Economic Analysis of California's Green Chemistry Regulations for Safer Consumer Products

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Biographies

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LIST OF ACRONYMS

Acronym	Definition
AA	Alternatives Assessment
AB	Assembly Bill
CAPA	California Administrative Procedure Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGE	Computable General Equilibrium
CEX	Consumer Expenditure Survey
CAFE	Corporate Average Fuel Economy
DTSC	Department of Toxic Substances Control
NAICS	North American Industry Classification System
OPEC	Organization of Petroleum Exporting Countries
PUC	Products under Consideration
REACH	Registration, Evaluation, Authorization and Restriction of Chemical Substances
R&D	Research & Development
RCRA	Resource Conservation and Recovery Act
SB	Senate Bill
TFP	Total Factor Productivity
TURA	Toxics Use Reduction Act

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Executive Summary

The California Administrative Procedure Act (CAPA) mandates that the California Department of Toxic Substances Control (DTSC) perform an economic analysis of the "adverse economic impact on California business enterprises and individuals" when engaged in rule-making. This assessment includes consideration of the impact on the ability of California businesses to compete with businesses in other states. Another provision of the CAPA calls for assessment of the extent to which the proposed regulation will lead to the creation or elimination of businesses and jobs in California.

This report provides a prospective economic analysis of the draft new Safer Consumer Product Alternatives regulation. This regulation intends to improve public health and the environment by introducing a set of rules that will affect how manufacturers produce their products and generates new information about the chemical content of products. Once the assessment is completed, firms may manufacture an alternative product if it meets prescribed conditions. Failing this, DTSC may issue a regulatory ruling mandating several possible actions by the firm, ranging from engaging in further research, labeling, adopting an identified alternative, to banning products from the California marketplace.

The economic approach for determining the benefits of such new public policies hinges on whether there are significant societal costs associated with the status quo. Today, both producers and California consumers know too little about the content of products. This Safer Consumer Products regulation will rectify this information gap and create incentives to encourage product makers to produce safer products. This mitigation effort demonstrates the regulation's potentially large societal benefits of protecting human health and the environment. Economists stress the importance of considering tradeoffs between benefits and costs. Manufacturers and consumers will incur some costs to comply with this regulation. One of the key goals in this economic analysis of public policy is to correctly describe this *tradeoff*. Throughout this report, we pay careful attention to identifying the factors that determine both the short run and long run costs of this regulation and its likely benefits.

Types and determinants of regulatory costs. Manufacturers will bear real costs as a result of this regulation. To evaluate these costs, this report begins by developing a causal framework within which the effects of this regulation on firms' costs can be evaluated. The focal types of costs include: 1) testing products for Priority Chemicals, 2) undertaking an alternatives assessment, 3) implementing a chosen alternative and 4) complying with various regulatory mandates. Because of a lack of empirical information, this report will not provide empirical estimates of these costs. Rather, for each type of costs, this report identifies those factors that will determine the likely size of the cost borne by manufacturers. In this way, this report provides a framework for evaluating causal claims about how the size of manufacturer costs and how they are likely to vary across different types of manufacturers. Throughout this report, we are careful to highlight which links in the supply chain will be affected by this regulation. Retailers of products are unlikely to be significantly affected by this regulation because they can substitute and sell products that have not been regulated by the DTSC. In an extreme case in which entire product lines are banned, then retailers can either import products designed in other

countries such as Europe that are likely to meet DTSC's regulatory requirements. If no such products exist, then retailers will have the option of substituting and selling other products that do not face DTSC regulation. Access to this broad set of options protects retailers from suffering significant profit losses due to this regulation.

Short-run costs in the California context. To place these impacts in context, this report presents information on household expenditures on chemical products, trends in job growth and trends in productivity in the chemical industry. Given the importance of protecting California jobs during the ongoing recession, we pay careful attention to the employment impacts of this regulation. We present evidence on the health of the chemical industry for the nation over time and for California. Because households' share of expenditures on chemical products is small, there are likely to be small impacts on households' budgets. Since most product manufacturing takes place outside of California, we expect the direct short-run California employment impacts to be minimal. There are scenarios under which there could be employment growth if greener California manufacturers gain in market share.

Incentives for innovation and eliminating barriers to market efficiency. Taken together, changes in relative cost of these regulations will create incentives to innovate toward safer products. Manufacturers which are found to produce products that contain priority chemicals are likely to suffer sales losses when this information becomes public knowledge. However, claims that such losses represent social costs of regulation are false since this shifting consumer demand represents a transfer to other firms that produce safer alternatives and will gain sales as consumers substitute toward safer products. We believe that Californian firms have an edge in gaining such market share. Such greener alternatives developed in California could enjoy a substantial export market given the phase in of Europe's REACH regulation. Europe's new regulation creates an export market for California manufacturers. Furthermore, this regulatory proposal sends a credible signal to risk averse innovators that investments of their scarce time in designing green products will offer a high rate of return.

Long-run regulatory costs are likely fall. Next, this report explains why firms are likely to overestimate the long-run costs of this regulation. Unlike in the short run, in the long run manufacturers can make many adjustments in response to this regulation. The net effect of this enhanced "flexibility" is that long run regulatory compliance costs are likely to be much lower than short run costs. Manufacturing firms will engage in research and development, learn by doing, and enjoy the effects of competition in markets for safer product inputs. We anticipate that some firms producing similar products will form industry research consortia to work together to achieve common regulatory goals. The combination of these factors lowers the cost of compliance. A review of past regulatory examples for lead and chlorine emissions supports these claims. Firms that have trouble adapting to the new regulatory environment exit the market and are replaced by new or expanding firms that are more nimble in complying with the regulatory code. In short, the time allowed for firms to adapt to the proposed regulations provides the average firm in the industry the opportunity to face lower regulatory compliance costs. Historic environmental regulations (i.e. The Clean Air Act) and Europe's REACH regulation provide direct empirical support of this claim.

The size and determinants of social benefits. The final section of this report identifies the types of societal benefits and those factors affecting their size. The size of these benefits will depend upon 1) how effectively DTSC prioritizes Priority Chemicals and priority products, 2) the number of Priority Chemicals it identifies and how quickly this identification takes places, 3) how motivated firms are to test their products and adopt alternatives, and 4) how quickly consumers will access information and exercise choice that will shift demand toward safer consumer products.

If DTSC focuses on priority chemicals for which the population has a high exposure, then the health benefits of this regulation could be large. The size of such benefits hinges on how many people are exposed to the priority chemical, how intense in their individual exposure, and how sensitive is their health to such exposure. A major and early benefit of this regulation is providing direct credible information to consumers. Armed with this new information, consumers will make healthier choices. In the long term, this regulation creates both market and regulatory incentives for firms to discover and adopt safer production methods and safer products.

A tool for advancing environmental justice. Currently only consumers with the time, information, expertise, and resources to identify safe and unsafe products can make welfare-improving market choices. There are other Californians who simply assume that all products are "safe" and seek out the cheapest product at the store. Low income populations are more likely to be over-represented in this group and will thus gain the greatest health benefits from this regulation. This regulation addresses this inequity in two ways. First, by increasing access and reducing the cost of obtaining this information, this regulation empowers all consumers to make better market choices. Second, over time the set of products offered in the market should become safer.

1. Introduction

This report provides an economic analysis of California's draft Green Chemistry Regulations for Safer Consumer Products. This regulation intends to improve public health by introducing a set of rules that will affect how manufacturers produce their products and that generates new information about the chemical content of products. The economic approach for judging the benefits of such new public policies hinges on whether there are significant social costs associated with the status quo. This Safer Consumer Products regulation helps to mitigate a significant information problem. Today, both producers and California consumers know too little about the chemical content of products. This regulation will rectify this information gap and create incentives to encourage product makers to produce safer products. This point highlights that this regulation offers potentially large social benefits. But, economists stress the importance of considering tradeoffs. Manufacturers and consumers will bear costs to comply with this regulation. One of the key goals in this economic analysis of public policy is to correctly describe this *tradeoff*. Throughout this report, we pay careful attention to identifying the factors that determine both the short run and long run costs of this regulation and its likely benefits.

The California Administrative Procedure Act (CAPA) mandates that the DTSC perform an economic analysis of the "adverse economic impact on California business enterprises and individuals" when engaged in rule-making. This assessment includes consideration of the impact on the ability of California businesses to compete with businesses in other states. Another provision of the CAPA calls for assessment of the extent to which the proposed regulation will lead to the creation or elimination of businesses and jobs in California. Where accurate or meaningful quantification is not possible, DTSC must "present a matrix of all reasonably foreseeable positive and negative impacts of the regulation."[1]

This report will address each of these key issues. We devote special attention to identifying those types of product makers who will face the highest costs of this regulation. We use economic theory to assess how California's businesses and workers will fare in the presence of this new regulation.

We will study in detail how California firms are likely to cope and adapt in the face of this new regulatory regime. This regulation will unleash a dynamic process of learning and technological change. It will provide firms with strong incentives to take a new look at their supply chains and production processes to try to reduce the quantity of priority products that are used to produce the final product. Given the diversity of firms and the multitude of possible innovations that each firm could discover through trial and error, there is no way for anyone to foresee what will transpire. The net effect of this dynamic discovery process is that the long run costs of compliance with this regulation will be much lower than the costs of compliance in the short run. This optimistic claim is backed up by thirty years of experience with environmental regulations.

1 California EPA, *Economic Analysis Requirements for the Adoption of Administrative Regulations* (December 9, 1996).

Below, we will discuss several salient examples. 2 The unifying theme across these examples is the point that firms adapt to the new "rules of the game". California's firms are likely to among the most nimble in responding and thriving in the new regulatory environment. In capitalist competition, they will be rewarded for their innovative production strategies.

1.1 Overview of cost impacts & firm adaptation

This report studies this regulation's short run and the long run impacts on product makers and chemical makers. We will argue that the short run costs of compliance are likely to overstate the long run costs of compliance. We emphasize the importance of recognizing firm heterogeneity as a key assumption. More nimble firms who seek a "green niche" are likely to gain market share from this regulation at the expense of firms who are locked into "old ways" of producing products. Using basic concepts from microeconomic theory, we pinpoint the conditions such that firms can adapt to the new regulations.

AB 1879 (Feuer, 2008) and SB 509 (Simitian, 2008) create a regulatory process in which firms, consumers, and the government will all learn about the chemicals embodied in common household products. The regulation creates a new set of "rules of the game" that will create a discovery and disclosure process, providing incentives for firms to produce safer products. The regulation provides firms with time to adapt to the new rules. Firms first have a chance to see if any of the chemicals embodied in their products are prioritized. Firms will also be granted time to research the feasibility of introducing an alternative. This explicit "cushion" highlights that DTSC recognizes that product adjustments costs that some manufacturers will face. The net result will be increased consumer confidence in products sold in California and reduced population exposure to harmful chemicals.

1.2 Regulation effects on product quality and public health

This regulation will raise the quality of products sold in California. Products containing chemicals known to be truly dangerous for which there are viable economically feasible alternatives will be banned. The regulation will push companies to take steps to reduce Californian's exposure to harmful chemicals. This will build trust among consumers and lower the likelihood of long run health consequences from using key products. Firms will take a new look at their global supply chains and take pro-active steps to improve the safety of their products.

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2 Examples include; Kerr, S. and R.G. Newell, 2000. "Policy-Induced Technology Adoption: Evidence from the U.S. Lead Phasedown", Resources for the Future Discussion Paper 01-14, Resources for the Future, Washington, DC. And Snyder L, Miller N, Stavins R., 2003. The effects of environmental regulation on technology diffusion: the case of chlorine manufacturing," *Am. Econ. Rev*. 93:431–35, Popp, David. 2003, "Pollution Control Innovations and the Clean Air Act of 1990", *Journal of Policy Analysis and Management*, 22(4), 641-660. , Popp, David. 2006, "International Innovation and Diffusion of Air Pollution Control Technologies: The Effects of NOX and SO2 Regulation in the US, Japan, and Germany", *Journal of Environmental Economics and Management*, 51(1), 46-71.

Ultimately, this regulation can only improve the public's health if it reduces Californian's exposure to dangerous chemicals. This regulation can achieve this goal through focusing its regulatory efforts on identifying such chemicals, making sure that companies that currently produce products using these chemicals are alerted about this fact, and using the regulatory tools at its disposal to encourage such firms which produce "priority products" to minimize population exposure to these chemicals. This requires that firms identify cost-effective alternatives to minimize exposure dangerous chemicals such as substituting safer chemicals, reducing the given chemical's use, or minimizing the possibility of the chemical's release.

Our study will also present a detailed logic chain for why this regulation offers significant social benefits. Today there is a fundamental asymmetry of information; consumers are unaware of potential chemical exposure when they buy a product. Some producers may also be unaware of what chemicals are contained in their products. Such firms may have settled upon a production process and product formulation years ago before current knowledge became available. If the consumer had more information about each product's toxicity would he or she make a "healthier" choice? We believe that the answer in many cases is "yes". This view is based on a major ongoing research program in environmental economics. Leading scholars have documented how people change their behavior when provided with new trusted information.3 While the Surgeon General's 1964 Report on Smoking and Health that linked smoking and cancer risk is the most famous example, there are several more recent examples that we discuss below. High quality new information provided by a trusted government regulator can offer significant social benefits through encouraging consumer substitution and purchases of "greener" products. Below, we will argue that this regulation could have significant environmental justice benefits as the low income populations, who may not be environmentally conscious, are the most likely to change their product consumption and hence exposure thanks to this regulation. As households change their product choices, the toxicity level of garbage in landfills will decline. This will translate into reduced chemical exposure for the residential community living near landfills.

1.3 Methods

Most prospective analyses of new regulation's likely consequences rely on one of two possible methodologies for generating an exact prediction. The first are computable general equilibrium models. Such models make strong assumptions about the cost of production for firms and household product preferences. The payoff of such a framework is that it yields precise predictions concerning the consequences of the regulation. But, by the very nature of this regulation's emphasis on information discovery, learning, and firms' evolutionary adaptive

3 Examples include; Jin, Ginger & Phillip Leslie, 2003. "The Effect Of Information On Product Quality: Evidence From Restaurant Hygiene Grade Cards," *The Quarterly Journal of Economics*, MIT Press, 118:409-451 and Shimshack, Jay P. & Ward, Michael B. & Beatty, Timothy K.M., 2007. "Mercury advisories: Information, education, and fish consumption," *Journal of Environmental Economics and Management*, Elsevier, 53(2):158-179.

responses, we view any attempt to offer precise predictions of this regulation's costs and benefits to be highly speculative and perhaps even foolhardy.

There are two key reasons why we do not believe that an explicit computable general equilibrium (CGE) modeling effort would be useful for predicting the consequences of this regulation. Today, economists simply do not know diverse firms' short run and long run cost of compliance with this regulation. Without knowing each firm's cost of production, we cannot determine how this regulation will affect each firm's labor demand or its output production. In the medium term and long term, we do not know what will be the production capabilities of new firms who will enter the product market to compete against incumbents. Just as Microsoft did not anticipate the impact that Google would have on how we use computers, we acknowledge that we cannot foresee such industry dynamics. But, without such foresight there is no way to make precise quantitative predictions about this regulation's medium term and long term impact on jobs, profits and consumer prices in product markets.

In addition to not knowing precise details about the costs of production for different products, we also do not know the true shapes of product demand curves. If consumer demand for products is highly inelastic, then this regulation will mainly affect final consumer prices for these products. In contrast, if aggregate demand for a specific product is highly elastic (i.e., higher prices will sharply lower demand), then firms whose cost of production goes up because of this regulation will respond by reducing their employment and output production. While economists have estimated the elasticity of demand for many products such as gasoline and food, we know of little research investigating the specific elasticities of demand for extremely narrowly defined products (such as a Blackberry cellular phone).

A second approach for generating predictions about a new regulatory program is to use statistical estimates of the effects of similar past regulatory efforts to extrapolate about the consequences of this new regulation. Unfortunately, from a research perspective, AB 1879 represents a unique law that has not been implemented elsewhere. While Europe is in the process of launching its REACH regulation, we do not have a sufficiently long history of regulatory compliance with this type of regulation to be able to statistically estimate how different firms adapt to similar regulation. We have carefully searched for relevant past cases, and we will below discuss examples that we believe speak to the likely consequences of this regulation but we are not aware of any regulatory actions that are closely similar to this specific regulatory action.

While we do not construct a formal economic model of supply and demand for products nor do we use econometrics to estimate a forecasting model, we devote special attention to describing the key cases and underlying economic parameters that will determine the size of the costs and benefits of this regulation. This taxonomy is useful for predicting how different types of products will compete in the face of this regulation and for judging how California's firms will fare in both the short run and the long run. Our overall assessment, despite the fundamental uncertainties, is that this regulation will offer California significant net benefits. This bottom line is based on three key facts. First, there is a historical record that the ex-ante predicted regulatory costs of compliance overstate the ex-post true regulatory costs of compliance. Second, California's firms are uniquely suited to thrive under this new regulatory environment. Such firms have access to a skilled workforce and leading research universities. California firms

have past experience in working to comply with stringent environmental regulations. Third, informed consumers make better choices. If consumers had access to information that AB 1879 will generate, then they would make different choices over product purchases. The net effect of such choices will be an improvement in household health.

2. The Regulatory Process

The *Safer Consumer Product Alternatives Regulation*, authorized by Assembly Bill 1879 and Senate Bill 509 gives the Department of Toxic Substances Control (DTSC) until January 1, 2011 to devise a new consumer product chemicals regulation. This regulation sets out procedures and standards in four basic steps:

1) identifying and prioritizing the chemicals of greatest concern;
2) indentifying products that contain those priority chemicals,
3) performing Alternative Assessments that compare health, environmental and economic trade-offs of those chemicals and relevant alternative chemicals, and
4) selecting regulatory responses, ranging from outright bans to no action at all and everything in between, that create incentives for firms to adopt alternative consumer products.

2.1 Identifying Priority Chemicals

The initial step in the regulatory process involves DTSC identifying two lists of chemicals. The first list identifies Chemicals under Consideration (CUC), those chemicals that may and do exhibit harmful health impacts based on a wide range of factors. From this first list, the DTSC will constitute a second list, which identifies those chemicals of highest priority, denoted Priority Chemicals. It is these Priority Chemicals that become actionable or regulated chemicals and subject to subsequent regulatory compliance. Both lists will be published and made public on the DTSC website.

2.2 Identifying Priority products

Upon request by DTSC, firms are required to provide evidence on whether or not their product contains a Priority Chemical. The DTSC will then establish two types of product lists which shall also be made public on its website. The first list is that of Products under Consideration (PUC), products that are, or contain Priority Chemicals. From this list of Products under Consideration the DTSC produces a second list of Priority Products that will be subject to subsequent compliance actions. Products are exempt if they contain less than a DTSC specific *de minumus* amount of the Priority Chemicals.

2.3 Alternatives Assessment

Once a product is determined by DTSC to be a Priority Product, the retailers of that product will be notified. DTSC will also issue a date by which the Alternatives Assessment (AA) must be completed by the manufacturing firm of that product. An Alternatives Assessment workplan and then a final report should be completed for the Priority Product. This report will be prepared by the firm or by a qualified third party assessor and will then be reviewed for quality assurance by a second outside assessor (Lead Assessor) to ensure no conflicts of interest bias the assessment of alternatives. An Alternatives Assessment should evaluate the alternatives with respect to human health, environmental and economic impacts in addition to products function and

performance impacts. Through this process, the regulation provides for the protection of trade or proprietary secrets and information.

2.4 Adoption of an Alternative

Following the Alternatives Assessment, the DTSC will not take any further action if all of the following occur:

a) The firm adopts an approach in which the alternative consumer product contains less than 0.1% of the Priority Chemicals or less than detectable amounts, and
b) The Priority Product in the course of the alternatives assessment is determined not to present a significant threat to human health or the environment, and
c) The Priority Product will be completely phased out and recalled from commerce in California within three years.

In the cases in which either 1) the alternative consumer product contains more than 0.1% of the chemical or 2) the firm does not adopt an alternative, then the firm must provide consumers with specific information on the Priority Chemicals. This information must be provided either through product labeling or at the point of sale. The firm must also develop a take-back program for this product and communicate this program's existence to consumers.

2.5 Failure to comply

DTSC's regulatory response depends on the results of the alternatives assessment. DTSC may engage in wide range of regulatory responses, including:

1) labeling mandates,
2) requiring research into green chemistry alternatives,
3) mandating changes in inputs and production process, and
4) prohibiting the sale of the product.

2.6 Exposure versus process regulations

Many environmental regulations seek direct limits on either releases of pollutants or exposures to pollutants. This regulation creates incentives for firms to change their production processes. These incentives take two primary forms. First, this regulation requires the production of information on Priority Chemicals and the communication of this information to consumers. This may change the market incentives that firms face by empowering consumers to make safer choices. Second, the regulation creates compliance incentives that induce the firm to change its use of inputs and production processes that involve Priority Chemicals. This forces firms to carefully consider, and possibly adopt, alternative inputs and production processes.

3. Direct Costs of this Regulation

Here we examine the types of costs that AB 1879 may impose on California firms in the short run. For each step in the AB 1879 regulatory chain, we will first explain how the regulation creates new costs for the firm, illuminate the nature of those costs and then explain what factors will determine the magnitude of those costs. While there are several stages in determining the costs that different firms will face from this regulation, it is important to keep in mind the key conceptual point that the ultimate cost of this regulation will be paid by firms, workers and consumers. The exact "cost sharing" depends on key economic parameters that we discuss below.

3.1 Cost of testing Priority Chemicals

The costs of identifying chemicals under consideration and Priority Chemicals will be borne initially by the DTSC. As a publicly-funded regulatory agency, how DTSC chooses to raise revenues for these public expenses will determine who ultimately bears these costs. For example if revenues are secured from the general fund, state tax payers will bear these costs while if some more targeted fee or tax is placed on the manufacturing industry or assessor firms, then firms, workers and consumers will bear these costs. Based on the general theory of tax incidence, consumers will face higher product products due to this tax if they inelastically demand the product in question. Intuitively, this will take place if there are few substitutes for the product that is being taxed. Cigarettes are a classic example of a product whose price increases as the tax rises.

The size of these costs will depend upon many factors that include; the number of Priority Products, the number of manufacturers who make them, the ***quantity*** of chemicals the DTSC seeks to evaluate and the ***speed of these evaluations***. The greater the number of chemicals targeted each year for evaluation, the larger the likely costs. Costs will also vary with the ***cost of testing methods or technologies*** and the ***de minimus levels*** of each chemical must be accurately measured to using current technology.

Finally, the acceptable ***standards of evidence*** for being placed on the list of chemical under consideration and the list of chemical of concerns will also influence these costs. These costs will be highest if DTSC has to conduct or subcontract chemical testing directly. Costs will be lower, at least initially, if DTSC utilizes existing knowledge to place chemicals on the list. This knowledge could come from existing scientific peer-reviewed data and articles and well as regulatory findings supporting California's Proposition 65, other comparable state-level regulations or foreign regulations such Canadian or European regulation.[4]

Furthermore, the cost to the DTSC will be lower if the ***burden of proof*** for challenges involving the listing or delisting of a chemical in light of new information is placed on industry. If this burden is on the DTSC, it must engage in an exhaustive suite of tests on products for which there

[4] http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp

is already scientific peer-reviewed data if industry challenges a chemical's listing. If the burden is placed on industry, it is likely that industry will only invest in testing and launch challenges for chemicals which have a reasonable chance of delisting in light of new information, for which there are poor substitutes, and for which there are promising future sales to recoup testing investments.

3.2 Cost of testing and reporting for Priority Products

A firm's cost of testing products will vary with a number of factors. First, the total ***number of products*** a firm produces will influence its aggregate testing costs, with the greater the number of products the larger the firms expected costs. Second, increases in the ***number of product components or chemicals*** involved in producing each product will likely increase the firm's aggregate costs. DTSC is focusing its regulatory efforts on intentionally added chemicals. This means that the manufactures will face low costs in determining whether the Priority Chemical is embodied in the product.

Third, the firm's ***prior knowledge of the chemicals*** used in it products will vary with several factors. Firms that already have investigated what chemicals are contained in their product will encounter very low costs for this step of the regulation. This may include firms who sell products in markets such as Europe. These firms may already have conducted the require testing. In addition, firms using chemicals that are regulated by TSCA or state laws may already have foreknowledge of certain chemicals. Finally, "green" firms who seek to target and re-assure green consumers are likely to have prior knowledge of the chemicals they utilize and the levels of these chemical in their products.

Fourth, the ***structure of the firm's supply chain*** may affect its cost of testing chemicals in products. Vertically integrated firms that produce all of their own components and chemicals will generally face lower testing costs, all other factors held constant.

In contrast, manufacturing firms who contract out for components and inputs from other companies will face higher costs of determining what chemicals are contained in their entire product. The informational challenges associated with contracting increase when supply chains cross national boundaries. In response to this regulation, firms which source inputs from outside vendors will likely place a higher value on verified information of product contents. This will support the growth of ISO 14040 firms outside of California firms which verify the chemical components of product inputs which are imported into the state.

Product testing as a fixed cost. Product testing for Priority Chemicals represents a fixed business cost. Once the firm has incurred this cost, its average fixed cost declines with the scale of its production. A firm that sells two cars per year will face a higher average fixed cost from testing this product for chemicals than a firm that sells 5,000 cars per year. If small firms do sell a smaller volume of output, then they are likely to face higher average fixed costs of compliance. If DTSC expands the list of chemicals that must be tested for, then companies will incur new testing costs.

3.4 Costs of Alternatives Assessment

Once DTSC has identified a priority product, the firm must undertake an alternatives assessment. The cost of undertaking these assessments depends upon many factors.

First, the ***role of the Priority Chemical in the product*** will matter. The costs of conducting these alternatives assessment will likely depend on the role the Priority Chemical plays in the production and performance of these products. A continuum of possibilities may result from the alternatives assessment; from a new chemical *input*, to a new *production* process, or an *entirely* new product. If a firm can substitute an alternative chemical to fill the same role in the product or production process, then the fixed costs of transitioning to the alternative chemical will be minimal. If the firm is unable to substitute an alternative chemical, it may seek an imperfect substitute which could require product redesign or new production equipment and processes, and the firm would need to make fixed investments in order to identify and adopt the preferred alternative.

Second, the ***number of alternatives considered and thoroughness of each assessment*** will impacts costs. Each alternative must be evaluated along several dimensions: health, environment, product performance and economic impacts. Costs will clearly vary with the standards of evaluation for each of these and how difficult it is to achieve those standards. If an alternative contains no Priority Chemicals, it may be less costly to consider than an alternative which contains a Priority Chemical, which would be subject to more testing to determine potential harm versus the status quo product.

Third, variations in firms' ***in-house research & development capacity*** will likely affect the costs identifying and assessing alternatives**.** Firms will differ with respect to their research and development capacity. Some firms may have already explored different ways to produce their product or have next-generation products under development. This is likely to be especially true for products with high rates of obsolescence and innovation. Generally speaking, larger firms in markets with a history of product innovation are more likely than smaller firms to have this in-house R&D capacity.

Fourth, the ***research capacity of the firm's trade or industry association*** may influence its costs. Firms' costs may fall if they belong to an industry association that assists in their alternatives assessment. Trade association research is most likely to reduce assessment costs when firms use common production technologies and products are made up of similar ingredients. A group of firms who produce similar products could contribute money to a collective pot to finance the overall assessment. For example, if there are ten firms in the collective, and they agree to share the costs of the third party verifier, then each would face 10% of the total cost.

Fifth, firm's cost will depend critically upon the ***degree of market competition among Third-party verifiers.*** AB 1879 creates a crucial role for third party verifiers at this stage in the regulatory process. This third party is expected to work with the firm who produces a priority product to identify alternative methods for mitigating the public health and environmental challenge. The costs of undertaking these assessments will fall as these markets in third-party assessors becomes competitive.

Initially, the market could experience a shortage of accredited third-party assessors, as the onset of the regulation will suddenly and substantially increase the demand for ISO 14040 firms and skilled workers. If there are insufficient assessor/verifiers to meet the industry-wide demand for alternatives analyses by the regulatory deadline, then a scarcity exists and these firms will be able to charge high fees and attain high profits for their services. The effects of this initial shortage can be mitigated if assessment firms know training requirements in advance and firms believe they will be able to recoup investment in capacity expansion when the regulation takes effect. In the long-run, firms and individuals seeking profits will attain the accreditation necessary to perform assessments. Such investments in specific human capital will mean that the quality of the third party efforts will improve and quality adjusted prices for hiring these consultants will decline due to market entry.

Liquidity constraints and Small Firms. Depending upon the product, some small firms may face financial constraints in implementing an assessments analysis. Small firms may not have sufficient cash available to pay such a consulting firm. If small firms are allowed to work together through a trade association, then there will be economies of scale and reduced costs of engaging in the alternatives assessment.

3.5 Regulatory response costs resulting from DTSC rulings

Regulatory uncertainty. The firm can incur significant costs in complying with a ruling if it takes significant time for DTSC to issue a ruling. Firms who produce a priority product may delay investments until a ruling is issued. These firms face uncertainty about the ruling outcome, and in light of this uncertainty will delay or suspend investments such as building or retooling a factory related to the priority product until they receive the DTSC ruling. In addition to the effect this delay will have on firm productivity, the firm may face financing costs for money borrowed in support of a suspended investment project. Also, a firm's investors may view the uncertainty as an increased risk to the firm, and this could reduce the firm's stock price.

***Costs associated with regulatory respon*ses**. For products which are submitted to the DTSC for a ruling, DTSC has many options at its disposal. It could require that a firm take no action or require additional information, or choose the minimal cost alternative. Additionally, the DTSC could require product labeling. While changing the product packaging to include the labeling would be low cost, it would result in additional consumers being aware of the product's potentially harmful nature than when the product was listed on the DTSC web site, and could result in additional loss of sales. If the DTSC restricts or prohibits a product's usage, this could result in substantial costs to the firm.

3.6 Regulatory response costs associated with implementing an alternative product

The cost to firms of actually deploying a new alternative will depend, in the first instance, on whether it requires a change in chemical used, changes to an existing production technology or a new production technology or the adoption of an entirely new product supply chain. The firm hires workers, purchases raw materials, develops production technology, and uses corporate knowledge to produce output. Implementing an alternative could involve several changes in production, the costs of which are not going to be well known ex-ante.

Substituting one chemical input for a safer chemical input. Alternatives that involve only switching of one chemical for another are likely to among the least complex and perhaps the cheapest. For example, in the production of electronics equipments manufacturers could substitute tin-copper solder for tin-lead solder.

Changes in input contracts for components. An alternative for some firms will be to change the product components that they use by changing their contracts with suppliers. The costs of this option cannot be known ex ante. Firms have an incentive to identify "green" alternatives to Priority Chemicals and engage in long-term contracts early, as firms which are late to contract for components may find a shortage of acceptable alternatives. However, assuming that the firm does not have to change their production technology processes or fixed capital, this option is likely to be less costly than the following two alternatives.

Drop-in or Add-on technologies. Rather than re-engineering their entire production process, this alternative would require a firm to change only one segment of the production process. For example, a firm which uses a Priority Chemical to condition input materials such as metals or plastics may seek to use an alternative chemical plus new machinery at that stage of the production process in order to eliminate Priority Chemical residue in the finished product.

Changes in fixed capital costs. This case would require the firm to change significant portions of its production technology to implement a new alternative. Probably the most expensive, this would require significant new capital investments, labor retraining and significant modification to existing components subcontracting. If product characteristics change enough it may also require new patent and marketing costs.

Length of phase-in period. Once DTSC makes a ruling, the actual impact on a firm will hinge on how much time the firm has to meet the requirement. The cost of adjustment will be lower if the firm has more time to adapt.

Macro-economic factors. Aggregate product demand trends will likely play an important role in determining the cost of implementing the alternatives assessment. In the case of products such as cell phones for which there is rising demand over time, producers anticipate that they will need to build new factories. Many of these factories are just in the planning stage. If these production facilities have not been built yet, then the firm will have access to many more options for how to design the new factory in order to be AB 1879 compliant. In contrast, for a product whose market is shrinking or stagnant; there is little reason to build new factories. Producers will use existing capacity and may not even be paying to reduce depreciation of the capital stock. For such declining industries, this regulation could even lead to product exit. The CEOs of such firms may reason that the irreversible investment required to comply with the regulation will not be recouped by selling a product already facing declining sales.

Firm Product Investment Cycles. Within broad product categories, product makers will differ with respect to their ability to comply with different regulatory mandates. Some firms will be more nimble in responding to regulatory changes. Such firms may have an innovative leadership. These firms may have recently invested in constructing a new production facility or have a flexibility in their contracting that allows them to substitute input providers without breaking long term contracts.

Past experience with major regulations such as the fuel economy Corporate Average Fuel Economy (CAFE) standards for vehicles highlights that different firms at a point in time face different costs in complying with regulation. In the CAFE standards case, Chrysler was much better situated to comply with the 27.5 MPG standard than Ford or General Motors because it had made past investments to build more fuel efficient vehicles. Chrysler President Harold R. Sperlich told a U.S. House subcommittee in September 1985 that "Chrysler will meet the standard because, even when we were going broke a few years back, we invested heavily in a corporate strategy geared to satisfying the market while meeting the fuel-economy law. Our compliance with the Corporate Average Fuel Economy (CAFE) standard is proof that the 27.5 mpg standard is technologically feasible and that other manufacturers could have met the law as well."5

The Porter Hypotheses and Production Costs Dynamics. In certain limited cases, this regulation could lower a firm's production cost. This counter-intuitive claim has been called the "Porter Hypothesis" named after the Harvard Business School Professor named Michael Porter.

Porter and van der Linde (1995) outline five different reasons why regulation can have this effect. First, regulation signals companies about likely resource inefficiencies and potential technological improvements. Second, regulation focused on information gathering can achieve major benefits by raising corporate awareness. Third, regulation reduces the uncertainty that investments to address the environment will be valuable. Fourth, regulation creates pressure that motivates innovation and progress. Fifth, regulation levels the transitional playing field.

The Porter Hypothesis posits that regulation can have *negative costs* as it forces firms to engage in a re-evaluation of their business practices. Implicit in the Porter Hypothesis is the view that firms suffer from inertia and face organizational costs for making their businesses "cutting edge". Under the Porter logic, established firms (think of Microsoft or General Motors) have become locked into "old ways" of production and have not devoted sufficient thought to adopting new methods of production. Proponents of the Porter Hypothesis claim that regulation such as AB 1879 can "wake up" a firm and allow it to discover cost savings that it would have ignored otherwise. Recent research conducted by David Popp (2003, 2006) has documented that firms regulated under the Clean Air Act increase their investments in patents to help them innovate to better adapt to regulatory requirements.

5 Chrysler President Harold R. Sperlich testimony before the House Subcommittee on Energy Conservation and Power, September 19, 1985

4. Regulation's Effects on California Consumers and Employment

In the previous section, we presented a detailed discussion of what types of firms are likely to face higher costs of production due to this regulation. When a manufacturing firm's cost of production increases, there will be general equilibrium consequences in both the product markets and the input markets. In the product market, the manufacturing firm will earn less profit if it chooses to discontinue selling the product or if it is unable to pass along the regulatory costs to final consumers. The impact of the regulation on the manufacturing firm's profits will hinge on what products it now focuses on producing. Retailers may choose to discontinue selling a Priority Chemical laden product. The impact on their firm's sales from no longer selling such a product will hinge on whether there is a close substitute product that does not embody a Priority Chemical. If this is the case, then consumers will continue to shop at the store and the retailer will experience no significant change in its economic performance. In the input markets, the manufacturing firm that now faces DTSC regulation may now choose to hire fewer workers. Such a firm is likely to reduce its production of specific priority products and facing less demand for such a production, this firm will reduce its workforce. This section examines how this regulation will affect the well-being of the consumers who buy the product, firm's shareholders, and workers and consumers. Our starting point is the basic economic theory of regulatory incidence. If a firm's cost of doing business increases as a result of this regulation, will it pass on this regulatory cost to consumers or will it cut back on its production and thus reduce its employment? If a firm can fully pass on the regulatory cost to final consumers then neither the firm's profits nor its employment will change. A firm's ability to pass the new regulatory cost to consumers hinges on the elasticity of demand. If demand for the final products is completely inelastic (i.e., price insensitive), then any regulation-induced cost increases will be passed on to final consumers and final consumer prices will rise. In this case, the firm will continue to produce its original level of output and not lay off any workers. For any specific manufacturing firm, the elasticity of demand will hinge on whether there are close substitutes for the specific product. Imagine a case in which this is the case such that one product such as a paint has Priority Chemical embodied in it while a similar competitor does not. The first paint maker might recognize that the elasticity of demand is extremely high (perhaps 30) such that the slightest increase in price leads all of its customers to substitute to its rival.[6] In this case, the paint company would not be able to pass on its regulatory costs to consumers and this firm would suffer a profit loss.

4.1 Effects on Consumers

Product price increases have their largest impact on our standard of living on households that spend a large share their budget on such products. If a household spends 50% of its disposable income on food and the price of food doubles, then the household's real purchasing power has declined by 25% even if its nominal income has not changed.

With this logic in mind, we have examined data from the United States Consumer Expenditure Survey (CEX), the leading data set economists use to study household consumption behavior. An analysis of the overall budget information based on data from 2008 indicates that that

6 An elasticity of demand equal to 30 means that a 1% increase in a product's price would reduce demand by 30%.

households spend a very small share of their income on these products.[7] Data from the 2008 CEX indicates that the average household spends 1.4% of its income on housekeeping supplies, and 3.4% of its expenditure on household furnishings. In contrast, it spends 17.6% of its expenditure on transportation. If DTSC focuses its regulatory efforts on products that are used within the home, then these average budget shares suggest that the new DTSC regulation will affect products that only represent a small share of overall household expenditure. This means that consumers are unlikely to suffer a significant loss in real purchasing power from any product price increases caused by this regulation.

International competition protects California consumers from facing higher prices for products. In capitalism, firms will enter markets where they can earn a profit. In extreme cases where only one producer is cleared to sell a product for which there are no substitutes in California, this producer could seek to exert its monopoly power by charging higher prices. In this age of globalization, such a monopoly could not persist even in the short run. Companies that sell products on the Europe REACH market are likely to be able to meet AB 1879 requirements. These firms are likely to begin to export to California if they sense that they can earn a profit from entering the market. This potential entry threat encourages incumbent firms to not "price gouge" and this protects California consumers.

In the aftermath of new costly regulation, product prices can only rise sharply if aggregate demand is highly inelastic. These would have to be products for which there is no substitute. While in competitive capitalism there are very few cases in which consumers have no choice across products, we can imagine cases in which all of the leading products are produced using a Priority Chemical. In this case, consumers would not have access to a "safe product" substitute. All of the firms that produce this product would face the same challenges in dealing with DTSC's regulatory choice. In this case, consumers in the short run are likely to bear the cost of this regulation through higher product prices. In the medium term and long run, new firms using new production techniques that economize on this Priority Chemical could enter this product market and consumers would enjoy reduced prices.

For many products such as a Dell computer, one or more close substitutes exists (an IBM computer). In these cases, there are many close substitutes for any one product. In such a competitive market, a company that tried to raise its prices to cover the new regulatory costs would lose many buyers. Consumers who stop buying a "priority product" will seek out other products whose combination of quality, price, and regulatory stamp of being "safe" make them a more attractive choice. This consumer substitution will create new sales opportunities for existing green companies and will encourage market entry to fill this niche. If there are low barriers to entry for competing in this industry, then consumers will not experience sharp price increases for products as the "green" firms scale up their production.

4.2 Regulation's impact on existing California employment

Given the fundamental uncertainty about the details of how DTSC will implement the regulation in terms of choosing priority products and the decisions it will make in the alternatives assessment, it is impossible to offer precise predictions concerning how California jobs will be affected. In this section, we first sketch the overall economic picture for the chemical

7 from ftp://ftp.bls.gov/pub/special.requests/ce/share/2008/cucomp.txt

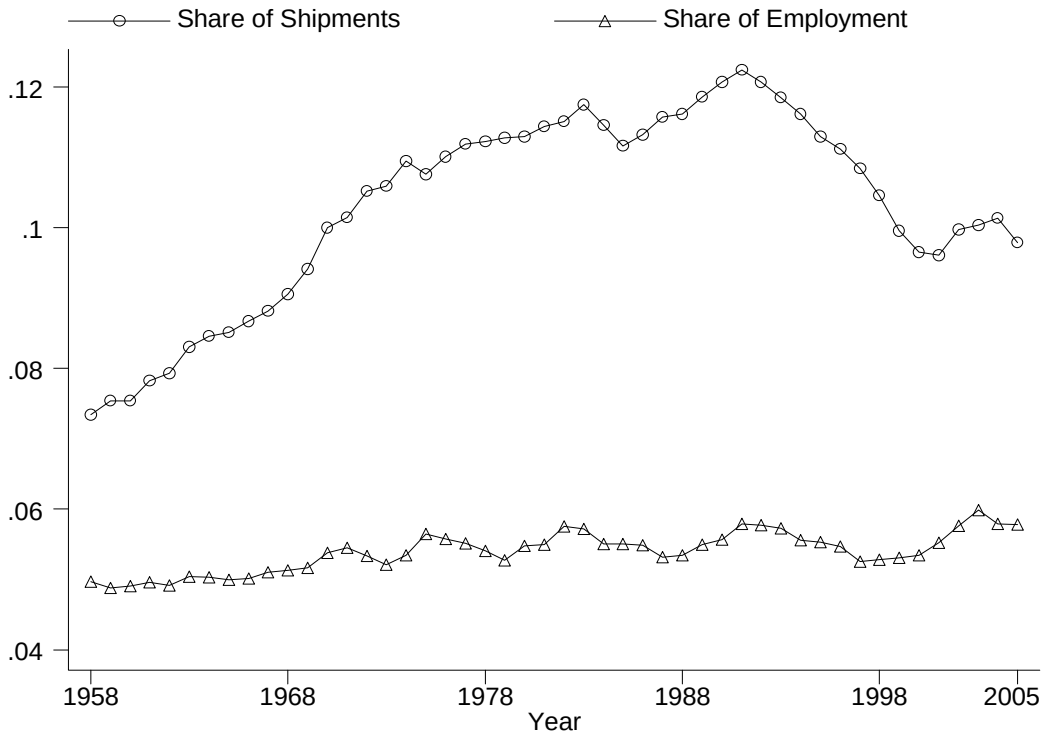
manufacturing industry both over time for the nation and for California. After setting up the basic facts about this industry, we return to the question of how this regulation is likely to affect diverse firms. We recognize that this regulation will also affect product manufacturers and we will present data on employment trends for many different manufacturing industries within California. We devote special attention to the chemical manufacturers because their core business will be directly affected by this regulation. For many product manufacturers who use such chemicals as an input of production, these producers will have significantly more flexibility in substituting inputs. For example, a company that sells a household cleaning product could contract with input suppliers who are currently selling to firms in Europe and thus satisfy the REACH regulation's requirements. This example highlights that many product makers can shield themselves from significant regulatory impacts by contracting with international input suppliers who are able to comply with DTSC regulation.

We focus on statistics about the chemical industry because this industry will face the most stringent costs from AB 1879 regulation. This industry sells the key chemicals used by product makers to produce final consumer products. It is important to note that raw chemical manufacturers will both produce Priority Chemicals and the same firms may also produce alternatives to these chemicals. This point highlights the nuanced effects introduced by this regulation.

The first important fact is that the U.S and California chemical industry is not a declining industry. To provide some long run statistics, we use data from the National Bureau of Economic Research's Manufacturing Productivity data base.[8] For four digit NAICS manufacturing industries covering the years 1958 to 2005, this data set provides national information on each industry's annual output and employment. In Figure 1, we graph the Chemical Industry (NAICS 3251-3259)'s share of total manufacturing employment and share of shipments over 47 years. Measured in terms of its employment share, the Chemical Industry employs roughly 5% of manufacturing workers and this has slowly grown linearly over time to roughly 6% of the manufacturing workforce today. Measured in terms of its share of shipments, the Chemical industry's output grew sharply from 1958 until 1990. Its share did fall sharply in the 1990s but has been stable in recent years.

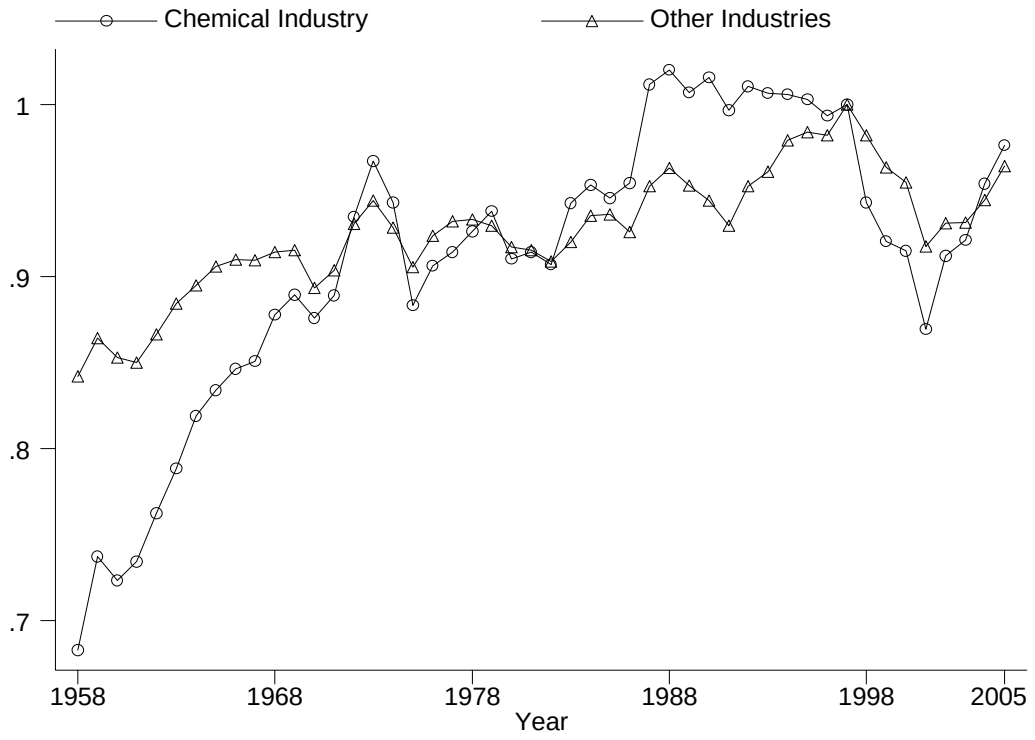
8 http://www.nber.org/nberces/nbprod96.htm

Figure 1 - Chemical industry's share of national manufacturing



Another measure of an industry's health is to look at its productivity. Productivity reflects an industry's output after accounting for the quantity of labor and capital it uses. Intuitively, a highly productive industry can produce a lot of output with relatively little labor and capital inputs. Figure 2 graphs the chemical industry's average total factor productivity (TFP) in comparison to all other manufacturing industries. In recent years, they are equally productive.

Figure 2 - National TFP for chemical industries and all other manufacturing industries



The U.S Census County Business Patterns employment data is useful for examining California employment trends by industry. In Table 1, we examine aggregate California manufacturing employment in 1997 and 2007 for 20 major manufacturing industries. The chemical industry's employment grew by over 10% during this period. In 2007, 74,821 Californians worked in the chemical industry.

It is important to note that pharmaceuticals and pesticides are excluded from AB1879 regulation. NAICS 327 includes; Basic Chemical Manufacturing, Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing, Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing, Pharmaceutical and Medicine Manufacturing, Paint, Coating, and Adhesive Manufacturing, Soap, Cleaning Compound, and Toilet Preparation Manufacturing, Other Chemical Product and Preparation Manufacturing.

We recognize that other industries are likely to be impacted by AB1879. Such industries include; petroleum, plastics, primary metals, and mineral products. As shown in Table One, employment in petroleum and mineral products has been stable over time while California has experienced job loss in plastics and primary metals. For these declining industries, DTSC will have to devote special care to balance the costs imposed on these industries in the alternatives assessment rulings relative to the public health benefits achieved by aggressive regulation. To build in safe guards, DTSC could revisit the regulation's job impacts for these "at risk" industries a few years into the implementation process.

Table 1 - California manufacturing employment in 1997 and 2007

Industry	NAICS	Employment	
		1997	2007
Food	311	147,733	153,746
Beverage and Tobacco	312	29,106	36,248
Textile Mills	313	13,140	11,458
Textile Product Mills	314	20,299	11,894
Apparel	315	132,720	73,723
Leather and Applied Product	316	7,116	4,850
Wood Product	321	39,230	34,098
Paper	322	34,358	25,855
Printing and Related Activities	323	84,116	64,453
Petroleum and Coal Products	324	12,922	12,484
Chemical	325	64,795	74,821
Plastic and Rubber Products	326	90,803	70,140
Non-Metallic Mineral Products	327	44,417	45,802
Primary Metals	331	25,891	19,807
Fabricated Metal Products	332	196,761	153,004
Machinery	333	106,612	71,694
Computer and Electronics	334	384,077	222,340
Electrical Equipment, Appliance	335	42,064	34,301
Transport Equipment	336	177,424	128,395
Furniture and Related Equipment	337	67,868	53,548
Miscellaneous	339	105,898	100,663

The final piece of evidence we present (Table 2) is the distribution of firm sizes of chemical firms within California in 1998 and 2007.

Table 2 - California chemical firm size distribution (NAICS 325)

Firm Size (worker count)	Count of Firms in 1998	Count of firms in 2007
1 to 4	477	483
5 to 10	278	255
11 to 20	262	244
20 to 49	302	316
50 to 99	133	139
100 to 249	94	68
250 to 499	27	31
500 to 999	9	13
100+	6	7

Table 2 shows the firm size distribution for the Chemical Industry in California in 1998 and 2007. There are many small firms and a small number of very large firms.

This empirical work highlights that California's chemical industry is growing during a time when many of the other manufacturing industries in the state are shrinking. This industry's productivity is high and the average chemical industry's capital to labor ratio is high. This suggests that relatively little employment is at risk relative to the dollar value of production. The only firms that would risk significant profit loss would be chemical manufacturers who have heavily invested in training a workforce and in a specific factory design that can only produce a small set of chemicals that DTSC has now determined are Priority Chemicals. We doubt that there are many factories which would be holding such an undiversified portfolio. The only California product manufacturers who could significantly suffer from this regulation would be firms that produce a product that requires as an input a specific chemical and for which there is no other possible chemical that could be substituted for it. If this chemical is determined to be a Priority Chemical, then this producer would be heavily regulated during the assessment stage. Basic economics predicts that few product makers would expose their firms to such risks by designing a product that can be only be produced using one unique production process. Having access to a broad set of different production strategies represents a type of insurance against unexpected shocks (such as price spikes, or new regulation).

4.3 Regulation's impact on future job creation in California

California's edge in producing "greener" products is threefold. First, producers will recognize that California's ***green conscious consumers*** will value such products and will be willing to pay a price premium for such quality. The typical California consumer's "green focus" means that many of the state's producers are uniquely suited to compete in a marketplace in which priority products will face greater regulator scrutiny. In terms of head-to-head competition, this regulation should aid many of California's producers. This conclusion is tentative but based on our belief that California has a comparative advantage in designing "green products" and this regulation will shift consumer demand away from products that have contain Priority Chemicals and towards "green" products. California is well known for its consumer environmentalism. There are more Toyota Priuses and solar panels bought in this state than in any other part of the

United States. California has a proven track record of "green job" creation even in the absence of this regulation. The National Green American Directory highlights the share of California's listing of businesses that have made firm commitments to green products. This directory lists 2,333 companies and 633 of them (over 25%) are located in California.[9]

Second, California's ***access to venture capital*** means that local producers will have an easier time raising the funds to finance new potentially high-risk, high-reward efforts at producing new products that comply with this regulation. Finally, ***California's universities and skilled workforce*** guarantee new firms a pipeline of employees who can be trained regarding or are familiar with alternatives assessments and new manufacturing processes.

There are, of course, scenarios in which California could lose jobs. Under AB 1879, some firms could face a product ban. This severe outcome would mean that demand for their product would fall sharply as Californians would no longer be buying their product. In addition, as the rest of the nation (and world) learns about California's DTSC action, aggregate demand for the product would decline. Such product demand declines would mean that such firms are likely to fire workers unless they increase their sales in countries that do not pass such regulation (such as developing countries). It is important to note that this extreme outcome would only take place for firms whose products are "priority products", and DTSC rules for a ban, **and** the firm is unable or unwilling to redesign the product or identify alternative inputs to substitute out for the chemicals or properties that led to the ban. We believe that very few firms will experience this outcome. When firms submit their alternatives assessment, they will submit information about their costs of compliance. DTSC will balance perceived economic harm to companies with the "good" caused by choosing a specific alternative.

4.4 Past lessons from the California employment effects of the Clean Air Act

Recently, environmental economists have studied whether the enforcement of the Clean Air Act has deflected manufacturing jobs away from highly regulated areas (i.e., polluted big cities) toward more rural, less regulated areas within the United States. This empirical work has documented that high polluting industries whose final output is cheap to ship back to final consumers have been migrating to counties that have been assigned to low regulation "Attainment Status" under the Clean Air Act (Becker and Henderson 2000, Greenstone 2002). At first glance, this suggests that AB 1879 will be costly because industry will leave California. But, this logic is false. The Clean Air Act regulation applies to where production takes place. This DTSC regulation applies to where consumption takes place. Regardless of where the factory is located, the product maker will face the same "priority product" issue if the producers seek to sell the product in California.

A relevant case study on the impact of the Clean Air Act on California manufacturing employment is offered by the oil refining industry. There is a lot of refining activity in California such in the coastal areas of Contra Costa County and the South Bay of Los Angeles County. Recent detailed micro econometric research conducted a "before/after" comparison to investigate how this regulation affects job growth for regulated industries. As analyzed by Berman and Bui (2001), the Clean Air Act has mandated multi-million dollar regulatory costs for

9 www.greenamericatoday.org/pubs/greenpages

oil refineries to lower their ambient air emissions. They conducted an empirical investigation comparing employment dynamics at California's oil refineries (who faced a significant increase in regulation costs) relative to employment dynamics at Texas oil refineries (the control group which did not face such regulations). They reject the hypothesis that California's regulation caused job loss. They attribute this negligible effect of regulation on the California firms' employment decisions to the fact that the oil refineries are highly capital intensive plants. This means that they use high levels of capital per worker in producing their output. This case study of how the California oil refining industry has adapted to regulation is very relevant because the chemical industry is also highly capital intensive. Using the latest national data from 2005 for 473 different NAICS industries, the industries that comprise the NAICS 325 chemical industry feature a capital to labor ratio that is significantly higher (by two standard deviations) than the average industry.

5. The Dynamics of a Firm's Regulatory Compliance Costs

This section will focus on firm and industry level dynamics that will result in lower long-run compliance costs. In the short run, firms have fewer ways to cope with the new regulatory environment. In the long run, firms have many more available strategies that help them to compete according to the new "rules of the game".

In the long run, new firms will enter the market, and they will be better equipped to compete. Within any industry, firms face evolutionary pressures. If they do not adapt to changing circumstances, they are likely to respond by no longer selling a product. Retailers will replace such products with new products that meet the regulatory standard. We envision this dynamic playing out in industries affected by AB 1879. Firms whose products have been designated as "priority products" will have strong dynamic incentives to invest in modifying their product. Such products are likely to face new competition from industry entrants featuring products that are similar in quality but have not been labeled "priority products". The net effect of this competition will be a safer typical product for consumers to purchase.

5.1 Research & development lowers regulatory costs

With the introduction of AB 1879 regulation, firms will have incentives to minimize their use of Priority Chemicals and chemicals under consideration in their production processes. Facing this new requirement, such firms will engage in directed technological change to achieve these goals. In recent years, empirical research conducted by environmental economists has documented an important fact that suggests firms can lower their regulatory compliance costs. When the price of a production input such as electricity goes up in price, firms engage in directed "endogenous technological change" to enable them to use less electricity. Intuitive examples of this phenomenon include improvements to air conditioners and automobiles. When the price of electricity increases, manufacturers subsequently produce energy efficient air conditioners (Newell, Jafee, and Stavins 1999). When the price of gasoline increases, auto manufacturers subsequently produce more fuel-efficient vehicles. This matters in the case of AB 1879 because this regulation will effectively raise the price of using Priority Chemicals. This will provide firms with a strong incentive to seek out alternatives. Whether individual firms will pursue their own substitutes or work together in trade associations to identify group solutions remains to be seen.

We recognize that such basic research can be costly; however the average fixed cost can be low if the firm sells many units over time. The global market for products offers large sales volume opportunities and thus the average fixed costs of such R&D investments could be quite low given the number of years a firm will exist. As written into AB 1879, one of the alternatives that DTSC can choose from is a requirement that firms contribute to a Research & Development fund under the green chemistry challenge grant. The funds raised from such firms can be used to help smaller firms finance innovation.

5.2 Learning by doing

Another trend that portends declining compliance costs is rising demand for safer chemicals. As product makers seek out "safe chemicals" (to minimize their DTSC regulatory exposure), profit-maximizing chemical firms will have strong incentives to conduct research to design and scale up their production of such chemicals. With any new product, there is significant learning over time. Research examining the dynamics of the "green economy" has highlighted that the average cost of producing "green power" (i.e., solar panels and wind turbines) has declined over time (Wiser et. al 2006). At the heart of learning by doing is the intuitive idea that "practice makes perfect". The new generation of hybrid vehicles and electric vehicles are of much higher quality than the early prototypes.

This regulatory mandate represents a type of commitment device such that innovators are now certain that there is a market demand for "safe chemicals". In the absence of such a government guarantee, risk averse innovators may devote their effort on other projects. The DTSC regulation sends a credible signal to such innovators that their investment of their scarce time in designing "green chemicals" will offer a high rate of return. While we cannot predict which of these innovators will succeed, we are confident that several of these efforts will payout and product manufacturers will benefit from being able to purchase new chemical inputs that allow them to comply with the DTSC regulation.

5.3 Compliance costs fall as new input markets become competitive

As described in Section 3 of this report, firms will face costs from testing their products, engaging in alternatives assessments, and implementing DTSC's orders. In the medium term, each of these costs will decline due to market forces. For example, consider a product maker's cost of hiring a third party assessor. In the short run soon after AB 1879 is implemented, there could be a scarcity of environmental consultants ready to work with firms through the alternatives assessment. In this case, product makers may in the short run pay a high price for such consulting services. But in the medium term, new university graduates and unemployed or underemployed workers will seek compliance with ISO 14040 standards and assessor accreditation to help firms comply with AB 1879. We foresee new degree programs opening up where MBA business students train in joint degrees in sustainability to have the skills for conducting life-cycle analysis and for understanding how to integrate life cycle assessment into product design and marketing. Such training of the next generation of workers will lead to lower "input prices" for product firms.

The DTSC can reduce the costs of the regulation to industry by accepting verification information which has been passed through a product's supply chain, or chain of custody. The regulation creates new value on verified information of product contents. In the absence of the regulation, industry would respond to this new value by producing verified information at the lowest cost point of the supply chain. For the inputs included in many finished products, the lowest cost stage to produce verified information may be at a primary or intermediate stage – where inputs are less complex and produced in higher volumes. If the supplier firm can have the products tested by a DTSC accredited firm and pass this verified information on to its customers, then firms which create products from many verified inputs may be able to use this information in lieu of performing tests on its finished product, which may be produced in lower volumes than

its inputs. This would reduce the testing costs for the firm that produces the finished product without compromising available information about product contents.

5.4 Market share shifts: transfers vs. costs

Short run

Once DTSC announces information on a public website, this information may spread by television, newspapers, and the Internet to consumers. If consumers use this new information to make more informed choices, this new information may lead to distributional effects across firms who compete for product sales. Firms whose products are listed as "priority products" will suffer lost sales and competitor firms whose products are not listed are likely to gain new sales. This claim rests on the assumption that within any product class, such as cell phones or household cleaners, there are both "priority products" and competing products that do not contain Priority Chemicals.

As consumers substitute to safer products, the firms who produce those products will gain market share. This transfer of sales from a "brown" firm to a "green" firm represents a financial transfer rather than a social cost of the regulation. In fact, this transfer actually represents a benefit to consumers because the regulation has resolved an important information asymmetry, reducing consumer uncertainty about product safety.

From California's perspective this is likely to mean that this regulation offers the benefit of higher demand for California products. Given California's business profile, California may garner a large share of these financial transfers. This regulation will encourage consumers to purchase products from "green firms" who produce products that are not listed as "priority products". California has an edge in being the home of many such firms because of its environmentally-conscious consumer market, skilled workforce capable of enhancing products, and the environmentalist leadership.

Consumers who are unable to find a viable substitute for a "priority product" may choose what they consider to be an inferior product, or may choose not to buy a substitute at all. Both cases will negatively impact consumer welfare, which would be considered a cost of the regulation. Additionally, if the consumer chooses not to purchase a substitute product, industry will bear an actual cost of the regulation in the form of an aggregate sales decrease for a product class. It is important to note that the consumers who change their consumption choices because of the regulation will enjoy a health benefit from not being exposed to potentially dangerous products. In Section Six, we will elaborate on this point.

Long run

Over time this regulation will shake up product markets as some product makers find that they have trouble complying with this regulation while other firms will find that they can thrive in this regulatory environment. Such industry dynamics is nothing new. In the auto industry in the 1960s, General Motors, Ford and Chrysler sold millions of cars while international firms such as Toyota exported very few vehicles to the United States. The domestic "Big Three" specialized

in producing large gas-guzzlers. A consequence of the OPEC oil shocks was that the Big Three's sales fell as imports of fuel-efficient Japanese vehicles skyrocketed. This example highlights the evolutionary dynamics of a mature product market (cars) in the face of shocks to inputs (in this case the price of gasoline). Today, we see the fuel efficient Toyota Prius' sales soar when gas prices go up and we see a growing nascent movement in California to design zero carbon electric vehicles.

Why are some firms so nimble in the face of new regulation while others engage in sluggish responses? Understanding the sources of this within industry diversity is a frontier research question in modern economics. Here, we offer a few insights. At any point in time, a firm's production process depends on its past investments in its workforce and its factory. A firm that has designed a flexible production plant that can produce different varieties of a product will be better able to respond to new regulatory mandates. A firm that hires more expensive nimble managers who have broad skills will be better able to cope under the new regulatory rules. Different firms may also have different business strategies. In the case of the car industry, Detroit's Big Three made a bet that Americans would keep driving big, fuel inefficient vehicles. They under-estimated the impact of gasoline price spikes (and the probability that such OPEC oil price shocks could occur) on the demand for their products. In the case of chemical industry and the push for "green chemistry", some chemical manufacturers are likely to seek out a market niche as an industry leader in providing "green chemicals". The rise of Europe's REACH regulation indicates that there is a growing market to supply to.

We foresee this AB 1879 legislation leading to dynamic evolutionary process so that some products that cannot compete under the new rules of the game exit the retail stores and they are replaced by new products produced by nimble firms. If Europe's REACH regulatory efforts and the AB 1879 standard become the world's "green" product standard, then firms will have incentive to design compliant products to compete for market share.

In this dynamic competition, some companies may merge to take advantage of superior corporate know-how in designing the next generation of "green" products. Such companies can merge with other companies which have production facilities but lack the human capital and knowledge to thrive in the new regulatory environment. In this sense, both through organizational change and free market competition; the "green firms" are likely to enjoy a growing market share. This will mean that the average product sold by the industry will be "greener", and the average cost of regulatory compliance will decline.

5.5 Evidence of dynamic responses induced by past toxics regulation

In this section, we describe what is known about industrial responses to three major pieces of regulation all affecting chemicals users. The three cases we discuss are the Massachusetts Toxics Use Reduction Act (TURA), the lead emissions phase out for oil refineries and the regulation of chlorine.

Toxics Use Reduction Act

TURA was enacted in 1989. It uses information disclosure and mandatory planning to promote 'voluntary' industry innovations focused on toxic chemical use reductions. "TURA has been able to motivate industry to reduce toxics use through two mechanisms: mandatory planning and learning support. Forcing firms to better understand their processes (and the costs of these processes) and helping them identify options for pollution prevention through training, case studies of leading firms and publications, has led to an atmosphere of innovation and learning in the state which helps even reluctant firms change" (O'Rouke and Lee, 2004).

O'Rouke and Lee (2004) argue that the TURA regulation has acted as a commitment device requiring "companies to create planning teams, to conduct assessments of production, to engage workers in these discussions and to assess the financial costs and benefits of production changes. … TURA quite simply helps get managers' attention and focuses them on toxics reduction." We anticipate that AB 1879 will have a similar impact.

Much past environmental regulation such as the Clean Air Act relies on a "top down" approach that features the regulator providing specific emissions levels that the firm must achieve. In contrast, in the case of TURA, O'Rourke and Lee (2004) emphasize the symbiotic relationship between the regulator and the regulated firms. "Relationships between regulators and industry are transformed, implementation occurs not through command but through joint exploration and information sharing, and uncertainty is acknowledged and accepted as a reality of problem solving. TURA provides a more flexible process, ripe with dialogue and learning, that encourages technical innovation."

The TURA case is an important precedent for AB1879. It provides a blueprint for how firms and the regulator can work together in an evolutionary, learning process that yields higher quality, safer products at low social cost.

Lead Regulation

Starting in the 1970s, there has been a major U.S effort to reduce the lead content of gasoline and this has affected the refining industry. Kerr and Newell (2002) study the consequences of the lead phase-out for innovation at petroleum refineries. In this specific regulatory case, a pollution permit market was created to allow petroleum refineries to buy the right to release lead emissions. As the lead standard was tightened over time, the aggregate quantity of lead that such refineries could release declined. In economics terminology, this meant that the supply of pollution permits declined and from simple supply and demand theory, the price of a permit increased.[10] Kerr and Newell document that increased regulatory stringency (which raised the effective price of emitting lead) encouraged greater adoption of lead-reducing technology. They also document heterogeneous responses to the regulation in that larger more technically sophisticated refineries were more likely to adopt the new technology. One key lesson from this specific case is that manufacturers have demonstrated an ability to change their production process when faced with new regulatory rules.

Chlorine Manufacturing

10 Policy-Induced Technology Adoption: Evidence from the U.S. Lead Phasedown

The third case is the regulation of chlorine manufacturing. "In 1972, a widely publicized incident of mercury poisoning in Minamata Bay, Japan led the Japanese government to prohibit the use of mercury cells for chlorine production. The United States soon imposed more stringent environmental constraints on mercury cell units during the early 1970s. Subsequently, chlorine manufacturing became subject to increased regulation under the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), popularly known as Superfund. In addition, chlorine manufacturing became subject to public disclosure requirements under the Toxics Release Inventory." (Snyder, Miller and Stavins 2003).

Snyder, Miller and Stavins (2002) argue that environmental regulation did affect technological change. It did so by reducing the demand for chlorine and hence encouraging the shutdown of facilities using environmentally inferior options. Their study highlights the role that firm heterogeneity plays. They highlight that that firms that were not nimble in responding to regulation were more likely to leave the industry. Thus, the regulation caused the industry average pollution level to decline due to the exit of "dirty firms" and the entry of firms better able to perform under the new regulatory code.

This case highlights how regulation encourages environmentally friendly production techniques. It is also relevant to note that the authors demonstrate that the new firms who entered this industry after the regulation was enacted were better suited to compete under the new rules. Both individual incumbent firms learning by doing, and the entry of low cost firms into the regulated industry are micro-foundations for how the long run costs of production under the regulation can be lower than short run costs.

5.6 Measuring the cost of compliance over time

This section's core argument has been that current compliance costs will over-state the long run cost of compliance with this regulation. Measuring the costs of compliance with environmental regulation has posed a major challenge to environmental economists. Environmental economists have continued to investigate alternative methods for quantifying how the costs that firms face due to environmental regulation change over time. In the 1980s and 1990s, the U.S Environmental Protection Agency invested in created the Pollution Abatement Cost Expenditure (PACE) survey to quantify this exact question. This data set has been discontinued as researchers learned that diverse firms answered the same survey questions in different ways. The interviewees had trouble distinguishing what costs they had incurred because of the new regulation versus what were normal business costs. If the interviewees could not make such distinctions, then the resulting data is of little research or policy value. The key unknown here is what would have been each regulated firm's cost of production in the absence of the regulation.

An alternative measuring tool that DTSC could use over time to judge how companies are responding to regulatory rulings is to study stock price dynamics. At any point in time, a stock's price provides information about the market's best guess of the expected present discounted value of future corporate earnings. If newly announced regulation is anticipated to sharply raise a firm's costs, then this would be reflected in a change in the company's stock price. The basic logic here is that regulation induced increases in costs means that the firm's profits will be lower each year. The fundamental theory of stock valuation predicts that a stock's rate of return moves

in lock step with "new news" about the financial health of the company. The theory predicts that stock prices will rise if there is new news about profit increases and that the stock price will fall as there is new news about unanticipated increases in costs or reductions in revenue. Consider the example of the April 2010 British Petroleum oil spill. This publicly traded company's stock price has fallen sharply since the event as investors have grown concerned about the liability this company will face from anticipated lawsuit settlements and cleanup costs. This salient example highlights that today's stock price is a leading indicator of the market's collected wisdom about the expected future profitability of a firm.

A common technique used in financial economics is to conduct an *event study* in which the researcher collects data on the stock price trends over time before and after an event takes place. In the case of this DTSC regulation, this would be major DTSC rulings. In recent research studying the impact of Europe's REACH regulation, researchers have documented that companies who have made greater past investments in technological capital and hence are more innovative companies experienced less of a market value reduction when this new regulation was announced (Canon-de-Francia, Garces-Ayerbe, and Ramirez-Aleson 2007).

As demonstrated by this REACH example, DTSC can use daily changes in stock prices for publicly traded companies to assess whether its regulatory rulings are having significant effects on the market's perception of product maker profitability. We recognize that for multi-product manufacturers that a regulatory ruling is less likely to affect the overall health of such a diversified company but this evidence provides a real time indicator of whether the market believes that specific regulatory rulings are costly for the affected firm. If DTSC conducts such straightforward event studies, then it will have extra information to help it determine the costs of this regulation. Such information will help DTSC to learn about the consequences of its regulation and this will help it to calibrate its regulatory response and to plan out how to give the affected firm the time to adapt to comply with its ruling.

6. Social Benefits of the Regulation

The social benefits of the regulation accrue as people's exposure to a dangerous chemical falls, thereby enhancing their health and extending their life spans. The regulation may affect people's exposures to unsafe products in two different ways. First, it may provide consumers with information that enables them to avert their exposures existing unsafe products through safer market choices. Second, through the alternatives assessment process, it may reduce the actual number of unsafe products available on the market at any one time. The size of the social benefits that result from this regulation cannot be known in advance but are likely to depend upon four general factors: 1) how well DTSC prioritizes chemicals, 2) how many Priority Chemicals DTSC identifies and how quickly it performs these identifications, 3) how motivated firms to both test their products as well as develop and implement safer alternatives and, 4) whether consumers are able to use new risk information to avert their own exposure.

6. 1 DTSC's prioritization of Priority Chemicals.

The benefits from this regulation will be larger if DTSC prioritizes those chemicals that cause the greatest health problems for exposed people and for which many people are exposed. The regulation intends to provide DTSC the information it needs to make this determination. Still the importance of this decision on the size of the social benefits cannot be overstated. This is especially true if relatively few chemicals are listed a priority chemical in the early years of the regulation's implementation.

The young and the elderly are the most likely demographic groups to be susceptible to chemicals exposure. Given ongoing demographic trends leading to an aging population, this suggests that the benefits from reducing exposure are rising over time. Reducing chemical exposure to substances deemed to affect children's long run development, IQ, and non-cognitive skills will yield large social benefits. Public health literature has documented the benefits in terms of cognitive and non-cognitive skills of not being exposed to lead and other toxics. The Nobel Laureate James Heckman has convincingly documented the dynamic complementarities in how a child grows up to be a productive adult. Put simply, "learning begets learning and skill begets skill". A child who is healthy is more likely to achieve a higher level of skill development.

In terms of life-cycle assessment, there will also be social benefits from this regulation if DTSC prioritizes chemicals that can cause significant damage once disposed of in landfills. When products that contain harmful chemicals are disposed, they often end up in landfills. Some of these landfills are located near populated areas. AB 1879 will reduce the amount of harmful chemicals that end up in California landfills. The benefits of reduced landfill toxicity depend on the concentration of population near the landfill, the probability of waste leakage from the landfill, and the effects of this leakage on the nearby population. Accurate measurement of these factors would require detailed geographical information and the results will vary on a case by case basis.

6.2 Firm Response Times for Product Testing and Alternatives Adoption

This regulation will offer larger social benefits if firms quickly take action to 1) release information on their products and 2) reduce the possible chemical exposure associated with purchases of priority products. As we discussed in sections 3 and 5, firms will engage in a host of short run and long run decisions such as substituting inputs in production and changing their supply chains in order to comply with the regulation. The benefits of this regulation will be larger if this transition to "greener" products can take place more quickly. We anticipate that the transition period will require more time for firms who learn in the assessments stage that there are not readily available substitutes that do not feature Priority Chemicals. In these cases, ongoing consumers of these products are less likely to enjoy short term benefits from this regulation.

6.3 The Public Web Site Providing New Product Information Triggers Consumer Learning

The social benefits will be larger if this regulation accurately changes consumers' perceptions of safety of products that they may purchase in California. Once DTSC posts its listing of priority products, this information will be available to all consumers. The benefits of this regulation will be larger if such a brand level list becomes common knowledge.

The social benefits of providing this information can take many forms. Retailers are likely to change their product mix and focus on selling products that DTSC has not deemed to be priority products.

A major benefit of AB 1879 will be its role in providing trusted information that will change consumer behavior. Consumers purchase a product if the benefits they perceive they gain from consuming it exceed the costs, as measured by the purchase price. This regulation will provide them with valuable new information that will allow them to make "better" choices. Before this regulation was enacted, it was very costly for consumers to know with certainty what chemicals were embodied in many products. This regulation substantially lowers a consumer's cost of knowing which products are safe and this improves their well being.

It is important to note that until DTSC has completed its prioritization of chemicals and products that there will continue to be incomplete consumer information. In the middle of the testing regime, products not labeled as a Priority Product could be safe or unsafe but whose true status has not yet been discovered.

In the absence of this regulation, there has been a fundamental asymmetry of information. Producers know more about the chemicals embodied in the products than consumers. This regulation will "level the playing field" and make California's consumers more confident about the quality of the products they are buying. This "peace of mind" offers significant intangible benefits to risk averse consumers who may have wondered about what they are exposing their families to in buying day to day household products. Economists define "risk aversion" as the willingness to pay money to avoid uncertainty. Consider a person who prefers to be paid $100 for sure rather than having a 50% chance of earning $300 and a 50% chance of earning $0. The second scenario has an expected value of $150, which is greater than $100, but many people do

prefer the "sure thing". Economists call such people "risk averse" and the market demand for homes and life insurance and disability insurance highlights our taste for avoiding risk. If before AB 1879 consumers knew that they did not know the quality of products they were consuming, this would cause discomfort due to the uncertainty. In recent research, economists have documented that household willingness to pay to avoid risk rises with income (Costa and Kahn 2004). Over time, as California's economy grows richer, the value Californian's place on the regulation's effects to increase information and reduce product risk will increase, and the total benefit of the regulation will increase.

6.4 **Three Examples of the Benefits of Information Regulation**

A recent environmental economics literature has documented the significant benefits of information regulation. Such regulation protects public health by changing household behavior and allows such households to make healthier choices. Information is costly to acquire, and the government has a cost advantage in collecting and distributing such information. Recent research has highlighted how consumers respond to this "new news". Here we offer three examples of the health benefits of information regulation.

In the case of Los Angeles Public Health Report Cards, restaurants must prominently display simple to understand report cards grades "A, B, C" that signal a restaurant's performance in its latest public health inspection (Jin and Leslie 2003). The introduction of this trusted information has changed consumer behavior as they have avoided such "C" grade restaurants. In the short run, this improves public health and in the medium term and long term it pushes restaurants to invest in basic hygiene.

A second example is the introduction of California's "Spare the Air" Days.

> "The Spare the Air Program was established by the Bay Area Air Quality Management District to educate people about air pollution and to encourage them to change their behavior to improve air quality …. The 2010 Spare the Air ozone season runs from May 3 through the end of September. During these summer months when ground-level ozone, or "smog," becomes a pollution problem, the Air District issues Spare the Air Smog Alerts for days on which air quality is forecast to be unhealthy. On these Spare the Air days, we urge residents to cut back on any activities that cause pollution - such as driving, using oil-based paints, gasoline-powered lawn mowers, or household aerosol products like hair sprays. People who are sensitive to unhealthy air are advised to limit their time outdoors, particularly in the afternoon hours."[11]

Matthew Neidell (2009) has documented how people change their behavior and avoid parts of Los Angeles that are the most extremely polluted on those days. His empirical strategy focused on collecting daily attendance data at the Los Angeles Zoo and the Botanical Gardens. These two places are located inland and thus are exposed to high ozone levels relative to coastal locations. He documented on that on Spare the Air days that attendance at the Zoo and at the Gardens was lower than on similar days during the same months when it was not a Spare the Air day. His study factored in the daily outdoor temperature. Intuitively, he compared attendance at the Zoo on hot summer days in which the smog levels were not high enough for a Spare the Air

[11] http://www.sparetheair.org/

day to be triggered versus similar days when the smog was bad enough for a Spare the Air day was announced. This "twins" comparison allowed him to isolate the effect of information on household daily locational choice. His results highlight that the Los Angeles population reduces its exposure to high outdoor pollution when provided with trusted environmental information.

A final example of the value of information regulation comes from mercury advisory warnings. Shimshack, Ward and Beatty (2007) examine responses to a US national FDA advisory that urged at-risk individuals to limit store-bought fish consumption due to the dangers of methyl-mercury. They find that some targeted consumers significantly reduced canned fish purchases as a result of the advisory. Education and newspaper readership were important determinants of response, suggesting that information acquisition and assimilation are key factors for risk avoidance. Each of these three empirical case studies document the same point, many consumers (once informed about new risks), respond by changing their behavior.

While we have emphasized the beneficial effects of information provision, there is a psychology and economics literature that emphasizes that households can be "overloaded" with too much information and that government messages lose their salience. Put simply, if all products on the supermarket shelves have warning labels, will the typical consumer "tune them out"? If the answer is yes, then DTSC should anticipate this adverse consequence its is regulatory rulings.

6.5 Environmental justice benefits from this regulation

This regulation will serve environmental justice goals by disproportionately reducing the chemical exposure of poor minorities. Information can only have value if it is "new news". Put simply, you would never buy a newspaper if you already knew all of the information in it. California's households are diverse. Today, there are sophisticated environmentalist consumers in cities such as Berkeley who actively use websites such as UC Berkeley professor Dara O'Rourke's GoodGuide.[12] GoodGuide allows users to access information on a product's toxicity and other dimensions of "greenness" using a web interface or iPhone application. However, not everyone is aware of this service, has time or motivation to seek additional product information, or has the tools (web access or iPhone) needed to access the information.

Households who do not or cannot use existing informational services will gain most from this regulation. Households who are poor, and do not speak English will be the ones who are likely to gain the most from having government protecting them or informing them about potentially harmful chemical exposure. In contrast, if environmentally-aware households are already protecting themselves from exposure to toxics, then they will gain less from active government policy to minimize exposure. While some California households have invested time and effort into discovering which products are safe, government clearly has an edge in providing such information and removing the informational asymmetry between firms and all segments of consumers.

In addition to disproportionately improving the quality of life of minorities, we predict that this regulation will also have its largest impact on the young. Reducing chemical exposure to substances deemed to affect children's long run development, IQ, and non-cognitive skills will

12 http://www.goodguide.com/

yield large social benefits (Reyes 2007). This regulation will reduce children's exposure to dangerous chemicals. While we cannot quantify the exact reduction in exposure, an enormous public health literature has documented the benefits in terms of cognitive and non-cognitive skills of not being exposed to lead and other toxics. The Nobel Laureate James Heckman has convincingly documented the dynamic complementarities required for a child to grows up to be a productive adult (Heckman 2006). Put simply, "learning begets learning and skill begets skill". A child who is healthy will learn more in school and this process reinforces itself.13

6.6 Ex-post torts do not sufficiently protect the population from dangerous products

The economic approach for determining the benefits of this regulation hinges on the counter-factual of whether firms would have sold products embodying dangerous chemicals in the absence of this regulation. In the absence of AB 1879, firms have not had sufficient incentives to reduce the chemical content from their products. They are not being held accountable for producing dangerous products. AB 1879 regulation focuses on reducing the chemical content of products before they are purchased. Such "ex-ante" precautions are more valuable to society in cases when "ex-post" after the fact remedies are unlikely to work.

Product makers who produce defective, risky products face the prospects of a liability, or torts, lawsuit. Ideally, a company will anticipate that if it makes potentially harmful products and if somebody suffers from using such a product (such as a defective vehicle) then the company will later be sued. In this case, a company might preemptively produce high quality products to minimize the torts risk of facing future liability lawsuits. If this were the case, then ex-ante product regulation would be less socially valuable because of the incentive effect introduced by the desire to avoid costly torts cases.

Ideally, society can hold negligent firms accountable for producing bad products but there are at least two reasons why we discount this possibility. First is the issue of latency and multiple exposure pathways. A victim of chemical exposure may not suffer symptoms for years. This person will only recognize that she has suffered when the symptoms appear. Once the symptoms are apparent, it will be quite difficult to establish which product caused the disease. Over the course of one's life, one is exposed to many products and environmental hazards, these multiple exposures create a fundamental attribution problem. It is nearly impossible to find the source of the exposure and this limits the accountability of the polluter. Without this clear mapping from product to disease, the producer is less likely to be held accountable for its misdeeds. This creates very bad incentives for producers to produce quality products and increases the social benefits of adopting ex-ante regulation that forces firms to minimize their use of proven toxics.

The second reason why we are skeptical that ex-post liability measures can be used to punish negligent firms is that economists have documented that chemical companies strategically use bankruptcy as a strategy to protect themselves against ex-post liability. If a firm configures itself in ways that protects itself against liability lawsuits then it is less likely to be held accountable when it is found liable for harm. Ringleb and Wiggins (1990) conclude that chemical companies are taking pro-active steps to protect their assets from anticipated future liability costs associated with product risk. Large firms have an incentive to divest risky activities and minimize the

13 http://jenni.uchicago.edu/human-inequality/

exposure of assets to potential liability claims. Using data from 1967 to 1980, Ringleb and Wiggins show that changes in potential liability are closely linked to substantial increases in the number of small firms operating in hazardous sectors. These small firms do not have the assets to cover large liability damage awards. They conclude; "Hence liability may not lead to large damage awards in the long run equilibrium, but instead may simply lead to a restructuring of enterprises to avoid damage payments (Ringleb and Wiggins 1990, page 576)."

Their paper highlights that the chemical industry has taken steps to reduce its ex-post liability risk. This fact is crucial for evaluating the benefits of AB 1879. AB 1879 is ex-ante risk mitigation legislation which will make products less risky. The benefits of such regulation are higher if traditional legal liability recourse measures that take place after harmful impacts are not available. Put simply, ex-ante precautionary regulation is more valuable when ex-post punishment of firms who knowingly or unknowingly sell harmful products is not credible.

We acknowledge that the Ringleb and Wiggins paper is based on historical data (covering the years 1967 to 1980) but it highlights that profit maximizing firms will take pro-active actions to protect themselves from costly litigation. If the lawyers for such firms are successful in fending off liability law suits, then the victims who have been exposed to dangerous products will never receive compensation. DTSC regulation will offer significant benefits because this unjust scenario cannot play out if regulation has pro-actively pushed manufacturers to phase out priority products.

6.7 Other Social Benefits

In discussing the benefits of this regulation, we have focused mainly on the health impacts for the household that purchases the product but society will also gain benefits in the product production and product disposal stage. Under this regulation, in the production stage, workers are less likely to be exposed to dangerous substances. When products with chemicals embodied in them are disposed of, they end up in landfills. Some of these landfills are located in geographical areas that place the surrounding community at exposure risk. AB 1879 reduces the likelihood of local communities near landfills suffering from toxic pollution. The benefits of reduction in the toxicity of landfills hinges on how many people live close to such landfills, what is the probability of leakage of toxic waste from such a landfill, and how much each "downstream" household is affected when such leakage occurs.

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