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LIST OF ABBREVIATIONS/ACRONYMS

ADA	Americans with Disabilities Act
AFDC	Aid to Families with Dependent Children
AFQT	Armed Forces Qualification Test
BLS	Bureau of Labor Statistics
CD	Certificates of Deposit
CDC	Centers for Disease Control
EALE	European Association of Labour Economics
FE	Fixed Effect Estimator
IRA	Individual Retirement Account
MSD	Musculoskeletal Disorder
NIOSH	National Institute of Occupational Safety and Health
NLS	National Longitudinal Survey
NLSY79	National Longitudinal Survey of Youth 1979
NORA	National Occupational Research Agenda
OLS	Ordinary Least Squares
OSHA	Occupational Safety and Health Administration
RE	Random Effect Estimator
SES	Socioeconomic Status
SOLE	Society of Labor Economics
SSI	Supplemental Security Income
UML	University of Massachusetts Lowell
US	United States of America
WC	Workers' Compensation

ABSTRACT

Issues Addressed and Importance of the Problem: While official US statistics show that occupational injury rates have continuously declined since the early 1990s, the costs of such injuries have remained high with spending breaking $142 billion dollars in 2004. The calculations of these costs are usually based on estimates of earnings losses experienced by injured workers or on the amount of workers' compensation (WC) benefits that are being paid. This research has aimed to increase our knowledge about some additional hidden social and economic outcomes of workplace injuries.

Approach: The main hypothesis of the study was that injuries cannot be studied as isolated events in workers' lives. Their consequences will largely depend on the individual's personal characteristics and pre-injury labor market experience. These factors, together with employers' characteristics, behaviors and working conditions, will then determine the potential long-lasting economic effects of the injury. Given its aims, the research proposal has used data that permit examination of workers' lives over a long period of time, both before and after the injury: the National Longitudinal Survey of Youth 1979 cohort is a nationally representative panel survey sponsored by the Bureau of Labor Statistics, U.S. Department of Labor. These data were analyzed both through descriptive statistics and with cross-sectional and longitudinal econometric techniques.

Key Findings: Workplace injuries have severe economic consequences that go beyond earnings losses. Income losses lead to a dramatic drop in wealth. Injuries also cause a decrease in consumption and increase the likelihood that workers will file for bankruptcy. Multiple injuries lead to a loss of health insurance. These outcomes suggest that current WC benefits may be inadequate. They may also reflect the fact that several workers with lost time injuries did not file for WC. Some injured workers also encountered difficulties in returning to work. Employment accommodation has become more likely since the introduction of the ADA, but some workers still face layoffs or firing after an injury. These terminations were more common among minority workers and among workers who had filed a WC claim. Finally, the burden of occupational injuries is not randomly distributed. Workers who had experienced low socio-economic status in their teens carry this burden through their working lives: they face a higher likelihood of experiencing multiple occupational injuries. Longer working hours are also related to higher accident rates over individual working lives.

How the Results Can Be Used: Workers should invest in more formal education and in longer employment relationships. This will diminish their exposure to occupational risks. Employers should provide young workers with safety training, prevent excessive working hours, apply the ADA, and facilitate the return to work of injured workers. Policy makers must reconsider the adequacy of current WC benefits and consider giving employers monetary incentives both to facilitate the return to work of injured workers and to educate employees about their entitlements under the WC system. Policymakers should also assess the merits of introducing incentives for precautionary savings for workers employed in dangerous industries and occupations. Finally, they should support policies to fight early factors that lead to multiple injuries over a working life: childhood poverty, poor health and early exposure to dangerous jobs.

HIGHLIGHTS / SIGNIFICANT FINDINGS

This research was developed in the context of the NORA Priority Research Area *"Social and Economic Consequences of Workplace Illness and Injury" (n. 20).* While official US statistics show that occupational injury rates have continuously declined since the early 1990s, the costs of such injuries have remained high. These costs are usually calculated in terms of wage losses, productivity losses, medical expenses and administrative expenses, but there are several additional potential costly outcomes of a workplace accident. This research project aimed to increase our knowledge about the experience of injured workers and some hidden social and economic costs of workplace injuries. The main hypothesis was that injury consequences will largely depend on the individual's personal characteristics and pre-injury labor market experience. These factors, together with employers' characteristics, behaviors and working conditions, will then determine the potential long-lasting economic effects of the injury.

The study has used data from the National Longitudinal Survey of Youth 1979 cohort (NLSY79), a nationally representative panel survey sponsored by the Bureau of Labor Statistics, U.S. Department of Labor. A total of 12,686 men and women were first interviewed in 1979. In 1988, respondents to the NLSY79 were asked questions regarding occupational injuries and illnesses for the first time. Between 1988 to 2000 injury rates at each survey year ranged from a low of 3.24% (in 1994) to a high of 6.68% (in 1988)

<u>The Profile of Injured Workers and Workers' Compensation Coverage</u>
Injuries were more common among male, white, and less educated workers. Those who were hurt were also more likely to have been in multiple marriages and divorces. Many of the injuries and illnesses were not minor since one-fifth of all surveyed individuals lost days of work because of the injury or illness and one-fifth filed a workers' compensation claim. Almost 12% of all workers reported having lost wages at least once in their life, while among those injured over one-third lost wages. The average number of days lost after an injury before returning to work was over a month (37 days) of time. The median number of days lost was 7 days. Finally, the incidence of illness and injury decline as these baby boomers get older. At each age, between 2.5% and 5% of baby boomers were hurt in workplace accidents, with *peak injuries occurring in the early 30s.* To the best of my knowledge, this is the first study to capture individuals' age profiles of workplace injuries. As these baby boomers age and take on more senior level positions, which contain less risk, workplace injuries should continue to decline.

Workers answered whether they had *filed a WC claim* after the accident. Among those who were hurt once and lost work time, just 61% ever filed a claim and only 40.7% of those who never lost time from work filed. Rates for filing a claim were much higher among those who were hurt multiple times. Among those that lost time from work because of several injuries almost 82% filed a claim. This shows that a relatively large proportion of occupational injuries are not captured by the workers' compensation system, but that workers learn how to use the system over time.

<u>Beyond Income Losses: the Impact of Workplace Injuries and Illnesses on Wealth</u>
Occupational risk represents a case where freely competitive markets fail to establish efficient markets for insurance. Such failure is usually attributed either to workers' lack of or imperfect

knowledge about each job's risk or to workers' optimistic bias. In addition, the workers' compensation system is designed to only partially replace lost wages given its additional goal of providing return-to-work incentives. A growing body of research has shown that occupational injuries dramatically reduce labor income. To the best of my knowledge, this study represents the first research focusing on the impact of workplace injuries and illness on different dimensions of financial well being: employees' wealth, consumption and bankruptcy propensity.

While there is a correlation between labor income and *wealth*, wealth represents a different dimension of financial well-being. Reduction in wealth is often a clear indicator that people are spending more than their income. Conversely, rising wealth occurs when people are saving extra income to deal with future uncertainties such as layoff, sickness and death. I created a net worth variable for each survey year by first summing for each respondent all the asset answers and then subtracting from that total all debt answers. I tracked median net worth both for respondents who reported never being injured at work and for those who ever reported being injured. I found that, on average, the typical boomer who was never hurt has 1.6 times the net worth of someone who was hurt at least once. This result could be misleading, however. It could simply reflect differences between the wealth of individuals in high-paying safe white-collar jobs and the wealth held by individuals in lower-paying riskier blue-collar jobs. In addition, unobserved heterogeneity among individuals could lead to a situation where low-skilled or less risk-averse individuals select themselves into more dangerous jobs and may save less and accumulate less wealth. Therefore, I used estimation techniques to account for these potential problems. I found that injuries which lead to self reported wage losses or to spells off work are associated with a wealth reduction of almost 20 percent. This negative impact on wealth occurs even when workers file for compensation. The negative result suggests that the partial income replacement offered by workers' compensation benefits has an additional long-lasting financial consequence on workers' lower wealth over time.

This first result highlighted a strong link between workers reporting an income loss and a reduction in wealth. As an additional step I have explored the additional hypothesis that, faced with both income and wealth loss, injured workers may end up not only drawing from their savings, but also reducing their *consumption*. A special NLSY79 module on food spending, which was inserted into all surveys from 1990 to 1994, provides a method of testing whether consumption is stable or falls among injured individuals. I found that yearly food spending fell by more than two hundred dollars when a worker was injured. To put this in perspective, this is a larger "consumption penalty" than the one found for Hispanic versus non-black/non-Hispanic individuals. This result suggests that workers do not have stable consumption after being injured.

I further built on my findings about wealth and consumption effects to study the relationship between occupational injuries and the propensity to file for *bankruptcy*. I found that, by 2004, 18% of injured workers had field for bankruptcy (vs. 11% of the non injured individuals) and that 60% of them had filed after being injured. Regression analysis confirmed that having an incident on the job and filing for workers' compensation increase the likelihood of filing for bankruptcy, respectively by 50% and 25%.

Finally I looked at the effect of injuries on a particular type of fringe benefits: *health insurance*. While the NLSY79 data reflect the national average with 15% of individuals without health

insurance, I found that among injured workers the percentage is higher (25%). Regression analysis also estimated the likelihood of workers being covered by health insurance at a specific point of time, 2002. These findings are not as clear. They show that being hurt at work increases the chance of having insurance. This possibly reflects the fact that injured workers must have a job and therefore have a higher likelihood of receiving health insurance through their employer (indeed the NLSY79 data also show that typical baby boomers spent almost 12 out of the 15 years working, but those that were injured spent more time working than the overall respondents). Each additional time a worker is hurt, however, lowers the chances of having insurance. Missing work and filing a WC claim lowers the probability as well.

This first set of findings related to the following specific aims of the project: Aim 3 (*To estimate the effect of a job related injury/illness on future earnings and on other economic consequences that are unaccounted for by changes in wages*), Aim 4 (*To evaluate the effect of an injury on the families of injured workers*) and Aim 5 (*To measure whether long term economic and social consequences of work-related injuries and illness vary among workers who receive or do not receive workers compensation benefits*).

Injuries and Employment Outcomes

Once an individual suffers a job-related injury or illness, it is possible that his future socio-economic status will be affected by the difficulty in returning to productive employment. We know that being able to return to the pre-injury-employer is one of the main determinants of the speed of return to work. Very little is known, however, about employers' ability and willingness to rehire employees who have suffered a work related injury. Most of the previous studies on this topic have been based on administrative data and therefore share the limitation of not permitting identification of the nature of job separations: whether they happened because of quits, layoffs, or firing. In the NLSY79 data, injured workers were specifically asked about the employment outcomes of their on-the-job injury or illness.

I have studied workers' answers between 1988 and 2000 to identify factors related to the following mutually exclusive *job separations: no separations, quits, layoffs, or firing*. I have found that minorities are indeed more likely to experience both voluntary and involuntary separation after the injury. While women are more likely to quit, African-American or older workers are more likely to be terminated. Workers who filed for workers' compensation were also more likely to have been laid off while the ones who reported a wage loss were both quitting and being terminated, possibly because a wage loss implies either a more severe accident or a more litigious claim.

The NLSY79 also includes very interesting information about the *accommodation* workers were offered after the job related injury: 12 percent of injured workers reported that they were assigned to another task on a temporary basis; almost 16 percent were given the possibility of returning to their regular job less than full time; and 29 percent could return to their regular job despite not being able to perform their normal duties. Interestingly, regression results show that women were more likely to receive accommodation. Workers who had filed for workers' compensation or who had reported wage losses also received accommodation more often, possibly again because these conditions capture more severe accidents. And the likelihood of

receiving accommodation increased substantially as of 1993, the first full year during which the ADA came into effect.

Finally an injury could be an even more disruptive event if the disability or the development of a newly litigious relationship between employer and employee affect what originally was a successful job match. At the same time, the incident could represent an excuse for both parties to terminate what was not a successful employment relationship. Workers were asked whether they had ended up changing occupation after the accident, although their answers did not differentiate between a change in occupation within the pre-injury firm and a change in occupation in a new firm or sector. As expected I found that all types of separation were strongly associated with *changes in occupation* and this was particularly true for the workers who had voluntarily left their employers.

These results suggest that indeed employers respond differently to a job-related injury depending on the gender and race of the employees, with women more likely to receive employment accommodation and African-Americans being more exposed to job termination. Also, while the implementation of the Americans with Disabilities Act may have played a role in increasing the likelihood of receiving accommodation after an injury, the experience with the workers' compensation system is related to more uncertain future employment: more involuntary separations and changes in occupation. These findings, however, still need further testing Specifically, they need to be further assessed by utilizing different estimation methodologies that will permit confirmation of the causal relationship between injuries and these occupational outcomes, against the alternative hypothesis that these injured workers were individuals who would have had a weaker attachment to their employer regardless of the accident.

These findings related to the following specific aims of the project: Aim 1 (*To estimate the effect of a job related injury or illness on individual's future employment*) and Aim 5 (*To measure whether long term economic and social consequences of work-related injuries and illness vary among workers who receive or do not receive workers compensation benefits*).

Pre-injury Factors and Recurrent Workplace Accidents

To date very little research has been dedicated to one particular aspect of occupational injuries, that is, their recurrent nature. Indeed, the few analyses on this topic indicate that on average at least 30 percent of injured workers experience at least one more occupational injury in the years following the first accident. The predictive power of most existing studies on the topic is limited by the fact that they were conducted only among workers who experienced at least one occupational injury, and this group may not be representative of the overall working population. My analysis on the topic overcomes this limitation because the NLSY79 data also cover workers who never experienced an injury; and for those who did, it allows identification of the first episode. To the best of my knowledge, my analysis represents the first attempt to investigate the role played by pre injury individual and job characteristics in determining workers' incidence rates over a long spell (the first twenty years) of their working history.

Between 1988 and 2000, 1,255 NLSY79 respondents, or 37% of all workers who had experienced one on-the-job accident reported additional injuries, a percentage consistent with what is found in the existing literature. I estimated a count model to identify the main

determinants of the total count of injuries reported by each individual over those twelve years. As far as *individual characteristics*, I found what had already been reported in other studies, i.e. that multiple injuries are more likely among male and white workers. Formal schooling is also one of the main individual attributes that can protect workers from injuries, either because it produces better skills or because it increases their ability to qualify for safer jobs. The survey permits us, however, to also assess the role played by an additional variable: whether individuals had ever experienced health problems that had prevented them from work or had limited the amount and kind of work they could perform in the years preceding the first reported occupational injury. This is a very important variable because in the calculation of workers' compensation benefits it is often debated to what extent employers should compensate for injuries that may have been caused by pre-existing non work related health conditions. The NLSY79 survey data seem to indicate that, indeed, the existence of pre-existing health conditions plays a very large role in causing multiple occupational injuries.

The first years of the survey (1978 to 1982) also investigated whether individuals lived in poverty during their youth and whether their very first jobs were dangerous or unhealthy. Regression analysis shows that young individuals who reported economic hardship before reporting the first injury, or who were exposed at very young age to unsafe jobs ended up reporting a larger number of multiple injures during the first 20 years of their working life. These findings suggest the existence of a strong negative relationship between the *early socio economic status* of young workers and their future risk of continuous exposure to dangerous jobs. This risk was reduced by the accumulation of labor market experience, however.

I also gained insights about *jobs' attributes* that may determine higher injury rates over a lifetime. Both blue collar workers and service workers are characterized by higher injury incidence rates while male and female employees face the same risk of multiple injuries when employed on the same job and in the same industry. Higher tenure and better hourly pay lower this risk of multiple injuries, suggesting that safety complements higher pay and is not traded with compensating wage differentials. Workers who work longer hours, however, are at risk of higher incidence rates over their working life. This may indicate a relationship between fatigue and the accumulation of injuries or illnesses. Indeed, the number of hours worked was higher in the month preceding the injury than one year before the injury and during the month of the injury.

These findings related to the following specific aim of the project: Aim 2 (*To determine the factors that may explain recurrent episodes of work related injury and illness*).

TRANSLATION OF FINDINGS /// OUTCOMES/RELEVANCE/IMPACT

The main aim of this research project was to identify some of the hidden socio-economic outcomes associated with workplace injuries. This research found that:

- Accidents have a long-lasting economic effect that goes beyond income losses. They affect worker's wealth, future consumption and the propensity to file for bankruptcy
- Both voluntary and involuntary job separations occur after an injury. Women are more likely to quit, and African-American workers are more likely to be laid off or fired.
- The Americans with Disabilities Act has increased the likelihood of receiving accommodation after an injury
- Filing for workers' compensation does not mitigate the negative effect of injuries on wealth. It was also related to more uncertain future employment: more involuntary job separations and changes in occupation.
- A large proportion of workers with lost time injuries never filed for workers' compensation.
- Low socioeconomic status and childhood poverty are strong predictors of recurrent injuries over an adult work life.
- Health conditions developed at early age are related to a higher number of future occupational injuries.
- Longer working hours are related to higher accident rates over individual working lives.
- At each age, between 2.5% and 5% of baby boomers are hurt in workplace accidents, with peak injuries occurring in the early 30s.

Recommendations for employers and employees

Blue collar and service workers are the ones at higher risk of injury. The above findings, however, suggest the following recommendations across all workplaces:

a. Both employers and employees should invest in longer employment relationships. When workers gain tenure and job specific skills they are less exposed to occupational risk.
b. Workers should strive to obtain higher formal education as this reduces their risk of being injured. Education increases their skills on the job and makes them eligible for safer occupations.
c. Employers should strongly monitor and prevent excessive working hours because they produce higher risk of workplace injuries.
d. Employers should target young workers (in their 20s) with safety training because they are the ones more at risk of occupational injuries.
e. Employers should strictly apply the ADA and be particularly concerned at preventing risk exposure to individual with pre-existing work-limiting health conditions. They also need to avoid discrimination between genders and minorities both in term of accommodation and of job terminations.
f. It should be made clear to workers that workers' replacement benefits provide only partial replacement of their labor earnings. When they work in dangerous industries and occupation they need to accumulate precautionary savings.

Implications for Policy Makers

a. *Adequacy of WC benefits, return to work policies, and workers' education.*

"Essential" recommendations issued at the federal level include both the adequacy and equity of income replacement benefits (National Commission on State Workmen's Compensation Laws, 1972). Nevertheless, to ensure there are incentives for someone to return to work, benefits payments for workers with temporary disabilities are usually two-thirds of pre-tax wages, or the state maximum benefits, whichever is less. Injured workers and their families, therefore, often need new strategies to maintain the standard of living they had before the injury. This research has shown that injuries lead to wealth losses and decrease in consumption.

If workers have not accumulated precautionary savings, they may fall into debt, or be unable to meet previous financial obligations. For workers without savings, injuries may result in negative economic consequences beyond the family. For example, lenders could be affected if workers can not repay their loans. Previous studies showed that injured workers reported having lost their home or car because of this new financial hardship. This is an example of how a wealth decrease leads to the loss of "tools" needed to return to fully productive employment. This means that policies which focus on providing injured workers with adequate benefits potentially provide an even larger social gain than the gain usually attributed to them.

In addition, the effect of lost income on wealth suggests the importance of implementing better systems to speed up the payment of workers' compensation benefits. Several studies have highlighted employees' difficulty in navigating the workers' compensation system. For low-wage workers, any delay between the accident's date and receipt of the first compensation payment can lead to a larger use of expensive loans.

Finally, the evidence of wealth losses and their potential long-term consequences highlight the need for accumulating precautionary savings. Workers often underestimate or do not know the occupational risks they face. It is also not clear if they know that the workers' compensation system only partially replaces their income if they are hurt. Moreover, ignorance may be a bigger problem among specific groups of workers such as young or immigrant employees. This raises the question of whether enough is done to educate workers about the real attributes of their job and about their rights under the workers' compensation system. Such education should happen in workplaces. States should consider offering incentives to employers to ensure workers are properly informed about their safety and their rights if hurt. Policy makers should also discuss the merits of introducing specific incentives to save (for example tax exempt salary deductions) for those workers who are employed in dangerous industries and occupations.

b. Return to Work Policies

There is general agreement that a prompt return to work is one of the major goals of worker compensation systems. It is indeed quite possible that the wealth losses detected in this research are not only caused by potential inadequacy of income replacement benefits but also by difficulties workers encounter in maintaining "good" jobs after the injury. This study had found the ADA has been successful in increasing the likelihood that workers will receive accommodation after an accident, although, it also found that individuals with early health conditions are at higher risk of recurrent occupational injuries. It has also shown, however, that injuries often become a cause of layoffs or firing, especially among minority workers.

Policy makers should discuss systems to better monitor employers' termination decisions in workplaces that are known for being dangerous. It is necessary to make sure that such decisions

do not disguise discriminatory actions. In addition, some U.S. states have already established policies to provide employers with monetary incentives to rehire injured workers. Policy makers should consider the funding of studies that will evaluate the outcome of such policies.

c. *Workers' Compensation Coverage.*
The study found that forty percent of workers with lost time injuries did not file for workers' compensation. It also found that workers who had filed for WC were more likely to face involuntary job separations and changes in occupation. Legislators should consider penalties for employers who implicitly or explicitly discourage their employees from using the WC system.

d. Poverty
This study has also highlighted the fact that occupational injuries represent one phase in the vicious cycle of poverty. Individuals who spent their youth in poor households and who in their teens worked in unsafe and dangerous jobs were at substantially higher risk of experiencing a higher number of occupational injuries during their working lives. This important new result stresses the great importance of supporting policies that will protect poor children's well-being. If such polices are not implemented, poor children's disadvantage is only going to accumulate over their life time.

Recommendation for future research

This study leads to several further research questions. Some of them had been raised in the original research proposal and some have emerged from the findings discussed in this report.

a. *About long term economic losses*: The results concerning wealth losses need to be further explored. We need to investigate more in detail the relationship between earning losses and decreases in wealth. From the existing literature we also know that bankruptcy filing can be affected by three different factors: strategic decisions to maximize financial benefits; stigma associated with filing; an adverse event, such as illness, divorce or job losses. We need to test to what extent injuries represent the main cause of filing against these alternative hypotheses. We also know that bankruptcy, a social insurance system, has been found to be a substitute for the unemployment system. We should explore whether there is substitution or complementarity between the WC system and bankruptcy. Finally, we also want to further explore to what extent injuries lead to losses in fringe benefits.

b. *About employment outcomes*: We need to determine which pre-injury factors (tenure, hours worked, pay rates, occupation, industry, gaps in employment, fringe benefits, global job satisfaction, promotion, shift work, employer size, and union coverage) and which post-injury factors (time off work, return to the same employer, being laid off, quitting, being fired, changing occupation) determine a successful return to work after an injury.

c. *About multiple injuries*: We need to further explore to what extent the characteristics of a first injury and a first workers' compensation claim affect the likelihood of experiencing both multiple injuries and multiple WC claims over a working life. We need research to understand

the nature of the pre-existing health conditions that make workers more prone to become injured on future jobs; we need to better understand what leads workers to accept unsafe jobs.

d. *About families' well-being*: To fully understand the burden of injuries we also need to study how family members are affected when a worker is injured. This implies first analyzing the effect of injuries on the labor force and on the employment status of spouses; and second, their effect on children's physical and mental health, time spent with parents, schooling, and employment experience.

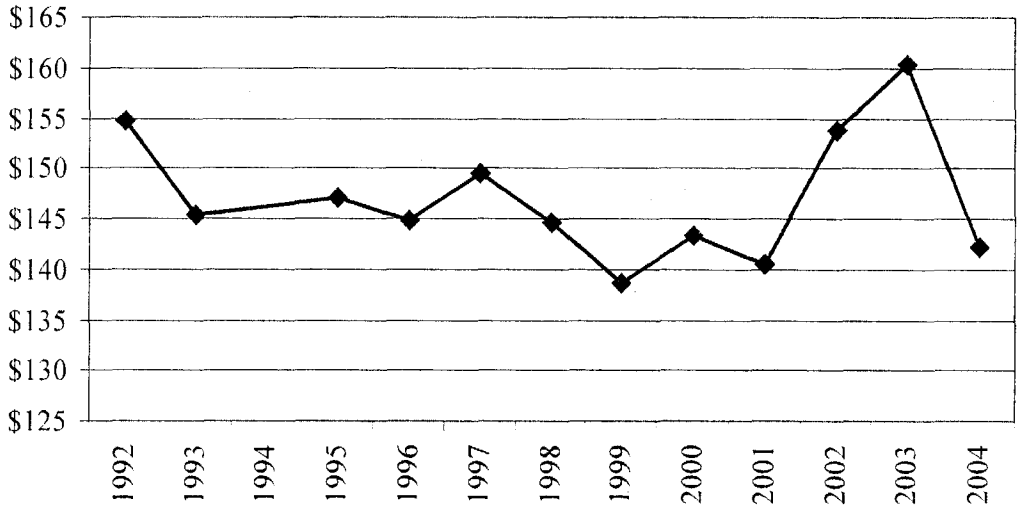
I am planning to make these topics the focus of my research agenda over the next few years.

SCIENTIFIC REPORT

Background and Significance.

This research was developed in the context of the following NORA Priority Research Area: *"Social and Economic Consequences of Workplace Illness and Injury" (n. 20).* The public policy interest toward this problem seems to have diminished during the last few years, partly because official US statistics have shown that occupational injury rates have continuously declined since the early 1990s. In 2004 U.S. workers experienced over 1.3 million injury and illness incidents that resulted in their taking days off from work (Bureau of Labor Statistics, 2005).1 These numbers are much lower than the ones for 1990 when there were 2.6 million incidents that resulted in cases with days away from work. Nevertheless, even though on-the-job injuries and sicknesses are falling, these problems are still quite costly. Figure 1 tracks the National Safety Council's estimates of the cost of unintentional injuries at U.S. workplaces. The figure shows that from 1992 until 2001 costs fell. However, over the last few years work-place injuries and illnesses costs have been rising, with spending breaking $142 billion dollars in 2004.2

Figure 1: Cost in Billions of Unintentional Work Injuries (2004 $)



NOTE: Calculations based on data from the National Safety Council's *Injury Facts,* various editions as reported by the U.S. Census Bureau (1993 to 2007). Cost data were adjusted for inflation using the CPI-W.

These costs included wage losses, productivity losses, medical expenses and administrative expenses. Indeed most of the estimates of the cost of workplace injuries usually are based on estimates of earnings losses experienced by injured workers or by the amount of workers' compensation benefits that are getting paid. However, there are several additional potential

1 Leigh, Marcin and Miller (2004) show these figures underestimate between 33% and 69% of all injuries because of underreporting and because the categories government workers and self-employed are excluded by the BLS Annual Survey.

2 The National Safety Council costs estimates are lower than the ones presented in Leigh et al. (1997). In addition, the Council's cost estimates do not include the costs of on-the-job assaults and murders.

costly consequences of a workplace accident. This research has aimed to increase the knowledge of some of these hidden costs by using a longitudinal survey of uninjured and injured workers (the NLSY79). It builds on the existing literature that has focused mainly on economic outcomes.

Effects on workers' employment

Once an individual suffers a job-related injury or illness, it is likely that his future socio-economic status will be affected by the difficulty in returning to productive employment. In fact, more generally, it is known that poor health status has a strong negative effect on labor force participation (Diamond and Hausman, 1984, and Stern, 1990) and is related to early retirement decisions (Bazzoli, 1985). The probability of leaving the labor force varies by measures of socio-economic status such as gender, race, education, and employment and work conditions (McDonough and Amick, 2001). In addition, differences in health care systems and disability insurance systems may explain some of the variation in the estimated effects (Campolieti, 2002). Also, individual with illnesses or health limitations are more likely to experience involuntary job changes (Baldwin and Shumacher, 2002), and suffer longer spells of unemployment (Stewart, 2001). More specifically, limitations to strength and mobility have more severe consequences on the employability of men than for women (Baldwin, Flacco, and Zeager 1994).

As far as the specific problems originated by on-the-job injuries, Butler and Worrall (1985) published the first analysis for the US of the effect of workers' compensation benefit levels on the duration of temporary disability benefit payments to injured workers. Their research originated a handful of studies that have looked at return to work patterns and economics losses by using workers' compensation data. The use of such data however presents important problems. First, given the fact that the US workers' compensation system is regulated at the state and not at the federal level, it is not always easy to compare the results of a body of research that describes the experience of workers who were compensated under different rules. Second, such data are often available only for workers who missed more days of work than the "waiting period" required to receive income benefits (which can vary from 3 to 7 days). Only few workers' compensation agencies have records for claims that did not result in income benefit payments. More generally, administrative data leave us with no information about those injured workers who may have failed to use workers' compensation systems. However, despite these data limitations, some results are consistent across studies and are a useful reference for any analysis aiming to explore the social and economic consequences of illnesses and injuries that may result in time off work.

First, as far as personal characteristics are concerned, age as been found to slow the speed of return to work. This is partly due to the increased difficulty that older people encounter in recovering from the injury. Also, for some older workers the injury or sickness absence may provide a push into retirement (Fenn, 1981, Fenn and Vlachonikolis, 1986, Cheadle et al., 1994, and Oleinick, Gluck, and Guire, 1996). Vice versa, experience, education, and skill levels affect return to work positively because they enhance the flexibility or capability to compensate for physical disability. This increases the value of employees, and therefore increases their chances of receiving alternate job offers or of being assigned a new task by the preinjury employer (Johnson and Ondrich, 1990, Fenn, 1981, and Butler, Johnson, and Baldwin, 1995). Women take longer to return to work, although the few specific economic studies addressing gender differences report very few important differences in the factors explaining the length of spells off

work.3 As in the general case of absenteeism (Vistnes, 1997), this result is usually explained by the household work or childcare responsibilities in which women are more likely to be involved even during recovery. Being married usually has a positive effect on the speed of return to work, although the effect of this factor may vary across gender (Fenn, 1981, Johnson and Ondrich, 1990, and Johnson, Butler, and Baldwin, 1994). The effect of union membership is also mixed (Butler and Worrall, 1985, Johnson and Ondrich, 1990, and Johnson, Butler, and Baldwin, 1994)4. As far as race is concerned, African-American and Hispanic workers have been found to face more difficulties in returning to work (Strunin and Boden, 2000).

However, the factors that seem to play a major role in determining the probability to return to work after an injury are clearly associated with the event of the injury itself. Studies that account for the severity of the injury or for the nature of the impairment, have often found that these factors are the primary determinants of the length of the time spent off work (Fenn, 1981, Fenn and Vlachonikolis, 1986, Johnson and Ondrich, 1990, Butler, Johnson, and Baldwin, 1995, Cheadle et al., 1996). At the same time, an increase in the workers' compensation benefit level or in the replacement rate (measured as the ratio between weekly temporary disability benefits and the gross weekly preinjury wage) usually is associated with a lower propensity to return work (Fenn, 1981, Butler and Worrall, 1985, Fenn and Vlachonikolis, 1986, Krueger, 1990, Johnson and Ondrich, 1990, Curington, 1994, and Meyer, Viscusi, and Durbin, 1995). Estimates of the duration/benefit elasticity have varied greatly among studies, from a minimum of 0.352 (Butler and Worrall, 1985) to a maximum of 1.67 (Krueger, 1990), depending on the estimation methods (Butler, Baldwin, and Johnson, 2001, Galizzi and Boden, 2003) and on the type and severity of cases that were studied.

These last results concerning the effect of changes in the level of benefits have traditionally represented the finding with the greatest interest for economists and for policymakers. However, two recent important sets of findings have highlighted the need to go beyond these results when studying the experience of workers following a job-related injury.

Role of employment accommodation

On one side, a recent set of findings has highlighted the need to explore the role that employers play in determining the future employment status of injured workers. Some studies confirm that workers return more slowly to physically demanding jobs (Johnson and Ondrich, 1990, and Fenn, 1981), to small establishments (Cheadle et al., 1994, and Oleinick, Gluck, and Guire,

3 It should be pointed out that, with few exceptions (Baldwin, Zeager, and Flacco, 1994, Galizzi and Boden, 2003, and Hersch, 1998), the economic literature has generally ignored potential gender differences in the characteristics and experiences of injured workers. This may be due in part to the common assumptions that women are usually employed in less risky jobs. But the change in the nature of many jobs is quickly challenging this belief, and women's injuries now represent one-third of the total number of lost time claims.

4 Butler and Worral (1985), and Johnson and Ondrich (1990) have found that union participation delays return to work, at least as far as U.S. workers are concerned. In a study based on data on Ontario workers, Johnson, Baldwin, and Butler (1998) found opposite results: Union membership increased the probability of a prompt return to work. The authors suggest that the observed difference between the results for U.S. and Canadian workers could be explained by the fact that U.S. unions often provide injured workers with attorney representation. If attorneys are able to provide injured workers with higher benefits, then these workers face a disincentive to a prompt return to work. At the same time, in a different study based on the same data, the same authors find also that, because of unions, workers can be facilitated in their first return to work but not necessarily in a sustainable return to work (Butler, Johnson, and Baldwin, 1995).

1996), and when they change employer (Galizzi and Boden, 2003). In a study based on interviews, Strunin and Boden (2000) found that half of the workers they studied experienced employer indifference or hostility as they tried to return to work. This applied especially to African-American, Hispanic and females workers. Many of the workers in this study reported that workplace accommodations were often only nominally implemented. Indeed, although job accommodations make intuitive sense, there is limited evidence on the frequency or success with which they have been implemented. In one of the very few studies on the subject, Burkahauser, Butler and Kim (1995) found that, even before the Americans with Disabilities Act, almost 30 percent of disabled workers in the sample they studied had been accommodated by their employers and that those accommodations increased the duration of employment –from two years to nine years- of workers with disabilities. Butler, Johnson, and Baldwin (1995) also found that specific disability management policies, such as a return at reduced hours or to modified employment, are important determinant of stable return to work after an injury. Finally, Daly and Bound (1995) reported that, in their sample, one-third of the employees who had remained with their employers had been explicitly accommodated, but that accommodations were made for only 14 percent of men and 25 percent of women who had changed employers.

Long term employment stability

On one other side, the important research by Butler, Johnson, and Baldwin (1995) has highlighted the need to go beyond describing the initial work absences of injured workers. In their study they found that for 61% of surveyed workers with permanent impairments an initial spell off work was followed by additional episodes of injury related unemployment. Similarly, Galizzi and Boden (2003) have estimated the probability that injured workers will be employed one year after they return to work and have found that the longer people take to return to work the less likely they are to remain employed one year after they returned. Women also have greater nonemployment after their first return to work – even after taking into account preinjury employment continuity and tenure. As far as the types of injuries are concerned, back injuries appear to decrease the long-term employability of workers. This evidence may suggest that, as in the case of displaced workers (Arulampalam et al. 2001), a period off work is perceived as a signal of low productivity or other undesirable employees' attributes: time off work is "scarring," affecting negatively both future wages and subsequent employment. But Abenheim et al. (1988) have also found that the rate of recurrence of occupational back pain was 36 percent at three years follow up and that the chance of recurrence was higher for men and younger workers. In Krause et al. (1999) 20% of low back pain claimants had experienced multiple episodes of temporary disability during the 1 to 3.5 years follow-up. Gotz, Liu, and Galizzi (2000) also found that workers who returned to work after a lost-time injury were more likely to have subsequent lost-time claims than others in their firms. In their study, 32 percent of the workers they studied had at least one more compensable lost-time claim during the following three years. The study by Campolieti (2001) follows only workers with temporary total disability over a shorter time period, 12 months, and finds that 14% of individuals had two or more claims.

This set of findings could be driven by the lack of proper accommodation or by employees returning to work before full recovery because of fear of losing their job or because of fear of stigmatization. In these cases, the lack of full recovery could increase their propensity to experience another episode of work related health problem. Indeed, in the more general context of studies regarding the frequency of grievance filing, some evidence has been found to support the hypothesis that employers exercise retribution against grievance filers (Lewin and Peterson, 1999).

Effect on income

Once we have established whether and when disabled workers continue to work or return to successful employment, we are led to ask about the magnitude of their economic losses. Several studies of income losses have been published based on statistical analyses of data on claims filed in various workers' compensation systems. All these studies measure losses by subtracting a measure of expected earnings from actual post-injury earnings. Expected earnings are usually estimated with the use of control groups of uninjured workers that match some of the characteristics of injured workers. Almost all studies to date have focused exclusively on injuries involving permanent disability benefits (Cheit 1961; Johnson, Cullinan, and Curington 1978; Ginnold 1979; Berkowitz and Burton 1987; Reville 1999). Among the 50 states, permanent partial disability claims comprise about one quarter of injuries involving time lost from work and typically involve three quarters of income benefit payments (Burton and Schmidle 1994). Still, many lost-time injuries fall outside the PPD category. Boden and Galizzi (1999, 2003) represent a study that estimates income losses both for permanent partial and temporary disability groups.5 In the more recent analysis (Boden and Galizzi, 2003) the same authors also find that women's losses are larger than men's. This is similar to the experience of displaced workers for whom studies have shown that displaced women with similar characteristics lose a greater proportion of preinjury earnings than do men (Ruhm 1987; Podgursky and Swaim 1987; Jacobson, LaLonde, and Sullivan 1993; Crossley, Jones, and Kuhn 1994). Both injury and displacement involve a period off work related to an exogenous event, both involve a loss of human capital and consequently in wages, and both present the possibility that employers will discriminate in decisions about reemployment.

Effect on wealth

But the economic consequences of a job-related injury or illness might not be fully captured by losses in labor earnings. For example, we know very little about the effect of injuries on workers' future ability to have jobs with good fringe benefits, and, more specifically, with health insurance. Also, some descriptive results (Galizzi, Boden, and Liu, 1998, Morse et al. 1998) indicate that some workers who use the workers' compensation system may eventually rely on different forms of government assistance. More generally, very little is known about the consequences of an injury on workers' wealth. While there is a correlation between labor income and wealth, the relationship is not very strong since there is a wide range of wealth values within particular income groups (Radner and Vaughan, 1987). This suggests that wealth represents a different dimension of financial well-being. Reduction in wealth is often a clear indicator that people are spending more than their income. Conversely, rising wealth occurs when people are saving extra income to deal with future uncertainties such as layoff, sickness and death. Two surveys of workers whose work-related injuries resulted in musculoskeletal disorders of the upper extremities present revealing numbers. After being injured up to one third of workers had to borrow money from friends and family or had been contacted by collection agencies (Keogh et al. 2000). These workers were also much more likely to lose their car or their home (Morse et al. 1998). Galizzi, Boden, and Liu (1998) found similar consequences among workers with injuries that required hospitalization or surgery, among workers who never retuned to work, and among those who returned to work for a different

5 Leigh et al. (1997) published a study that calculated lost earnings for workplace injuries in the US. However, they did not statically estimate lost earnings. Rather, the authors calculated income losses by assuming specific ratios between income benefit payments and losses. They assumed this ratio was 60% for temporary disability claims, 50% for permanent partial, and 40% for permanent total disability claims.

employer. Sullivan, Warren, and Westbrook (2000) show in a survey of debtors who filed for bankruptcy in five states (Illinois, Pennsylvania, Texas, California, and Tennessee) during 1991, about 15% of debtors explained that the reason for their bankruptcy had been a combination of medical problems and time lost from work. Although this percentage can not be further analyzed to quantify how often such a description referred to *a job-related* injury or illness, the qualitative evidence collected in the same study suggested that work-related health problems were the events most of those debtors were citing. A more recent 2001 survey by Himmelstein, Warren, Thorne, and Woolhandler (2005) shows that 35.3 % of families bankrupted by medical problems indicated at least one member had decreased their employment because of illness or injury. The impact of an injury or illness often extends throughout the family. More than half (52.8%) of the bankrupt families who decreased their employment did so to care for someone else.

Effect on the family's well-being

We have very limited knowledge about how a job-related injury may affect the worker's household. Family relationships may suffer not only because of economic losses, but also because of injured workers' limitations in performing their household work and their role as spouses and parents (Strunin and Boden 2002). Also, some household members may need to change their working status either to assist the injured workers or to integrate the family income. The very few related studies that examine these kinds of issues primarily address how wives respond to an adverse change in their husbands' health, and in most the results are mixed (Neslusan, 1996). Moreover, they rarely specifically address job-related health problems (Hensler et al.1991, Morse et al. 1998, Levenstein, 1999). What they show is the importance of the spouse or partner's gender, education and income, of the number of children, and of the health status of all household members. Finally, we have no knowledge about how the life of their children may be affected. Standard economic analysis has recognized the legitimacy of household economics by looking for example at parental investment in children's human capital. But relatively scarce evidence exists on how shifts in parental behavior may affect the creation and maintenance of such investment. There is some mixed evidence on the impact that changes in amount and quality of parental care (because of divorce, deaths or addictive behavior) may have on outcomes such as future income, health, or cognitive performance of children (Chatterrij and Markowitz, 2001, Lang and Zagorsky, 2001, Angrist and Johnson, 1998, Page and Huff Stevens, 2002). Menaghan et al. (2000) find a relationship between maternal unstable employment patterns on "oppositional" actions of adolescents. However, so far no research has shown how this type of analysis could be applied to the study of the potential human costs suffered by children of injured workers.

Specific Aims

This research project aimed to increase our knowledge about some hidden social and economic consequences of workplace injuries. The main hypothesis of the study was that such injuries cannot be studied as isolated events in workers' lives. Their consequences will largely depend on the individual's personal characteristics and preinjury labor market experience. These factors, together with employers' characteristics, behaviors and working conditions, will then determine the potential long-lasting economic effects of the injury. To test the above hypothesis the study had defined the following aims:

1. To estimate the effect of a job related injury or illness on individual's future employment: What are the main factors affecting the return to work, and more specifically, what is the role of

preinjury labor market experiences? How often do workers lose their jobs or leave their employers because of an injury? What is the likelihood of quitting, changing job, or being fired or laid off after the injury? Did this likelihood change after the implementation of the Americans with Disabilities Act? With respect to uninjured workers, do injured workers who return to work face more difficulties in holding a stable job?

2. To determine the factors that may explain recurrent episodes of work related injury and illness: Do they include the length of time off work experienced by workers after their previous incidents? Are they related to the likelihood of receiving certain types of job modification? Are they related to specific workers or employer characteristics?

3. To estimate the effect of a job related injury/illness on future earnings and on other economic consequences that are unaccounted for by changes in wages: Compared to uninjured workers, do injured workers experience a decline in earnings over time? Do workers lose also in terms of fringe benefits, and, more specifically, do they lose health insurance? Does the injury/illness increase the likelihood that individuals will participate in government assistance programs such as welfare or unemployment insurance?

4. To evaluate the effect of an injury on the families of injured workers: What is the effect on the working status of household members? Does a mother's injury affect in any way the well being of her children? Does it produce behavioral problems? Does it affect their school attendance or their likelihood of working?

5. To measure whether long term economic and social consequences of work-related injuries and illness vary among workers who receive or do not receive workers compensation benefits. Do the economic consequences vary also among workers who miss or do not miss days of work?

Procedures and Methodology

Given its aims, the research proposal needed to use data that permit examination of workers' lives over a long period, both before and after the injury. Such data also had to allow comparison with the work histories of employees who have not suffered on the job injuries. The "National Longitudinal Survey of Youth 1979" was the data set that was chosen to serve this purpose.

The data

The National Longitudinal Survey of Youth 1979 cohort (NLSY79) is a nationally representative panel survey sponsored by the Bureau of Labor Statistics, U.S. Department of Labor. The NLSY79 survey has questioned the same group of young baby boomers 19 times between 1979 and 2000 to provide an in-depth picture of this generation's work experience. Young baby boomers are individuals who were between the ages of 14 and 22 in 1979. The NLSY79 distinguishes between Non-black/non-Hispanic, Black, and Hispanic. The survey includes both a random nationally representative sample of 6,111 young men and women and a supplemental sample, of 5,295 Black, Hispanic, or economically disadvantaged non-Hispanic, Non-Black men and women. Until 1994 the survey was conducted on an annual basis, and after 1994 it was administered every other year. In 2000, these individuals were interviewed for the eighteenth time. For the 12,686 individuals who were interviewed in the original sample in 1979 the 2000 retention rate was exceptionally high: 83.2. A set of sampling weights is available for each year to permit estimates of how many individuals in the US each respondent represents.

The primary focus of the NLSY79 is to collect longitudinal information on labor force experience, labor market attachment, and investment in education and training. Each individual

is asked detailed questions on new experiences in these areas since the last time that he/she was interviewed. In addition, the survey also includes information on topics such as income and assets (the "wealth module"), health conditions, insurance coverage, household composition, participation in social programs, alcohol and substance abuse, marital and fertility histories, and spouses' labor market participation. Additional labor market information includes hours-worked, occupation, industry, benefits, and other job characteristics. It also includes high school transcripts and an aptitude indicator (the Armed Services Vocational Aptitude Battery) to measure knowledge and skills in areas such as arithmetic and language.

Since 1986 the survey started collecting information biannually about children born to female respondents. Such information is included in the separate *NLSY79 Children and Young Adult* data. Starting 1994, children 15 years and older completed another separate survey modeled on the standard NLSY79 questionnaire. Specific sections are dedicated to their schooling, work experiences, and relationships with their parents.

In 1988, respondents to the NLSY79 were asked for the first time: "First, during the past 12 month, have you had an incident at any job we previously discussed that resulted in an injury or illness to you?" In the following years, 1989-1988, the question became "Since [Date of last interview], have you had an incident at any job we previously discussed that resulted in an injury or illness to you?" These questions prompted to a sequence of additional questions that resemble quite closely records found in workers' compensation data (about the accident, the nature of the injury, the part of the body that was affected). In addition, workers reported the length of the time off work, whether they quit, changed job, were laid off or fired because of the injury/illness, and whether they had received workers' compensation benefits. From 1988 to 2000 a total of 3,280 individuals reported to have suffered at least one occupational injury or illness (see Table 1). This represent 25.86 % of the entire population surveyed during those years by the NLSY79 (n=12,686) and incidence rates at each survey range from a low of 3.24% (in 1994) to a high of 6.68% (in 1988) (Pergamit and Krishnamurty, 2006).

Table 1. Percent of subjects who reported job related injuries for different years.

Survey year	**Injury/Illness** (n=5185)
1988	849 (16.3 %)
1989	614 (11.8 %)
1990	620 (11.7 %)
1992	563 (10.8 %)
1993	449 (8.6 %)
1994	411 (7.9 %)
1996	610 (11.7%)
1998	563 (10.8%)
2000	506 (9.7%)

The theoretical framework

My analysis has drawn on the theoretical economic models developed to describe job search behaviors. In this context, injured workers have to decide whether or not to change their employment status after suffering a work related injury or illness. They make their decisions by comparing the discounted lifetime value of extra time off work with the value of additional earnings in different jobs. The key variables that will affect such comparison are: the wage

offers w_a that workers receive both from their preinjury employers and from alternate employers; additional job characteristics that affect the value of a job; the reservation wage w_r (the wage below which a person will not work); and the probability of arrival of alternative wage offers. The alternative wage, w_a, and the more general value associated with employment at different employers will depend on personal characteristics, job and firm characteristics. The reservation wage, w_r, will depend on personal characteristics but also on variables that reflect the worker's budget constraint, including family income, workers' compensation benefits received while not working, and possible other sources of government financial assistance. The arrival rate of alternative job offers is likely to depend on employees' pre-injury employment histories, their preinjury employment relationship with employers, their disability status, and local labor-market conditions.

In the case of work related injuries and illness, this underlying model differs somewhat from a standard job-search model because of the effects that an injury can have on the individual's reservation wage, w_r. While a period out of work typically decreases w_r, both because of the depletion of savings and because of the diminishing productivity of workers, an injury-related absence could also shift w_r upward, both because the injured workers receive income benefits and because they value more their time away from work during the healing period, either because working is more difficult and painful or to promote better healing. Presumably, the magnitude of this shift should decline over time as the worker recovers and as benefits are more likely to be terminated. Long-term disability could also reduce the value of additional income, the disutility of work, and the value of leisure activities, thus affecting w_r. Furthermore, an injury will increase uncertainty about the arrival rate of alternative job offers. If a worker incurs a long period of work loss or if an injury has caused a long-term decline in productivity, the pre-injury employer may decide to hire a replacement instead of re-employing the injured worker. This decision is going to be affected by the importance of the worker's role in the production process and by the amount of job-specific investment the employer had made on the worker before the injury. The employer may exercise considerable discretion in evaluating both the extent of productivity decline and the value of replacing the injured worker. Similar discretion allows the employer to place the returning worker in a lower-paying job or to bypass the injured worker when promotion opportunities arise.

Planned and actual research

Given this theoretical background, I have developed empirical analyses that have made use of both the cross-sectional and longitudinal nature of the NLSY79 data. Again, for the purpose of my study, this data set has offered unique advantages because it permits:

- to reconstruct in detail workers' longitudinal employment histories of workers before and after the injury;
- to explore information about the experience of family members of injured workers;
- to compare the experiences of three specific groups of employees: those who received workers' compensation claims, those who got injured but did not receive workers' compensation benefits, and those who were not injured

Given the scope of my study, the main limitation of the NLSY79 has been are the lack of information about the amount of workers' compensation benefits paid to the worker and about their health status. In all survey years workers are only asked whether their health status limits them in the kind and amount of work they can do. More detailed questions were asked only starting in 1992.

The sections below describe in detail the main results and empirical methodologies that were used to address the specific aims. The main deviations from the original proposed plan were caused by the difficulty I encountered over the last four years in hiring a graduate research assistant with the needed technical skills to clean and analyze the data. My department (the Department of Economics) has no graduate students and therefore, since the very beginning, I had planned to hire research assistants among the students of the UML Department of Work Environment. Indeed, I was able to hire some students but they all worked with me for no more than a semester given their needs to concentrate on their own PhD research topics. The NLSY79 has a tremendous richness of information but this creates great challenges for its analysis. It requires new researchers to commit a substantial initial investment of their time to organize the incredible number of observations and variables contained in the data. This learning process is very complex. It had to start again any time a new research assistant was hired and was lost when he/she left. I ended up being personally responsible for most of the data extraction, cleaning and manipulation I eventually used in my analyses. This obstacle dramatically diminished my ability to address all the research questions I had originally planned to study.

Results and Discussion

To understand the NLSY79 data I started studying some individual characteristics for respondents who reported a job-related injury or illness in any survey year from 1988 to 20006. Table 2 has three columns of data. The first column tracks everyone in the sample. The second column tracks those who were never hurt while the third tracks those who reported one or more injuries. The top section *Marital Status* shows that those who are hurt are more likely to have been in multiple marriage and divorces. The lines under the heading *Sex* shows that men are more likely than women to have been injured. The lines under *Race* show that the blacks and Hispanics are less likely to be injured than whites. The next section shows that people injured at work come disproportionately from individuals with relatively less education. Additionally in 2000 the typical respondent was almost 39 years old.

6 The tables 2 and 3 and figures 2 and 3 refers to all individuals who participated in more than half (> 6) of the NLSY79 surveys since a wealth module was first fielded in 1985.

Table 2. Demographics of NLSY79 Young Baby Boomers Sample as of 2000.

	Overall	*Never Hurt At Work*	*Ever Hurt At Work*
Marital Status			
Single	17.0%	17.0%	17.0%
Married Once	51.8%	54.4%	46.3%
Married & Divorced Once	11.0%	10.3%	12.3%
Multiple Marriage-Divorce	20.3%	18.3%	24.4%
Sex			
Male	49.6%	45.0%	59.1%
Female	50.4%	51.0%	40.9%
Race			
White	78.7%	77.8%	80.7%
Black	14.7%	15.6%	12.8%
Hispanic	6.6%	6.6%	6.6%
Highest Degree			
No Degree	8.7%	7.7%	10.7%
High School Diploma/GED	41.5%	37.8%	49.2%
Start College	17.0%	17.2%	16.6%
Associate Degree	8.0%	7.9%	8.2%
BA/BS	17.9%	21.0%	11.7%
Advanced Degree	6.9%	8.5%	3.6%
Avg. Age	38.7 yrs.	38.7 yrs.	38.6 yrs.
Number of Respondents	9,186	6,259	2,927

Table 3 shows that during this period one-third (32.5%) of all boomers were injured or became ill at work. Many of these injuries and illness were not minor since one-fifth (20.9%) of all boomers lost days of work because of the injury or illness and one-fifth (20.2%) filed a workers' compensation claim. It is important to note that filing a claim does not necessarily mean that benefits were paid. The next section of the table track the number of times workers lost wages because of the accident. Almost 12% of all boomers reported having lost wages at least once in their life, while among those injured over one-third lost wages. The following section of the table labeled "Times Injured" and "Times Ill" shows that the vast majority of problems are workplace injuries. The typical young baby boomer experiences relatively few (0.05) occupational illnesses but has roughly ten times as many on-the-job injuries (0.51). The "Weeks Worked" line tracks the amount of time from 1985 to 2000 the average boomer spent in the labor market. This line shows the typical boomer spent almost 12 out of the 15 years working, but those that were injured spent more time working than the overall respondent. The last line of table 2 shows that the average (mean) number of days lost before returning to work is over a month (37 days) of time. The median number of days lost (not shown) was 7 days. Moreover, the days lost figure is an underestimate because it does not include workers unable to ever return to the labor force and

it does not include workers who will return in the future but did not do so before being surveyed. Even if this extra time were included, workers who died on the job are not picked up, further downwardly biasing the calculation of days lost.7

Table 3. Labor Market Impact of Workplace Injury or Illness from 1985 to 2000.

	Overall	*Ever Hurt At Work*
Percent		
Ever Hurt At Work	32.5%	100%
Losing Work Days	20.9%	64.2%
Filing Work Comp	20.2%	62.3%
Lost Wages		
Never	88.3%	64.0%
Once	8.8%	27.2%
Twice	2.2%	6.7%
Three or More Times	0.7%	2.1%
Number of		
Times Injured	0.51	1.58
Times Ill	0.05	0.14
Weeks Worked 1985 to 2000	618	657
Days Lost Before Return		37

The further understand the phenomenon of occupational injuries described by the NLSY79 I created a year-by-year history for each respondent tracking if and when they were injured. Using this year-by-year history figure 2 shows that over time the NLSY79 is tracking fewer and fewer workplace incidents. In 1988 when the first workplace questions were added about 7.0% of all young baby boomers were injured. By 2000 the injury rate had fallen by more than half to 2.5% tracking the trend found in nationally recorded rates.

7 As of the 2000 interview 335 respondents have died. Unfortunately, the cause and place of death are not part of the NLSY79 data collection. Additionally, 3% of the cases who reported being out of work did not provide the number of missed days. In the cases where the time of work was censored (.05%) we imputed the value to be equal to the sample average.

Figure 2. Percent of Young Boomers Reporting a Work Injury or Illness by Year.

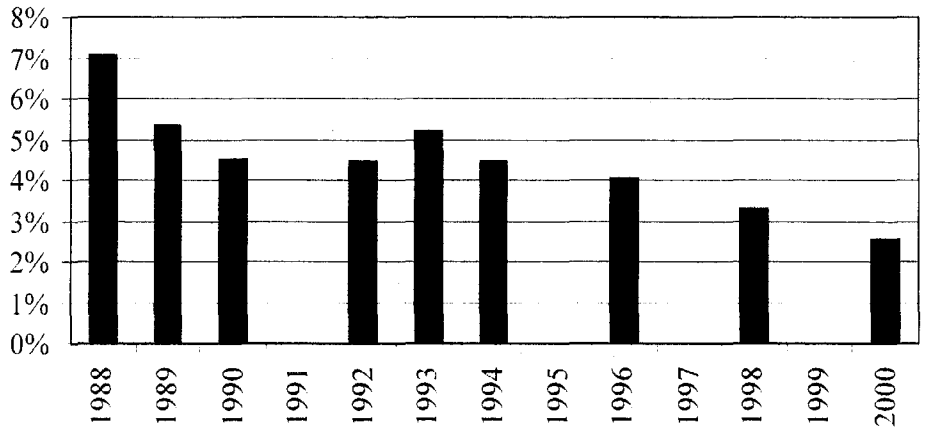
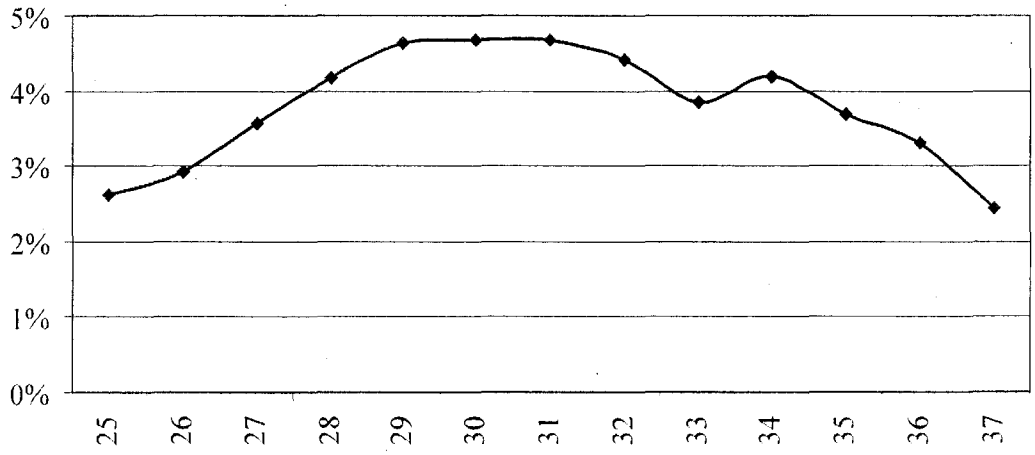


Figure 3, looks at the percentage of young baby boomers injured or ill in the workplace injury by age. This figure shows a rising, then declining incidence of illness and injury as baby boomers get older. At each year of age, between 2.5% and 5% of baby boomers are hurt in workplace accidents, with peak injuries occurring in the early 30s. As boomer's age and take on more senior level positions, which contain less risk, workplace injuries should continue to decline.

Figure 3. Percentage of Young Baby Boomers Experiencing a Workplace Injury by Age.



Specific Aim # 1 : ***To estimate the effect of a job related injury or illness on individual's future employment***

Despite the acknowledged importance of returning injured workers to productive employment, very little is known about employers' ability and willingness to rehire employees who have suffered a work related injury. Over time several states in the US have developed programs to provide employers with incentives to rehire injured workers. Such programs vary differently in their nature: they may consist in wage subsidies, in subsidies for tools, equipment, or redesign of

the work site, in exemptions from payments of workers' compensation premiums, and in financial penalties for unreasonably refusing to rehire an injured worker (Galizzi and Boden, 1996). Once again, we have so far very little evidence to evaluate such programs. At the same time we know that being able to return to the pre-injury-employer is one of the main determinants of the speed of return to work (Galizzi and Boden, 2003). However, most of the previous studies on this topic have been based on administrative data and therefore share the limitation of not permitting identification of the nature of job separations: whether they happened because of quits, layoffs, or firing.

Return to Pre Injury Employer: In the NLSY79 data injured workers were specifically asked about the employment outcomes of their on-the-job injury or illness. 6% of injured workers reported they had quitted their job; 3 % had been fired; and 7% had been laid off. I have studied their answers to estimate a multinomial Logit model where I have compared the likelihood of four mutually exclusive events: remaining with the preinjury employer ("no separation"), quitting, being laid-off, and being fired. Table 4 presents parameter estimates describing the effect of different regressors on the probability of experiencing one specific type of separation as opposed to remaining with the preinjury employer.

Table 4: Multinomial Logit Model for Type of Separation after an On-the-Job Injury or Illness

Selected Variables	**(1) To Quit vs. No Separation (n=4,429)**	**(2) To Be Laid Off vs. No Separation (n=4,429)**	**(3) To Be Fired vs. No Separation (n=4,429)**
Female	0.68 (0.20)	-0.14 (0.19)	-0.39 (0.27)
25<age<=30	-0.24 (0.36)	-0.48 (0.33)	-0.07(0.48)
30< age<=35	-0.22(0.43)	-0.11 (0.37)	0.49 (0.49)
35<age<=40	0.35 (0.55)	0.07 (0.45)	1.24 (0.59)
Age>40	0.46 (0.88)	1.12 (0.56)	1.81 (0.85)
Married	-0.09 (0.23)	0.05 (0.19)	-0.42 (0.26)
With children	-0.04 (0.10)	0.02 (0.07)	0.01 (0.11)
Black	0.45 (0.21)	0.78 (0.18)	0.88 (0.24)
Hispanic	0.51 (0.33)	0.40 (0.34)	0.20 (0.39)
Workers' compensation claim	-0.28 (0.20)	0.74(0.20)	0.12 (0.24)
Lost wages	1.17 (0.20)	2.08 (0.18)	2.06 (0.26)
Years with ADA	-0.04(0.28)	0.33 (0.24)	-0.22(0.32)
Accommodation	-0.14(0.22)	0.17(0.16)	0.32 (0.24)
Subsequent injury	-0.27(0.25)	-0.17(0.19)	-0.12 (0.26)
Log Likelihood	-1,704		

NOTE: A constant is included in each equation. Robust standard errors are in parentheses and they were derived from the Huber-White estimator of variance.

These results show that after an on-the-job accident:

- Women are more likely to quit the job

- Black workers are more likely to experience any kind of separation, but especially to get fired
- Older workers face higher probability of being laid off or fired.
- The filing of a workers' compensation claim increases the likelihood of being laid off by the preinjury employer.
- The loss of wages is also associated to higher likelihood of leaving the employer, possibly because such variable captures either a more severe incident or a more litigious claim.
- The receipt of accommodation, as well as the history of previous injuries, does not seem to play a role in the likelihood of leaving the employer.

Employment Accommodation: The Americans with Disabilities Act was signed into law in 1990 and became effective in July 1992. Such act requires employers to make reasonable accommodation to disabled workers and prohibits discrimination against disabled individuals in hiring, firing, and setting wages. Despite the general agreement about the advantages of returning injured workers to employment, we still know very little about the effect of the ADA and, more generally, about the factors that are related to the likelihood of receiving accommodation after a job related injury. The NLSY79 asks workers specific questions about the accommodation they were given after the job related incident: 12 percent of injured workers between 1988 and 2000 reported that they were assigned to another task on a temporary basis; almost 16 percent were given the possibility of returning to their regular job less than full time; and 29 percent could return to their regular job despite not being able to perform their normal duties.

To determine which factors affected the likelihood of receiving any of these types of accommodation, I have estimated a Logit model described in Table 5.

Table 5: Logistic Estimate of Probability of Receiving Employment Accommodation after an On-the-Job Injury or Illness

Selected Variables	**(1)** **(n=4,996)**	**(2)** **(n=4,429)**
Female	0.19 (0.07)	0.21 (0.08)
25<age<=30	-0.22 (0.14)	-0.20 (0.14)
30< age<=35	-0.24(0.16)	-0.22 (0.16)
35<age<=40	-0.07 (0.18)	-0.03 (0.20)
Age>40	-0.18 (0.26)	-0.25 (0.31)
Married		-0.03 (0.08)
With children		-0.01 (0.03)
Black		0.17 (0.09)
Hispanic		-0.02(0.15)
Workers' compensation claim	0.45 (0.07)	0.38 (0.07)
Lost wages		0.49(0.08)
Years with ADA	0.39 (0.11)	0.40(0.10)
Subsequent injury	0.03 (0.07)	0.05 (0.08)
Log Likelihood	-3,271	-2,859

NOTE: A constant is included in each equation. Robust standard errors are in parentheses and they were derived from the Huber-White estimator of variance.

The results presented in table 5 suggest that:

- Women seem more likely to receive some type of employment accommodation after a job related injury or illness
- The likelihood of receiving accommodation increased substantially as of 1993, the first full year during which the ADA came into effect
- Workers for whom a workers' compensation was filed were also more likely to receive accommodation.
- Workers who claimed to have lost wages because of the injury were also more likely to receive accommodations, possibly because the loss of wages could indicate the higher severity of the incident.
- Employers seem to be willing to provide accommodation regardless of previous histories of on-the-job injuries.

Changes in career patterns: Without rich information about the employment history of individuals, it is quite difficult to state whether an on-the-job injury has long-lasting consequences for workers. In theory, an injury could be a very disruptive event if the disability or the development of a newly litigious relationship between employers and employee, affects what originally was a successful job match. Then, the rewards of previous investment in on-the-job training or of expected career advancements could be lost. At the same time, the event of the incident could represent an excuse for both parties to terminate what was not a successful employment relationship. After all, in the case of unemployed workers, some evidence has suggested that the reemployment process may provide employers with a new opportunity to discriminate without being easily detected (Mavromaras and Rudolph, 1997). And young workers have been found to change jobs both by moving across sector and occupations in search for the right "career match" (Neal, 1999).

Table 6 presents the estimation of a Logit model where the dependent variable captures weather injured workers reported that they ended up changing occupation after the incident. 7% of injured workers had reported such a change. In their answer, workers did not differentiate between a change in occupation within the preinjury firm and a change in occupation in a new firm or sector. 7% of injured workers had reported such a change.

The results indicate that:

- Workers who received job accommodation after the injury were more likely to change occupation
- Workers who field a workers' compensation claim or lost wages were also more likely to change occupation. Again, these variables could possibly capture the higher severity of the incident.
- As expected, all types of separation were strongly associated with changes in occupation and this seems particularly true for the workers who voluntarily left their employers.

I presented these set of finding at the Eastern Economic Association Annual Conference (Washington, D.C., February 2004). I am planning to further test them after exploiting additional variables included in the data about the occupation, employer, and the time off work as a potential proxy of injury severity. These findings also need to be assessed by utilizing different estimation methodologies (such as difference in differences probit models) that should permit to rule out the possibility that these injured workers are somehow individuals who would have had

a weaker attachment to their employer regardless of the injury. Once I have completed this analysis I am planning to submit a paper based on this set of results to *Industrial Relation.*

Table 6: Logistic Estimate of Probability of Changing Occupation after an On-the-Job Injury or Illness

Selected Variables	**(1)** **(n=4,976)**	**(2)** **(n=4,415)**
Female	0.08 (0.14)	0.06 (0.17)
25<age<=30	-0.21(0.31)	0.06 (0.37)
30< age<=35	0.07(0.32)	0.23 (0.40)
35<age<=40	0.51 (0.37)	0.87 (0.46)
Age>40	0.31 (0.51)	0.58 (0.64)
Married		0.02 (0.19)
With children		-0.09 (0.07)
Black		0.15 (0.19)
Hispanic		0.63 (0.33)
Workers' compensation claim	0.52 (0.15)	0.38 (0.18)
Lost wages		0.55(0.19)
Years with ADA	0.28 (0.19)	0.17(0.26)
Accommodation		0.74 (0.17)
Quit		3.35 (0.24)
Laid-off		2.21 (8.56)
Fired		2.98 (0.28)
Subsequent injury	-0.05 (0.14)	-0.08 (0.17)
Log Likelihood	-1,173	-728

NOTE: A constant is included in each equation. Robust standard errors are in parentheses and they were derived from the Huber-White estimator of variance.

Return to Work: I had originally planned to estimate a model of the probability of returning to work. Given my understanding of the NLSY79 data I have considered three different measures of time to return to work:
- the time workers declared to have been out off work because of the injury;
- the time between the injury and the week when the NLSY79 data show a new employment record for injured workers (a variable, however, that will be sensitive to the decision regarding how many hours per week represent a legitimate return to work. This choice should account for the number of weekly hours individuals were working before getting injured);
- a time that may be correctly labeled as leading to a "successful" return to work: if workers go back to work, but then are off again after few days, should this count as return to work? The NLSY79 data provide the opportunity to so something quite new: calculate the time from the injury until the point of time when workers start being continuously employed for x days. Here x could be: (a) the average length of spells of continuous employment they had experienced before getting injured, or, for example, during the year preceding the injury; (b) the average spell of continuous employment that similar workers have had around that time.

The construction of all these different measures of return to work, however, has been very problematic and time consuming. This has been one area where my difficulty in recruiting a

valid graduate research assistant with the needed technical skills has not permitted me to make progresses on this topic.

Specific Aim # 2 : ***To determine the factors that may explain recurrent episodes of work related injury and illness.***

Table 7 ranks all NLSY79 surveyed workers according to the number of occupational injuries and illness they suffered between 1988 and 2000: 1,255 individuals, or 37% of all workers who had experienced one on-the-job accident reported additional injuries, a percentage consistent with what found in the previous studies reviewed above8.

Table 7. Percent of subjects with multiple occupational injuries (1988-2000).

Number of injuries	**Individuals** (n=12,686)
0	9,406 (74.14 %)
1	2,055 (16.20 %)
2	782 (6.16 %)
3	284 (2.24 %)
4	107 (0.84 %)
5	32 (0.25 %)
6	15 (0.12%)
7	4 (0.03%)
8	1 (0.01%)

Compared to other data sources that were limited to workers who had experienced at least one work related problem, the NLSY79 covers also workers who never experienced an injury; and for those who did, it allows identification of the first episode. Therefore the data permits to study the factors that may explain recurrent episodes of work related injury and illness through a regression model where the dependent variables is the expected number of injuries or illness C for individual i . This is a situation, however, where the dependent variable, the count of injury, assumes predominantly the value of zero and where its value is bounded from below by zero. Under these conditions the preferable estimation technique is the Poisson regression model. Such model assumes that every dependent variable y_i is drawn form a Poisson distribution with parameter λ_i (the rate of event occurrence) and which is related to the regressors $\mathbf{x}_i$. The values of a Poisson random variable are non negative integers and so the distribution is well suited for modeling injuries counts.

In the Poisson regression model the expected number of events (here injuries or illnesses) per period is given by

$$C_i = E[y_i \mid \mathbf{x}_i] / Z_i = \lambda_i = \exp [\ln (Z_i) + X_i \beta]$$

In my model Z indicates "exposure", the time interval (calculated in term of weeks) during which each person was working between the survey year 1987 and 2000. X_i represents the explanatory variables. These will include information about individual and occupational

8 In this table the calculations are produced using unweighted data and the percentages are calculated out of the total number of cases with "injuries and illnesses" for with no missing values for the characteristics used in the following regressions.

characteristics up to 1987, the first year for which a large number of respondents to NLSY79 got injured on the job9. In 1987 respondents' age ranged between 22 and 31 years.
Poisson regression models, however, are based on the implicit assumption that the variance of y_i is equal to its mean: $E[y_i \mid \mathbf{x}_i] = Var[y_i \mid \mathbf{x}_i]$. If this condition does not hold either because the events are correlated or because the event rate λ_i is heterogeneous, we run into a condition called "overdispersion". Then, the expected number of injuries is better described by a negative binomial model through the following equation:
$C_i^* = E[y_i \mid \mathbf{x}_i] / Z = \lambda_i = \exp[\ln(Z_i) + X_i \beta + u_i]$
where u_i is an omitted variable capturing heterogeneity. It is usually assumed that e^u follows a gamma distribution.
In my analysis I first estimated Poisson regression models but then conducted a likelihood ratio test to test whether the overdispersion parameter was equal zero (Greene, 2003). This test rejects the hypothesis that the process I describe follows a Poisson distribution. Therefore, I am here mainly presenting the regressions based on the Negative Binomial model. In addition, to be able to compare only individuals for whom I have all the available information about potential occupational injuries, I have limited my analysis to the subset of 6,855 individuals who participated to all survey rounds from 1988 until 2000. Among this subgroup, 19.6% (n=1,342) had experienced only one occupational accident while 13.3% (n= 913) reported two or more occupational injuries or illnesses during the surveyed years.

Demographic characteristics: NLSY79 respondents were first asked about their experience with on-the-job injuries in 1988. I started the exam of the determinants of the total count of injuries reported by individual between 1988 and 2000 by looking at the role played by demographic characteristics measured at that 1988 survey round.
Model 1 of table 8 shows that multiple injuries are more likely to be found among male and white (more precisely "non Black and non Hispanic") workers. In addition they are much more frequent among respondents who resided in the western region of the US. Age does not play a large role in my estimates and this is not surprising given that our sample is composed by very young individuals who were very similar in age. It becomes however immediately clear that human capital accumulation - in terms of formal schooling- is one of the main individual attributes that can shelter workers from injuries, either because it produces better skills or because it increases their ability to qualify for safer jobs. The survey permits me, however, to assess also the role played by an additional variable: whether individuals had ever experienced health problems that had prevented them from work or had limited the amount and kind of work they could perform in the years preceding the first reported occupational injury. This is a very important variable because in the calculation of workers' compensation benefits it is often debated to what extent employers should compensate for injuries that may have been caused by pre-existing non work related health conditions. The NLSY79 survey data seem to indicate that, indeed, the existence of pre-existing health conditions plays a very large role in causing multiple occupational injuries.

9 In 1988, 854 respondents answered to have experienced an occupational injury or illness, but for 245 (29%) individuals the injury had happened in 1987 and for 10 individuals (1%) in previous years starting 1977.

Table 8: Negative binomial regression models (dependent variables: count of occupational injuries or illnesses reported between survey rounds 1988 and 2000)

	Model 1		Model 2		Model 3		Model 4	
	Coef.	**S.E.**	**Coef.**	**S.E.**	**Coef.**	**S.E.**	**Coef.**	**S.E.**
Female	-0.34***	0.05	-0.28***	0.06	-0.04	0.07	0.01	0.08
Black	0.11*	0.08	0.05	0.09	0.02	0.09	-0.02	0.10
White	0.15**	0.07	0.16**	0.07	0.13**	0.07	0.12*	0.08
Age	-0.01	0.01	-0.01	0.01	0.01	0.01	0.01	0.01
Education: High Sch.	-0.19***	0.07	-0.13*	0.08	-0.06	0.09	-0.02	0.09
College	-0.77***	0.08	-0.65***	0.09	-0.40***	0.10	-0.35***	0.11
Post col.	-1.11***	0.16	-1.16***	0.18	-0.75***	0.19	-0.65***	0.22
Region of residence: North Central	0.08	0.08	0.02	0.09	-0.01	0.09	-0.06	0.09
South	0.03	0.08	0.01	0.08	-0.06	0.09	-0.11	0.09
West	0.39***	0.08	0.33***	0.09	0.31***	0.09	0.24***	0.10
Pre88: Health prob.	0.44***	0.06	0.40***	0.06	0.40***	0.07	0.40***	0.08
in poverty			0.18***	0.06	0.14***	0.06	0.08	0.07
dangerous/ unhealth.job			0.38***	0.06	0.29***	0.06	0.26***	0.07
Tot wks. of Work exp.			- 0.01***	0.01	- 0.01***	0.01	- 0.01**	0.01
Occupation: Tech./adm. Support					0.11	0.11	0.14	0.12
Service					0.52***	0.11	0.51***	0.12
Agric., or other					0.36*	0.23	0.39*	0.25
Skilled blue Collar					0.76***	0.11	0.79***	0.12
Unskilled blue collar					0.70***	0.11	0.74***	0.12
Industry dummies					Yes			
Tenure							- 0.01**	0.01
Ln (hourly wage)							-0.11*	0.07
Weekly Hrs							0.01**	0.01
Observations	6,689		5,381		4,870		3,901	

NOTE: Regressions account for sampling weight. Omitted reference variables include: males, Hispanic, less than high school education, Northeast region, managerial and professional occupation. * means significant at 90%, ** significant at 95%, *** significant at 99% level.

Preinjury economic and work experiences: During each survey round workers are asked about their different sources and level of income. Their answers are used to determine whether their family lives above the official corresponding poverty line. I exploited this information for all the years preceding 1987 to calculate a variable capturing whether respondent ever lived in poverty during that period. From 1979 and 1982 respondents were also asked whether they were employed in jobs that were dangerous or unhealthy. Given the very young age of individuals during these first interviews rounds, their answers apply to some of their very first jobs.
Model 2 in table 8 exploits these pieces of information. It is interesting to observe that young individuals who reported economic hardship before reporting the first injury, or who were exposed at very young age to unsafe jobs ended up reporting a larger number of multiple injures during the first 20 years of their working life. These findings suggest the existence of a strong negative relationship between the socio economic status of young workers and their future risk of continuous exposure to dangerous jobs. The model also shows, however, that this risk is reduced by the accumulation of labor market experience.

Job characteristics: I looked then at the main jobs held by respondents in correspondence of the 1988 survey. For the injured workers I selected the characteristics of the job where they suffered the accident in either 1988 or 1987. Model 3 in table 7 accounts first for the type of occupation and the three digit industrial sector where individuals were employed. The possibility of controlling for this job attributes makes disappear any gender difference, suggesting that both male and female face the same risk of multiple injuries when employed on the same job and in the same industry. In addition we learn that both blue collar workers and service workers are characterized by higher injury incidence rates. Finally Model 4 in table 7 gives us additional insights about workers' and jobs' attributes that may determine higher injury rates over a lifetime: higher tenure and better hourly pay lower the risk of multiple injuries. This suggests that safety complements higher pay and is not traded with compensating wage differentials. Workers who work longer hours, however, are at risk of higher incidence rates over their working life. This may indicate a relationship between fatigue and the accumulation of injuries or illnesses. Indeed, my preliminary descriptive findings had shown that in the NLSY79 the number of hours worked was higher in the month preceding the injury than one year before the injury and during the month of the injury.

Exposure: The models described in table 8 accounted implicitly for the level of exposure, ln (Z_i). Z_i was measured in terms of the total number of weeks during which each person was working between the survey years 1987 and 2000. The models in table 9 reproduce model 2 of table 8 by explicitly estimating the expected positive and significant effect that the length of exposure has on individual incident counts.
Table 9 also compares the preferred model Negative Binomial model with both the Poisson model and an Ordinary Logit model (that could also be used to estimate the likelihood of observing the ordinal increasing dependent variable, the injury count). The main results I discussed above remain consistent across all models specifications.

Table 9: Alternative models for estimating individual injuries counts (dependent variable: count of occupational injuries or illnesses reported between survey rounds 1988 and 2000)

	Negative Binomial		Poisson		Ordinary Logit (max count=8)	
	Coef.	**S.E.**	**Coef.**	**S.E.**	**Coef.**	**S.E.**
Female	-0.31***	0.06	-0.33***	0.06	-0.38***	0.07
Black	0.03	0.09	0.01	0.09	-0.10	0.11
White	0.15**	0.07	0.17***	0.07	0.15*	0.09
Age	-0.01	0.01	-0.01	0.01	-0.01	0.02
Education: High Sch.	-0.10	0.08	-0.07	0.08	-0.18**	0.11
College	-0.60***	0.09	-0.58***	0.09	-0.81***	0.11
Post col.	-1.08***	0.18	-1.10***	0.18	-1.25***	0.19
Region of residence: North Central	0.02	0.09	0.02	0.09	0.04	0.11
South	- 0.00	0.08	-0.02	0.08	0.06	0.10
West	0.32***	0.09	0.29***	0.09	0.44***	0.11
Pre88: health prob.	0.37***	0.06	0.35***	0.07	0.43***	0.09
in poverty	0.18***	0.06	0.17***	0.06	0.24***	0.08
dangerous/ unhealth.job	0.38***	0.06	0.36***	0.06	0.45***	0.07
Tot wks. of Work exp.	- 0.01**	0.00	- 0.01*	0.00	- 0.01*	0.00
Ln(Exposure)	0.69***	0.07	0.63***	0.07	0.74***	0.09
Observations	5,381					

NOTES: Regressions account for sampling weight. Omitted reference variables include: males, Hispanic, less than high school education, Northeast region. Exposure is calculated in terms of the total number of weeks during which each individual was employed between the 1987 and the 2000 survey rounds. * means significant at 90%, ** significant at 95%, *** significant at 99% level.

Specific Aim # 3: ***To estimate the effect of a job related injury/illness on future earnings and on other economic consequences that are unaccounted for by changes in wages***

My original plan was to estimate a pre and post injury wage change model. Early in the project, however, I had the opportunity of discussing my research plan with Dr. Jay Zagorsky of the Center for Human Resources Research, Ohio State University (the agency in charge of the NLSY79). Besides being one on the main supervisors of the NLS data, Dr. Zagorsky's research has concentrated on studies of workers' wealth accumulation. So far workers' compensation research has focused on the effect of work related injuries on labor income and has neglected the effect of injury and illness on wealth. Wealth is very important to understand, however, because the amount of wealth shows how much of a financial cushion is available to deal with future uncertainties such as layoffs and sicknesses. Wealth is also correlated with a person's economic and psychological well being.

Dr. Zagorsky and I have collaborated on the study of this wealth effect and of some additional topics reported in this section for Aim #3. This collaboration has resulted in a paper titled "How do on the job injuries and illness impact wealth?" This paper has already been resubmitted with revision to *Labour Economics*. I have also presented different stages of this research at several professional meetings: the Annual Fall Meeting of the Workers' Compensation Research Group (Boston, November 2004), the Annual Conference of the Eastern Economic Association (New York, March 2005), the EALE/SOLE Joint Conference (the most important world conference for labor economists, San Francisco, June 2005), and the NIOSH National Occupational Research Agenda (NORA) Symposium 2006: Research Makes a Difference (April, 2006).

Wealth: Different scenarios may lead injured workers into further wealth losses or consumption decreases. For example, a sudden decrease in earnings could cause households that do not usually rely on credit to begin borrowing money. This need for new sources of financial support happens when workers' compensation benefits are inadequate or because of delays in receiving disability benefit checks. A loss of family income, caused by another family member dropping out of the labor force to assist the injured worker, has the same effect.

If the worker's household were already borrowing before the injury to maintain their lifestyle, the loss of income may make it impossible to repay their previous debts and may plunge them further into debt because of the accumulation of interest and penalties.

Injuries can also lead to an increase in living costs, because of extra medical bills and attendant care. Surveys of injured workers have often indicated that workers' compensation benefits do not cover all the medical expenses associated with an injury and that a portion of such expenses falls on individuals and their families (Keogh et al., 2000, Galizzi, Boden, and Liu, 1998). Workers may also be responsible for their medical bills if, for whatever reason, they fail to file a workers' compensation claim. Combining these situations with the 20 percent of a sample of debtors reporting medical reasons as the main cause of their bankruptcy (Sullivan, Warren and Westbrook, 2000) means a reasonable hypothesis is that unpaid or extra medical bills will impact an injured workers' wealth.

Another reason why wealth might fall after an injury is that some workers are compensated with a lump sum payment as a result of compromised workers' compensation claims. If these workers overestimate the amount of their payment they will overspend and reduce their wealth.

For all the above reasons when a worker is injured there is a high likelihood their wealth will diminish and their consumption will fall.

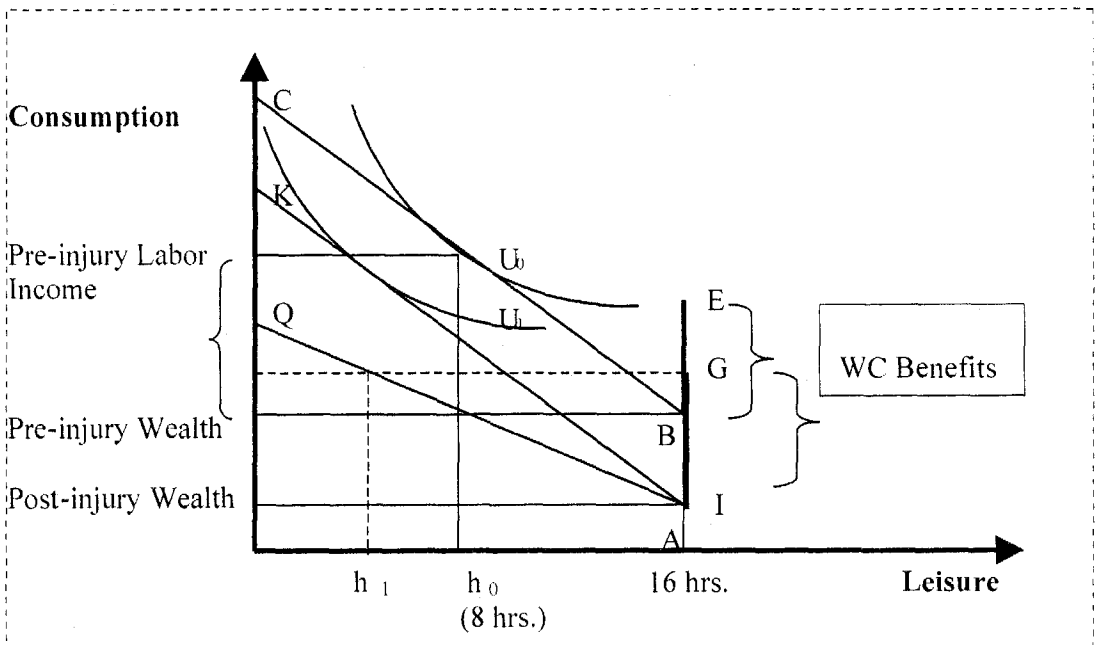
Figure 4 captures these changes graphically by describing the work-related decisions made by an individual *i* who has time off work because of a temporary disability. The individual maximizes the following utility function:

$U_i = U_i(C, L)$

where C stands for consumption and L indicates leisure. Consumption is a function of wages (w), hours of work (h) and wealth (V) so that $C = w \times h + V$.

In this context, line ABC describes the original budget constraint that has led the worker to chose to work h_0 hours a day before the occupational injury; line EBC describes the new budget constraint faced by the worker when he receives income replacement benefits, EB, equal to two thirds of the pre-injury labor earnings as long as he is considered temporarily disabled and unable to return to work;10 finally, line GIK describes the budget constraint faced by the worker who also suffer a wealth loss because of the injury. Under both scenarios, the injury leads to a loss of consumption.

Figure 4. Graphical Model of an Injury Wealth Effect



ABC: Original budget constraint
EBC: After injury with benefits = 2/3 wages
GIK: After injury with benefits = 2/3 wages plus wealth losses

10 In the case of a partial disability that is permanent, the worker could continue receiving income benefits even after his return to employment. In this case benefits are calculated as a function of preinjury income, type of injury and severity of injury.

Figure 4 gives some insight about the possible consequences of wealth losses. First, to compensate for lost income and to return to the preinjury level of consumption, the worker may return to work at more hours or look for a second job, which would reduce leisure to h_1 hours. Also, increased financial needs may lower the worker's reservation wage and induce him to return to a lower paying job along the new budget constraint GIQ. This leads to a reduction in household labor income and possibly produces further need for credit and a reduction in wealth.
Furthermore, for most workers safety is a normal good characterized both by positive income elasticity and wealth elasticity (Hamermesh, 1999, Evans and Viscusi, 1993, Shanmugam, 1997). This means when income and wealth fall workers are more likely to return to more dangerous jobs, where they face an increasing probability of further injuries. If another injury occurs this would trigger another round of income and wealth losses.
There is the possibility for some workers that injuries may not lead to wealth changes. For example, workers and their family might respond to income losses or delays in benefit payments by simply diminishing their consumption of non-essential items. There is also the possibility that wealth could even increase. Workers who experience an injury and subsequent financial losses could change their behavior and become more likely to accumulate precautionary savings and investments so they are better prepared for future uncertainties.
Finally, wealth might increase if a worker is successfully able to sue a third party whose negligence caused the injury or illness. For example, if a worker is injured because of a faulty machine, a lawsuit could be brought against the machine's manufacturer. This path to increased wealth is very rare, however, because the workers' compensation system is designed as a no-fault program.
This study investigates these alternative hypotheses by estimating the magnitude of potential losses by comparing the change in wealth experienced by injured workers to the change experienced by similar uninjured employees over the same period of time. Not all NLSY79 respondents are used in this phase of my research. To ensure that the precise effects of injuries on wealth are examined, a simple sample selection criterion was used. All individuals used in this research needed to participate in more than half (> 6) of the NLSY79 surveys since a wealth module was first fielded in 1985. This criterion ensures a detailed history for every respondent. The key variable used in this research is net worth. Net worth was computed from the wealth questionnaire, which was first added to the NLSY79 in 1985, when the youngest respondent was 20 years old. Each wealth module follows the same simple pattern. Respondents are first asked if they currently own an asset or have a debt. If they answer yes, the interviewer asks them to state its current market value as of the interview date.[11] All missing values were then imputed.[12] While many imputation algorithms are available, the longitudinal aspect of the NLSY79 data provides a simple but effective solution. Data were linearly interpolated if bracketing values were available. This algorithm is a slight refinement to the procedure used in the Netherlands Socio-Economic Panel (Camphuis, 1993) and is based on the assumption that wealth changes are primarily low-frequency trend movements. This imputation choice causes

11 Four breaks occur in the wealth time series, one in 1991 and the others in 1995, 1997 and 1999. Budgetary restrictions resulted in all wealth questions being eliminated in 1991 for one round of questioning. There are no data for 1995, 1997 and 1999 since the NLSY79 switched from interviewing respondents every year to every other year in 1994 to lower the survey's cost and reduce respondent burden.
12 First, all valid skip codes (-4) were found in the data. Valid skips mean the respondent does not own the asset. These items were given a value of zero. This step ensures that individuals with no wealth have zero assets. Then, all other problem codes, marking invalid skips, refusals, don't knows and out-of-range, were flagged as candidates for the imputation algorithm.

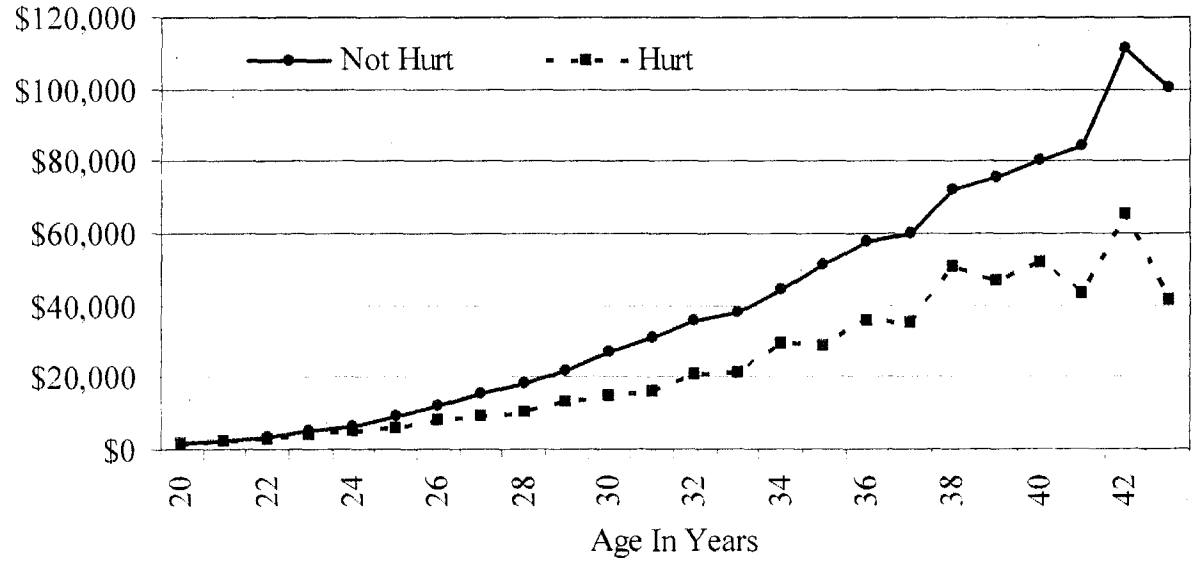
some data smoothing because of the interpolation. However, no matter what algorithm is chosen, the high response rates of the survey mean little imputation was needed. The complete details of constructing the computed net worth series are described in Zagorsky (1999). The net worth variable, described in the below equation, was then created for each survey year by first summing for each respondent all the asset answers and then subtracting from that total all debt answers.

Net Worth = Home Value - Mortgage - Property Debt + Cash Saving + Stock + Trusts + Business/Farm/RE Equity – Business/Farm/RE Debt + Car Value - Car Debt + Possessions - Other Debt + IRA + 401K + CD.

Wealth data were also adjusted to account for inflation so that all amounts are in 2000 dollars. These steps eliminate most of the problems in the NLSY79 raw data and provide a data set capable of making long-term comparisons over time. The final step was to change all NLSY79 wealth data from a survey-specific format into an age-specific format. Raw NLSY79 data are publicly released and grouped by survey year. This grouping implicitly treats all individuals in a survey similarly. While the NLSY79 cohort covers only a seven year age range, Figure 3 has shown that seven years is a particularly large time span when looking at on-the-job injuries. To fix this problem, instead of grouping people by survey year, all variables were reordered by the age of a respondent. This means that at a specific age, say 25 years old, the wealth, injury and demographic data were extracted from a number of different NLSY79 surveys.

Graphing the transformed injury and net worth data clearly shows large differences over the life-cycle. Figure 5 tracks median net worth both for respondents who reported never being injured at work and for those who ever reported being injured. On average the typical boomer who was never hurt has 1.6 times the net worth of someone who was hurt at least once.

Figure 5. Median Net Worth of Young Baby Boomers by Age and Incident Status



While figure 5 provides a simple method of showing that wealth differs by incident status, the figure could be misleading. Figure 5 tracks wealth solely based on injury status and implicitly

may simply reflect differences between the wealth of individuals in high-paying safe white-collar jobs and the wealth held by individuals in lower-paying riskier blue-collar jobs. A clearer way to investigate the precise effects of occupational injuries on wealth is to use regression analysis which tracks wealth changes while controlling for a larger variety of factors.

Our regressions estimate the impact on the natural log of net worth by using the equation below. The equation states that the natural log of net worth is a function, f( ), of injury factors and demographic factors for three different status groups: never injured, injured once and injured multiple times. These three groups are demarcated in the equation by the far right hand term found after the "|", or given symbol.

Ln (Net Worth) = f (Injury Factors, Demographic Factors | Status).

To reduce the impact of extremely rich individuals, wealth was measured as the natural log of net worth. This reduces the influence of outlying wealth values. Since the natural log of negative numbers is not defined, the Kennickell-Woodburn (1999) wealth transformation, which is the sign(x) * ln (abs(x)), was used for all values.13 Finally, a simple equivalence scale was used. In each year the wealth of individuals reporting being married was divided in half. In years when individuals were not married their wealth was not changed. Since the NLSY79 tracks the wealth held by both husband and wife, this operation adjusted for married couples' higher wealth values. Tests show that using or not using this equivalence scale has little impact on the qualitative results.

The regressions in this section contain a variety of injury factors14: ever hurt, hurt 1st time, hurt 2nd time, the number of times injuries or illnesses resulted in lost wages, the number of spells off work, as well as the specific number of "scheduled days" missed because of the injury.

Variables were constructed to capture the potential long-term effect of injuries. Once a worker has reported an on-the-job injury or illness in a particular survey year, the "Hurt 1st Time" flag becomes true for all following ages. Similarly, the "Hurt 2nd Time" flag is true for all ages once the worker reported another injury.15

Unlike the hurt flags, which once they become true stay true, the "Times Lost Wages" variable varies over time. This variable is based on the individual's perceptions and is not based on payroll or tax records.16 The lost wages variable is zero for all ages until the point where the respondent states they first lost wages because of being injured. From that age onward the variable is a counter, which increments each time the respondent reports losing wages due to an injury. The "Times Lost Days" variable, which counts the number of spells off work because of an injury, is also time-varying and was similarly constructed.

The demographic variables used in the regressions control for key demographic and occupational factors: age, female, black, Hispanic, highest school grade completed, married, income, self-employment, nine occupational categories and nine industry categories computed separately for

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13 The sign ( ) preserves the positive or negative sign that is removed by the absolute value or abs ( ) transformation.

14 The NLSY79 User Guide (Zagorsky 1997) suggests not to use weights in regression analysis, however, but instead use dummy variables for the black and Hispanic oversamples. In our analysis of wealth losses we follow this suggestion.

15 The "Hurt 1st time" and "Hurt 2nd time" variables were designed to capture the potential permanent effect of injuries on wealth. The models presented in tables 10 and 11 were rerun using variables which marked only ages when an individual was injured, but the results were similar.

16 Individuals were asked "Did you lose any wages because of the illness/injury?" It is important to note that the questions used to create net worth are asked in a later separate survey section.

each age that data are available.17 Except for age, highest grade and income, the remaining variables are Boolean flags which are true if the condition holds at a particular age and false otherwise. Highest grade is the highest amount of schooling the respondent completed at a particular age. The income variable is the natural log of the family's total income over the past calendar year, and is logged to reduce the impact of outliers on the results.

The first regressions run were ordinary least square (OLS) regressions, with the left-hand-side variable being the natural log of net worth. Because the left-hand-side variable is logged all regression coefficients are interpreted as percentages.

Previously, figure 5 showed that individuals who have ever been injured at work have much lower wealth than those who have never been hurt. Table 10's first column uses an OLS regression to estimate the exact impact and shows that injured workers have thirty-eight percent less wealth than non-injured individuals. When demographic and occupational characteristics are controlled, the impact rises (table 10, column 2) to a forty-four percent reduction in wealth.

Column 3 of the table replaces the "Ever Hurt" variable with variables that track injury status at different points of time. This column shows that being hurt once ("Hurt 1st Time") lowers net worth by twenty-two percent in the injury year and in the following years. However, the low magnitude (-0.02) and the statistical insignificance on the "Hurt 2nd Time" variable shows additional injuries do not impact wealth. The large and statistically significant coefficient on the "Times Lost Wages" variable shows that each time a respondent loses earnings due to a job-related injury their wealth is reduced by more than half.

The total impact of injuries on wealth is much larger than either the -0.51 on the "Times Lost Wages" or the -0.22 on "Hurt 1st Time." The total impact is calculated by first multiplying the number of times a respondent lost wages by the negative 51% coefficient. Then the coefficient on hurt the first time is added to the total. For example, the cumulative impact of being injured once and also losing wages once because of that injury is a 73% drop in net worth.

Some concerns could arise given the self reported nature of the "Lost Wages" variable. Such variable could reflect perception and not actual reduction of income. We recall, however, the growing body of literature that has shown the dramatic negative effect of injuries on income. In addition, we need use the self reported answer because the family income variable included in our regressions is not a good measure to capture potential variations in individual earnings. It is a yearly measure that includes also spousal income, and income from additional sources such as dividends, interests, welfare payments and self-employment18.

While the third column's regression is our preferred specification, columns (4) and (5) test two additional models. In column (4) the lost income variable is replaced with a counter called "Times Lost Days." This counter tracks the number of times all injuries resulted in missed spells of work.19 This regression shows each spell of missed employment reduced net worth by 15%. Column (5) uses a counter labeled "Number Missed Days" which tracks the number of days reported lost. The coefficient on this new variable shows the number of missed workdays does

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17 Occupational classifications are managerial, technical, administrative, service, farming, precision production occupations, and operators. Industrial classifications are agriculture, construction, manufacturing, transportation, trade, FIRE, services, and public administration. The omitted occupational and industry dummies are for individuals who were not working at the time they were surveyed.

18 When an individual is injured some of these incomes could increase to compensate the family income for the earning losses. For example, a spouse may work longer hours to make up for the partner's lost wages. Or an individual who was working at multiple jobs may shift to work longer hours on the job requiring less physical effort, making up for part of the income lost from the primary job.

19 The correlation between "Times Lost Wages" and "Times Lost Days" was only 0.44.

not impact wealth. However, including this new variable increases the magnitude of the "Hurt 1st Time" (-0.39) and "Hurt 2nd Time" (-0.24) variables, suggesting that being hurt twice reduces wealth by 73%.

While these OLS results are provocative they are not conclusive because they do not account for the potential problem of unobserved heterogeneity. Unobserved heterogeneity means there might be missing factors that are associated with both higher injury risk and lower wealth. Observed variables such as education and occupation can only partially control for the fact that low-skilled or less risk-averse individuals may select themselves into more dangerous jobs and may save less and accumulate less wealth.

To assess if unobserved heterogeneity is a problem this research first uses additional information contained in the NLSY79 data set. The NLSY79 in 1993 asked respondents a set of questions about their willingness to work in different jobs that would either dramatically increase or decrease their income. These questions provide one measure of an individual's risk tolerance. Barsky et al. (1997) found these questions are significantly related to risky behaviors.20 Given that the correlations between this risk tolerance measure and being ever hurt at work (-0.01), ever missed work due to an injury (-0.01) and ever filed a workers' compensation claim (-0.03) are all negative suggests that injured individuals are not more risk-prone.21

Second, this research re-estimates the previous regressions using both fixed effect and random effect models to control for unobservable individual characteristics and differences in risk propensities among workers. The additional regression results are shown in table 11. The focus of the discussion is on the fixed effect models because Hausman tests suggest that the unbiased fixed effect estimator (FE) are preferred to the random effect estimator (RE).

Table 11 shows that once we account for potential unobserved heterogeneity, the two variables that capture a simple injury effect, "Hurt 1st Time" and "Hurt 2nd Time", become insignificant. "Times Lost Wages" and "Times Lost Days," however, remain key significant variables. The coefficients in columns 3 and 5 show that injuries which lead to wage losses or to spells off work are associated with a wealth reduction of almost 20 percent. The fixed effect results in column 8 show that the "Number Missed Days" has a significant, although very small, negative effect on net worth. The other coefficients in table 11 track the demographic factors and in most cases the results are similar to what was found in the OLS regressions. First, on the "age" line we find that young baby boomers on average increase their net worth by around fifteen percent each year. While this growth seems quite high, looking back at figure 5 shows that for most years baby boomers have extremely low net worth levels. At age 30, the typical boomer has a net worth only in the low $20,000 range. Hence, a 15% growth results in net worth climbing only a few thousand dollars.

The regressions also highlights that females have lower net worth than males and that blacks and Hispanics have lower net worth than white individuals irrespective of a person's injury status. Occupational coefficients, which are not shown for space reasons, reveal that workers in service, farming, and operator jobs have lower net worth than white-collar workers. Finally, being married, having additional income and being self-employed all boost net worth regardless of injury status.

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20 The risk tolerance scale ranges from 1, which is a respondent with no tolerance for risk, to 4, which means a very high tolerance.

21 The correlation between "risk tolerance" and "ever filed a workers' compensation claim" is significant at the 0.01 level. The other two correlations are not statistically significant.

Table 10. OLS Regressions Using Ln (Net Worth) as Dependent Variable

	Effect of Injury and				
	Nothing else	*Demographic Factors*	*Lost Wages*	*Spells Off Work*	*Days Off Work*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Regression Constant	6.62 (0.02)***	-5.95 (0.19)***	-6.27 (0.19)***	-6.31 (0.19)***	-6.31 (0.19)***
Ever Hurt	-0.38 (0.04)***	-0.44 (0.04)***			
Hurt 1st Time			-0.22 (0.06)***	-0.30 (0.08)***	-0.39 (0.06)***
Hurt 2nd Time			-0.02 (0.11)	-0.11 (0.11)	-0.24 (0.10)***
Times Lost Wages			-0.51 (0.07)***		
Times Lost Days				-0.15 (0.06)**	
Number Missed Days					0.001 (0.001)
Age		0.13 (0.01)***	0.13 (0.01)***	0.13 (0.01)***	0.13 (0.01)***
Female		-0.47 (0.04)***	-0.46 (0.04)***	-0.46 (0.04)***	-0.46 (0.04)***
Black		-1.60 (0.05)***	-1.59 (0.04)***	-1.59 (0.04)***	-1.59 (0.04)***
Hispanic		-0.81 (0.05)***	-0.81 (0.05)***	-0.81 (0.05)***	-0.81 (0.05)***
Highest Grade		0.17 (0.01)***	0.17 (0.01)***	0,17 (0.01)***	0.17 (0.01)***
Married		1.66 (0.04)***	1.66 (0.04)***	1.66 (0.04)***	1.66 (0.04)***
Ln (Income)		0.61 (0.01)***	0.61 (0.01)***	0.61 (0.01)***	0.61 (0.01)***
Self Employed		1.07 (0.08)***	1.08 (0.08)***	1.08 (0.08)***	1.08 (0.08)***
Occupational Dummies		Yes	Yes	Yes	Yes
Industry Dummies		Yes	Yes	Yes	Yes
R^2	0.01	0.14	0.14	0.14	0.14
Observations	99,635	96,002	96,002	96,002	96,002

NOTES: Standard errors are in parenthesis. Stars track significance with * p<0.10, ** p<0.05 and *** p<0.01.

Table 11. Fixed and Random Effects Regressions Explaining Ln (Net Worth)

	Effect of Injury and							
	Demographics		*Lost Wages*		*Spells Off Work*		*Days Off Work*	
	1	2	3	4	5	6	7	8
	FE	**RE**	**FE**	**RE**	**FE**	**RE**	**FE**	**RE**
Regression Constant	-0.49 (0.41)	-3.70 (0.22	-0.51 (0.41)	-3.77 (0.23)	-0.52 (0.41)	-0.10 (0.08)*	-0.51 (0.41)	-3.79 (0.23)
Hurt 1st Time			0.01 (0.08)	-0.09 (0.07)	0.05 (0.08)	-0.11 (0.09)	0.03 (0.07)	-0.18 (0.06)***
Hurt 2nd Time			0.09 (0.12)	0.06 (0.11)	0.12 (0.13)	0.04 (0.11)	0.01 (0.11)	-0.06 (0.11)
Times Lost Wages			-0.21 (0.09)***	-0.33 (0.08)***				
Times Lost Days					-0.19 (0.08)***	-0.16 (0.07)***		
Number Missed Days							-0.001 (0.00)**	-0.001 (0.00)
Age	0.15 (0.01)***	0.13 (0.01)***	0.15 (0.01)***	0.14 (0.01)***	0.15 (0.01)***	0.14 (0.01)***	0.15 (0.01)***	0.14 (0.01)***
Female		-0.46 (0.07)***		-0.47 (0.07)***		-0.47 (0.07)***		-0.47 (0.07)***
Black		-1.90 (0.08)***		-1.91 (0.08)***		-1.91 (0.08)***		-1.91 (0.08)***
Hispanic		-0.95 (0.09)***		-0.95 (0.09)***		-0.95 (0.09)***		-0.95 (0.09)***
Highest Grade	-0.06 (0.03)**	0.19 (0.01)***	-0.06 (0.03)**	0.19 (0.01)***	-0.06 (0.03)**	0.19 (0.01***)	-0.06 (0.03)**	0.19 (0.01)***
Married	1.06 (0.05)***	1.33 (0.04)***	1.06 (0.05)***	1.33 (0.04)***	1.06 (0.05)***	1.33 (0.04)***	1.06 (0.05)***	1.33 (0.04)***
Ln (Income)	0.27 (0.01)***	0.38 (0.01)***	0.27 (0.01)***	0.38 (0.01)***	0.27 (0.01)***	0.38 (0.01)***	0.27 (0.01)***	0.38 (0.01)***
Self Employed	0.47 (0.09)***	0.67 (0.08)***	0.47 (0.09)***	0.66 (0.08)***	0.47 (0.09)***	0.66 (0.08)***	0.47 (0.09)***	0.66 (0.08)***
Occupational Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Chi-squared	1137		1167		1166		1170	
Observations	96,002	96,002	96,002	96,002	96,002	96,002	96,002	96,002

NOTES: Standard errors are in parenthesis. Stars track significance with * p<0.10, ** p<0.05 and *** p<0.01. The Chi-squared line is a Hausman test where the null hypothesis is that the two estimates are the same.

Consumption: The previous regressions suggest a link between workers reporting an income loss and a reduction in wealth. As an additional step, we have explored whether being injured has an effect on respondent's consumption.

Wealth is changed via three different channels: having capital gains or losses, giving or receiving inheritances and other gifts, and saving or spending down savings. For injured individuals in the NLSY79 age range capital gains or losses are not a likely cause of wealth changes. Figure 5 has shown relatively low net worth among those injured. Low net worth means that even if these individuals have consistently large percentage capital gains, their absolute net worth stays relatively small. Inheritance is also not a likely key factor since only half of those who were ever injured on the job received an inheritance or a large monetary gift sometime before the year 2000, and the median value was just $7,886. The low median figure combined with only half the injured ever getting an inheritance shows that for at least three-quarters of those injured, inheritances are not an important factor in changing wealth. This leaves changes in saving as the most likely source for wealth changes among those injured.

Given workers' compensation benefits provides only a partial replacement of income, workers in dangerous jobs theoretically should accumulate precautionary savings to draw down when they experience income losses. This consumption smoothing behavior is consistent with standard models of intertemporal allocation, which predict anticipated income changes should not affect consumption patterns (Browning and Collado, 2001). However workers often are either unaware or underestimate the risk and potential income losses they face on the job (Arrow and Lind, 1970, and Moss, 2002). In addition they may be working in low-paying jobs, which do not provide enough money to allow any savings. Even if these workers plan correctly they may end up not only drawing from their savings, but also reducing their consumption when they are injured.

A special NLSY79 module on food spending, which was inserted into all surveys from 1990 to 1994, provides a method of testing whether consumption is stable or falls among injured individuals.22 Running first an OLS and then a fixed effect regression, which have total yearly food spending as the dependent variable, provides a simple method of checking if food spending falls when workers were first injured between 1990 and 1994. Table 12 shows a negative and statistically significant term on "Hurt Previous Years," a variable capturing whether the worker had experienced any job related injury since 1990. The -215 or -239 coefficient means that food spending fell by more than two hundred dollars when a worker was injured. To put this in perspective, this is a larger "consumption penalty" than the 91 dollars found for Hispanic versus a white individuals in the OLS regression. A complete analysis of consumption behavior goes beyond the scope of this study. Nevertheless, this preliminary result suggests that workers do not have stable consumption after being injured.

22 Total food spending is calculated by summing four questions which determine the amount spent on restaurant meals, food delivered to the home, groceries paid for by food stamps and other grocery spending. Median yearly food spending is $4,248.

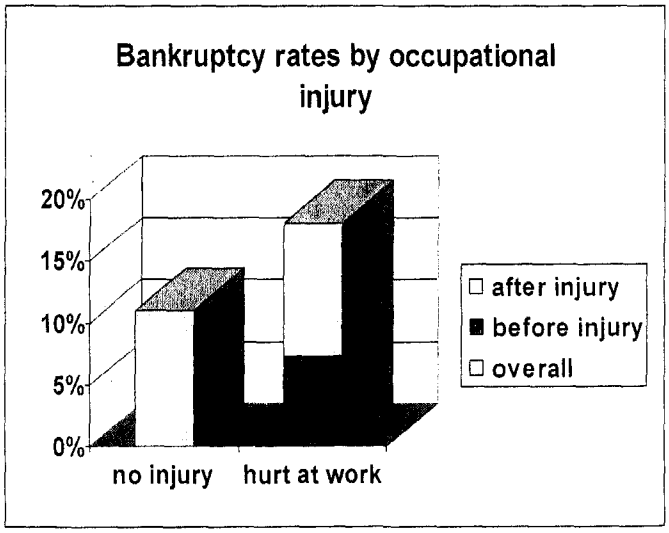
Table 12. OLS and Fixed Effects Regression using Food Spending as Dependent Variable.

NLSY79: Individuals surveyed from 1990 to 1994		
	OLS	**Fixed Effects**
Regression Constant	1073*** (474)	-1530* (890)
Age	80 (16)***	179 (30)***
Hurt Previous Year	-215 (93)***	-239 (105)***
Female	-128 (75)*	
Black	-577 (91)***	
Hispanic	-91 (98)	
Married	1257 (85)***	1181 (150)***
Family Size	141 (26)***	5 (40)
R^2	0.12	0.04
Observations	4,134	4,134

NOTE: Standard errors in parentheses (significant: * p<.10, ** p<.05, *** p<.01). The regressions include year dummies

Bankruptcy: In 2006 the 2004 wave of the NLSY79 data was made available to researchers. This wave included new questions, one of which asked individuals about their experience with bankruptcy. We decided to build on our findings about wealth effect to study the relationship between occupational injuries and the propensity to file for bankruptcy. We found that 18 percent of injured workers had field for bankruptcy (vs. 11% of the non injured individuals) and that 60% of them had filed after being injured.

Figure 6: Bankruptcy Rate



Logit analysis (table 13) has confirmed that having an incident on the job and filing for workers' compensation increase the likelihood of filing for bankruptcy, respectively by 50% and 25%. I am now planning to further study these results to explore first whether occupational injuries play a main role in bankruptcy decisions (against alternative explanations suggested by Fay, Hurst, White (2002) that see bankruptcy as the result of strategic decisions or of neighborhood/stigma effects) and, second, whether there is complementarity or substitution between bankruptcy and workers' compensation systems.

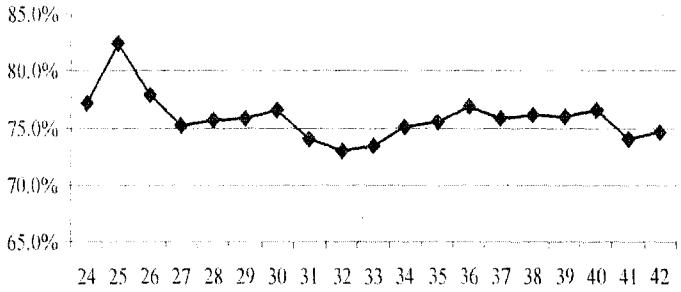
Table 13. Logistic Regression: Odds ratios of filing for bankruptcy in 2004

Hurt At Work	1.576*	1.477*	1. 358*	1.254
Hurt Count		1.038	1.022	1.001
Missed Work			1.178	1.117
Filed WC				1.256
Average Income	1.000	1.000	1.000	1.000
Average Wealth	1.000	1.000	1.000	1.000
Age	1.047*	1.047*	1.047*	1.046*
Female	1.45*	1.454*	1.457*	1.463*
Black	0.863	0.866	0.864	0.868
Hispanic	0.786*	0.789*	0.789*	0.789*
AFQT	0.995*	0.995*	0.995*	0.996*
Highest Grade Completed	1.367	1.365	1.373	1.366
Married	1.669*	1.668*	1.662*	1.654*
Divorced	1.041	1.041	1.042	1.039
Number of Children	0.935*	0.935	0.934*	0.935*

NOTE:* Significant at 95% level

Fringe Benefits: We have also looked at the effect of injuries on a particular type of fringe benefits: health insurance. While the NLSY79 data reflect the national average with 15% of individuals without health insurance, we found that among injured worker the percentage is higher: 25%.

Figure 7: Percentage of injured workers with health insurance



We conducted a logit analysis (table 14) to examine the factors affecting the likelihood a worker having health insurance in 2002. The findings show that being hurt at work increases the chance of having insurance. This possibly reflects the fact that injured workers must have a job and therefore may have a higher likelihood of receiving health insurance through their employer. Each time a worker is hurt, however, lowers the chances of having insurance. Missing work and filing a WC claim lowers the probability as well.

Table 14. Logistic Regression: Odds ratios of having health insurance in 2002

Hurt At Work	1.018	1.261*	1.283*	1.303*
Hurt Count		0.878*	0.882*	0.886*
Missed Work			0.967*	0.979
Filed WC				0.950
Average Income	1.000	1.000	1.000	1.000
Average Wealth	1.000	1.000	1.000	1.000
Age	0.997	0.997	0.997*	0.997
Female	0.618*	0.614*	0.614*	0.614*
Black	1.076	1.06	1.061*	1.060
Hispanic	1.010	0.998	0.999*	0.999
Highest Grade Completed	0.877*	0.877*	0.877*	0.877*
AFQT	0.996*	0.996*	0.996*	0.996*
Ever Marry	0.589*	0.59*	0.591*	0.591*
Ever Divorce	1.707*	1.708*	1.708*	1.709*
Number of Children	1.020	1.021	1.021*	1.021

NOTE: * Significant at 95% level

Government Programs: I had originally planned to test the hypothesis of "claim contagion": whether the likelihood of using the WC system can be affected by the frequency of the use of government programs in the areas of residence of workers. I had read that the NLSY79 geocode data included information about the number of recipients of payments from AFDC, SSI, and Social Security for the area of residence of the interviewed worker. However in studying the NLSY79 geocode data I found out that 1982 was the last year when information regarding area participation in those government programs had been collected. Furthermore, the AFDC variables track only AFDC dollars spent in the geographic area in 1976. I decided therefore not to pursue this research questions because the information about occupational injuries was collect only starting 1988. In fact, the use of the goecode information would have been legitimate only under two assumptions: that individuals had not moved from 1982 to the 1990s, and that the AFDC spending in the mid 1970s was the same as in the 1990s (except for a scale factor). Both assumptions did not seem plausible enough to make worthwhile to pursue this analysis.

Specific Aim # 4: ***To evaluate the effect of an injury on the families of injured workers.***

As reported above, in devolving Aim #3 I have found that an occupational injury has strong negative effects both on individual wealth and on household consumption (food spending). These results clearly imply that the injury has negative consequences not only for the workers but also for their families. In my original research plan, however, I had planned to examine more specifically the effect that accidents may have on spouses' labor force status and employment. I had also planned to assess the impact of injuries on the well being of female workers' children. I could not complete these analyses, however. In fact they both required very complex data extraction and data cleaning processes. The spouse information is collected in the NLSY79 but the longitudinal information has to be extracted and organized separately before being merged with the interviewed workers' records. The children records are instead included in a completely separated survey, the *NLSY79 Children and Young Adult.* Out of 10,918 children (age 20 or less) in this dataset between 1986 and 1998, 2,138 had mothers who reported a work-related injury or illness during that time period. This group includes 749 "young adults" (between ages 15 and 20). These records also need to be separately extracted and completely organized before being able to merge with the mothers' information. As in case of my return to work analysis, my difficulty in recruiting a valid research assistant to serve as data analyst has compromised my ability to accomplish this aim of my grant.

Specific Aim # 5: ***To measure whether long term economic and social consequences of work-related injuries and illness vary among workers who receive or do not receive workers compensation benefits.***

The NLSY79 asks the following questions to workers who report a work related injury or illness: whether the injury or illness caused them to miss one or more scheduled days of work; whether their employer filled out a workers' compensation form; whether they collected workers' compensation benefits; whether there is still a workers' compensation claim pending. In accordance with my original research plan, I have exploited this different information as

explanatory variables in assessing almost all the outcomes that I have described under the previous aims. Here I am discussing only some additional relevant results.

Filing for Workers' Compensation: Table 15 provides additional descriptive statistics. It shows that females and higher-educated individuals are less likely to lose time when they are hurt, while blacks and blue-collar workers are more likely to have time off. The key line here is labeled "Ever Filed WC Claim." This line shows that, among those who were hurt once and lost work time, just 61% ever filed a claim and only 40.7% of those who never lost time from work filed. This shows that a relatively large proportion of occupational injuries are not captured by the workers' compensation system. Rates for filing a claim are much higher among those who were hurt multiple times. Among those that lost time from work almost 82% filed a claim.

Table 15. Descriptive Statistics for Key Series.

	Hurt Once Time Lost (1)	*Hurt Once No Time Lost (2)*	*Hurt Multi Time Lost (3)*	*Hurt Multi No Time Lost (4)*
Age (Years)	30.0	30.0	30.0	29.9
Ever Filed WC Claim	61%	40.7%	81.7%	64.6%
Times Lost Wages	0.45	0.05	0.94	0.16
Female	41.8%	45.0%	37.5%	43.2%
Black	17.1%	10.0%	11.7%	6.3%
Hispanic	7.4%	6.4%	6.2%	4.9%
Blue-Collar	49.4%	40.4%	58.5%	52.0%
Highest Grade (Years)	12.5	13.1	12.2	12.8
Married	52.4%	55.5%	53.1%	51.8%
Ln (Income)	10.1	10.3	10.2	10.3
Self Employed	7.3%	6.6%	6.4%	4.6%

NOTES: Blue-collar is true if the respondent's primary job is in the service, farming, forestry, precision, production, craft, repair or operator occupations. Blue-collar was computed separately for each age that data are available. Ln ( ) stands for natural logarithm and is used to prevent a few very rich respondents from driving the results.

Workers' compensation and wealth losses: The wealth regressions results described above under Aim #3 take into account all respondents, multiple years of data, a large number of demographic controls and injury controls. They show that injuries by themselves do not affect individual net worth. However, the regressions predict that individuals who report losing wages or needing to take time off from work will experience a large wealth drop. Controlling for the number of days a person missed work reduces the impact of job injuries on wealth. Table 16 eliminates all respondents who were never injured on-the-job and focuses on the experience of just those hurt. There are six groups of regressions. The first group analyzes individuals injured just once and not injured again. The other five sets of regressions look at individuals injured multiple times, did not miss scheduled days of work, missed work, did not file for compensation and those who filed. Again the discussion highlights the fixed effect estimator (FE) since the Hausman test suggests it is preferred to the random effect. The coefficients on "Times Lost Wages" in columns 3 and 7 of table 6 show not surprisingly the frequency of earnings losses caused by the injury has a large and statistically significant effect on wealth for workers who were injured several times (-0.22) and missed days of work (-0.19). This negative impact on wealth occurs even when workers file for compensation (column 11, -0.18). The negative result suggests that the partial income replacement offered by workers' compensation benefits has an additional long-lasting financial consequence on workers lower wealth over time.

Table 16. Effect of Wage Losses by Post Injury Experience, Ln (Net Worth) as Dependent Variable.

	Hurt only once[a]		*Hurt multiple times*		*Did not miss days of work*[b]		*Missed days of work*[b]		*Did not file for workers' compensation*		*Filed for workers' compensation*	
	Fixed Effect and Random Effect Models											
	FE (1)	**RE (2)**	**FE (3)**	**RE (4)**	**FE (5)**	**RE (6)**	**FE (7)**	**RE (8)**	**FE (9)**	**RE (10)**	**FE (11)**	**RE (12)**
Hurt 1st Time (T/F)	-0.06 (0.14)	-0.04 (0.12)	0.03 (0.16)	-0.02 (0.15)	-0.11 (0.16)	-0.16 (0.15)	0.07 (0.13)	0.10 (0.12)	0.07 (0.17)	0.03 (0.16)	-0.01 (0.13)	0.01 (0.12)
Hurt 2nd Time (T/F)			0.24 (0.17)*	0.30 (0.16)**	-0.27 (0.26)	-0.18 (0.24)	0.19 (0.15)*	0.16 (0.14)	-0.27 (0.27)	-0.37 (0.25)*	0.21 (0.15)*	0.20 (0.14)*
Times Lost Wages	-0.09 (0.19)	-0.18 (0.16)	**-0.22 (0.11)****	-0.37 (0.10)***	-0.15 (0.41)	-0.17 (0.36)	**-0.19 (0.11)****	-0.32 (0.09)***	-0.26 (0.22)	-0.36 (0.19)**	**-0.18 (0.10)*****	-0.34 (0.10)***
Ln (Income)	0.29 (0.03)***	0.40 (0.02)***	0.34 (0.04)***	0.49 (0.04)***	0.31 (0.04)***	0.40 (0.04)***	0.31 (0.03)***	0.45 (0.03)***	0.27 (0.04)***	0.38 (0.04)***	0.34 (0.03)***	0.50 (0.03)***
Chi-squared[c]	239		187		145		313		201		250	
Obs.	18,210		12,760		10,232		20,738		11,256		19,714	

NOTES: The regressions include all the demographic and occupational factors included in tables 4 and 5. Standard errors in parentheses

[a] The results for individuals who were *never* hurt were very similar to the ones presented in columns 1 and 2 of table 5.

[b] After the first recorded injury.

[c] Hausman test for null hypothesis that the two estimates are the same

Conclusions

This research was developed in the context of the NORA Priority Research Area: *"Social and Economic Consequences of Workplace Illness and Injury."* While official US statistics show that occupational injury rates have continuously declined since the early 1990s, the costs of such injuries have remained high with spending breaking $142 billion dollars in 2004. The calculations of these costs are usually based on estimates of earnings losses experienced by injured workers or on the amount of workers' compensation (WC) benefits that are being paid. This research has aimed to increase our knowledge about some additional hidden social and economic outcomes of workplace injuries.

The main hypothesis of the study was that injuries cannot be studied as isolated events in workers' lives. Their consequences will largely depend on the individual's personal characteristics and pre-injury labor market experience. These factors, together with employers' characteristics, behaviors and working conditions, will then determine the potential long-lasting economic effects of the injury. Given its aims, the research proposal has used data that permit examination of workers' lives over a long period of time, both before and after the injury: the National Longitudinal Survey of Youth 1979 cohort is a nationally representative panel survey sponsored by the Bureau of Labor Statistics, U.S. Department of Labor. In 1988, respondents to the NLSY79 were asked questions regarding occupational injuries and illnesses for the first time. At each age, between 2.5% and 5% of these individuals were hurt in workplace accidents, with peak injuries occurring in the early 30s. Several workers with lost time injuries did not file for WC. Among those workers who were hurt once and lost work time, just 61% ever filed a claim and only 40.7% of those who never lost time from work filed.

This study represents the first economic analysis to focus on the impact of workplace injuries and illness on the following dimensions of financial well being: employees' wealth, consumption and bankruptcy propensity. While there is a correlation between labor income and wealth, wealth represents a different dimension of economic and psychological well being. My results show that for young baby boomers, once unobserved heterogeneity among individuals is controlled, the event of an injury by itself does not impact wealth. However, there is a large reduction in wealth (20%) for those individuals who reported having lost wages or who lost days of work because of the injury. This wealth reduction occurred regardless of employees' participation in the workers' compensation system.

I have explored the additional hypothesis that, faced with both income and wealth loss, injured workers may end up not only drawing from their savings, but also reducing their *consumption*. I have found that yearly food spending fell by more than two hundred dollars when a worker was injured between 1990 and 1994. Having an incident on the job and filing for workers' compensation also increase the likelihood of filing for bankruptcy, respectively by 50% and 25%.

This set of findings suggests that current WC benefits may be inadequate. Since most U.S states set benefit levels to replace only two-thirds of earnings losses, injured workers and

their families often need new strategies to maintain the standard of living they had before the injury. If workers have not accumulated precautionary savings, they may fall into debt, or be unable to meet previous financial obligations. For workers without savings, injuries may result in negative economic consequences beyond the family. For example, lenders could be affected if workers can not repay their loans. Existing literature has described cases where injured workers reported having lost their home or car because of this new financial hardship. This is an example of how a wealth decrease leads to the loss of "tools" needed to return to fully productive employment. This means that policies which focus on providing injured workers with adequate benefits potentially provide an even larger social gain than the gain usually attributed to them. The evidence of wealth losses and their potential long-term consequences also highlights the need for accumulating precautionary savings. Workers often underestimate or do not know the occupational risks they face. It is also not clear if they know that the workers' compensation system only partially replaces their income if they are hurt. Moreover, ignorance may be a bigger problem among specific groups of workers such as young or immigrant employees. This raises the question of whether enough is done to educate workers about the real attributes of their job and about their rights under the workers' compensation system. Such education should happen in workplaces.

In addition, some injured workers encountered difficulties in returning to work. The findings suggest that indeed employers respond differently to a job-related injury depending on the gender and race of the employees, with women more likely to receive employment accommodation and African-Americans being more exposed to job termination. Also, while the implementation of the Americans with Disabilities Act has played a role in increasing the likelihood of receiving accommodation after an injury, the experience with the workers' compensation system is related to more uncertain future employment: more involuntary separations and changes in occupation. These findings, however, still need further testing against the alternative hypothesis that these injured workers were individuals who would have had a weaker attachment to their employer regardless of the accident. They do suggest, however, that policy makers should discuss systems to better monitor employers' termination decisions in workplaces that are known for being dangerous. It is necessary to make sure that such decisions do not disguise discriminatory actions. In addition, some U.S. states have already established policies to provide employers with monetary incentives to rehire injured workers. Stakeholders should consider the funding of studies that will evaluate the outcome of such policies.

To the best of my knowledge, my analysis also represents the first attempt to investigate the role played by pre injury individual and job characteristics in determining workers' incidence rates over a long spell (the first twenty years) of their working history. Between 1988 and 2000, 37% of all NLSY79 workers who had experienced one on-the-job accident reported additional injuries, a percentage consistent with what is found in the existing literature. My study identifies some of the main determinants of multiple injuries: lower education, lower experience and tenure, unskilled occupation, and longer working hours. This factor may indicate a relationship between fatigue and the accumulation of injuries or illnesses. Indeed, the number of hours worked was higher in the month preceding the injury than one year before the injury and during the month of

the injury. The most interesting results, however, refer to the role played by preinjury individual characteristics: life in poverty, early exposure to dangerous jobs, and health limitations are among the main determinants of higher counts of occupational injuries later in life. These findings provide new evidence about the role played by the socioeconomic conditions of young people as important determinants of their future occupational injuries. They stress the great importance of supporting policies that will protect poor children's well-being. If such polices are not implemented, poor children's disadvantages are only going to accumulate over their life time.

The development of this research project has raised several research questions that need to be addressed by future research. We need to investigate more in detail the relationship between earning losses and decreases in wealth or bankruptcy filing. We should study the role played by preinjury factors versus post-injury working conditions in determining a successful return to work. We must further explore to what extent the characteristics of a first injury and a first workers' compensation claim affect the likelihood of experiencing both multiple injuries and multiple WC claims over a working life. We need research to understand the nature of the pre-existing health conditions that make workers more prone to become injured on future jobs; we need to better understand what leads workers to accept unsafe jobs. And finally, to fully understand the burden of injuries, we also want to study how family members are affected when a worker is injured. I am planning to make these topics the focus of my research agenda over the next few years.

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PUBLICATIONS

As reported in the Scientific Report section, different papers were written, presented at professional conferences or are under review at professional journals.

INCLUSION OF GENDER AND MINORITIES /// INCLUSION OF CHILDREN

Not applicable

This research has not involved any direct interaction with living persons. It has made use of the publicly available survey data, NLSY79, sponsored by the Bureau of Labor Statistics, U.S. Department of Labor. This is a national sample of 12,686 men and women chosen to be representative of all men and women born in the late 1950s and early 1960s and living in the US when the survey began in 1979. Women were 49%, African-American 25%, and Hispanic 16% of the entire original sample. The relevant information can be found in the *NLSY79 User's Guide* available on line at http://www.bls.gov/nls/nlsy79.htm

In addition, the youngest individuals surveyed by the NLSTY79 in 1988 (the first year when the survey included questions regarding occupational injuries) were 23 years old. Some of the results discussed in the Scientific Report under Aim 2, however, are potentially relevant in terms of conditions affecting children's future well-being.

MATERIALS AVAILABLE FOR OTHER INVESTIGATORS

The NLSY79 data is publicly available through the BLS website: http://www.bls.gov/nls/nlsy79.htm
The calculations presented in this report were obtained using the SAS and STATA statistical packages. All the programs referring to data manipulation and regression analysis are available under request by contacting Dr. Galizzi at: Monica_Galizzi@uml.edu.