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.

Introduction

Background:

- California passed Proposition 12 in November 2018 with 62.6% in favour
- Today, all eggs produced or sold in California have to be cage-free

Question:

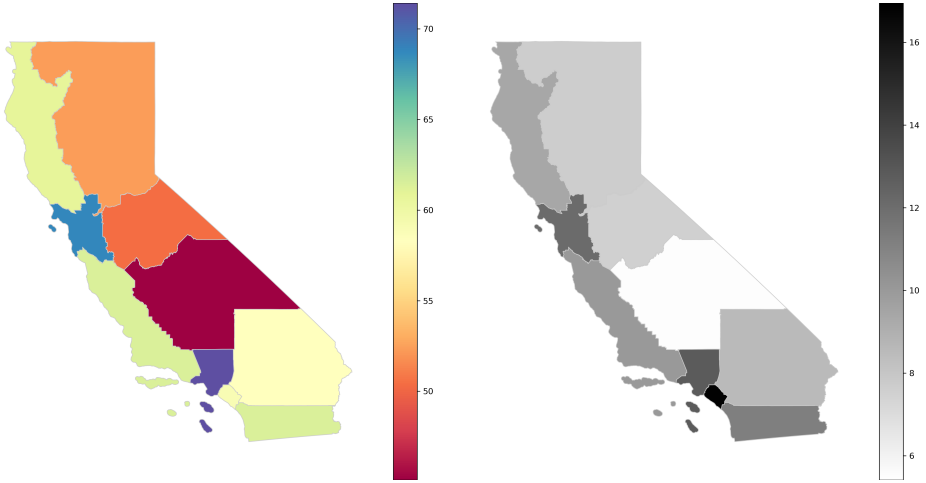
- How do animal welfare policies affect different groups of consumers? Which groups become better/worse off?

Approach:

- Use NielsenIQ datasets and voting data from California elections to understand consumer demand for eggs and preferences for animal welfare policies

Contribution:

- Understand the impact of Proposition 12 on consumer welfare across California
- Study whether consumers vote for policies based on their expected gains/losses



(a) Voted Yes for Prop 12 in 2018 (%)

(b) Share of CF/OG eggs, 2017 (%)

Figure 1: Spatial Correlation of Prop 12 Vote and Egg Consumption

Related Literature

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

- **Consumer preference for 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)




Clockwise from top left: battery cage, enriched colony, aviary (barn), free-range/pasture-raised

Clockwise from top left: battery cage, enriched colony, aviary (barn), free-range/pasture-raised

Clockwise from top left: battery cage, enriched colony, aviary (barn), free-range/pasture-raised

	Battery Cage[1]	Enriched Colony[2]	Aviary (Barn)	Free-range	Pasture-raised
Min. space per hen (sq ft)	0.5	0.8	1	2*	108*
Perching/scratching	×	✓	✓	✓	✓
Access to outdoors	×	×	×	✓	✓
Unit cost[3] ($)	0.670	0.756	0.913		

[1] Banned by Proposition 2 with effect from 1 Jan 2015.

[2] Banned by Proposition 12 with effect from 1 Jan 2022.

[3] Capital and operating costs per dozen eggs (Matthews & Sumner, 2015)

* Refers to outdoor space where hens spend at least 6 hours per day.

Table 1: Key Characteristics of Hen Housing Systems

Recap of Timeline

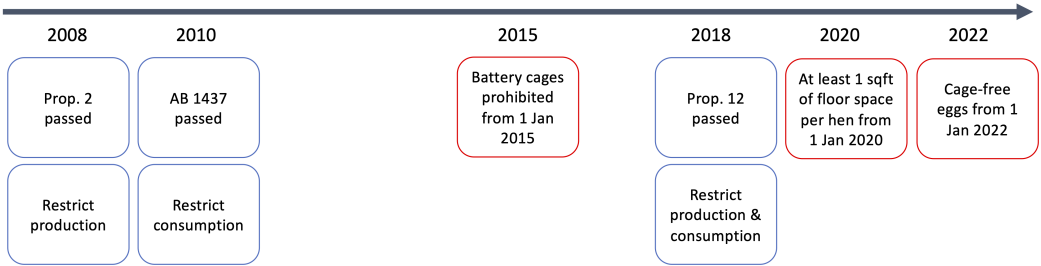


Figure 2: Development of Animal Welfare Policies in California

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 (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)

	Full Consumer Panel				Matched Consumer-Retailer Sample			
	HHs (All)	HHs (Eggs)	Trips (All)	Trips (Eggs)	HHs (All)	HHs (Eggs)	Trips (All)	Trips (Eggs)
2011	5,329	4,375	327,490	33,892	3,453	1,534	55,786	5,761
2012	5,483	4,344	320,162	33,457	4,000	1,943	66,870	7,273
2013	5,610	4,178	314,206	30,426	4,256	2,191	100,474	9,772
2014	5,575	4,077	309,991	28,056	4,359	2,193	104,067	9,412
2015	5,473	3,942	297,950	25,923	4,444	2,063	80,037	6,953
2016	5,258	4,100	295,617	28,772	4,635	2,540	127,282	11,804
2017	5,373	4,171	303,818	31,889	4,506	2,580	121,475	12,785
2018	5,299	3,919	298,229	29,301	4,632	2,678	141,496	14,063
2019	5,272	3,910	300,697	30,235	4,706	2,793	145,777	14,796
2020	4,875	3,790	284,693	28,683	4,573	2,816	142,291	15,411
All	12,198	10,843	3,052,853	300,634	10,952	7,700	1,085,555	108,030

Table 2: Comparison of Consumer Panel vs. Matched Sample

- $\sim$ 90% of households/consumers in Nielsen's Consumer Panel purchase eggs
- Eggs are purchased in $\sim$ 10% of all trips to the stores

Consumer Heterogeneity

	% of HHs		Avg. Eggs Cons.	% of Inside Goods		
	Outside	Inside	(dozens/year)	*Regular*	*Cage-free*	*Organic*
Less than $25,000	20.36	79.64	18.09	96.26	2.01	1.73
$25,000 to $49,999	19.67	80.33	20.03	96.38	2.12	1.50
$50,000 to $69,999	19.40	80.60	19.93	94.58	3.37	2.05
$70,000 to $99,999	19.07	80.93	19.74	92.25	4.69	3.06
$100,000 and above	18.31	81.69	20.84	89.11	5.61	5.28
34 and below	19.30	80.70	16.64	90.28	5.24	4.48
35 to 64	19.24	80.76	20.55	93.22	3.71	3.06
65 and above	19.20	80.80	19.69	93.81	3.58	2.61
High school and below	19.71	80.29	24.42	96.48	2.00	1.52
College and above	19.17	80.83	21.63	92.27	4.36	3.37

Table 3: Summary Statistics of Matched Consumer-Retailer Data (2011-2020)

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

Egg Consumption Trends

Year	Avg. Cons. (dozens)	% of Inside Goods			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 4: Consumption, Market Shares and Prices of 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

Approach

- Ban on battery cage (Prop 2) in 2015 $\implies$ supply-side shock, prices $\uparrow$
- Sample: 123,927 weekly shopping trips, 5,454 households, 2014W01 to 2015W52
  - Aggregate household shopping trips to weekly basis
  - Trips and purchases are matched to grocery stores with price data
  - Multinomial choice model using xlogit package (Arteaga et al., 2022)
- Fit model to 2017 data
  1. Check out-of-sample fit by counties (predicted choice probabilities vs. data)
  2. Welfare analysis: expected consumer surplus without regular eggs
     - Prop 12 vote in Nov 2018 $\rightarrow$ a vote to remove regular eggs from the market
     - Why fit to 2017? News leading up to vote could affect demand (Lusk, 2010)
  3. Compare with Prop 12 vote $\rightarrow$ do consumers vote based on their expected gains/losses from consumption?

Consumer Choice

Consumers choose $j \in \{0, rg, cf, og\}$. Let the value of i who chooses j in week t be:

$$V_{ijt} = \beta_j' X_i + \alpha P_{ijt} + \theta_j + \gamma_{c(i),j} + \varepsilon_{ijt}$$

- X_i represents consumer demographics, with alternative-specific coefficients β_j
- P_{ijt} is the price of alternative j seen by i in week t and α is the price coefficient
- θ_j is an alternative-specific intercept for regular, cage-free and organic eggs
- $\gamma_{c(i),j}$ represents county-by-type fixed-effects
- ε_{ijt} is the logit error term
- Outside option: $j = 0$ and $V_{i0t} = 0$

Expected Consumer Surplus

The expected consumer surplus of i in week t (Small & Rosen, 1981):

$$E(CS_{it}) = -\frac{1}{\alpha} \log \left(\sum_j \exp(V_{ijt}) \right)$$

For the welfare analysis, I calculate the *per week* expected consumer surplus of i:

$$E(CS_i) = \frac{1}{T_i} \sum_t^{T_i} E(CS_{it})$$

Under two scenarios:

1. $E(CS_i)^0$: Consumers choose $j \in \{0, rg, cf, og\}$
2. $E(CS_i)^1$: Consumers choose $j \in \{0, cf, og\}$

Price Variation and Horizontal Attributes

Problem: No single price for regular, cage-free or organic eggs (many UPCs)

Solution: Use OLS to remove price variation and construct price by type

Price for UPC k in store s in week t is decomposed as:

$$\begin{aligned} P_{kst} = {} & b_0 + b_1 cagefree_k \cdot week_t + b_2 organic_k \cdot week_t \\ & + b_3 grade_k + b_4 eggsize_k + b_5 brown_k + b_6 omega3_k + b_7 packagesize_k \\ & + b_8 store_s + b_9 month_t + b_{10} year_t + b_{11} week_t + \nu_{kst} \end{aligned}$$

$\rightarrow$ Each $week_t$ in the data indexes a specific week ($2014W01, \ldots, 2015W52$)
$\rightarrow$ $month_t$ and $year_t$ control for seasonal and macro trends
$\rightarrow$ Store effects $store_s$ isolate price changes from intertemporal variation

Price by Types

The price of each type seen by consumer i in week t is then constructed:

$$\hat{P}_{ijt} = \hat{b}_0 + \hat{b}_8 store_s + \hat{b}_9 month_t + \hat{b}_{10} year_t + \hat{b}_{11} week_t + \hat{b}_1 cagefree_j \cdot week_t + \hat{b}_2 organic_k \cdot week_t$$

→ Consumers and stores are matched on store visited and purchase date

→ Horizontal attributes are normalised[1] and absorbed by the constant term

→ Remaining price variation is across stores and time

[1] grade = None, egg size = large, color = White, omega-3 = None, package size = 12

Identification of Demand Parameters

Estimate MNL model: $V_{ijt} = \beta_j' X_i + \alpha \hat{P}_{ijt} + \theta_j + \gamma_{c(i),j} + \varepsilon_{ijt}$

$\rightarrow$ Price may be endogenous to local markets

$\rightarrow$ Use county-by-type fixed effects $\gamma_{c(i),j}$ to isolate intertemporal variation in price

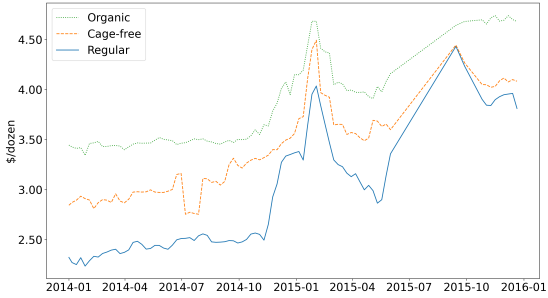


Figure 3: Average $\hat{P}_{ijt}$ by Type

Coefficients:	Price	Regular	Cage-free	Organic
	-0.100***	-1.723***	-3.492***	-4.099***
	[0.014]	[0.081]	[0.206]	[0.258]
Interactions:				
Income (25K-49K)	-	0.265***	-0.076	-0.442***
	-	[0.034]	[0.139]	[0.153]
Income (50K-69K)	-	0.237***	0.648***	-0.059
	-	[0.036]	[0.132]	[0.149]
Income (70K-99K)	-	0.237***	0.626***	-0.075
	-	[0.035]	[0.129]	[0.143]
Income (>100K)	-	0.345***	0.971***	0.597***
	-	[0.035]	[0.126]	[0.132]
Age (35-64)	-	-0.297***	-0.611***	-0.805***
	-	[0.043]	[0.126]	[0.14]
Age (>65)	-	-0.320***	-1.004***	-1.070***
	-	[0.046]	[0.14]	[0.157]
College	-	-0.142***	-0.159	0.226
	-	[0.028]	[0.099]	[0.143]

Robust standard errors reported in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Price × Income | County × Type FEs

	Regular	Cage-free	Organic
Regular	-0.2660	0.0329	0.0329
Cage-free	0.0033	-0.3416	0.0033
Organic	0.0024	0.0024	-0.3884
Observations:		123,927	

Table 5: Average Own-Price and Cross-Type Elasticities

In-sample fit

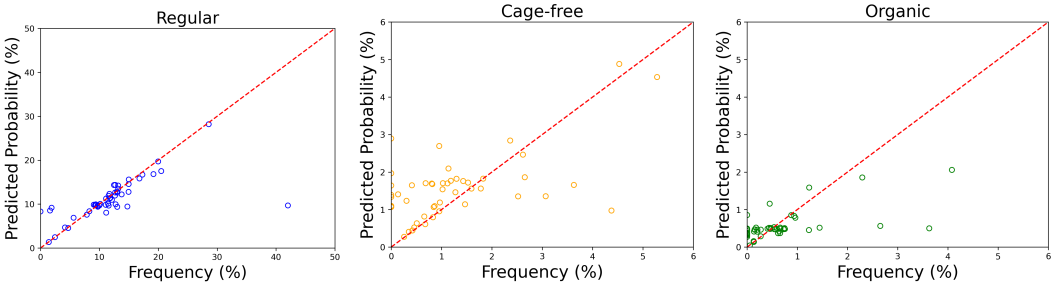


Figure 4: Purchase of Eggs by California Counties in 2014 and 2015

Out-of-sample fit

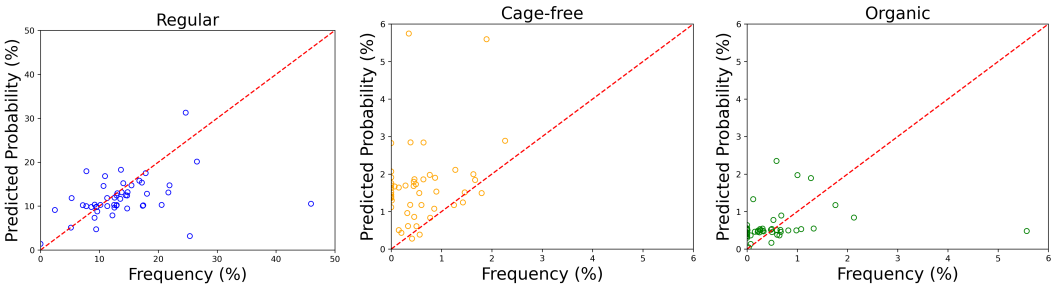


Figure 5: Purchase of Eggs by California Counties in 2017

Impact of Prop 12 on consumers

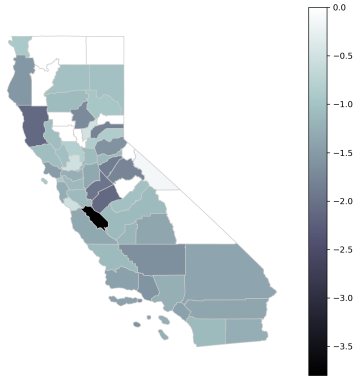
- Use projection factors w_i in NielsenIQ Consumer Panel Dataset to scale estimates
  - NielsenIQ: 4,506 sample households represented 11 million households in 2017
  - US Census Bureau: 12.89 million California households in 2017

- $\sum_i w_i E(CS_i)^1 - \sum_i w_i E(CS_i)^0 = -\$13.94$ million *per week* in California

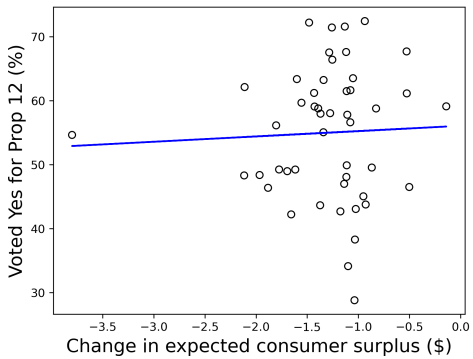
- Annual impact: $-\$726.6$ million in 2017

- Average household impact: $\Delta E(CS) = \frac{-\$15\text{M/week}}{11\text{M}} = -\$1.26\text{/week}$
  - Impact varies across counties: from $-\$3.80$/week to $-\$0.14$/week
  - . . . but does not explain variation in votes

Do consumers vote based on their expected consumer surplus?



(a) $\Delta E(CS)$ across counties ($)



(b) County Vote Shares vs. $\Delta E(CS)$

Change in expected consumer surplus does not explain Prop 12

Dep. Variable:	%_Voted_Yes	R-squared:	0.002
Model:	OLS	Adj. R-squared:	-0.020
No. Observations:	48 counties		

	coef	**std err**	**t**	**P> |t|**	**[0.025**	**0.975]**
Constant	56.0691	3.909	14.344	0.000	48.201	63.937
$\Delta E(CS)$	0.8308	2.774	0.299	0.766	-4.753	6.415

Table 6: OLS Regression of Vote Share on $\Delta E(CS)$

Next Steps

1. Improve the demand model
   - Random coefficients, nested logit
   - Leverage micro moments in Consumer Panel

2. Supply-side and price effects of Prop 2 and Prop 12
   - How do producers respond?
   - Why did prices of cage-free and organic eggs go up?

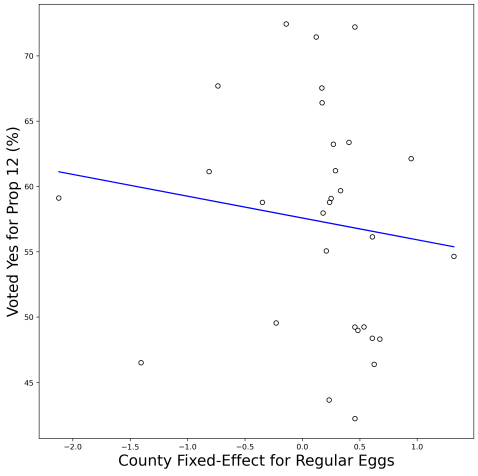
3. Other explanations for Prop 12 vote
   - California producers vs. California consumers?

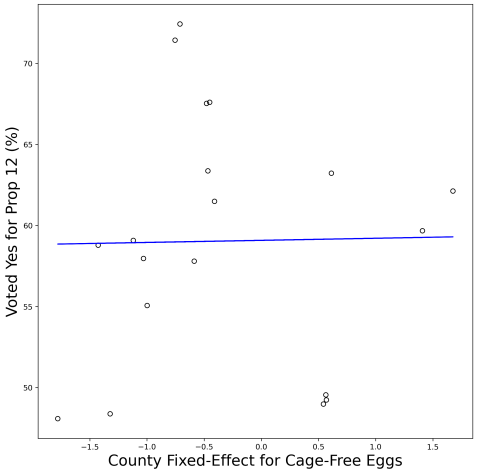
End

Coefficients:	Price	Regular	Cage-free	Organic
	-0.155***	-1.564***	-3.305***	-3.888***
	[0.042]	[0.14]	[0.246]	[0.299]
Interactions:				
Income (25K-49K)	0.012	0.231	-0.114	-0.486**
	[0.05]	[0.15]	[0.223]	[0.248]
Income (50K-69K)	0.099*	-0.051	0.307	-0.442*
	[0.053]	[0.159]	[0.226]	[0.254]
Income (70K-99K)	0.090*	-0.025	0.316	-0.424*
	[0.051]	[0.152]	[0.218]	[0.243]
Income (>100K)	0.058	0.175	0.77***	0.371
	[0.049]	[0.148]	[0.212]	[0.232]
Age (35-64)		-0.297***	-0.61***	-0.805***
		[0.043]	[0.126]	[0.14]
Age (>65)		-0.319***	-1.004***	-1.069***
		[0.046]	[0.14]	[0.157]
College		-0.143***	-0.159	0.227
		[0.028]	[0.099]	[0.143]

Robust standard errors reported in brackets.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

County-by-type fixed-effects are not reported above. Back


Voted Yes for Prop 12 (%)
70
65
60
55
50
45
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
County Fixed-Effect for Regular Eggs


Voted Yes for Prop 12 (%)
70
65
60
55
50
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
County Fixed-Effect for Cage-Free Eggs

Back

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