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Predicting State-Wide Votes on Ballot Initiatives to Ban Battery Cages and Gestation Crates

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After California voters decided in a state initiative to ban gestation crates and battery cages, some are asking whether other states will host similar initiatives and if they will pass. This study addresses this question by using voting data in California to predict how voters in other states would respond to a similar initiative. Results suggest that a number of states allow such initiatives and possess a demographic profile favorable to the initiative's passage. However, because these states host only a small portion of the livestock population, the impact of such initiatives on the well-being of farm animals is questionable.

Key Words: animal welfare, battery cage, demographics, gestation crate, state initiatives

JEL Classifications: H7, K2, Q1

The vast majority of egg and pork production takes place in confined production facilities, where layers and hens face extensive restrictions on their movement. Small groups of layers are housed in battery cages, providing each bird only a fraction of the space needed to move about and fully stretch their limbs. Sows are confined to solitary gestation crates or stalls so small the sow cannot turn around. While providing many of animals' biological needs, these cages deny most behavioral needs, resulting in a low level of welfare compared with other production methods (Bracke et al., 2002a, 2002b; De Mol et al., 2006). Not surprisingly, pictures of these cages disturb the general public. Capitalizing on this public sentiment, animal advocacy organizations have petitioned for ballot initiatives and lobbied for legislation banning restrictive cages.

As a result, eight states have banned cages for layers, sows, or both. Some bans are the result of initiatives and some of legislation. Three times an initiative to ban restrictive cages has been held and in each case—Florida in 2002, Arizona in 2006, and California in 2008—the initiative passed. The California initiative received considerable attention, and its passing suggested initiatives in other states would realize similar success, motivating the United Egg Producers (UEP) to recently strike a deal with the Humane Society of the United States (HSUS) to enlarge and enrich the cages used for layers, resulting in the Egg Products Inspection Act Amendments of 2013 bill currently before the House and Senate. This bill requires that

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battery cages be replaced with housing systems that double the space allotted to each hen and to provide environmental enrichments like scratching areas and nesting boxes (Feinstein, 2013). It is presumed that most farmers will use enriched or colony cages to meet these specifications. The legislation is described by the agribusiness newspaper *Feedstuffs* as "the result of an agreement negotiated between HSUS and UEP two years ago to transition the egg industry away from conventional cage housing to enriched colony cages" (Smith, 2013a). With the support of both the HSUS and UEP, such legislation seemed destined to pass, but now that other livestock groups have opposed the measure, its future remains unclear (Wyant, 2013).

A nationwide agreement over gestation crates in hog production has not occurred. The debate over gestation crates will thus continue, and state-level initiatives and lobbying to ban the crates are expected. The question is: which states are the next targets? Obviously, states that do not allow initiatives can only exploit the ballot box indirectly, through lobbying—but lobbying has worked for states like Michigan, Colorado, Oregon, Maine, and Ohio. The ability of an animal advocacy group to influence policy through lobbying or initiatives depends on public support for cage bans, and public support is related to demographics (among other things). A state whose demographics resemble California, Florida, or Arizona is likely to support bans on battery cages and gestation crates.

The purpose of this study is to use data from the California initiative (commonly referred to as "Prop two") to project whether similar referenda for gestation crates might pass in other states. After analyzing the relationship between a California county's demographics and their voting behavior for Prop two, this relationship is assumed to hold for other states, allowing statistical models to project the fate of a Prop two measure in other states based on their demographics.

Survey work has shown that demographic factors do influence views on animal welfare. States with a higher population density, higher income, more educated public, stronger support for Democratic politicians, older citizens, more females, and less Evangelical Protestants have all been shown to have increased concern for the well-being of farm animals (Prickett, Norwood, and Lusk, 2010; Videras, 2006).

Admittedly, similar demographics across different states may not represent identical preferences for farm animal care. The average Democrat in California will not share identical views with the average Democrat in Virginia, and the faith of Evangelical Protestants may have a different flavor in Alabama than in California. However, the fact that citizens of different counties do often share political parties, ethnicities, and versions of the Christian faith suggests these similarities can be used to predict voting behavior. The voting behavior of a demographic in one state should reveal something about the behavior of the same demographic in another state.

Views on animal welfare are expected to evolve over time. When Floridians first voted to ban gestation crates in 2002, citizens in other states read about this peculiar initiative and for the first time learned how sows were housed. By the time similar initiatives reached Arizona and California, voters were better prepared for the issue. Just as the same demographic manifests itself differently across regions, the same categories of people may vote differently across time. As an example, the initiative in Arizona did not earn itself a special episode on the Oprah Winfrey Show; the initiative in California did.

Marketing and political science studies have demonstrated that individual preferences are profoundly influenced by a minority of individuals referred to as "influencers" (Katz and Lazarsfeld, 2006; Keller and Berry, 2003). This implies that the idiosyncratic personalities of these influencers can be manifested in overall voting behavior, perhaps causing voting behavior to differ across states. However, an influencer in California can have an effect on voters in Nebraska. There is no reason to believe the orbit of influencers is confined only to their state, especially with today's Internet. As a result, there is little reason to expect the voting behavior of the same demographic in two states to be independent of one

another. No two states are identical, but what happens in one state provides insights into other states.

Using California data to project voting behavior on a hypothetical initiative in other states can be considered a thought experiment: an abstract, hypothetical scenario providing a useful index of each state's concern for animal welfare as determined by their demographic profiles. There are a number of states where initiatives are not allowed, yet this study can still illuminate our understanding of those states also. For example, Minnesota, North Carolina, and Iowa are the three largest hog states but do not allow initiatives—yet these industries can still be affected by legislation sponsored by politicians with a personal interest in animal welfare or politicians influenced by a particular lobby. The absence of an initiative does not mean constituents have no influence nor does it imply constituent demographics are irrelevant. Which of these state's constituents will be the most or least accepting of gestation crate bans according to the state's demographics? This research has an answer.

Because the debate regarding battery cages is likely to be resolved by the recent UEP/HSUS agreement, discussion will focus primarily on gestation crates. However, no law about battery cages has been signed, and until such law passes, state-level initiatives to ban battery cages are a possibility. Moreover, the results of this research are relevant to every aspect of the farm animal welfare debate, because they concern not just predicted voting behavior, but general public sentiments about animal welfare issues.

Our statistical models project approval rates should a measure like California's Prop two be held in each state. The exact wording of Prop two is provided in the next section, along with a discussion of state laws regarding initiatives and referenda as well as hog populations across states. The third section describes the methods and data, the fourth section reveals the regression estimates, and the fifth section predicts the percent of voters approving a Prop two-like measure in each state. The final section discusses the implications of the results for the hog industry.

Prop Two, Initiatives, and Hog Populations

The statistical model used in this study is taken from voting behavior in California's Proposition two (hereafter, Prop two). It is thus prudent to explicitly remark on the wording of the proposition, which read:

> "...a person shall not tether or confine any covered animal, on a farm, for all or the majority of any day, in a manner that prevents such animals from (a) lying down, standing up, and fully extending his or her limbs; and (b) turning around freely (California Secretary of State, 2008)."

The wording of this proposition makes it clear that the battery cages used to produce 95% of U.S. eggs, and gestation stalls used to produce the vast majority of U.S. pork, would be prohibited. A more detailed reading of the proposition shows that farrowing crates may still be used, because the definition of a "covered animal" does not include sows that are birthing or nursing. Initially, most believed that this proposition would only allow cage-free egg production. Then, an egg producer who wished to use colony cages (larger and enriched cages) began a contentious debate over whether it would be allowed under Prop two. After all, a hen in a large cage may still have ample room to turn around and extend its limbs. This question has yet to be settled, but given the fact that the HSUS and UEP are seeking a nationwide conversion of cage to colony cage facilities, the future of colony cages in California seems optimistic.

The passing of Prop two has real consequences for food. Pork production costs increase by 2.3% without gestation crates. Depending on whether an egg farmer replaces battery cages with enriched/colony cages or cage-free production, Prop two raises their production costs by 10–25% (Norwood and Lusk, 2011; Seibert and Norwood, 2011; Sumner et al., 2008).

If more state-level initiatives do take place after Prop two, to what extent would the wording of the initiative resemble that of Prop two? Because colony cages fulfill Prop two requirements, subsequent initiatives would not have to be altered to accommodate the recent agreement between the UEP and HSUS. Also,

new initiatives are likely to target both the hog and the veal industries, so there is no reason to suspect the wording of the initiative would apply exclusively to hogs. Finally, history suggests animal advocacy groups will only attempt to ban restrictive cages. There is no reason to believe HSUS will seek to provide outdoor access for hogs, access to bedding, and the like. HSUS has themselves stated, "We're not going to come in and try to write regulations because that isn't our role. . .. Our aim is to end the worst abuses, and a gestation crate in the pork industry is the worst abuse" (Kilian, 2008). An initiative to ban something can be easily articulated on a ballot, but it is far more difficult to write an initiative describing the proper inches of straw, hay, or sawdust that sows, piglets, barrows, and farrows will receive. A narrative on the proper amount of "outdoor" access is equally difficult to place on a ballot. Everything considered, if animal advocacy groups petition for new initiatives, the wording of the initiative is expected to mimic that of Prop two closely or at a minimum imply the same ultimate consequence (i.e., a ban on battery cages).

Although the results will say something about every state, they are obviously most relevant to states that allow initiatives, have the largest hog populations, and have not yet hosted an initiative. An "initiative" is a formal policy term, referring to a specific proposition citizen's vote for or against. To place an initiative on a ballot, groups must gather signatures expressing their support for the issue, and the rules for gathering petitions vary across states. For example, California requires groups to gather a number of signatures greater than 5% of the last votes cast for governor, groups must gather these signatures within a 20-month time period, and the petition must be completed four months before the election date. Some states have geographical distribution requirements. For example, in Missouri, signatures exceeding 5% of the votes cast for governor in the last election must be achieved in six of its nine congressional districts. Other states like Illinois specify the type of items an initiative may address, and in Illinois, the regulation of livestock farms is not among these items (Initiative & Initiative Institute at the University of Southern California, 2011).

Table 1 lists the 50 U.S. states, sorted according to hog production, and indicating whether an initiative is allowed in each state. Twenty-three states allow initiatives. Although New Mexico, Kentucky, and Maryland allow "popular referenda," these only allow citizens to repeal a passed measure (all states with initiatives also allow popular referenda) and are hence less relevant to the present study. Of these initiative states, Florida and Mississippi only allow initiatives to alter the state constitution, not a law. This is why the gestation crate ban was enshrined in the Florida state constitution, which seemed odd to many people at the time.

Because the possibility of initiatives is especially relevant for the hog industry, Table 1 lists the hog revenues in each state, but to facilitate discussion, egg production is listed as well. In the top five hog-producing states, only Illinois allows initiatives. The narrow range of items an Illinois initiative can address is so limiting that it is, for practical reasons, often not even considered an initiative state. Because an Illinois initiative cannot refer to farm regulations, it is considered a noninitiative state for the purpose of this analysis.

Notice Ohio is the second largest egg-producing state but only the eighth largest hog-producing state. Ohio allows initiatives, and after an awkward public relations battle, Ohio producers sought a compromise with HSUS to prevent an initiative, where a defeat of the livestock industry was likely. Ohio producers sought to pre-empt a ballot initiative by HSUS by offering one of their own, which would have delegated decisions about animal production decisions to a specially appointed committee. This ballot initiative passed, but did not—as producers had hoped—keep the HSUS from pursing their interest in ultimately banning cages. The resulting compromise prohibits new egg facilities from using battery cages, and gestation crates cannot be used after 2026.

After the Ohio compromise was a nationwide agreement for eggs but not hogs. Both the UEP and HSUS have lobbied congress (Fatka, 2012) to phase out battery cages in 15–18 years—approximately 2026, the time horizon for the Ohio compromise, and that is not a

Table 1. Hog and Egg Production and Initiatives in U.S. States

		Hog Sales in Millions of $ (2007)	Egg Production in Millions of Eggs (2010)	I = Initiative Process Allowed			Hog Sales in Millions of $ (2007)	Egg Production in Millions (2010)	I = Initiative Process Allowed
1	Iowa	4827	14614		26	Montana	36	119	I
2	North Carolina	3105	3251		27	North Dakota	35		I
3	Minnesota	2140	2869		28	Tennessee	34	308	
4	Illinois[a]	1105	1272		*29*	*California*	*33*	*5390*	*I*
5	Indiana	974	6493		30	New York	28	1161	
6	Nebraska	923	2751	I	31	Washington	6	1739	I
7	Missouri	726	1949	I	*32*	*Oregon*	*6*	*715*	*I*
8	*Ohio*	*572*	*7535*	*I*	33	Maryland	4	616	
9	Oklahoma	556	769	I	34	Delaware	2		
10	Kansas	506			35	Hawaii	2	69.5	
11	South Dakota	381	672	I	*36*	*Florida*[b]	*2*	*2592*	*I*
12	*Michigan*	*357*	*2912*	*I*	37	Idaho	1		I
13	Pennsylvania	336	6976		38	West Virginia	1	267	
14	Texas	238	4811		39	Massachusetts	1	36	I
15	Utah	196	929	I	40	New Jersey	1		
16	*Colorado*	*159*	*1066*	*I*	41	Louisiana	1	462	
17	Mississippi[b]	129	1467	I	42	Vermont	1	59	
18	Wisconsin	100	1312		*43*	*Maine*	*1*	*1034*	*I*
19	Kentucky	90	1119		44	Connecticut	0	695	
20	Arkansas	84	2894	I	45	New Hampshire	0		
21	South Carolina	77	1102		*46*	*Arizona*	*0*		*I*
22	Georgia	68	4419		47	New Mexico	0		
23	Virginia	57	729		48	Rhode Island	0		
24	Alabama	55	2182		49	Nevada	0		I
25	Wyoming	42	2.4	I	50	Alaska	0		I

[a] Although Illinois technically allows initiatives for constitutional amendments, the initiatives are restricted to very specific issues, and for practical reasons, Illinois is treated the same as states without initiatives.

[b] Initiative can only be used to alter the state's constitution.

Source: National Agricultural Statistics Service (2007, 2011).

Notes: Maryland, New Mexico, and Kentucky allow popular initiatives, but these can only be used to void an existing law. States in italics have already banned gestation crates though initiatives and/or legislation.

coincidence. It seems plausible that Ohio, the second largest egg producer, feared being unable to compete with other states where battery cages are allowed and thus pushed for all states to ban battery cages. Because Ohio does not lead the nation in hog production like it does eggs, a similar push for banning gestation crates is absent. It is expected, then, that HSUS will push for initiatives in other states, hoping to ban gestation crates in enough states that enthusiasm for a nationwide ban among the hog industry will intensify.

Is such a strategy feasible? Assuming an Illinois initiative is impractical, Nebraska is the next largest initiative state in terms of hog production. Requirements for an initiative are daunting in Nebraska too: signatures must not only be at least 7% of all registered voters, but must exceed 5% in 38 of 93 counties; this last requirement seems impossible. Nebraska is a rural state with only two major cities, each city comprising only one county. The third largest city has only 50,137 people, and rural Nebraska counties are highly unlikely to pass any measure sponsored by HSUS. Banning gestation crates in Nebraska seems unlikely, but the models we develop here at least allow one to use more than just their intuition to judge the likelihood of success in a state like Nebraska.

A salient difference between the gestation crate and the battery cage debate is that gestation crates are of smaller value to hog producers. Gestation crates do lower the cost of raising hogs, but not as much as battery cages save in egg production (Norwood and Lusk, 2011). If animal advocacy organizations can ban crates in enough states, even if those states contain few hogs, the hog industry may decide the negative exposure from the initiatives is not worth the small increase in costs from alternatives to gestation crates and may agree to a nationwide ban. Thus, HSUS could still achieve its objectives by banning crates in states like Massachusetts, Nevada, Utah, and Washington. Moreover, the present discussion of initiatives should not cause us to forget the possibility of direct legislation, which should also be influenced by state demographics. It is impossible to predict how the gestation crate debate will unfold, but it is also impossible to deny that citizen sentiment toward the crates, which can be partially predicted with demographic data, will play a role.

Some studies have recorded people's preferences for the types of animal welfare changes required by Prop two. Richards, Allender, and Fang (2011) study how advertising changes people's value for cage-free eggs in an experiment, and Tonsor and Wolf (2010) investigate support for Prop two measure but in hypothetical surveys. Lusk (2010) measures how in-store demand for cage and cage-free eggs was influenced by Prop two's passing in California. These are interesting studies, providing insight into attitudes toward animal welfare, but none of them study actual votes cast by citizens for a Prop two measure. Only Videras (2006) analyzed actual votes, and it is this study we mimic in California.

Method and Data

The objectives of this study are to estimate the statistical relationships between county demographics and votes cast for Prop two in the 2008 California election and then to use these relationships to predict the outcome of a similar vote in other states. The method involves a two-step process. First, the voting record of the 2008 Prop two initiative in California is used in conjunction with demographic data to construct a regression model of voting behavior. This model describes how the percent of voters who approve of Prop two is influenced by demographics. Second, the parameters of this regression are assumed to be stable across other states and are used to project voting patterns in other states if a measure resembling Prop two were placed on a ballot. Our approach is similar to the methods used in environmental economics on benefits transfer, where economists use results from a study in one region or area to project benefits in another (e.g., Smith, Van Houtven, and Pattanayak, 2002).

The theoretical structure of the statistical models is quite simple: people can be grouped according to measurable demographics, and different demographic groups have their own distinct voting patterns. This empirical fact was made salient in a 2012 poll, which found

presidential candidate Mitt Romney earned 0% of black voters (Demby, 2012), but the vote for whites was considerably higher. To suggest that ethnicity might also impact initiatives to ban animal cages seems hardly a stretch, especially considering survey work showing differing levels of stated support for animal welfare laws across ethnicities, income levels, gender, education, age, and religious beliefs (Prickett, 2007), empirical work showing how demographics affect food preferences (Albisu, Gracia, and Sanjuan, 2011), but more importantly the work by Videras (2006) on the relationship between demographics and the Florida initiative to ban gestation crates.

The only theoretical structure needed is the notion that some demographics might influence voting behavior, but this structure can be nested within any of the theories regarding voting behavior. Three such theories are the rational voter hypothesis, the expressive voter hypothesis, and the ethical voter hypothesis (Mueller, 2003).

The rational voter hypothesis, sometimes referred to as the Rochester model, treats voting decisions much like shopping decisions, where voters support whatever initiatives or candidates provide them with the highest expected utility. It is only the outcome of the vote that matters (Amadae and Bueno de Mesquita, 1999), and if different demographics receive different streams of utility from banning gestation crates and battery cages, then demographics will be correlated with votes cast for Prop two. Individuals in rural areas might oppose Prop two because they feel it may harm rural economic growth and thus their personal income. The urban poor may oppose it in fear food prices will increase. Of course, if the benefits of voting depend solely on the outcome, a person might be for or against Prop two but would have little incentive to vote, because the probability their vote will decide the fate of Prop two is almost zero (they are probably more likely to die in a car crash on the way to the polls than they are to influence the outcome).

People do vote, however. Turnout for California in 2008 was almost 80% (Field Research Corporation—California Opinion Index Secretary of State, 2009). This suggests that better explanations of voting behavior might be found in what is called the Michigan model of voting, in which a person's personality, political identification, social identity, and ethical beliefs determine how a person votes. This model suggests that people may choose to vote, and vote for certain candidates and initiatives, regardless of how the election outcome impacts them personally. Instead, the individual pays heed to their duty as a citizen, a member of a political party, a religious order, and a moral community (Miller and Shanks, 1996).

One genre of the Michigan model is the expressive voter hypothesis, where voters receive benefits from voting in addition to the election outcome. Call it loyalty to one's political party or the desire to express one's opinion, but the point is that people will pay a cost to vote for the mere act of voting, regardless of the expected outcome. This means that people who supported Barack Obama for president out of a sense of self-identity may also vote for Prop two, in the belief that electing Obama and passing Prop two are outcomes consistent with their political identity, their values, and the social groups they align with. In this sense voting is like attending a football game. The game has virtually no consequence in the person's life other than the enjoyment from watching the game and knowing "their team" was victorious. Grouping citizens into economic, political, religious, and ethnic groups is like parsing people into their various identities, which should exhibit different voting patterns. Like the rational voter hypothesis, the expressive voter hypothesis predicts that demographic variables and voting behavior should be correlated.

Because animal welfare is an ethical issue, the ethical voter hypothesis—another manifestation of the Michigan model—should be particularly important. Many people really do care about farm animals and want them treated humanely not because it benefits them directly, but because it is "the right thing to do." However, not every demographic holds the same ethical values. A higher income allows one to focus more on the well-being of animals in addition to oneself. Different political parties hold different values on regulation (and

regulation in general contains some ethical notions). Religion certainly involves ethics, and different ethnicities pass down different ethical beliefs from one generation to another. To the extent that the ethical voter hypothesis is valid and various demographics reflect different ethical beliefs, demographics and voting behavior for Prop two should be correlated.

These three theories all suggest demographics and voting behavior are correlated, and most readers probably see some truth in all three. Because this study is concerned with how people vote and not why, it is irrelevant whether just one or more than one theory reflects why and how people vote.

The next section estimates a regression using demographic variables as explanatory variables in predicting the percent of individuals in each California county voting in favor of Prop two. Theories of voting behavior do not reveal which demographic variables should be included, so we select a wide range of demographics, so long as they meet one important criteria: they must be observable in all 50 states. Otherwise, the regression for California cannot be used to predict outcomes in other states. That said, it should be recognized that there are many other variables (like spending by special interest groups in support of or opposition to Prop two) that could provide more accurate predictions of voting patterns within California. Further research focusing on California solely would want to consider a larger array of variables than those in Table 2.

California contains 58 counties, and the share of individuals in each county voting for Prop two constitutes the dependent variable. When they entered the ballot box to vote for Prop two, they were also given the opportunity to vote for their preferred presidential nominee. It is likely that those who voted for candidate Obama were also more likely to vote for Prop two. Other demographic variables are compiled from various sources; these include income, value of the person's home, gender, religion, ethnicity, age, population density, and proximity to farms. Table 2 provides descriptive statistics of these variables, which are used as explanatory variables in a regression model.

A few remarks about these variables are warranted. Home values are used in addition to household incomes because home values reflect current income, past income, and expectations of future income (but because it is an imperfect measure of wealth, the variable current household income is also included). Income and house prices are not adjusted for differences in cost of living across regions, because higher living costs generally reflect more valuable amenities (it costs more to live at the beach because the beach itself is highly valued). The percentages for white, black, and Hispanic ethnicities can exceed 100%, because someone may identify with both whites and Hispanics. Population density is measured by people per square mile and lack of exposure to farms by the population per farm in the county.

These demographic variables shown in Table 2 are selected according to published empirical research (Prickett, Norwood, and Lusk, 2010; Videras, 2006) and *a priori* expectations, and the adjusted R^2 is then used to select the best combination of variables, because it considers both the in-sample predictive ability of a model as well as the loss in degrees of freedom from adding more variables. The following two sections describe the econometric model structure.

Econometric Model Structure

The statistical model used is an extension of the basic ordinary least-squares regression. The regression is constructed to predict the percent of voters who approve of Prop two, denoted V, but V cannot be used as the dependent variable because it is censored between zero and one, which would bias parameter estimates (Maddala, 2001). Instead, a simple transformed variable Y results in an uncensored dependent variable (see subsequently), and so Y is the dependent variable used in the regression. This procedure is appropriate for cases in which V will never precisely equal zero or one in the sample and where predicted values of V should always be between zero and one. This is the approach used by Videras (2006) for similar data.

$$(1) \qquad Y_i = ln\left(\frac{V_i}{1 - V_i}\right) = X_i\beta + e_i,\ e_i \sim N\left(0,\sigma^2\right)$$

In equation (1), X_i is a vector of explanatory variables for the i^{th} county or state, β is a parameter vector, and e_i is a stochastic error term. Once the parameter vector is estimated, the

Table 2. Descriptive Statistics of Voting Behavior and Demographics Across All 58 California Counties

	Average/Weighted Average[a]	Standard Deviation (of nonweighted)
V = Votes in favor of ban (%)	57%/64%	8.83%
Y = ln(V/[1-V])	0.31/0.54	0.37
W = County population/state population	0.0172/—	0.04
Explanatory Variables		
Wealth		
Income = median household income (2008)	$54,452/$61,591	$13,964.06
House = median value of owner-occupied housing units (2005–2009)	$407,602/$498,474	$170,863.77
Poverty = percent of people of all ages in Poverty (2008)	14%/13%	4.48
Male = males per 100 females (2008)	103.94/100.23	12.44%
Education = persons 25+ years of age with a Bachelor's degree or higher (2005–2009)	24%/29%	10.28%
Obama = vote for Obama in presidential 2008 election (%)	53%/61%	13.20%
Religion		
MainProt = Mainline Protestants (per 1000 population)	34/35	12.39
EvanProt = Evangelical Protestants (per 1000 population)	76/73%	29.79
Catholic = Catholic (per 1000 population)	222/295	116.97
Ethnicity[b]		
White = white alone, not Hispanic (%)	57%/40%	19.47%
Black = black (%)	3%/6%	3.29%
Hispanic = Hispanic (%)	29%/38%	17.32%
Age = median age	39%/35%	6.08
PopDensity = people per square mile	659/1746	2,329.12
PopPerFarm = population per farm	2914/5760	17,662.98

[a] Weighted by population.

[b] Because some Hispanics/Latinos may also identify themselves with white ethnicities, the percent of whites, blacks, and Hispanics sometimes exceeds 100%.

Sources: Votes on Prop two came from California's statement of vote from the November 4, 2008, general election. The membership data for religious affiliations came from the Association of Religion Data Archives for 2000. All other data were acquired from the U.S. Census Bureau collection of data sets at /www.census.gov/support/USACdataDownloads.html#AGN.

predicted V_i is acquired first by taking the inverse of equation (1).

$$(2) \qquad V_i = \frac{e^{X_i\beta+e_i}}{1+e^{X_i\beta+e_i}}$$

The expected value of equation (2) is a nonlinear function of a random error e_i. So although equation (1) can be estimated using simple ordinary least squares, the expected value of V goes by a highly nonlinear equation, which can be approximated using bootstraps.

Other models could be used. A simple logit model could be used where the zero/one dependent variable is used to determine if a county voted in favor of the measure (but this excludes valuable information on the actual vote shares) or by using the share of votes for each county as the dependent variable (logit models do not have to have discrete dependent variables). If the latter estimate was used, the logit would be specified such that the percent of votes is said to be $V_i = \frac{e^{X_i\beta+e_i}}{1+e^{X_i\beta+e_i}}$. However, this is the same specification as in equation (2), so our model and the logit model are built on the same basic assumptions.

The reader might suspect a Tobit regression would be valid, considering the variable V_i is

censored. Such a model would describe V as follows.

$$(3) \quad V_i = X_i\beta + e_i, \text{ if zero} \le X_i\beta + e_i \le 1$$
$$V_i = 0, \text{ if } X_i\beta + e_i < 0$$
$$V_i = 1, \text{ if one} < X_i\beta + e_i$$
$$e_i \sim N(0,\sigma^2)$$

The model in equation (3) is then easily estimated using maximum likelihood (see Haab and McConnell, 2002). Although it is true that the values of V_i are always greater than zero and less than one, the value of $X_i\beta + e_i$ could lie outside the (0, 1) interval, so the Tobit model would be a valid estimation procedure. However, there is no reason the Tobit or logit model would be superior to the simpler regression model in equation (1). All require numerical/simulation techniques either at the estimation or prediction stage, and our choice is merely a preference.

Regardless of the model used, the vector β cannot be interpreted as the change of shares of votes for Prop two as a result of a unit change in the elements of X_i. To detect the exact change in V_i as a result of a change in explanatory variables, either the exact V_i 's must be calculated before and after the change or numerical integration must be used. The sign of β does indicate the change in V_i in that a positive number means voter—shares rise as the explanatory variable increases in value.

Selecting the Dependent Variables

Because of the low sample size (58 observations), care must be taken in including explanatory variables. If all 15 potential variables in Table 2 are used, that would constitute less than five observations per coefficient estimated—a low degrees of freedom. At the same time, variables should not be excluded before their explanatory power is appraised. Rather than estimating one set of explanatory variables, a range of regressions is estimated, each one varying in the set of explanatory variables used. A model selection criterion is then used to determine which model makes the best tradeoff between the information content of a variable and degrees of freedom. For now, simply denote any one regression as

$$(4) \quad Y_i = ln\left(\frac{V_i}{1 - V_i}\right) = X_{i,m}\beta_m + e_{i,m}$$

In equation (4), i denotes the i^{th} county and m denotes the m^{th} collection of explanatory variables constituting a model. The prediction error is $e_{i,m}$, and because the data are cross-sectional, this error may be heteroscedastic. To reflect this possibility, all test statistics are computed using White's (1978) variance–covariance matrix.

Because the purpose of the regression is to predict state-wide election results based on county-level data, each county should not be treated equally; counties with larger populations will have a greater impact on the state-level vote. For this reason, instead of minimizing the sum-of-squared errors, the procedure will minimize the weighted sum-of-squared errors. Coefficients will be chosen to minimize $\sum_i W_i e_{i,M}^2$, where W_i is the "weighting variable" equaling the population of county i divided by the total population of California such that the sum of all the W_i s equals one (the sum of the weights could be set to any number though).

The construction of W_i is intuitive: if County A has twice as many citizens as County B, and the percent of citizens voting is identical, County A will have twice the impact on state-level results. Consequently, in the regression, County A should be given twice the consideration; weighted regression ensures this is the case. The reader will note that in Table 2, the weighted average of the variable Vequals the actual percent of Californians who voted for Prop two (64%), whereas the non-weighted average is seven percentage points less.

Equation (1) defines a general model, but the exact variables from Table 1 that will be used are identified by first estimating a parsimonious model and then gradually adding additional variables, up to 15, resulting in seven different estimated models. The variables chosen in the parsimonious models, and the order in which additional variables are added, is chosen by the researchers. For example, the percent of the county that voted for Obama in 2008 is suspected of being the most important variable

and so it alone is included in the parsimonious model (Model one). Population density and farm density are then added to the second model (Model two) after which is added three variables on wealth (Model three); then variables on education, age, and gender (Model four); then three variables regarding race are added (Model five); then the three ethnicity variables are removed and replaced with three ethnicity variables (Model six); and Model seven contains all 15 explanatory variables. The adjusted R^2 values are computed for each model and the highest ranked models are used to predict voting behavior in other states. These are a few of the many combinations of explanatory variables that could be used.

Once the top models have been identified, the value of the explanatory variables associated with states (denoted $X_{s,m}$) will be plugged into equation (1) to predict each state's *Y*. However, the variable of interest is *V*, not *Y*, and as a result of Jensen's Inequality, the predicted voting share cannot be calculated as $V = e^{E(Y)}(1 + e^{E[Y]})^{-1}$. However, using Krinsky-Robb bootstraps (Krinsky and Robb, 1986) to compute an asymptotically unbiased estimated of *V,* we get virtually identical results for all models. In the following discussion, all references to changes in "support" levels refer to projected support levels from the regressions, not the actual votes for a county.

Regression Estimates

Seven combinations of explanatory variables are used in the regressions reported in Table 3. The positive signs on the Obama variables are not surprising, because progressives are more receptive to regulation, although two coefficients for *Obama* are not statistically significant. Population density and population per farm were only significant in Model five, a model in which—surprisingly—a higher population density signified less projected support for the measure. However, because the correlation between these two variables is 0.68, their joint effect could be positive and significant.

Both *income* and *house* have a correlation of 0.81, so their effects are joint also. Poverty significantly decreases support for Prop two in one model, and the effect of education, age, and males is mostly insignificant. Regarding the ethnicity variables, blacks (and in one model Hispanics) are more likely to vote for Prop two. In the two models with religious variables only, Mainline Protestants are significant, and in only one model, but this variable will become particularly important when predicting support rates for other states.

Across the models it is clear that adding more variables (up to 15) increases the adjusted R^2, suggesting many demographic variables together are useful in explaining voting patterns even with a low sample size. Thus, states with different demographics than California are expected to show differing levels of projected support for Prop two measures. Because only these seven models are estimated, it is possible that a different model could result in an even higher adjusted R^2 and different (perhaps even more accurate) predictions for each state. For the seven models estimated, however, Model seven appears to provide the best predictions, so most state-level predictions will use Model seven.

Videras (2006) estimates similar regressions using Florida data. Like Videras, we find that counties supporting Democratic candidates were more likely to vote for a Prop two-like measure, but religious variables play a smaller role in our regressions as did age and gender. These are crude comparisons, however, because we use a different set of explanatory variables and estimate a different number of models.

State Predictions

The second objective of this research is to use the models in Table 3 to predict the percentage of voters in each state that would vote for a Prop two initiative. Data on the values of each explanatory variable in Table 3 are inserted into Model seven to calculate the projected support rates in Table 4.

The states with the strongest support for a Prop two include three New England states, Maryland, and Louisiana; one of these is not like the other (Louisiana). Their one common feature is the composition of their religious identities. Notice that states with the lowest

Table 3. Models as Determined by Statistical Information Criterion

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
				Parameter Estimate (test statistic)			
Intercept	**–0.617**	**–0.596**	0.318	1.333	–0.502	1.304	–0.472
	(–4.12)	**(–4.46)**	(0.60)	(1.40)	(–0.53)	(1.54)	(–0.63)
Obama	**0.019**	**0.018**	**0.014**	**0.013**	0.000806	**0.01**	0.001
	(9.30)	**(11.07)**	**(6.17)**	**(5.58)**	(0.21)	**(3.90)**	(0.34)
Popdensity	—	0.00004	–0.000001	–0.000006	**–0.000075**	–0.000009	–0.000047
	—	(1.66)	(–0.02)	(–0.24)	**(–2.54)**	(–0.47)	(–1.91)
Popfarm	—	–0.000005	–0.000001	–0.000001	**0.000008**	0.000001	**0.000006**
	—	(–1.69)	(–0.21)	(–0.07)	**(2.47)**	(0.48)	**(2.33)**
Income	—	—	–0.00001	**–0.000016**	**–0.000013**	–0.000009	–0.000003
	—	—	(–2.00)	**(–2.35)**	**(–2.76)**	(–1.21)	(–0.41)
House	—	—	**0.000001**	**0.000001**	**0.000001**	0.000001	**0.000001**
	—	—	**(2.25)**	**(2.31)**	**(3.40)**	(0.11)	**(2.78)**
Poverty	—	—	–0.03	**–0.044**	–0.025	–0.035	–0.006
	—	—	(–1.75)	**(–2.10)**	(–1.30)	(–1.74)	(–0.31)
Education	—	—	—	0.008	**0.01896**	0.012	0.013
	—	—	—	(1.03)	**(2.85)**	(1.66)	(1.48)
Age	—	—	—	–0.016	0.00861	–0.005	0.003
	—	—	—	(–1.66)	(0.74)	(–0.48)	(0.24)
Males	—	—	—	–0.000328	–0.000862	–0.004	–0.004
	—	—	—	(–0.10)	(–0.30)	(–0.98)	(–1.27)
White	—	—	—	—	0.0036	—	0.008
	—	—	—	—	(0.78)	—	(1.78)
Black	—	—	—	—	**0.04275**	—	**0.046**
	—	—	—	—	**(4.42)**	—	**(5.84)**
Hispanic	—	—	—	—	**0.00955**	—	0.007
	—	—	—	—	**(2.24)**	—	(1.35)
Mainprot	—	—	—	—	—	–0.005	**–0.006**
	—	—	—	—	—	(–1.27)	**(–2.10)**
Evanprot	—	—	—	—	—	–0.002	–0.002
	—	—	—	—	—	(–0.99)	(–1.25)

Table 3. Continued

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Parameter Estimate (test statistic)						
Catholic	—	—	—	—	—	0.0005	0.00055
	—	—	—	—	—	(1.81)	(0.97)
R^2/Adjusted R^2	0.636/0.629	0.649/0.629	0.744/0.714	0.759/0.714	0.848/0.808	0.781/0.734	0.871/0.815

Notes: All models were estimated using weighted regression; instead of minimizing the sum-of-squared errors, the estimation procedure minimized a weighted sum. Each squared error was multiplied by the variable *W*, which equals the county population divided by the state population. Because the data were cross-sectional, which is usually suspected of exhibiting heterogeneity, test statistics were calculated using the White standard errors (White, 1978). Variables in bold are statistically significant at the 5% level.

projected support rates—from Kansas to North Dakota—are those dominated by Mainline Protestants, who are less likely to vote for Prop two. North Dakota is the highest ranked state in terms of Mainline Protestant, whereas Louisiana is ranked 43. The strong Catholic presence in Louisiana (named after Louis XIV of France), Maryland (named for the Catholic Scottish Queen), and New England (where the Irish immigrated to in flocks) makes it a very different place than the Protestant Dakotas.

To see the importance of religion in explaining Louisiana's high ranking in Table 4, consider the following thought experiment. Both Louisiana and Mississippi have roughly the same proportion of black people, and Mississippi is ranked 17^{th} in support for Prop two, whereas Louisiana is second. Now suppose we gave Mississippi the same religious profile as Louisiana—less Protestants, more Catholics. The support of votes for Prop two in Mississippi would then rise from 55% to 74% and would make Mississippi the most enthusiastic predicted supporter of Prop two of all the U.S. states!

As another illustration of the importance of demographic variables, suppose we predicted support rates with the more parsimonious Model two, as shown in Table 5. Because Model three ignores religion and race, Louisiana falls from the second biggest supporter of Prop two to the 48^{th}. Also notice that the support rates overall for Model three are higher than that of Model seven. If we ignore religion and race as in Models three and four (there is almost no difference in projections from Models three and four), we would get the false impression that every state might approve Prop two.

Also notice how Hawaii is the top state for Model three but the 25^{th} for Model seven. Hawaii voted for Obama more than any other state, and because Model three ignores so many demographic variables, it places considerable weight on the *Obama* variable and thus probably treats Hawaii as more Democrat/regulation-friendly than it really is.

Now let us consider the implications of Model seven. Of the New England states, all of which are predicted to approve of Prop two in Table 4, only Maine and Massachusetts allow initiatives, and Maine already has legislated to

Table 4. Predicted Success of a Proposition Resembling Prop Two in All U.S. States (Model Seven)

Predicted Percentage of Voters Approving Initiative Mimicking Prop Two in each U.S. State					
		Model Seven			Model Seven
1	Maryland	72	26	*Maine* (L)	49
2	Louisiana	70	27	New Mexico	49
3	New York	70	28	*Ohio* (L)	47
4	New Jersey	69	29	Idaho	47
5	Massachusetts	67	30	Alabama	46
6	*California (64%)*	64	31	Texas	45
7	Rhode Island	62	32	Missouri	44
8	Connecticut	62	33	Pennsylvania	44
9	Delaware	61	34	North Carolina	44
10	Nevada	61	35	Alaska	42
11	*Florida (55%)*	61	36	Indiana	41
12	Georgia	58	37	Wisconsin	40
13	Illinois	58	38	Tennessee	40
14	Utah	57	39	Wyoming	40
15	*Michigan* (L)	56	40	Montana	39
16	New Hampshire	56	41	Arkansas	35
17	Mississippi	55	42	Kentucky	35
18	Virginia	53	43	Kansas	33
19	*Arizona (62%)*	52	44	Minnesota	30
20	*Colorado* (L)	52	45	Nebraska	28
21	Washington	51	46	West Virginia	28
22	Vermont	51	47	Oklahoma	23
23	*Oregon* (L)	50	48	Iowa	21
24	South Carolina	49	49	South Dakota	17
25	Hawaii	49	50	North Dakota	14

Notes: States shaded in gray allow initiative referenda. As indicated by italics, Florida, California, and Arizona have already hosted an initiative to ban certain animal cages. For these states, the actual percent of voters approving is given next to the state name. Oregon, Colorado, Maine, Michigan, and Ohio have already banned gestation crates through legislation, as identified with the *(L)* following the state name. Florida and Arizona only banned gestation crates for sows, whereas California banned this and battery cages for layers. To acquire a rough confidence interval to the percentages, add and subtract six percentage points.

ban gestation crates. An initiative to ban gestation crates in Massachusetts is predicted to pass with high likelihood. Moreover, the obstacles to establishing an initiative in Massachusetts are low, because the signatures needed must only exceed 3% of last votes cast for governor, and the only geographic requirement is that no more than 25% of the signatures come from one county. Although Massachusetts may not be a large hog or egg state, do not doubt a nonagricultural state's ability to influence livestock policy. Consider New Jersey, where Model seven suggests a Prop two measure would pass with 69% of the vote. Although the state does not allow initiatives, legislation to ban gestation crates was passed by both the New Jersey House and Senate. Governor Christie ultimately vetoed it in June of 2013, but the bill passed by such a wide margin in the state legislature that overriding his veto seems likely.

Table 5. Predicted Success of a Proposition Resembling Prop Two in All U.S. States (Model Three)

Predicted Percentage of Voters Approving Initiative Mimicking Prop Two in each U.S. State					
		Model Three			Model Three
1	Hawaii	71	26	*Ohio* (L)	57
2	*California (64%)*	66	27	Montana	57
3	Vermont	65	28	Indiana	57
4	Massachusetts	64	29	Missouri	57
5	Rhode Island	64	30	North Carolina	56
6	Maryland	64	31	North Dakota	56
7	New York	63	32	*Arizona (62%)*	55
8	Delaware	63	33	South Dakota	55
9	New Jersey	62	34	Nebraska	55
10	Connecticut	62	35	Georgia	55
11	Washington	62	36	Kansas	54
12	Nevada	61	37	South Carolina	54
13	New Hampshire	61	38	Utah	54
14	Illinois	61	39	Idaho	53
15	*Maine* (L)	61	40	Tennessee	53
16	*Oregon* (L)	61	41	Alaska	53
17	Wisconsin	61	42	West Virginia	53
18	Minnesota	60	43	Wyoming	53
19	*Colorado* (L)	60	44	Texas	52
20	Virginia	59	45	Kentucky	52
21	*Florida (55%)*	59	46	Alabama	52
22	Pennsylvania	59	47	Arkansas	51
23	Iowa	59	48	Louisiana	51
24	*Michigan* (L)	59	49	Mississippi	50
25	New Mexico	58	50	Oklahoma	50

Notes: States shaded in gray allow initiative referenda. As indicated by italics, Florida, California, and Arizona have already hosted an initiative to ban certain animal cages. For these states, the actual percent of voters approving is given next to the state name. Oregon, Colorado, Maine, Michigan, and Ohio have already banned gestation crates through legislation, as identified with the *(L)* following the state name. Florida and Arizona only banned gestation crates for sows, whereas California banned this and battery cages for layers. To acquire a rough confidence interval to the percentages, add and subtract six percentage points.

Nevada is ranked high in terms of predicted votes, and although the requirements for establishing an initiative are not easy (the petition must contain signatures exceeding 10% of votes cast in last general election, applied both to the entire state and each Congressional district), they are similar to the requirements in Florida, where an initiative to ban gestation crates has already taken place—and passed.

A number of states with large livestock industries reside in the top half of the list. Illinois ranks 13th in Table 4 and is also the fourth largest hog producer in terms of cash receipts (see Table 1). This would be alarming for Illinois if the requirements for an initiative were not so burdensome as to prevent a gestation crate initiative. This illustrates the importance of establishing high costs for state-level

initiatives—if the goal is to prevent a Prop two event.

Approximately 47% of Ohio citizens are predicted to vote to ban restrictive livestock cages. Ohio is the eighth biggest hog producer and the second largest egg-producing state, illustrating both why HSUS targeted Ohio and why Ohio agriculture capitulated before an initiative could be held (47% is close to a 50–50% chance of passing). Michigan and Colorado have legislated gestation crates away before an initiative could be held. Installing an initiative in Michigan or Colorado is not overly expensive, and given the projected support for Prop two in both states, it is clear why they sought to avoid an initiative.

Utah voters are predicted to support Prop two, and the requirements for a Utah initiative are low enough that a Utah Prop two would not be surprising. The state of Washington was considering an initiative on battery cages, which may be irrelevant if the HSUS and UEP can continue their alliance—and one now wonders whether Washington will pursue a gestation crate initiative given its demographics are favorable to its approval.

The hypothetical initiative in North Carolina would fail with a predicted vote of 44% for Prop two, but like Maine, is not far from passing, yet North Carolina raises more hogs than any other state besides Iowa. Although North Carolina does not allow initiatives, environmental groups have demonstrated an ability to threaten the hog industry (Environmental Defense Fund, 2000). Could animal advocacy groups do likewise? Given that Smithfield Foods, who owns almost all the state's hogs, has voluntarily committed to replacing gestation crates with group pens on the North Carolina farms it owns (Smith, 2013b), one cannot say gestation crates are immune from animal advocacy groups. Iowa is the biggest hog-producing state, does not allow initiatives, and exhibits a very low support rate of 21%, perhaps making the most powerful hog state immune from gestation crate bans.

At the bottom of the list are the Dakotas with percentages under 20%. The Dakotas are the highest and second highest ranked in terms of Mainline Protestants, have the smallest number of people per farm, and are among the highest in terms of white ethnicities. In areas of rural white Protestants, Prop two stands little chance of passing.

How accurate are the percentages in Table 4? One measure can be found in the fact that two other states besides California have hosted a similar initiative for gestation crates. Although the votes occurred before 2008, they are nevertheless a useful test for discerning whether the relationship between demographics and voting behavior is relatively stable across states and time. Florida passed their measure with 55% of the actual vote, whereas Table 4 predicts 61%, which seems close enough to deem the prediction accurate. Although the Arizona measure is predicted to pass and it did, the difference is ten percentage points. We leave the reader to decide whether these are accurate predictions or not.

Implications for Hogs

The egg industry's weakness is Ohio. It is the second largest egg-producing state, 63% of its voters are projected to vote in favor of an initiative resembling Prop two, and Ohio's laws make initiatives possible and relatively inexpensive. For these reasons, the egg and pork industries were worried HSUS would be able to ban gestation crates and battery cages through an initiative resembling Prop two and capitulated to prevent a public defeat and to negotiate favorable terms. The Ohio egg lobby, we suspect however cannot prove, sought to force other states to also phase out the battery cage. Otherwise, Ohio would be hobbled by higher production costs. Regardless of the reason, the UEP has joined with the HSUS to pursue a nationwide ban.

It is worth noting that the hog industry has no counterpart to Ohio; there is no single state serving as a weak link resisting gestation crates. The top seven hog-producing states are insulated from gestation crate bans by the absence of initiatives, high costs to installing an initiative, and/or state demographics opposed to a Prop two initiative. These seven states comprise 77% of all hog production (as measured by sales revenue), and so more than three-fourths of the hog industry is well defended against initiatives. This suggests a nationwide ban on gestation crates, following as a result of state-level initiatives, is unlikely.

There are still ways the HSUS and other animal advocacy groups might increase pressure on the hog industry, and given the relatively small benefit of gestation crates in terms of production costs, a nationwide gestation crate ban might be achieved with only minor state victories by the HSUS. Consider the following scenario. The HSUS targets Massachusetts, Nevada, Utah, and Washington, where initiatives can be reasonably established and where a majority of voters might approve a measure like Prop two. Although these four states host small hog populations, news of the gestation crate ban would be covered by media across the country—and not all publicity is good publicity.

The hog industry would then begin to wonder whether the benefits of gestation crates are worth the bad publicity. Research has estimated gestation crates to reduce costs by only 2.3% compared with farms where gestation crates are replaced with group pens (Seibert and Norwood, 2011). Compare this with the benefit of battery cages in egg production, which reduce costs by 25% compared with cage-free egg production (Sumner et al., 2008) and 10–15% compared with enriched cages (Norwood and Lusk, 2011). Considering costs only, *ceteris paribus*, pork producers have less to lose from Prop two than egg producers.

Even if bad publicity from bans in Massachusetts, Nevada, Utah, and Washington are not enough to convince the hog industry to replace gestation crates with group pens, additional pressure from alternative organizations may. The federal government has considered requiring all government purchases of pork be produced without gestation crates, and although the proposal received little support, it could be revived with more fervor. More restaurants may require their food supplies be produced without gestation crates. A state court may someday decide that gestation crates violate their anticruelty laws, as New Jersey once considered (Norwood and Lusk, 2011).

Although an economist might ask whether consumers will begin replacing conventional pork with crate-free pork, there is little evidence of this occurring. Certainly, some crate-free pork is sold in stores like Whole Foods, but as a percentage of pork production, crate-free pork is virtually nonexistent. If gestation crates are banned, it will likely be the result of pressure from interest groups and citizens at the ballot box, not the average grocery store shopper.

The bottom line for the hog industry is this. Over three-fourths of U.S. hog production is insulated from state-level initiatives banning gestation crates. The question is whether the bad publicity from initiatives in other states and groups, combined with the relatively small benefit of gestation crates, is strong enough to induce the hog industry as a whole to voluntarily discard gestation crates. The answer to this question is unknown. What this study does show is that a state-level initiative to ban gestation crates in Massachusetts, Nevada, Utah, and Washington is a real possibility.

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