

Randomized Government Safety Inspections Reduce Worker Injuries with No Detectable Job Loss

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Good morning, Mr. Chairman, and Members of the Committee. My name is David Levine. I am the Trefethen Professor of Business Administration at the Haas School of Business, University of California, and Berkeley. My Ph.D. is from Harvard University, and I have been a professor for 25 years at the Haas School of Business, where I chaired the Economic Analysis and Policy group. I also co-founded the Center for Effective Global Action, which promotes rigorous evaluations of government programs and other projects around the world.

To put it mildly, OSHA has always been controversial. While some criticize it for being too lenient, others refer to it as a job-killer that increases employers’ costs and erodes America's competitiveness. What, in fact, does OSHA do?

Matthew Johnson of Boston University, Michael Toffel of the Harvard Business School, and I answered that question for randomized inspections carried out by California's Cal/OSHA. Our results appeared in *Science*, one of the world’s most respected academic journals.¹

The bottom line of our study is simple: We analyzed randomized Cal/OSHA inspections the way scientists analyze a clinical trial. **These inspections protect workers’ health and safety. The randomly inspected firms experienced 9% fewer injuries and had 26% lower workers’ compensation costs than the control group of similar firms.**

Workplace inspections cause no discernible damage to employers' ability to stay in business and no reductions in sales or credit ratings, according to our research. Nor did we identify any effects of workplace inspections on employment or wages. These inspections save

¹ David I. Levine, Michael W. Toffel and Matthew S. Johnson, “Randomized Government Safety Inspections Reduce Worker Injuries with No Detectable Job Loss.” *Science* **336**, 907 (2012).

employers billions of dollars a year, and a figure that only grows when we include injured workers' lost earnings.

The challenge of rigorous evaluations

Debates about OSHA's effectiveness have raged for decades. When I learned Cal/OSHA randomly selected some workplaces in dangerous industries for inspections, I felt an obligation to use that natural experiment to study the effects of these inspections.

It is understandable that debates rage on when evidence is scarce. It is less understandable why, 40 years after its founding, so little rigorous evidence exists on the effects of OSHA's activities. The government—and taxpayers—would have a much better understanding of which policies and regulations work well if policymakers built rigorous evaluations into many more programs. We have moving stories of regulatory successes and failures, of jobs lost and jobs saved. We have no way to know how well those stories generalize of what would have happened with stricter or less strict regulations or inspections.

Rigorous evidence is lacking in part because it is difficult to measure the causal effect of OSHA inspections. One challenge arises because many OSHA inspections target workplaces with recent accidents or safety complaints, and these workplaces often have ongoing safety problems. Thus, workplaces with inspections often have injury rates that are higher than workplaces without inspections, but the inspections did not *cause* the high injury rates.

A second issue is that workplace injury rates usually decline soon after they experience a big spike upward such as after a serious accident.² If the spike induces inspectors to visit, the inspection did not necessarily *cause* any subsequent decline in injuries.

Fortunately for evaluation purposes, as I noted above, California's Division of Occupational Safety and Health (Cal/OSHA) randomly selected workplaces in dangerous industries for inspections from 1996 to 2006.³ From a scientific perspective, this randomization lets us analyze our data as would date from a clinical trial for a new drug. The resulting randomized controlled trial is the "gold standard" for evaluation, the most convincing type of

² J. W. Ruser, Self-correction versus persistence of establishment injury rates. *Journal of Risk and Insurance* **62**(1), 67 (1995).

³ California Department of Industrial Relations, *2005 Report on the High Hazard Enforcement Program and High Hazard Consultation Program* (Division of Occupational Safety and Health, 2007), <http://www.dir.ca.gov/dosh/enforcementpage.htm>, accessed September 2011.

evidence when measuring the effects of a program. Randomization is important because on average the randomly inspected firms and the control group of firms we identified are identical except for the luck of the “flip of a coin” that determined whether they were inspected or not. That similarity makes it possible to compare trends in the two groups and be confident that inspections are responsible for any major differences.

An additional challenge for rigorous evaluation is that most previous studies that examined how inspections affect injury rates have relied on the injury logs that OSHA requires these companies to maintain. This data source can be problematic because OSHA inspections often find record-keeping is incomplete and mandate more complete recordkeeping. If you looked at the injury trends recorded in these logs, it could seem as if inspections caused higher injury rates, simply because the company began documenting a greater proportion of the injuries that were occurring. For example, the injury rates reported by very large manufacturing plants more than doubled in the late 1980s after OSHA imposed multi-million dollar fines on a few large plants for poor recordkeeping.⁴

To avoid this problem we analyze injury data from the workers’ compensation system. Unlike OSHA-mandated logs, OSHA inspections do not change incentives for workers’ compensation recordkeeping.

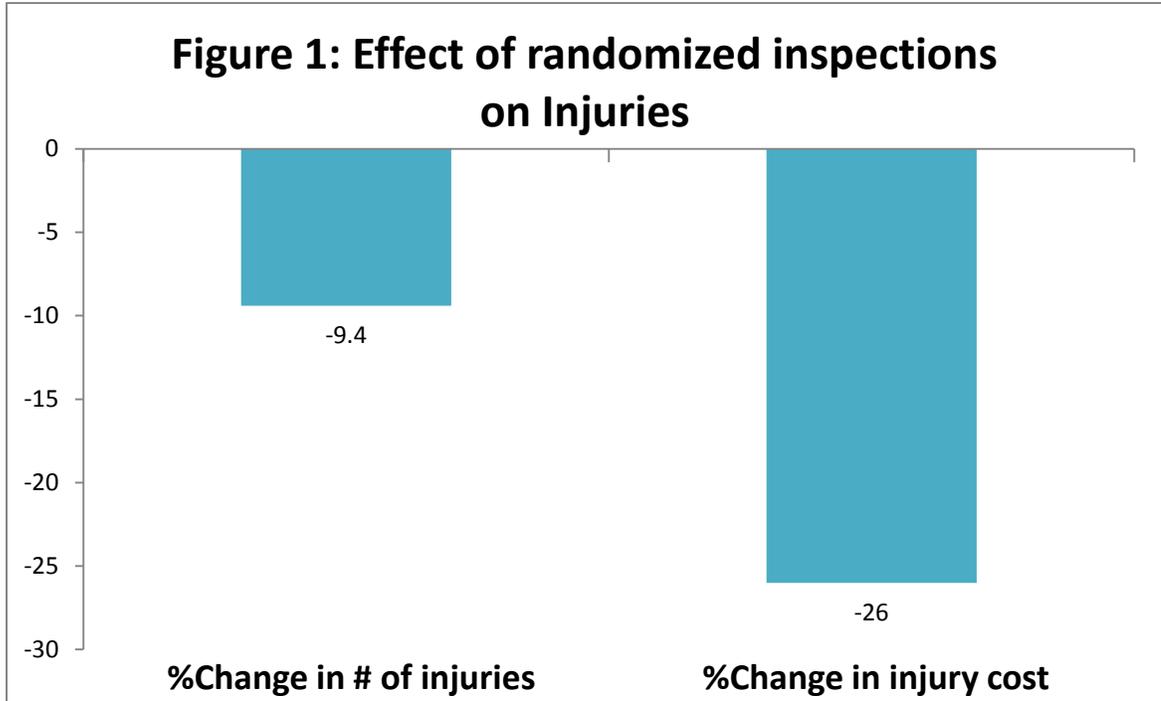
While injuries are important, so are the costs of reducing those injuries. Thus, in addition to injuries we also analyze company survival, credit ratings, sales, employment and total payroll to look for unintended harms from inspections.

Our research paper and supplementary materials detail how OSHA randomizes inspections and how we constructed our dataset of 409 inspected firms and 409 controls. Our sample is single-plant firms in hazardous industries in California. Each control firm is from the same industry and region of the state as a randomly inspected firm. If we had multiple potential controls we selected the firm most similar in employment prior to the inspection.

⁴ J. P. Leigh, J. P. Marcin, T. R. Miller, An estimate of the U.S. government's undercount of nonfatal occupational injuries. *Journal of Occupational and Environmental Medicine* 46(1), 10 (2004).

Results on injuries and injury costs

Cal/OSHA’s randomized inspections work as intended. Our analysis indicates that on average randomized inspections reduce annual injuries by 9.4 percent (Figure 1). This estimate of the decline in injuries due to inspections was similar when we used a several different statistical models and looked at several subsets of the data. There was also evidence that the declines persist for at least 5 years (the longest period we studied).



Note: Results from Table 1 of the accompanying article, comparing trends at 409 randomly inspected firms and 409 controls. The decline in injury count is statistically significant at the 5% level and in injury costs at the 1% level.

Results on unintended consequences

Even if the benefits are large, it is crucial to know how much employers pay for these improvements in safety. Employees also want to know how much (if at all) inspections threaten wages or employment (for example, if improving safety raises costs substantially).

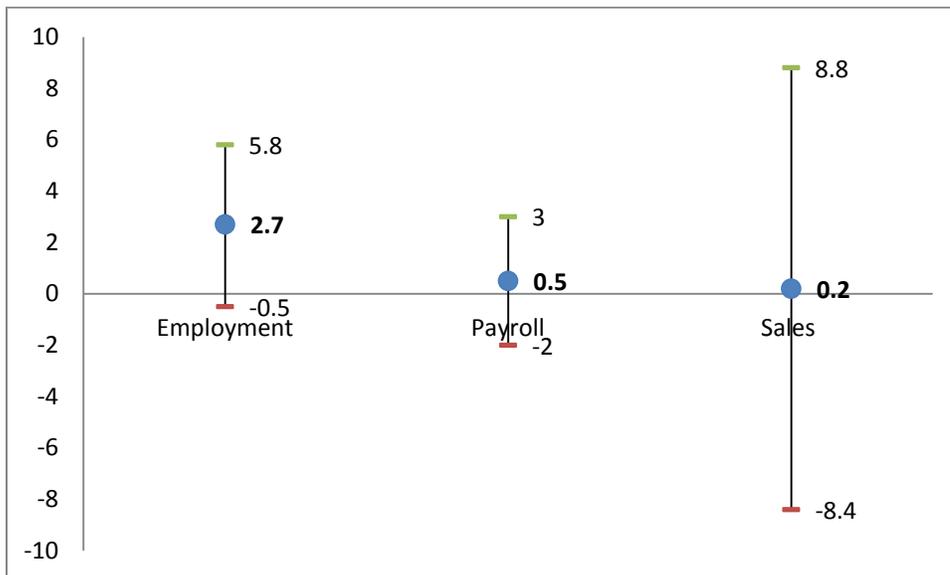
We find very similar survival rates for randomly inspected firms and the control group. Specifically, 4.4 percent of the randomly inspected firms did not survive until 2006, compared to 5.6 percent, of control firms. The inspected firms had a slightly higher survival rate, but the

difference is not statistically significant. Results were similar in analyses that control for pre-inspection characteristics (see Table S7).

We also assessed whether inspections might lead companies to become financially stressed, as measured by two Dun and Bradstreet indicators of whether a company is a good credit risk. The results hint that inspections increase creditworthiness a tiny amount—but the estimates are nowhere near statistically significant (Table S8).

To assess whether random inspections might have impeded firm growth, we examined employment, payroll, and sales (Figure 2). There is no evidence that randomly inspected firms had slower growth in employment, total earnings, or sales than control firms.

Figure 2: The Effects of Randomized Inspections on Firm Growth (%changes)



Note: Results from Table 2 of the accompanying article, comparing trends at 409 randomly inspected firms and 409 controls. The middle figure is the point estimate of the %change in the outcome due to the randomized inspection. The bars indicate the 95% confidence interval. None of the estimated effects of inspections are statistically significant at the 10% level.

Discussion

In sum, **workplaces that Cal/OSHA chose for a random inspection subsequently experienced substantially lower injury rates and workers' compensation costs compared to a matched set of workplaces that were eligible for but not chosen for a random inspection. The lower injury rates endured several years following the inspection.**

These results are broadly consistent with recent findings of most, but not all, previous research on OSHA inspections.⁵ While those studies were typically careful, none had a randomized design that separates the factors that led to the inspections with the effects of the inspections.

It is interesting to calculate the savings employers enjoy from lower injuries. The workers' compensation insurer Liberty Mutual's estimates that each dollar of direct workers' comp costs implies employers pay 2-5 additional dollars of indirect costs (e.g., from lower productivity). Using our sample's mean workers' compensation costs and estimated cost reduction following inspections implies a randomized Cal/OSHA inspection averts \$98,000 to \$197,000 in direct and indirect costs to employers and their insurers.⁶

⁵ For results finding (some or all) OSHA inspections predict declines in injuries see:

A. Haviland, R. Burns, W. Gray, T. Ruder, J. Mendeloff, What kinds of injuries do OSHA inspections prevent? *Journal of Safety Research* **41**(4), 339 (2010).

W. B. Gray, J. T. Scholz, Does regulatory enforcement work? A panel analysis of OSHA enforcement. *Law & Society Review* **27**(1), 177 (1993).

J. Mendeloff, W. Gray, Inside the black box: How do OSHA inspections lead to reductions in workplace injuries? *Law & Policy* **27**(2), 219 (2005).

A. Haviland, R. M. Burns, W. B. Gray, T. Ruder, J. Mendeloff, A new estimate of the impact of OSHA inspections on manufacturing injury rates, 1998-2005. *American Journal of Industrial Medicine* (2012).

Baggs, B. Silverstein, M. Foley, Workplace health and safety regulations: Impact of enforcement and consultation on workers' compensation claims rates in Washington State. *American Journal of Industrial Medicine* **43**(5), 483 (2003).

At the same time, several older studies did not find any relation:

R. S. Smith, The impact of OSHA inspections on manufacturing incidence rates. *Journal of Human Resources* **14**(2), 145 (1979).

W. K. Viscusi, The impact of occupational safety and health regulation. *Bell Journal of Economics* **10**(1), 117 (1979).

J. W. Ruser, R. S. Smith, Reestimating OSHA's effects—Have the data changed? *Journal of Human Resources* **26**(2), 212 (1991).

While careful, none of these studies used a randomized design or other method that assured the inspected firms were similar those in the comparison group.

⁶ Workers' compensation costs for medical care and replacing wages averaged \$25,253 per year at the employers we studied. If workers' comp costs fall 26%, that equals savings to employers of \$6566/year, or \$32,829 over 5 years. The workers' compensation insurer Liberty Mutual (2002) reports:

If we also include lost wages for employees, then (with many assumptions) our point estimate on injury costs implies that on average the reduction in injuries in the five years following a workplace inspection reduces medical costs and lost production and earnings by roughly \$230,000 (in 2011 dollars).⁷ This estimated five-year total is roughly 10 percent of the average annual payroll of this sample of employers.

Each injury's indirect costs are far larger than its direct costs. In fact, 56 percent of business executives from a range of geographic locations, company sizes and industries surveyed by the 2001 Liberty Mutual Executive Survey of Workplace Safety reported that businesses faced between \$2 and \$5 of indirect costs for each \$1 of direct costs.

Braun (2002) explains, "Indirect costs are the result of down time, lost production, training replacement workers, scheduling changes, damaged equipment, filling out forms, and so on." Adding in \$2 to \$5 of indirect costs per dollar of direct costs implies a randomized Cal/OSHA inspection averts \$98,000 to \$197,000 in direct and indirect costs to employers and their insurers.

This method does not count lost wages that were not covered by workers' compensation, ignores the under-reporting of injuries (Rosenman 2000; Biddle 1998), and includes data from inspected firms in the mean workers' comp costs. Both this method and the method in the following footnote ignore safety benefits lasting more than four years, any reduction in pain and suffering, and (working in the opposite direction) the discounting of future lower injury rates.

Because we are estimating cost savings I base these calculations on the 26% reduction in workers' compensation costs we estimated in Table 1. Results of this calculation and those of the next 3 footnotes would be smaller, but still large, if we conservatively based the calculations on the estimate of roughly 9.4% fewer injuries due to inspections.

Theodore W. Braun, "Prevention through Design (PtD) from the Insurance Perspective." *Journal of Safety Research* 39 (2008) 137–139 [<http://www.cdc.gov/niosh/topics/ptd/pdfs/Braun.pdf>], last accessed June 19, 2012.

J. Biddle, K. Roberts, K. D. Rosenman, E. M. Welch, What percentage of workers with work-related illnesses receive workers' compensation benefits? *Journal of Occupational and Environmental Medicine* 40(4), 325 (1998).

K. D. Rosenman, J. C. Gardiner, J. Wang, J. Biddle, A. Hogan, *et al.*, Why most workers with occupational repetitive trauma do not file for workers' compensation. *Journal of Occupational and Environmental Medicine* 42(1), 25 (2000).

Liberty Mutual, "Liberty Mutual Releases Latest Workplace Injury Data" *Ergonomics Today*. (April 19, 2002). [<http://www.ergoweb.com/news/detail.cfm?print=on&id=516>], last accessed June 20, 2012

⁷ Leigh (2011) estimates the total cost of occupational injuries and illnesses to employees was roughly \$250 billion in 2007. If we divide by 140 million workers, that comes to \$1,786 in costs per worker per year. The high-hazard employers we studied were about 3 times as risky as the average firm in California. If California is as costly and as risky as the rest of the nation, that implies about \$5,357 cost of occupational injuries and illnesses in our sample. With 34 employees per firm in our sample, injury costs for these companies average about \$183,000 per year. If an inspection reduces all costs by the same 26% we estimate for workers' compensation costs, then a Cal/OSHA inspection averts roughly \$47,000 in lower medical costs and lost wages per year. If the effect lasts five years (as in Table 1, Column 4), the total value to society of each inspection is very approximately \$230,000. The figures here are slightly lower than those in the *Science* article because we now use estimates of the cost of injuries from Leigh (2011), which appeared after our original calculations.

J.P. Leigh, Economic Burden of Occupational Injury and Illness in the United States. *Milbank Quarterly*, 89(4), 728 (2011).

State and Federal OSHA's conduct about 100,000 inspections per year (96,956 in 2006, for example). Most of these inspections are carried out by different regulators from the one we studied. In addition, about half of the inspections are conducted in response to complaints or accidents, not randomized within hazardous industries. With those differences in mind, if all these (non-repeat) inspections happened to be as useful as those we studied, Liberty Mutual's estimate on the indirect costs of injuries that employers bear implies OSHA inspections could save industry \$9 to \$18 billion per year.⁸ Including employees' lost wages gives a *very* rough estimate that state and Federal OSHA inspections could avert as much as \$22 billion in costs of injuries and illnesses per year.⁹

While we cannot rule out unintended consequences such as lower employment or earnings, we find no evidence that inspections harmed employees or employers. The estimates taken literally suggest inspections increase firm survival, credit rating, employment, payroll, and sales, though all coefficients are small and none approach statistical significance.

Our results are also indirectly somewhat informative about the value of OSHA regulations (and Cal/OSHA's sometimes-stricter regulations). Imagine a scenario where most regulations were costly for employers, but did little to improve safety. In that situation, inspections enforcing those regulations would have few safety benefits and would impose high costs. These costs, in turn, would lead to slower firm growth, job losses and plant closures. In fact, we found the opposite: randomized inspections led to substantial safety benefits and no detectable job loss or plant closure. Thus, our results imply that on average the Cal/OSHA regulations that employers comply with due to inspections are not poorly designed and costly.¹⁰

⁸ Footnote 6 estimated each randomized Cal/OSHA inspection saved employers and their insurers an average of \$98,000 to \$197,000 in total costs from occupational injuries. Multiplying by the 96,956 inspections per year (minus 3% for repeat inspections) implies savings to employers and their insurers of roughly \$9 to \$18 billion per year.

⁹ Footnote 7 built off of Leigh (2011) and estimated very approximately \$230,000 in reduced medical care and lost earnings due to one Cal/OSHA randomized inspection. Multiplying by the 96,956 (minus 3% for repeat inspections) inspections per year implies a social value of (*very approximately*) \$22 billion per year.

¹⁰ The increased compliance can be due to fixing a problem that led to a violation, information provided by the inspector, or increased awareness of safety concerns after an inspection.

Much more to learn

Our study has examined only a subset of companies (single-establishment firms in high-hazard industries and with at least 10 employees) in one region (California), and an enforcement activity (not consultations or voluntary programs). We also examined only a single type of enforcement action: a randomized inspection, not those driven by complaints or by serious accidents. And we studied just one workplace-safety regulator, Cal/OSHA. Our method also does not measure the impact that the threat of an inspection might have on other workplaces, or the costs and benefits of regulations that are complied with regardless of inspections.

It is important to replicate this study in other settings and to use other rigorous study designs to examine the generalizability of our results. Ideally, Congress and the Executive branch would encourage all major programs to build more learning into their programs. Regulators can also share more data (with appropriate protections of confidentiality) to facilitate independent evaluations and could also facilitate partnerships with organizations that have helpful ancillary data, such as agencies with data from the worker's comp system. In addition, an important complement to statistical studies is qualitative research that examines how workplace regulations and inspectors affect workers and employers.

As the GAO has emphasized, it is crucial that rigorous evaluations be conducted for voluntary programs as well as enforcement.¹¹ OSHA reports that VPP participants have injury rates far below their industry average.¹² However, this encouraging news is not convincing evidence of whether VPP *causes* improvements in workplace safety because having an injury rate below the industry average is a requirement both to join and to remain in the VPP.¹³

¹¹ GAO (2009) *OSHA'S Voluntary Protection Programs*, GAO-09-395 <http://www.gao.gov/assets/300/290017.pdf>

¹² US Department of Labor, "All about VPP." (2012) [http://www.osha.gov/dcsp/vpp/all_about_vpp.html], last accessed June 19, 2012.

¹³ The evaluation challenge is made more difficult because even looking at trends is not sufficient. As an illustrative example, consider the extreme case where following the VPP method has *no* effect on safety. Assume 100 firms with average injury rates for their industries want to receive VPP recognition and so begin implementing the VPP method. Two years later some firms will have injury rates below their industry average, some still near the average, and some above. Only the subset with declines can then join VPP. Even though VPP methods have no effect on injuries in this example, only the firms that purely by chance experienced a downward trend were allowed into the VPP. Thus, we will observe: (1) VPP members have below-average injury rates and (2) prior to implementing the VPP method their injury rates were near the industry average. More generally, no matter how useful the VPP methods are any simple comparison of trends that does not identify those who implemented the VPP methods and failed to qualify will over-estimate the benefits of VPP.

Rigorous evidence showing VPP saves companies money would help encourage more employers to join. Rigorous evidence is equally important for policy-makers, in part because voluntary programs are not always effective. For example, two studies that evaluate environmental self-regulation programs find no evidence they are effective at improving environmental performance.¹⁴ More encouragingly, studies have shown that the EPA's voluntary Audit Policy leads to improved compliance on average¹⁵ but even it is not effective under all circumstances.¹⁶

Many of the rigorous evaluation techniques I am advocating for were invented roughly a century ago, in large part to study how to improve farm productivity. While hardly the only factor, you all know trends in agricultural productivity in the U.S. in the last century. In the last half century pharmaceutical companies have run over a million randomized trials, and the resulting discoveries are a significant contributor to improving and lengthening lives. Nowadays high-tech firms such as Intel and Google run thousands of randomized experiments each year.

The OMB has recently pushed all Executive Branch agencies to build rigorous evaluations into a substantial share of their programs.¹⁷ My understanding is that OSHA has begun its own randomized trial. While the Executive Branch actions are helpful, Congress has to choice to take a leadership role and encourage even more major programs to demonstrate their effectiveness. Our government could spend more wisely, and potentially quite a bit less, if we invested more in learning what is working and what is not.

Thank you, Mr. Chairman and committee members, for the opportunity to appear before you today. I stand ready to answer any questions you might have.

¹⁴ Andrew King and Michael Lenox. 2000. "Industry Self-Regulation without Sanctions: The Chemical Industry's Responsible Care Program." *Academy of Management Journal*, vol. 43, no. 4, pp. 698-716. J. Rivera, P. de Leon, and C. Koerber. 2006. "Is Greener Whiter Yet? The Sustainable Slopes Program after Five Years." *Policy Studies Journal*, vol. 34, no.2, pp. 195-224. J. Rivera and P. de Leon (2004). "Is Greener Whiter? The Sustainable Slopes Program and the Voluntary Environmental Performance of Western Ski Areas." *Policy Studies Journal*, vol.32, no. 3, 417-437.

¹⁵ Michael W. Toffel, and Jodi L. Short. 2011. "Coming Clean and Cleaning Up: Does Voluntary Self-Reporting Indicate Effective Self-Policing." *Journal of Law and Economics*, vol. 54, no. 3, pp. 609-649. (Unlike OSHA's VPP, EPA Audit Policy participants are not promised fewer inspections.)

¹⁶ Jodi L. Short and Michael W. Toffel. 2010. "Making Self-Regulation More Than Merely Symbolic: The Critical Role of the Legal Environment." *Administrative Science Quarterly*, vol. 55, no. 3, pp. 361-396.

¹⁷ "Use of Evidence and Evaluation in the 2014 Budget", OMB Memorandum to the Heads of Executive Departments And agencies May 18,2012 M-12-14
<http://www.whitehouse.gov/sites/default/files/omb/memoranda/2012/m-12-14.pdf>