Impact of Animal Welfare Policies in California

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Note: All material presented are the researcher(s)' own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

Background

- 4 Nov 2008: CA passes Proposition 2: *"Standards for Confining Farm Animals"*
- 1 Jan 2015: Hen-laid eggs sourced from 'battery cages' are not allowed (but the larger enriched colony cage system is still allowed in egg production)
- 6 Nov 2018: CA passes Proposition 12 to require higher standards for hens:
  - 1 Jan 2020: at least 1 square feet of floor space per hen
  - 1 Jan 2022: indoors or outdoors cage-free housing must be provided
- **Proposition 12 requires that all eggs consumed in CA be cage-free from 1 Jan 2022** — this also applies to out-of-state suppliers
  - Cage-free eggs have higher costs of production compared to caged production
  - Setting a minimum quality standard will raise the price of eggs in CA

Introduction

Question:

- How do animal welfare (AW) policies affect the welfare of different groups of consumers? Which groups become better/worse off?

Approach:

- Use NielsenIQ datasets and voting data from CA elections to understand consumer preferences and WTP for AW
- Study how egg consumption in California changed after the introduction of AW laws, (i) for different income groups and (ii) across counties in California

Contribution:

- Understand the distributional impact of AW policies in CA and provide a detailed discussion of how consumer welfare was affected

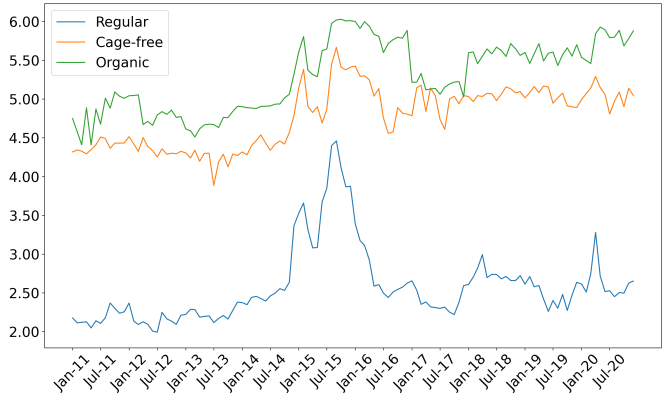


Figure 1: Average Price of a Dozen Eggs in California

1. Cage-free eggs refer to products with 'cage-free', 'free-range', or 'pasture-raised' labels.
2. All organic eggs are cage-free by definition.

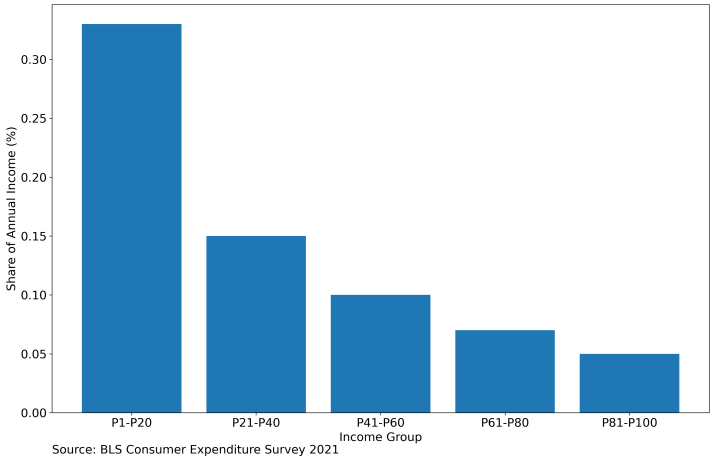
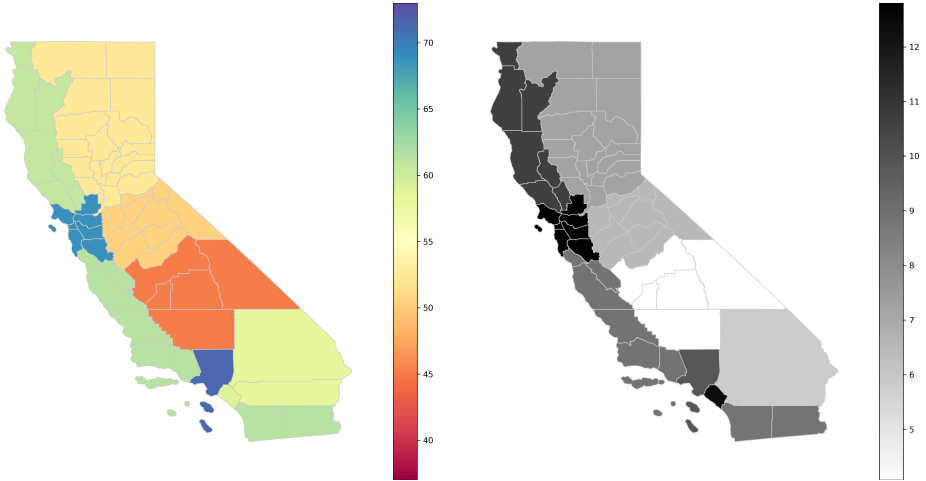


Figure 2: Annual Household Expenditure on Eggs in US



(a) Voted Yes for Prop 12 (%)

(b) Share of Cage-free/Organic Eggs (%)

Figure 3: Spatial Correlation of Prop 12 Vote and Egg Ctonsumption

Related Literature

- **Impact of animal welfare policies on egg prices**
  Allender and Richards (2010), Malone and Lusk (2016), Mullally and Lusk (2017), Carter, Schaefer, and Scheitrum (2021)

- **Consumer preference for egg quality**
  Kotschedoff and Pachali (2020), Oh and Vukina (2021)

- **Consumer demand and policy preferences**
  Deacon and Shapiro (1975), Holian and Kahn (2015), Burkhardt and Chan (2017), Fajgelbaum et al. (2023)

Data

1. **NielsenIQ Consumer Panel Dataset (2004 -)**
   - Household grocery purchases (shopping trips, items purchased, price, quantity, date of purchase, store visited (*subsample*), product characteristics, etc.)
   - Demographics (income, age, education etc.) and location (state, county)
   - *Subsample of consumer data can be matched to retail data with store code and purchase date*
2. **NielsenIQ Retail Scanner Dataset (2006 -)**
   - Weekly prices and quantities of products sold by participating retailers (incl. grocery stores); store location information (state, county, 3-digit zipcode)
3. **UC Berkeley California Statewide Database**
   - Ballot results by voting precinct in California
   - Proposition 2 (2008) and Proposition 12 (2018)

Consumer Data

	Full NielsenIQ sample			Matched to retailer data		
Year	Households	Grocery Trips	Bought Eggs	Households	Grocery Trips	Bought Eggs
2011	5,329	327,490	33,892	3,190	48,563	4,949
2012	5,483	320,162	33,457	3,860	50,736	5,662
2013	5,610	314,206	30,426	4,291	105,374	10,261
2014	5,575	309,991	28,056	4,363	104,103	9,407
2015	5,473	297,950	25,923	4,576	122,989	10,240
2016	5,258	295,617	28,772	4,644	127,637	11,841
2017	5,373	303,818	31,889	4,521	121,987	12,818
2018	5,299	298,229	29,301	4,632	141,672	14,076
2019	5,272	300,697	30,235	4,708	145,876	14,795
2020	4,875	284,693	28,683	4,572	142,283	15,409

Table 1: Summary Statistics: Grocery Trips in California

Retailer Data

Year	Number of grocery stores	Stores that sell all types of eggs	Matched to consumer data
2011	1,365	543	517
2012	1,335	984	924
2013	1,302	1,037	978
2014	1,177	1,085	1,026
2015	1,140	1,099	1,019
2016	1,122	1,085	997
2017	1,113	988	876
2018	1,677	1,298	1,117
2019	1,788	1,406	1,203
2020	1,779	1,427	1,205

Table 2: Summary Statistics: Grocery Retailers in California

Matched Sample Covers All Regions in California

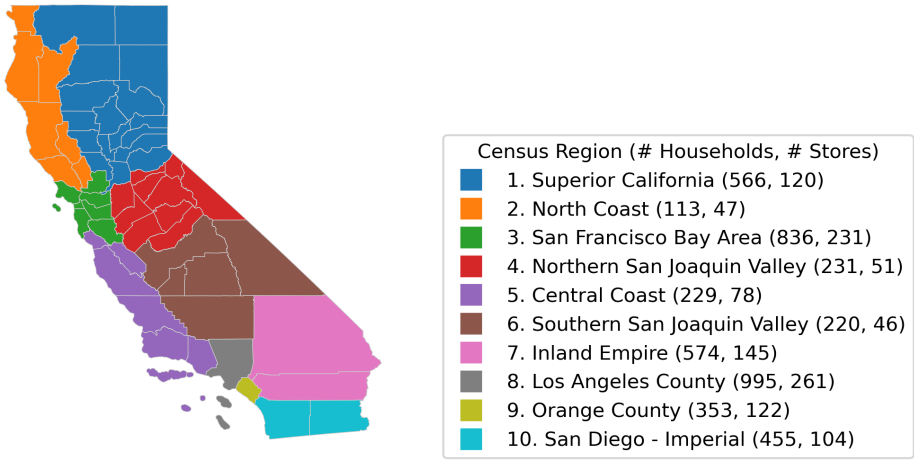


Figure 4: Matched Households and Stores in 2020 Counties

Egg Consumption Trends

Year	Avg. Cons. (dozens)	Market Share (%)			Price per Dozen ($)		
		Regular	*Cage-free*	*Organic*	*Regular*	*Cage-free*	*Organic*
2011	24.1	97.5	0.8	1.7	2.18	4.39	4.81
2012	23.2	97.4	1.0	1.6	2.14	4.35	4.83
2013	21.9	96.0	2.1	1.9	2.23	4.23	4.70
2014	19.2	94.0	2.8	3.2	2.53	4.47	4.97
2015	18.3	91.6	4.6	3.8	3.75	5.19	5.74
2016	21.6	93.6	3.5	2.9	2.78	4.99	5.84
2017	24.4	92.5	4.6	2.9	2.39	4.95	5.16
2018	22.6	90.4	6.0	3.5	2.73	5.06	5.60
2019	24.2	90.3	5.6	4.1	2.48	5.03	5.58
2020	23.2	90.0	6.5	3.5	2.64	5.05	5.74

Table 3: California Egg Consumption, Market Shares and Prices

Product Heterogeneity

	UPCs	Mean	S.D.	Min.	Med.	Max.
Price (All)	442	3.69	1.37	1.50	3.65	6.99
Price (Regular)	305	3.14	1.07	1.50	3.02	6.98
Price (Cage-free)	59	4.40	1.00	1.67	4.47	6.99
Price (Organic)	79	5.27	1.17	1.99	5.47	6.93
Regular	442	0.69	0.46	0	1	1
Cage-free	442	0.13	0.34	0	0	1
Organic	442	0.18	0.38	0	0	1
Brown	442	0.48	0.50	0	0	1
Omega 3	442	0.08	0.27	0	0	1
USDA Grade (A/AA)	442	0.94	0.24	0	1	1
XL / Jumbo	442	0.22	0.41	0	0	1
Pack	442	14.39	9.01	6	12	60

Table 4: Summary Statistics of Egg UPCs in California (2011-2020)

Consumer Heterogeneity

	Avg. Cons. (dozens/year)	Market Share (%) *Regular*	*Cage-free*	*Organic*
Less than $25,000	18.09	96.26	2.01	1.73
$25,000 to $49,999	20.03	96.38	2.12	1.50
$50,000 to $69,999	19.93	94.58	3.37	2.05
$70,000 to $99,999	19.74	92.25	4.69	3.06
$100,000 and above	20.84	89.11	5.61	5.28
34 and below	16.64	90.28	5.24	4.48
35 to 64	20.55	93.22	3.71	3.06
65 and above	19.69	93.81	3.58	2.61
High school and below	24.42	96.48	2.00	1.52
College and above	21.63	92.27	4.36	3.37

Table 5: Summary Statistics of Egg Consumers in California (2011-2020)

Model

- For this analysis I use a subsample of 94,386 egg purchases made by 5,866 households in California from 2016 to 2017 in the Nielsen Consumer Panel
- Assume that the observed choice Y_{it}^* is a function of the latent variable Y_{it}:

$$Y_{it}^* = \begin{cases} Regular & \text{if } Y_{it} < \theta_1 \\ Cagefree & \text{if } \theta_1 \leq Y_{it} < \theta_2 \\ Organic & \text{if } Y_{it} \geq \theta_2 \end{cases}$$

$$Y_{it} = X_i'\beta + \delta_t + \varepsilon_{it} \ , \ \varepsilon \sim Logistic$$

$$X_i = \left(income_i, age_i, college_i, married_i, female_i\right)'$$

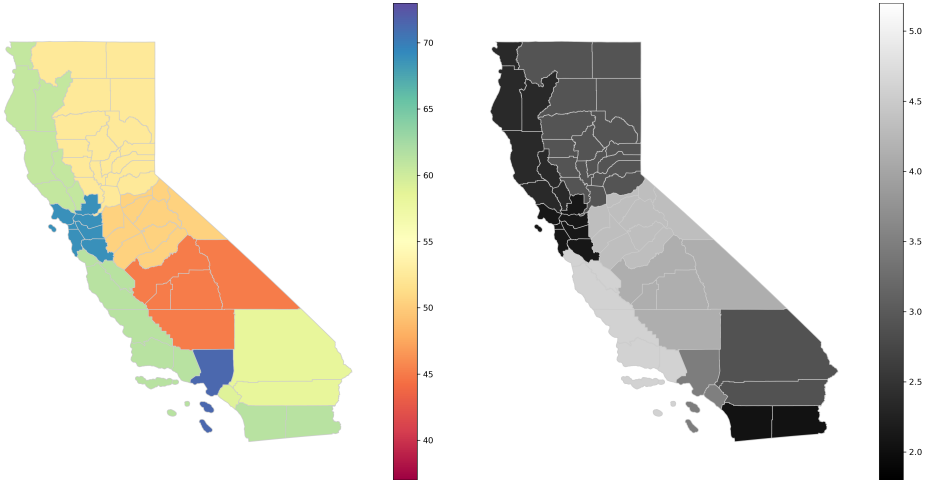
$$\delta_t = \text{ year and month dummies for trip } t$$

- Consumer preference for egg quality is (θ_1, θ_2)

Results

	MLE	Std. Error.	Odds Ratio
β: \$25,000 to \$49,999	0.095*	0.054	1.099
β: \$50,000 to \$69,999	0.259***	0.058	1.295
β: \$70,000 to \$99,999	0.590***	0.056	1.804
β: \$100,000 and above	0.932***	0.051	2.534
β: Age 35 to 64	-0.212***	0.042	0.809
β: Age 65 and above	-0.543***	0.055	0.581
β: College and above	0.623***	0.040	1.864
β: Married	0.049	0.030	1.050
β: Female head	0.258***	0.061	1.294
θ_1	2.687***	0.082	
θ_2	3.448***	0.084	
Observations	94,386		

Standard errors are bootstrapped with 50 replications
*** p<0.01, ** p<0.05, * p<0.1



(a) Voted Yes for Prop 12 (%)

(b) Estimate of θ_1 by Region

Figure 5: Spatial Correlation of Prop 12 Vote and Estimated Cutoffs

Summary

1. Before 2022, the majority of eggs consumed and sold in California were regular eggs from caged sources.

2. On average, cage-free eggs and organic eggs cost more than regular eggs, by 40% and 68% respectively.

3. Higher-income, younger, and/or college-educated households are more likely to purchase cage-free and organic eggs.

4. Regions with more support for Proposition 12 consumed more cage-free and organic eggs at the time.

5. Estimates of consumer preference show a positive spatial correlation between support for AW policy and taste for egg quality.

Future Work

- Specify a demand model with prices that allows for substitution with an outside good (no eggs purchased)
  - Consumers of regular eggs have to choose between cage-free eggs or no eggs after Proposition 12
  - Allow consumers who only want organic eggs to enter market when price of organic eggs is low enough

- Analyse consumer welfare
  - Calculate the change in consumer welfare before and after Proposition 12
  - Analyze the impact across income-groups and household profiles
  - Devise a method that maps observed prices and market shares to the vote data

End

Appendix A

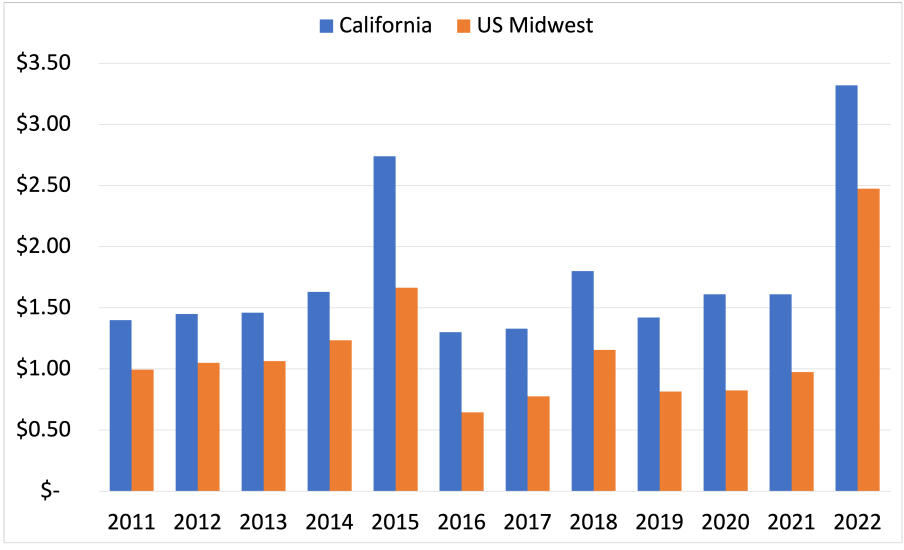


Figure A1: Median Wholesale Price of Dozen Large White Eggs (Source: USDA)

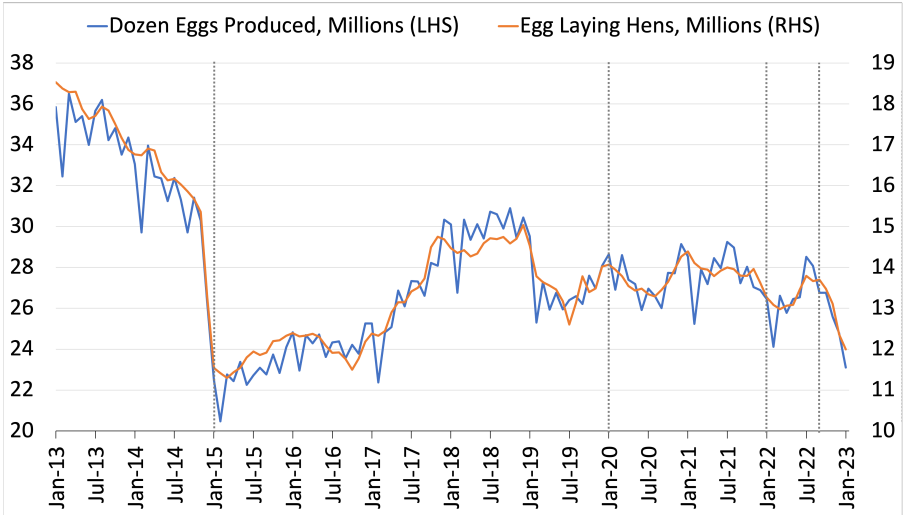


Figure A2: Egg Production in California (Source: USDA)

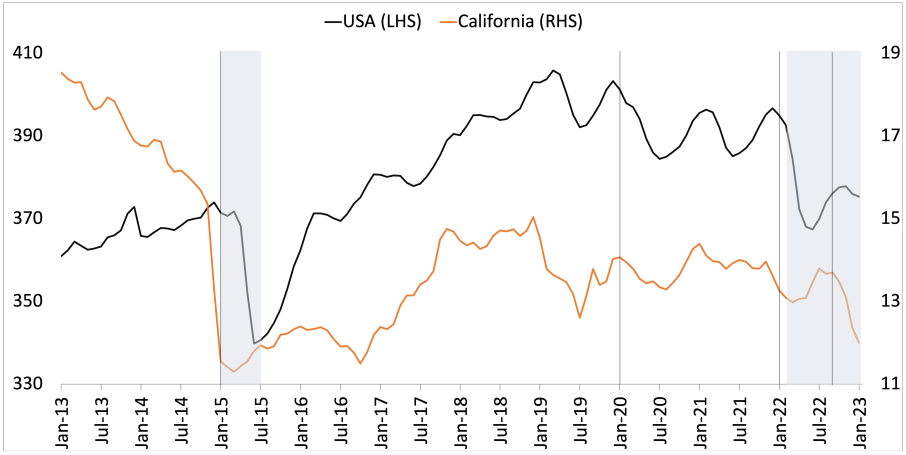
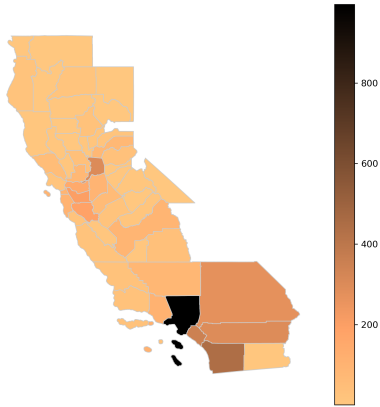


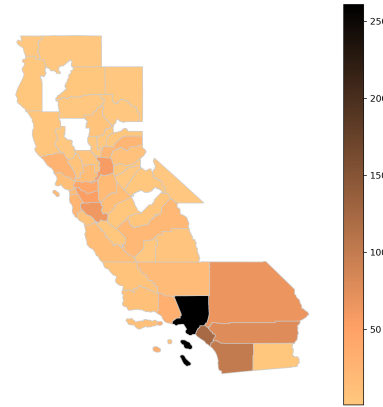
Figure A3: Number (in millions) of Egg-laying Hens (Source: USDA)[1]

[1]Vertical lines show CA policy changes; Shaded regions show bird flu events

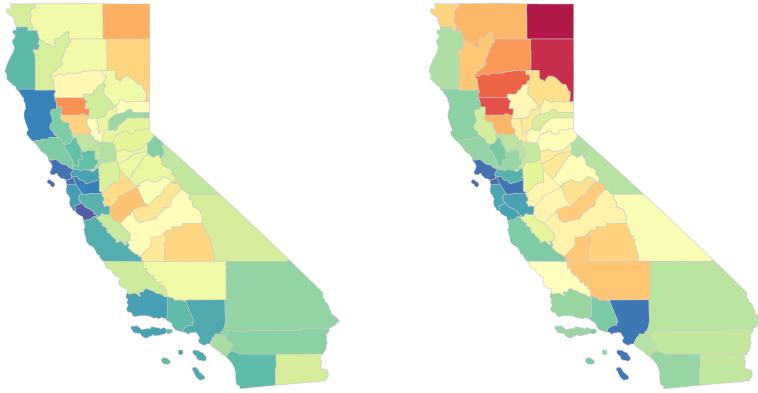
Back



(a) Matched Households (2020)



(b) Matched Stores (2020)



(a) Proposition 2 (2008)

(b) Proposition 12 (2018)

Figure A5: % voted Yes for Animal Welfare Propositions in CA

Appendix B

Model II

- Observed price depends on consumer choice: $P(Y_{it}^*)$
- In this alternate specification I use a 2-step approach to account for price effects in consumer choice (Oh & Vukina, 2021)
- Step 1: Regress price on a constant, observed product characteristics $Z(Y_{it}^*)$ and demand shifters (*Easter* and *Christmas* dummies) to predict residual price π_{it}

$$P(Y_{it}^*) = \gamma_0 + Z(Y_{it}^*)'\gamma + \delta_1 Easter + \delta_2 Christmas + \pi_{it} + \nu_{it}$$

- Step 2: Use predicted residual price $\hat{\pi}_{it}$ to account for price effects:

$$Y_{it} = X_i'\beta + \delta_t + \rho\hat{\pi}_{it} + \varepsilon_{it}$$

Step 1

	Coefficient	Std. Error.
Cagefree	0.723***	0.015
Organic	0.960***	0.016
XL / Jumbo	0.242***	0.008
USDA Grade (A/AA)	0.215***	0.008
Brown	1.442***	0.012
Omega-3	1.165***	0.016
Easter	0.192***	0.014
Christmas	0.074***	0.014
Constant	1.678***	0.008
Observations	94,386	
R^2	0.433	

*** p<0.01, ** p<0.05, * p<0.1

Step 2

	MLE	Std. Error.	Odds Ratio
ρ	-0.068***	0.017	0.935
β: \$25,000 to \$49,999	0.098**	0.048	1.103
β: \$50,000 to \$69,999	0.266***	0.045	1.305
β: \$70,000 to \$99,999	0.598***	0.048	1.819
β: \$100,000 and above	0.947***	0.049	2.579
β: Age 35 to 64	-0.220***	0.044	0.803
β: Age 65 and above	-0.547***	0.052	0.579
β: College and above	0.627***	0.040	1.872
β: Married	0.060**	0.029	1.062
β: Female head	0.247***	0.061	1.280
θ_1	2.657***	0.070	
θ_2	3.418***	0.068	
Observations	94,386		

Standard errors are bootstrapped with 50 replications
*** p<0.01, ** p<0.05, * p<0.1

Results

	MLE	MLE (Alt.)
ρ		-0.068***
β: \$25,000 to \$49,999	0.095*	0.098**
β: \$50,000 to \$69,999	0.259***	0.266***
β: \$70,000 to \$99,999	0.590***	0.598***
β: \$100,000 and above	0.932***	0.947***
β: Age 35 to 64	-0.212***	-0.220***
β: Age 65 and above	-0.543***	-0.547***
β: College and above	0.623***	0.627***
β: Married	0.049	0.060**
β: Female head	0.258***	0.247***
θ_1	2.687***	2.657***
θ_2	3.448***	3.418***
Observations	94,386	

Standard errors are bootstrapped with 50 replications
*** p<0.01, ** p<0.05, * p<0.1

Allender, W. J., & Richards, T. J. (2010). Consumer impact of animal welfare regulation in the california poultry industry. *Journal of Agricultural and Resource Economics*, *35*(3), 424-442.

Burkhardt, J., & Chan, N. W. (2017). The dollars and sense of ballot propositions: Estimating willingess to pay for public goods using aggregate voting data. *Journal of the Association of Environmental and Resource Economics*, *4*(2), 479-503.

Carter, C. A., Schaefer, K. A., & Scheitrum, D. (2021). Piecemeal farm regulation and the us commerce clause. *American Journal of Agricultural Economics*, *103*(3), 1141-1163.

Deacon, R., & Shapiro, P. (1975). Private preference for collective goods revealed through voting on referenda. *American Economic Review*, *65*(5), 943-955.

Fajgelbaum, P., Gaubert, C., Gorton, N., Morales, E., & Schaal, E. (2023). *Political preferences and the spatial distribution of infrastructure: Evidence from california's high-speed rail.*

Holian, M. J., & Kahn, M. E. (2015). Household demand for low carbon policies: Evidence from california. *Journal of the Association of Environmental and*

Resource Economics, *2*(2), 205-234.

Kotschedoff, M. J., & Pachali, M. J. (2020). Higher minimum quality standards and redistributive effects on consumer welfare. *Marketing Science*, *39*(1), 253-280.

Malone, T., & Lusk, J. L. (2016). Putting the chicken before the egg price: An ex-post analysis of california's battery cage ban. *Journal of Agricultural and Resource Economics*, *41*(3), 518-532.

Mullally, C., & Lusk, J. L. (2017). The impact of farm animal housing restrictions on egg prices, consumer welfare, and production in california. *American Journal of Agricultural Economics*, *100*(3), 649-669.

Oh, S. E., & Vukina, T. (2021). The price of cage-free eggs: Social cost of propostion 12 in california. *American Journal of Agricultural Economics*, *104*(4), 1141-1163.