A Note on the Robustness of OSHA Ergonomics Benefits

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I. Introduction

In proposing its rule on ergonomics\(^1\), the Occupational Safety and Health Administration (OSHA) relied extensively on data from a study by Webster and Snook (1994) of Liberty Mutual Insurance Company compensation claims from 1989 for cumulative trauma disorders (CTDs), which OSHA treats as equivalent to the “musculo-skeletal disorders” (MSDs) targeted by its rule.\(^2\) While the authors of the original study were cautious regarding claims about and extrapolations from the data they used, OSHA was evidently less so. Throughout its evaluation of the proposed rule, OSHA relied on mean cost estimates from the Webster and Snook study to determine the nationwide expected costs and benefits of its proposed rule. While arithmetically, this may be a convenient approach, it can lead to seriously misleading inferences in cases where the sample data are not normally distributed.

This note briefly examines some of the uses to which the study data were put by OSHA in its determination of the rule’s expected benefits. It also examines the magnitude of inferential error that can result when skewed data are used to derive results that rely on an implicit assumption of normality. Finally, it concludes with a cursory examination of the rule’s promulgation from the perspective of whether political preferences for a particular regulatory outcome can override rational political calculus.

II. How Much Do MSDs Cost?

OSHA estimated that its proposed ergonomics rule will generate benefits to society exceeding $9.1 billion per year based on mean per-case cost estimates of $8,070 provided in
Mean cost estimates, however, can overstate expected benefits for most injury claimants if a handful of outliers disproportionately influence the distribution of costs. Indeed, in their study, Webster and Snook took pains to point out that the Liberty Mutual data were skewed to the right in the distribution, and even cursory examination of the data they presented substantiates this observation. New Hampshire, for example, reported 48 cases in 1989 with a median cost of $3,175, and a mean cost of $28,430. The mean and median data for all 45 reporting states are plotted in Figure 1, and suggest immediately that a relative handful of outlier case costs are skewing the mean results significantly.

**Figure 1**
Mean and Median Costs of Cumulative Trauma Disorders by State  
*Source: Webster and Snook (1994, Table 2)*

Overall, among the 45 states reporting cumulative trauma disorders, the median per-case cost was $824, or nearly an order of magnitude lower than the overall mean estimate. In other words, the majority of all CTD claims were settled for less than a thousand dollars. In addition, it is important to note that states with larger sample sizes saw their mean costs
converge toward the median and therefore toward the lower end of the cost estimates. In the analysis by Dudley discussed elsewhere in the symposium, a mean cost of $3,000 per case results from eliminating the largest outliers. Dudley’s analysis adjusts both expected costs and benefits of the proposed rule, and shows that a more normally shaped distribution causes the rule to in its proposed form to be uneconomical.

III. On the Benefits from Means and Medians

The difficulty in assessing the societal benefits that might flow from the imposition of an ergonomics rule stems in part from the relative newness of ergonomics as a science in its own right and from a paucity of reliable injury data. Ambiguity exists, for example, as to the time and place where actual injuries may have occurred (e.g., was one’s back pain caused by a poorly designed office chair, or by 36 holes of golf over the previous weekend?). Definitional disputes may also exist over what constitutes an injury (e.g., is wrist pain the onset of arthritis or an episode of Carpal tunnel syndrome?), as well as what measures can reasonably be expected to relieve reported symptoms. In econometric terms, analyzing MSDs involves the familiar potential for both identification and measurement errors.

Laying identification difficulties aside however, of the MSD data that are available, one still must carefully evaluate any sample distribution’s shape and therefore the measure of center used to estimate expected costs. Under a normal distribution of course, the mean is the customary choice since it has desirable properties, including economy of computation and equivalency with other measures of center, including the median. However, as a sample distribution departs from normality, estimates derived from the mean will become increasingly less robust. That is, a handful of observations can have an arbitrarily large effect on the resulting expectation formation of the rule’s effects on social welfare (i.e., on
the utility of the rule to most citizens). When confronted with policy questions that involve considerations of social utility, Levy (1995, pp. 313-14) observes that:

The mean well-being requires both the obnoxious interpersonal additivity requirement and is terribly sensitive to ‘utility monsters’, the philosophical counterpart of statistical outliers. On the contrary, the median well-being requires only being able to order the well-being of individuals across institutions and it is maximally insensitive to outliers or computational errors at the extremes.

In other words, the measure chosen to reflect expected utility will determine the potential benefits that one might expect to accrue, and therefore will determine the practical reach of the proposed rule. By relying on mean-based measures, OSHA has chosen the option of allowing a relatively few right-tailed observations to influence this determination inordinately, rather than the welfare of the broad majority of citizens. Whether this choice reflects a good or bad policy judgment on OSHA’s part is not a determination this paper can make. However, the observation itself does beg the question: what combination of constraints and incentives may have contributed to OSHA’s choice?

IV. Constrained Truth-Seekers?

To frame the question slightly differently, does the choice of a mean-based metric reflect the preferences of individual regulators, or does it reflect a benevolent concern for the public’s well-being? The tendency for scientists as well as policymakers to present facts comporting with a particular world-view is widely documented. Standard economic assumptions suggest that investigators can be motivated by preferences for certain outcomes just as anyone else can, and in fact may engage in activities designed to secure those outcomes—subject to prevailing constraints. In the world of scientific inquiry, these activities can range from the relatively benign, such as using ordinary least squares estimates
to analyze data that do not exhibit normally distributed error terms, to less benign procedures such as falsifying datasets, or deliberately reporting incorrect results.

Peer review and scientific replication of reported results, however, typically operate as two powerful constraints against any such tendencies among scientists. Thus, even if a scientist were to pursue his preferences at the expense of truth, the costs in terms of lost reputation upon being discovered could be quite steep. Conversely though, the constraints of peer review and replication operate less powerfully in the world of regulation. From a political perspective moreover, even the corrective threat of periodic electoral recall is less binding for regulators than for elected politicians. Consequently, one might expect the opportunities and incentives to indulge personal policy preferences to be larger among regulators than they are among scientists or legislators, since the constraints operating against such regulatory behavior bind less tightly.

Indeed, rational political calculus suggests that elected officials will tend to weigh a policy’s cost and benefits according to its effects on the median voter, inasmuch as the median is the center around which majorities form. Were this calculation undertaken by the unelected officials at OSHA with respect to their ergonomics regulation, the rule may not have been promulgated—or at least not in its currently costly formulation. However, to expect such weighing by regulators may be unreasonable, given currently prevailing constraints.

NOTES

1 See Federal Register for the complete text of the proposed rule, which runs to 311 pages. OSHA’s proposed rule seeks to “address the significant risk of work-related musculo-skeletal disorders (MSDs) confronting employees in various jobs in general industry workplaces.” (p. 65768, Federal Register 64)

According to the Oxford English Dictionary (OED), “ergonomics” refers to “The scientific study of the efficiency of man in his working environment.” Interestingly, the initial definition that appears when one
searches the electronic version of the OED (http://etext.lib.virignia.edu/oed) refers to “one who is fond of saying ‘ergo’; a wrangling logician.”

2 OSHA’s definition of MSDs, described in the introductory paper of this symposium, is likely to be more expansive than the CTDs observed in the Webster and Snook sample.

3 In the proposed rule, OSHA’s economic analysis (based on mean per-case costs) estimated average annual benefits of $9.1 billion against average annual costs of $4.2 billion, producing a net benefit of $4.9 billion.

4 Nearly two-thirds of the reported cases (65.3 percent) incurred mean per-case costs less than the overall mean of $8,070, reinforcing the notion a skewed distribution of cost incidence.

5 One way to see this is by dividing a given state’s mean by its median observation. The ratio that emerges provides a rough approximation of the relative skewness of that state’s observations. Just as one might expect, as sample size increases, this skewness ratio tends to decline; although, in the Liberty Mutual dataset it does not reach a normal ratio of 1:1. Although the true population distribution may never approach complete symmetry, it does seem reasonable as a first approximation to expect the mean to converge toward the median. This result obtains because (in the absence of the rule) employers and employees have incentives to reduce the most costly cases first. In the presence of the rule, however, incentives may be structured such that overall costs will rise, thereby forcing the median to rise also.

6 See, for example, Levy (1992, p. xxiii).

7 See, for example, Leamer (1983).

8 See, for example, Black (1958), or Buchanan and Tullock (1962).

9 Of course, the desirability of constrained concern for the welfare of the median citizen rests itself on an implicit assumption of a unimodal cost distribution. It may very well be that, in proposing the ergonomics rule, OSHA regulators were serving some other concentrated constituency, and in so doing, establishing the incentives that will create a bimodal distribution of costs. (Under bimodality, the median ceases to be a robust estimate of center.) Consideration of that factional alternative, although interesting, is beyond the scope of the present note, however.

REFERENCES


