GMO Food Labels in the United States: Economic Implications of the New Law

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Abstract

In July 2016, the U.S. Congress passed Senate Bill 764, which requires the U.S. Department of Agriculture to establish a national disclosure standard for GE foods, as a compromise between forces pressing for a much stricter labeling law versus forces that opposed mandatory labeling laws altogether. The legislation, now known as Public Law 114-216, also preempts states from setting their own standards for mandatory GE labels. This article discusses the implementation of the new law and its potential economic consequences. We conclude that PL 114-216 is worse than a complete absence of mandatory labeling laws. However, it should be better than the likely scenario of policies that it pre-empted, and could be reasonably inexpensive, depending on the implementation details of the new law—which are yet to be determined—and how producers and consumers choose to respond to it.

Highlights:

- Discusses the implications of the new U.S. GMO food labeling law: the 2016 National Bioengineered Food Disclosure Standard (NBFDS)
- NBFDS will require disclosure of genetically engineered content in many food products
- Details of NBFDS implementation and thus its major consequences are yet to be determined
- NBFDS likely to be costly to producers, consumers, and taxpayers but limited in effectiveness and potential benefits

Keywords:

U.S. food policy, mandatory GMO food labels, food labeling law, economics of GE labeling

1. Introduction

Genetically modified (GM) food has been controversial from the outset, and governments have responded to pressure from consumers and various non-governmental organizations (NGOs) by regulating the use of the technology and requiring approval of "new organisms" in food. In many countries genetically engineered (GE) varietal technologies are effectively prohibited, and even in those countries that have most enthusiastically embraced GE varieties, such as the United States, they are subject to much more stringent regulatory oversight than the "conventional" varieties they might replace. Opposition to GE varietal technologies is also manifest in political pressures to require GM foods to be labeled as such. Unlike many other countries, in the United States the policy at the outset was one of voluntary labeling when GE crops were first released in 1996. Increasingly over time, however, we have seen political pressure building to introduce mandatory GE food labels, with formal policy proposals introduced in at least 25 states (Van Eenennaam et al., 2014) and, ultimately, federal legislation passed in July 2016.

Various consumer groups and NGOs have argued for mandatory labeling of GE foods in the United States, most often on the grounds of consumers' "right to know" what is in their food. However, many economists and others oppose mandatory labels on the basis of the scientific evidence demonstrating that genetic engineering poses no inherent threat or risks while bringing substantial benefits to producers, consumers, and the environment; and furthermore, because a market solution has emerged in the form of voluntary labels for non-GE food (see, e.g., Carter and Gruère, 2003; Alston and Sumner, 2012; Saletan, 2015; *Boston Globe*, 2016; Qaim, 2016;

Sunstein, 2017).[1] Thus, as argued by Marchant, Cardineau, and Redick (2010) and others, mandatory labeling imposes a cost on the food industry, which will be passed through to consumers in the form of higher food prices and back to agricultural producers in terms of lower returns for their products, without providing tangible benefits (instead, providing a public disservice by falsely implying that GE foods are unsafe).[2]

Nevertheless, in July 2016, the U.S. Congress passed Senate Bill 764, which requires the U.S. Department of Agriculture to establish a national disclosure standard for GE foods, as a compromise between forces pressing for a much stricter labeling law versus forces that opposed mandatory labeling laws altogether. The legislation, now known as Public Law 114-216 or the National Bioengineered Food Disclosure Standard (NBFDS), also preempts states from setting their own standards for mandatory GE labels, and immediately nullified a state law to mandate GE labels in Vermont, which had entered force earlier that month.[3] Several other states had passed similar laws that had not yet come into effect; a patchwork of potentially conflicting state requirements was expected to ensue and the new law also prevented this from happening.

In this paper, we first review the economic history of the political and policy processes that gave rise to the 2016 passage of PL 114-216, paying some attention to economic and scientific evidence and arguments, the role of NGOs in promoting mandatory labeling policies,

[1] As shorthand, throughout this paper, we use the term "non-GE" to refer to products that have verification requirements related to inspection of premises and procedures and testing, with some allowance for adventitious presence of GE material at low rates (say <1%). The NBFDS regulation is very likely to allow for such an approach to defining "non-GE" products such that producers of food with small amounts of GE material can avoid having to make disclosure statements.

[2] Sunstein (2017) outlines the possible methods for interpreting the costs and benefits of mandatory GE labeling, and concludes that the benefits to consumers are based on a misunderstanding of the science, and that the "right to know" does not bring benefits that outweigh the costs to producers.

[3] PL 114-216 refers to the legislation; NBFDS may refer to the legislation or the pending regulations. For clarity, we use NBFDS when we refer to the pending regulations.

and the role of the food industry as an intermediary between consumers and farm producers. Next we discuss the implementation of the new law and its potential economic consequences, first describing the nature of likely consumer, marketer, and producer responses to the law and then outlining estimates of various categories of costs. The relevant comparisons are with both a hypothetical scenario of no mandatory labeling laws as well as with the alternative future regime that the new law pre-empted, which would have entailed a patchwork of potentially more onerous state regulations.

We conclude that PL 114-216 is a clumsy and incoherent piece of legislation that will be burdensome to producers and, regardless of one's views on GE technology, will be limited in effectiveness and potential benefits. PL 114-216 is worse than a complete absence of mandatory labeling laws. However, it should be better than the likely scenario of policies that it pre-empted, and could be reasonably inexpensive, depending on the implementation details of the new law—which are yet to be determined—and how producers and consumers choose to respond to it.

2. The Genesis of PL 114–216

The United States has been the global leader in the development and adoption of GE crop technology, and has been comparatively slow to adopt mandated GE labels, consistent with the broader international patterns and the political economy rationale offered by Bovay and Alston (2016), drawing on Gruère, Carter and Farzin (2009); see, also Zilberman (this issue). However, in recent years many proposals for mandated GE labels have been made in the United States. This movement parallels the worldwide trend as the number of countries with mandatory GE food labels has increased from none before the European Union first introduced its labeling policies in 1997, to more than 40 having some kind of GE food labeling requirement by 2006,

and now at least 65 countries including the United States (see, e.g., Gruère and Rao, 2007; Qaim, 2016).

2.1. Background to the law: the U.S. debate

Van Eenennaam et al. (2014) discuss the key elements of the U.S. debate over mandated labels for GM food, which ultimately led to PL 114–116. In that discussion, the debate is one-sided: the con side holds all the winning cards; none of the arguments presented by the proponents of mandatory labeling are very persuasive. Because some of these aspects of the issue are pertinent to the discussion of the implications of PL 114–216, we will summarize the main points before turning to a discussion of the law and its implications.

First, at least some proponents of GM labeling laws are concerned about the potential environmental impacts of GE crops or the potential food-safety implications of GM food. Clearly, in spite of the overwhelming volume of scientific and economic evidence supporting the continued use of GE technology (e.g., Brookes and Barfoot, 2013; Klümper and Qaim, 2014; Qaim, 2016; National Academies of Sciences, Engineering, and Medicine, 2016), there is no consensus among the general public on whether GE technology poses significant potential risks to human health or the environment. Hence, while some proponents may argue that mandatory GE labels would improve the information status of consumers, opponents contend that a mandatory labeling requirement would arbitrarily single out a particular technology for specific attention and would signal falsely to consumers that the presence of GE ingredients is of material importance, and could mislead them into thinking that they should be concerned about the presence of GE ingredients (e.g., see Marchant, Cardineau, and Redick, 2010; Alston and Sumner, 2012; Qaim, 2016; Sunstein, 2017).

Second, proponents of mandatory GE labeling often claim that consumers have the "right to know" whether foods were produced using genetic engineering, and that this "right" justifies mandatory GE labels, even if there is no scientific basis or other reasonable justification for wanting to know whether GE ingredients were used to make the product (see, e.g., Caplan, 2015; Hamblin, 2015; Gostin, 2016; Just Label It Campaign, 2017). Opponents of mandatory labeling contest whether the "right" to know exists as such (see, e.g., Kalaitzandonakes, 2004) and point out that if consumers really do demand food to be segregated and labeled according to its GE content, the market can provide that service and will do so (appropriately) at a cost to those who demand it, through voluntary labeling (see, e.g., Marchant, Cardineau, and Redick, 2010). Indeed, the market is already meeting such demand in two ways: first, by providing food explicitly labeled as having been produced in ways that avoid (or seek to avoid) the use of GE ingredients—in many cases certified as such through the third party Non-GMO Project;[4] and second, by providing organic food, which satisfies the non-GMO requirement while also meeting other demands.

Third, proponents typically claim that mandated labels would enhance the range of choices available to consumers. But, as argued by Carter and Gruère (2003), Alston and Sumner (2012) and Bovay and Alston (2016), at least some of these proponents have a broader aim, to demonize and effectively ban the crops. Indeed, Europe's experience with GE labels has shown that foods bearing GE labels could be eliminated from retail outlets (see, e.g., Gruère, 2006). In other words, mandatory GE labeling can act as a de facto ban on those GE foods that require

[4] The Non-GMO Project was started by two natural-foods grocery stores in 2005 and certifies food as "Non-GMO" (Non-GMO Project, 2016). A full list of requirements producers must meet to achieve certification can be found at the organization's website, http://www.nongmoproject.org. See Kuchler et al. (2017) for a more complete discussion of the Non-GMO Project Verified label.

labels (but not on all GE foods, since many are not subject to regulations). The ultimate outcome of mandatory GE labeling thus may be to reduce rather than enhance the choice available to consumers.

2.2. Policy timeline

As discussed by Bovay and Alston (2016) and documented in detail by Van Eenennaam et al. (2014), at least 25 U.S. states have considered proposed legislation to require GE labeling. Five statewide initiatives requiring labeling were not supported by a majority of the voters, specifically: in Oregon in 2002 (Measure 27), in California in 2012 (Proposition 37), in Washington in 2013 (Initiative 522), in Colorado in 2014 (Proposition 105) and in Oregon in 2014 (Measure 92).[5] Four other states have passed legislation mandating GE labels, which in three of the four never took meaningful effect for various reasons. An Alaskan law (passed in 2005) requires labeling of GE fish sold in the state, and federal legislation passed in 2015 required the U.S. Food and Drug Administration (FDA) to develop labeling guidelines for GE fish before such fish can be sold in the United States. In 2013, Connecticut and Maine passed bills with limitations (e.g., one bordering state and four other states with a total population collectively exceeding 20 million people would have had to enact similar labeling rules).

The first unconditional GE labeling law was passed by the Vermont legislature and signed into law in May 2014. Act 120 came into effect on July 1, 2016, but allowed a grace period of six months for products distributed before that date, and was overturned by federal

[5] In November 2016, in the same election that legalized the recreational use of marijuana in California, Sonoma County, California, voted to join its contiguous neighbors, Marin County and Mendocino County, in banning the cultivation of GE crops. County-level restrictions on the cultivation GE crops are also in place in Humboldt County, Trinity County, and Santa Cruz County, California, and were in place in Maui County, Hawaii County and Kauai County, Hawaii before a federal judge overturned the Hawaii restrictions in November 2016 (Acosta, 2014; Associated Press, 2016; McClurg, 2016).

legislation within a month. This was a broad GE labeling law, with general coverage of food containing GE ingredients sold for consumption at home, similar in scope and form to California's Proposition 37 and the other state-specific initiatives.

Beginning in 2015, various bills were introduced in the Senate and the House related to labeling of foods produced using GE. One of these, the Safe and Accurate Food Labeling Act of 2015, passed the House of Representatives by a vote of 275–150 on July 23, 2015. A related bill was rejected by the Senate, 48–49, in a cloture vote on March 16, 2016. The Safe and Accurate Food Labeling Act of 2015 would have preempted states from developing mandatory GE labeling requirements, and at the same time would have established national standards for both voluntary non-GE and voluntary GE label claims. In both the House and the Senate, the bill was supported mostly by Republicans, with a few Democrats voting for passage and a few Republicans voting against.

A few months later, under pressure as a result of the ongoing implementation of Vermont's Act 120, lawmakers reintroduced the Senate bill with extensive revisions; a compromise was necessary to gain the requisite 60 votes in the Senate. This compromise bill retained the preemption of state regulations but did not establish a voluntary national standard for non-GE claims, instead implementing a mandatory disclosure standard for certain foods containing GE ingredients. S.764 passed the Senate by a vote of 63–30 on July 7, 2016; it passed the House by 306–117 a week later, and was signed into law as PL 114-216 by President Obama on July 29, 2016. Much of the regulatory detail, which will determine the consequences of the policy in practice, remains to be determined. Regulations under existing and proposed mandatory labeling laws provide some indication of what we might reasonably expect.

2.3. Elements of proposed state-level policies

California's Proposition 37 failed in 2012 but subsequent initiatives in other states have contained similar provisions. These, along with those in Vermont's Act 120 and EU policies, are indicative of both what might be expected under federal regulations to come, and what might have developed state-by-state, albeit piecemeal, in the absence of federal regulations. As discussed by Bovay and Alston (2016), to illustrate the nature of the specific detail, Proposition 37 would have required labels for food and beverages purchased for home consumption if they were "or may have been entirely or partially produced" with genetic engineering. After a phase-in period, foods and beverages containing any amount of a genetically modified ingredient would have required a label indicating that the product was "Partially Produced with Genetic Engineering" or "May be Partially Produced with Genetic Engineering," and raw agricultural commodities would have had to be sold with the words "Genetically Engineered" displayed.

However, more than two-thirds of food products consumed in California would have been exempted, arbitrarily, from the labeling requirement—regardless of whether they contained GE ingredients or were made from ingredients produced using GE technologies—including food consumed away from home (i.e., in a restaurant or other "food facility");[6] foods consisting of or derived entirely from animals;[7] beverages containing 0.5% or higher alcohol content;[8] foods

[6] Food away from home accounted for 49.0% of the total value of food consumption (not including alcohol) in the United States in 2014 (Elitzak and Okrent, 2016).

[7] Meat, poultry, fish, eggs, and dairy products accounted for 32.4% of food-at-home expenditures (not including alcohol) in the United States in 2012 (BLS, 2015).

[8] Alcoholic beverages accounted for 11.3% of the value of all food and alcohol consumption in the United States in 2014 (Elitzak and Okrent, 2016).

certified as organic.[9] Similar exemptions are typical. For instance, in the EU, labels are not required for foods produced with the use of GE processing aids, nor for foods derived from animals that were raised with GE feed (European Parliament, 2003). Likewise, Vermont's Act 120 exempted from the labeling requirement alcohol and food served in restaurants as well as any other unpackaged, ready-to-eat foods, foods derived from animals that were raised with GE feed, and foods manufactured using GE processing aids such as enzymes (taken together, these last two provisions exempted cheese, which is important to Vermont).

Another crucial dimension of the policy is tolerance for adventitious presence of GE products. Many countries that have mandatory labeling laws have some reasonable tolerance—say, 0.9% by weight for any individual ingredient, as in the EU, or 5% by weight of the finished product for processed foods that contain certain ingredients, as in Japan (European Parliament, 2003b; Umeda, 2014). Under California's Proposition 37, after a phase-in period, the tolerance was to be reduced from 0.5% to zero, although food certified as organic could contain GE material and still be exempt from the GE labeling requirement. As discussed by Alston and Sumner (2012), compliance with a zero-tolerance rule could be very difficult and costly, even if GE and non-GE production systems were entirely segregated, which is in itself costly.

The Vermont law, Act 120, required that products sold in Vermont be labeled if they were entirely or partially produced with the use of GE technologies. Manufacturers would have been fined $1,000 per day, per product, if improperly labeled items were offered for sale, regardless of whether the manufacturer had intended for the products to be distributed in Vermont. Like the

[9] Organic products accounted for over 4% of all food sales in 2012 (Greene, 2016). To have their products certified as organic, producers must not intentionally use GE inputs. However, organic certification does not require testing for GE content (see, e.g., Alston and Sumner, 2012; USDA−Agricultural Marketing Service, 2013).

Non-GMO Project standard, the threshold for labeling would have been 0.9% GE ingredients, by weight. To prove that their products did not require labels, producers would have had to either obtain sworn statements from suppliers about the non-GE status of ingredients or have a third-party organization verify the status of finished products. Although some producers introduced GE disclosure statements in 2016, apparently in anticipation of the Vermont law, other producers announced (at least privately) that they planned to cease distributing products to Vermont, which contains about 0.5% of the U.S. population.

3. Implementation of PL 114–216

In this section we discuss the implementation of the new law, including the likely timing and the form the policy will take, and the nature of the change in policy in practice. The first step is to define likely future GE labeling rules and regulations under PL 114-216 compared with those that would have been likely to apply otherwise.

3.1. Regulatory requirements

PL 114-216 requires that some food products bear a disclosure statement if they contain[10] "genetic material that has been modified through in vitro recombinant deoxyribonucleic acid (DNA) techniques; and for which the modification could not otherwise be obtained through conventional breeding or found in nature."[11] This disclosure statement need not be explicit on a label; the legislation allows manufacturers to use a text statement, a symbol (presumably, a uniform symbol to be developed by USDA), or a QR code readable by smartphones,

[10] The bill language does not include the phrase "may contain," but does require USDA to "establish a … disclosure standard … with respect to any food that may be bioengineered." We expect that, similar to the requirements under Vermont Act 120 and the proposed California Proposition 37, foods will be required to carry a disclosure statement unless they are certain to be non-GE.

[11] This is a specific and somewhat limited definition of bioengineering that excludes new technologies such as CRISPR and TALEN.

accompanied by text simply stating: “Scan here for more food information.” This QR code will direct users to a website where information about the food’s GE content will be available. Some alternative compliance options will be available for small manufacturers.

Similar to California’s Proposition 37 and Vermont’s Act 120, PL 114-216 exempts food served in restaurants and similar retail food establishments; organic food is automatically considered non-GE; and animals may be raised on GE feed without their products having to be labeled as GE. Beyond these broad (and conventional) exemptions, the definition of products for which GE labels will be required is convoluted. In the United States, food labels are regulated by the Food and Drug Administration (FDA, part of the Department of Health and Human Services) and the Food Safety and Inspection Service (FSIS, part of the USDA). Generally speaking, FSIS oversees meat, poultry, meat and poultry products, egg products, and catfish, while FDA oversees everything else.[12] Keeping these definitions in mind, PL 114-216 applies only to foods for which the predominant or second-leading ingredient is regulated by FDA, and to products for which the predominant ingredient is broth, stock, water, or a similar solution, regardless of whether these leading ingredients are GE. So, for example, a package of marinated beef with GE high-fructose corn syrup in the marinade would require a GE disclosure statement because all ingredients except the beef are regulated by FDA; whereas a package of mixed beef and lamb, marinated in the same solution, would not require a GE disclosure statement because the leading two ingredients are both regulated by USDA.[13]

[12] The details are even more complicated. See FDA (2017), page 106.

[13] At the time of this writing (October 2017), it remains unclear what roles FDA and USDA will play in enforcing the NBFDS standards. Presumably, each agency will retain authority over the foods it generally regulates. Consistency of enforcement and penalties for noncompliance may differ across agencies.

Figures 1 and 2 illustrate the uses for corn and soybeans, respectively, in the United States, and demonstrate that only small shares of all GE corn and soybeans—which account for 92 percent of all planted acreage of GE crops in the United States (ISAAA, 2016)—are used for purposes that will require disclosure under NBFDS. In figures 1 and 2, we assume that the shares of GE corn and soybeans used for various products and purposes are proportional to the respective shares of total corn and soybeans used for such products and purposes. In reality, greater shares of GE corn and soybeans are used for animal feed and industrial purposes, so the implication that 6% of corn and 12% of soybeans are currently being used in products that would require disclosure statements is likely to be an overstatement.

[Figure 1: U.S. GE corn that could be used in food products sold without GE labels or other disclosure statements]

[Figure 2: U.S. GE soybeans that could be used in food products sold without GE labels or other disclosure statements]

These figures illustrate that, if the farm products could be readily segregated according to ultimate end-use and if the food industry wanted to do so, GE varieties of corn and soybeans could be replaced entirely with non-GE varieties in the U.S. foods that would potentially require disclosure statements while continuing to produce predominantly GE varieties primarily for other uses, including foods that would not require disclosure statements. But the devil is in the details. Even though only a comparatively small fraction of the total production of corn and soybeans is directly implicated, these commodities—in particular in the form of high-fructose corn syrup and soybean oil—are being (or could be) used in the production of a much larger fraction of the food products that would potentially require disclosure statements.[14] Hence, the

[14] High-fructose corn syrup and soybean oil do not contain proteins, so it is not possible to test these products (ingredients) for GE material. It is unclear at the time of this writing (October 2017) whether products that cannot be

challenges facing the U.S. food industry are not trivial and could be seriously expensive, depending on key features of the policy and its enforcement that remain to be determined.

The Congressional legislation, PL 114-216, leaves several aspects of the NBFDS to be determined by USDA before July 2018; many critical questions surrounding these aspects remain open at the time of this writing (October 2017):

The threshold for labeling of GE content. 0.9% GE content, by weight, has emerged as the leading standard as the threshold for labeling requirements or non-GE claims, used by the EU (on a per-ingredient basis) and the Non-GMO Project (on the basis of product weight). A lower threshold than 0.9% could create the awkward situation where a product qualifies for the Non-GMO Project Verified standard but also must be labeled with a GE content disclosure statement—unless the Non-GMO Project changes its rules. Therefore, it seems likely that USDA will select 0.9% as the threshold for mandatory disclosure of GE content.

The process for verifying that disclosure statements are not required. Who will enforce the label requirements? Will that agency randomly test products to verify compliance, or randomly audit manufacturers' records? Or will it only respond to complaints from consumers or consumer-advocacy groups or competitors? What records will manufacturers be obliged to keep to document that they do not have to label products as containing GE ingredients?

Consequences for non-compliance. The legislation (Sec. 293(g)(4)) states that the USDA "shall have no authority to recall any food… on the basis of whether the food bears a disclosure that the food is bioengineered." The USDA also may not fine manufacturers or

tested for GE material will be required to carry disclosure statements. Examples of products for which there is ambiguity because of low or zero protein content are indicated in figures 1 and 2 with "(?)".

retailers for non-compliance. States will be able to adopt the language of the federal disclosure requirement as part of their state laws. If they do so, will they choose to force recalls of improperly labeled products or levy fines as enforcement strategies?

Exemptions from verification or testing. Will products that do not use ingredients for which GE varieties exist have to undergo testing on the grounds that they might be contaminated with the residue of GE ingredients used elsewhere in a processing facility? If such products are exempt from testing, would the exemption apply only to single-ingredient foods, such as oatmeal or pears? Or would it apply to all processed foods that did not list among the ingredients species with GE varieties in use?

3.2. Verification of non-GE status and enforcement

Kuchler et al. (2017) discuss the drawbacks of third-party verification of label claims, and argue that government intervention in setting standards, verifying claims, and enforcing penalties can improve understandability, credibility, and truthfulness of label claims. The role of government in enforcing standards under the NBFDS is still to be determined. Will the federal government allow private, third-party certifiers to take primary responsibility for verifying that GE disclosure statements are not required? If so, will these third parties be accredited, and how will the accreditation process work? How will the USDA formally exempt foods that meet those standards and allow for the possibility of competition within the non-GE certification and labeling space?

Related to verification, the mechanism for enforcement of the NBFDS is yet to be determined, and many issues may arise as the USDA develops the regulations that are to be enforced. If products are found to have incorrect or missing labels or disclosure statements or QR

codes that link to broken or outdated websites, will the producers be obliged to withdraw those products from the market? Will the FDA have the authority to police QR codes and websites, and will it exert that authority? The legislation precludes the USDA from ordering recalls of improperly labeled foods. Will states be able to order recalls, or will the FDA? What will be the penalties for noncompliance? How will they be set and enforced, and by whom?

Will states have the authority to enforce the NBFDS? If so, and if some states do while others choose not to invest resources to investigate whether products have been properly labeled and to enforce the law, the effective result is that a patchwork of standards will emerge—albeit, a less pronounced patchwork than would have emerged absent PL 114-216—in which products marketed exclusively in regions without strong enforcement will be able to avoid the mandatory disclosure requirement.

The mechanism for enforcement of the NBFDS is yet to be determined, but the legislation (PL 114-216) prohibits USDA from recalling food on the basis of NBFDS violations. Proposition 37 would have explicitly authorized consumers to sue for violations of the labeling requirements, "without needing to demonstrate that any specific damage occurred as the result of the alleged violation." As discussed by Alston and Sumner (2012), this clause would have opened the door to a new cottage industry for lawyers suing manufacturers and marketers and settling out of court. Vermont Act 120, Vermont Consumer Protection Rule 121, and the state's consumer protection statute (9 V.S.A., Chapter 63, Sec. 2461) appear to permit similar activities, although the language is less explicit. If federal regulations permit consumers to sue for violations of the NBFDS, this could add tremendous costs for industry; in any event, state-level regulations mirroring the NBFDS are likely to emerge under which, as proposed for California

under Proposition 37 (like the existing Proposition 65), consumers could sue marketers even without alleging damages.

All of these unresolved issues raise serious questions about the enforcement of the NBFDS and, indeed, whether the law will effectively incentivize producers and marketers to comply. If federal regulators do not have any authority to enforce the law or cannot impose penalties for noncompliance, all pressure on manufacturers will come from state governments—that are now free to pass state-specific standards for mandatory GE labeling identical to the NBFDS—and possibly from private entities bringing complaints against manufacturers for non-compliance. In this scenario, the market effects could be similar to those anticipated under the regulatory patchwork that would have resulted without the new national law, albeit with harmonization of standards for GE labeling across states, and increased costs for federal bureaucracy.

3.3. Issues regarding understandability, credibility, and truthfulness

GE labels do not refer to the product itself, but rather to the production process by which the product is made. This is a credence attribute that cannot be verified by the consumer. Kuchler et al. (2017) suggest that, in order to be effective, labels related to credence attributes must be understandable, credible, and truthful. Credibility and truthfulness of positive mandatory disclosure statements are not likely to be issues of concern, chiefly because, in a context in which many (or most) consumers are unlikely to prefer to buy GE foods, marketers will have no incentive to falsely use "made with GE" claims in an effort to increase market share. However, the requirements laid out in the legislation do not ensure that the mandatory disclosure statements will be broadly understandable.

If it transpires that the dominant response by food manufacturers to the NBFDS is to add smartphone-readable codes to product labels, directing users to websites, the information status of consumers might not change materially. First, the legislation does not specify whether manufacturers and food marketers will be required to maintain an individual website for each product. Perhaps they will not, and most products will be labeled with a code directing users to a generic website stating, for instance: "This product may contain genetically engineered ingredients."[15] If, in an abundance of caution, all manufacturers were to apply the claim "may contain GE material" to all their products, the quality of information provided to consumers might actually be lower than in the absence of mandatory disclosure or state-mandated labels. Alternatively, if in practice the NBFDS does not allow manufacturers to direct consumers to generic websites or does not allow them to hedge their bets by issuing vague statements like "may contain" for all products, then who will enforce the NBFDS and ensure that claims are truthful? This relates to credibility, also. Will consumers realize that "may contain GE" is an empty albeit possibly negative statement?

The response of consumers to "may contain GE" labels and "Non-GMO Project Verified" labels or other labels such as "GMO Free" and "made using genetic engineering" is likely to be dependent on the details of the wording and other information provided and the shopping context, as evidenced by the results of an economic experiment by Liaukonyte et al. (2013). In particular, Liaukonyte et al. (2013) found that the average willingness-to-pay (WTP) premium for an unlabeled granola bar, relative to one with the label "contains genetically modified ingredients," was different from the average WTP premium for a granola bar labeled "free of

[15] "May contain" is a blanket statement that can be applied to any product, whether it contains GE material or not.

genetically modified ingredients," relative to an unlabeled granola bar. Liaukonyte et al. (2013) also found that providing additional information could mitigate consumers' aversion to GM ingredients. These findings suggest an important role for USDA to ensure that mandatory disclosure statements under the NBFDS do not needlessly frighten consumers. As the FDA has done for milk packaged with the claim "made from cows not treated with rBST," the USDA could recommend standard language indicating the scientific evidence on the safety of genetic engineering technology and products made using GE.[16] In addition, unlike a package label, a website has no corresponding space limitations. Hence, in conjunction with other information about the appropriate interpretation of the labels, the government could also provide language that would inform consumers about genetic engineering and the advantages of GE technology. This would improve the provision of information to consumers and limit confusion and misinformation resulting from mandatory disclosure statements.

4. The Likely Economic Consequences of PL 114–216

In this section we discuss the likely economic consequences of the new law, compared with other possible realities. The relevant comparisons are with both a hypothetical scenario of no mandatory labeling laws as well as with the alternative future regime that the new law pre-empted, which would have entailed a patchwork of potentially more onerous state regulations. We outline a range of consumer and producer responses, discuss how costs of the regulation could be determined, and compare the costs with both alternative realities.

[16] Even with such language included, milk processors and retailers have shied away from milk that does not include the label claim "made from cows not treated with rBST," so milk without that label is no longer widely available to consumers—a cautionary tale for those who think such labels are innocuous if accompanied by advice about the relevant scientific evidence (An and Butler, 2012).

As outlined in the preceding section, many of the details of the policy and government's role in enforcing that policy remain to be determined. At this point, therefore, attempting to quantify precisely industry and consumer responses to the NBFDS is a fruitless exercise involving many details that are known to be unknown, as well as potential unknown unknowns. We now outline a range of possible consumer and industry responses, summarized in Table 1, and identify our best guesses as to the most likely responses based on the available evidence.

[Table 1 about here]

4.1. Possible consumer demand responses

Consumers might respond in various, diverse ways to the implementation of the NBFDS disclosure standard. One possibility is indifference. Even consumers who are interested in avoiding GE foods may be indifferent to the introduction of new disclosure statements, especially if these statements are in the form of QR codes, because of the existence of voluntary non-GE claims.[17] If consumers react to the implementation of the NBFDS disclosure standard at all, a variety of different responses are possible. Will a group of consumers avoid all QR codes? Will a group of consumers gravitate toward food products that do not specify "contains GE" but remain ambivalent about all products that do not carry the NBFDS disclosure statement for whatever reason? Will a group become interested in the Non-GMO Project Verified label or other non-GE claims because the NBFDS disclosure statements have piqued their interests in

[17] In an online survey, McFadden and Lusk (forthcoming) found that participants stated they were willing to pay an average premium of $0.22 to $0.38 for a pound of apples accompanied with a QR code that linked to a website disclosing GE content, relative to a pound of apples with a text disclosure, "contains genetically engineered ingredients". They found similar results when asking survey participants about their willingness to pay for granola bars accompanied with QR codes and text disclosure statements.

non-GE foods? All of these responses are possible—or indeed, likely, for at least some groups of consumers—and all have different implications for marketers and manufacturers.

In the current regulatory environment, consumers who wish to avoid GE foods can obtain information about GE content of foods for which there is any ambiguity by searching for the Organic label, the Non-GMO Project label, or other non-GE label claims.[18] One subtle aspect of the NBFDS labeling requirement, and GE-related labeling generally, is that there is not a simple, black-and-white distinction between GE and non-GE foods. As discussed above, according to the NBFDS legislation, only certain categories of food are subject to the disclosure requirement; other categories are exempt. Thus, there will be some GE foods that will not carry any disclosure statements. Among the non-GE foods are many foods that could not possibly be GE because GE varieties of their ingredients do not exist; other non-GE foods include organic, foods privately certified as non-GE, and foods that do not contain GE material but carry no label to that effect.

Consumers may differ in their preferences among these different alternative products (i.e., GE labeled as such; conventional non-GE, with no label; conventional non-GE, labeled as such; and organic, labeled as such), and might even disagree about the ranking of them from their perspective as prospective buyers. While some might be willing to pay a premium for GE products with a smaller environmental footprint (in that GE products are typically grown with less use of toxic pesticides) or because, globally, they reduce world hunger and allow for the use

[18] At present, well-informed consumers can "unravel" information about GE content by noting whether food products have Non-GE or organic claims and whether they have ingredients that can be made using GE varieties. Consumers are heterogeneous in their ability to unravel and their knowledge about GE and their interpretation of ambiguous information about GE. Many consumers may assume that all food products are non-GE unless they are told otherwise. After the NBFDS is implemented, these consumers might begin categorizing many more food products as having some GE content.

of less land for agriculture, it seems likely that a majority of Americans would have a lower WTP for GE-labeled products than the others in the current context.[19]

4.2. Possible marketer demand responses

Marketers, including retailers, serve as an intermediary between consumers and food producers and determine what products are made available to consumers, as analyzed by Carter and Gruère (2003) and Saitone, Sexton, and Sumner (2015). Even when it is legal to produce and sell GE foods, with or without specific labels, the food manufacturing and retailing industry might be persuaded by the prospect of political action by anti-biotech activists that it will be against their interest to do so. Consequently, when retailers like Walmart and Safeway opt not to sell milk unless it is labeled as not having been produced from cows treated with rBST, we have no information about consumer preferences for rBST milk; likewise, when McCain and McDonald's opt not to produce consumer products using GE potatoes (Charles, 2015; McCain Foods, 2015). Repeated protests against Monsanto, and NGO campaigns promoting the misinformed view that genetic engineering poses risks, have likely dissuaded food manufacturers and retailers from expanding the production and sale of GE food products.

With this in mind, marketers may respond to consumers' demands (more precisely, marketers' perceptions of or expectations about consumers' demands) in a number of different ways. If consumers are indifferent about NBFDS disclosure statements, marketers may not demand any change in product specifications. If, on the other hand, the NBFDS increases

[19] The newest generation of GE crops promise differences in terms of finished products with regard to diminished browning and carcinogen content, and future GE crops may have improved nutritional benefits. However, we suspect that few consumers are willing to pay more for the vast majority of GE products available today. In their economic experiments in several grocery stores, James et al. (2005) found that labeling sweet corn as biotech versus conventional had little effect (in either direction) on consumers' purchasing decisions or willingness to pay for it.

consumer awareness of GE and consequently changes the share of consumers who prefer non-GE food, or changes the way consumers judge whether foods are GE-free, then manufacturers and retailers may have some incentive to change the formulation of products and substitute away from GE ingredients, or to undertake segregation and verification or auditing to ensure that their products do not have to carry the NBFDS disclosure. Marketers may demand that their suppliers avoid disclosure statements or avoid QR codes more generally; they may begin PR campaigns around their avoidance of NBFDS disclosure statements or GE foods (more generally); or they may shift more broadly to carrying a wider variety of organic or Non-GMO Project Verified products. Passuello and Boccaletti (2016) describe conversations with European retail managers who stated that their response to more restrictive GE labeling requirements (e.g., more stringent thresholds) would depend on whether consumers had a high WTP for non-GE-labeled foods. Passuello and Boccaletti (2016) anticipate growth in the market for GE crops with enhanced attributes such as nutrition if consumers are relatively indifferent about non-GE-labeled foods. If, however, consumers have a high WTP for non-GE labels, a de facto ban on GE products, particularly imports and meat raised with GE feed, would be more likely.

Some retailers, including Whole Foods Market, are already making a push toward disclosure of GE content.[20] We expect that a federal standard would push more retailers toward avoiding products that carry a GE disclosure statement. Some large retailers will be quick to move in this direction and even proclaim it to achieve some marketing advantages, if prior experience is any guide; other retailers may eventually be driven to follow these leaders either by competition in the market or by the consequences of political activists. Such an outcome would

[20] See http://www.wholefoodsmarket.com/our-commitment-gmo-transparency.

mirror the experience in the European Union following the introduction of mandatory GE labels there, and could occur even if consumers do not demand non-GE food or if all consumers who demand non-GE food already are able to meet their demands by using existing voluntary non-GE labels and knowing which foods do not have GE varieties in commercial production.

4.3. Industry response to consumer and marketer demands

The responses of firms to the NBFDS are likely to depend on their costs, consumers' and marketers' demands for information about GE content, whether the mandatory disclosure statements draw consumers toward non-GE products, and the anticipated response of competitors to the NBFDS and any induced changes in consumer demand. If consumers and marketers are indifferent toward information about GE content or the disclosure statements (there is a subtle distinction here), then firms may find that the best strategic response to the NBFDS will be to disclose GE content, according to the legal requirement, but not to change anything else about operations or marketing. A range of other responses by firms is possible, including reformulation of products to avoid having to label them as containing GE ingredients, by replacing those ingredients with non-GE ingredients produced using conventional technology or with organic ingredients—noting that to be eligible to be labeled as organic, and thus exempt, all the ingredients would have to be organic not just those that would have been GE. (Note that manufacturers are likely to need to incur costs to have their products verified as non-GE, even if reformulation is not necessary.)

The response of food manufacturers to the NBFDS will depend in part on whether consumers respond to the law by avoiding foods produced using GE ingredients, but ultimately it will depend on whether retailers and other intermediaries begin to demand food not carrying the disclosure statements, as discussed by Gruère, Carter, and Farzin (2008). It is easy to imagine

that some retailers would want to avoid carrying products labeled with the federal disclosure statements or QR codes, even if these statements are vague or placed in an abundance of precaution on products that have little chance of containing any GE material. If this were the case, any manufacturers intending to make sales to such retailers would have to replace all GE ingredients with non-GE ingredients; and, in addition to paying a premium for non-GE inputs, they would have to incur segregation costs and, if required under the final NBFDS regulation, further costs to have the segregation verified by Non-GMO Project or a similar accreditation body. It is of special importance to note that if manufacturers incur significant costs to reformulate products or have their processes verified, and consumers are not willing to pay for those changes, significant welfare losses will result (see Saitone, Sexton, and Sumner, 2015 for a discussion of this phenomenon in a different context).

Claims that food is "Non-GMO" or "Not made with genetic engineering" are not currently regulated by the federal government or any state government, so manufacturers may make these claims without being held accountable if the claims are incorrect. Organic food must be made without the use of genetic engineering, so consumers interested in avoiding GE already had the option of purchasing organic products to that end. However, there was evidently a market opportunity for a third-party certification agency, the Non-GMO Project, to set standards for the use of its label (Non-GMO Project Verified) and charge firms for the right to use that label, subject to meeting the technical requirements of limited GE content, without having to meet the more stringent additional requirements to be labeled "Organic." Under the NBFDS, manufacturers may make claims such as "non-GMO" for foods certified as organic through the National Organic Program; however, food may not be labeled as "non-GMO" merely because it is not required to carry a disclosure statement.

It is of interest to consider the role of the Non-GMO Project and whether it will continue to operate—and whether the label will continue to grow—in the context of a mandatory GE standard. We suggest that, because many producers are likely to respond to the disclosure requirement by placing QR codes on product labels, there will continue to be some demand for Non-GMO Project Verified items, at least among retailers.[21] If consumers demand information about GE content, the various categories of exemptions from the disclosure requirement could necessitate the continued use of non-GE label claims. Punt, Venus, and Wesseler (2016) report that at least 37 percent of German dairy companies produced at least some organic or otherwise 'GM-free'-labeled milk in 2014, and describe the results of a survey of producers, who adopted 'GM-free' labels to improve their public image and reduce the threat of direct attacks from anti-GMO activists and as a product-differentiation strategy.

If, in the absence of PL 114-216, a patchwork of state regulations were to have emerged, a failure of coordination among covered products and even among states' definitions of genetic engineering would likely have meant that ever-more products needed to carry labels as additional states developed their own labeling requirements. Hence, the NBFDS may dampen the responses of both consumers and manufacturers, compared with a patchwork. This dampening compared with a patchwork may be reinforced because PL 114-216 allows the use of QR codes instead of explicit on-package statements. For these reasons, the NBFDS is likely to be less costly to both consumers and industry than a patchwork of standards would have been; all costs discussed

[21] In an unpublished paper, Adalja (2016) reports results suggesting that consumers are not paying a premium for the Non-GMO Project Verified label. Nevertheless, as Adalja documents, that segment of the market continues to grow indicating that sellers see some advantage in the label even if consumers apparently do not!

below are relative to a baseline in which no state is enforcing mandatory GE disclosure or labeling regulations.

4.4. Benefits from a National Bioengineered Food Disclosure Standard

Insofar as mandatory disclosure of GE content provides zero (or negative) benefits because it does not provide useful information (or misleads consumers and perpetuates a false perception that GE food is something to be avoided—see Sunstein, 2017), the primary benefit of the NBFDS is that it preempts the patchwork of state-level mandatory labels that was inevitably going to emerge. Although the NBFDS does not eliminate all possible sources of confusion surrounding non-GE label claims, it at least ensures consistency in the use of GE disclosure statements.

5. Anticipating costs of compliance and costs to consumers and taxpayers

Alston and Sumner (2012) and Lesser (2014) outlined the nature of costs that may be incurred by farmers, food manufacturers and processors, and other participants in the food supply chain upon the implementation of mandatory GE labeling laws. In this section, we draw upon these studies and others to describe the likely costs of compliance with the NBFDS, borne initially by producers, and the likely ultimate costs to consumers and taxpayers. The basic categories of costs can be described as follows: labeling foods with disclosure statements or barcodes that allow consumers to access websites that provide disclosure statements; switching some production from GE to non-GE, including organic; segregating GE seeds and ingredients from non-GE seeds and ingredients and documenting this segregation through third-party verification and recordkeeping; storing, shipping, and marketing parallel GE and non-GE product lines; enforcement and litigation; and other long-run costs.

5.1. Estimates from the literature

As a baseline, all food producers will incur some costs to learn about the regulatory status of the products they produce and all the requirements with which they may have to comply. In addition, at a minimum, the producers of products for which labels are required will incur costs to develop the new packages or labels that comply with the NBFDS and (optionally) to maintain websites with disclosure information—even in the case of consumer and marketer indifference toward GE food disclosure information, as described above.

Estimates of the costs of creating and printing new labels—expressed in terms of consumer price increases—have ranged from $1,104 per product in California (Shepherd-Bailey, 2012)[22] to a one-time cost of $2.3 billion (Dunham, 2016)—an annualized cost of $230 million per year using the standard 10-year horizon for government cost-benefit analyses. Although the requirements for labeling under the NBFDS vary slightly from the requirements of the proposed state laws in California and Vermont, the costs of disclosure are likely to be a relatively trivial component of the overall costs of the NBFDS, although there is some possibility that the other costs discussed below will not be incurred by the majority of producers. For some firms, the costs of developing and maintaining a website with disclosure information may be significant relative to the size of their business.

If producers undertake any actions besides developing new labels in response to new consumer or marketer demands that result from the NBFDS, these actions are likely to involve segregation of non-GE inputs from GE inputs, certification or verification of non-GE status, and

[22] Although Shepherd-Bailey (2012) scales this to $0.67 per household, implying about $8.5 million in total costs for California, this in turn implies that fewer than 8,000 packaged products in California would require disclosure. We find this estimate implausibly low, given that there are approximately one million food products offered for sale in the United States (see, e.g., Kuchler et al., 2017).

keeping records about these aspects of the production process. Although Organic certification automatically qualifies products to be sold without the NBFDS disclosure statement, it also requires that the substantial majority of inputs are organic; hence, adjusting a product's formulation so that it can attain the Organic certification would require that the producer incur additional costs for all ingredients.[23] Nevertheless, manufacturers may find that purchasing organic ingredients to replace GE ingredients is the most cost-effective way of ensuring that the end products are not required to carry NBFDS disclosure statements.[24]

Lesser (2014) cited various analyses that used data for 2008–13 to show that the farm price differential between GE and non-GE, non-organic corn and soybeans ranged from 7 to 24 percent. Using these farm price increases as the basis for calculating increases in food prices, Lesser (2014) suggests that the cost of replacing all GE production with non-GE production to serve the New York market would be $11 to $103 per capita, or $3.6 to $33 billion per year for the United States as a whole, based on the farmgate price differentials of 7 to 24 percent; similarly, he suggests that replacing all GE production with organic would increase costs by the equivalent of $29 to $125 billion for the United States. As noted by Alston and Sumner (2012), the price differential between GE and non-GE inputs may rise as demand for non-GE inputs increases, so the scaled estimates we report here may understate true costs. The assumption of Lesser (2014) that retail markup is a constant value—i.e., that a $0.01 increase in farmgate price leads to a $0.01 increase in retail price—also suggests that the scaled estimates presented above may be understated. Under the NBFDS, manufacturers may also elect, as an alternative to

[23] The 100% Organic label, of course, requires that all ingredients are organic; the Organic label allows up to 5% of ingredients to be non-organic, excluding salt and water (see https://www.ams.usda.gov/sites/default/files/media/Labeling%20Organic%20Products.pdf).

[24] Note that the limited availability of organic farm products and land for organic agriculture would make an immediate and complete shift from GE to organic production impossible.

producing the same products with non-GE versions of the same ingredients, to reformulate products so that they use, for example, butter (which is exempt from scrutiny under the NBDFS) instead of GE soybean oil.

Having switched from GE to non-GE inputs for at least part of their line of production, farmers, processors, and manufacturers will incur costs to certify that they have done so and keep records of all segregation activities, if they intend to market the product as non-GE, or, if they are final processors, to avoid using the NBFDS disclosure statement. As noted by Kuchler et al. (2017), as of November 14, 2016, the standard annual fees paid to a third party licensed to verify products for the Non-GMO Project ranged from $650 to $3,490 for a single high-risk product or ingredient—i.e., a product or ingredient for which GE varieties are available. To verify ten high-risk products and ingredients, the standard fees ranged from $2,000 to $3,490. These costs are merely the fees paid to third parties for verification and do not include the (potentially much higher) costs of physically segregating products.

Alston and Sumner (2012) estimated the costs for segregation, certification, and monitoring or recordkeeping under California's proposed Proposition 37, for producers serving the California market. They suggested that these costs could amount to 3 percent of the value of output for the affected industries, somewhat lower than earlier estimates of comparable costs for the purpose of country-of-origin labeling.[25] If applied to the food manufacturing industries

[25] Alston and Sumner (2012) used as the value of output for affected industries in California $40 billion, which they calculated as follows. The total value of agricultural processing output was $98 billion. This $98 billion included several industries that would not have been covered by Proposition 37: livestock feed and pet foods, seafood processing, and animal slaughter. After eliminating these industries from the total and also eliminating one-half of dairy processing and one-half of beverage processing to reflect partial coverage for these industries, the estimated total value of agricultural processing covered by Proposition 37 in California was $60 billion. Finally, Alston and Sumner (2012) applied the 3 percent cost of segregation, certification, and monitoring to only two-thirds of $60

covered by the NBFDS across the United States, a 3 percent cost of compliance would amount to perhaps $11.6 billion annually.[26]

Lesser (2014) estimated that costs of identity preservation for non-GE ingredients—the same, in essence, as segregation and certification—were about 10 percent of the farm-gate price of corn and soybeans, an intermediate value in a range of estimates from the literature. This translates to up to $9 per capita in New York, or about $2.9 billion annually for the United States, and would be higher if the marginal cost of segregation and certification rises with volume. The costs under the NFBDS could be considerably lower, however, because manufacturers can segregate some products that will be sold at grocery stores and regulated by the NBFDS from those to be used in downstream manufacturing or foodservice.

Although it is by no means a legislative or regulatory requirement, the NBFDS may induce retailers to stock both non-GE and GE varieties of similar or even nearly identical products, much as they have done with organic and non-organic, and with low-fat or low sodium product varieties.[27] If retailers pursue such a marketing strategy, this will introduce additional costs in the form of warehousing space and retailer storage and shelf space, as well as adding

billion, to reflect the likely share of California food processing output dedicated to markets outside California or to food-service, neither of which would have required labeling under Proposition 37.

[26] Based on the U.S. Census 2015 Annual Survey of Manufactures, the value of products shipped by food and beverage industries not including pet and animal food, meat, poultry, and seafood, and alcohol—i.e., a rough approximation of the product categories that would be subject to mandatory disclosure under the NBFDS—was $515 billion in 2015. We take this number to be equivalent to the $60 billion value of covered agricultural processing referenced by Alston and Sumner (2012) for California. If we assume roughly that three-quarters of U.S. agricultural processing is not dedicated to export markets or to food-service, then the cost of segregation, certification, and monitoring under the NBFDS may be approximately 3 percent of 75 percent of $515 billion, or $11.6 billion.

[27] General Mills currently markets non-GE Original Cheerios in the United States and markets all Cheerios as non-GE in Europe, but other flavors of Cheerios currently marketed in the United States use GE ingredients. See http://www.cheerios.com/en/Articles/cheerios-and-gmos (accessed March 29, 2017).

complexities in supply-chain management. Lesser (2014) suggests the additional costs of warehousing in New York alone may be $39 to $45 million per year, based on a doubling of warehouse costs for 21,000 to 25,000 products to serve New York;[28] scaled to the nation using the population of New York relative to the nation, this would be $640 to $740 million per year, substantially smaller than the other categories of compliance cost. Again, the rising marginal cost of warehouse space could suggest that our scaling represents an underestimate.

Regardless of the exact cost incurred by farmers, processors, and manufacturers to document segregation of non-GE inputs from GE inputs and to label GE products as such, these costs will be passed through to consumers. The nature of assumptions about marketing margins greatly affects estimates of the effects of mandatory GE labeling laws on consumers. For example, under the assumption of proportional marketing margins, a 10 percent cost increase for manufacturers would lead to a 10 percent increase in prices facing consumers. Alternative assumptions might suggest that a 10 percent increase in the farm costs of breakfast cereal result in an 0.4 percent increase in the retail price of breakfast cereal.[29]

Finally, costs of enforcing the NBFDS should also be considered. The more action government undertakes to enforce the NBFDS, the greater will be the public costs of enforcement. What actions or effort are justified to enforce a law that brings no public benefit? Perhaps the USDA and the FDA will see the NBFDS simply as a tool for preventing the development of a patchwork of state-level regulations, and will not devote any resources to

[28] We expect that more than 25,000 products in New York, and certainly in the national market, will require labels, but we are skeptical that manufacturers and retailers would need to double warehouse space to accommodate duplicative product lines.

[29] The USDA-ERS Food Dollar data series indicates that 4% of the retail price of breakfast cereal accrued to farm production in 2007 (https://data.ers.usda.gov/reports.aspx?ID=17885).

enforcing the law. To audit food products for compliance with the NBFDS could be extraordinarily costly for taxpayers unless the federal government would be willing and able to levy fines for noncompliance that exceed the cost of enforcement. Depending on the enforcement mechanism and whether private citizens will be able to initiate complaints, litigation over violations of the NBFDS could also be costly; as discussed by Alston and Sumner (2012), the industry that has formed around lawsuits over California's Proposition 65 (which relates to disclosure about chemicals) illustrates an outcome that regulators should strive to avoid.

In summary, the costs to producers and food sellers of compliance with the NBFDS can be organized into several categories, as seen in Table 2. The cost of disclosing that foods are (or may be) made using genetic engineering—which is estimated to cost around $200 million per year in various analyses—is likely to be a tiny fraction of the cost to manufacturers and consumers of adjusting product formulations so that the disclosure statements do not have to be made. If GE inputs were avoided entirely, the total of the price premium paid to farmers for non-GE or organic inputs and the cost of documenting segregation or identity preservation could together be at least $7 billion and possibly over $100 billion. This range of estimates is too wide to be very useful, but highlights the high degree of uncertainty about the costs of the NBFDS, which contrasts with our considerable confidence that the law will not bring benefits to justify the costs. Other categories of costs to producers, consumers, and taxpayers include the requirements for additional warehouse space, and the costs of enforcement, including, possibly lawsuits over noncompliance. The existing studies in the literature, from which we derive the range of cost estimates reported in Table 2, have flaws, shortcomings, and oversights, but we have no reason to believe they consistently represent overestimates of the various categories of

costs. These studies suggest that producers will potentially face tremendous burdens under NBFDS, which will be passed through to consumers in the form of increased prices.

[Table 2 about here]

5.2. Long-term cost considerations

In addition to the costs incurred immediately by producers, consumers, and government, if the NBFDS results in a shift away from the use of GE technology, this will mean a shift in derived demand for other agricultural inputs. Because non-GE production requires more land than production using many types of GE traits, a shift away from GE production will increase the demand for land for agriculture. That shift would also change demand for chemicals—less for Roundup in particular and more for other chemicals (which typically present greater risk than Roundup based on both acute and chronic toxicity; see Kniss, 2017). Changes in demand for both land and chemicals have difficult-to-quantify environmental implications, and the use of chemicals has implications for the health of farm workers and local residents.

In the long run, the NBFDS may also result in changes to the way seed companies create profits and may reduce the returns to agricultural R&D. These pressures could ultimately reduce the incentives for technology firms to invest in a host of innovative genetic technologies, including drought-, insect-, and disease-resistant varieties that promise to contribute to reducing world hunger, especially if consumers and governments in the developing world continue to view the attitudes of developed-country consumers toward GE foods as an example to emulate.

Many aspects of these questions are quite uncertain given the recent development of gene-editing tools such as CRISPR and TALEN, which might offer many of the same

technological opportunities without having to face the burdens associated with the GE rubric and its baggage. In particular it is uncertain whether the opponents of GE food will be successful in their current efforts to characterize these new technologies as a subclass of the GE technology covered by existing discriminatory technology regulatory policies, including the NBDFS.

6. Conclusion

This paper reviews the economic history of the political and policy processes that gave rise to the 2016 passage of PL 114-216, the National Bioengineered Food Disclosure Standard. We discuss the rhetoric of various participants in the debate over GE technology and mandatory labeling of GE foods, and give an overview of the requirements of the NBFDS legislation and the elements of the standard that remain to be determined by federal regulators. Among the most important of these outstanding issues is whether federal agencies will have the power to enforce the NBFDS, and what penalties will be levied for violations. We highlight some problematic features of the legislation, discuss some potentially problematic features of the NBFDS regulations, and suggest options for regulators to consider as they develop the regulations. We then contemplate how consumers, food marketers, and producers may respond to the NBFDS requirements. Finally, we review various estimates of the cost of implementing state-level GE labeling regulations and discuss the implications of those estimates for nationwide implementation of GE labeling requirements.

We conclude that PL 114-216 is a clumsy and incoherent piece of legislation that will be burdensome initially to producers and ultimately to consumers—potentially, to the tune of billions of dollars in annual expenses, if the competitive response of marketers to the law is a substantial increase in demand for non-GE inputs and products, an outcome that may result even

if (most) consumers express indifference toward the disclosure statements. Regardless of one's views on GE technology, the NBFDS will be limited in effectiveness and potential benefits, primarily because the option to disclose information on GE content through a barcode linking consumers to a website does not seem to be a promising method of disclosing information to consumers. However, it is much better than the likely scenario, which PL 114-216 preempted, of a patchwork of state-level policies that differed in key details from one another; and it could be reasonably inexpensive, depending on the details of the NBFDS yet to be developed and how consumers and producers choose to respond to it.

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Table 1: Possible Consumer, Marketer, and Producer Responses to the National Bioengineered Food Disclosure Standard

Possible consumer responses	Possible marketer responses	Possible producer responses
1. Indifference toward buying foods with or without GE disclosure label	1. Indifference toward marketing foods with or without GE disclosure label	1. Add GE disclosure label to existing products
2. Avoiding foods with text disclosure statements	2. Opting not to market foods with text disclosure statements	2. Opting not to produce foods with text disclosure statements
3. Avoiding foods with QR codes	3. Opting not to market foods with QR codes	3. Opting not to produce foods with QR codes
4. Avoiding foods with GE disclosure labels	4a. Opting not to market foods with GE disclosure labels	4a. Increased production of foods that do not require GE disclosure labels; reduced production of foods that require labels
	4b. Advertising and PR campaigns about marketing foods that do not require GE disclosure labels	4b. Increased production of foods that do not require GE disclosure labels; reduced production of foods that require labels
5. Increased demand for foods with non-GE or organic labels	5. Increased shelf space for foods with non-GE or organic labels	5. Increased production of foods with non-GE or organic labels

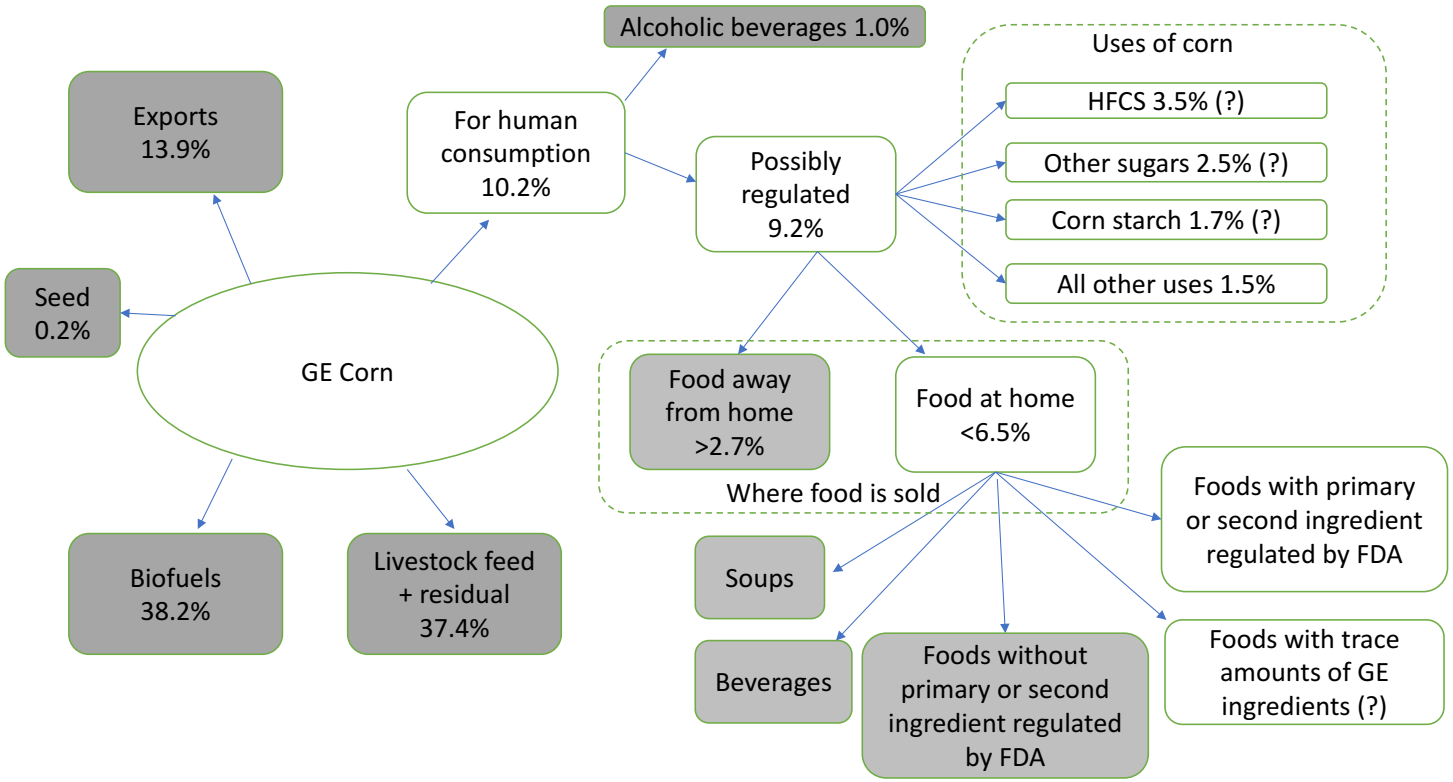
Notes: This table represents a consumer-driven structure in which the (perceived or anticipated) responses of consumers and marketers to the NBFDS drive responses of marketers and producers, respectively. Each horizontal or numbered response in the table reflects one possible response of consumers or a subset of consumers, and the corresponding response of marketers and producers. If producers respond to NBFDS with a label only (items 1–3), costs will be substantially lower than if they respond by replacing GE ingredients with non-GE ingredients and undertaking segregation, certification, and monitoring activities (items 4–5). See section 5 and Table 2 for additional discussion of costs.

Table 2: Some Estimates of the Cost of Compliance with the National Bioengineered Food Disclosure Standard

Type of cost	Estimated annual cost	Source	Context of estimate	Scaled to nation, under NBFDS
Labeling	$1,104 per product (one-time cost)	Shepherd-Bailey (2012)	California Prop. 37	N/A
Labeling	$2.3b (one-time cost)	Dunham (2016)	Nationwide producer response to Act 120	$2.3b (one time); $230m/year over 10 years
Complete replacement of GE with non-GE ingredients	$11–103/capita	Lesser (2014)	New York's proposed labeling law	$3.6b–33b/year
Complete replacement of GE with organic ingredients	$90–$388/capita	Lesser (2014)	New York's proposed labeling law	$29b–125b/year
Segregation, certification, and monitoring	$1.2b	Alston & Sumner (2012)	California Prop. 37	$11.6b/year
Segregation, certification, and monitoring	$9/capita	Lesser (2014)	New York's proposed labeling law	$2.9b/year
Warehousing and retail space	$39m–$45m	Lesser (2014)	New York's proposed labeling law	$640–740m/year
Total minimum cost of labeling alone				Up to $230m per year
Total for all other cost categories listed above				$7.1b to $137b per year

Notes: Scaled estimates based U.S. Census Bureau 2016 estimates of population of United States and New York State (https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2016_PEPANNRES&prodType=table); and as described in footnote 26.

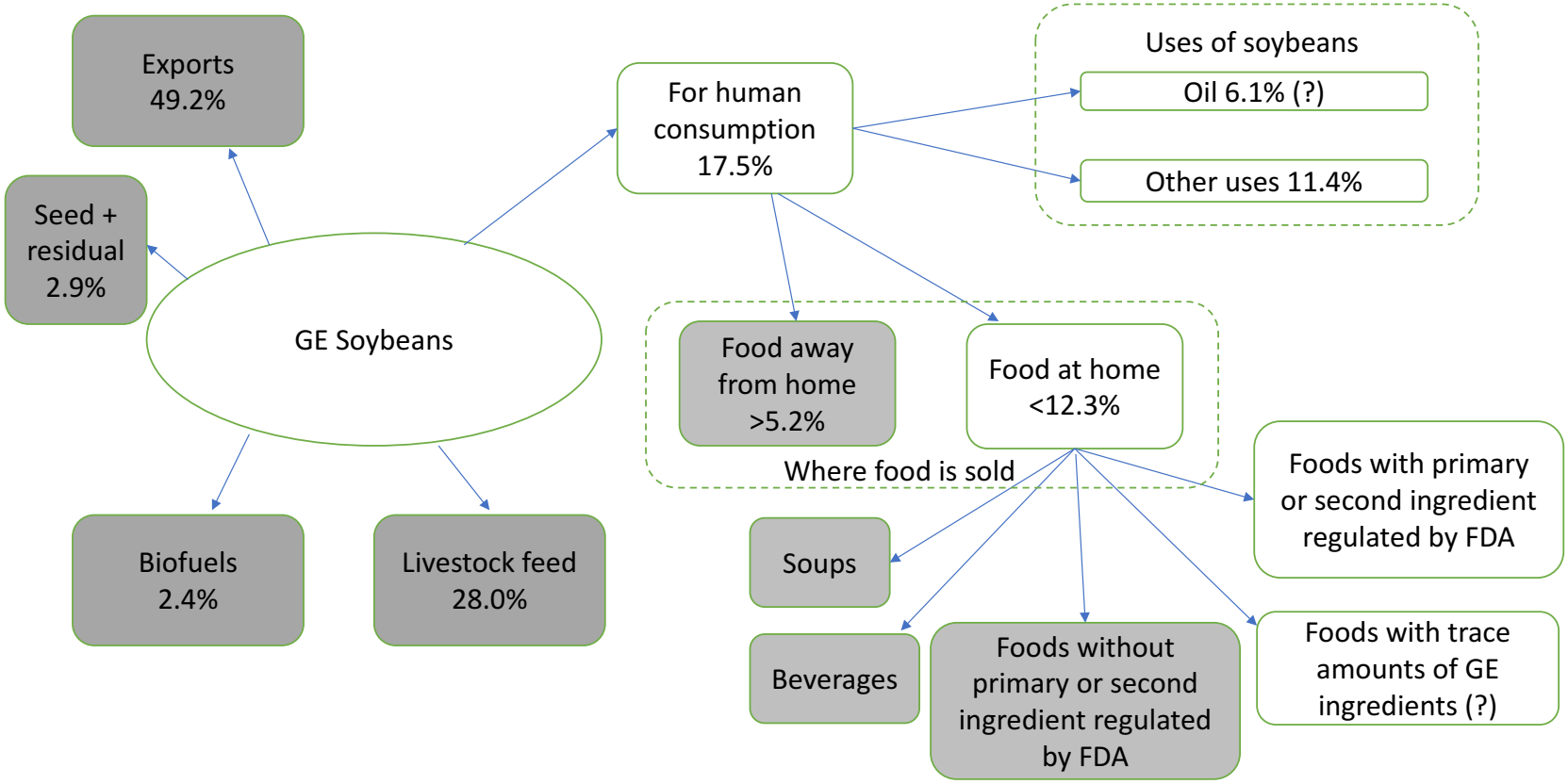
Figure 1: U.S. GE corn that could be used in food products sold without GE labels or other disclosure statements



Notes: Products, venues, and uses indicated with gray boxes will not require disclosure statements for GE content. Depending on the details of the final regulation, products and uses indicated with (?) may not require disclosure statements. The food-at-home (<70%) and food-away from home (>30%) shares are based on the shares of total calories consumed at home and away from home. Lin (2014) found that, over 2007–2010, 29.6% of calories were consumed away from home; Elitzak and Okrent (2016) found that the away-from-home share of total food expenditures climbed from 47.4% to 49.0% over 2010 to 2014; we conclude that at least 30% of calories are now consumed away from home. HFCS = high-fructose corn syrup.

Sources: Lin (2014); Elitzak and Okrent (2016); Capehart and Liefert (2017), Tables 1 and 5, 2015/16 crop year.

Figure 2: U.S. GE soybeans that could be used in food products sold without GE labels or other disclosure statements



Notes: See notes to Figure 1.

Sources: Lin (2014); Elitzak and Okrent (2016); Ash and Matias (2017), Tables 1 and 3, 2015/16 crop year; USDA–Economic Research Service (2017), data for soybean meal, quantities fed, 2016.