Barriers to Anti-GMO Legislation in the United States

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Abstract

Increasingly, social movements gain attention and support at the global level. Movements such as Occupy, Arab Spring, and the anti-Genetically Modified Organisms/ Labeling initiatives have grown from locally based efforts into internationally established uprisings. While these movements have established strong global momentum, the anti-GMO/labeling movement appears to face stronger resistance from policy makers in the United States. Globally, some 90 countries have implemented anti-GMO legislation. In the U.S, only a few states have passed labeling legislation, most of which only go into effect if more states follow suit. No legislation has gained traction at the national level. Further complicating this issue, polls indicate that an overwhelming majority of Americans support GMO labeling. Why then has this issue stalled when it comes to policy in the U.S.? In this paper, we question why the United States is an outlier when it comes to passing legislation pertaining to GMOs. Furthermore, we seek to determine what variables contribute to whether a country has GMO legislation or not. We hypothesize that the extent to which a country's citizens are able to participate in government selection and the levels of freedom of expression, freedom of association, and a free media, the extent to which a country is democratic, its education levels, quality of life, and the amount of US Aid a country receives for agriculture are likely to contribute to whether a country has GMO legislation or not. Using a 2-tiered correlation test of the variables, we found positive correlations between GMO Legislation and “voice and accountability”, education levels, Human Development Index, and democracy rankings. We found no significant correlation between USAID and GMO Legislation.

Barriers to Anti-GMO Legislation in the United States

Social movements have long been a part of the historical development of civil society in the United States and other parts of the world. Historically, successful movements have instigated change in the course of state action and have altered the status quo. Increasingly, social movements gain attention and support at the global level. Movements such as Occupy, Arab Spring, and the anti-Genetically Modified Organisms/Labeling initiative have grown from locally based efforts into internationally established uprisings. While these movements have established strong global momentum, the anti-GMO/labeling movement, appears to face stronger resistance from policy makers in the United States. Globally, some 90 countries have implemented anti-GMO legislation. According to the organization Just Label It, over 64 countries world-wide have implemented legislation that requires labels on foods containing GM ingredients (Just Label It, 2015). Additionally, as of 2011, 26 countries have established bans against the human consumption of GMOs (Bayer, 2011). While many countries have legislation regulating GMOs, in the U.S. only a few states have passed labeling legislation, and most of the laws passed only go into effect if more states follow suit. No legislation has gained traction at the national level. Further complicating this issue, polls indicate that a majority of Americans support GMO labeling. Why then has this issue stalled when it comes to policy in the U.S.? In this paper, we question whether the United States is indeed an outlier when it comes to passing legislation pertaining to GMO regulations and why. Furthermore, we seek to determine what variables contribute to whether a country has GMO legislation or not. We hypothesize that the extent to which a country's citizens are able to participate in government selection and the levels of freedom of expression, freedom of association, and a free media, the extent to which a country is democratic, its education levels, quality of life, and the amount of USAID a country receives for agriculture are likely to contribute to whether a country has GMO legislation.

**Genetically Modified Organisms**

Prior to discussing our findings, we believe that it is important to understand the debate surrounding GMO legislation, particularly within the United States. What follows is an overview of genetically modified organisms and a brief history of the debate in the U.S.

**What are GMOs?**

As the name suggests, a genetically modified organism (GMO) is any organic material that has had its DNA modified through biotechnology for one reason or another.[[1]](#footnote-1) Generally this is done through crossing a plant’s genes with genes from a virus or bacteria in order to make the plant resistant to pesticides or herbicides (like Round-Up), to add nutrients to the plant, or to make the plant more resistant to drought or flood. Many agricultural products have been modified in order to resist natural dangers that have historically killed entire crops, such as pests, disease, and extreme climate changes. The first GMO approved for human consumption was Monsanto’s Round-Up Ready corn, which went on the market in 1996. This type of corn is not only resistant to the herbicide glyphosate (aka Round-Up), which is also produced by Monsanto, but it also produces its own insecticide, called Bt Toxin (Non-GMO Project, 2015a). Other modifications are intended to simply grow bigger, more flavorful, and more visually appealing plants.

Since the mid-1900s, GMOs have been utilized in a number of ways to strengthen the agricultural industry and increase the ability of agricultural companies to farm large quantities of crops with minimal loss. Furthermore, “in July 2008, against the backdrop of the current world food crisis, several agribusiness corporations [formed] an ‘Alliance for Abundant Food and Energy’ which makes claims that it will meet the global demand for food and energy through the use of new technologies (biotechnology, genetic engineering) and agrofuel production” (Pojda, 2010, p. 285). According to corporate entities, GMOs could solve the world hunger crisis, which is the primary argument that has historically enabled GMO research to continue unabated. However, the greatest gains in corn production occurred well before the introduction of bioengineered corn, so arguments that GMOs are the means through which to feed the world are widely exaggerated (Plumer, 2012). Ultimately, GMOs have proven more harmful in many instances than helpful.

**Brief History of Regulations in the U.S.**

In the United States, the production of GMOs has been relatively un-regulated for a number of reasons. Scientists were initially uncertain about the impact of GMOs on the health of humans and the environment and called for strict regulations while tests were conducted, “initial support of the scientific community for strict regulatory controls was undermined by growing awareness of biotechnology’s commercial potential” (Lynch & Vogel, 2001, p. 5). Corporate entities realized that they could potentially make large profits off genetically modified foods because they could be modified (as previously discussed) to resist destruction. Crop yields could be improved because fewer of the plants would die from external factors. Funding through the National Institute of Health (NIH), a U.S. governmental organization that had been instrumental in driving this research goal forward, was slowly replaced by private and corporate funding. “The growth of privately-funded experiments made the NIH regulations, which governed only government-funded work, increasingly irrelevant” (Lynch & Vogel, 2001, p. 5). Private industries funded their own research to produce GMOs that would fit the needs of the agricultural company to turn the most profit. “To date, the biotechnology industry has conducted its research primarily in commodities such as soybeans, corn, canola, and cotton to improve yields and insect resistance” (Pojda, 2010, p. 285). These items are widely used in numerous products marketed both nationally and globally, bringing the agricultural industry huge profits.

Prior to the 1980s, many of the government’s regulations developed to ease public concern about particular issues. Up until the issue of GMOs, the United States was relatively strict in terms of its regulations to protect public health (Lynch & Vogel, 2001). However, the tide turned when GMOs were introduced, and these cautious regulations were never established for GMOs.[[2]](#footnote-2) In 1984, the White House gave the Cabinet Council on Economic Affairs full responsibility for regulating biotechnology, which allowed the White House “to avoid public oversight since the groups’ meetings were not open to public scrutiny” (Lynch & Vogel, 2001, p. 6). Essentially, the public had little say over how regulations were established and implemented, and the public was kept mostly in the dark about the science behind the development of genetically modified foods. Little research was conducted to determine whether there were negative impacts of GMOs on human health, and in 1994, the FDA “determined that Calgene, Inc.’s FLAVR SAVRTM tomato was ‘as safe as tomatoes bred by conventional means’” (Lynch & Vogel, 2001, p. 7). Because of this determination, other genetically modified foods were no longer subjected to scientific reviews because it was assumed that if the process of genetic modification could produce a safe tomato, then the process was safe for other products as well. “This decision also affected food labeling requirements: the FDA determined that labeling was not required on the basis of the method of food production (i.e. genetic engineering), but only if the new food itself posed safety problems for consumers” (Lynch & Vogel, 2001, p. 7). This determination remains in place to this day and has made it difficult for concerned consumers to influence policy that would require GMO labeling in the U.S. In addition, the protests of farmers and the agricultural industry have been influential in keeping other agencies, like the EPA, from imposing their own labeling regulations (Lynch & Vogel, 2001). Hence, agencies that attempt to prioritize public health are restricted from action by the corporations who profit from GMO production and distribution. Furthermore, in 2000 the National Academy of Sciences endorsed the safety of biotech foods, essentially validating the idea that regulations are not necessary (Lynch & Vogel, 2001). The report did, however, argue that long-term studies needed to be conducted because the increasing use of GMOs could lead to the creation of more dangerous substances than those which were initially developed (Lynch & Vogel, 2001). To the dismay of anti-GMO and GMO-labeling groups, industry, and essentially the government, overlooked this aspect of the report. Support from the scientific community has provided a strong foundation for governmental agencies to support limited oversight and regulation, including no labeling requirements, of genetically engineered foods. In fact, “the FDA and USDA [both government agencies] actively worked to promote the introduction of GMOs” (Lynch & Vogel, 2001, p. 7).

**GMOs Today**

Genetically modified organisms (GMOs) make up a large portion of the food consumers eat today: “By late 1999, it is estimated that approximately 60 percent of grocery-store food in the United States was grown from genetically modified seeds” (Lynch & Vogel, 2001, p. 9). There are currently eight genetically modified plants that are widely commercially grown in the United States. The “big four” are: corn, soybeans, canola and cotton (Non-GMO Project, 2015b). Sugar beets, papaya, alfalfa, and zucchini/yellow squash are also widely produced. Since their initial development in the mid- to late-1900s, GMOs have been used as fresh produce, as livestock feed, and as ingredients for processed goods. The big four are major cash crops in America and are mostly used to produce ingredients for processed foods (i.e. high fructose corn syrup or soy protein, which are found in most processed foods). “Between 1996 and 1998, crop acreage using genetically modified seeds had increased fifteen fold in the United States: a third of the American corn and cotton crop and more than half of the soybean crop is now grown from genetically modified seeds” (Lynch & Vogel, 2001, p. 9). Because of the rapid growth of GMOs and relative lack of regulations, typical consumers remain unaware of the presence of biotechnology in the food they consume. “Indeed as late as August 1999, only 33 percent of Americans were aware that genetically modified foods were being sold in supermarkets, while less than 3% were aware that soybeans were genetically engineered” (Lynch & Vogel, 2001, p. 9). This lack of awareness combined with growing scientific concern about the side effects of GMO foods influenced the organization of an anti-GMO and GMO labeling movement.

**Conflict and Disapproval in the United States**

There are two primary groups who lead the fight against the un-regulated spread of GMOs: anti-GMO groups and GMO-labeling groups. Anti-GMO proponents argue that the production and distribution of GMOs should be banned entirely, whereas those who favor GMO labeling laws assert that GMOs should not necessarily be entirely eliminated, but that products made with GM ingredients should explicitly state that they contain genetically modified materials. It is only in recent years that these groups have garnered such widespread support that they can more effectively speak out about the possible harmful effects of GMOs and their want for increased transparency through legislative regulations. In a study conducted at Cornell University, researchers found “that the use of a genetically modified Bt-corn variety could kill not only targeted pests, such as the corn borer, but also Monarch butterfly larvae” (Lynch and Vogel, 2001, p. 7). Monarch butterflies rely on milkweed, which grows on and around crop fields that are treated with pesticides. While the GM crops are resistant to these pesticides, the milkweed is not, and hence, the Monarch habitat is destroyed. The huge decline in milkweed in the American Midwest and other areas is closely linked to “the increased use of glyphosate herbicide in conjunction with increased planting of genetically modified (GM) glyphosate-tolerant corn (maize) and soybeans (soya)” (Pleasants & Oberhauser, 2012, p. 1). As science began showing unintended consequences of some GMOs, people started questioning the legitimacy of other statements by the industry claiming GMO’s safety. While the government attempted to increase and improve scientific research as a result of these findings, little has been done to impose regulations on GMOs or to increase public awareness that they are consuming potentially harmful products. “In 1996 a controversy about genetically modified organisms (GMOs) erupted, but for the first 3 years, the debate focused on the commercial use of GM crops and foods, while field trials remained largely uncontroversial” (Bonneuil, 2008). Therefore, even though concern swelled, it was limited to demands for only cursory changes rather than comprehensive changes and relatively ineffective in evoking policy change. Furthermore, concern was relatively localized among small groups of individuals who had little or no impact on the political system, making political progress difficult.

While increasing consumer concern in the United States is still relatively ineffective at sparking national political support, there have been a number of organizations that have formed to combat the minimal regulations on genetically modified foods in the United States. In 2005, the Natural Grocery Company and the Big Carrot Natural Food Market established the Non-GMO project in order to create “a standardized meaning of non-GMO for the North American food industry” (Non-GMO Project, 2005a). They believed that creating a unified definition would help build a collective movement. Based on the belief that all consumers should be given the opportunity to decide for themselves whether or not to consume GMO foods, the Non-GMO project was formed as a non-profit “committed to preserving and building sources of non-GMO products, educating consumers, and providing verified non-GMO choices” (Non-GMO Project, 2005b). The organization’s website provides facts about GMOs, as well as products that are certified non-GMO so that consumers can decide whether or not they want to eat GMO foods. The organization includes a lengthy document that provides “Truths and Myths” about genetically engineered products (see Antoniou et al., 2012). Other groups have also emerged, such as the GMO Eradication Movement, which is a campaign that attempts to completely eliminate the production of GMOs, and the Occupy Monsanto movement, which actively seeks to block production attempts of Monsanto, “the world’s largest developer, grower and marketer of [GMO] vegetable seeds” (RT News, 2012). While these groups have been largely unsuccessful in building recognition on the national political agenda, groups in California were successful in developing a proposition “that would require the labeling of genetically modified food…as just that, genetically modified” (Helena, 2012). The proposition was so successful that it made it on the 2012 ballot. If CA Proposition 37 had succeeded—which it did not—it “would [have made] California the first state in the U.S. to require labeling of most foods made with genetically modified organisms” (Andrews, 2012). The initiative failed to pass, but as Robyn O’Brien argues “rather than consider this [loss] ‘the end’ of the issue, perhaps it should be seen as the beginning of a long-overdue dialogue in the United States, a dialogue that the industry spent $45 million dollars to try to keep from having” (O’Brien, 2012). Even though the proposition failed, people continue to fight for increased awareness and another chance to influence the ballot. For example, since the California initiative, groups in 22 states have worked to put GMO regulations on their state ballots (Center for Food Safety, 2014). While some have had local success, there has remained almost no discussion about GMO legislation at the national level, and it does not appear that a national ballot initiative is currently possible.

**Hypotheses**

In this study, we built on preliminary research and expected to find the following correlations:

H1: Countries that have higher Voice and Accountability, which according to the world Bank, reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media, are more likely to have GMO legislation.

H2: Countries that have higher levels of democracy are more likely to have GMO legislation.

H3: Countries that have higher education ratings are more likely to have GMO legislation.

H4: Countries that have a higher Quality of Life as measured by the Human Development Index are more likely to have GMO legislation.

H5: Countries that receive USAID for agriculture are less likely to have GMO legislation, as are countries with a high percentage of their gross domestic product (GDP) from agriculture.

During our research, we also found evidence to suggest that the precautionary principle plays a role in whether countries have GMO legislation. Consequently we hypothesize that the impact of the “precautionary principle” is apparent in countries with GMO legislation. For this stage of the study, however, this hypothesis was not tested. We plan to look at this component of the research in more depth in a subsequent study, and test whether our hypothesis holds.

**Methodology**

For this project, we compiled data from 161 countries across the globe. We utilized secondary data sources for each of these countries compiled by large-scale, well-known organizations: the Center for Food Safety, The World Bank, the United Nations, and the Global Democracy Ranking Organization. Our dependent variable was GMO Legislation, which we used as a dichotomous variable (*GMO Legislation* or *No GMO Legislation*). To make the data parsimonious, we combined all countries that had either labeling regulations or bans into the same category. Because voluntary regulations are more symbolic than effective, any country with only voluntary legislation was grouped into the “No GMO Legislation” category. We pulled the data about GMO regulations from the Center for Food Safety, which compiles information about GMO legislation in most countries around the world. The independent variable voice and accountability (H1) measures the ability of citizens to interact with their government. This includes the presence of free and fair elections, the freedom of association and expression, and the extent to which a country has a free media (World Bank, n.d.). This dataset was obtained from the World Bank’s Worldwide Governance Indicators, which is a meta-analysis of several large-scale statistical studies. We hypothesized that higher levels of voice and accountability would be positively correlated with GMO legislation because we suspected that when people’s concerns can be voiced freely and are taken seriously by the government, governments will be more likely to pass legislation to appease those concerns.

The second independent variable, level of democracy (H2), was accessed through The Global Democracy Ranking. These rankings are compiled using six dimensions. Countries receive a score based on a series of indicators. Politics comprises 50% of the score, gender equality, economy, knowledge, health and environment each comprise 10%. These scores range from 1 to 100, where a score of 100 would indicate the country is completely democratic. We hypothesized that higher democracy scores would be positively correlated with the presence of GMO legislation for similar reasons to why we thought voice and accountability would positively correlate with GMO legislation. When people have a strong voice in their government, the government is more likely to respond to citizen concerns.

The third and fourth independent variablesare education ratings (H3) and the Human Development Index (HDI) (H4). We pulled education ratings from the United Nation’s Human Development Report. This variable measures the percentage of a country’s population that receives secondary education. We believed that higher levels of education would also lead to higher levels of involvement and awareness of citizens. This would translate into better information about the costs and benefits of GMOs, and perhaps a higher occurrence of GMO regulations. HDI is a measurement used to determine a country’s overall quality of life and living standards. The HDI consists of three parts: “a long and healthy life, being knowledgeable and … a decent standard of living” (United Nations Development Programme, n.d.). While education ratings and the HDI are interrelated in that education ratings are a component of the HDI, we wanted to specifically see whether there is a relationship between GMO legislation and a country’s overall quality of life.

The fifth independent variable that we anticipated might impact whether a country has GMO legislation is USAID (H5). USAID is international funding provided by the United States to foreign countries “to end extreme poverty and to promote resilient, democratic societies while advancing our security and prosperity” (USAID, 2014). USAID provides assistance for many different types of projects, ranging from food aid to projects providing electricity. In 2012, the total budget for “operations and assistance” totaled $47 billion, and about $1.1 billion were directed to “Feed the Future,” a stimulus program for agriculture (U.S. Department of State, 2011). This was in addition to agricultural funding included in aid programs to individual countries. Initially, we thought that the level of USAID for agriculture would be an indicator for more leniency towards genetically modified organisms since most large GM companies reside in the U.S. This hypothesis was based on the idea that with the allocation of aid from the United States there would be stipulations directing recipients to open their markets for GMOs developed in the US. We collected our data directly from the USAID website, which offers detailed data broken down by country and aid sector. In addition, we compiled data from the CIA World Fact Book that identified the percentage of the GDP for each country that is constituted by agriculture. We thought that it would be important to the overall context of the study to note how much each country relies on agricultural production for its income. We expected that countries with a larger percent of GDP from agriculture would be less likely to have GMO legislation.

Using GMO Legislation as the dependent variable, we conducted a 2-tiered correlation test using SPSS software. We then looked at the Pearson Correlation of each variable to determine whether a relationship exists. Variables with a Pearson Correlation over 0.45 with a significance rate of 0.05 or lower were said to have a positive correlation to our dependent variable. Additionally, we looked at the variables for the United States and compared them to the average of all countries to show whether it can indeed be considered an outlier.

**Results**

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| --- | --- | --- | --- |
| **Table 1** | | | |
|  | **Mean** | **Maximum** | **United States** |
| **Voice and Accountability** | -0.1366 | 1.75 | 1.13 |
| **Democracy** | 59.6733 | 87.8 | 76.9 |
| **Education** | 52.2689 | 100 | 95 |
| **HDI** | 0.6881 | 0.94 | 0.91 |
| **%AG of GDP** | 0.2784 | 20.8 |  |

|  |  |  |
| --- | --- | --- |
| **Table 2** | | |
|  | **Pearson Correlation** | **Sig. (2-tailed)** |
| **Voice and Accountability** | .551 | .000 |
| **Democracy** | .547 | .000 |
| **Education** | .503 | .000 |
| **HDI** | .471 | .000 |
| **USAID** | -.296 | .000 |
| **%AG of GDP** | -.089 | .266 |

**Voice and Accountability**

*H1: Countries that have higher Voice and Accountability, which according to the world Bank, reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media, are more likely to have GMO legislation.*

The 2-tiered correlation test shows a statistically significant positive relationship between the presence of GMO regulations and higher levels of voice and accountability. Using the Pearson Correlation, our results indicate a very significant (Sig. = .000) correlation of .551.

Voice and accountability is scored from -2.5 to 2.5, where 2.5 indicates higher levels of freedom. Norway received the highest score of any country in our study at 1.75. The mean of all 161 countries is -.1366. The United States’ score is higher than the average, at 1.13. According to our results, higher levels of voice and accountability are generally correlated with GMO regulations. The United States, however, does not follow the trend. This is curious in light of our hypothesis, indicating that the United States is indeed an outlier when it comes to GMO regulations and voice and accountability. The United States has a relatively high score for voice and accountability, and U.S. citizens are overwhelmingly in favor of regulating GMO’s, with some polls finding over 90% of Americans supporting labeling (Langer, 2014), but the national government still has not adopted legislation.

**Democracy**

*H2: Countries that have higher levels of democracy are more likely to have GMO legislation.*

The results of the Pearson correlation show a statistically significant positive relationship between higher levels of democracy and the presence of GMO regulations within a country. As with voice and accountability, these results show a very significant (Sig. = .000) correlation of .547.

According to the data prepared by Democracy Ranking, the most democratic nation is Norway with a score of 87.8 (out of a possible 100). The mean score of all 161 countries is 59.67. The United States scored 76.9, which is high compared to the average. The United States is again an outlier because our results suggest that the more democratic a country is, the more likely it is to have GMO regulations. Similar to voice and accountability, we would suspect that with a high democracy score, the United States would be more likely to have GMO regulations; however, even though it has a high democracy ranking and the public predominately supports labeling, ballot initiatives continually fail at the state level and never reach the national agenda.

**Education Rating**

*H3: Countries that have higher education ratings are more likely to have GMO legislation.*

For education, the Pearson Correlation was .503 with high significance (Sig. = .000). This indicates a positive correlation between education level and GMO legislation.

Based on this data, it appears that countries with a high education levels are more likely to have GMO regulations in place. This could mean that education leads to heightened awareness and safeguards for agricultural development and experimentation. Again, we see the United States as an outlier when it comes to the relationship between education and GMO regulations. The mean education rating is 52.3, and the U.S. has a much higher education level at 95. However, the U.S. perpetually has no GMO legislation at the national level.

**Human Development Index**

*H4: Countries that have a higher Quality of life as measured by the Human Development Index are more likely to have GMO legislation.*

The Pearson Correlation indicates a positive correlation between GMO legislation and HDI levels within a country. This finding is very significant (Sig. = .000), with a correlation of .471, meaning countries with high HDI ratings are more likely to have GMO regulations than countries with low HDI ratings. As with the other variables, the United States does not fit within this hypothesis. The U.S. has a much higher HDI at .91 than the mean of .6881. However, the U.S. has no GMO legislation at the national level.

**USAID**

*H5: Countries that receive USAID for agriculture are less likely to have GMO legislation, as are countries with a high percentage of their gross domestic product (GDP) from agriculture.*

The data did not support our fifth hypothesis that USAID influences whether or not a country has GMO legislation. Conversely, they show that there is not a significant relationship between the amount of USAID received by a country and whether it has legislation regulating the use of GMOs. This variable, however, has weaknesses, which may have influenced this result. For one, the data does not differentiate between the amounts of USAID each country receives. It also does not address how the aid is used by each country’s governmental regime. A common criticism of international aid, such as USAID, is that funds are often poorly utilized by corrupt governments and not directed to the projects for which they were intended. This could be one reason for the lack of a correlation in the data. If USAID for agriculture does not actually reach intended programs or regions, then its impact on local agriculture and its relationship to GMOs may be contrary to what we would expect. This argument could prompt an entirely new discussion of USAID and the success of these programs, but the discussion would be misplaced in this study.

Similar to the USAID data, the percentage of agriculture of a nation’s GDP did not show any significant relationship to GMO legislation. We anticipated that nations with a larger agricultural sector would show an inverse relationship to the use of genetically modified organisms because GMOs typically instigate higher crop yields and more efficient growth than ‘conventional’ agricultural production. However, this expectation did not hold true. There is no indication in our data that the size of a nation’s agricultural sector inversely correlates with GMO specific legislation.

Our assumptions about the agricultural influence were based on the example of the United States, where a strong agricultural lobby is involved in the limitation of GMO legislation. It appears that, again, the US is an outlier or isolated case. In our analysis of international data, no significant correlation between the size of agriculture and GMO legislation was apparent. Ultimately, our primary question remains unanswered: What makes the U.S. different from so many other nations? In other words, *why* is the U.S. an outlier? Perhaps our research into the precautionary principle will help to establish a more definitive answer to this question.

**Limitations and Future Research**

There are a number of limitations that may affect the results of this study. One of the primary challenges is the large number of countries in our study. For many countries, the data is either unavailable or extremely difficult to obtain.

Another limitation has to do with the operationalization of GMO legislation. For the purposes of this study, we classified any legislation that was deemed “voluntary” under “no GMO legislation” because it is mostly ineffectual in practice. Furthermore, we only categorized countries by “legislation” or “no legislation,” therefore the information is limited in that countries with extremely rigid policies are not differentiated from those with very lax policies.

Another possible limitation to studying GMO legislation has to do with the reality that tracking the money of pro-GMO companies is extremely difficult. Many countries may be linked to companies who support or produce GMOs, but with very little trace. These connections are unaccounted for in our study. This would be a valuable study to undertake in the future, but would require extensive resources and much more time.

During our preliminary research, we find evidence that there may be an important connection between GMO legislation and the precautionary principle. We would like to investigate this potential connection, but time limitations made it impossible for this initial analysis. Additionally, while we found connections between GMO legislation and our independent variables, we need to dedicate more research assessing possible reasons for these connections.

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1. Reasons for modification vary depending on the needs of the organization conducting the modifications. [↑](#footnote-ref-1)
2. An in-depth discussion of the “precautionary principle” is considered for the article version of this study. [↑](#footnote-ref-2)