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Who Wants the Right to Know? An Analysis of GMO-labeling in California

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Cover Page Footnote

I am very grateful for Professor Nathan Chan for his guidance throughout this research project.

1. Introduction

Genetically Modified Foods (GMO food) have been a hotly debated topic in the past decade. The main issue of the debate is that there remains no concrete evidence, scientific or otherwise, which would sway the conversation in one direction or the other. Advancements in genetic modifications have only been present within the last 50 years or so, with the first GMO patent granted in 1980, allowing Exxon Oil Company to use bacterium that absorbs crude oil to help clean up oil spills. By 1994, the first genetically modified food, the "Flavr Savr" tomato appeared in grocery stores, with promises of a longer shelf life and delayed ripening (Woolsey, 2013). Today, the potential possibilities of biotechnology range from saving entire crops from a persistent species of beetles to offering children vaccine-injected fruits in place of a costlier, traditional vaccination ("Genetically Modified Foods," 2015). However, these advanced technologies are certainly balanced with the risks involved with modifying genetics. For this reason, scientists and various organizations alike cannot seem to agree on whether or not the benefits outweigh the costs in regards to genetically modified foods.

On one hand, supporters of GMOs argue that this genetic engineering can increase a farmer's yield and could be the key to feeding the world's growing population. According to the U.S. Department of Agriculture, this biotechnology can drastically change a farmer's annual crop by making it less susceptible to weeds, pests, and plant diseases, while keeping the production costs low. The USDA states that currently, biotechnology is used in 88%, 94% and 93% of the production in corn, cotton, and soybeans, respectively. Additionally, they claim that this genetic engineering has been studied and tested to ensure that all modifications pose no significant risk to consumers (USDA, 2015). On the other hand, critics of the issue say that these benefits are over exaggerated and that there is no proof of the actual safety of these foods. The Food and Agriculture Organization of the United Nations claims that among the negative impacts that have held back the wide use of genetically modified foods, one important argument against GMOs is our uncertainty about genetics and mutations. This could potentially danger both the environment and human health. It would be extremely worrisome if, for example, herbicide resistant mutations got passed to weeds; however, research on the matter has left scientists divided and tentative (FAO, 2003). These debates over the benefits and safety of GMOs have persisted, from households, to classrooms, to the Capitol. Bills regarding GMO labeling have been introduced in 30 different

states, and only three states (Vermont, Maine, and Connecticut) have passed bills requiring GMO labeling (Cox, 2014).

In 2012, the state of California introduced a Mandatory Labeling of Genetically Modified Food Initiative on the November 6, 2012 ballot. This bill, if passed, required all raw and processed foods sold to consumers to be labeled if they were genetically modified or engineered in specific ways. The bill also prohibited the labeling of such foods as "natural," "naturally made," "all-natural," etc. Certain exemptions applied, such as food from an animal that was not itself genetically modified, but may have been fed genetically modified food. It is important to note that the initiative also included a fiscal impact to increase the annual California state costs of up to one million dollars in order to monitor and regulate GMO labeling. The bill was narrowly defeated with 51.4% of voters against and 48.6% of voters in support (Ballotpedia, 2012).

In this paper, I hope to identify the determinants of whether an individual votes "yes" or "no" on Proposition 37. I will examine the voting behavior among people at a census zip-code data level and I hope to identify the patterns present within voting behavior in California. The main focus of this paper is to illustrate that people, even those from similar demographics (political, socioeconomic, education level, etc.) may exhibit different voting patterns when it comes to both personal health and broader environmental issues.

> **Hypothesis 1:** There is no party affiliation regarding GMO labeling. People of all parties will form varying opinions on their right to know.

> **Hypothesis 2:** People with presumed higher levels of scientific literacy will be in favor of the proposition. I propose that those with higher levels of scientific literacy include individuals with a more advanced education, those with science, engineering, and related degrees, and people who work in an occupation that is more exposed to the various components and nuances behind GMO-labeling, such as scientific, farming or food-related fields.

> **Hypothesis 3:** Zip codes that are more populated with children, and therefore families, tend to be more in favor of the proposition.

The motivation for this paper stems from the negative attention that recent GMO-labeling laws have received. This summer, the House of Representatives passed the Safe and Accurate Food Labeling Act of 2015, which has been given the nickname: Deny Americans the Right to Know (DARK) Act. The Act negates all existing GMO labeling laws and gives the U.S. Department of Agriculture jurisdiction over all non-GMO certification (Roth, 2015). There is likely to be a great deal of pushback from the American people, especially from health and organic associations and organizations as the bill will soon reach the Senate and the President's desk.

The goal of this paper is to explore what types of people tend to support GMO labeling. This debate is not just a matter of natural vs. processed foods, but it is also a matter of the right for the American people to know what is in their food and how it was produced. I hope that my findings may shed some light on who and what type of person should be targeted in the future regarding GMO-labeling support or otherwise.

2. Literature Review

This paper contributes to two types of previous literature. Following the defeat of the California initiative in 2012, many news articles were published regarding the defeat of Proposition 37 and why its result should matter. The New York Times reported that this debate illustrates the public's thoughts and beliefs on the industrial food chain, and reflected the call for a greater sense of transparency, not just in California, but also across the country. Additionally, this proposition closely aligned with President Obama's platform during his first campaign for office, in which he voiced his support for the labeling of genetically modified foods. Although he has failed to take much action in this accord, the DARK Act will soon reach his desk and one can only assume what his decision will be. There has yet to be a scholarly journal written regarding the proposition specifically and this paper provides an educational analysis on the bill.

This paper also contributes to a variety of voting papers that have been published. Past studies have examined the success or lack thereof of different environmental ballot measures. Holian and Kahn (2015) examined the voting behavior and patterns among households of propositions in California relating to low carbon emissions (Proposition 23 and Prop 1A). More specifically, they are interested in how voting behavior of these two initiatives affected an individual's support in investing in and building a high-speed rail in California. Using block-group data, the authors found that individuals who identify as liberals consistently

support lower carbon initiatives. Those who lived at a considerable distance from a city's center often had negative impact on the low carbon policies. These findings were consistent with voting patterns found in other legislation, such as the 2009 American Clean Energy and Security Act (Holian and Kahn, 2015). Similarly, there have been several other papers analyzing the difference in voters in regards to different bills and legislature (Banzhaf, et al., 2010; Kahn, 2007; Salka, 2003; Wu and Cutter, 2011).

3. Data

I compiled data from statewidedatabase.org, run by the University of California, Berkeley, which includes statewide voting and census data in the state of California running from as far back as 1992. This precinct data contains voting results for both statewide and district-level races. It includes the total number of individuals registered to vote, and the total of people who voted yes and no, with which we can infer how many people abstained from voting. The data I use is strictly from the 2012 California General Election.

I also used 2012 census data from American Fact Finder, which was also merged with the voting data on a zip-code level. In total, the dataset includes data from 1,669 zip codes, which captures every major zip code division in the state. The demographics I used include political affiliation, length of education, type of degree, employment status, number of children per zip code, median household income, and a variety of other education and employment related statistics (highest level of education, specific occupation field, etc.).

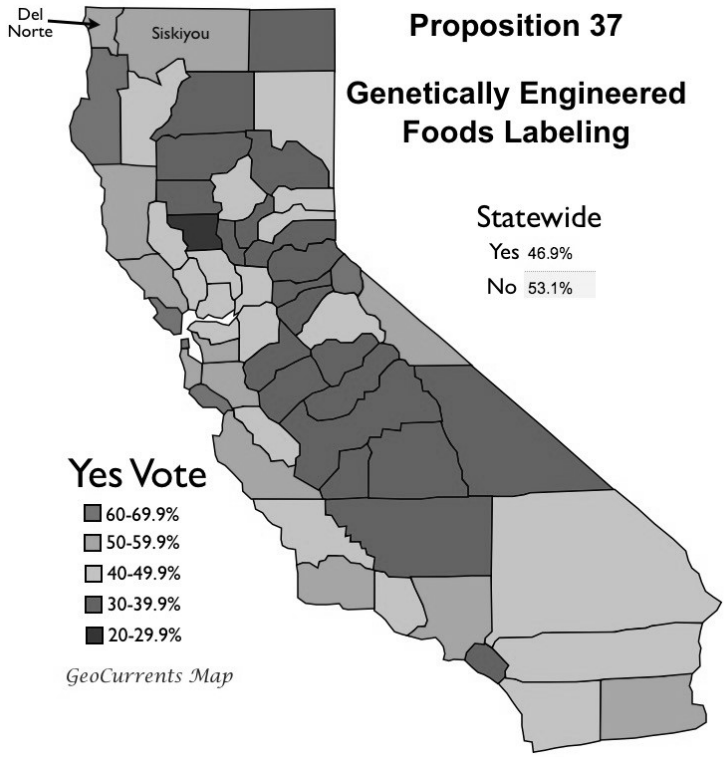

Figure 1. Percent of the county voting yes on Prop 37 *(source: http://www.geocurrents.info)*

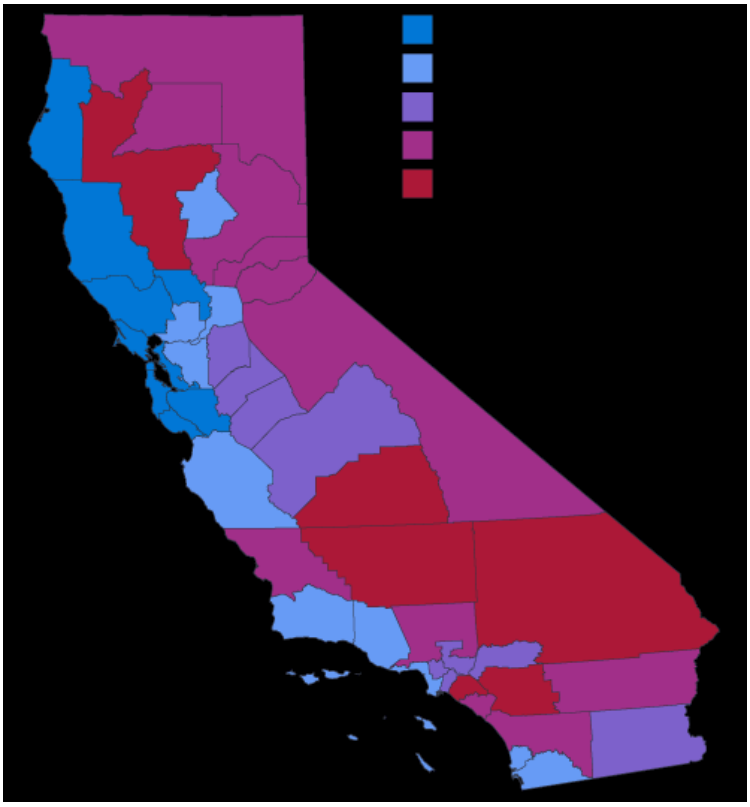

Figure 2. Political Affiliation by County *(source: http://www.ppic.org)*

For each of these demographics markers, it is important to keep in mind that I am looking at voting behavior at a zip-code level and thus does not reflect voting patterns or ideologies at a household or individual level.

Figure 1 illustrates the state of California, spatially divided by county and what percent of each respective county voted yes on Proposition 37. In Figure 2, we see the cross-county spatial distribution of political affiliation, ranging from loyal liberal to committed conservative. We see immediately by comparing these two figures that in Proposition 37, a political affiliation does not necessary correlate strongly with whether or not a county voted yes on the initiative. Therefore, we might expect Hypothesis 1 to be true, that there does not exist any political affiliation across counties on Proposition 37.

Table 1 shows variable descriptions and summary statistics of relevant variables. There are several things to note. First, it is interesting that within a zip code, the maximum percent of voters against Proposition 37 is 100% while the maximum percent of voters in support of the initiative is only 87.4%. This might

suggest that voters and zip codes against Proposition 37 felt very strong opposition towards the initiative while voters and zip codes in support of the bill were less resoundingly so. Second, the median household income across all zip codes was indeed lower than the mean household income across zip codes, suggesting that there may be varying levels of income disparity within each geographic area. Finally, the maximum value of the percent with a Graduate degree is 100%, suggesting that there is a zip code in which every single occupant has beyond an undergraduate degree. Upon further research, I found that this zip code is Echo Lake, 95721, a neighborhood just south of Lake Tahoe, an area of California with a population of 14 residents, all of whom have a Master's or Doctorate degree.

Table 1. Variable Descriptions and Summary Statistics, Voting and Census Data

Variable	Description	Mean	Std. Dev.	Min	Max
Voting					
Demographics					
pct_37y	Percent of zip code of voters voting yes on Prop 37	47.5	12.3	0	87.4
pct_37n	Percent of zip code of voters voting no on Prop 37	52.2	12.3	0	100.0
sum_totreg	Number of total registered voters	10070.5	9953.1	0	48492.4
pct_other	Percent registered Green, Independent and Other Party members	1.2	1.7	0	19.1
pct_dem	Percent registered Democratic Party members	55.1	17.5	0	95.0
pct_rep	Percent registered Republican Party members	43.5	18.0	0	100.0
Education					
pct_belowhs	Percent with below high school education	8.8	10.7	0	80.9
pct_somehs	Percent with some high school education	8.1	6.7	0	54.4
pct_hs	Percent with GED or equivalent	21.5	10.5	0	100.0
pct_somecollege	Percent with some college	23.4	9.9	0	100.0
pct_assoc	Percent with Associate's degree	7.9	5.8	0	100.0
pct_bach	Percent with Bachelor's degree	17.9	11.3	0	64.9
pct_grad	Percent with Graduate degree	10.6	10.3	0	100.0
Household					
hh_count	Number of households in zipcode	7094.5	6857.8	0	33365.0
median_hh_inc	Median household income	58924.8	30359.0	0	226875.0
tot_child	Number of children in zipcode	5226.4	5953.4	0	34014.0
pct_emp	Percent employed	51.6	15.0	0	100.0
pct_unemp	Percent unemployed	6.8	4.4	0	61.5

4. Method

A standard Ordinary Least Squares regression was used to estimate the percent of voters who would support Proposition 37 in California. The model is seen here below:

$$pct_{37y} = \alpha + \beta_1 V + \beta_2 Educ + \beta_3 HH + \beta_4 Occu + \varepsilon$$

The percent of voters voting yes on Prop 37 is a function of *V*, a vector of voting demographic data; *Educ*, a vector of education related characteristics; *HH*, a vector of household characteristics; and *Occu*, a vector of occupational characteristics.

In addition, I ran two separate weighted regressions, which places stronger weights on zip codes with greater population and greater amount of registered voters.

5. Results

Table 2 summarizes the initial regression results of demographics that correlate with support for Proposition 37. For party affiliation, I omit Democrats from our regression. We see that with Democrats as the baseline, members of the Green Party, Independent Party and other parties are expected to be 2.13% more likely to vote yes on Proposition 37. Alternatively, Republicans have a negative correlation. Both relationships are highly statistically significant. This rejects our first hypothesis that party affiliations do not exist in GMO-labeling. The results show that while Republicans are only 0.46% less likely to support the bill than Democrats, this number is still highly significant and each political party clearly has a voting trend.

A second finding is that the median household income is positive and statistically significant. This result is aligns with results from previous voting papers, that families with greater income are more supportive of environmental ballot measures. Food brands that are "organic" or "GMO-free" are generally more expensive than a generic brand. Additionally, this GMO-labeling law would have required a significant increase in taxes in order to fund the bill, which provides a further explanation as to why wealthier families may support the bill.

Table 2. Initial Regression

Variables	(1)	(2)
pct_other	2.13***	2.31***
	(0.10)	(0.11)
pct_rep	-0.46***	-0.47***
	(0.01)	(0.01)
ln_median_hh_inc		1.07**
		(0.44)
pct_child		0.02
		(0.05)
pct_emp		0.02
		(0.02)
Constant	64.98***	52.20***
	(0.50)	(4.33)
Observations	1,769	1,643
R-squared	0.69	0.74

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, we see that although not statistically significant, an increase in the percent of children per zip code has a positive relationship with the likelihood of voting yes on Proposition 37. Thus, according to our results, hypothesis 3 is false, as our data does not show any statistically significant coefficients.

In Table 3, I report additional regression estimates that include the amount of school, type of degree, and occupation (all as percentages of each zip code). For the amount of school, I included all tiers of schooling, with the exception of "Below High School," which we have omitted from the regression. I also used five types of degrees, those being Science/Engineering, Business, Education, Related, and Humanities, where Humanities is the omitted variable. I added six different industry variables in order to check whether various industries or fields of occupation differ in their support for GMO-labeling. These six are Management/Business/Science, Farming, Wholesale Trade, Healthcare, Food Services, and Public Administration. I expect that these occupations will be a positive correlate to Proposition 37. All other occupations are omitted in this regression.

When we move from column (1) to columns (2) and (3), we see that most of the statistically significant variables remain as such, and therefore I will focus my interpretation on column (3) for simplicity. All levels of education are not statistically significant with respect to the percentage at a zip code level with a "Below High School" education except the percentage with a Bachelor's. A one-percent increase in Bachelor's degrees per zip code is expected to increase the vote on Proposition 37 by 0.14%.

A second finding to note is an increase in business and education degrees is expected to decrease the support for GMO-labeling by -0.07% and 0.05%, respectively. This falls in line with my second hypothesis. While we do not see statistically significant results of science related degrees, those with a business degree may be more interested in the economic repercussions of GMO-labeling (the hundreds of thousands of dollars spent on managing and overseeing the labeling) and thus tend to vote against the initiative. Similarly, individuals with an education degree might recognize that tax dollars could be funneled away from public education and into supporting GMO-labeling, and thus would oppose the bill.

The third observation is regarding the types of occupations that correlate with support for Proposition 37. Individuals in the farming industry are expected to oppose the bill while workers in the health care, food services, and public administration sectors are expected to be in support of the bill. These results are all highly statistically significant. These industries are more exposed to the scientific research of GMOs and thus may form their own opinion on the related safety, risks, and benefits. It makes intuitive sense that farmers, who directly benefit from genetically modified organisms in the farming process, oppose Proposition 37. Individuals in health care and public administration support the labeling of GMOs, potentially due to the related health risks. Finally, those in Food Services are likely to vote in support of the bill. Large food service companies rely on continued improvements in food sustainability to distinguish themselves from their competitors, which could explain why individuals in the food services industry are in favor of Proposition 37.

Table 3. Initial Regression, with Education and Occupation proxies

Variables	(1)	(2)	(3)
pct_other	2.00***	1.76***	1.86***
	(0.10)	(0.10)	(0.11)
pct_rep	-0.46***	-0.50***	-0.47***
	(0.01)	(0.01)	(0.01)
pct_somehs	-0.05	0.01	-0.07
	(0.03)	(0.05)	(0.05)
pct_hs	-0.02	0.05*	-0.03
	(0.02)	(0.03)	(0.03)
pct_somecollege	0.02	0.11***	0.03
	(0.02)	(0.02)	(0.03)
pct_assoc	-0.01	0.02	-0.08
	(0.03)	(0.04)	(0.05)
pct_bach	0.13***	0.20***	0.14***
	(0.02)	(0.03)	(0.03)
pct_grad	-0.04*	0.01	-0.05
	(0.02)	(0.03)	(0.03)
pct_sci_eng		-0.03	-0.03
		(0.02)	(0.02)
pct_business		-0.07***	-0.07***
		(0.03)	(0.03)
pct_education		-0.05*	-0.05**
		(0.03)	(0.03)
pct_humanities		-0.04*	-0.04*
		(0.02)	(0.02)
pct_mng_bus_sci			-0.05
			(0.03)
pct_farming			-0.15***
			(0.04)
pct_wholesale_trade			-0.06
			(0.10)
pct_healthcare			0.10***
			(0.04)
pct_foodservices			0.22***
			(0.04)
pct_pub_admin			0.18***
			(0.05)
Constant	63.78***	63.05***	67.63***
	(1.02)	(2.73)	(3.00)
Observations	1,769	1,689	1,689
R-squared	0.70	0.74	0.75

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In my data set, the population in zip codes ranges from 0 to 105,940. Similarly, the number of total registered voters ranges from 0 to 48,492. Table 4 shows the initial regression by weight in order to take into account the different sizes of the zip codes. Column (1) shows a regression weighted by population per zip code while column (2) is weighted by total number of registered voters per zip code. I include the initial regression results in column (3) for reference.

Table 4. Initial Regressions, Weighted

Variables	(1) population	(2) sum_totreg	(3) initial
pct_other	3.07***	2.94***	2.31***
	(0.15)	(0.13)	(0.11)
pct_rep	-0.46***	-0.45***	-0.47***
	(0.01)	(0.01)	(0.01)
ln_median_hh_inc	0.47	-0.03	1.07**
	(0.40)	(0.37)	(0.44)
pct_child	0.04	0.03	0.02
	(0.03)	(0.03)	(0.05)
pct_emp	0.07***	0.11***	0.02
	(0.02)	(0.02)	(0.02)
Constant	54.78***	57.89***	52.20***
	(3.79)	(3.56)	(4.33)
Observations	1,643	1,642	1,643
R-squared	0.81	0.84	0.74

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results show that when weighted by both population and total registered voters, there exist some differences in the results. Now, there is no longer a statistically significant relationship between household income and the likelihood to support Proposition 37. When we consider zip codes of larger populations, especially in the state of California, there exists a great deal of income disparity. Thus, median household income of a zip code may not effectively measure the voting behavior of a large zip code. However, employment is now a statistically significant factor in the likelihood a zip code will favor the bill. Instead of median household income, an increase in the percentage of employed residents in a zip code may have some stronger implications on the relative wealth of that zip code.

So, zip codes with more employment and therefore higher wealth may be more likely to be in support of Proposition 37.

6. Conclusion

In recent years, the debate of GMO-labeling has become increasingly prevalent. In the state of California, voters ultimately decided to vote against the initiative for modified food labeling by a vote of 51.4% to 48.6%. While previous voting papers have shown that individuals with higher income and education are likely to be in favor of environmental ballot measures, this paper shows that voting patterns may also exist in type of education and occupation. Specifically, I found that individuals with an education degree, a business degree, or work in the farming industry are expected to oppose the bill while employees in the health care, food services and public administration sectors are likely to support Proposition 37. Additionally, it is particularly interesting to note the magnitude of the coefficients along with the degree to which the bill was defeated. For example, the results show that a one percent increase in the mean percent of individuals in the Green Party, Independent Party and other parties from 1.2% (across all zip codes) to 2.2% would have increased the votes in favor of Proposition 37 from 47.5% to 50.57% (using the coefficient from Table 4, column 1). Although a one percent increase in Green Party (and other party) members is a significant number, relative to the population of California, it is interesting to note that using this model, even a slight shift in the voting demographic could have affected the results of the bill. Future research might examine voter turnout behavior in order to address what types of zip codes are most likely to vote on GMO-labeling and other related issues.

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