0.002**	**-0.003**	**-0.016**
		(0.040)	(0.029)	(0.007)	(0.008)	(0.021)	(0.010)
	Number of Transitions to Non-Employment	**-0.019**	**-0.008**	**0.071**	**0.041**	**0.024**	**0.056**
		(0.031)	(0.021)	(0.007)	(0.008)	(0.018)	(0.010)
(5)	Log(Average Quarterly Earnings)	**-0.439**	**-0.465**	**-0.082**	**-0.225**	**-0.529**	**-0.256**
		(0.051)	(0.035)	(0.006)	(0.012)	(0.054)	(0.024)
	Number of Non-Employment Spells Lasting At Least A Year	**-0.263**	**-0.253**	**-0.053**	**-0.045**	**0.187**	**0.001**
		(0.414)	(0.293)	(0.015)	(0.018)	(0.047)	(0.025)

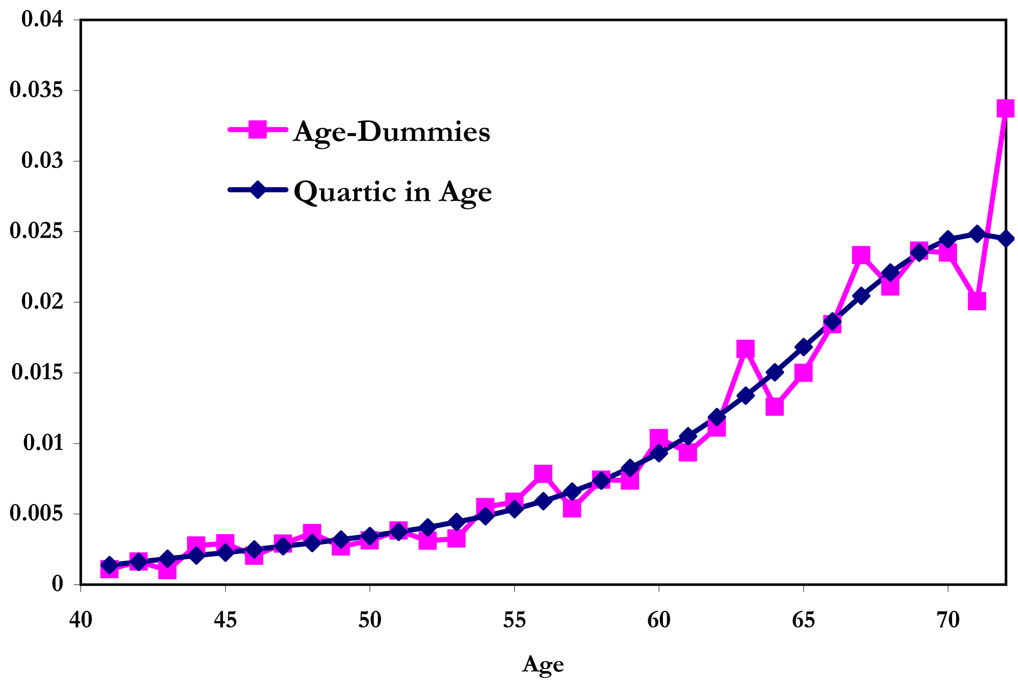
Notes: Entries in table are coefficients from logit models of the annual probability of dying from 1987 to 2002. All models also include dummies for age and year. Standard errors are in parentheses. Columns give details on sample specifications, the range of birth cohorts, and the length of the base-line period over which career outcomes are calculated. Different rows correspond to different models. Model 5 also controls for the number of non-employment spells.

Appendix Figure 1: Age-Gradient in Death Rates - Mass-Layoff Sample

Panel A: Log-Odds Ratio by Age



Panel B: Mortality Rate by Age



Appendix Figure 2: Alternative specifications for the effect of the standard deviation of log earnings on mortality