# NON-RESPONSE BIAS ANALYSES OF THE SURVEY OF WORKPLACE VIOLENCE PREVENTION

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**Abstract**[1]

This paper examines two methods for analyzing non-response bias using establishment indexed data sets from the 2005 Survey of Workplace Violence Prevention (WVP), the 2003 Survey of Occupational Injuries and Illnesses (SOII), and the BLS Longitudinal Database (LDB). First, comparisons were made using 2003 SOII and LDB frame data conditional on response status to the 2005 WVP survey. The data indicated WVP responders had higher SOII incidence rates than WVP non-respondents, response rates were higher for larger establishments, and for industries with relatively higher risk for workplace violence. Our second method used a two-stage logarithmic regression procedure to investigate the correlation of efforts to contact respondents (mailings and non-response calls) to the likelihood of actually contacting the respondent and securing participation.

Additional effort past the first non-response mailing and first round of non-response calls did not appear to improve the chances of contacting a given respondent. Conditional on making confirmed contact with the respondent, repeated efforts to obtain cooperation were negatively correlated with participation rates.

Based on these findings, we conclude that WVP respondents tended to be establishments that were predisposed to cooperating, most likely had familiarity with occupational hazards, and tended to be those most likely to have programs and training. Therefore, the estimates produced by the Survey of Workplace Violence Prevention of program and training utilization should be regarded as conservatively high estimates despite their low levels.

## 1. The Survey of Workplace Violence Prevention

In September 2005, The National Institute for Occupational Safety and Health (NIOSH), the Bureau of Labor Statistics (BLS), and the U.S. Department of Labor (DOL), conducted a survey of 39,998 establishments regarding their workplace violence prevention awareness and efforts. The data collected from the WVP was intended for use by NIOSH to identify by industry sector (the North American Industry Classification System/NAICS) and establishment size: 1) workplace violence prevention polices and programs; 2) training regarding workplace violence prevention; 3) risk factors associated with workplace violence; and 4) workplace violence prevention strategies. This survey involved an initial mailing of physical survey booklets, a follow-up mailing to non-respondents, and two rounds of calls to non-respondents. Data collection efforts concluded in June 2006, with a final response rate of 61 percent.

The 2005 WVP utilized a stratified probability sample drawn from 2003 SOII respondents. Therefore, the WVP sample was a subsample of SOII respondents. Each year, approximately 250,000 units make up the SOII sample and the survey data are solicited from employers having 11 employees or more in agricultural production, and from all employers in agricultural services, forestry, and fishing; oil and gas extraction; construction; manufacturing; transportation and public utilities; wholesale trade; retail trade; finance, insurance, and real estate; and services (except private households).

We take advantage of this sampling strategy to link three sets of data for analyzing non-response bias in the WVP survey: administrative data from the LDB from which the SOII sample is selected, 2003 SOII responses of establishments selected for the WVP survey in 2005, and indicators of which methods were used to attempt to contact WVP units. The dataset includes whether or not each establishment was actually reached or responded to the survey. By linking the three groups of data by establishment identities, we are able to study patterns in establishment demographics and likelihood of response.

## 2. Estimation Procedures in the Survey of Workplace Violence Prevention

In the WVP probability sample, sample unit weights represent all units in their employment size group for a particular industry. The weight assigned to an establishment is determined by the inverse of the sampling ratio for the industry/employment size group from which the unit was selected. Because not all of the survey forms will be returned, weights of responding employers in a sampling cell are adjusted to account for the non-respondents. An additional adjustment involves

[1] Any opinions expressed in this paper are those of the authors and do not constitute policy of the Bureau of Labor Statistics.

benchmarking to adjust the weights generated using 2003 employment data to reflect the fact that the WVP survey was conducted in 2005 with potentially different relative employments for surveyed firms. Although the final weights used to generate WVP estimates involved both non-response factor and benchmarking factor adjustments, the effects of benchmarking on the WVP estimates are beyond the scope of this paper. We focus attention solely on the non-response adjustment factors (NRAF).

The 39,998 unit subsample of 2003 SOII respondents used as the survey sample for WVP was stratified by three-digit NAICS industry code and employment size class. For each sampling stratum, the NRAF is computed as the number of viable units in the stratum divided by the number of usable units in the stratum. Sample units that are out of business or for which the U.S. Postal Service returns an unopened package of survey materials are not considered viable. Usable units are defined as those whose responses passed data editing criteria. If a sampling stratum contains no usable units, the stratum will be combined with all other size groups in the three-digit industry category, and non-response adjustment is computed for the stratum at the three-digit industry level. An assumption implicit in the adjustment process is that there are no systematic differences between respondents and non-respondents to the survey along the stratification dimensions. If this assumption is incorrect, estimates generated using this adjustment process could be biased.

## 3. Data and Methods for Administrative Data Comparisons

While there are several dominant approaches to quantifying non-response bias, two were used for the WVP survey: comparing frame information between respondents and non-respondents; and a "level-of-effort" analysis which simulates statistics based on a restricted version of the observed protocol. This section focuses on the former method.

Administrative data from the LDB from which the SOII sample was selected was used as "frame information" in order to compare characteristics of WVP respondents and non-respondents. In particular, the total number of hours worked for full-time employees (hours), industry sector at the three-digit NAICS level, and establishment size class[2] were used. Days away from work (DAFW) rates and days of job transfer or restriction (DJTR) rates, taken from the 2003 SOII, were also used as frame informational variables.

Each establishment in the LDB has its own unique identifier. The same identifier that was used in the SOII survey was used in the WVP survey. Thus, combining these three datasets was a fairly straightforward task. Having one complete dataset with frame information and WVP data allowed for analyses of WVP response rates by cross sections of the frame data.

The ultimate goal of these comparisons is to determine if WVP non-respondents have similar characteristics to WVP respondents. If so, this would provide some evidence that there is little non-response error and that final WVP estimates are minimally affected by non-response bias.

### 3.1 WVP Response Rates

**Figure 1. Comparing WVP Respondents and Non-Respondents by Size Class**

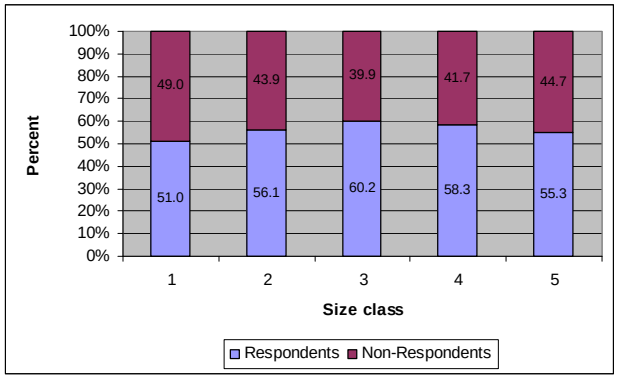
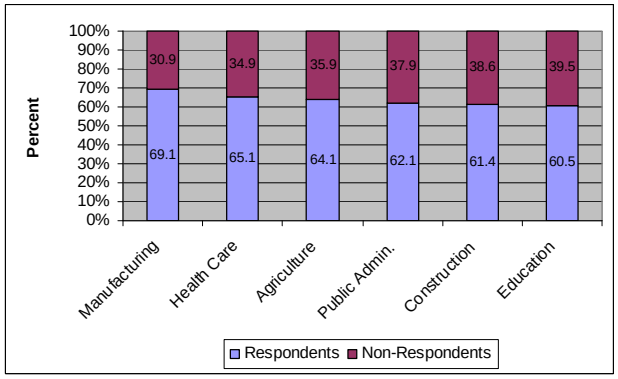



Figure 1 compares the WVP non-response and response rates by size class. The rates for both non-respondents and respondents exhibit a curvilinear effect across size classes, with size class 3 being the peak for respondents and the low for the non-respondents.

**Figure 2. Comparing WVP Respondents and Non-Respondents by Selected Industry Sectors**



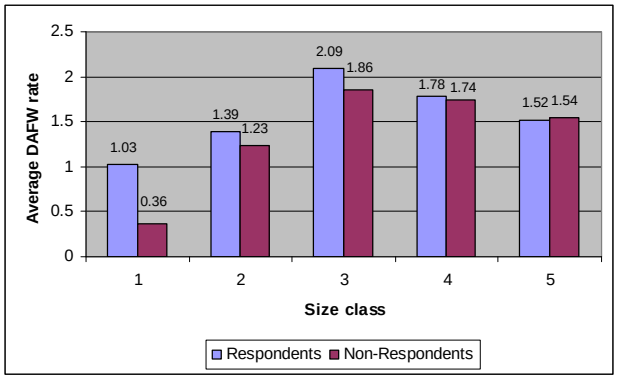

[2] The five size classes are: 1-10 employees (size class 1), 11-49 employees, 50-249 employees, 250-999 employees, and 1000 or more employees (size class 5).

Figure 2 shows the total percent of non-respondents and respondents by selected industry sectors. The selected industries are those that had the highest response rates over all of industry sectors (over 60%): manufacturing; health care; agriculture, forestry, fishing and hunting; public administration; construction; and education services.

For all data provided in figures 1 and 2, a chi-square test of independence was performed, which resulted in significance at the $\alpha$=0.05 level: for size class, $\chi^2$= 100.63 (p-value < 0.0001); and for industry sector, $\chi^2$=968.45 (p-value < 0.0001). This indicates a relationship between an establishment's participation in the 2005 WVP survey and the establishment's size class, and/or industry sector.

### 3.2 SOII Incidence Rates

**Figure 3. Average DAFW Comparisons between WVP Respondents and Non-Respondents by Size Class**



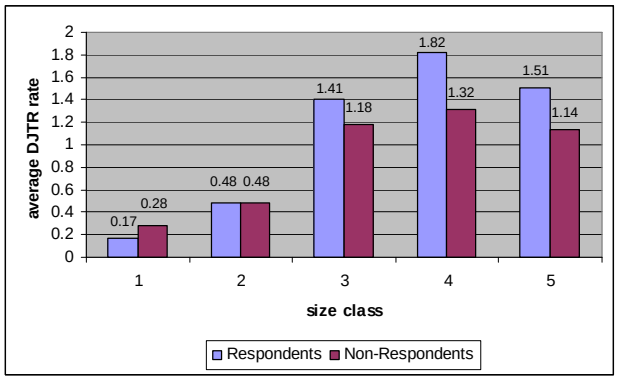

An examination of the DAFW rates and DJTR rates was also considered. Figure 3 shows the mean DAFW rates for non-respondents versus respondents by size class. It is apparent that larger size classes tend to have higher DAFW rate averages, for both WVP respondents and non-respondents.

Individual 2-sample t-tests were also performed for each of the size classes, to determine whether or not there existed a significant difference in mean DAFW rates between respondents and non-respondents. Size classes 1 and 3 were significant at the $\alpha$=0.05 level, p-values being 0.003 and 0.0001, respectively.

A close inspection of the average DJTR rates across size classes strongly illustrates the trend that both respondents and non-respondents in larger size classes experience higher DJTR rates (figure 4).

Also, size classes 3, 4, and 5 show large discrepancies in DJTR means for respondents and non-respondents. In order to assess significant differences between average DJTR rates for respondents versus non-respondents, separate t-tests were performed for each size class, as was done for DAFW average rates.

**Figure 4. Average DJTR Comparisons between WVP Respondents and Non-Respondents by Size Class**




T-tests confirmed a difference between respondents' and non-respondents' DJTR rates for size classes 3, 4, and 5 (p-values < 0.0001 for all three size classes).

An analogous analysis was completed for DAFW and DJTR rates by industry sector. For DAFW rates, four out of the 20 total industry sectors showed higher mean DAFW rates for WVP non-respondents (finance and insurance; mining; other services except public administration; transportation). Similarly, four industries had higher average DJTR rates for non-respondents (agriculture, forestry, fishing and hunting; arts and entertainment; mining; transportation). T-tests showed that transportation was the only industry to have significance at the $\alpha$=0.05 level for those industries that had higher average DAFW and DJTR rates for non-respondents.

## 4. Data and Methods for Level of Effort Analysis

As an alternative method of detecting non-response bias, we turn to a two-stage logistic regression approach that estimates response propensities. The response propensities of a unit measures how likely it is to be contacted and how likely it is to provide data for the survey. Following Olson (2006), we estimate two separate logistic regression equations. The first model uses confirmed contact with the respondent as the dependent variable. This could mean successful delivery by the U.S. Postal Service of a physical WVP survey booklet to a confirmed mailing address, a non-response call that successfully made contact with the targeted establishment, receipt of survey data from the unit regardless of how it was contacted, or even a confirmed refusal to participate. In the second model,

**Table 1. Level of Effort: Response Propensity Models for Contact and Cooperation**

| | Predicting Contact | | Predicting Cooperation, Conditional on Contact | |
|---|---|---|---|---|
| | Coefficient | SE | Coefficient | SE |
| Intercept | 4.6146*** | 0.1290 | 5.1167*** | 0.1756 |
| Frame Variables | | | | |
| Size Class 2 | 0.0646 | 0.7430 | 0.1705 | 0.0996 |
| Size Class 3 | 0.2455** | 0.0679 | 0.3501*** | 0.0908 |
| Size Class 4 | 0.1952** | 0.0695 | 0.257** | 0.0930 |
| Size Class 5 | 0.0874 | 0.0770 | 0.2496* | 0.1024 |
| Hours (FTE worked) | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| DART case rate | 0.0176 | 0.0032 | 0.0178 | 0.0039 |
| Effort Variables | | | | |
| 1st NR mail (Nov 05) | 0.1574 | 0.1703 | -0.6702** | 0.2007 |
| 1st round calling | 0.3470** | 0.1096 | -0.9599*** | 0.1357 |
| 2nd NR mail (Apr 06) | -5.302*** | 0.1322 | -3.7619*** | 0.1042 |
| 2nd round calling | - | - | -5.4309*** | 0.1144 |
| N | 37273 | | 28585 | |
| Likelihood Ratio Chi-Square | 14842.6357*** | | 14864.4626*** | |

*p < 0.05, **p < 0.01, ***p < 0.0001

we considered only those units who were considered to have been successfully contacted and set the dependent variable to be a dummy variable where 1 indicated the unit provided a non-refusal survey response (a 0 indicated non-participation by a unit).

The models in this paper consider four levels of effort on the part of BLS to contact the respondents and secure participation beyond the initial mailing. Two months after the initial mailing of physical survey booklets in September 2005, BLS made a second mailing of booklets to any unit that had not yet responded. Efforts were made by BLS to incorporate updated mailing address information obtained from the United States Postal Service (USPS) on Post Office Returns of undeliverable surveys. In January and February 2006, the first non-response calls were made to any unit that had not yet responded at that time. Phone numbers obtained from the LDB, 2003 SOII returns, and comparison against an updated commercial database of businesses in the United States were used in this round of calls. Subsequent to the first round of non-response calls, a letter was mailed to the remaining pool or respondents. A second round of non-response calls were made in early May 2006 to any unit that had not yet responded at that time, but focused on those contacted in the first round of non-response calls. The call list in this second round incorporated any updated phone number information obtained by BLS agents during the first round of non-response calls.

These four levels of effort were incorporated into the two logistic regression models as indicator variables where 1 meant the unit was included in the group that received the corresponding contact attempt by BLS: the non-response mailing, first round of non-response calls, and second round of non-response calls. Note that because the second round non-response calls were almost exclusively placed to units that were confirmed contacts in the first non-response round, it would be nearly perfectly correlated if placed in the contact propensity model. Therefore, we include only the first three levels of effort indicator variables in the contact propensity model but all four in the cooperation propensity model. Additional independent variables included were size class data and total hours worked by all employees and incidence rate of cases with days away from work, job transfer, or restriction (DART rate).

### 4.1 Estimation Results

Table 1 gives the results for the logistic regressions run for both contact propensity and cooperation propensity. Size class dummy variable coefficients on size classes 3 ($\alpha$=0.01) and 4 ($\alpha$=0.01) in the contact model were positive and statistically significant. Likewise, estimated coefficients for size class 3 ($\alpha$=0.0001), size class 4 ($\alpha$=0.01), and size class 5 ($\alpha$=0.05) in the cooperation model were positive and statistically significant. This supports the curvilinear pattern observed in the previous section: contact and cooperation appear to increase

slightly with the surveyed unit size. However, it is unclear how strong this effect may be. A size class 3 unit with 100 full time employees, each working 2,000 hours annually that was contacted in the first rounds of non-response is only predicted to be one tenth of one percent more likely to be contacted than a comparable size class 1 unit with one FTE working 2,000 hours. A similar comparison produces only one tenth of one percent difference in predicted cooperation rates.

In the contact propensity model, two of the three levels of effort included in the model as independent variables had statistically significant coefficients. The first round of phone calls had a positive coefficient that was significant at the $\alpha$=0.01 level, while the second mailing had a negative coefficient that was significant at the $\alpha$= 0.0001 level. One possible interpretation is that calling the respondent as an additional measure to mailing the survey increased the chances of making contact with the unit. This is completely intuitive, since this involves trying more than one mode of communication. On the other hand, the insignificant negative coefficient on the first non-response mailing and the large significant negative coefficient on the second non-response mailings suggest that trying the same mode of communication additional times (even with address updating from Post Office Returns) at best yields minimal improvement in contact propensity.

In the cooperation propensity model, every level of effort variable had a negative coefficient that was statistically significant at the $\alpha$=0.01 level or better. The detected relationship between the amount of effort exerted by BLS to contact the respondents and the likelihood of securing cooperation is not surprising: the lower the likelihood that particular units were willing to participate in the survey, the more effort was required to attempt to secure their cooperation. However, the small magnitudes of the coefficients on the first non-response mailing and first round of non-response calls are surprising. For a hypothetical size class 3 unit with 100 full time employees working 2,000 hours each in a year, the marginal effects on cooperation rates from those two variables lower the predicted cooperation rate just 2.66 percent, from 99.33 percent to 96.67 percent. That predicted cooperation rates only fall drastically with the second non-response mailing and second round of non-response calls reinforce the findings from the administrative data comparisons: once each contact method had been attempted in non-response, the chances of receiving a response from one of the remaining "difficult" units did not change much with subsequent attempts.

To further investigate this possibility, we analyzed predicted propensity rates for the entire sample and compared the expected likelihood of participation of each unit against whether it actually responded to the WVP survey. Abraham, Maitland, and Bianchi (2006) raise a conjecture that BLS may face "difficult" and "easy" household respondents in the American Time Use Survey (ATUS). Here we examine a similar situation, but along two dimensions. The logistic regression results suggest that the units in the sample could be characterized as "difficult" or "easy" in terms of both contacting and securing a response. E.g. a unit could be "easy" to contact but "difficult" to secure a response from.

**4.2 Predicted Response Rates**

Table 2 displays average actual rates and predicted propensities for both contact and cooperation, by quintile. Following Olson (2006), we ranked the propensities from lowest to highest and divided the sample into five roughly equal size groups so that quintile 1 contains those with the lowest propensity scores and quintile 5 contains those with the highest propensity scores. For both contact and cooperation, strata 4 and 5 are above 99 percent for all units in those strata. Similarly, for both contact and cooperation, strata 1 and 2 consist entirely of units with propensity scores of around 50 percent or below.

The transition from the lower predicted propensity units to the higher predicted propensity units occurs rather suddenly in both the contact and cooperation rankings. For contact, the predicted propensity movement occurs almost entirely within quintile 3. By examining the split between actual contacts and actual non-contacts within that group, we find that quintile 3 consists of a large number of units similar to quintile 4 and 5 units with predicted propensities above 0.9, and a large number of units similar to those in quintiles 1 and 2 with predicted propensities below 0.6. While the mean predicted propensity among actual contacts in quintile 3 is 0.734, the median predicted propensity among those same units is 0.561, suggesting this stark divide within the quintile. A similar phenomenon occurs between quintiles 2 and 3 for cooperation. The median of the actual non-cooperators in quintile 3 is 0.977, indicating a small number of very low propensity score units are grouped with a relatively larger number of very high propensity units to yield a mean propensity for that subgroup of 0.90.

The structure of the sample when ranked by propensity scores is consistent with the pattern of significant coefficients in the regression results. Those results indicated that additional means of contact were not likely to increase the likelihood of actually making contact with a unit or securing cooperation from them. The dichotomous nature of the predicted propensity scores reinforce the characterization of two types of respondents when considering each dimension in turn: one "easy" to

**Table 2. Level of Effort: Response Propensity Strata for Contact and Cooperation**

| | Response Propensity Strata | | | | |
|---|---|---|---|---|---|
| | Low | Group 2 | Group 3 | Group 4 | High |
| Contact | | | | | |
| Actual rate | 0.5055 | 0.5455 | 0.8857 | 0.9934 | 0.9964 |
| (n) | (2538) | (2739) | (4447) | (4988) | (5003) |
| Predicted Non-contact rate | 0.5125 | 0.5436 | 0.5836 | 0.9942 | 0.9949 |
| Predicted Contact rate | 0.5132 | 0.5433 | 0.9175 | 0.9941 | 0.9967 |
| Cooperation | | | | | |
| Actual rate | 0.3576 | 0.5526 | 0.9848 | 0.9944 | 0.9980 |
| (n) | (1410) | (2179) | (3883) | (3921) | (3935) |
| Predicted Refusals rate | 0.3163 | 0.5477 | 0.9843 | 0.9953 | 0.9968 |
| Predicted Cooperation rate | 0.4326 | 0.5559 | 0.9858 | 0.9948 | 0.9967 |

contact or predisposed to agreeing to respond to the survey (our quintile 4 and 5 type units), and one "difficult" to locate or predisposed to not responding to the survey (our quintile 1 and 2 type units). This predisposition to be found or cooperate appears to be the main distinction between respondents and non-respondents, rather than other characteristics.

## 5. Discussion / Conclusion

The 2005 Survey of Workplace Violence Prevention utilized an estimation process that adjusted for non-response based on cells stratified by size class and industry. Due to the unavailability of a dataset containing "true" independent measures of responses for the WVP sample, we are unable to obtain precise and accurate magnitudes of any bias that may be present due to non-response. We are, however, able to make some conjectures regarding the relative direction of potential bias, if any exists.

Analysis of linked data from the BLS Longitudinal Database and 2003 SOII produced some evidence that there may have been relatively more responses from larger units and those with relatively higher rates of occupational injuries and illnesses within particular industries. Logistic regression results and computed propensity scores for both likelihood of contact and likelihood of cooperation confirm slightly higher response rates from larger units. The wide and largely discontinuous separation between WVP respondents and non-respondents lead us to believe the sample may be justifiably characterized as having "easy" and "difficult" units regarding contact and cooperation.

Overall, the data presented in this paper imply that the estimates generated by the methods used in the WVP may be slight overestimates regarding policy and program implementation. Table 3 presents some of the patterns observed in the WVP data that suggest larger establishments were relatively more familiar with workplace violence issues, and were more likely to implement security measures and workplace violence policies and programs. Due to the higher response rates from larger units, this would tend to bias the estimates upwards.

The industries showing the highest response rates are consistent with this picture, involving industries with high awareness of safety issues and heavy public sector involvement. Some of the industries discussed in section 3 have components that have high injury and illness rates (Agriculture, Manufacturing, Health Care, and Construction), and some have been the focus of NIOSH studies on workplace violence (Health Care, and Retail Trade). WVP data showed that public sector units, especially State government units, had higher rates of workplace violence program and policy implementation, higher rates of experiencing all types of workplace violence incidents, and tended to employ more security measures than private sector units. The relatively high WVP response rates in Public Administration and Education, which both have large public sector presences, also support the view that WVP data may have had somewhat stronger representation from units that were more likely to have programs, policies, and experience with workplace violence[3].

[3] Some states have executive orders or legislation that require executive branch agencies to have workplace violence prevention policies in place, e.g. Indiana Exec. Order. No. 99-6, 22. Ind. Reg. 3569 (1999) and South Carolina S.C. Code § 1-1-1410.

**Table 3. Percent of Establishments with Selected Security and Workplace Violence Policy/Program Implementation, by Size Class**

| | All Size Classes | Size Class 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Unit had at least one form of security | 72.1 | 64.9 | 84.7 | 94.0 | 97.0 | 99.0 |
| Unit had physical security and either electronic surveillance or security staff | 38.4 | 29.9 | 50.6 | 70.8 | 88.1 | 90.6 |
| Unit experienced an incident of workplace violence in the 12 months prior to the survey | 5.3 | 2.4 | 9.1 | 16.0 | 28.8 | 49.9 |
| Unit had a workplace violence program or policy | 29.1 | 20.1 | 42.2 | 63.8 | 77.4 | 86.4 |
| Unit had neither a workplace violence program nor a policy | 70.1 | 78.8 | 57.7 | 35.9 | 22.4 | 13.2 |
| Unit tracks costs related to incidents of workplace violence | 20.1 | 16.7 | 24.2 | 35.9 | 41.5 | 45.3 |

Note: The five size classes are: 1-10 employees (size class 1), 11-49 employees, 50-249 employees, 250-999 employees, and 1000 or more employees (size class 5).

These units, possessing greater familiarity with the consequences and use of the data, probably had greater enthusiasm and interest in participation. We do not possess the counterfactual data that would have been received on the WVP survey from non-respondents if they had in fact decided to respond. However, the trends examined in this paper suggest that non-respondents were similar to respondents except that they were more difficult to contact and secure cooperation from. Any changes to the WVP estimates would result mainly from the size class and industry effects discussed above, possibly adjusting the estimates down. Therefore, we believe that the relatively low overall WVP policy and program implementation estimates are likely to be conservative, if there is any non-response bias present.

## 6. Future Work

An interesting puzzle that arose during analysis of the data for this paper was the reversed inequality of SOII DAFW and DJTR rates for respondents and non-respondents in the Transportation sector alone. What made this sector unusual was that it reversed the trend of higher SOII incidence rates that other high-risk sectors displayed, despite being associated with many risk factors: having a mobile workplace, working in small numbers, and working directly with the public. A possible partial explanation may be the prevalence of independent operators in Transportation industries such as trucking and passenger transport (taxis). If owner operators work for multiple companies on a contract basis and bear most of the risk involved, the link between investment in workplace safety training and benefits may be weakened. We believe this is a phenomenon that may warrant further investigation.

Finally, while resource intensive, it would be interesting to do a follow-up survey of WVP non-respondents to generate estimates of actual non-response bias. This would test our conjecture that the WVP implementation estimates could be overestimates, and would permit measurement of the magnitudes of any bias present.

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