COST IMPACT OF VERMONT'S GMO LABELING LAW ON CONSUMERS NATIONWIDE

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Abstract

This paper examines the cost impact that labeling legislation from one state can have on national food prices. Vermont, a state that has a population of just over 625,000 is setting standards that could require changes in the production or labeling of most of the nation's food supply. This could impact over 300 million Americans, far beyond the population of Vermont and could cost consumers as much as $81.9 billion annually or approximately $1,050 per American family.

Vermont enacted legislation (Act 120) that would require a large number of food products sold by retailers in the state of Vermont to either be: 1) produced without the use of virtually any genetically modified (GMO) ingredients; or 2) carry mandatory labels regarding genetically modified (GMO) ingredients. This requirement applies to products even if the manufacturer does not intend to sell them in Vermont. For a number of reasons explained in this paper, this law would encourage most national food manufacturing companies to either relabel their products, or most likely reformulate products from using GMO ingredients to non-GMO ingredients.

If manufacturers shift to non-GMO ingredients, these costs would be substantial, and, will inevitably be passed on to consumers. This paper examines the cost of the Vermont legislation across all 50 states and the District of Columbia. It concludes that, the one-time cost to consumers of the new Vermont labeling requirement could be as high as $3.8 billion, while the estimated cost of switching all covered products to non-GMO supplies could reach as high as $81.9 billion annually or approximately $1,050 per family in the United States.

Introduction

Vermont, which is one of the smallest states in the country, enacted legislation that would require certain food manufacturers to label products that contain GMO ingredients if: 1) these products are produced entirely or in part from genetic engineering; and 2) these products are offered for sale in Vermont. As discussed below, this requirement effectively applies to products even if a manufacturer decides not to sell them in Vermont.

The law, which goes into effect July 1, 2016 requires all products containing genetically modified ingredients (GMOs) to state that the products were either: 1) "produced with genetic engineering," 2) "partially produced with genetic engineering," or 3) "may be produced with genetic engineering." The requirement applies to a wide range of foods, although there are substantial exemptions including most meat products or products containing meat, most dairy products, vegetables, some baked goods, alcohol, and foods sold for immediate consumption such as restaurant foods. Food that has been grown, raised, or produced without the intentional use of GMO ingredients or seed would not require the new label.

Providing customers with more information is generally considered a positive economic benefit. The study concludes, however, that the Vermont law is structured in such a way it would force manufacturers to either reformulate or relabel their products. Specifically, the law applies to food distributed (sold or transported to retailer) in Vermont, even a manufacturer determines to not sell in Vermont. Under the law, manufacturers are subject to a fine of $1,000 per day per product that is

deemed mislabeled, and there are additional fines for filing false sworn statements, and failure to keep records. In addition to the direct cost of these fines, food companies would face the costs of potential adverse publicity associated with even unintended violations. Moreover complexities throughout the distribution chain make it difficult for manufacturers to have complete control over where their products end up. Therefore, it is impossible for a manufacturer to produce a specific product for Vermont or to restrict sales entirely to the state.

This means that – in order to avoid the fines imposed by the new Vermont law – manufacturers must at a minimum label all their products (even those not intended for sale in Vermont) in accordance with the Vermont law. Moreover, if manufacturers believed complying with the Vermont labeling requirements would place them at a competitive disadvantage, they would have a strong economic incentive to reformulate their products to remove GMOs. Each of these responses has direct economic costs both to consumers and to the food supply chain as a whole, not only in Vermont, but throughout the country.

Supporters of the labeling restrictions base their arguments on food safety concerns, an issue that is much more complex than labeling requirements. However, they do make a cogent point when they suggest that some consumers want to know what they are eating and have a right to know what is in their food.

Even if this is the case, and even if many manufacturers already label their food to recognize the use of GMO products, one thing is certain. Vermont, a state with just 0.2 percent of the nation's population, is setting standards that effectively require change in the production or labeling of most of the nation's food supply. This will have economic effects on over 318.2 million Americans, far beyond the population of Vermont.[1]

Little academic research has been published on the actual costs of either food labeling requirements or the cost of switching supplies from predominantly GMO products to non-GMO sources. This paper concludes it is likely that these costs could be substantial, and, will be passed on to consumers in the form of higher food prices. This paper therefore, examines the cost of the Vermont legislation across all 50 states and the District of Columbia, and concludes that the one-time cost to consumers as a result of the labeling requirement will be as high as $3.8 billion, while the estimated cost of switching all covered products to non-GMO supplies could reach as high as $81.9 billion annually or approximately $1,050 per family in the US.

Literature Review

Little academic research has been published on the actual costs of labeling requirements or the cost of switching food ingredient material supplies from predominantly GMO products to non-GMO sources.[2] A brief review of the literature suggests that the costs of developing an appropriate marketing system in response to mandatory labeling, coupled with the apparent consumer reluctance over GMOs can affect the economic valuation of innovations, as well as on the incidence

[1] Population data based on Census Bureau figures for 2014.

[2] Although a number of papers sponsored by industry and by advocacy groups have been produced.

of the associated costs and benefits.[3] Many consumers are not well informed about the actual, science-based risks versus benefits of GMO products. Given this situation, a label in and of itself provides little relevant information. In particular labeling of products based on perceived ecological benefits can have unintended consequences if the information provided to the consumer is not especially clear.[4] This was documented in an analysis of labeling laws by the Council for Agricultural Science and Technology (CAST). In that paper, the authors state that *labeling can send a signal to uninformed consumers that they should avoid or be worried about the safety of the product. For example, a consumer could be reluctant to consume products that are labeled to contain GE ingredients, not because of the objectively definable inherent risks of such ingredients, but simply because the label itself sends a warning signal about the product*.[5]

This lack of clarity could be expensive when it comes to GMO labeling requirements, because of the substantial costs incurred in the process of establishing a credible non-biotech product label.[6] One such cost arises from keeping non-biotech commodities and food products free of biotech material. Manufacturers could also reformulate their products to use ingredients from crops that are exclusively non-GMO. Another set of costs that arises are associated with convincing consumers that the product is truly free of non-GMO ingredients which is usually demonstrated by testing for biotech content, or setting up an organization to monitor the integrity of the labeling process.

While these are real costs, benefits can also accrue to manufacturers if labeling helps to increase profitability. One study found that 58 percent of adults bid less for at least some GMO labeled products, while 26 percent bid less for every GMO labeled product. The average difference was about 14 percent.[7] The U.S. Department of Agriculture (USDA) has also suggested that firms may want to have better access to European markets where GMO products are severely restricted.[8] In this case, labeling and reformulation might be necessary to open up those new markets.

The lower yields and higher production costs of non-GMO crops, along with demand from certain markets, has required that (to incentivize production) prices must be higher to farmers. Old data reported by the USDA put the price differential in 1999 at roughly 2-3 percent for soybeans and 2-6 percent for corn.[9] This has increased significantly since then, with the current premium on futures markets for non-GMO corn and soybeans averaging about 11 percent.[10] In addition, changing the

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3 Moschini, GianCarlo, *Biotech—Who Wins? Economic Benefits and Costs of Biotechnology Innovations in Agriculture*, The Estey Centre Journal of International Law and Trade Policy, Vol. 2, No. 1, 2001.

4 Crespi, John M. and Stephan Marette, *Some Economic Implications of Public Labeling*, Journal of Food Distribution Research, Vol. 34, No. 3, November 2003.

5 *Process Labeling of Food: Consumer Behavior, the Agricultural Sector, and Policy Recomme*ndations, Council For Agricultural Science And Technology, Issue Paper Number 56, October 2015, at: www.cast-science.org/download.cfm?PublicationID=283819&File=1030ac46417e576660c87b6b2553352b6624TR

6 Golan, Elise, et. al., *Economics of Food Labeling*, US Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 793, December 2000.

7 Huffman, W. E.; Shogren, Jason F.; Rousu, M.; and Tegene, A., *Consumer Willingness to Pay for Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions*, Journal of Agricultural and Resource Economics, Vol. 28, No. 3, December 1, 2003.

8 Op. cit. Golan.

9 Ibid.

10 *National Weekly Non-GE/GMO* Report, United States Department of Agriculture, and Colorado

composition of foods sold in the market today in order to avoid the use of labels would involve the replacement of GMOs with others derived from commodities that have not yet been genetically modified (e.g., wheat or rice) or with non-GMO and organic ingredients. Such changes are both difficult to implement and costly.[11]

Even if some consumers are willing to pay more for non-GMO products, the literature suggests that mandatory government regulation of the labeling of GMO products is still problematic. This is particularly true when standards are set too high for products to claim a non-GMO status which can result in the collapse of the market for non-GMO products.[12]

Data Sources and Economic Model

JDA developed a model to help determine how Vermont's GMO labeling restrictions could cost consumers across the country. This study evaluates three separate costs across a range of 41 different food and beverage production categories (Table 1). Data on the production function for each of these categories was obtained from the IMPLAN input-output model for each state and the District of Columbia.[13]

Table 1
Food and Beverage Categories Examined in Analysis

Department of Agriculture, January 27, 2016, at: https://www.ams.usda.gov/mnreports/gl_gr112.txt.

11 *The Potential Impacts of Mandatory Labeling for Genetically Engineered Food in the United States,* Council for Agricultural Science and Technology, Issue Paper 54, April 2014.

12 Lapan, Harvey E., and GianCarlo Moschini, *Grading, Minimum Quality Standards, and the Labeling of Genetically Modified Products*, Iowa State University Department of Economics Working Papers Series, Working Paper # 06012, March 2006.

13 The IMPLAN model adopts an accounting framework through which the relationships between different inputs and outputs across industries and sectors are computed. It is based on the national income accounts generated by the US Department of Commerce, Bureau of Economic Analysis (BEA). The BEA model, RIMS II is a product developed by the U.S. Department of Commerce, Bureau of Economic Analysis as a policy and economic decision analysis tool. IMPLAN was originally developed by the US Forest Service, the Federal Emergency Management Agency and the Bureau of Land Management. It was converted to a user-friendly model by the Minnesota IMPLAN Group in 1993. Data in this model come from the 2014 IMPLAN accounts, IMPLAN Group LLC

Code	Industry Category	Code	Industry Category
65	Dog and cat food manufacturing	88	Ice cream and frozen dessert manufacturing
66	Other animal food manufacturing	89	Animal, except poultry, slaughtering
67	Flour milling	90	Meat processed from carcasses
68	Rice milling	91	Rendering and meat byproduct processing
69	Malt manufacturing	92	Poultry processing
70	Wet corn milling	93	Seafood product preparation and packaging
71	Soybean and other oilseed processing	94	Bread and bakery product, except frozen, manufacturing
72	Fats and oils refining and blending	95	Frozen cakes and other pastries manufacturing
73	Breakfast cereal manufacturing	96	Cookie and cracker manufacturing
74	Beet sugar manufacturing	97	Dry pasta, mixes, and dough manufacturing
75	Sugar cane mills and refining	98	Tortilla manufacturing
76	Nonchocolate confectionery manufacturing	99	Roasted nuts and peanut butter manufacturing
77	Chocolate and confectionery manufacturing from cacao beans	100	Other snack food manufacturing
78	Confectionery manufacturing from purchased chocolate	101	Coffee and tea manufacturing
79	Frozen fruits, juices and vegetables manufacturing	102	Flavoring syrup and concentrate manufacturing
80	Frozen specialties manufacturing	103	Mayonnaise, dressing, and sauce manufacturing
81	Canned fruits and vegetables manufacturing	104	Spice and extract manufacturing
82	Canned specialties	105	All other food manufacturing
83	Dehydrated food products manufacturing	106	Bottled and canned soft drinks & water
84	Fluid milk manufacturing	107	Manufactured ice
85	Creamery butter manufacturing	108	Breweries
86	Cheese manufacturing	109	Wineries
87	Dry, condensed, and evaporated dairy product manufacturing	110	Distilleries

The categories listed in Table 1 are aggregated food industry product manufactures with similar production processes as derived from the Input-Output accounts. Each of these industries requires a large number of supplier goods and services from other industries, some of which produce a prevalence of GMO products, some of which produce products used to create labels, and some of which are involved in the testing and verification of the final food products. In addition, each of the industries produces a range of products outside of their core categories (for example: Canned fruit and vegetable manufacturers also produce a small amount of soft drinks).

It is impossible to know exactly how a manufacturer will respond to the labeling requirements. Manufacturers are solely responsible for fines imposed by the law, and because proponents of the law have at their disposal many tactics to force the government to levy fines on companies found not in compliance,[14] the practical result is that in order to avoid these fines, nearly all national food companies will likely modify or change their product labeling in some way to note either the presence or absence of GMOs. This means that the costs associated with relabeling should be the lowest price increase that consumers should expect to see as a result of the regulations.

Manufacturer Prices

The model starts with the IMPLAN data for each state and each industry. First, the categories of production for each industry are examined and the percentage of total sales from the primary category is calculated. For example only the percentage of dollar sales of canned fruit and vegetables in the canned fruit and vegetables sector is used in the analysis. This eliminates any double counting in situations which one manufacturing sector produces products that are sold by another. This is denoted as matrix (B) in the model.

Next, the various inputs into the production process are detailed for each industry. These are calculated as a percentage of each dollar of manufacturer sales. From this, and input/output matrix

[14] By, for example, having a like-minded retailer stock products that were never intended for sale in Vermont.

is generated for each of the 41 categories in each state in which they are produced. This is the food and beverage industry production matrix (A).

As previously noted, some categories of food and beverage production are not fully subject to the Vermont law. For example, there are exemptions for dairy products, meat products, and certain baked good unless they have added GMOs. Many dairy products, however, have added ingredients such as sweeteners, and these categories will face significant costs to comply with the Vermont law. Because of the law's exemptions, however the study removes these 13 product categories from the analysis (Table 2). This leaves a total of 28 covered production categories for use in the analysis.

Next, a code was assigned to each of the 533 input industry categories in the IMPLAN model. These codes were used to assign an input to either labeling, GMO testing and certification, or GMO containing commodities. Table 3 outlines the input industries and their assignments which are denoted as (B) in the model. These were multiplied by an estimate of the percentage of GMO in the product line. For example, about 92 percent of the corn grown in the U.S. uses genetically modified seed, as does 90 percent of canola.[15] In the case of product lines where no reliable data is available on the actual percentage of GMO product (for example nearly all mangoes are GMOs; however, data on the total amount of fruit that is GMO is not reported), a proxy of 5 percent has been used.[16] These data are included in matrix (D) in the model.

Table 2
Food and Beverage Categories Removed from Analysis

Code	Industry Category
65	Dog and cat food manufacturing
66	Other animal food manufacturing
70	Wet corn milling
72	Fats and oils refining and blending
84	Fluid milk manufacturing
85	Creamery butter manufacturing
86	Cheese manufacturing
87	Dry, condensed, and evaporated dairy product manufacturing
89	Animal, except poultry, slaughtering
90	Meat processed from carcasses
91	Rendering and meat byproduct processing
92	Poultry processing
94	Bread and bakery product, except frozen, manufacturing

[15] *See Adoption of Genetically Engineered Crops in the U.S.*, U.S. Department of Agriculture, Economic Research Service, at: http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx#.UfFqm9LCaM4.

[16] As of April 2014, a total of 165 GE crops in 19 plant species were approved in the United States although not all were being grown commercially. See: *The Potential Impacts of Mandatory Labeling for Genetically Engineered Food in the United States*, Council for Agricultural Science and Technology, Issue Paper 54, April 2014.

Based on this data, it is possible to determine the percentage of sales value (or in this case economic output which is used as a proxy for sales) for each of the 28 product categories that is due to labeling, testing, and commodities that could potentially contain GMO based materials. These percentages are then multiplied by total output of the core product line in each of the categories. The result is the total amount of industry sales (at the level of production or ex-dock) that falls into each of the three cost categories. The full model is therefore denoted as:

$A_{is}*B_s*C_z*D_{cz}*Output_{is}=Cost_{is}$ where:

A_{is} = The industry production matrix for each industry (i) and each state (s)
B_s = The percentage of each Ai production in each state (s)
C_z=The matrix of each cost component in each category (z) – labeling, GMO commodity, testing
D_{cz}=The matrix containing the estimated of GMO in each component (c) for each category (z)
$Output_{is}$ = The economic output in each industry (i) and each state (s)
$Cost_{isz}$=The cost to manufacturers for each industry (i) each state (s) and each category (z)

In each case the costs occur over a different period of time. For labeling, there would be a one-time cost as labels are changed to denote GMO ingredients. In the case of the testing and reformulation costs, the model assumes that they occur on an annual basis, even though it is likely that a significant portion of the reformulation may occur up front.

Table 3
Input Industries Used in the Model

Input Industry	Labeling	Certification	GMO Commodity
Support activities for printing	X		
Specialized design services	X		
Advertising, public relations, and related services	X		
Photographic services	X		
In-vitro diagnostic substance manufacturing		X	
Biological product (except diagnostic) manufacturing		X	
Electromedical and electrotherapeutic apparatus manufacturing		X	
Search, detection, and navigation instruments manufacturing		X	
Analytical laboratory instrument manufacturing		X	
Surgical and medical instrument manufacturing		X	
Surgical appliance and supplies manufacturing		X	
Dental equipment and supplies manufacturing		X	
Ophthalmic goods manufacturing		X	
Dental laboratories		X	
Environmental and other technical consulting services		X	
Scientific research and development services		X	
Veterinary services		X	
Junior colleges, colleges, universities, and professional schools		X	
Medical and diagnostic laboratories		X	
Oilseed farming			X
Grain farming			X
Vegetable and melon farming			X
Fruit farming			X
Cotton farming			X
Sugarcane and sugar beet farming			X
Dairy cattle and milk production			X
Commercial fishing			X
Wet corn milling			X
Fats and oils refining and blending			X

The cost of testing and reformulating products to remove GMO ingredients would occur annually and would be based on the difference between GMO and non-GMO input costs. In this case the average price differential on futures markets between GMO and non-GMO corn and soybeans is used as a proxy. This currently equals 11.9 percent for corn and 11.5 percent for soybeans; therefore 11.7 percent is used in the model.[17] This same difference is applied to all potential GMO inputs as price differentials for mangoes, or squash, for example, are not readily available.[18] These costs represent the market costs of traded commodities, not necessarily the cost that manufacturers will pay, which could be slightly higher or lower depending on how they purchase commodities.

Since consumers have little information about the benefits or costs of genetically modified crops, many may react by demanding that food companies remove these ingredients from their products. It is certainly possible, given consumers' lack of lack science based information on this subject, that 100 percent of all products would eventually be reformulated.[19] This would lead to extreme disruptions in the nation's food supply chain that could take many years to overcome. The 11.5 percent price differential represents the difference in cost of production per unit of output between GMO and non-GMO crops. Genetic modification allows farmers to plant crops on fields that would not otherwise be economically viable. (This could be due to insects or weed control issues, but most likely because GMO seeds allow farmers to bring agriculture to more marginal lands.)

The ability to actually reformulate products is therefore an extremely important assumption to this model. It is quite likely that the costs of reformulation could be dramatic - at least over a several year horizon and these costs would be passed on to consumers both through higher prices and lower product quality. It is worth noting that several farm commodities in the U.S. are produced almost exclusively with genetically modified seed, and some substitutes simply are not available in the marketplace. In some cases, substitute commodity inputs for products such as these would not be available for many years as farmers switch from GMO to non-GMO crops.

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17 *National Weekly Non-GE/GMO* Report, United States Department of Agriculture, and Colorado Department of Agriculture, January 27, 2016, at: https://www.ams.usda.gov/mnreports/gl_gr112.txt.

18 This is likely a low estimate. According to The Council for Agricultural Science and Technology, *The prices received by U.S. non-GE corn and soybean producers in recent years have averaged 15% more than the prices received by conventional commodity producers. Likewise, the prices received by U.S. organic corn and soybean growers have at times been more than twice the prices received by the nonorganic growers*, See: *The Potential Impacts of Mandatory Labeling for Genetically Engineered Food in the United States*, Council for Agricultural Science and Technology, Issue Paper 54, April 2014.

19 According to Alston and Sumner The most likely response by the food processing industry to mandatory labeling *Would be to substitute non-GE ingredients for GE ingredients where possible, either by using certified non-GE (including organic) forms of current ingredients, or reformulating products to use alternative ingredients that are not produced in GE forms. As in Europe, food processors and retailers … will be reluctant to offer for sale food with labels that may (a) frighten or otherwise dissuade some consumers, even though the label is not informative about food safety or the process used to produce it, and (b) provide a target for political action by groups opposed to GE foods, whose stated intention is to take action if such foods are offered for sale.* Alston, Julian and Daniel Sumner, *Proposition 37 – California Food Labeling Initiative: Economic Implications for Farmers and the Food Industry if the Proposed Initiative Were* Adopted, Working Paper, September 3, 2012, http*://www.noprop37.com/wp-content/uploads/2014/09/Alston-Sumner-Prop-37-review.pdf*

Even if only a small percentage of food manufacturers were able to switch to non-GMO ingredients, there would be major costs associated with the Vermont law. Companies would be forced to segregate GMO and non-GMO grains for example and document them as such, leading to higher wholesaling costs. Food manufacturers would be required to produce multiple versions of products which would increase overall production costs as run-lengths would decrease. Also, a system with smaller volume sales of more product lines would lead to higher wholesaling costs as more trucks and equipment would be required to handle the smaller batches. The actual costs of this regulation will depend on the interplay between these higher production and distribution costs relative to higher ingredient costs.

The production cost differentials for each product category across states are calculated as documented above. These are weighed by the actual 2014 output in each state, which provides overall figures on costs to manufacturers. Table 4 outlines these costs for each category. In the first year, these costs include the cost of relabeling and are estimated at approximately about $51.7 billion. This is equal to about $440 per household in America.[20]

Assuming 2.5 percent inflation and discounting at 7 percent, the cost of the Vermont GMO Labeling rule could be nearly $950 billion over the next 20 years. These are real costs that will be paid by food manufacturers located across the U.S.

Table 4
Manufacturers' Costs and Discounted Manufacturers' Costs over Time

Cost Category	Year 1	Year 2	20 Year Discounted Costs
Labeling	$2,329,884,900	$0	$2,329,884,900
Reformulation and Testing	$105,511,500	$101,074,100	$2,017,579,032
Non GMO Commodity Costs	$49,274,611,300	$47,202,314,563	$942,223,573,314
Total	$51,710,007,700	$47,303,388,664	$946,571,037,246

The long-term discounted cost of the Vermont GMO labeling regulation is quite dependent on the assumption that differences between GMO and non-GMO ingredients will continue into the future. If new technologies or planting techniques are developed, or just more land is put into production, costs of non-GMO ingredients could come down. As Table 5 shows, should these costs to begin to adjust over a 20 year period, with non-GMO ingredients approaching the price of GMO, the 20-year discounted manufactures' cost would fall by about 75 percent. If this were to occur over a 10-year period, the 20-year discounted manufacturers' costs could fall to about one-sixth of the base case. As the table shows, the results are not particularly sensitive to the selection of discount rate.

[20] Based on 118,492,917 households and 78,019,577 families. See *Households And Families*, 2014 American Community Survey 1-Year Estimates, US Department of Commerce, Bureau of the Census.

Table 5
Sensitivity Analysis of Discounted Manufacturers' Costs

Discount Rate	Base	10 Year Adjust	20 Year Adjust
7%	$ 946,571,037,000.00	$ 145,698,585,000.00	$ 226,251,317,000.00
3%	$ 985,124,997,000.00	$ 149,591,773,000.00	$ 219,197,588,000.00

This analysis differs from other reports that have examined the impact of labeling requirements. For example, in a report produced for the Council for Biotechnology Information (CBI), a range of costs associated with bringing products to market such as warehousing costs, slotting allowances, costs for substituting organic ingredients and costs associated with keeping different product lines segregated from each other were included in the analysis.[21] Many of these costs would not be incurred under the scenario examined in this report. For example, this analysis is indifferent to the use of organic and non-organic ingredients, and it assumes that non-GMO ingredients are removed from the production process, thereby eliminating the need to segregate products). The CBI report also attempted to model out retailing costs. In this report, standard margins are used so the final consumer costs figures are relatively modest in comparison.

Consumer Prices

Higher costs for producers, manufacturers, and retailers get passed on to consumers in the form of higher overall food prices. To determine how the Vermont GMO labeling requirements affect American consumers, manufacturers' (ex dock) prices are first converted to consumer prices. This is done by applying what economists refer to as "margins," to the standard price increases placed on products by wholesalers, transportation firms, and retailers. The difference between manufacturer and consumer prices across all affected categories is equal to 65.9 percent. In other words, products costing $100 leaving a food processing factory would cost $165.90 by the time they were sold in a grocery store or supermarket.[22] Margins come from the U.S. Department of Commerce, and reflect averages across the country.[23] Once product outputs (or sales figures) are margined up to the retail level, costs are redistributed across states based on sales patterns. The most recent food sales patterns (by retailer type) are from the 2012 Economic Census.[24] Using these data to allocate consumer costs across states ensures that the reflected price increases correspond closely to actual consumer purchasing patterns.[25] The cost at retail would, therefore, would be much higher than the

21 Lesser, William and Susan Lynch, *Costs Of Labeling Genetically Modified Food Products In N.Y. State*, Council for Biotechnology Information, undated manuscript.

22 This does not include state and local sales taxes which can add significantly to the cost in certain jurisdictions.

23 See *Margins after Redefinitions 2007 Detail*, Industry Economic Accounts Directorate, Bureau of Economic Analysis (BEA), U.S. Department of Commerce. These statistics reflect the 2007 Economic Census and are the latest currently available.

24 Retail Trade: Industry Series: Product Lines Statistics by Industry for the U.S.: 2012, 2012 Economic Census of the United States, U.S. Department of Commerce, Bureau of the Census

25 Note that this is a "closed model," and does not account for international trade. In the model, it is assumed that all production of food in the U.S. is eventually purchased in the country, and that there is no import market. This is an obvious simplifying assumption to the model; however, it can be assumed that any imports coming into the country would also have to abide by the Vermont labeling standards, ensuring that

producer price change. As Table 6 shows, the cost of relabeling products would be as high as $3.8 billion at the consumer level, or about $32 per household. If manufacturers find it necessary to reformulate their products, the cost per household in the first year could be as much as $723, and the 20-year discounted cost could reach $13,250 per household.

Table 6
Consumer Costs and Discounted Manufacturers Costs over Time

Cost Category	Year 1	Year 2	20 Year Discounted Costs
Labeling	$3,843,197,800	$0	$3,843,197,800
Reformulation and Testing	$174,767,700	$167,417,657	$3,341,888,296
Non GMO Commodity Costs	$81,713,035,000	$78,276,505,491	$1,562,507,461,608
Total	$85,731,000,500	$78,443,923,147	$1,569,692,547,704

Based on these data, it is estimated that the overall first year cost increase in off-premise retail food prices would be about 1.76 percent and the ongoing increase in retail prices would be approximately 1.61 percent. While this may seem modest, the costs are equal to about 1.4 percent of the median household income in the U.S., and nearly 2.4 percent of the median income of the poorest 20 percent of the population.

As Table 7 on the following page shows, the long-term discounted consumer cost of the Vermont GMO labeling regulation is quite dependent on the assumption that differences between GMO and non-GMO ingredients will continue into the future. If new technologies or planting techniques are developed, or just more land is put into production, costs of non-GMO ingredients could come down. Should these costs begin to adjust over a 20 year period, with non-GMO ingredients approaching the price of GMO, the 20-year discounted retail cost would fall by about 80 percent. If this were to occur over a 10-year period, the 20-year discounted retail costs could fall to about 15 percent of the base case. As the table shows, the results are not particularly sensitive to the selection of discount rate.

Table 7
Sensitivity Analysis of Discounted Consumer Costs

Discount Rate	Base	10 Year Adjust	20 Year Adjust
7%	$ 1,569,692,548,000	$ 241,590,367,000	$ 363,475,177,000
3%	$ 1,633,627,161,000	$ 248,046,356,000	$ 375,172,352,000

The tables in the appendix to this report document the costs across each state. The first table documents the costs to producers, while the following three outline costs by state in total, for each family and for each household. Three cost categories are presented in the tables. These are: Annual GMO Switching Cost, or the annual costs at the manufacturing and retail level that result from

these costs would also be higher. Some countries, particularly in the European Union ban the use of GMO food products. Food manufacturers in these countries may therefore experience a cost advantage over U.S. based manufacturers and may gain market share at the expense of American manufacturers. This would have a positive impact on consumer prices.

impacted manufacturers switching from GMO ingredients to non-GMO ingredients at current price differential; Annual "Science Costs," which represents the costs of continued testing and potential additional reformulations that occur each year to ensure that products contain no GMO ingredients; and One-Time Labeling Cost, which represent a one-time expense that manufacturers would incur to change its labels to reflect the presence of GMOs or to otherwise be in compliance with the Vermont law.

Discussion and Conclusions

In this paper, we have developed a straight-forward input-output accounting model of how a labeling law passed by an individual state can have significant implications for consumers and businesses across the country. In this case, a labeling law intended to ensure that consumers in Vermont are aware that certain common GMO ingredients are contained in processed food could lead to broad changes in food manufacturing and sourcing nationwide. While a small segment of the population may desire this change, nearly every American will wind up paying for this new regulation enacted by a tiny state representing just 0.2 percent of the U.S. population.

Regulations can and do serve important purposes. The new Vermont GMO labeling regulation, however, will provide few benefits since most consumers have little or no access to actual, science-based information on the risks versus the benefits of GMO ingredients. A label, in and of itself, therefore, provides little relevant information on this issue. As Crespi and Marette (2003) suggest, labeling of products based on perceived ecological benefits (like the GMO label) can have unintended consequences if the information provided to the consumer is not especially clear.

This lack of clarity could be expensive when it comes to GMO label requirements and confusing to consumers. Take the dairy category, for example, which was excluded from this analysis, but is significantly impacted by the Vermont law. Flavoring ingredients added to dairy products, such milk or ice cream, may contain GMO ingredients and, therefore, these products would require new labeling or reformulation. As noted previously, the costs to comply with the Vermont law will be passed on to consumers, not just consumers in Vermont. As this analysis demonstrates, the costs incurred by American food processors could lead to a 1.76 increase in average food prices nationwide in the first year, and as much as 1.61 percent ongoing. These costs are incurred by consumers in every state and the District of Columbia and could be as high as $723 per household in the first year and $13,250 per household over the next 20 years, a cost which is highly dependent on the assumption that non-GMO ingredients will continue to be expensive substitutes for GMO based products.

While certain consumers in Vermont may want regulations mandating GMO labeling, our study concludes that these regulations will lead to food price increases that all Americans—including the poorest-- will have to pay. All consumers will bear the costs of these regulations, despite the fact that they were never represented in this process of promulgating them.

Table 1

Summary of Costs by State
Costs to Manufacturers

State	Annual GMO Switching Cost	Annual "Science" Costs	One-Time Labeling Costs
AL	$660,610,200	$1,007,800	$21,652,200
AK	$18,487,800	$2,227,700	$15,188,400
AZ	$392,159,100	$900,200	$17,661,100
AR	$1,267,338,100	$1,222,900	$29,535,700
CA	$4,206,126,400	$13,338,200	$310,200,300
CO	$285,476,000	$1,216,400	$29,279,400
CT	$176,053,500	$489,200	$16,328,200
DC	$4,629,600	$24,500	$317,100
DE	$19,441,700	$164,300	$2,391,900
FL	$885,973,900	$3,435,500	$66,421,400
GA	$4,011,751,100	$5,068,600	$175,316,800
HI	$227,960,000	$816,300	$17,336,000
ID	$622,392,800	$1,969,600	$32,103,800
IL	$4,492,133,500	$6,122,400	$136,150,700
IN	$2,053,154,700	$2,435,700	$56,760,600
IA	$2,848,595,200	$2,510,700	$46,983,500
KS	$1,051,874,800	$1,597,800	$34,418,600
KY	$795,482,600	$1,659,700	$33,408,200
LA	$803,701,300	$1,594,600	$30,710,800
ME	$62,140,500	$571,500	$8,060,000
MD	$458,737,200	$1,091,600	$34,231,300
MA	$500,042,900	$2,204,800	$37,468,700
MI	$1,276,280,200	$2,603,000	$62,894,900
MN	$2,716,012,200	$2,965,700	$69,895,600
MS	$646,113,900	$784,200	$9,928,500
MO	$611,996,900	$1,875,200	$34,650,200
MT	$171,225,900	$229,900	$6,023,000
NE	$1,216,992,800	$887,800	$12,874,400
NV	$191,540,800	$577,700	$12,631,000
NH	$61,586,300	$258,500	$4,857,300
NJ	$604,690,000	$2,759,500	$74,245,200
NM	$98,818,300	$456,700	$9,527,800
NY	$1,260,629,800	$3,440,300	$89,045,500
NC	$1,166,668,100	$2,701,200	$54,189,700
ND	$649,027,700	$515,000	$13,172,300
OH	$2,142,481,100	$4,254,900	$107,504,100
OK	$95,631,900	$738,700	$7,988,500
OR	$471,852,500	$3,475,900	$55,394,500
PA	$1,577,583,000	$4,837,600	$142,053,300
RI	$238,537,600	$256,500	$4,737,900
SC	$416,186,900	$737,900	$11,485,300
SD	$352,063,500	$258,500	$2,602,400
TN	$1,716,747,900	$2,729,800	$58,637,700
TX	$2,555,676,900	$5,169,200	$116,006,200
UT	$294,905,300	$1,213,000	$23,180,900
VT	$81,411,400	$574,100	$13,730,400
VA	$389,987,100	$1,803,400	$42,720,300
WA	$1,505,103,200	$4,503,800	$63,631,600
WV	$19,221,600	$66,100	$1,538,000
WI	$797,207,800	$3,116,900	$68,860,000
WY	$104,167,800	$50,500	$3,953,700
US	$49,274,611,300	$105,511,500	$2,329,884,900

Table 2

Summary of Costs by State
Costs to Consumer at Retail

State	Annual GMO Switching Cost	Annual "Science" Costs	One-Time Labeling Costs
AL	$904,403,600	$1,283,300	$42,060,800
AK	$75,278,600	$557,700	$10,325,400
AZ	$2,770,437,700	$3,575,100	$67,378,200
AR	$510,344,400	$783,500	$26,140,200
CA	$10,666,866,900	$23,795,300	$522,113,700
CO	$1,041,221,200	$3,329,200	$76,175,900
CT	$635,319,900	$1,914,900	$48,482,300
DC	$28,638,600	$260,400	$3,594,100
DE	$88,646,900	$596,600	$13,420,800
FL	$3,638,078,900	$11,650,400	$239,932,700
GA	$3,770,661,400	$4,620,800	$115,186,300
HI	$401,737,500	$1,048,400	$19,567,900
ID	$547,412,800	$1,318,000	$29,818,900
IL	$3,676,459,500	$6,919,700	$158,232,200
IN	$1,249,001,100	$2,531,400	$50,696,900
IA	$832,268,800	$1,585,700	$34,668,300
KS	$740,542,800	$1,088,800	$26,181,100
KY	$1,216,620,300	$2,162,600	$39,460,900
LA	$556,486,100	$1,978,600	$40,313,400
ME	$186,161,500	$1,147,800	$24,490,100
MD	$1,560,958,400	$3,082,100	$90,974,400
MA	$2,196,801,500	$5,196,000	$99,758,600
MI	$2,143,925,100	$3,997,600	$102,037,400
MN	$2,660,815,600	$3,838,500	$87,812,300
MS	$715,880,300	$790,300	$20,270,200
MO	$1,245,872,200	$3,219,900	$63,383,700
MT	$287,762,400	$510,300	$13,496,000
NE	$529,767,300	$993,100	$18,802,100
NV	$1,218,886,400	$1,467,500	$30,608,500
NH	$469,579,900	$1,252,300	$27,500,000
NJ	$1,153,709,900	$7,207,200	$157,870,400
NM	$155,914,700	$884,500	$20,587,300
NY	$4,212,902,900	$11,513,700	$282,522,700
NC	$2,769,649,700	$5,131,100	$104,892,000
ND	$179,014,900	$284,600	$9,005,600
OH	$4,036,147,600	$6,148,500	$143,988,600
OK	$197,631,400	$1,791,400	$19,255,400
OR	$639,000,500	$3,606,800	$59,640,000
PA	$2,357,384,700	$7,246,600	$174,458,300
RI	$711,038,300	$536,200	$10,044,500
SC	$1,504,384,100	$2,876,700	$52,915,400
SD	$301,770,700	$498,700	$5,974,200
TN	$1,731,851,700	$3,149,400	$54,991,200
TX	$6,844,079,800	$10,834,400	$264,391,900
UT	$621,236,900	$1,915,900	$33,570,300
VT	$327,529,600	$538,100	$10,496,800
VA	$1,566,081,800	$4,432,500	$100,285,200
WA	$4,065,424,900	$5,582,900	$96,757,100
WV	$127,342,700	$571,400	$13,489,300
WI	$1,419,191,400	$3,305,000	$72,689,000
WY	$224,909,200	$216,300	$12,489,300
US	$81,713,035,000	$174,767,700	$3,843,197,800

Table 3

Summary of Costs by State
Costs Per Family at Retail

State	Annual GMO Switching Cost	Annual "Science" Costs	One-Time Labeling Costs
AL	$733.79	$1.04	$34.13
AK	$456.19	$3.38	$62.57
AZ	$1,754.02	$2.26	$42.66
AR	$678.46	$1.04	$34.75
CA	$1,217.39	$2.72	$59.59
CO	$791.63	$2.53	$57.92
CT	$716.04	$2.16	$54.64
DC	$242.98	$2.21	$30.49
DE	$380.46	$2.56	$57.60
FL	$775.15	$2.48	$51.12
GA	$1,554.02	$1.90	$47.47
HI	$1,278.80	$3.34	$62.29
ID	$1,343.35	$3.23	$73.18
IL	$1,186.27	$2.23	$51.06
IN	$753.67	$1.53	$30.59
IA	$1,038.31	$1.98	$43.25
KS	$1,016.39	$1.49	$35.93
KY	$1,081.84	$1.92	$35.09
LA	$500.14	$1.78	$36.23
ME	$540.25	$3.33	$71.07
MD	$1,079.52	$2.13	$62.92
MA	$1,363.98	$3.23	$61.94
MI	$862.69	$1.61	$41.06
MN	$1,942.78	$2.80	$64.12
MS	$969.42	$1.07	$27.45
MO	$825.73	$2.13	$42.01
MT	$1,145.66	$2.03	$53.73
NE	$1,102.95	$2.07	$39.15
NV	$1,897.21	$2.28	$47.64
NH	$1,357.56	$3.62	$79.50
NJ	$523.54	$3.27	$71.64
NM	$318.50	$1.81	$42.06
NY	$911.50	$2.49	$61.13
NC	$1,111.40	$2.06	$42.09
ND	$953.22	$1.52	$47.95
OH	$1,380.58	$2.10	$49.25
OK	$204.48	$1.85	$19.92
OR	$661.32	$3.73	$61.72
PA	$740.14	$2.28	$54.77
RI	$2,764.91	$2.09	$39.06
SC	$1,251.97	$2.39	$44.04
SD	$1,428.60	$2.36	$28.28
TN	$1,043.07	$1.90	$33.12
TX	$1,068.19	$1.69	$41.27
UT	$898.40	$2.77	$48.55
VT	$2,021.58	$3.32	$64.79
VA	$760.67	$2.15	$48.71
WA	$2,356.63	$3.24	$56.09
WV	$269.30	$1.21	$28.53
WI	$955.12	$2.22	$48.92
WY	$1,509.13	$1.45	$83.80
US	$1,047.34	$2.24	$49.26

Table 4

Summary of Costs by State
Costs Per Household at Retail

State	Annual GMO Switching Cost	Annual "Science" Costs	One-Time Labeling Costs
AL	$491.20	$0.70	$22.84
AK	$301.53	$2.23	$41.36
AZ	$1,140.69	$1.47	$27.74
AR	$451.12	$0.69	$23.11
CA	$836.05	$1.87	$40.92
CO	$510.50	$1.63	$37.35
CT	$468.59	$1.41	$35.76
DC	$103.25	$0.94	$12.96
DE	$253.46	$1.71	$38.37
FL	$496.46	$1.59	$32.74
GA	$1,051.05	$1.29	$32.11
HI	$891.23	$2.33	$43.41
ID	$925.33	$2.23	$50.40
IL	$770.36	$1.45	$33.16
IN	$499.05	$1.01	$20.26
IA	$670.39	$1.28	$27.93
KS	$667.59	$0.98	$23.60
KY	$710.60	$1.26	$23.05
LA	$323.88	$1.15	$23.46
ME	$338.57	$2.09	$44.54
MD	$720.85	$1.42	$42.01
MA	$861.72	$2.04	$39.13
MI	$559.10	$1.04	$26.61
MN	$1,249.68	$1.80	$41.24
MS	$653.28	$0.72	$18.50
MO	$529.08	$1.37	$26.92
MT	$700.22	$1.24	$32.84
NE	$715.16	$1.34	$25.38
NV	$1,193.21	$1.44	$29.96
NH	$903.46	$2.41	$52.91
NJ	$361.12	$2.26	$49.41
NM	$204.90	$1.16	$27.06
NY	$578.50	$1.58	$38.80
NC	$730.66	$1.35	$27.67
ND	$586.11	$0.93	$29.48
OH	$878.73	$1.34	$31.35
OK	$135.39	$1.23	$13.19
OR	$416.15	$2.35	$38.84
PA	$476.63	$1.47	$35.27
RI	$1,735.70	$1.31	$24.52
SC	$823.46	$1.57	$28.96
SD	$902.22	$1.49	$17.86
TN	$690.07	$1.25	$21.91
TX	$737.73	$1.17	$28.50
UT	$676.46	$2.09	$36.55
VT	$1,273.30	$2.09	$40.81
VA	$507.84	$1.44	$32.52
WA	$1,517.18	$2.08	$36.11
WV	$173.17	$0.78	$18.34
WI	$614.98	$1.43	$31.50
WY	$966.96	$0.93	$53.70
US	$689.60	$1.47	$32.43