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**European Chemical Policy and the United States:
The Impacts of REACH**

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European Chemical Policy and the United States: The Impacts of REACH

Frank Ackerman, Elizabeth Stanton and Rachel Massey¹

Abstract

The European Union is moving toward adoption of its new Registration, Evaluation and Authorization of Chemicals (REACH) policy, an innovative system of chemicals regulation that will provide crucial information on the safety profile of chemicals used in industry. Chemicals produced elsewhere, such as in the United States, and exported to Europe will have to meet the same standards as chemicals produced within the European Union. What is at stake for the U.S. is substantial: we estimate that chemical exports to Europe that are subject to REACH amount to about \$14 billion per year, and are directly and indirectly responsible for 54,000 jobs. Revenues and employment of this magnitude dwarf the costs of compliance with REACH, which will amount to no more than \$14 million per year. Even if, as the U.S. chemicals industry has argued, REACH is a needless mistake, it will be far more profitable to pay the modest compliance costs than to lose access to the enormous European market.

Introduction

The European Union (EU) is moving toward adoption of an innovative system of chemicals regulation that will provide crucial information on the safety profile of chemicals used in industry. After several years of development, debate, and amendment, the EU's new Registration, Evaluation and Authorization of Chemicals (REACH) policy is expected to take effect in 2006 or early 2007. Chemicals produced elsewhere, such as those produced in the U.S., and exported to Europe will have to meet the same standards as chemicals produced within the European Union.

Will REACH harm American industry, imposing expensive new regulatory burdens on its exports? The chemical industry on both sides of the Atlantic initially argued strongly against REACH; but as the debate has continued, American firms have been slower to accept REACH than their European counterparts. In the U.S., moreover, industry complaints about REACH have been echoed by the federal government.

This report presents a different perspective, reviewing estimates of the surprisingly low cost of compliance with REACH, and arguing that U.S. producers are far better off paying these costs and retaining access to European markets. U.S. exporters have faced similar dilemmas in the past, with genetically modified crops, and with beef following mad cow disease scares. Unfortunately, experience has shown that it is possible to lose foreign markets quite rapidly by ignoring foreign regulations and concerns about health, safety and the environment.

¹ The authors would like to acknowledge the research assistance of Samuel Bell and Jessica Katz.

What is at stake for the U.S. is substantial: we estimate that chemical exports to Europe that are subject to REACH amount to \$13.7 billion per year, and are directly or indirectly responsible for 54,000 jobs. Revenues and employment of this magnitude dwarf the costs of compliance with REACH, which will amount to no more than a few *million* dollars per year. Even if industry remains convinced that REACH is a needless mistake, it will be far more profitable to pay the modest compliance costs than to lose access to the enormous European market.

Background: What is REACH?

REACH is intended to revamp chemicals regulation in the EU, replacing a complicated set of more than 40 interlocking regulations with a single piece of legislation. REACH closes loopholes that have existed in European chemicals regulation for years and lays out a series of requirements for collecting, systematizing and using information about the health and environmental and health effects of industrial chemicals.

REACH has three main components. Under the *registration* provision, chemical manufacturers and importers are required to carry out health and environmental safety tests on their products; exact testing protocols depend on the volume at which a chemical is sold in the EU, with the highest volume chemicals subject to the most stringent testing requirements. The results of these tests are registered with a central regulatory agency. In registering a chemical, the manufacturer or importer is responsible for specifying safe conditions of use and appropriate risk management techniques for each known use of the chemical. In the *evaluation* phase, EU member States evaluate the information provided in the registration phase and assess the hazards associated with each chemical. Substances of particularly high concern are subject to *authorization*, meaning that they can be used only with special permission. This includes chemicals that cause cancer, genetic mutations, or birth defects, as well as substances that are persistent and bioaccumulative. Finally, as a safety net in case a substance is not adequately controlled through these measures, REACH also allows for *restriction* of substances that pose unacceptable risks to health or the environment. Restrictions can take the form of risk management measures, or partial or complete bans.²

Under the EU chemicals policy that prevailed prior to REACH, chemicals that were on the market in 1981 – so-called “existing” chemicals – were not routinely subject to testing requirements. Chemicals that entered the market after 1981, in contrast, were subject to extensive safety testing. The vast majority of the chemicals used in industry, however, are the “existing” ones; chemicals that are new since 1981, and were therefore tested, account for a very small part of total chemicals use. Before REACH, the burden of proof was on government agencies to demonstrate that an “existing” chemical was harmful. Under REACH, the system is streamlined and the burden of proof is reversed: companies are responsible for providing the data to support a claim of safety. Traditional regulation has assumed that chemicals are innocent until proven

² For a more detailed description of REACH, see the website for the European Commission: http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm.

guilty; REACH will assume that chemicals, especially when used in large volume, are suspect until their supplier proves them innocent.

A litany of complaints

In the U.S., both the federal government and the chemical industry have been actively involved in efforts to influence the implementation of REACH. U.S. government involvement has included high-level communications from State Department officials, distribution of policy papers, and formal statements on possible implications of REACH for global trade. In parallel, U.S. industry associations, notably the American Chemistry Council (ACC), have engaged in direct and indirect lobbying of EU officials, and have expressed grave concerns about the potentially dire effects of REACH. In some cases ACC has gone so far as to argue that European business will lose competitive advantage in relation to the U.S. as a result of REACH – an odd concern for the trade association of an industry that competes with Europe (CGR April 2004).

The official U.S. stance on REACH has prompted a series of protests from both U.S. health and environmental advocacy networks, and members of Congress. Critics argue that the U.S. government's arguments have generally used industry analyses wholesale, without interpretation, corrections, or independent analysis. Second, many observers think that U.S. government officials have overstepped the bounds of normal diplomatic communication and have meddled inappropriately in the EU's internal process of policy development.

Some U.S. government responses to REACH have been overt, while others were clandestine at the time that they occurred. Thanks to Freedom of Information Act requests by the Environmental Health Fund – a U.S.-based advocacy group – and by the office of U.S. Representative Henry Waxman (Democrat-California), there is now clear documentation of communications by U.S. government officials regarding REACH.

As summarized in a report by Representative Waxman's office, Bush Administration officials met repeatedly with representatives of the U.S. chemicals industry to develop a position on REACH. Goals identified in consultation with industry included the possibility of "educating" other countries so that they could join the U.S. in raising concerns about REACH. In March 2002, Secretary of State Colin Powell cabled U.S. diplomatic posts with instructions to "raise the EU chemicals policy with relevant government officials" and to object to REACH as "costly, burdensome, and complex." The Assistant U.S. Trade Representative for Europe and the Mediterranean invited U.S. chemical companies to develop "themes" for the U.S. government to cite in its communications with EU officials regarding REACH. Secretary of State Powell used these themes – including calls for more in-depth cost/benefit analyses, as well as concerns about REACH's potential to harm small and medium-sized businesses and to stifle innovation – in a second cable to diplomatic posts in Europe, again urging them to express concern about REACH (CGR April 2004).

US government officials also actively worked to generate opposition to REACH within Europe. Their efforts included, for example, visits by U.S. Environmental Protection Agency officials (together with ACC representatives) to European government and business

representatives. Formal comments filed by the U.S. with the European Commission in 2003 expressed the usual set of concerns, including the possibility of high implementation costs and decreased innovation (CGR April 2004). In addition, U.S. agencies circulated chemical industry claims that exports to the EU would be halted by REACH (DiGangi 2004).

While many of the same criticisms of REACH were also advocated by some European stake-holders, the efforts of the Bush Administration and the ACC may have helped to shift the balance of European discourse. The final REACH proposal, published in October 2003, reflected many of the specific changes for which the U.S. had advocated, including exclusion of polymers, less regulation of intermediates, and looser requirements regarding chemicals found in products. The European Commission also bowed to U.S. pressure in agreeing to present a new impact assessment of REACH (CGR April 2004). Varying assessments of the cost of implementing REACH have played a major role in the final stages of the REACH debate.

Most recently, in June 2006, the U.S. Diplomatic Mission to the EU organized a joint statement of the Missions of Australia, Brazil, Chile, India, Israel, Japan, South Korea, Malaysia, Mexico, Singapore, South Africa and Thailand in which they ask the European Parliament to reconsider the implementation of REACH. The joint statement argues that REACH regulation and implementation procedures are opaque, that REACH has the potential to disrupt international trade, and that developing countries in particular will be harmed by REACH (U.S. Diplomatic Mission to the European Union 2006). As demonstrated in the next two sections, the U.S. government's keen interest in quashing REACH seems particularly strange when its small implementation costs are compared to the much larger value of exports subject to REACH standards.

US exports subject to REACH

Estimates of billions of dollars of U.S. exports lost as a result of REACH are surely mistaken. There is no need for any loss of exports, beyond the small number of substances found to be truly hazardous, if U.S. companies comply with REACH. It is true, however, that billions of dollars of U.S. exports will be subject to REACH, and that exporters will be required to comply with its regulations.

How much is at stake, in terms of sales revenue and employment? The categories of chemicals subject to REACH do not correspond exactly to the data on exports and imports; there is no official figure available. We have developed an estimate, based on U.S. trade and employment data, and our reading of REACH. Our national estimate, in brief, is that U.S. exports subject to REACH amounted to \$13.7 billion in 2004, and were directly or indirectly responsible for 54,000 jobs. Our study is limited to 43 states because data were incomplete for Alaska, Hawaii, Idaho, Montana, North Dakota, South Dakota, and Vermont (states with very limited chemical production). In addition, Puerto Rico is not included because its large chemicals industry consists almost entirely of pharmaceuticals production, which is not regulated under REACH. In addition, our study only includes U.S. exports of chemicals subject to REACH and not the export of articles that contain these chemicals. The inclusion of articles containing

chemicals subject to REACH would increase our estimates of the value of REACH exports and the number of jobs related to these exports.

The building blocks of our estimate are as follows (for a more detailed description of our methodology, see Appendix A; state-by-state results for each of these calculations can be found in Appendix B):

A. Only about half of chemical industry output consists of substances regulated by REACH. Pharmaceuticals and agricultural chemicals are covered by other European regulations, and polymers (plastics) are also exempt. U.S. production of “REACH chemicals” – that is, chemicals that fall under REACH – in the 43 states amounted to \$234 billion in 2004.

B. About 6 percent of all U.S. chemical industry output is exported to the EU. We assume that the same percentage applies to the \$234 billion of REACH chemicals in 2004, that is, that about 6 percent of U.S. REACH chemical output is exported to the EU. We confirmed this rough national estimate by doing the corresponding calculations state-by-state, using state-specific data, and then adding the results; we rely on the state-by-state calculation for our final estimate.

C. To calculate the number of jobs, we started with the 848,000 employees in the chemical industry in the 43 states as of 2004. We assumed, based on the estimates described above, that about half of them produce REACH chemicals, and 6 percent of those are producing chemicals for export to the EU. That yields the number of jobs in direct employment for exports subject to REACH.

D. An input-output study of U.S. exports estimated that total (direct plus indirect) employment related to chemical exports is 1.85 times direct employment. We applied this multiplier to obtain the total employment dependent on exports subject to REACH. Again, we did the corresponding calculation state by state, using state-specific multipliers and employment data, and then added the results, yielding a slightly different number than implied by the national totals.

The U.S. chemical industry has been expanding in recent years in exactly the areas affected by REACH. From 2002 to 2004, U.S. exports of REACH chemicals to the EU grew by 37 percent in the 43 states, from 39,000 jobs and \$10.2 billion in value, to almost 54,000 jobs and \$13.7 billion in value. Three-quarters of this increase in jobs was in six states, with Massachusetts by itself accounting for 39 percent of the total job growth (see Table 1).

	Direct and Indirect Employment (number of employees)			Value of Shipments (millions)		
	2002	2004	Growth	2002	2004	Growth
Massachusetts	3,444	9,110	5,666	\$598	\$1,581	\$983
Texas	3,609	4,871	1,262	\$1,792	\$2,418	\$626
California	5,137	6,326	1,189	\$788	\$971	\$183
Illinois	1,805	2,865	1,060	\$540	\$856	\$316
Minnesota	739	1,636	897	\$92	\$204	\$112
Ohio	1,845	2,614	769	\$386	\$547	\$161
43 states	39,284	53,778	14,494	\$10,169	\$13,716	\$3,547

Source: Authors' calculations; see Appendix A for data sources.

While these exports of REACH chemicals to the EU are not a large fraction of the U.S. economy, or even of the nation's total exports, they have been growing at an impressive rate. And the importance of export markets will only grow in the future, as the massive U.S. trade deficit and long-term weakness of the dollar will become increasingly difficult for economic policymakers to ignore.

States where exports of REACH chemicals are most important

REACH's impact on the U.S. chemical industry is by no means equally distributed across the 43 states in our study. Table 2 lists the states where exports of REACH chemicals to the EU are most important, ranked by four criteria: total jobs, share of state employment, total value of exports, and exports as a share of state economic output.³ Massachusetts, California, Texas, Illinois, Ohio, and New Jersey lead in terms of total REACH-related jobs, and also have a large volume of REACH exports. Other states where REACH accounts for a relatively high proportion of state employment include Kentucky, South Carolina, Rhode Island, West Virginia, and Tennessee (see Table 2).

³ Output is measured by gross state product (GSP), the state equivalent of gross domestic product (GDP) for a country as a whole.

Table 2: States where REACH exports to EU are most important (2004 data): four rankings

Direct and Indirect Jobs		Direct and Indirect Jobs as a % of Total Employment		Value of Shipments (millions)		Value of Shipments as a % of GSP	
Massachusetts	9,110	Massachusetts	0.29%	Texas	\$2,418	Massachusetts	0.50%
California	6,330	Kentucky	0.11%	Massachusetts	\$1,581	Louisiana	0.43%
Texas	4,870	South Carolina	0.10%	California	\$971	West Virginia	0.41%
Illinois	2,860	Rhode Island	0.08%	Illinois	\$856	Kentucky	0.35%
Ohio	2,610	West Virginia	0.08%	New Jersey	\$714	Texas	0.27%
New Jersey	2,470	Tennessee	0.07%	New York	\$710	Mississippi	0.21%
Michigan	2,200	New Jersey	0.06%	Louisiana	\$651	South Carolina	0.19%
Kentucky	1,950	Minnesota	0.06%	Georgia	\$575	Indiana	0.18%
South Carolina	1,880	Mississippi	0.05%	Ohio	\$547	New Jersey	0.17%
Tennessee	1,850	Texas	0.05%	Kentucky	\$477	Georgia	0.17%
Georgia	1,830	Michigan	0.05%	Indiana	\$405	Illinois	0.16%
New York	1,690	Illinois	0.05%	Michigan	\$355	Wyoming	0.16%
Minnesota	1,640	Ohio	0.05%	Tennessee	\$347	Tennessee	0.16%
Indiana	1,080	Georgia	0.05%	Missouri	\$313	Missouri	0.15%
Missouri	1,020	Louisiana	0.05%	Virginia	\$274	Ohio	0.13%

Source: Authors' calculations; see Appendix A for data sources.

Costs of paying for REACH versus losing REACH-exports

The expected costs of implementing REACH have been debated extensively in the course of policy development within Europe, and a number of studies have been commissioned to estimate the likely costs to industry of testing and registering chemicals. Some studies look only at the “direct” costs: the actual outlay of funds required to complete the tests, analyze the results and submit the registration documents. Other studies also attempt to estimate “indirect” costs: the broader effects of a possible increase in the cost of chemicals.

There is broad, order-of-magnitude agreement on the size of the direct costs of testing and registering chemicals – and that cost turns out to be several orders of magnitude smaller than the value of the jobs and sales revenues that are at stake. The most recent estimate by the European Commission puts the direct costs of REACH at €2.3 billion over eleven years (European Commission 2003). (Earlier estimates were somewhat higher because they built in provisions that have since been eliminated from the regulation, such as testing and registration of polymers.) Our own estimate, with slightly different assumptions, yields an 11-year cost of about €3.5 billion, or roughly one-tenth of one percent of sales revenue per year (Ackerman and Massey 2004).

For U.S. chemicals producers – assuming that the cost of complying with REACH is the same percentage of sales in the U.S. as it is in the EU – a cost increase of one-tenth of one percent of REACH exports would amount to additional costs of \$14 million annually, or \$250 per affected job per year. It would cost Massachusetts, for example, \$2.3 million per year to retain its 9,000 chemical industry jobs. That’s compared to an annual state budget of \$38 billion (U.S. Census 2004).

Many states' budgets include hundreds of dollars in workforce development per existing job in that state; these funds are earmarked for attracting new jobs, retaining old ones and training workers for new careers. For example, the total budget of Massachusetts' Department of Workforce Development is \$2 billion for 2007, which includes both job placement and workforce training programs; that's \$625 for every existing job in Massachusetts (State of MA 2006). Similarly, California spends \$760 on workforce development per existing job (State of CA 2006).

The use of REACH-level testing and registration standards by U.S. chemical companies – even if only for those products being exported to the EU – also has potential health and occupation safety benefits. While no estimate of these benefits exists for the U.S., several studies have tried to estimate the benefits of REACH in the EU. While varying widely in methodology, most have found that partial estimates of the benefits of REACH range into the billions of euros, often tens of billions of euros, over the ten to 30 years after it is adopted.⁴

The high price of ignoring foreign standards

As a number of studies have documented, compliance with REACH is not expensive, but it will be essential to retain European chemical sales. Recent experience has shown that it is all too possible for the U.S. to lose access to export markets, based on failure to meet environmental standards and to respond to concerns in the countries that buy American goods.

One cautionary tale is provided by genetically modified (GM) corn. Bt corn, a variety of genetically-modified corn developed in the 1980s, won its first regulatory approvals in 1992 and burst onto the market in the mid-1990s. (The Bt gene is added to corn in order to repel insect pests, potentially reducing requirements for insecticide applications.) From 1.4 percent of U.S. planted area in 1996, Bt corn rose rapidly to 32 percent in 2004 (Ackerman, Wise et al. 2003; Nadal and Wise 2004).⁵ European consumers have strongly rejected genetically-modified food of any variety, however, and U.S. exporters are not able to reliably separate traditional from genetically-modified corn. U.S. corn exports to the EU were above \$100 million per year in the early 1990s but essentially vanished within a year or two after the large-scale introduction of genetically-modified Bt corn. Specifically, corn exports to Europe have been \$8 million or less per year from 1999 to the present (FAS 2006). In 1998, the EU began passing regulations banning genetically modified crops; these regulations have become increasingly stringent over time. Yet the decline in sales preceded the regulation; it resulted from a widely-held, and well-known, consumer preference in Europe, which corn growers and their seed suppliers ignored.

A similar but larger loss occurred in meatpacking, when U.S. producers failed to respond to foreign consumers' fears of bovine spongiform encephalopathy (BSE), or mad cow disease, with an appropriate, readily available level of testing. U.S. beef exports were around \$3 billion annually from 2000 to 2003. Despite the enormous number of cattle slaughtered each year in the U.S. – 33 million in 2004 – U.S. testing for BSE has remained far below the European level.

⁴ See also European Commission 2003; RPA 2003; Pedersen, et al. 2005; Pickvance, et al. 2005.

⁵ All varieties of genetically-modified corn together amounted to 45 percent of the U.S. corn plantings in 2004 (Nadal and Wise 2004).

Before mid-2004, testing had never exceeded a rate of about 20,000 animals per year, representing only a small fraction of the high risk groups. Following the detection of two North American BSE cases in 2003, USDA introduced a new testing procedure in June 2004. A new, rapid screening test was adopted, and the pace of testing increased, reaching about 24,000 per month in the second half of 2004, and 30,000 per month (360,000 per year) thereafter. Yet even this record level of testing represents just over 1 percent of the cattle slaughtered annually in the U.S. – compared to 48 percent in Europe and 100 percent in Japan (USDA 2005).

The discovery of mad cow disease in the U.S. in 2003 led to worldwide rejection of U.S. beef. Exports dropped to \$550 million in 2004 and remained below \$1 billion in 2005 (FAS 2006). Japan, the largest export market for U.S. beef, and Britain, the country with the worst history of BSE, test every animal that is slaughtered; in contrast, U.S. regulators have insisted on testing only a small fraction of slaughtered cattle, and using different tests for BSE than Japan and many European countries. In 2004, Creekstone Farms, a Kansas beef producer, negotiated an agreement with the Japanese government to resume sales in Japan, if Creekstone voluntarily adopted Japanese BSE testing standards. However, the U.S. Department of Agriculture invoked old food safety laws to prohibit any American producer from exceeding U.S. government BSE testing standards! Over \$2 billion of annual exports have been lost, all in order to maintain the principle that U.S. industry doesn't need to meet other countries' standards.⁶

A smarter and happier ending occurred in the wheat industry, one of the most export-dependent sectors of U.S. agriculture. Roughly half of the U.S. wheat crop is exported, with exports of wheat and wheat products to the EU-15 fluctuating around \$200 million in recent years (FAS 2006). Monsanto, a leading supplier of seeds and agricultural chemicals, applied for permission to grow genetically-modified Roundup-Ready wheat in the U.S. and Canada in December 2002. Recognizing the threat to foreign markets, advocacy groups throughout wheat-growing areas organized an effective campaign against genetically-modified wheat. The campaign quickly gained support from the Montana Legislature, the Canadian Wheat Board, and other major organizations in the region. In May 2004, Monsanto announced the withdrawal of its application to grow genetically-modified wheat (OCA 2006).

The high price of failing to meet other countries' health and safety regulations is painfully clear in the recent histories of the U.S. corn and beef industries: Genetically-modified crops mean a loss of access to foreign markets, and the prohibition on Japanese-level testing for mad cow disease has crippled the industry, including meatpackers that wanted to meet those regulations at their own expense.

Wheat growers, in contrast, understood the importance of foreign markets and rejected a dubious innovation that would have jeopardized their export sales. As the U.S. faces the dilemma of a huge and mounting trade deficit, the conclusion must be that the wheat growers got it right, making the choices that maintained market access, while the corn and beef industries (and USDA) got it wrong, stubbornly losing foreign buyers who wanted a slightly different product.

⁶ See "U.S. Won't Let Company Test All Its Cattle for Mad Cow," *New York Times*, April 10, 2004.

Conclusion

The costs of paying for REACH testing and registration, as estimated using the same ratio of costs to sales expected in Europe, are very small. The costs of non-compliance – of losing REACH exports just as U.S. markets for corn and beef lost their European sales – are enormous: Paying \$14 million per year compared to losing \$14 billion per year. Compliance with REACH also has added benefits to public health and occupation safety, especially for workers in the chemical industry. Failing to comply with REACH, on the other hand, exposes an important and growing sector of the U.S. economy to the total loss of its European trade – a lesson that should have been learned from the experience of U.S. corn growers and meatpackers.

For some U.S. states, the impact of REACH is far greater than that on the nation's chemical industry as a whole. Massachusetts in particular would risk losing 9,000 jobs and the highest percentage of REACH production of any state if industry fails to comply with REACH. Texas and California risk the loss of 6,000 and 5,000 jobs, respectively, and Louisiana, West Virginia and Kentucky are some of the states with the most to lose as a percentage of their total production. No state can afford to lose thousands of jobs, especially when regulatory costs equal to just a few hundred dollars per job could prevent it.

With the help of the U.S. government, the U.S. chemical industry has demonstrated a great reluctance to specify safe conditions of use and appropriate risk management techniques for their products. Even if REACH is a mistake, it is a very inexpensive one. And if, on the other hand, REACH has the result of creating an efficient process for regulating dangerous substances and protecting the public health, the EU's new regulations could pave the way for similar legislation in the U.S. and around the world. Far from posing any threat to the U.S. chemical industry, REACH may provide benefits for environmental quality in the US at a very affordable price.

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Appendix A: Methodology

A.I. Data Definitions and Sources:

Total Chemicals Employment (TCE): Total Chemicals Employment (TCE_{2002}) for 2002 is the number of paid employees reported in the 2002 U.S. Economic Census, Industry Statistics Sampler, NAICS 325, Column 7.

Indirect Employment Multiplier (IEM): The Indirect Employment Multiplier (IEM_{2001}) is the ratio of the total (direct and indirect) chemicals manufacturing employment to direct chemicals manufacturing employment. Chemicals manufacturing, here and throughout, is defined as that portion of the U.S. manufacturing sector classified as category 325 under the North American Industry Classification System (NAICS). Total and direct employment are for 2001 and are taken from a July 2004 U.S. Census Bureau report, "Exports from Manufacturing Establishments: 2001", Table 4, Columns 6 and 9 (for 325 only), which uses I/O accounts to derive indirect exports. According to this report, indirect employment is any employment associated with the intermediate goods and services necessary to manufacture exported goods.

Share of 325 Production Exported to the EU-25, 2002 and 2004 (SEU): The share of 325 production exported to the EU-25 ($SEU_{2002/2002}$ and $SEU_{2004/2002}$) is the ratio of the value of all 325 exports to the EU-25 to total 325 value of shipments. The value of 325 exports to the EU-25, for 2002 and 2004, is taken from "TradeStats Express: State Export Data" from the Office of Trade and Industry Information, Manufacturing and Services, International Trade Administration, U.S. Department of Commerce. The total value of 325 shipments is available for 2002 only, and is taken from the 2002 U.S. Economic Census, Industry Statistics Sampler, NAICS 325, Column 4.

Share of Production that is REACH-affected (SR): The share of production that is REACH-affected (SR_{2002}) is the ratio of the value of shipments for 2002 in the four-digit NAICS categories assumed to fall under REACH regulation (3251, 3255, 3256, and 3259) to the total 325 value of shipments. The value of 325, 3251, 3255, 3256, and 3259 shipments is for 2002, and is taken from the 2002 U.S. Economic Census, Industry Statistics Sampler, NAICS 325, Column 4.

Value of REACH-affected Shipments (VRS): The value of REACH-affected shipments (VRS_{2002}) is the sum of the value of shipments for 2002 in the four-digit NAICS categories assumed to fall under REACH regulation (3251, 3255, 3256, and 3259), and is taken from the 2002 U.S. Economic Census, Industry Statistics Sampler, NAICS 325, Column 4.

Total Employment, 2002 and 2004 (TE): Total Employment (TE_{2002} and TE_{2004}) for 2002 and 2004 is the number of non-farm employees and is taken from the Bureau of Labor Statistics, State and Area Employment, Hours, and Earnings.

Gross State Product, 2002 and 2004 (GSP): Gross state product (GSP_{2002} and GSP_{2004}) for 2002 and 2004 is taken from the Bureau of Economic Analysis, Regional Economic Accounts.

A.II. Calculations:**1. Direct and Indirect Employment related to REACH-Exports, 2002 and 2004 (DIE)**

Direct and Indirect Employment related to REACH-exports for 2002 (DIE) is the product of total 325 employment (TCE), the indirect employment multiplier (IEM), the share of 325 production exported to the EU-25 (SEU), and the share of production that is REACH-affected (SR).

$$(1) \text{DIE}_{2002} = \text{TCE}_{2002} * \text{IEM}_{2001} * \text{SEU}_{2002/2002} * \text{SR}_{2002}$$

$$(2) \text{DIE}_{2004} = \text{TCE}_{2002} * \text{IEM}_{2001} * \text{SEU}_{2004/2002} * \text{SR}_{2002}$$

2. Direct and Indirect Employment related to REACH-Exports as a Percentage of Total Employment, 2002 and 2004 (%DIE)

Direct and indirect employment related to REACH-exports as a percentage of total employment for 2002 (%DIE) is direct and indirect employment related to REACH-exports (DIE) divided by total employment (TE).

$$(3) \% \text{DIE}_{2002} = \frac{\text{DIE}_{2002}}{\text{TE}_{2002}}$$

$$(4) \% \text{DIE}_{2004} = \frac{\text{DIE}_{2004}}{\text{TE}_{2004}}$$

3. Value of REACH-Exports, 2002 and 2004 (VRE)

The value of REACH-exports for 2002 (VRE) is the product of the value of REACH-affected shipments (VRS) and the share of 325 production exported to the EU-25 (SEU).

$$(5) \text{VRE}_{2002} = \text{VRS}_{2002} * \text{SEU}_{2002/2002}$$

$$(6) \text{VRE}_{2004} = \text{VRS}_{2002} * \text{SEU}_{2004/2002}$$

4. Value of REACH-Exports as a Percentage of Gross State Product, 2002 and 2004 (%VRE)

The value of REACH-exports as a percentage of gross state product for 2002 (%VRE) is the value of REACH-exports (VRE) divided by gross state product (GSP).

$$(7) \% \text{VRE}_{2002} = \frac{\text{VRE}_{2002}}{\text{GSP}_{2002}}$$

$$(8) \% \text{VRE}_{2004} = \frac{\text{VRE}_{2004}}{\text{GSP}_{2004}}$$

Appendix B: Data**Appendix Table B1: Employment and Value of Shipments related to REACH Exports (2002)**

	Direct and Indirect Employment related to 325 REACH Exports to the EU-25	as a percentage of Total Employment	Value of Shipments of 325 REACH Exports to the EU-25	as a percentage of Gross State Product
Alabama	710	0.038%	\$164,000,000	0.133%
Arizona	130	0.006%	\$11,000,000	0.006%
Arkansas	320	0.028%	\$59,000,000	0.083%
California	5,140	0.036%	\$788,000,000	0.058%
Colorado	420	0.019%	\$51,000,000	0.028%
Connecticut	230	0.014%	\$59,000,000	0.036%
Delaware	140	0.034%	\$77,000,000	0.164%
Florida	270	0.004%	\$92,000,000	0.018%
Georgia	1,810	0.047%	\$568,000,000	0.185%
Illinois	1,800	0.031%	\$540,000,000	0.111%
Indiana	620	0.021%	\$233,000,000	0.114%
Iowa	10	0.001%	\$9,000,000	0.009%
Kansas	290	0.021%	\$70,000,000	0.078%
Kentucky	1,530	0.085%	\$374,000,000	0.307%
Louisiana	700	0.037%	\$517,000,000	0.385%
Maine	70	0.012%	\$9,000,000	0.022%
Maryland	720	0.029%	\$161,000,000	0.080%
Massachusetts	3,440	0.106%	\$598,000,000	0.208%
Michigan	2,290	0.051%	\$369,000,000	0.106%
Minnesota	740	0.028%	\$92,000,000	0.046%
Mississippi	480	0.043%	\$127,000,000	0.185%
Missouri	590	0.022%	\$179,000,000	0.096%
Nebraska	90	0.010%	\$21,000,000	0.035%
Nevada	20	0.002%	\$6,000,000	0.007%
New Hampshire	160	0.026%	\$10,000,000	0.022%
New Jersey	2,260	0.057%	\$651,000,000	0.172%
New Mexico	0	0.001%	\$1,000,000	0.002%
New York	1,520	0.018%	\$639,000,000	0.080%
North Carolina	510	0.013%	\$139,000,000	0.046%
Ohio	1,840	0.034%	\$386,000,000	0.100%
Oklahoma	60	0.004%	\$20,000,000	0.021%
Oregon	480	0.030%	\$75,000,000	0.065%
Pennsylvania	390	0.007%	\$144,000,000	0.034%
Rhode Island	550	0.115%	\$39,000,000	0.104%
South Carolina	1,800	0.100%	\$242,000,000	0.198%
Tennessee	1,470	0.055%	\$276,000,000	0.144%
Texas	3,610	0.038%	\$1,792,000,000	0.231%
Utah	110	0.010%	\$23,000,000	0.031%
Virginia	590	0.017%	\$192,000,000	0.067%
Washington	330	0.012%	\$47,000,000	0.020%
West Virginia	410	0.056%	\$142,000,000	0.313%
Wisconsin	590	0.021%	\$157,000,000	0.083%
Wyoming	30	0.013%	\$22,000,000	0.107%
43 states	39,280	0.031%	\$10,169,000,000	0.100%

Source: Authors' calculations; see Appendix A for data sources.

Appendix Table B2: Employment and Value of Shipments related to REACH Exports (2004)

	Direct and Indirect Employment related to 325 REACH Exports to the EU-25	as a percentage of Total Employment	Value of Shipments of 325 REACH Exports to the EU-25	as a percentage of Gross State Product
Alabama	690	0.036%	\$159,000,000	0.114%
Arizona	210	0.009%	\$18,000,000	0.009%
Arkansas	450	0.039%	\$82,000,000	0.101%
California	6,330	0.044%	\$971,000,000	0.063%
Colorado	510	0.023%	\$62,000,000	0.031%
Connecticut	290	0.017%	\$75,000,000	0.040%
Delaware	130	0.030%	\$69,000,000	0.128%
Florida	300	0.004%	\$102,000,000	0.017%
Georgia	1,830	0.047%	\$575,000,000	0.168%
Illinois	2,860	0.049%	\$856,000,000	0.164%
Indiana	1,080	0.037%	\$405,000,000	0.178%
Iowa	10	0.001%	\$9,000,000	0.008%
Kansas	230	0.018%	\$57,000,000	0.057%
Kentucky	1,950	0.108%	\$477,000,000	0.349%
Louisiana	880	0.046%	\$651,000,000	0.425%
Maine	40	0.007%	\$5,000,000	0.012%
Maryland	790	0.032%	\$179,000,000	0.079%
Massachusetts	9,110	0.286%	\$1,581,000,000	0.497%
Michigan	2,200	0.050%	\$355,000,000	0.095%
Minnesota	1,640	0.061%	\$204,000,000	0.091%
Mississippi	610	0.054%	\$159,000,000	0.209%
Missouri	1,020	0.038%	\$313,000,000	0.154%
Nebraska	100	0.011%	\$24,000,000	0.035%
Nevada	10	0.001%	\$4,000,000	0.004%
New Hampshire	110	0.018%	\$7,000,000	0.014%
New Jersey	2,470	0.062%	\$714,000,000	0.172%
New Mexico	30	0.003%	\$7,000,000	0.011%
New York	1,690	0.020%	\$710,000,000	0.079%
North Carolina	970	0.025%	\$263,000,000	0.078%
Ohio	2,610	0.048%	\$547,000,000	0.130%
Oklahoma	60	0.004%	\$19,000,000	0.018%
Oregon	470	0.029%	\$73,000,000	0.057%
Pennsylvania	520	0.009%	\$191,000,000	0.041%
Rhode Island	410	0.084%	\$29,000,000	0.069%
South Carolina	1,880	0.103%	\$253,000,000	0.186%
Tennessee	1,850	0.068%	\$347,000,000	0.159%
Texas	4,870	0.051%	\$2,418,000,000	0.274%
Utah	170	0.016%	\$37,000,000	0.045%
Virginia	840	0.024%	\$274,000,000	0.083%
Washington	320	0.012%	\$46,000,000	0.018%
West Virginia	580	0.079%	\$201,000,000	0.407%
Wisconsin	550	0.020%	\$148,000,000	0.070%
Wyoming	60	0.022%	\$39,000,000	0.164%
43 states	53,780	0.042%	\$13,716,000,000	0.118%

Source: Authors' calculations; see Appendix A for data sources.

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