



United States Department of Agriculture

Price Premium and Welfare Implications of the 'Natural' Label: A Machine Learning Application

Gianna Short
PhD Candidate, UMN
USDA ERS Pathways Intern

Working with: Stacy Sneeringer,
Elina Page, and
Maria Bowman

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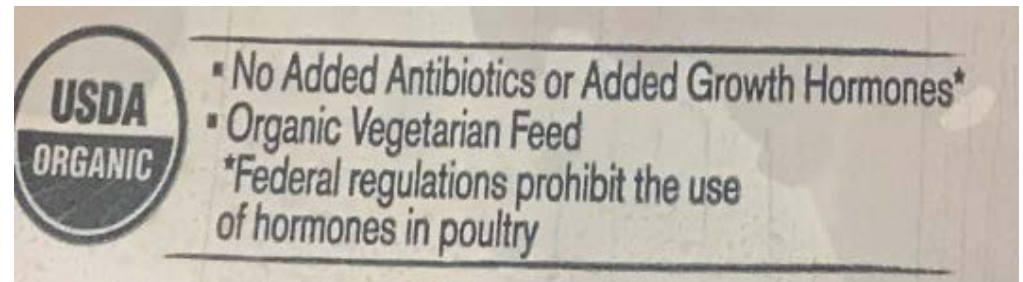
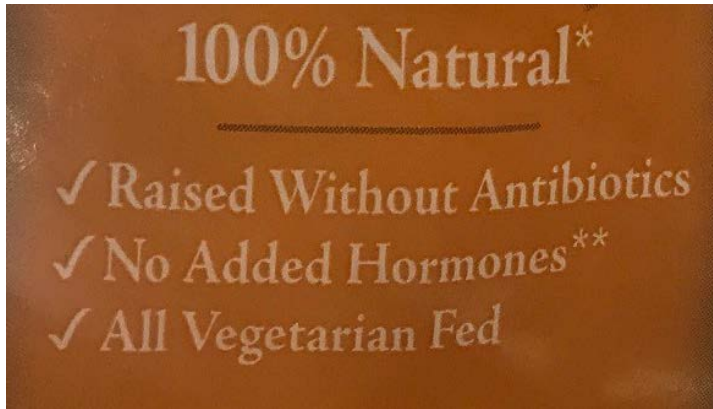




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Credence Claims



Photos by Gianna Short



Credence Claims

- Claims regarding aspects of *production* rather than physical attributes of the final product.
- Unlike physical attributes, consumers are generally not able to verify the claim in store.
- Some claims are required to have third-party verification to assure consumers that the claims are true. (*Organic*)
- Other claims are not required to have third-party verification. (*Raised without antibiotics*)
- Finally, some claims have technical definitions, but don't convey much information. (*Natural, No added hormones*)
 - Natural means minimally processed with no artificial ingredients
 - By U.S. law, no chickens can receive additional hormones



Credence Claim Regulation

- USDA's Food Safety and Inspection Service (FSIS) defines standards for some claims.
 - The general claim 'no antibiotics' is not allowed.
- For new labels, each firm
 - defines criteria for its label claim
 - develops label
 - provides supporting paperwork that its claim is truthful and not misleading
 - E.g., “raised without antibiotics,” “no antibiotics ever”



Research Questions

- What are the implicit prices/values of credence claims for chicken?
 - Organic, raised without antibiotics, natural, and non-hormone
- Are consumers paying extra for something without real value?
 - Focus on natural, non-hormone



Data

- 2016 IRI InfoScan retail data
 - Weekly, store/region-based UPC-level retail sales data (revenue and quantity) for a selection of retail stores
- Product claims dictionary (sourced from)
 - Research
 - Label Insight
 - USDA Food Safety Inspection Service label-claims database



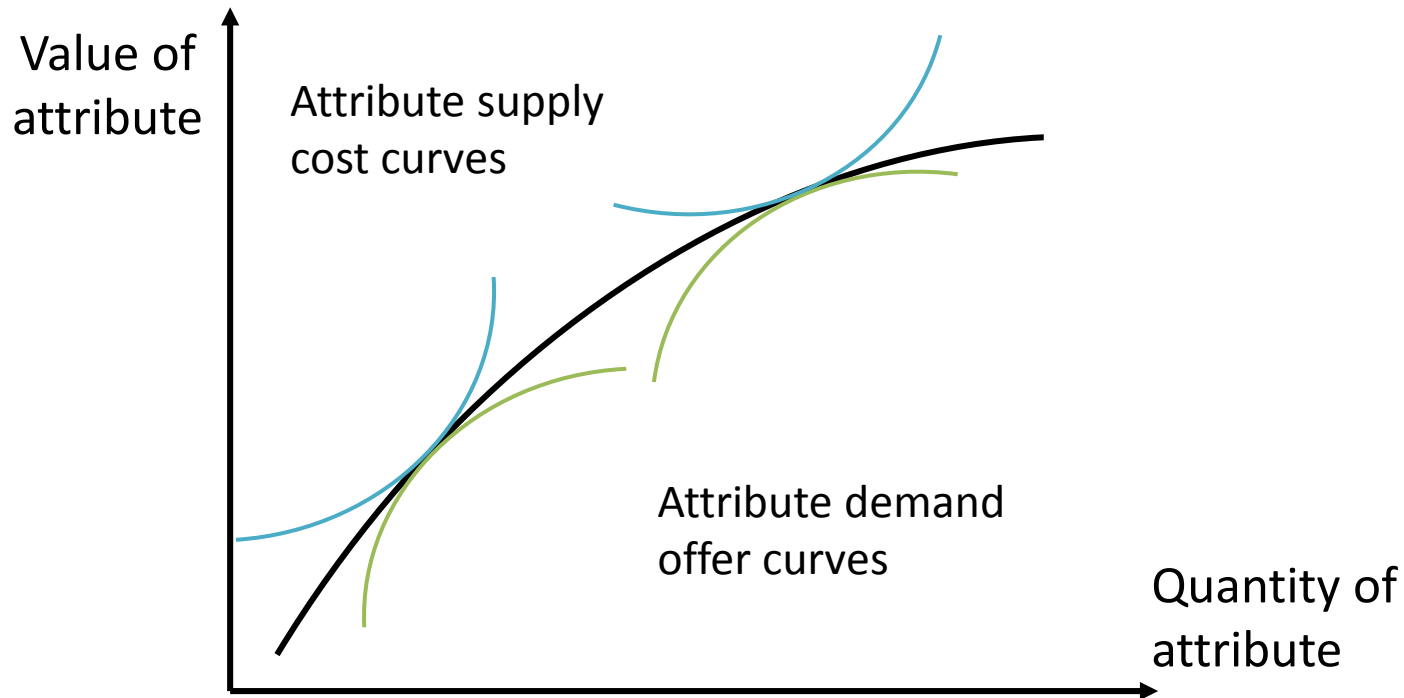
Descriptive Statistics

Item	Statistic
Unit of observation	Store's weekly sales of a product*
Number of observations (2016)	5,612,589
Weekly observations (average)	~ 107,934
Sample mean of "average price/pound"	\$2.91
Standard deviation of "average price/pound"	\$1.50
Initial number of variables	303
Variables after machine learning selection	123
Variables of interest	11

*or a regional market area for stores that don't report at the store-level for privacy reasons.



Hedonic Price Equilibrium



- The tangencies of many cost and offer curves for a given attribute trace out its hedonic equilibrium implicit price.



Hedonic Estimation

Average price/pound is a function of:

Region and store type

Product attributes, packaging, brand

Credence claim attributes

- The implicit prices are estimated by a hedonic function as a cross-section for each week in 2016.



Hedonic Estimation Equation

avg_price_lb =

α_1 * rural_urban	+	α_2 * state	+	α_3 * store_type
β_1 * top5_brand	+	β_2 * brand_type	+	β_3 * brand
β_4 * ounces	+	β_5 * package	+	β_6 * additives
β_7 * new_item	+	β_8 * form	+	β_9 * texture
γ_1 * organic	+	γ_2 * natural	+	γ_3 * non_antibiotics
γ_4 * non_hormone	+	γ_5 * family_farm	+	γ_6 * free_range
γ_7 * cage_free	+	γ_8 * vegetarian_fed	+	γ_9 * religious_claim
γ_{10} * welfare_uncertified	+	γ_{11} * humane_certified	+	γ_{12} * total_claims

- With over 300 explanatory variables in the hedonic equation (bold indicates a vector of variables), standard regression has issues with multicollinearity and overfitting.



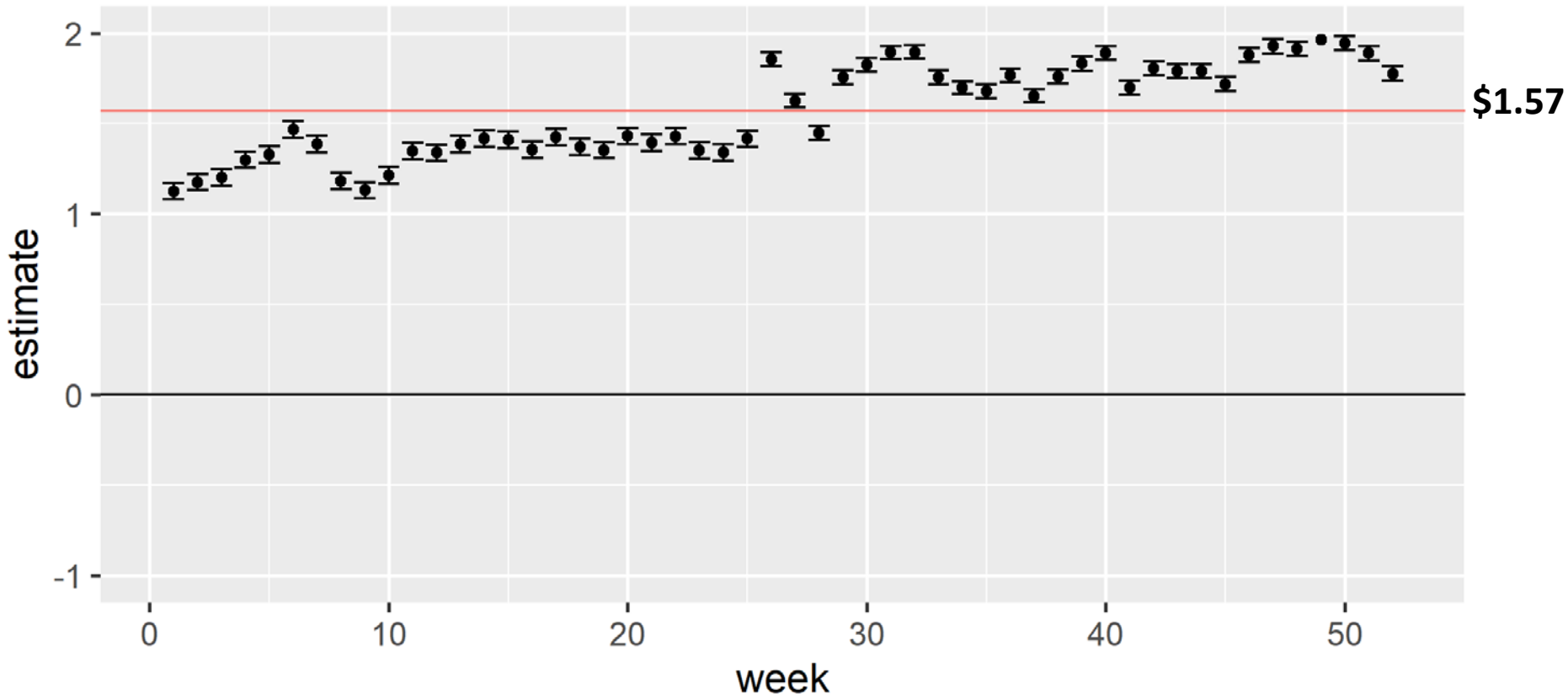
Machine Learning Approach

- Machine learning approaches can help to avoid poor model performance with new data due to overfitting.
- LASSO regularized regression (set to always retain the credence claims variables) reduced the total number of variables by over half.
- Final estimation using post-LASSO OLS regression.



Organic

2016 Implicit price per pound (US\$) by week: 'organic' label claim with 95% confidence intervals (error bars) and year average (red line)

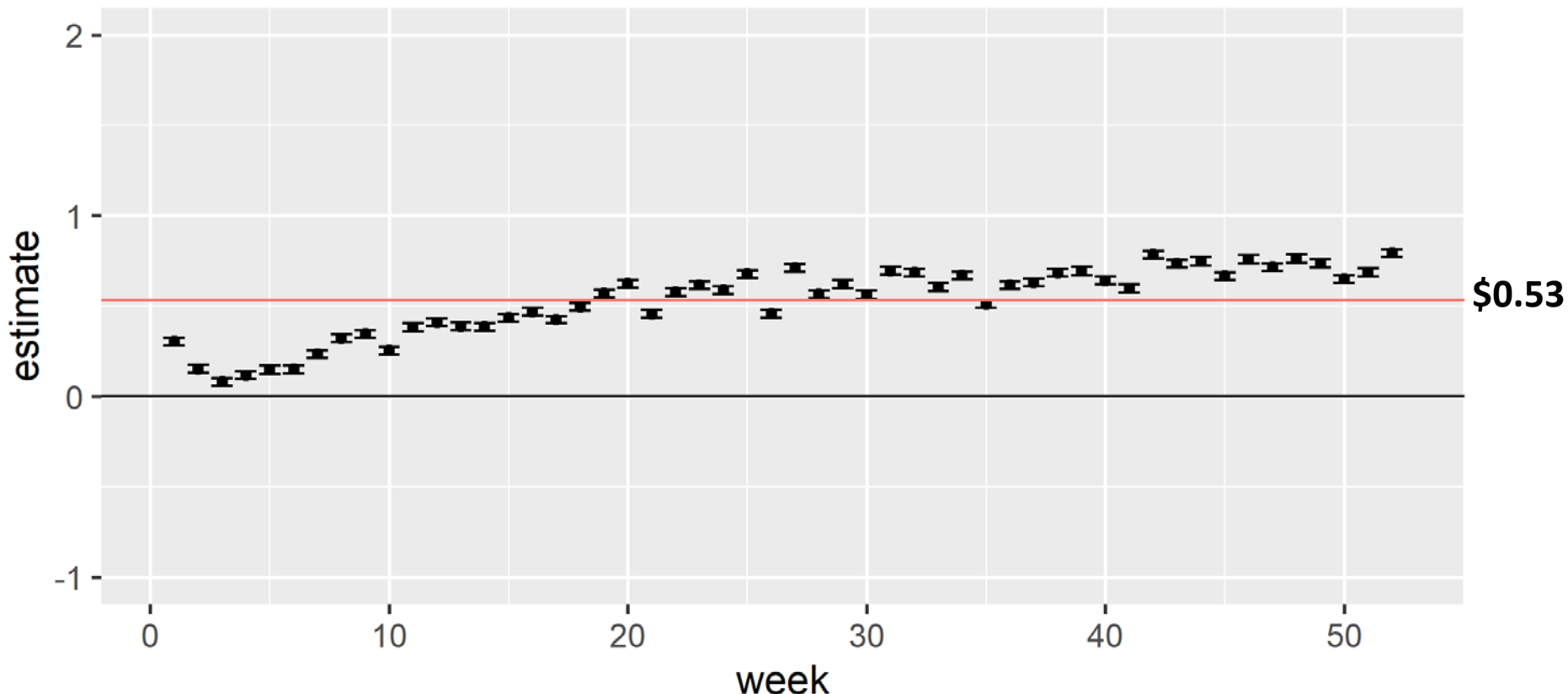


Source: USDA ERS using IRI, Label Insight, and FSIS data



Raised without antibiotics

2016 Implicit price per pound (US\$) by week: 'rwa' label claim with 95% confidence intervals (error bars) and year average (red line)

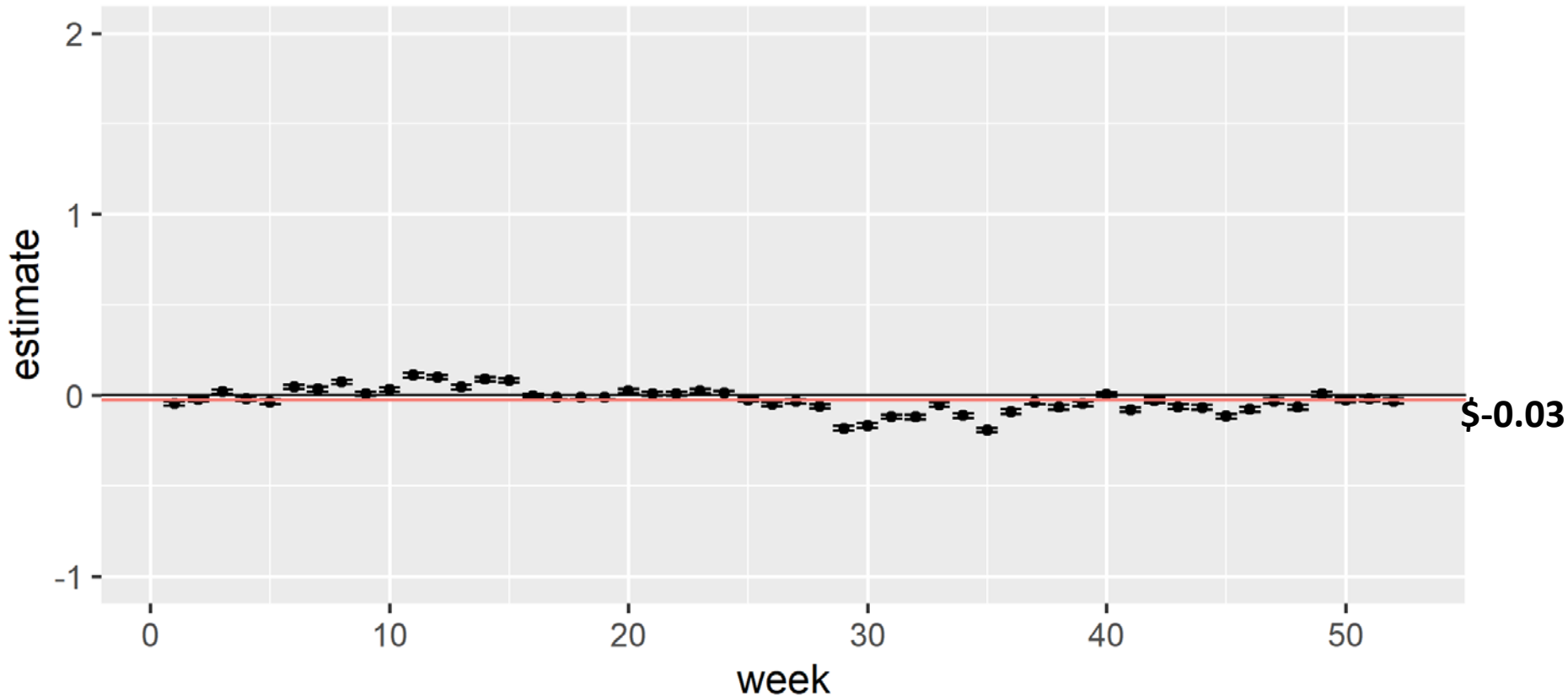


Source: USDA ERS using IRI, Label Insight, and FSIS data



Natural

2016 Implicit price per pound (US\$) by week: 'natural' label claim with 95% confidence intervals (error bars) and year average (red line)

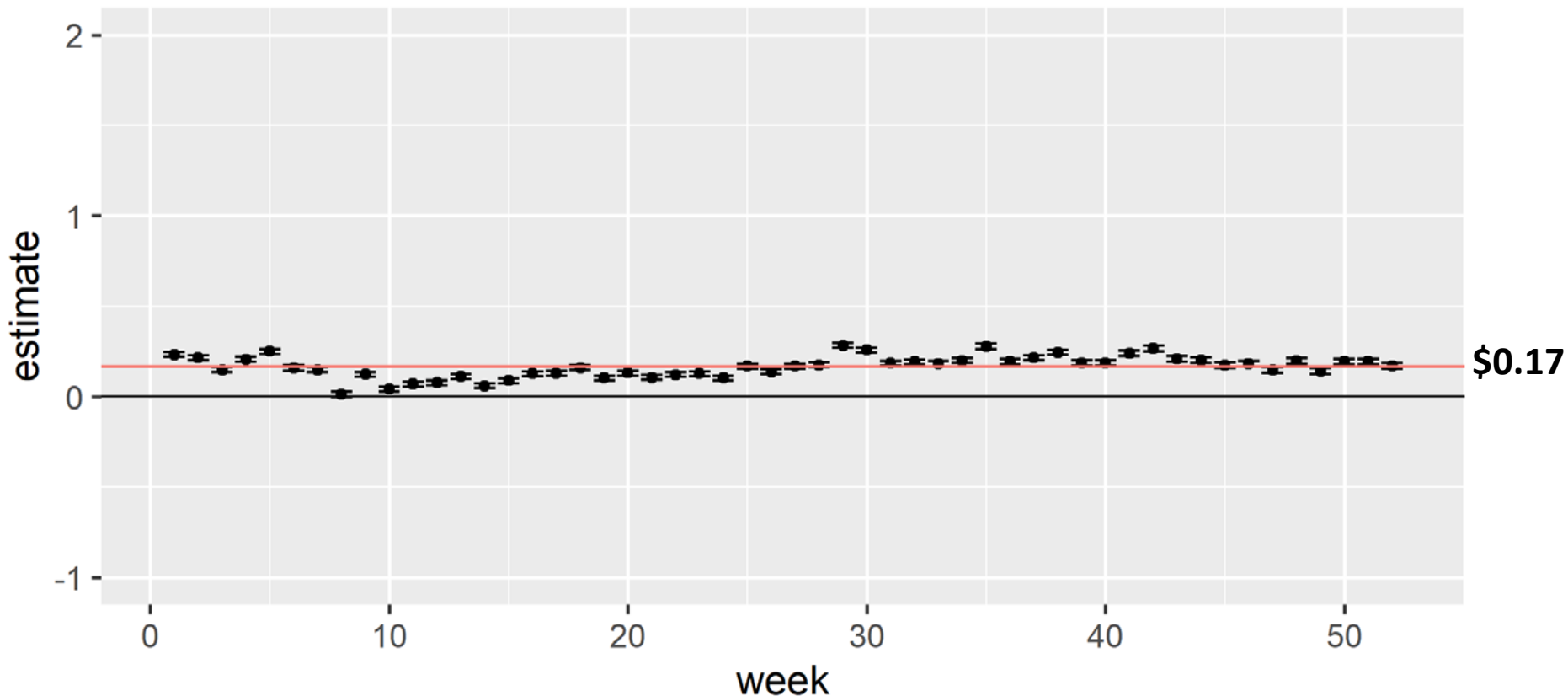


Source: USDA ERS using IRI, Label Insight, and FSIS data



Non-hormone

2016 Implicit price per pound (US\$) by week: 'non_horm' label claim with 95% confidence intervals (error bars) and year average (red line)



Source: USDA ERS using IRI, Label Insight, and FSIS data



Discussion of Preliminary Findings

- The *organic* label implicit price was substantial (between \$1-2/lb) and increased over 2016
- The *RWA* label implicit price was also substantial (averaging about \$0.50/lb), also increased over 2016
- The *Natural* label implicit price was basically \$0 (\$-0.03) throughout 2016
- The *non-hormone* label implicit price averaged about \$0.17 with little variation over 2016



Thank you!

Any questions?

Contact:

GIANNASHORT@ers.usda.gov

