Performance Pay and Workplace Injury: US Survey Evidence

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Abstract

Using US survey evidence, we show an elevated risk of workplace injury for those paid piece rates and bonuses. While consistent with Adam Smith's behavioral conjecture, this could also reflect sorting by workers. In response we control for a risk proxy, for worker fixed effects and for worker with employer match effects. The estimates suggest that injury risk increases when blue-collar workers become paid by piece rates and bonuses. This evidence hints that a portion of the estimated returns to these payment methods may reflect compensating differentials for risk of injury.

Keywords: performance pay, injury, incentives

JEL Code: J33, J28

1. Introduction

At its best, performance pay more closely aligns the interests of workers and firms. A wide variety of studies confirm that performance pay (especially a reward tied to output) is associated with increased productivity (see for instance Lazear 2000, Banker et al. 1996, Haley 2003, Jones et al. 2010, Gielen et al. 2010, Heywood et al. 2011, and the cites within Frick et al. 2013). Yet, increases in productivity can be offset by other worker behavior that ultimately hurts profitability and efficiency. Thus, Freeman and Kleiner (2005) emphasize that output based incentives cause workers to skimp on quality, to use excessive materials and not share valuable information. Critically, they emphasize that output based incentives cause workers to increase their speed and to take greater risks increasing the probability of injuries on the job. These injuries often generate substantial costs for both workers and their employers.

We add to the literature testing for the presence of a link between injuries and performance pay. Using broad US survey data, we confirm higher on-the-job injury risk associated with the provision of such incentives. We show that the risk of injury remains elevated when controlling for worker characteristics, detailed occupational and industry controls, and complex error structures. Nonetheless, we suggest that this could reflect workers sorting according to risk preferences and present a series of estimates in response. First, we account for a proxy for risk preferences and second, estimate the relationship holding worker fixed effects constant and then holding worker in employer fixed effects constant. These approaches are unique to this literature and affirm a link between incentives and injury. The evidence suggests that the link is largely driven by blue-collar occupations, as might be anticipated, and that it holds for injury on-the-job rather than for work related illness more broadly.

The idea that output based incentives may reduce worker safety and health is as old as modern economics and summarized in Adam Smith's famous dicta that "w*orkmen…when they* *are liberally paid by the piece, are very apt to overwork themselves, and to ruin their health and constitution in a few years*" (Smith, 1776, p.83). Our evidence confirming such an association is important for several reasons. First, the strong, robust relationship between injuries and incentives suggests that the benefits to firms of increased productivity may be partially offset by higher costs for absence and workers' compensation / sickness insurance payments (increased premiums paid to public or private schemes). Second, the relationship suggests that the frequently estimated wage premium for output based incentives (Pekkarinen and Riddell 2008, Parent 1999, Seiler 1984) may be, in part, a return to greater risk of injury. In this way, performance pay may serve as a mechanism for workers to capture compensating differentials, not simply to be rewarded for greater productivity.[1] Third, to the extent that there are public good rationales for the creation and enforcement of health and safety regulations, our findings point to blue-collar jobs providing output incentives as being particularly relevant for attention. We emphasize that our results do not demonstrate that workers paid such incentives are worse off or have lower job satisfaction, only that the injury rates appear higher (see Green and Heywood 2008 for evidence that overall worker satisfaction is greater with performance pay).

In what follows, we briefly review the relationship between output based incentives schemes and injury emphasizing that there have been relatively little use of broad survey data to explore this relationship and that they have not controlled with worker sorting. The third section presents our data which has good, if imperfect, information on both injuries and payment schemes. The fourth section presents our empirical approach while the fifth section establishes the relationship between incentives and a heightened risk of workplace injury. We follow this by estimation designed to control for worker heterogeneity through fixed effects estimation. The final section concludes and suggests avenues for future research.

2. Background

In a simple agency model of piece rates, the principal faces a worker utility constraint from the labor market and so sets the earnings contract such that it just offsets effort and earnings risk costs leaving workers equally satisfied as without piece rates (e.g., Holmstrom and Milgrom 1987, Gibbons 1998). Presumably in such a model, allowing for the increase in injuries associated with increased output or speed of production requires an even more generous piece rate to offset not only effort and earnings risk costs but to compensate for the increased risk of injury. Thus, if a firm finds the increased output sufficient to pay such compensation, we would anticipate that the resulting piece rates are associated with greater output, earnings and injury. In this simple model, all workers are typically assumed to be identical along the critical dimension of risk preferences.

In alternative models, Lazear (1986) and Booth and Frank (1999) among others view piece rates as generating a self-sorting process by heterogeneous workers. The firms face a zero profit market constraint allowing workers with greater ability to capture the rent associated with their ability by sorting into performance pay. In a similar way, those with lower inherent risk aversion will sort into performance pay to capture the associated rent. Cornellissen et al. (2011) provide a formal model and evidence demonstrating sorting into performance pay by both the more able and the less risk averse. Curme and Stefanec (2007) and Grund and Sliwka (2010) also show the importance of sorting by the less risk averse into performance pay. The critical point of such sorting for our investigation is that it may spuriously generate a higher risk of injury observed among workers on output based incentives. Those with lower aversion will sort into jobs with such incentives and their low aversion for risk causes them to naturally engage in fewer activities to mitigate the risk of injury or to more willingly take on activities that increase the risk of injury.[2] To the extent that workers differ in their attitudes toward risk and so in their efforts to reduce risk, one might even think of the sorting as attracting the inherently more accident prone (the less risk averse). Put differently, workers with lower risk aversion will respond to the presence of output based incentives by increasing output more and accepting the larger associated increase in risk of injury. The higher risk of injury of those paid incentives then reflects not only the incentive effect but also the sorting of those most likely to respond to the incentive.

Our recognition that the observed probability of injury may reflect individual worker specific characteristics mimics that behind the association of performance pay with productivity. Output based incentives may increase worker productivity regardless of inherent productivity (ability) but they also attract the more able. Similarly, output based incentives may increase worker risk of injury but also attract the less risk averse who more willing take on a greater risk of injury. While others have recognized this potential (Bender et al. 2012), we are the first to empirically address such sorting using standard longitudinal survey data. While we will control for a typical proxy for risk aversion, smoking behavior, most of our attention will focus on using repeated observations on individuals to control for individual fixed effects (see Lazear 2000).

While accounting for an individual specific component of injury risk can be crucial, we recognize that other dimensions of sorting could exist. While we suspect that output based incentives are not randomly distributed across workers, they may also not be randomly distributed across jobs (see Parent 2002). Jobs that provide such incentives may be inherently more dangerous. This could cause what looks like an elevated risk of injury for incentives to be driven by omitted technology factors that increase the likelihood of both injury and incentives.

Thus, working with a dangerous piece of equipment (say a drill press) might make it easy to measure productivity (completed pieces) and be inherently dangerous. Thus, some of the elevated injury risk could be associated with the production technology that allows output based incentives, not the incentives themselves.

We make a strong effort to control for the possibility of unmeasured employer and job heterogeneity. We will use highly detailed controls for occupation in a variety of estimates as one potential correction. More fundamentally, while we cannot easily follow workers from job to job we can follow them across employers. We exploit this by augmenting our worker fixed effect estimates to control for worker with employer matches. The fixed effects identify each worker with an employer. The remaining variation in injury risk is then generated by changes in the incentive pay variable for a given worker at the same employer. While still imperfect, this should help control for variation in the inherent risk of jobs. First, that inherent risk may have a large employer element for which we control. Second, most of the observations (obviously not all) of a given worker at a specific employer will be in the same or similar jobs. We view controlling for first worker and then employer match fixed effects as important steps in this literature as it addresses issues of sorting in a manner not yet undertaken.

While any simple correlation may have multiple causes (including sorting), the suggestion by Adam Smith that workers facing output based incentives take additional risks with their health cannot be easily ruled out and seems worthy of empirical inquiry. The number of past studies that explore this suggestion is modest and several are case studies by occupational health specialists focusing on specific occupations in specific locations. Thus, Sundstroem-Frisk (1984) studies the transition from piece rates to hourly earnings among Swedish loggers finding that the former was associated with significantly higher accident rates. Toupin et al. (2007)

present evidence on heart rates from tree cutters in Canada showing that piece rates cause workers to dramatically increase their intensity in less difficult plots in order to make "easy money." The resulting heart rate data suggested "negative consequences for worker health and safety." A five year medical study of workers in fertilizer production in India concludes that piece rate workers are more vulnerable to occupational accidents (increased probability and severity of an accident) than otherwise similar time rate workers (Saha et al. 2004 p. 240). The authors suggest a path of causation from the financial incentive to the speed of work to the increased accident risk. Evidence has also been presented suggesting increased risk for over-the-road truckers in the United States paid by the mile (Williamson et al. 2009, Rodriquez et al. 2006, Belman et al. 2005, Monaco and Williams 2000). While the evidence is not unanimous, Monaco and Williams (2000) find that hourly wage drivers have significantly smaller probabilities of being in an accident and of violating safety standards even when controlling for training, demographics, firm size and type, unionization, characteristics of the vehicle and actual miles being driven. Frick et al. (2013) provide a detailed case study from a German steel plant finding that introducing team production bonuses generated increased absence but not an increase in reported accidents.

Direct broad survey evidence by economists is limited. Using the Finnish Quality of Work Survey, Bockerman et al (2012) examine the influence of "high performance work practices" on the probability of a worker having an accident on the job. They include incentive pay among the "bundle" of practices but discover no relationship between this bundle and accidents. Somewhat different results are presented by Bender et al. (2012) who use the cross country data of the European Working Conditions Survey. They examine the link between being paid by piece rates and the probability of an injury on the job after including a wide range of controls and accounting for country specific fixed effects and error structures. They present a robust positive relationship between piece rates and accidents but, critical for our purposes, each worker is observed only a single time in the repeated cross-sections. Bender and Theodossiou (2013) use the British Household Panel Study to examine the relationship between a very broad measure of performance related pay and worker health. They show that the hazard of falling out of good self-reported health is greater when receiving performance pay even when accounting for worker heterogeneity. This is matched by similar results for the hazard of reporting specific aliments such as anxiety and heart difficulties. These results obviously do not focus on injuries and the general health measures are not explicitly tied to the job but they nonetheless are supportive of a link.

Less direct evidence on the link between incentives and injuries can be found in the shoe manufacturing case study by Freeman and Kleiner (2005) who present simulations indicating that piece rates are associated with much higher Worker's Compensation costs. Further indirect evidence comes from Foster and Rosenzweig (1994) who find a link between piece rates and lower overall health for agricultural workers.

Again, performance pay may mitigate agency problems by creating incentives to work harder or faster. Yet, performance pay is well known to generate adverse specialization (MacDonald and Marx 2001) in which workers perform only those aspects of the job that are best rewarded and ignore other aspects of the job. Thus, a piece rate may not reward machine maintenance, the taking of work breaks, visiting the infirmary for minor issues or many other job aspects that would otherwise reduce the risk of a reported injury. We add to the literature by examining broad US survey data for a link between on-the-job injuries and performance pay. We ultimately focus on blue collar workers, controlling first for worker and then for worker in employer fixed effects to hold constant heterogeneity and sorting. We build up a series of sensible estimations and routinely confirm an elevated level of injury risk associated with performance pay.

3. Data from the NLSY

We draw our data from the National Longitudinal Study of Youth 1979 (NLSY). The key advantage of the NLSY is that it contains information on payment methods, injury/illness arising from work and a reasonable set of worker controls. Also, despite critical questions not being asked in all waves, there remain multiple complete observations on most workers. An obvious disadvantage is that the NLSY follows a single cohort that may not be fully representative of the population.

The key dependent variable is a self-reported measure documenting an injury or illness that occurred at the workplace. Specifically respondents report whether they had an incident at their job since their last interview that resulted in an injury or illness.[3] This generates a binary variable that takes the value of 1 if respondents report an injury or illness and 0 if they do not. This question is not asked in either the early or later waves but is available for 1988 through 2000. If the respondent indicates they had such an incident, a subsequent question asks them to identify it as either an "injury" or an "illness."

Among the waves in which the injury/illness question is asked, respondents are asked about their receipt of performance pay in the 1988, 1989, 1990, 1996, 1998 and 2000 waves. The waves of the survey are annual in the first three of these waves and are biannual in the last three waves. Thus, the resulting longitudinal panel is comprised of 6 NLSY waves. While we typically use all six waves, we recognize it might be seen as two sets of three adjacent waves and explore whether the gap between the two sets drives our results. Thus, we are able to track workplace injury/illness incidents and performance pay schemes for individual workers across time by focusing on these six waves.

The NLSY performance pay indicators follow from an initial statement telling the workers that "earnings are sometimes based on job performance" and asking if that is the case for them. If they respond that it is the case, a subsequent question asks them to identify any of the following five types of such pay that they received on their job in the last year: piece rates, bonuses, commissions, stock options and tips. Some of these categories represent only a very small share of the respondents. Piece rates, in particular, represent only 2 or 3 percent of the observations depending upon the wave (Parent 2002). Much more common are bonuses based on performance yet the dimension of performance being rewarded is not made explicit. We do know these are not bonuses associated with profit sharing as these are asked about elsewhere in the survey.[4] For blue collar workers many of these bonuses will likely be for speed or quantity and will share important elements with piece rates in terms of potentially changing worker behavior toward risk. Thus, we pair piece rates and bonuses together as the indicator of interest while controlling for the other types of pay in a combined category of "other". We recognize that the combination of piece rates and bonuses could introduce an errors-in-variables problem of unknown magnitude. Some bonus schemes may be rewarding performance dimensions not thought to change the risk of injury but as a first cut this would seem to bias the coefficient toward insignificance. While we conduct several robustness tests to explore combining the two categories, the resulting imprecision remains. Thus our critical performance pay indicator equals one if a worker receives either piece rates, performance bonuses or both and zero if the worker receives neither.

Descriptive statistics for the crucial independent and dependent variables are shown in Table 1. As shown, 6.4% of all workers report an incident on the job that resulted in an injury/illness. As expected, blue collar workers are more likely to report such an incident than white collar workers, 8.0% and 4.8% respectively. Moreover, the raw averages suggest workers paid piece rates or bonuses are also more likely to report an injury or illness. At the extremes, blue collar workers paid piece rates or bonuses report the highest rate of injury/illness at 10.0% while white collar workers paid another type of performance pay have the lowest rate at 4.4%.

INSERT TABLE 1

The raw differences shown in Table 1 could reflect, at least in large part, both observable and unobservable differences in workers and jobs. We now describe our estimations that seek to control as best we can for these differences.

4. Empirical Approach

We focus on the role played by the piece rate/bonus indicator in increasingly complete specifications of the determinants of injury/illness. Our estimates can be expressed as variants on the following equation:

$$I_{it}^{*} = \alpha_0 + \beta X_{it} + \delta W_{it} + \phi PayType_{it} + \sigma_i + k_t + \varepsilon_{it} \qquad (1)$$

where *i*, and *t* index workers and survey waves. *I* is the risk of injury, *X* is a vector of personal characteristics, *W* is a vector of work-related characteristics including occupational and industry dummies, *Pay Type* is the vector of performance related pay schemes (piece rate/bonus and other), and σ_i and kt, are worker and year fixed effects. Eventually, the worker fixed effect will be a unique indicator for each worker employer match. As mentioned, we will build up toward this full specification. In all cases the likelihood of being injured at work is an unobserved latent variable I_{it}^* that is proxied by the dichotomous NLSY indicator assumed to be one above a threshold, h: $I_{it} = 1$ if $I_{it}^* > h$, $I_{it} = 0$ otherwise. We will present the marginal effects for each logit estimate to allow easy comparisons of magnitudes associated with our critical performance pay variable. Logit estimates are chosen to allow an easy translation to the conditional or fixed effect logits that control for time invariant heterogeneity. At that point we will present the influence on the log-odds to facilitate comparison with the pooled estimates. We note, however that probit estimates on the pooled sample are very similar and return the identical patterns of sign and significance. All estimates use the sample weights and we cluster errors by worker to account for repeated observations.

We begin by including typical worker and job characteristics. These include demographic and human capital controls, the hours worked, union status, tenure and employer size among others. The set of these variables and their descriptive statistics are shown in Table 2.

INSERT TABLE 2

After estimates that control for industry and occupation, we narrow the sample by focusing on blue-collar workers (while showing the influence for white-collar workers).

We also control for a proxy of individual risk preferences. Such preferences could drive sorting into performance pay and identify workers who take less care avoiding injury. We exploit a long recognized association between cigarette smoking and risk preference. Thus, Hersch and Viscusi (1990) and Hersch and Pickton (1995) use cigarette smoking to identify individuals with greater risk preference. Experiments confirm that those who undertake larger risks in the laboratory are significantly more likely to smoke (Barsky et al 1997). Moreover, cigarette smoking has been correlated with important labor market choices. Viscusi and Hersch (2001) demonstrate that US workers who smoke take substantially more risky jobs (in terms of injuries on the jobs) while Brown et al. (2006) show that smokers are more likely to accept jobs with greater earnings and employment risk. The critical point from this literature is that smokers (as a proxy for the less risk averse) can be expected to both report greater injury risk and be in jobs that offer greater earnings risk, those with performance pay.

We follow these estimates with those that control explicitly for worker fixed effects and so the individual invariant component of injury risk. We finally replace this estimate with the ultimate estimate that controls for worker in employer fixed effects so that the variation in injury risk is generated by changes in the provision of performance pay on a given worker with a given employer. We continue to show that a positive association that is driven by blue-collar workers and we show it is unique to work related injuries and not to illnesses.

We recognize two limitations before presenting our estimates. First, workers who suffer particularly severe workplace injuries (including death) will likely not appear as working in the NLSY. If more severe injury types are highly correlated with productivity incentives our point estimates may be biased down. Second, we have no indication what portion of the workers' earnings are actually paid through incentives. Thus, the estimates provide a single estimate across workers who may have all or only a portion of the earnings at risk through performance pay.

5. Results

Table 3 presents the marginal effects from logit estimates of the determinants of workplace injury. These are pooled estimates across all individual wave observations in the six relevant waves. In the first column only the two performance pay variables are included repeating the pattern shown in the descriptive statistics of Table 1 and showing a weak positive statistical relationship between injury/illness risk and the performance pay indicator. The second column adds the worker controls and indicates a strengthening of the role of the indicator. The third column adds the job controls and the final column adds controls for broad industry and occupation. Among other results, the specifications suggest that there are higher injury rates for males, union members, those who work more hours and who have less education. The most complete specification suggests that those paid by piece rates or bonuses face an increased risk of injury/illness of 1.1 percentage points. This seems a meaningful marginal effect as the average of the dependent variable is 6.4 percent. The size and strength of the relationship seems to increase modestly with the addition of the controls and is not apparent for the other performance pay types.

INSERT TABLE 3

The evidence that performance pay influences injury risk may differ by jobs. Jobs that involve strenuous activity and work with dangerous machines will entail more injuries but may also show a stronger relationship between worker effort or speed and the extent of injuries. We explore this conjecture by making a distinction between blue-collar and white-collar occupations (Bender et al. 2012). Columns 1 and 3 of Table 4 report estimates of workplace injury incidence split by these occupational groups. Blue-collar workers on piece rates and bonuses have an incidence of injury of nearly 2.5 percentage points higher than workers without performance related pay. The estimate easily clears all standard tests of statistical significance. At the same time, there is no statistically significant relationship between piece rate/bonuses and risk for white-collar workers.

As a further control, we include a variable available in two waves which indicates whether or not the worker's job requires routine physical exertion. While such exertion might be a response to performance pay, it serves as a further control for job type. As columns 2 and 4 show, workers with such jobs are significantly more likely to report an injury or illness. Yet, including this variable changes neither the basic coefficient magnitude nor the significance of the critical performance pay indicator. It does not appear that strenuous physical labor is such a meaningful excluded variable that it drives both injury risk and performance pay for blue collar workers.

INSERT TABLE 4

We next investigate the consequences of detailed occupational controls and our proxy for risk preferences. Table 5 drops the measure of physical exertion and so returns to the full six waves of data. The estimates first increase the occupational detail by accounting for each 3-digit code. This includes 138 occupational dummies across the sum of blue- and white-collar workers. It is easy to reject the hypothesis that the additional detail adds nothing to explanatory power but including such detail shows only modest influence on the relevant coefficients (these comparisons and tests are available upon request). The difference between blue-collar and white collar samples remains evident in the Table. Blue-collar workers paid by piece rates/bonuses are significantly more likely to have injuries than those blue-collar workers not paid performance pay. Moreover, the estimates change little when the worker's smoking status is included. We have only a single question asked of workers at one point in time that indicates whether or not they have been or are regular smokers. The suggestion from past literature that smokers take on more risk in aspects of their work life receives evident support. Among both blue-collar and white-collar workers, those that have been or are regular smokers are significantly more likely to have been injured on the job. Yet, as columns 3 and 5 show, this proxy for risk preference does not materially change the coefficient on the piece rate/bonus indicator. The blue-collar workers face a 1.7 percentage point increase in the risk of injury when paid by piece rates or bonus. Although, the influence is absent for white-collar workers, it is sufficiently strong among blue-collar workers that the full sample estimate in Column 1 continues to show a significant relationship between injury and piece rates or bonuses.

INSERT TABLE 5

We now exploit the richness of the panel data to control for individual fixed effects. Specifically, we focus on blue collar workers and provide conditional logit estimates using the same set of controls. These estimates use the variation within a worker over time to examine whether changes in the method of pay influence that worker's risk of injury or illness. We motivated these estimates with the concern that worker fixed effects could influence both the observed risk of injury and sorting into piece rate and bonus jobs. In the face of such fixed effects, the cross-sectional estimates are recognized to be inconsistent (Chamberlain 1980 and Maddala 1987). As we've suggested, low risk aversion could result both in a worker taking less care on the job (and so facing higher injury risk) and seeking a piece rate or bonus job with its associated earnings risk. If the fixed effect was poorly proxied by the earlier smoking variable, these estimates should control for the unobserved but invariant individual component. Using the repeated observations of the NLSY, the estimates that account for worker fixed effects are presented in Table 6.

INSERT TABLE 6

The first column of Table 6 shows the individual fixed effect estimate and continues to indicate a significant positive influence of being paid piece rates or bonuses upon the risk of injury for blue collar workers. This estimate accounts for sorting on invariant characteristics including risk preference and continues to support the notion that workers take greater risks when paid for productivity. A similar estimate for white collar workers continues to find no influence for piece rates or bonuses. The overall estimates (the sum of blue and white collar) are based on a reasonably large number of status changers. The Appendix Table shows that there are 5437 transitions into and out of receiving piece rates or bonuses. Moreover, these consist of approximately an equal number of movers in and movers out. This makes it unlikely that some excluded secular phenomenon is causing large numbers of workers to move into such payment schemes and is also causing increased work place incidents.

It might be thought that there exists asymmetry in the influence and we tested this with separate estimates of the whole sample of workers for those who move into and out of bonuses and piece rates. The two estimates return virtually identical coefficients that also match the combined estimate but they fail to achieve statistical significance presumably because of the smaller sample sizes. It might also be worried that the sample of movers (both into and out of piece rates and bonuses) is somehow not representative of the broader sample. To test this we ran the original pooled logit on only the sample of movers and recovered significant positive estimates of approximately the same size as those in the entire sample (these are available upon request). Thus, the initial fixed effect estimates do not seem to be artifacts of sample selection.

We recognize that we have two sets of three adjacent waves. There are several waves between the 1990 and 1996 waves and this gap may account for a large share of the transitions. To examine this we limited our sample to only the second set of three adjacent waves which allows only two opportunities for transitions. The resulting fixed effect estimator remains positive and significant despite the substantial loss of variation. In the first set of adjacent waves, the estimate retains rough size but it misses statistical significance. Statistical significance remains in the pooled estimate across the first waves. Thus, while not definitive, we think it is unlikely that the break in the data is somehow generating the results.[5]

Column 2 reproduces the fixed effect estimates but limits even further the source of the variation. In this estimate each worker and employer match is held constant. Thus, a worker changing from an employer paying time rates to one paying piece rates does not influence the coefficient as it would have in the first column. The estimated role of receiving piece rates or bonuses is now be measured by a given worker with a given employer changing the nature of their payment scheme. While this asks a lot of the data, it goes far in controlling for both invariant worker components and invariant employer components. Thus, even if workers are randomly distributed across employers, it may be the case that employers with technology that allows piece rates or bonuses are also those with higher inherent risk of injury. The transition data in the Appendix Table shows that about half of the previous observations used in the individual fixed effect are lost showing that many workers have a change in payment scheme associated with a change in employer.

Despite the loss of both observations and a source of variation, the evidence makes clear that the payment method continues to play a role. The positive and significant coefficient for blue-collar workers remains in Column 2 as does the lack of significance for white-collar workers (available upon request). Thus, even controlling for worker in employer invariant heterogeneity, Adam Smith's conjecture that the method of pay influences injury and illness appears to receive support.

We now explore the difference between injuries on the job and illnesses on the job. The raw statistics indicate that across the entire sample 2,198 worker wave observations report injury and 167 worker wave observations report illness. We take this distinction to the estimates in Table 6. Here we show the final worker with employer fixed effect estimates separately for injury and illness. As might be anticipated, the results for injury appear to be driving the previous results. There is not a significant relationship between receiving such forms of pay and illness. These estimates are again for blue collar workers and no relationship for either injury or illness could be found for white collar workers.

This pattern seems reasonable for several reasons. First, the number of years being observed may not be sufficient to generate a meaningful number of work related illnesses. Second, these illnesses may be more likely to appear later in careers and the NLSY cohort remains young at the time of our observation. The average age in the latter three years is only 37. Thus, using a longer panel with older workers might yield different results (See Bender and Theodosiou 2013). While there is no evidence of an association with illness, the NLSY does provide evidence of a strong association between work place injury and payment method.

We now summarize the evidence on our original concern that time invariant worker characteristics such as risk preferences were correlated with both injury rates and the piece rate /

bonus indicator. Despite this concern, the fixed effect estimates continue to show a relationship between payment method and injury. In Table 7 we highlight the critical coefficient for the influence of piece rates and bonuses across six separate estimates. All estimates are limited to blue collar workers. Those in the top row examine the combined injury and illness indicator while those in the bottom row examine only injury. The first two estimates are for the pooled logit, the next two for the worker fixed effect estimate and the last two for the worker in employer fixed effect estimate. All estimated influences are given in terms of the log-odds. This provides a sensible way of comparing the pooled and fixed effect estimates (Long 1997).[6]

The pooled estimate implies that those paid by piece rates and bonuses face odds of being injured that are 33 percent larger than otherwise equal workers receiving only time rates. In the worker fixed effect estimate, a worker that moves from a time rate to a piece rate or bonus experiences a 43 percent increase in the probability of an injury. Finally, the last estimate indicates that a worker remaining with the same employer but moving from a time rate to a piece rate or bonus experiences a 48 percent increase in the probability of an injury. The modest increases in the fixed effect estimates should probably be discounted as any two of the three estimates are within the confidence interval of the remaining estimate. In essence, the three estimates return indistinguishable results. This suggests that invariant worker effects are not misleadingly driving an association between injury and performance pay. This provides a unique suggestion that actual behavior of workers may change in response to performance pay to heighten the chance of injury.

We now briefly describe several additional robustness exercises. First, we observed that 77 percent of workers who identify the fixed effect estimates for blue-collar workers were men. We estimated the fixed effect estimates separately for each gender and found that the point estimates for each gender were positive and large but only that for males was statistically significant. When carried over to the worker with employer fixed effects the coefficient for women was smaller but that for men remained large and highly significant. Second, we experimented with separating out the piece rates and bonuses. The pattern that resulted was mixed. Despite the relatively small number of workers earning piece rates, the coefficient emerged as larger than that for bonuses in the worker with employer fixed effect estimate. Moreover, both were statistically significant at the one percent level (available from the authors). In the worker fixed effect estimates, the coefficient for piece rates remained larger for piece rates than for bonuses but fell just below statistical significance at the 10 percent level. The coefficient for bonuses remained highly significant. Thus, while these robustness tests provide additional detail, they do not undermine the association between injuries and payment schemes that rely on piece rates and bonuses.

Confirming such an association is important because while a long string of research demonstrates that piece rates increase productivity, recent work has increasingly suggested a series of unintended consequences that reduce profitability. Increased injury risk and the resulting costs have been pointed to as one of those unintended consequences. Moreover, the association is important not only in its own right but also because it may imply that a portion of the return to piece rates and bonuses may represent a compensating differential.

It might be tempting to use the injury variable to directly test for compensating differentials and then determine how piece rates moderate such a test. Yet, this proves uninformative as the variable measures an actual injury sustained by a worker rather than the risk of injury associated with a worker's job or detailed occupation. It is the latter which is the typical variable used in the compensating differential literature (Black and Kneisser 2003). Actual injuries and the associated lost work time and disabilities are well recognized to be associated with reduced earnings (Boden and Galizzi 2003; Crichton et al. 2011) making it impossible to uncover a positive compensating differential. Thus, estimating a compensating differential with this data is hobbled by the absence of outside evidence on risk of injury by the job. Finally, it is also hampered by the absence of key identifying variables such as wealth and non-labor earnings critical for controlling for income effects that tend to suggest that those with high incomes buy more of all on-the-job amenities including reduced injury risk (see Viscusi 1978).

In the end, we cannot offer direct evidence on the implication that the return to piece rates may represent, in part, a compensating differential for increased chance of injury. We have shown that our data follows the large literature confirming the return to piece rates and we have shown that those piece rates are associated with a higher chance of injury. Superior data will be required for a proper test of the interaction between piece rates, injuries and compensating differentials.

6. Conclusion

We built up a series of estimates using the NLSY to explore a link isolated by Adam Smith. He suggested that the incentive to produce more created by piece rates causes workers to take risks with their health. We show that piece rate and bonus workers have substantially higher risk of injury that cannot be explained by their personal or employer characteristics.

We show that the risk associated with these payments is largely a blue-collar phenomenon and that it applies to injury but not to broader illness. Yet, we recognize that the age of the NLSY cohort limits our ability to draw conclusions on illness. Throughout the series of estimates, the marginal effect associated with piece rates is not only statistically significant but large and robust. It is typically in the neighborhood of 1 to 2 percentage points. Critically, our attempts to account for sorting do not fundamentally alter the basic result. We controlled first for worker specific invariant characteristics and found a significant association remained. We then controlled for worker and employer match specific invariant characteristics and continued to find a large significant association. Thus, we are unable to rule out Adam Smith's conjecture that workers respond to output incentives by changing behavior in ways that are detrimental to their health. We again emphasize that one should not assume such changes are detrimental over-all as workers may have an increased chance of injury but also higher earnings.

While we have assumed that workers respond to incentives by working with greater speed and effort, our data does not allow tracing out that process. We recognize that the incentives may also result in reduced breaks or reduced investment and effort in safety and maintenance. These tasks are likely to be unrewarded by piece rates and bonuses and so adverse specialization moves workers away from them and toward production, and with production, injury. Future work might focus on exactly how the mix of activities changes as a result of performance pay.

Table 1: Injury/illness rate by sub-sample (NLSY waves 1988, 1989, 1990, 1996, 1998, 2000)

	Whole sample	Piece rates / bonuses	Tips, stock options, commissions or other
Whole sample	0.064 (0.245) [36,871]	0.072 (0.259) [6,083]	0.055 (0.228) [4,557]
Blue collar	0.080 (0.271) [19,100]	0.100 (0.300) [2,887]	0.083 (0.276) [1,342]
White collar	0.048 (0.213) [17,771]	0.048 (0.213) [3,196]	0.044 (0.204) [3,215]

The standard deviation is presented in parenthesis and the sample size is in brackets.

Table 2: Summary statistics and definitions

Variable	Definition	Mean (St. Dev.)
Piece rate / bonus	Paid by piece rate or bonuses	0.165 (0.371)
Other pay	Paid by tips, commissions, stock options or another form	0.124 (0.329)
College	College degree or more education	0.180 (0.384)
Married	Worker is currently married	0.510 (0.500)
Male	Worker is male	0.531 (0.499)
Age	Age in years	31.738 (5.089)
Age squared	Age in years x age in years	1033.185 (331.800)
Hispanic	Worker is Hispanic	0.173 (0.378)
Black	Worker is Black	0.266 (0.442)
Hours	Usual weekly hours worked	41.051 (10.311)
Big firm	More than 200 employees at worker's location	0.286 (0.452)
Union member	Worker is a member of a union	0.104 (0.305)
Tenure	Worker's time at employer in weeks	196.972 (222.134)
Tenure squared	Time at employer x time at employer	88140.100 (182695.0)
Blue collar	Worker is in the following occupations: administration support, farming, forestry, fishing, precision production, craft, repair, operators, fabricators, laborers	0.518 (0.500)
Physical effort	Worker's job requires "lots of physical effort" all or most of the time. (Only found in the 1998 and 2000 waves; n=10,438)	0.339 (0.473)
Daily Smoker	Worker has smoked daily at some point in their lives. (Only found in the 1998 wave)	0.450 (0.498)

Total number of observations equals 36,871 across all 6 NLSY waves unless otherwise noted.

Table 3: Payment methods and risk of injury, NLSY (waves 1988 – 1990 and 1996 – 2000)

	Whole sample logit estimations			
	(1)	**(2)**	**(3)**	**(4)**
Piece rate / bonus	0.117*	0.149**	0.180**	0.185***
	(1.680)	(2.104)	(2.551)	(2.565)
	{0.007}	{0.011}	{0.009}	{0.011}
Other pay	-0.233***	-0.194**	-0.152	-0.117
	(-2.603)	(-2.184)	(-1.611)	(-1.301)
College	-----	-1.134***	-1.106***	-0.794***
	-----	(-10.021)	(-9.581)	(-6.279)
Married	-----	-0.068	-0.097	-0.094
	-----	(-1.163)	(-1.641)	(-1.582)
Male	-----	0.481***	0.316***	0.066
	-----	(7.817)	(4.890)	(0.889)
Age	-----	0.039	-0.018	-0.021
	-----	(0.488)	(-0.216)	(-0.252)
Age squared	-----	-4.38×10^{-4}	3.37×10^{-4}	4.09×10^{-4}
	-----	(-0.360)	(0.272)	(0.328)
Hispanic	-----	-0.160**	-0.142*	-0.138*
	-----	(-2.192)	(-1.946)	(-1.868)
Black	-----	-0.347***	-0.332***	-0.366***
	-----	(-5.106)	(-4.848)	(-5.259)
Hours	-----	-----	0.017***	0.017***
	-----	-----	(6.621)	(6.665)
Big firm	-----	-----	-0.018	-0.024
	-----	-----	(-0.267)	(-0.353)
Union member	-----	-----	0.569***	0.421***
	-----	-----	(6.867)	(4.889)
Tenure	-----	-----	0.001***	0.001***
	-----	-----	(3.601)	(4.124)
Tenure squared	-----	-----	-1.47×10^{-6}***	-1.60×10^{-6}***
	-----	-----	(-3.092)	(-3.376)
Industries	No	No	No	Yes
Occupations	No	No	No	Yes
Constant	-2.395***	-3.175**	-3.005**	-2.999**
	(-43.748)	(-2.505)	(-2.328)	(-2.219)
Observations	36,871	36,871	36,871	36,871

All models include year dummies and survey population weights. Marginal effects are in brackets and robust standard errors are calculated. T-statistics are in parentheses with ***, ** and * indicating statistical significance at the 1%, 5% and 10% level, respectively.

Table 4: Payment methods and risk of injury, NLSY (waves 1998 and 2000)

	Sub-sample logit estimations			
	Blue collar workers		**White collar workers**	
	(1)	**(2)**	**(3)**	**(4)**
Piece rate / bonus	0.358**	0.350**	-0.367	-0.346
	(2.117)	(2.078)	(-1.596)	(-1.501)
	{0.025}	{0.025}	{-0.015}	{-0.014}
Other pay	-0.221	-0.220	0.111	0.144
	(-1.297)	(-1.288)	(0.522)	(0.677)
Job requires lots of physical effort	-----	0.332**	-----	0.532***
	-----	(2.151)	-----	(3.069)
Worker controls	Yes	Yes	Yes	Yes
Job controls	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes
Occupations	Yes	Yes	Yes	Yes
Constant	-26.566**	-26.492**	13.466	14.618
	(-1.975)	(-1.970)	(0.837)	(0.911)
Observations	5,120	5,120	5,318	5,318

All models include year dummies and survey population weights. Marginal effects are in brackets and robust standard errors are calculated. T-statistics are in parentheses with ***, ** and * indicating statistical significance at the 1%, 5% and 10% level, respectively.

Table 5: Payment methods and risk of injury, respondents to smoking variable, NLSY (waves 1988 – 1990 and 1996 – 2000)

	Logit estimations				
	Whole sample	**Blue collar**		**White collar**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Piece rate / bonus	0.141*	0.220**	0.222**	0.027	0.031
	(1.737)	(2.191)	(2.220)	(0.205)	(0.232)
	{0.008}	{0.016}	{0.017}	{0.001}	{0.001}
Other pay	-0.047	-0.043	-0.042	-0.034	-0.032
	(-0.457)	(-0.294)	(-0.290)	(-0.230)	(-0.216)
Worker has smoked daily	0.248***	-----	0.217**	-----	0.296***
	(3.513)	-----	(2.397)	-----	(2.716)
Demographic controls	Yes	Yes	Yes	Yes	Yes
Job controls	Yes	Yes	Yes	Yes	Yes
Industries	Yes	Yes	Yes	Yes	Yes
Expanded occupations#	Yes	Yes	Yes	Yes	Yes
Constant	-1.726	-3.813**	-3.917**	-0.381	-0.212
	(-0.987)	(-1.978)	(-2.032)	(-0.148)	(-0.082)
Observations	28,947	15,046	15,046	13,901	13,901

All models include year dummies and survey population weights. Marginal effects are in brackets and robust standard errors are calculated. T-statistics are in parentheses with ***, ** and * indicating statistical significance at the 1%, 5% and 10% level, respectively. #Occupation categories now total 138.

Table 6: Payment methods and risk of injury or illness, blue collar workers, NLSY (waves 1988 – 1990 and 1996 – 2000)

	Sub-sample conditional logit estimations			
	Worker fixed effects	**Worker in employer fixed effects**		
	Injury or illness	**Injury or illness**	**Injury only**	**Illness only**
	(1)	**(2)**	**(3)**	**(4)**
Piece rate / bonus	0.307***	0.333**	0.393***	-0.756
	(3.024)	(2.449)	(2.816)	(-0.994)
Other pay	-0.213	-0.218	-0.235	0.313
	(-1.531)	(-1.157)	(-1.205)	(0.430)
College	0.156	0.532	0.398	2.533
	(0.319)	(0.815)	(0.538)	(1.421)
Married	-0.142	-0.175	-0.224	0.769
	(-1.302)	(-1.055)	(-1.293)	(0.712)
Age	-0.000	-0.307	-0.263	-1.097
	(-0.001)	(-1.038)	(-0.877)	(-0.729)
Age squared	0.002	0.007*	0.007*	0.009
	(1.128)	(1.879)	(1.794)	(0.384)
Hours	0.013***	0.007	0.008	-0.079
	(2.637)	(0.948)	(1.037)	(-1.332)
Big firm	0.126	0.072	0.079	-0.942
	(1.141)	(0.403)	(0.439)	(-0.603)
Union member	0.387**	0.156	0.123	1.158
	(2.456)	(0.632)	(0.494)	(1.063)
Tenure	0.004***	1.34×10^{-4}	0.001	0.003
	(6.285)	(0.042)	(0.274)	(0.271)
Tenure squared	-3.55×10^{-6}***	-2.41×10^{-6}***	-2.09×10^{-6}**	-1.37×10^{-5}**
	(-5.037)	(-2.918)	(-2.498)	(-2.279)
Industries	Yes	Yes	Yes	Yes
Occupations	Yes	Yes	Yes	Yes
Observations	4,390	2,361	2,265	169

Robust standard errors are calculated. T-statistics are in parentheses with ***, ** and * indicating statistical significance at the 1%, 5% and 10% level, respectively.

Table 7: Impact of bonus/piece rate pay on risk of injury or illness, blue collar workers, NLSY (waves 1988 – 1990 and 1996 – 2000)

	Pooled Logit	**Worker fixed effects**	**Worker in employer fixed effects**
Injury or illness	1.280*** (3.345)	1.359*** (3.024)	1.394** (2.449)
Injury only	1.328*** (3.782)	1.433*** (3.438)	1.482*** (2.816)

All results are odds ratios and each entry comes from a separate regression estimate. T-statistics are in parentheses and reflect robust standard errors.

Appendix: Number of movements into and out of piece rate / bonus payment schemes

	Exit from piece rate / bonus pay schemes	Entry into piece rate / bonus pay schemes
Same worker movements	2,699	2,738
Same worker in same employer movements	1,429	1,476

REFERENCES

Banker RD, Field, JM Schroeder RG Sinha KK (1996) Impact of Work Teams on Manufacturing Performance: A Field Study. *Academy of Management Journal* 39(4): 867 – 890

Barsky, Robert B., F. Thomas Juster, Miles S. Kimball and Mathew D. Shapiro. 1997. "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study." *Quarterly Journal of Economics,* Vol. 112, pp. 537–79.

Baum CF (2006) *An Introduction to Modern Econometrics Using Stata*. Stata Press: College Station Texas

Belman DL, Monaco KA, Brooks TJ (2005) *Sailors of the Concrete Sea: A Portrait of Truck Drivers' Work and Lives*. Michigan State University Press: East Lansing Michigan

Bender KA, Green CP, Heywood JS (2012) "Piece rates and Workplace injury: Does survey evidence support Adam Smith? *Journal of Population Economics* 25(2): 569 - 590.

Bender, KA and Theodossiou I. (2013) "The unintended consequences of the rat race: The detrimental effects of performance pay on health." Working Paper, Department of Economics, University of Aberdeen.

Black DA,. Kneisser TJ (2003) On the Measurement of Job Risk in Hedonic Wage Models. *Journal of Risk and Uncertainty* 27(3): 205 – 220.

Bockerman, P, Johansson E, Kauhanen A (2012) Innovative Work Practices and Sickness Absence: What does a Nationally Representative Employee Survey Tell? *Industrial and Corporate Change* 21(3) 587 – 613.

Boden L, Galizzi M (2003) Income Losses of Women and Men Injured at Work. *Journal of Human Resources*, 38(3): 727 – 757.

Booth AL, Frank J (1999) Earnings, Productivity, and Performance-Related Pay. *Journal of Labor Economics* 17(3): 447 – 463.

Brown C (1990) Firms' Choice of Method of Pay. *Industrial and Labor Relations Review* 43(s): 165s – 82s.

Brown S, Farrell L, Harris M, Sessions JG (2006) Risk Preference and Employment Contract Type. *Journal of the Royal Statistical Association A* 169: 849–863.

Chamberlain, G (1980) Analysis of Covariance with Qualitative Data. *Review of Economic Studies* 47(2) 225 – 38.

Cornellissen T, Heywood JS, Jirjahn U (2011) Performance Pay, Risk Attitudes and Job Satisfaction. *Labour Economics* 18(2): 229 – 239.

Crichton S, Stillman S, Hyslop D (2011) Returning to Work from Injury: Longitudinal Evidence on Employment and Earnings. *Industrial and Labor Relations Review* 64(4): 765 – 785.

Curme M, Stefanec N (2007) Worker Quality and Labor Market Sorting. *Economics Letters* 96(2): 202 – 208.

Dale-Olsen H (2006) Estimating Workers' Marginal Willingness to Pay for Safety using Linked Employer–Employee Data. *Economica* 73(294): 99 – 127.

Dembe AE, Erickson JB, Delbos RG, Banks SM (2005) The Impact of Overtime and Long Work Hours on Occupational Injuries and Illnesses: New Evidence from the United States. *Occupational and Environmental Medicine* 62: 588 – 597.

Foster AD, Rosenzweig, MR (1994) A Test for Moral Hazard in the Labor Market: Contractual Arrangements, Effort, and Health. *Review of Economics and Statistics* 74(2): 213 – 227.

Freeman RD, Kleiner M (2005) The Last American Shoe Manufactures: Decreasing Productivity and Increasing Profits in a Shift from Piece Rates to Continuous Flow Production. *Industrial Relations* 44(2): 307 – 330.

Frick B, Gotzen U, Simmons R (2013) The Hidden Costs of High Performance Work Practices:

Evidence form a Large German Steel Company. *Industrial and Labor Relations Review* 66(1): 189 – 214.

Garen J (1988) Compensating Wage Differentials and the Endogeneity of Job Riskiness. *Review of Economics and Statistics* 70(1): 9 – 16

Gibbons R (1998) Incentives and Careers in Organizations. *Journal of Economic Perspectives* 12(4): 115 – 132

Gielen AC, Kerkhofs MJM, van Ours, JC (2010) How performance related pay affects productivity and employment. *Journal of Population Economics* 23(4): 291 - 301

Green CP, Heywood JS (2008) Does Performance Pay Increase Job Satisfaction? *Economica* 75(300): 710 – 728

Grund C, Sliwka D (2010) Evidence on Performance Pay and Risk Aversion. *Economics Letters* 106(1): 8 – 11.

Haley MR (2003) The Response of Worker Effort to Piece Rates: Evidence from the Midwest Logging Industry. *Journal of Human Resources* 38(4): 225 – 249

Hersch, Joni and Viscusi W. Kip (1990) Cigarette Smoking, Seatbelt Use and Differences in Wage-Risk Tradeoffs. *The Journal of Human Resources* 25(2): 202 – 227.

Hersch, Joni and Pinkton, T.S. (1995). 'Risk Taking Activities and Heterogeneity of Job-Risk Tradeoffs'. *Journal of Risk and Uncertainty* 11(2): 205–17.

Heywood, JS, X. Wei and G. Ye (2011) Piece Rates for Professors. *Economics Letters* 113(3): 285 – 287.

Holmstrom B, Milgrom P (1987) Aggregation and Linearity in the Provision of Intertemporal Incentives. *Econometrica* 55(2): 303 – 328

Jones D, Kalmi P, Kauhanen, A (2010) Teams, Performance-Related Pay, Profit-Sharing and

Productive Efficiency: Evidence from a Food-Processing Plant. *Industrial and Labor Relations Review* 63(4): 606 - 626

Korn EL, Graubard BI (1990) Simultaneous testing of Regression Coefficients with Complex Survey Data: Use of Benferroni *t*-Statistics. *The American Statistician* 44(4): 270 – 276

Lazear EP (2000) Performance Pay and Productivity. *American Economic Review* 90(5): 1346 – 1361

Lazear EP (1986) Salaries and Piece Rates. *Journal of Business* 59(3): 405 – 431

Long, JS (1997) *Regression Models for Categorical and Limited Dependent Variables*. Sabe Publications: Thousand Oaks CA.

MacDonald G, Marx LM (2001) Adverse Specialization. *Journal of Political Economy* 109(4): 864 – 899

Maddala GS (1987) Limited Dependent Variable Models using Panel Data. *Journal of Human Resources* 22(3): 205 – 38.

Monaco K, Williams, E (2000) Assessing the Determinants of Safety in the Trucking Industry. *Journal of Transportation and Statistics* 3(2): 69 – 80.

Parent D (2002) Performance Pay in the United States: Its Determinants and Effects. In Brown M, Heywood JS (eds) *Paying for Performance: An International Comparison*. M.E Sharpe Publishers: Armonk NY.

Parent D. (1999) Methods of Pay and Earnings: A Longitudinal Analysis. *Industrial and Labor Relations Review* 53(1): 71 – 86.

Pekkarinen T, Riddell C (2008) Performance Pay and Earnings: Evidence from Personnel Records. *Industrial and Labor Relations Review* 61(3): 297 - 319

Rodriquez DA, Targa, F Belzer, M (2006) Pay Incentives and Truck Driver Safety: a Case

Study. *Industrial and Labor Relations Review* 59(2): 205 – 225

Saha A, Tamnath T, Chaudhuri R, Saiyed H (2004) An Accident-Risk Assessment Study of Temporary Piece Rated Workers. *Industrial Health* 42(3): 240 – 45

Seiler E. (1984) Piece Rates vs. Time Rates: The Effect of Incentives on Wages. *Review of Economics and Statistics* 46(3): 363 – 376

Smith A (1776) *An Inquiry into the Nature and Causes of the Wealth of Nations* as reprinted in 1909, edited by CJ Bullock, PF Collier & Son: New York.

Sundstroem-Frisk C (1984) Behavioral Control through Piece-rate Wages. *Journal of Occupational Accidents* 6(1-2): 49-59

Toupin D, LeBel L, Dubeau, D, Imbeau D, Bouthiller L (2007) Measuring the Productivity and Physical Workload of Brushcutters within the Context of a Production-Based Pay System. *Forest Policy and Economics* 9(8): 1046 – 55

Viscusi WK (1978) Wealth Effects and the Premiums for Job Hazards. *Review of Economics and Statistics* 60(3): 408 – 16

Viscusi, WK Hersch J (2001) "Cigarette Smokers as Job Risk Takers." *Review of Economics and Statistics* 83(2): 269 - 280

Williamson A, Bohle P, Quinlan M, Kennedy, D (2009) Short Trips and Long Days: Safety and Health in Short-Haul Trucking. *Industrial and Labor Relations Review* 62(3): 415-429

Wooldridge J (2002) *Econometric Analysis of Cross-Section and Panel Data*. MIT Press: Cambridge MA.

ENDNOTES

[1] See Dale-Olsen (2006) for a recent confirmation of compensating differentials for injury.

[2] Garen (1988) similarly emphasizes the endogeneity of injury risk arguing that workers with the largest earnings capacity and most aversion will avoid the risk as safety is a normal good.

[3] Specifically the question asks "I would like to ask you a few questions about any illness or injury you might have received or gotten while you were working on a job. Since (date of last interview) have you had an incident at any job that resulted in an injury or illness to you?" In cases in which workers held more than one job, we limit ourselves to those that indicate they suffered such an incident on their "primary" job and then match all job characteristics to the same primary job (See Dembe et al. 2005 for more detail).

[4] Starting in 2002 the NLSY replaces this narrower bonus question with one that asks about bonuses from virtually any source including profit sharing. Yet, we emphasize that the injury questions were not asked after 2000.

[5] We also split the estimates by gender which again reduces sample size. When combining blue and white collar workers both genders show a significant positive coefficient in the fixed effects. When further splitting the sample, the blue collar result is highly significant for males but the separate estimates for females miss significance while both being positive.

[6] Indeed, the two standard marginal effect routines available for the conditional (or fixed effect) logit in the current version of STATA are an unsatisfactory linear projection and a marginal effect projected on the assumption that all fixed effects are zero.