An Analysis of U.S. Cooking Oil Demand

Miyeon Son and Jayson Lusk

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Jayson Lusk is the head and Distinguished Professor of agricultural economics at Purdue University, and Miyeon Son is a postdoctoral fellow. *This work was conducted for the Center for Food Demand Analysis and Sustainability (CFDAS) at Purdue University and was made possible through grants from the United Soybean Board and the Foundation for Food & Agriculture Research.*

Cooking Oil Consumption

Data Description

For this study, we utilize weekly point-of-sale scanner data of cooking oil product sales from the first week of January 2018 to the first week of December 2022, provided by Nielsen. The sales data is collected through in-store scanners of affiliated retailers and are recorded at the Universal Product Code (UPC) level. From the product dictionary, we identified 8,656 UPCs for various types of cooking oils. The types of cooking oils include soy, canola, olive, corn, other remaining oil, peanut, coconut, grapeseed, popcorn, sesame and cotton seed oil. In this study, five major cooking oils were utilized for demand analysis: soy, canola, olive, corn and other remaining oil, which account for about 90% of total consumption. Remaining oil means vegetable cooking oil made by mixing two or more materials among various types of resources including soybean, canola, corn, etc. Other minor types of cooking oil were excluded, including peanut, coconut, grapeseed, popcorn, sesame and cotton seed oil. Summary statistics are shown in Table 1.

For the period of 2018-2022, the average weekly expenditure of five major cooking oil products is $62 million. The average weekly expenditure of olive oil is $28 million, accounting for the largest share of cooking oil products at 45.1%, followed by soy oil at 26.6% with $17 million (Figure 1)[1]. For canola and corn oil, the average weekly expenditure is $8 million (12.9%) and $5 million (7.4%), respectively. From 2018 to 2022, the expenditure of soy oil has increased with the largest at 74.0% among cooking oil products, followed by remaining oil at 67.7% and canola oil at 53.2%.

[1] The change in weekly sales in 2022 compared to 2018 is calculated using the average weekly sales for 2018 and 2022. The average weekly sales for 2018 is a 52-week average from the first week of January to the last week of December, and the average weekly sales for 2022 is a 49-week average from the first week of January to the first week of December.

For the average weekly price per ounce of the cooking oil products, soy oil and corn oil products are relatively cheaper than other cooking oil products, with $0.055/oz and $0.076/oz., respectively. Among cooking oil, olive oil is the most expensive at $ 0.281/oz. The average weekly prices of all cooking oil products have risen over the past five years. Remaining oil has the highest price increase rate at 66.8% in 2022 compared to 2018, followed by corn and canola oil with an increase rate of 65.2% and 61.2%, respectively.

Table 1. Summary of descriptive statistics on expenditure, prices, and budget share (2018-2022)

Variable	Mean	SD	Min	Max	% Change (18-22)
Average weekly sales ($1000)					
Soy	16,642	4,295	11,422	33,081	74.0%
Canola	8,010	1,787	5,753	14,762	53.2%
Olive	27,672	4,146	20,726	58,078	27.4%
Corn	4,561	749	3,513	9,809	28.8%
Other remaining oil	4,993	1,063	3,518	10,190	67.7%
Weekly expenditure shares					
Soy	0.266	0.025	0.224	0.332	19.3%
Canola	0.129	0.008	0.109	0.150	5.1%
Olive	0.451	0.032	0.371	0.507	-12.5%
Corn	0.074	0.006	0.057	0.100	-11.6%
Other remaining oil	0.080	0.005	0.071	0.090	15.0%
Average weekly price ($/oz.)					
Soy	0.055	0.013	0.045	0.086	65.2%
Canola	0.062	0.014	0.049	0.099	61.2%
Olive	0.281	0.014	0.251	0.317	2.2%
Corn	0.076	0.012	0.065	0.111	44.1%
Other remaining oil	0.150	0.029	0.106	0.214	66.8%

Source: Author's calculation based on the 2018-2022 weekly point-of-sale data from Nielsen.

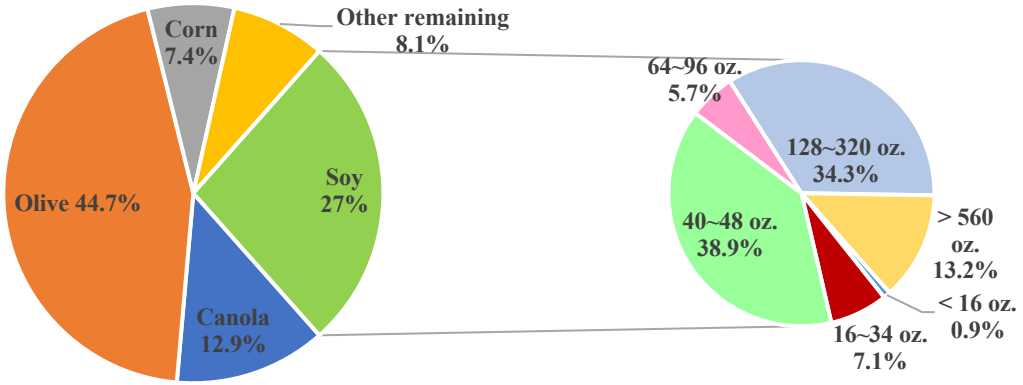

Figure 1. Expenditure share by oil type, and composition of soy oil consumption by package size

Cooking Oil Consumption Trend

The weekly expenditure of cooking oil and consumption quantity in ounces of cooking oil over the years 2018-2022 are shown in Figure 2 and Figure 3. The weekly expenditure of olive oil is the largest proportion among cooking oil products due to its relatively higher price than others. When it comes to the consumption quantity in ounces, soy oil has the largest proportion among cooking oil products. The average weekly expenditure of all cooking oil products has increased over five years with an average of 9.1% per year. The larger expenditure increase trend of soy oil, compared to others, has driven an increase in soy oil price. The consumption of each oil product is consistent over the period. In November and December, there is a seasonality in which weekly consumption of cooking oil temporarily increases during the baking season. Similar to dairy product consumption, in mid-March 2020, the consumption of cooking oil products sharply increased due to the government's shutdown implementation and stay-at-home order to prevent the spread of COVID-19. Overall weekly milk expenditure in the third week of March 2020 was $52 million, which increased by 129.4% compared to the same period in 2019. The consumed quantity in ounces in the same period was 1,209 million ounces increase of 111.6%.

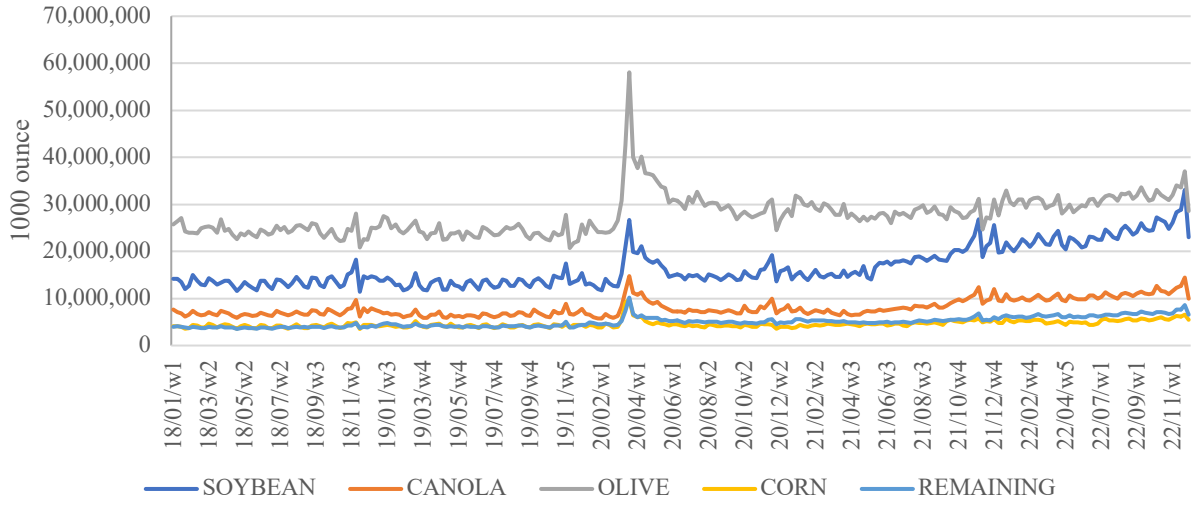

Figure 2. Weekly expenditure (1000 USD) of cooking oil products

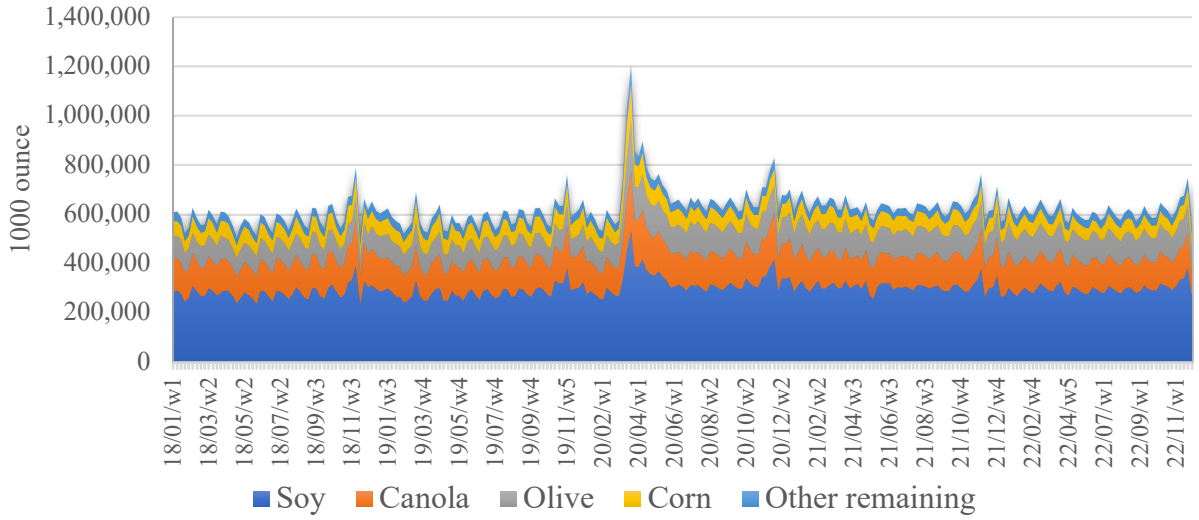

Figure 3. Weekly consumption quantity (1000 oz.) of cooking oil by oil type

Soy Oil Consumption Trend

Compared to 2018, soy oil weekly expenditure in 2022 increased by 74.0% and its consumption in ounces increased by 5.1%. Considering the packaging size of soybean oil, mid-sized packages (40-48oz) account for the largest portion with 38.9%, followed by large-sized packages (120-320oz) with 34.3%. The share of small-sized packages (less than 16oz) accounts for less than 1%. The weekly consumed quantity and weekly price are shown in Figure 4. The consumed quantities of 40-48 oz and over 560 oz have slightly decreased, while the others have increased over the periods. Among them, the consumed quantity of mid-large-sized packages (64-96oz) and large-sized packages (128-320oz) largely increased to 45.1% and 26.7% in 2022, respectively, compared to 2018. This consumption trend implies consumer desire to save expenditure by purchasing large-sized packaging products that are relatively cheaper than others as the price of soy cooking oil rises.

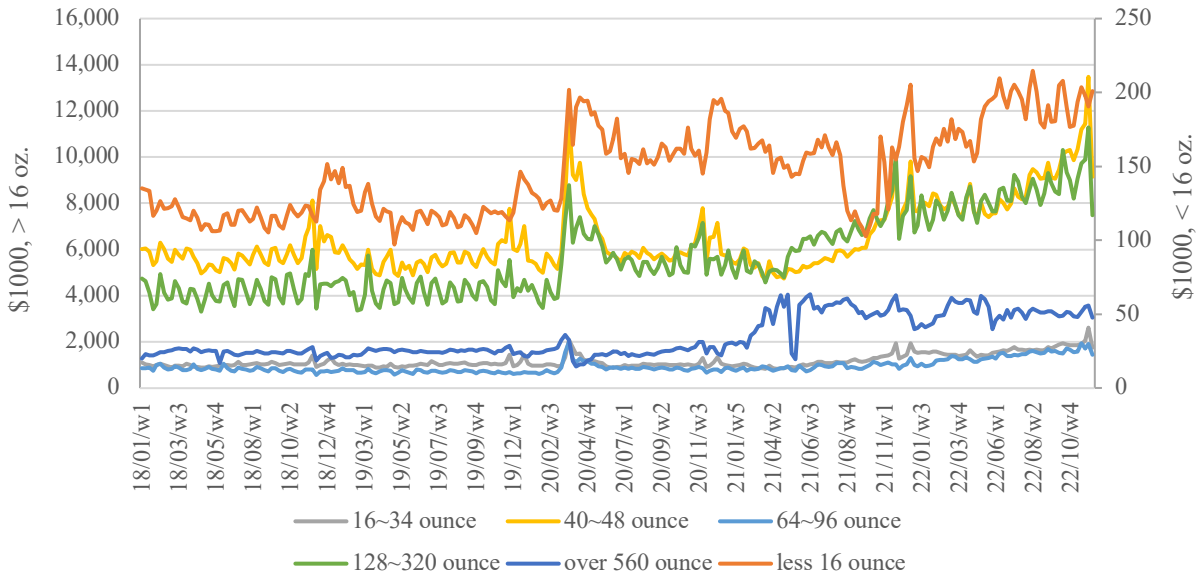

Figure 4. Soy oil weekly expenditure ($ 1000) by packaging size

Estimation of Cooking Oil Demand

We assess the impact of changes in the price of different cooking oils on soy oil demand. An Almost Ideal Demand System (AIDS) is used to estimate own- and cross-price elasticities for major cooking oil varieties, soy, canola, olive, corn, and other remaining oil. Here, other remaining oil include vegetable cooking oil in the form of a mixture of soybean, canola and corn, which is difficult to classify into one specific category. Data used in this analysis is national weekly scanner data for the calendar year 2018-2022 available from Nielsen.

Table 2 presents elasticity estimates from our AIDS model. Given our interest in the edible soy oil market among cooking oil, we focus on these categories with a particular focus on cross-price elasticity estimates. The elasticity of expenditure of all cooking oil is found to be close to one, implying when prices change by 1%, demand also changes by close to 1%. Own-price elasticity of soy, olive, and other remaining oil demand is estimated to be similar at -0.72 to -0.82. In the case of corn oil, the demand reduction for a 1% increase in price is 2.05, which is more elastic than other cooking oils. Looking into the cross-price elasticity, the impact of a 1%

increase in canola and corn oil prices on soy oil increases in demand to 0.17 and 0.14, indicating soy oil is a substitute for them. The cross-price elasticity of change in other remaining oil prices on soy oil demand is estimated to be 0.07, indicating the cross-price effect is small.

Table 2. Marshallian price elasticity and expenditure elasticity of cooking oil product

	Price of:					Expenditure
Quantity of:	Soy	Canola	Olive	Corn	Others	elasticity
Soy	**-0.824**	0.174	-0.493	0.144	-0.021	0.977
Canola	0.323	**-1.059**	-0.151	-0.071	-0.155	1.112
Olive	-0.295	-0.028	**-0.721**	0.087	-0.038	0.994
Corn	0.521	-0.104	0.544	**-2.051**	0.127	0.962
Others	0.074	-0.229	-0.198	0.117	**-0.726**	0.962

References

1. Angus Deaton and John Muellbauer. 1980. “An Almost Ideal Demand System” The American Economic Review. 70(3), 312-326

Appendix: AIDS Model for Estimation of Demand Elasticities

The Almost Ideal Demand System (AIDS), introduced by Deaton and Muellbauer (1980a) would be exploited in this study. In this demand system, by imposing adding-up, symmetry and homogeneity restrictions, the budge share of different categories of product are linearly related to the logarithms of the total expenditure on them and relative prices. The budget share equation in AIDS model is given as:

(1) $w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left\{\frac{M}{P}\right\}$,

where ***M*** is the total expenditure in each retail product, and ***P*** is the stone price index as a linear proxy, provided by

(2) $\log P = \sum_j w_j \, log p_j$.

Imposing restrictions on the parameters, equation (1) represent the system of demand equations: The first adding-up restriction implies that all budget shares are sum to one, changes in cost share responding to one price change add up to zero, and changes in the total expenditure won't affect cost shares.

(3) $\sum_i \alpha_i = 1, \sum_i \gamma_{ij} = 0, \sum_i \beta_i = 0.$

Second restriction imposed is homogeneity, indicating that the proportional change in prices would not change the cost shares.

(4) $\sum_{ij} \gamma_{ij} = 0.$

The third restriction is Slutsky symmetry.

(5) $\sum_{ij} \gamma_{ij} = \gamma_{ji}.$

With restrictions (3) – (5) hold, equation (1) satisfies homogeneity of degree zero in prices and total expenditure, and Slutsky symmetry. In the linearized AIDS model, the price elasticity could be calculated as

(6) $\varepsilon_{ij} = \frac{\gamma_{ij} - \beta_i w_j}{w_i} - \delta_{ij}, \begin{cases} \delta_{ij} = 1, & if\ i = j \\ \delta_{ij} = 0, & if\ i \neq j \end{cases}$.

And the income elasticity could be computed as

(7) $\varepsilon_{ij} = \frac{\beta_i}{w_i} + 1.$