

Are Hazardous Substance Rankings Effective?

An Empirical Investigation of Changing Assessments of the Relative Hazards of Chemicals and Voluntary Emissions Reductions

Enacting environmental legislation, such as limits on emissions, requires detailed cost and benefit assessments, involves many players, typically proceeds in a long-drawn fashion, and, thus, has an uncertain outcome. Conversely, despite not directly regulating the behavior of facilities or firms, information-based regulatory approaches—such as the *dissemination of information* on the potential hazards of chemicals or the requirement that facilities or firms *disclose emissions* of certain chemicals (e.g., as is required under the United States Environmental Protection Agency's (US EPA's) Toxics Release Inventory (TRI) Program)—result in public awareness of chemical hazards and the environmental implications of facilities' or firms' operations and sequentially lead to public pressure on facilities or firms to internalize the risks revealed by the information.

An example of the public dissemination of information on chemicals is the Substance Priority List (SPL), administrated by the Agency for Toxic Substances and Disease Registry (ATSDR). Established under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly known as the “Superfund” Act, ATSDR is the knowledge center for the health effects of exposure to hazardous chemicals and is responsible for the maintenance of toxicological databases and the dissemination of information for other governmental agencies and public health professionals. ATSDR gathers information on the hazards of chemical substances, ranks chemicals based on toxicity, frequency of being found at polluted sites, and probability of human exposure, and biennially publishes a list of chemicals at the top 275 of the SPL. In addition to governmental agencies, non-governmental organizations (NGOs) also disseminate information on chemical hazards; examples include the Substitute It Now List (SIN List) by the International Chemical Secretariat and the Dirty Laundry Report by Greenpeace.

The toxicological information prepared by ATSDR is referenced in various regulatory programs, including the TRI program. In addition, ATSDR also assists other agencies in determining future regulations pertaining to chemical substances. Furthermore, as an outcome of progress in toxicological research, the relative assessed hazard levels of chemicals—reflected in the form of their ranks in the SPL—are dynamic. For example, the SPL rank of 1,2,3-Trichlorobenzenes advanced from 334 in 1992 to 137 in 2015. Concurrently, in addition to implementing new technologies to reduce the use of water and chemicals in its dyeing processes, Nike encouraged its suppliers to specifically phase out the chemical from their manufacturing processes. This appears to be anecdotal evidence that firms acknowledge the assessments of chemical hazards and undertake voluntary environmental actions in response. On the other hand, it is also possible that firms may not voluntarily or proactively respond to information such as in the SPL and may wait for the enactment of regulations before taking action.

Studies in the environmental management literature have indicated that waste prevention and emissions reductions, driven by the management of business risk, should reflect the hazards of chemicals released by a firm's facilities. Although governmental organizations such as ATSDR provide extensive, periodically-updated public information about the potential hazards of specific chemicals, limited empirical research has been devoted to examining: (1) the link between such information and voluntary environmental efforts of facilities or firms that use these chemicals, and (2) the implications of the operational characteristics of facilities or firms on the extent and the nature of these efforts. We add to the understanding of these relationships by investigating voluntary reductions in chemical emissions in relation to changes in the relative assessed hazard

levels of the chemicals, as evidenced in the periodically-updated public information. When a chemical is found to potentially cause greater harm as compared to other chemicals, as a upward movement in the SPL, firms can expect higher future costs for environmental compliance and occupational and consumer liability related to that chemical and may be more likely to prioritize the (voluntary) reductions of emissions of that chemical.

To capture firms' voluntary reductions of chemical emissions, we make use of data from the TRI. The TRI Program mandates facility-level reporting and public disclosure of emissions of over 650 chemicals and its data has been extensively used in the literature to examine voluntary environmental actions by facilities or firms. Within efforts to reduce chemical emissions, the two broad categories of practices employed are source reduction and end-of-pipe (EOP) treatment. Source reduction (also referred to as "pollution prevention"), which includes changing product designs and modifying production processes to avoid pollution, has been recommended as a way to achieve better environmental performance, provide competitive advantages, promote innovation, and improve firm financial performance. In contrast, EOP treatment (also referred to as "pollution control") includes the use of equipment or methods to recycle, burn, or neutralize (i.e., treat) pollutants. While EOP treatment is typically not regarded to be as strategically valuable as source reduction, it requires no modifications to existing product designs and has a limited disruptive effect on production processes. While both categories of practices are prevalent, we improve our understanding by investigating the nature of firms' emission reduction efforts when the relative assessed hazard levels of chemicals change over time.

Perhaps the most significant operations management practice pertinent to proactive environmental actions, or actions beyond regulatory compliance, is lean operations. The phrase "lean is green" has emerged due to rationale that, because of the focus on waste (including emissions), leaner facilities/firms can be expected to achieve better financial performance, as well as have smaller environmental. However, certain studies have empirically shown that operational leanness might be disadvantageous in a dynamic environment. Specifically, when a business environment is more competitive or faces greater uncertainty, facilities or firms with more closely integrated operations with little slack are less flexible to adapt than facilities or firms that allow operational buffers. We therefore examine how operational leanness moderates these relationships.

In addition to the SPL from the ATSDR and the TRI from the US EPA, to control for various facility and industry factors, we draw secondary data from the National Establishment Time-Series, and Compustat. We also employ a panel model with facility-chemical- and time-fixed effects to ease the concern of unobserved variables. We find that public information dissemination on the relative hazards of chemicals is effective, as indicated by the significant association between increases in the relative assessed hazard levels of chemicals and greater subsequent emissions reductions, as well as the increased use of source reduction. As for the implications of operational leanness, we find that its overall effect is positive, i.e., leaner facilities outperform less lean facilities with regard to emissions reductions. However, we find that when the relative assessed hazard level increases, less lean facilities increase their emissions reductions more than leaner facilities, i.e., we find a negative moderating effect of operational leanness on emissions reductions. In addition, we also find partial support for a positive moderating effect of operational leanness on the use of EOP treatment. To the best of our knowledge, our study is the first in the environmental management and sustainable operations literature that is aimed at understanding the effects of publicly-disseminated information pertaining to the relative assessed hazard levels of chemicals on the voluntary emissions reduction efforts of facilities using those chemicals, while also providing insights into the implications of operational leanness.