

U.S. DEPARTMENT OF AGRICULTURE

Food Safety and Inspection Service

Appendix to the Preliminary Cost-Benefit Analysis

The Implicit Price Premiums of U.S.-Origin Labeling Claims on Ground Beef Products

Introduction

FSIS analyzed potential price premiums of U.S.-origin label claims on uniform-weight ground beef products. Results reveal marginal price premiums for products that indicate they are exclusively of U.S. origin (10 cents per pound) and for products that indicate they are of U.S. and other countries' origin (16 cents per pound). While modest price premiums for U.S.-origin claims are evident on ground beef products, other marketing claims (such as organic, grass-fed, natural) had more substantial price premiums.

Data Used for Regression Analysis

The data used to estimate price premiums for U.S.-origin claims was developed using Information Resources Inc. (IRI) scanner data¹ and Label Insight data. IRI is a market research firm that collects sales data on food products from retail establishments across the United States. Some retailers allow IRI to release sales data at the individual store level while others allow aggregated sales data to the retail marketing area (RMA). On average, the IRI data records over 132 million observations each week from about 41,000 retail stores and 18,000 RMAs. The IRI InfoScan data covers about 55% of total

¹The analysis, findings, and conclusions expressed in this report should not be attributed to IRI.

food sales reported in the Economic Census.² This study used data from the individual store level and the RMA level for a robust sample. The IRI data has product characteristics for over 1 million universal product codes (UPCs), including brand, size, or nutrition-related claims, such as “organic” or “gluten-free”. The most recent IRI data available for the analysis was 2020. The IRI InfoScan data, however, does not include the country-of-origin information, which is necessary to estimate the price premiums for such claims. For country-of-origin information on labels, we relied on Label Insight data.

Label Insight is a market research firm that collects pictures and other extensive descriptive data, including the country-of-origin information, on most food products in the retail market. Label Insight covers more than 99% of all online consumer queries across over 80 percent of United States food, pet, and personal care products with a market-leading database of over 200,000 product nutrients, 400,000 product ingredients and 9 million product claims.³ Label Insight data is collected

² Mary K. Muth, Megan Sweitzer, Derick Brown, Kristen Capogrossi, Shawn Karns, David Levin, Abigail Okrent, Peter Siegel, and Chen Zhen. Understanding IRI Household-Based and Store-Based Scanner Data, TB-1942, U.S. Department of Agriculture, Economic Research Service, April 2016. Available at: https://www.ers.usda.gov/webdocs/publications/47633/57105_tB-1942.pdf?v=4727.2

³ NielsonIQ. 2021. NielsonIQ Acquires Label Insight- Product Attribute Powerhouse. Press Release. Available at <https://nielseniq.com/global/en/news-center/2021/nielseniq-acquires-product-attribute-powerhouse-label-insight/> (Last Accessed Nov 2022).

mostly from public websites and from companies providing them pictures of their food product labels. The data covers the labels that are currently in the market.

FSIS first cleaned the Label Insight data to find all the meat and poultry products and any corresponding country-of-origin claims, to determine which product groups would have a good sample for a hedonic model. After the initial cleaning, FSIS found that ground beef products had a large sample (about 1,800 products), and a large proportion of them (about 35 percent) had an accompanying country-of-origin claim. Ground beef products are also commonly manufactured from different sources, including source materials from other countries.⁴ With this knowledge, FSIS decided to focus the model on raw, uniform-weight ground beef products.

For the data cleaning process, FSIS searched Label Insight data in July 2021 for the term "ground beef" or "beef (ground)" in the ingredient, product title, and category fields. To ensure the model had a homogeneous group of products, the data was cleaned to remove duplicate products and other products not in scope, such as veal, meatballs, beef patties or random weight products. In total, FSIS found approximately 700 raw, uniform-

⁴ Ishmael, W. 2016. Most U.S. beef imports go toward feeding the nation's massive appetite for ground beef. Beef Magazine. Available online at Feeding demand for ground beef (beefmagazine.com) (Last Accessed in November 2022).

weight ground beef products in Label Insight. FSIS matched approximately 335 of these to the IRI product dictionary, which is a database of all descriptive information on unique UPCs.⁵ Of these 335 ground beef products, 184 UPCs had retail sales information at either the RMA or store level in 2020.

The analysis matched 2020 IRI retail sales data and 2021 Label Insight data. Given that label claims on UPCs can sometimes change, FSIS was less confident that earlier years of IRI sales data would capture the correct country-of-origin claims. Also, earlier years' data do not have as much sales data, and 2020 sales data is the most recent IRI data available at the time of this analysis. As such, the 2020 sales data was best for the purposes of this analysis. FSIS acknowledges the possibility that the COVID-19 pandemic in 2020 may have impacted the analysis.

Of these 184 UPCs for uniform-weight ground beef products, IRI recorded approximately 176 million pounds sold with total sales volume of \$750 million across the United States and some territories in 2020. These are the products and sales information used in this model.

FSIS checked to see if the sample used for the model

⁵ UPC is a barcode on a package that identifies a particular item.

provided good coverage of ground beef products in the IRI data. To do this, FSIS cleaned the IRI data and found 372 additional unique raw, uniform-weight ground beef UPCs (556 total UPCs) with pricing information in the store and RMA data during 2020. Of these 556 UPCs, IRI recorded around 358 million pounds sold with total sales volume of \$1.4 billion. This is likely an overestimate of UPCs and sales for raw, uniform-weight ground beef products, as the IRI product dictionary does not explicitly categorize uniform-weight ground beef products so other products, such as patties or burgers, could be include in this estimate. Regardless, this allows us to compare the data differences between what is in the IRI data to what is in the sample used for the model.

From this comparison, FSIS found that private (store) brands were not represented in the model sample, while private brands for the ground beef products in the IRI data accounted for approximately 13.5 percent of total sales volume and 19.4 percent (108/556) of the total UPC count. IRI often masks the UPCs of private label products for data privacy reasons, so UPCs from private labels could not be matched to the UPCs in Label Insight. Because of this, private labels were absent from the model. Private brand loyalist households (i.e., households where greater than 27 percent of total dollars spent are on private

brands) tend to be older and live in larger households.⁶ We acknowledge that excluding these private labels could potentially underrepresent sales from this group in the analysis.

FSIS estimated that the model's sample is sufficient for this study as the 184 ground beef products in the model's data set covered approximately 53 percent of total sales, or 176 million pounds sold worth \$750 million, of uniform weight ground beef products in 2020 IRI data. Given that IRI data covers approximately 50 percent of the total U.S. store sales, and the sample for the model covers approximately 53 percent of the total sales for uniform-weight ground beef products in the 2020 IRI data, FSIS assumed that the sample for the model was enough to estimate price premiums for U.S.-origin information on ground beef products.

Hedonic Model Variables

The focus of this appendix is to estimate the price premium of U.S.-origin claims on ground beef products with hedonic modeling. Hedonic regression models estimate the influence that

⁶ Information Resources Inc. "Private Brands 2022, Private Brands: Look Who's Buying Now" November 29, 2022. Available at: <https://www.iriworldwide.com/IRI/media/Library/private-brands-report.pdf>

various attributes have on the price of a good.⁷ An item's total price (dependent variable) is defined by the implicit prices of attributes (independent variables) that cannot be individually sold in the market.⁸

For the ground beef model, the dependent variable is the log price, and the independent variables are country-of-origin (COO) label claims, packaging type, packaging size, percent fat content, marketing claims, store type and month. The empirical model can be written as shown in Eq (1) below,

$$\text{Eq(1)} \quad \ln(p) = \beta_0 + \beta_1 \text{COO} + \beta_2 \text{packaging type} + \beta_3 \text{packaging size} + \beta_4 \% \text{ fat content} + \beta_5 \text{marketing claims} + \beta_6 \text{store type} + \beta_7 \text{month} + e,$$

where p is the price of ground beef per pound (in log), COO is the country-of-origin dummies based on different origin classification, packaging type is a dummy for packaging style (e.g., vacuum packed or not), packaging size is a continuous

⁷As Rosen (1974, page 34) indicated that hedonic model fits for the description of competitive equilibrium. In some cases, though, the model naturally incorporates the case of monopolistic competition (Rosen, S., 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of political economy*, 82(1), pp.34-55). In addition, the dummy marketing claim variables included in our model capture some of those imperfect or monopolistic impacts of market.

⁸For more information, refer Montero, JM., Fernández-Avilés, G. (2014). Hedonic Price Model. In: Michalos, A.C. (eds) *Encyclopedia of Quality of Life and Well-Being Research*. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-0753-5_1279

variable in ounces, fat content⁹ is a continuous variable for the level of fat content, marketing claims are based on different marketing labels (such as whether organic or not or grass-fed or not) or based on the beef type shown on the label (such as chuck or wagyu), store type is retail channel which indicates the type of store (grocery, drug store), month is purchase month. β_1 to β_7 are estimable parameters for each of the identified traits. The null hypothesis of primary interest is that the coefficient associated with country of origin is equal to zero ($\beta_1 = 0$). β_0 is the value of ground beef without any of the stated traits. e is the error term.

The semi-log hedonic models determine the implicit prices of characteristics for ground beef products using observable differences in market prices. However, the coefficients for the dummy variables in a semi-log model are not equal to percent changes. For the estimated coefficient corresponding to a dummy variable, such as β_1 , the percentage effect of this dummy on price is calculated using $100 * (\exp\beta_1 - 1)$.¹⁰

In addition, the ground beef price is modeled as a function of a U.S.-origin claim and many products, packaging, place, and

⁹ Protein was omitted due to expected correlation between percent of fat content and protein content variables.

¹⁰ For more information, refer Chang, J.B., Lusk, J.L. and Norwood, F.B., 2010. The price of happy hens: A hedonic analysis of retail egg prices. *Journal of Agricultural and Resource Economics*, pp.406-423.

time specific controls. The price premium is estimated by comparing the predicted general price under two cases: with some kinds of U.S.-origin labeling (where U.S.-origin = 1) and no U.S.-origin labeling (U.S.-origin = 0). After estimating the price under these two cases along with all other controls at their average values, FSIS can identify either the percent of price premium or the value of the price premium in real dollar term for the U.S.-origin claims.¹¹ The relative price premium, for instance, can be defined using Eq(2) below:

$$\text{Eq(2) } US \text{ ground beef premium}(\%) = \frac{100 * (E(p)_{U.S.-Origin=1, all else=mean} - (E(p)_{U.S.- Origin=0, all else=mean})}{(E(p)_{U.S.-Origin=0, all else=mean}}$$

For each UPC, FSIS calculated the average price paid in each week at either the store level, or the RMA level. Since the packages range in size, FSIS calculated the average price per pound. FSIS then used the log price for a semi-log model. Overall, there were 923,638 average weekly prices at either the store or RMA level used in our model.

FSIS also weighted the weekly prices by the pounds of product per UPC at the store or RMA level. This helps ensure the

¹¹ Based on Carlson, Andrea and Edward Jaenicke, 2016, Changes in Retail Organic Price Premiums from 2004 to 2010, ERR No. 209, U.S. Department of Agriculture, Economic Research Service, May, 44 pages.

volume of products is proportionally influenced in the model, so that products with higher sales volume have more weight in the model.

Country-of-Origin Claims on Ground Beef Products

Since the purpose of this appendix is to find the price premium for U.S.-origin label claims on ground beef products, FSIS first used Label Insight to find the specific country-of-origin claim on each label to create the variables in our model. When the image in Label Insight's database is clear, the text information is scraped from the image and organized into pre-coded categories. There was a pre-coded category for "Country-of-Origin" claims, but FSIS also visually verified this information by looking at all 184 product images. FSIS did this because sometimes the images weren't clear enough, or the claims were too small for Label Insight to capture the country-of-origin claim information in the pre-coded field.

After documenting the specific country-of-origin claims on these 184 UPCs, FSIS found that there were many unique ways to make a U.S.-origin claim. The most common country-of-origin claim was "Product of USA," although there are many ways to indicate that the product is of U.S. origin, such as "Made in America," "Born, Raised and Harvested in the USA" or "100% American." Together, 71.4 percent of the ground beef volume sold

from the 184 UPCs had some indication that the product was exclusively of U.S. origin, as shown in Table 1.

FSIS also created a variable for "Product of USA Plus Other Countries" for claims such as, "Product of USA and Canada," "Product of USA, Canada, Australia, and New Zealand," or "Product of Australia, processed in the USA." These types of claims were on approximately 11.9 percent of the volume sold from the 184-ground beef UPCs. Labels without a country-of-origin claim (13.1 percent) or with another country-of-origin claim that does not include the U.S. (3.6 percent) such as "Product of Australia" or "Product of New Zealand" were included in the base of the model.

FSIS also found that the country-of-origin claims varied by size (space on label), location on the package, and print type. Based on the sales volume of the products with an exclusive U.S.-origin claim, 83 percent of claims were small, and 17 percent were medium or large. The small U.S.-origin claims took up less space on the label and were usually exclusively printed separately on the package (such as with the expiration date) or printed on the back of the package. The medium claims were more prominent on the label and on the front of the package. Large claims were the most prominent on the label and typically advertised a State or region. About 58 percent of the volume of

products sold had a U.S.-origin claim on only the back of the package and about 13 percent had a U.S.-origin claim on the front, or on both the front and back of the package.

Control Variables in the Model

The model controlled for packaging type, packaging size, percent fat content, marketing claims, store type, location, and month. The packaging type was either, box (such as a cardboard box), tray (such as a plastic tray with plastic film on top), vacuum packed (such as vacuum sealed with plastic wrap), and chub (such as a plastic ground beef roll). FSIS relied on pre-coded packaging data in both IRI and Label Insight, with an additional visual check on the 184 product images to confirm this information.

In general, the price per pound decreases for products in larger packaging sizes and with higher fat content. For the analysis, FSIS included continuous variables for ounces and percent fat content to control for this in the model. However, fat content and packaging size were grouped in Table 1, to simplify the summary and to protect confidential product information. Approximately 43 percent of the sales volume were from packages weighing one pound or less, 21 percent were between 21 and 36 ounces, and 37 percent were greater than 36 ounces. Since the sample only included uniform weight packages,

there were no packages over 16 and under 21 ounces, as indicated in the categorical variables in Table 1. Some of the products did not display the fat content on the package. For these UPCs, FSIS imputed the missing fat content values to 15 percent as this was the most common occurrence on labels in our sample.

FSIS controlled for some other marketing claims in the model, including "organic," "grass fed," "vegetarian fed," "pasture raised," "natural," and "no antibiotic or no hormone." FSIS made one variable for "no antibiotic" and "no hormone" because the two were highly correlated. Products may possess none, one, or more than one of these marketing claims. FSIS also controlled for the meat types of "chuck" and "Kobe or Wagyu" in the model. Kobe and Wagyu were also highly correlated, so FSIS created one variable for these two claims.

The model controlled for store type and months as well. The store types were pre-coded in the IRI data, and included club, convenience, defense commissary, dollar, drug, ecommerce, grocery, liquor, and mass merchandisers. FSIS used the store type categories as IRI assigned them. IRI organizes the sales data by week, so all weeks that started in a particular month were assigned that month variable. This method resulted in some months having several days in the wrong month, but this was the best option for a month control variable given the data

limitation.

Table 1. Summary of Label Attributes on Uniform-Weight Ground Beef Products

Attribute	Percent of Volume Sold	Number of UPCs	Percent of UPCs
Country-of-Origin Claims:			
U.S.-Origin Only Claim	71.4%	106	57.61%
U.S.-Origin Basic, such as "Product of USA" or "Made in USA"	62.51%	54	29.35%
U.S.-Origin Extra, such as "born and raised in US" or "100% American"	8.85%	52	28.26%
U.S.-Origin Front	13.03%	72	39.13%
U.S.-Origin Back	58.33%	34	18.48%
U.S.-Origin Small	58.94%	48	26.09%
U.S.-Origin Medium/Large	12.42%	58	31.52%
U.S. Plus Other Country Origin	11.9%	18	9.78%
Other country origin, such as "Product of Australia" or "Product of New Zealand"	3.6%	15	8.15%
No Country-of-Origin Claim	13.1%	45	24.46%
Packaging Type:			
Box	0.59%	5	2.72%
Tray	47.61%	29	15.76%
Vacuum	21.39%	108	58.70%
Chub	30.41%	42	22.83%
Packaging Size²:			
16 oz or less	42.96%	149	80.98%
21 oz to 36 ounces	21.27%	4	2.17%
36 ounces or more	35.77%	31	16.85%

Fat²:			
24-27% fat (high fat)	49.00%	27	14.67%
15-20% fat (medium fat)	18.73%	99	53.80%
10-7% fat (lean)	29.31%	51	27.72%
2-5% (extra lean)	2.96%	7	3.80%
Marketing Claims¹:			
Organic	3.77%	29	15.76%
Grass-fed	9.37%	62	33.70%
Vegetarian fed	3.60%	11	5.98%
Pasture Raised	2.82%	28	15.22%
Natural	86.68%	110	59.78%
No Antibiotics or No Hormone	16.62%	78	42.39%
Meat Type:			
Chuck	6.34%	15	8.15%
Kobe or Wagyu	1.76%	9	4.89%
<p>1. Note: products may possess none, one, or more than one of these marketing claims.</p> <p>2. The packaging size and percent of fat content are continuous variables in the model. We grouped them to simplify the summary and to protect confidential product information.</p>			

Regression Results

Below are results of two regression models, which estimate the price premium associated with U.S.-origin claims. The first model only included a variable for origin claims exclusive to the U.S. The second model compared a variable for origin claims exclusive to the U.S. and a variable for origin claims to the U.S. plus other countries, to similar products without any U.S.-origin claim. Based on the r-squared, the models have a good

fit, where roughly 81 percent of the ground beef price variation is explained using the given attributes.

The first model showed a marginal implicit price premium for the origin claims exclusive to the U.S. (0.67 percent or 3 cents per pound),¹² at the 10 percent significant level. The second model found slightly higher implicit price premiums, at a higher significance, when including a variable for the origin claims of the U.S. plus other countries. The second model found an implicit price premium of 2.5 percent or 10 cents per pound for origin claims exclusive to the U.S., and an implicit price premium of 4.2 percent or 16 cents per pound for origin claims of the U.S. plus other countries.

Conclusion

Although the models typically showed modest implicit price premiums for U.S.-origin claims, the premiums were small compared to the other marketing claims on ground beef products. All the other marketing claims (organic, grass-fed, no antibiotic and no hormone, pasture raised, vegetarian-fed, natural) yielded higher price premiums than the U.S.-origin

¹² The average ground beef price in our data set with an origin claim exclusive to the U.S. is \$3.93 per pound with standard error of 0.007. The average ground beef price without an origin claims exclusive to the U.S. based on our model (U.S.-Origin= 0 and all other variables at their mean), base price, is \$3.90 per pound with a standard error of 0.012. Any price premium is on top of this base price.

claims.

Table 2 - Regression Results

Variables	(1)	(2)
	U.S.-Origin Only	U.S.-Origin & U.S. Plus Other Country Origin
<i>Country-of-Origin Claims</i>		
<i>(Base: NO COO or Other Country)</i>		
	0.007 (0.087)	0.025 (0.000)
U.S.-Origin Only		
U.S. and Other Country	--	0.041 (0.000)
<i>Packaging Type (Base: Chub)</i>		
	-0.068 (0.000)	-0.057 (0.001)
Box		
	0.089 (0.000)	0.081 (0.000)
Tray		
	-0.029 (0.000)	-0.028 (0.000)
Vacuum		
<i>Fat Percentage</i>		
	-0.021 (0.000)	-0.021 (0.000)
Fat		
<i>Marketing Claims</i>		
	0.150 (0.000)	0.157 (0.000)
Organic		
	0.193 (0.000)	0.196 (0.000)
Grass-fed		
	0.183 (0.000)	0.183 (0.000)
No Antibiotics/No Hormone		
	0.166 (0.000)	0.159 (0.000)
Pasture raised		
	0.050 (0.000)	0.055 (0.000)
Vegetarian-fed		

Natural	0.076 (0.000)	0.068 (0.000)
<i>Meat Type</i>		
Chuck	0.053 (0.000)	0.062 (0.000)
Kobe/Wagyu	0.628 (0.000)	0.627 (0.000)
<i>Size</i>		
Ounces	-0.003 (0.000)	-0.003 (0.000)
R-squared	0.812	0.813
Number of Observations	923,638	923,638
<p>Note: probabilities are shown in parentheses. -- indicating these controls are not included in the model</p>		