Modernizing Occupational Safety and Health Enforcement: Improving OSHA's Capability to Prevent, Detect, and Control Grave Risks to U.S. Workers

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Research Questions

- Do characteristics of firms, *other than* self-reported injury rate, correlate with the number and severity of workplace safety and health hazards?
- Could a multivariate "profiling" algorithm reduce the number and severity of false positives and false negatives among OSHA's programmed worksite safety inspections?
- Could such an algorithm also increase the efficiency of OSHA's health-hazard enforcement program?

Intellectual Indebtedness:

- David Weil
- Les Boden
- Knut Ringen
- Wayne Gray
- John Mendeloff
- etc., etc.

Theoretical Framework

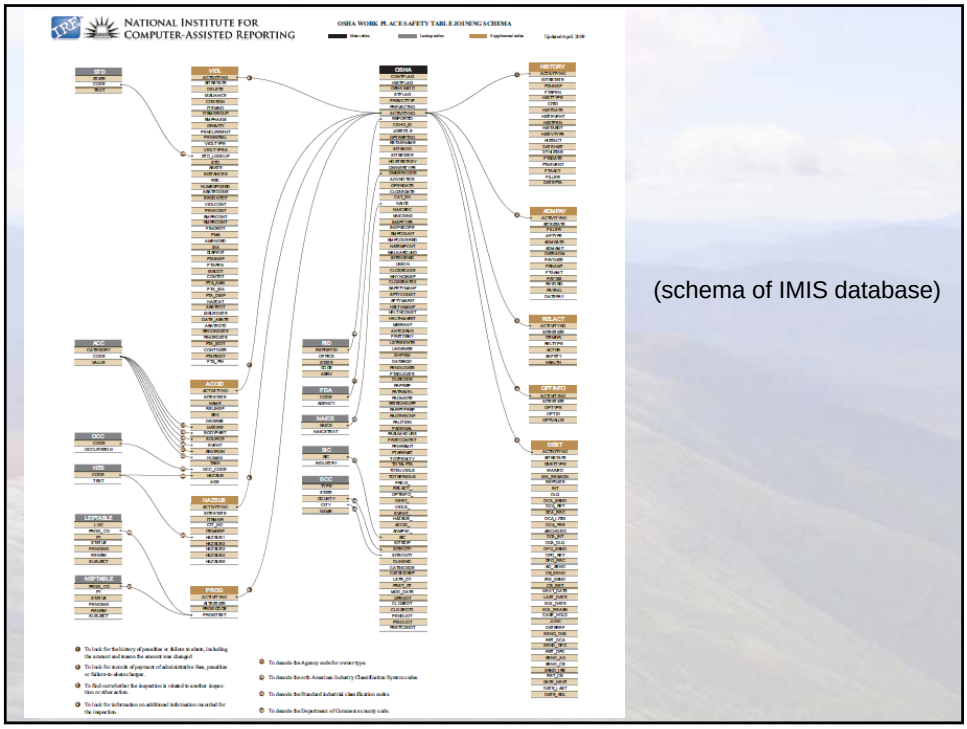
- OSHA currently targets 2/3 of its inspections (about 60,000 visits/yr) via self-reported "injury rates" and other criteria; it inspects about 0.5% of covered US establishments each year. This system results in large numbers of FPs (time-consuming inspections of pristine workplaces) and FNs (no inspections of establishments that soon thereafter have fatal injuries– which then triggers a reactive *post hoc* inspection)

Theoretical Framework (continued)

- If OSHA (and EPA, FDA, FAA, CPSC, etc….) targeted firms for inspection via "red flags" of demographic, financial, cultural, and other variables, could they find more serious hazards before they cause irreversible harm?

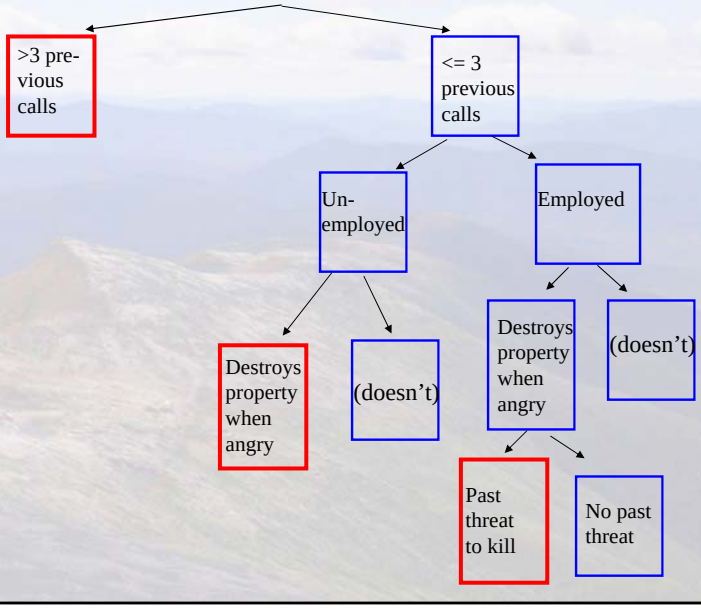
Study Design

- Obtain complete database of OSHA enforcement and violations (30 years; approx. 3 million records);
- Merge into this database various covariates of each firm inspected (see following slides);
- Develop two indices for the results of each inspection: one that indexes the overall gravity of the dangerous conditions that were found, and one that denotes the magnitude of the "missed opportunity" for each prior year in which the firm was not visited;
- This analysis (by definition) is constrained to comparing firms that were inspected (not the unknown conditions in firms not inspected)– BUT, mandatory inspections post-fatality at least brings all those firms into the universe.



(schema of IMIS database)

Berk, He, and Sorenson (2005): "Developing a Practical Forecasting Screener for Domestic Violence Incidents"



Measurements

- Note– no new data or surveys in this study; instead, the combination of existing datasets
- Categories of non-enforcement data: NOTE– we will be looking for variables that are presumptively NEGATIVELY correlated with violations as well– say, appearance on any of various lists of "safest companies," "greenest companies," etc– we may be able to improve predictive yield by targeting AWAY from "white flags" as well as targeting towards the "red flags"
- ***Other violations:***
  - ***EPA ("ECHO" and "OTIS" databases (Abt Assocs.))***
  - ***DOL Wage/Hour database***

…The Federal Chief Information Officer and the Chief Technology Officer, in coordination with the Director of the Office of Management and Budget (OMB) and their counterparts in each agency, shall work to explore how best to generate and share enforcement and compliance information across the Government, consistent with law. Such data sharing can assist with agencies' risk-based approaches to enforcement: ***A lack of compliance in one area by a regulated entity may indicate a need for examination and closer attention by another agency.*** Efforts to share data across agencies, where appropriate and permitted by law, may help to promote flexible and coordinated enforcement regimes.

- Barack Obama, Jan. 18, 2011, Presidential Memorandum on Regulatory Compliance (emphasis added)

Data Types (continued)

- ***Financial:***
  - ***Debt/equity ratios***
  - ***Recent change of ownership***
  - ***Return on Equity***
  - ***Sales growth compared to competitors***
  - ***Credit rating***
- ***Geographic:***
  - ***% minority population in Zip*** ***(Kleindorfer 2004)***
- ***CSR:***
  - ***Recommended by socially responsible funds***

Data Types (3)

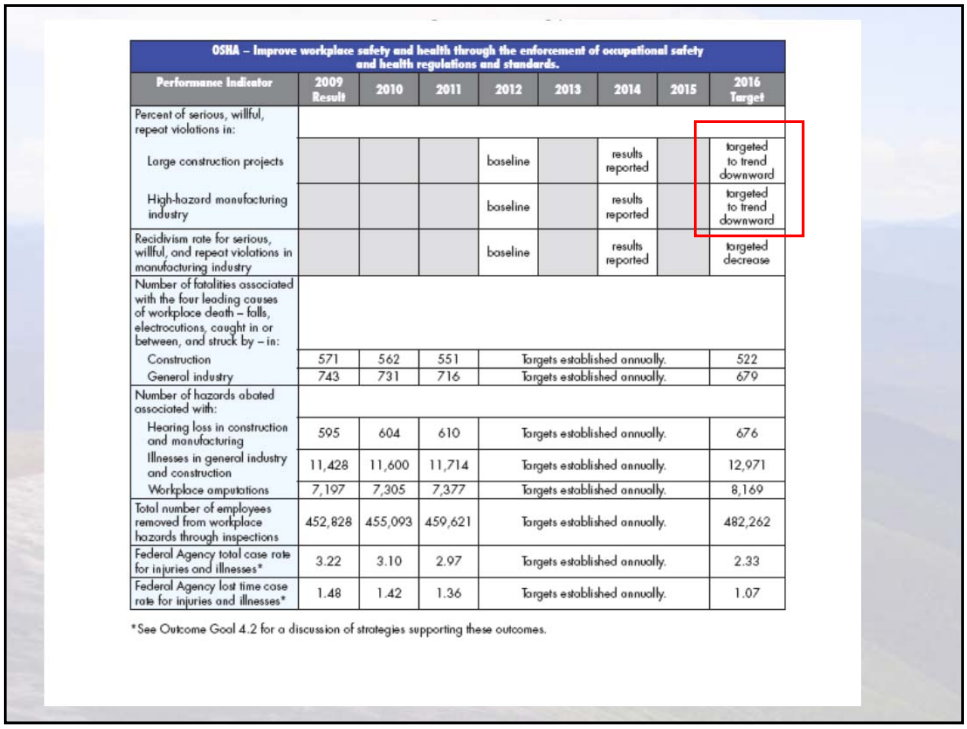
- ***Demographic:***
  - ***Age of plant***
  - ***# employees***
  - ***Union/non-union***

Analysis

- Multivariate regression results used to develop profiling algorithms: test each algorithm [using inspection data not used to develop them] to see if various outcome measures (total yield of violations, # of false positives (in-compliance inspections), # of false negatives (worksites with subsequent fatality in year $N+k$ not visited in year N) can be improved relative to OSHA baseline

Challenges; Concerns

- Difficulty merging external datasets into IMIS (sporadic use of Dun's Number as identifier)
- Difficulty detangling firm-level effects from corporate-level effects– further complicated by lack of accessible data on actual ownership (anecdotally, Berkshire-Hathaway is the #1 Toxic Release Inventory "polluter" because of its holdings). *Note: White House initiative has begun to create an "IOPedia" of industrial organization, making public what Dun's charges for…*
- Targeting system must constitute a "neutral criterion" to comport with 1978 Supreme Court decision in *Marshall v. Barlow's Inc.*
- Are firms in crisis less likely to actually improve behavior?



OSHA – Improve workplace safety and health through the enforcement of occupational safety and health regulations and standards.

Performance Indicator	2009 Result	2010	2011	2012	2013	2014	2015	2016 Target
Percent of serious, willful, repeat violations in:								
Large construction projects				baseline		results reported		targeted to trend downward
High-hazard manufacturing industry				baseline		results reported		targeted to trend downward
Recidivism rate for serious, willful, and repeat violations in manufacturing industry				baseline		results reported		targeted decrease
Number of fatalities associated with the four leading causes of workplace death – falls, electrocutions, caught in or between, and struck by – in:								
Construction	571	562	551	Targets established annually.				522
General industry	743	731	716	Targets established annually.				679
Number of hazards abated associated with:								
Hearing loss in construction and manufacturing	595	604	610	Targets established annually.				676
Illnesses in general industry and construction	11,428	11,600	11,714	Targets established annually.				12,971
Workplace amputations	7,197	7,305	7,377	Targets established annually.				8,169
Total number of employees removed from workplace hazards through inspections	452,828	455,093	459,621	Targets established annually.				482,262
Federal Agency total case rate for injuries and illnesses*	3.22	3.10	2.97	Targets established annually.				2.33
Federal Agency lost time case rate for injuries and illnesses*	1.48	1.42	1.36	Targets established annually.				1.07

*See Outcome Goal 4.2 for a discussion of strategies supporting these outcomes.

Early in 2012, we learned that the version of its enforcement database OSHA had provided was missing some fields that were not confidential, but not usually provided. We eventually obtained a complete dataset with approx. 50 fields on each establishment inspected. We will analyze inspection data from calendar years 2008 and 2009 (the last year of the Bush administration and the first of the Obama administration), with fatality data from 2009-2011 merged into each base year. These descriptive data from 2008 will help explain our dataset preparation:

- We began with data on 106,189 inspections that year, in which a total of 335,688 individual violations of OSHA standards were cited.
- Of the 12 types of OSHA inspections, we removed several types that are not germane to this project (e.g., inspections to grant variances, follow-up inspections to verify abatement). We retained the inspections based on complaints, however, both for comparison and also because OSHA could exercise discretion to triage complaints based on a forecast of the severity of conditions to be encountered.
- We also removed all inspections in SICs 1500-1799 (residential and commercial construction), because these are not fixed worksites, and because the relationships among the many disparate contractors on each project could confound the analysis.
- This left us with 49,870 inspections. More than half of these (25,204) were assessed zero monetary penalties, attesting to the large number of "false positive" inefficiencies in OSHA's current targeting system.

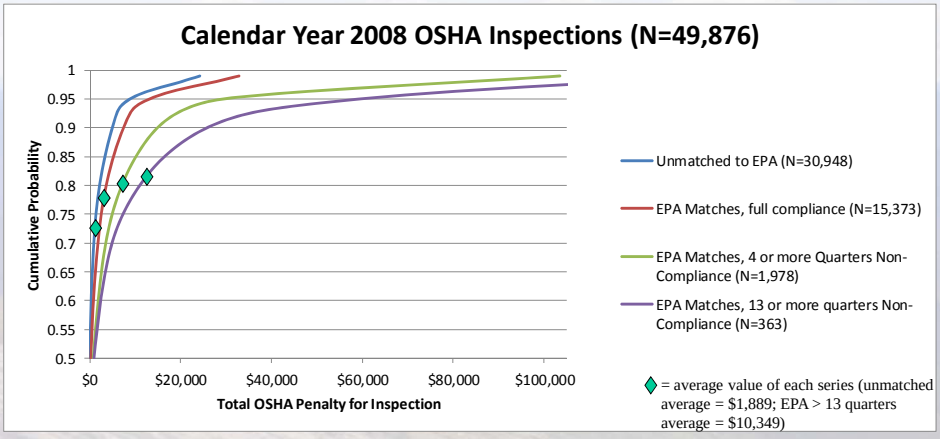
We next matched establishments OSHA inspected in 2008 and 2009 to the "ECHO" (Enforcement and Compliance History Online) database EPA maintains. ECHO contains information on more than 700,000 establishments, including demographics of the local community and various measures of facility non-compliance with Clean Air Act, Clean Water Act, and hazardous waste regulations. Because *none* of the databases we will use in this project contains any common facility identifier codes, we worked with EPA contractors (Abt Associates, Cambridge, MA) to refine fuzzy-matching algorithms that reliably identify 3 separate types of matches: (1) instances where the establishment name, street address, and ZIP code match ("NSZ"); (2) where the name and state match (presumably either intrastate relocations of the same establishment, or sister/parent relationships); and (3) where the address and SIC match (presumably firm name changes or sale of physical plant to a similar operation).

Similarly, we matched OSHA facilities found in the enforcement database of the Dept. of Labor Wage/Hour Division (WHD)– about 155,000 records of firms that may have violated minimum wage, work visa, or any of 10 other sets of regulations.

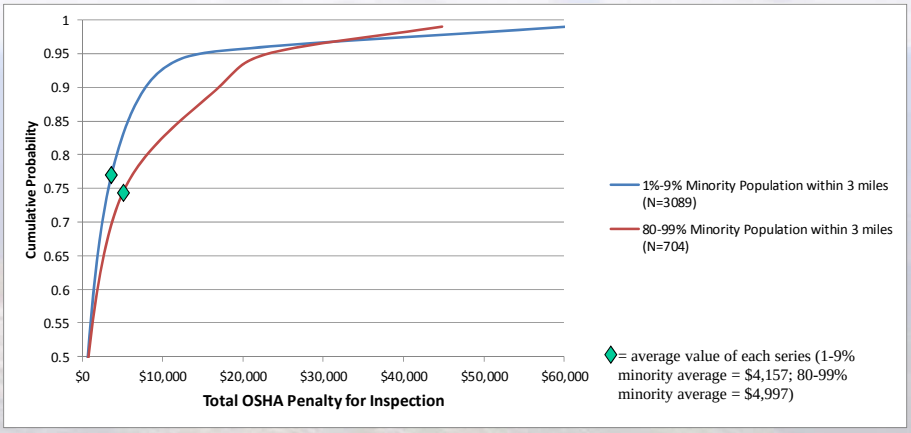
- About 38% of the relevant OSHA inspections in 2008 (N=18,925) had an EPA match (about half of these were complete "NSZ" matches). A similar %age of OSHA inspections had matches in the WHD data (although fewer than 1% of establishments were visited by all 3 agencies, suggesting a real need for more coordination).

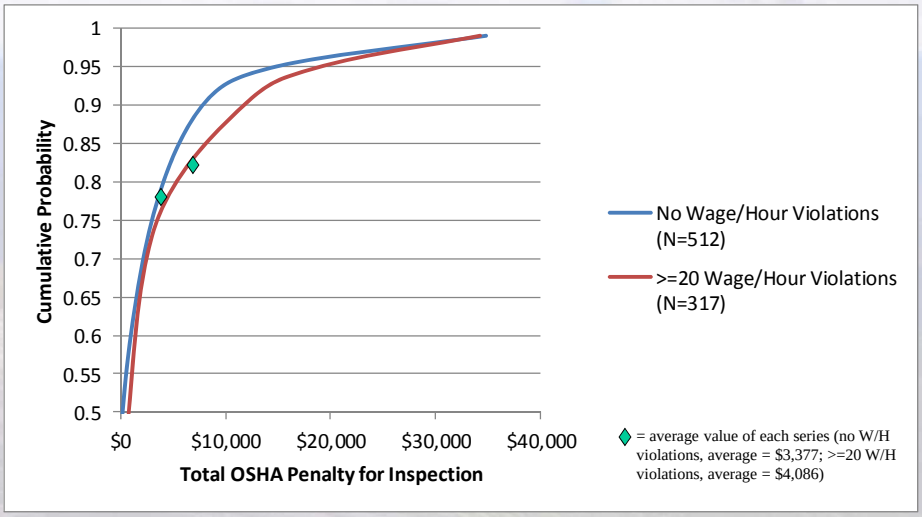
♦ Analysis of the average and upper-bound penalty per OSHA inspection, as a function of inspection type, reveals that "planned" inspections tend to target facilities with the least severe conditions, while inspections prompted by "referrals" from another government agency, journalists, etc., are reaching facilities with the most severe conditions (other than fatality inspections):

Type of Inspection (in CY 2008)	Average Total Penalty	95th Percentile Total Penalty
Fatality (N=3197)	$9,265	$28,710
Referral (N=4268)	$4,210	$12,600
Complaint (N=12776)	$2,640	$10,500
Planned (N=26856)	$1,773	$7,800



2008 OSHA Inspections: Influence of Nearby Demographics





As we continue the statistical analysis of the newly-created database, we are also preparing a series of six additional journal articles, each exploring a particular aspect of how OSHA (or other public health regulatory agencies) could improve its enforcement efficiency. We plan to analyze the legal and policy aspects of these questions:

- *Can OSHA "profile" firms without running afoul of statutory or case law prohibitions (or severe political backlash)?* We believe the controlling Supreme Court decision in Marshall v. Barlow's Inc. (436 U.S. 307, 1978) would regard a well-reasoned profiling algorithm as a "neutral criterion" similar to OSHA's current use of injury rates. Firms who believe they are unfairly disadvantaged by the current criterion may become allies if OSHA seeks to modernize its targeting and complaint-triage systems.
- *Can OSHA greatly increase the number of "referrals" it receives (see Table in Slide 21) from stakeholders serving as its "eyes and ears"?* The technology now exists for regulatory agencies to encourage other federal/state/local officials, and private citizens, to recognize likely workplace hazards "in plain sight" and send information (including pictures or video) directly to the agency– but proper training and processing of referrals is needed.

- *Can OSHA vastly increase the penalties it can levy for toxic-substance overexposures, using a "per day multiplier"?* Congress was silent on this issue when it established OSHA in 1970, but subsequent statutes (e.g., the 1972 Noise Pollution and Abatement Act, as well as various clean air, clean water, and hazardous waste laws) establish penalties of up to $25,000 per day (as opposed to OSHA's $7,000 per *violation).* We contrast an employee found to have been exposed to a fall hazard every day for six months– she has faced risk but not yet been harmed– to one exposed to a toxic chemical for the same period– here the employer may merit a penalty commensurate with the accumulated and continuous harm.

- *Do countries in Europe, Asia, and Oceania employ other data-driven ways to target workplace inspections, and are they receptive to our idea of statistical profiling?*

- *Can OSHA reverse the burden of proof to classify a violation as "willful" (carrying a much higher maximum penalty), in certain narrow and predefined circumstances?*

- *More generally, administrative law has long demanded that agencies provide reasons for their actions, but what does "reason" mean when agencies make decisions through machine-based learning?*

"I want to see an OSHA that is a leader in the national dialogue on safety and health…. OSHA is perceived on the sidelines - enforcing the standards, issuing citations, but not leading the national discussion. I intend to change that."

-John Henshaw, Assistant Secretary of Labor/OSHA (2001-2005); speech a VPP conference, Sept. 2001

Will David Michaels also declare "Mission Not Accomplished" at the end of his tenure? How can we help him break this pattern?

"The burdens and hurdles the agency is required to meet make it impossible for OSHA to be at the leading edge of workplace safety and health."

-John Henshaw, Assistant Secretary of Labor/OSHA (2001-2005); speech at an AIHA conference, Oct. 2005

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Thanks!