Analyzing Determinants of Sugar-Containing-Product Prices

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EXECUTIVE SUMMARY

This report examines factors influencing highly sweetened sugar-containing-product (SCP) prices in the United States (US). A fixed-effects panel regression is used to determine if US sugar prices affect SCP prices, as is argued by US sugar-using firms, while controlling for firm financial performance, macroeconomic conditions, and SCP characteristics. For this paper, sugar is limited to sucrose.

Results indicate that firm financial performance, SCP weight, the percentage of sugar in the SCP, and macroeconomic conditions have an impact on SCP prices. However, US sugar prices do not have a statistically significant impact on SCP prices. Thus, sugar-using firms do not consider the price of US sugar when making SCP pricing decisions, but instead more heavily consider their firm financial performance and other SCP characteristics. While contrary to sugar-using firm declarations, these results are not inconsistent with other evidence. For example, Triantis (2016) notes that although sugar is the primary ingredient of highly sweetened SCPs, the cost of sugar in SCPs is typically very low. Indeed, in this report, the average cost of sugar among the SCPs was only 2.56% of the SCPs' retail price. These results reaffirm that US sugar policy does not harm sugar-using firms.

The remaining sections of this report are Appendices A and B. Appendix A provides the full list of the sugar-using firms in the data set and descriptive statistics of the variables used in the regression by firm. Appendix B provides stock returns, revenues, and cost of goods sold for the sugar-using firms in the data set.

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Abstract

United States (US) sugar policy buffers domestic sugar producers against subsidized and dumped world market sugar. Thus, some sugar-using firms criticize US sugar policy for causing them to pay higher sugar prices and harming their profitability. A fixed-effects panel regression is used to determine if US sugar prices affect sugar-containing-product (SCP) prices. The model controls for firm financial performance, macroeconomic conditions, and other SCP characteristics. US sugar prices did not have a statistically significant impact on SCP prices. However, other SCP characteristics, macroeconomic conditions, firm sales growth, historical earnings per share (EPS), and firm size had a statistically significant impact on retail SCP prices. Thus, the price of sugar is not one of the several factors firms consider when making SCP pricing decisions. While SCPs' primary ingredient is sugar, the average cost of sugar among SCPs in this study was only 2.56% of the value of the product. Indeed, it is well known that most foods exhibit this characteristic, as the commodity value constitutes a relatively small portion of the cost of the product. Results provide evidence that US sugar policy does not harm sugar-using firms.

Keywords: Sugar-containing-products, pricing model, sugar-using firm financial performance

1. Introduction

United States (US) sugar policy utilizes domestic marketing allotments and a tariff-rate quota (TRQ) system to regulate how much sugar is allowed to be marketed in the US (US Department of Agriculture (USDA) Economic Research Service (ERS), 2021a). Domestic marketing allotments establish the amount of sugar domestic producers are allowed to market by company and are split between cane sugar and beet sugar production. Forty countries are granted access to the World Trade Organization (WTO) TRQ and many also export sugar into the US in amounts specified by various trade agreements. Additionally, Mexico exported an unrestricted amount of sugar into the US due to the North American Free Trade Agreement (NAFTA) (now the US-Mexican-Canada Agreement) during 2008-2013. However, there are now constraints to Mexico's access to the US market due to the suspension agreements negotiated by the US and Mexican governments in 2014 (USDA ERS, 2021a) that suspended severe antidumping and countervailing duties imposed on Mexican sugar imports due to anticompetitive behavior. Additionally, the USDA Secretary of Agriculture can increase the TRQ amount if he or she believes the domestic supply of sugar is "inadequate to meet domestic demand at reasonable prices" (USDA ERS, 2021a).

US sugar prices are generally higher than world sugar prices, since the domestic and foreign sugar supply is limited by US sugar policy; whereas the global market has surplus sugar supplies encouraged by production subsidies in most sugar-producing countries (e.g., Elobeid & Beghin, 2006; Hodari, 2018; Hudson, 2019). However, notwithstanding the rationale for US sugar policy, some sugar-using firms claim US sugar policy is harmful to their business since they cannot easily access the discounted subsidized world sugar price. The Sweeteners Users Association (SUA) (2021) claims that "US sugar prices are often double world prices—a cost

that typically gets unfairly passed on to consumers." The SUA recently issued a press release that called the US sugar program "overly restrictive" and committed to "keeping sugar supplies tight and domestic prices high" (SUA, 2021).

While somewhat counter-intuitive, Trejo-Pech et al. (2020) found that as US sugar prices increase relative to world sugar prices, sugar-using firm financial performance actually improves. Further, candy industry reports assert that as sugar prices increase, sugar-using firms can use this as an opportunity to become more profitable by increasing SCP prices (IBIS *World*, 2020). If sugar-using firms become more profitable when sugar input costs increase, firms may be increasing sugar-containing-product (SCP) prices in an amount that exceeds their input-cost rise.[1] Consider for example, the retail price of a Hershey candy bar, which increased 326% from 1983 to 2018, increasing from 35 cents to $1.49 (American Sugar Alliance (ASA), 2021). Meanwhile, the US wholesale refined sugar price rose less than 10 cents per pound, or just 36%, between 1983 and 2018 (USDA ERS, 2021b). Thus, there is evidence that sugar-using firms have, indeed, raised their SCP prices in a greater magnitude than the rise in US sugar price. However, this research postulates that changes in US sugar prices are not related in a statistically significant way to US SCP prices.

No previous research has investigated whether sugar-using firms consider US sugar prices when deciding SCP prices (i.e., if there is a statistically significant relationship between US sugar prices and SCP prices). It is common industry knowledge that sugar costs represent a small fraction of SCP prices despite being their primary ingredient (Triantis, 2016), which is the case with most food products (USDA, 2021c). In 2020, the average cost of sugar in highly

[1] Holding other things constant, when the percent increase in cost equals the percent increase in price, profitability increases due to profit margins (i.e., the dollar value increase of revenues is higher than the dollar value increase in cost).

sweetened SCPs ranged from 1.56% to 10.03% (ASA, 2021). Thus, since sugar costs represent such a minor component of SCP price, it is likely that there is no direct relationship between changes in sugar prices and SCP prices.

The goal of this paper is to determine if there is a statistically significant relationship between US wholesale refined sugar prices and US retail SCP prices. Specifically, this study will use a database of SCP prices from 2008 through 2020 to determine the factors influencing SCP prices. SCPs owned by publicly traded firms with observed firm financial performance are used in the analysis. We formally test the hypothesis of whether US wholesale refined sugar prices affect SCP prices. While research shows that, counterintuitively, sugar-using firms are more profitable when US sugar prices increase relative to world sugar prices (Trejo-Pech et al., 2020), no known research has investigated whether US sugar prices are statistically significant in determining SCP prices. Given sugar prices represent a small fraction of SCP prices (Triantis, 2016), it is likely sugar-using firms do not consider the price of sugar when determining SCP prices. This research will determine if there is a statistically significant relationship between US wholesale refined sugar prices and SCP prices while controlling for SCP characteristics, firm financial performance, and macroeconomic conditions. Results will be informative to the performance of US sugar policy and whether it ultimately affects sugar-using firms' SCP pricing decisions.

2. Literature Review

Previous research has analyzed many aspects of the U.S. sugar market such as sugar-sweetened beverage taxes (e.g., Cawley et al., 2021; Lee et al., 2019), the impact of NAFTA (e.g., Kennedy and Schmitz, 2009; Knutson et al, 2010; Schmitz and Lewis, 2015), Mexican trade violations

(e.g., Schmitz, 2018; Lewis and Schmitz, 2015; Zahniser et al., 2016), US genetically modified (GM) sugarbeets (e.g., Lewis et al., 2016; Kennedy et al., 2019; Carter and Schaefer, 2019) and how US sugar prices impact sugar-using firm financials (e.g., Triantis, 2016; Trejo-Pech et al., 2020).

Cawley et al. (2021) provides a review of literature concerning the impact of sugar-sweetened beverage taxes. They also analyzed Nielsen Retail Scanner Data along with hand-collected price data on sugar-sweetened beverages to determine the pass-through effect of a sugar-sweetened beverage tax in Boulder, Colorado. They found that the pass-through effect of the tax was slightly less than 75% when analyzing hand-collected store data, but was 50% when using the scanner data. In general, they found consumers paid most of the tax.

Schmitz and Lewis (2015) found that NAFTA cost US sugar producers $474 million to $1.3 billion annually due to increased Mexican sugar imports into the US. Lewis and Schmitz (2015) estimated that Mexican trade violations cost US sugar producers $525 million to $1.6 billion annually. Schmitz (2018) observed that the 2014 Mexican-US sugar suspension agreements would have saved US sugar producers $138 million annually if they had been in effect from 2008 through 2014.

Kennedy et al. (2019) used a partial equilibrium framework to evaluate the possible demand impact of US sugarbeets being GM compared to their non-GM sugarcane counterpart. They found that the negative demand impact from sugarbeets being GM could outweigh any supply-induced gains from GM sugarbeets. They concluded that since the National Bioengineered Food Disclosure Standard does not classify beet sugar as bioengineered, that this negative welfare result would not be fully realized for sugarbeet producers.

Trejo-Pech et al. (2020) examined the effect of US sugar policy on sugar-using-firm financial profitability when considering both US and world sugar prices. They examined how the relative US-to-world sugar price ratio impacted US firms' return on assets and market-to-book ratio. Counterintuitively, they found that as US sugar prices increase relative to world sugar prices, US sugar-using firms became more profitable.

While research has examined several aspects of the US sugar market and US policy, no known research has examined factors associated with SCP prices and whether sugar-using firms consider US sugar prices when pricing SCPs. Therefore, this research analyzes a panel of SCP prices across various sugar-using firms and examines whether US sugar prices are associated with SCP prices.

3. Conceptual Framework and Hypothesized Results

The goal of this project is to determine factors influencing SCP pricing decisions of publicly traded sugar-using firms. The categories of variables hypothesized to affect SCP prices are SCP characteristics, firm financial performance, and macroeconomic conditions. For each uniquely identified SCP, i, in a calendar quarter, t, we hypothesize that the SCP price per pound ($SCPprice_{i,t}$) can be explained as a function of the following factors:

(1) $$SCPprice_{i,t} = f(SCP_{i,t}, F_{i,t}, ME_{i,t}).$$

where $SCP_{i,t}$ are characteristics relating to the SCP, $F_{i,t}$ are variables relating to the respective SCP firm's financial performance, and $ME_{i,t}$ controls for macroeconomic conditions over the sample's time period.[2]

3.1 SCP Characteristics

It is hypothesized that the SCP characteristics that will impact the SCP price per pound are the SCP weight (*Weight*), the percentage of sugar in the SCP (*%Sugar*) and the price of US wholesale refined sugar (*SugarPrice*). The SCP weight has been shown to affect pricing decisions of foods (Ghazaryan et al., 2018). To incentivize sales volume, manufacturers in general might increase a product's package size, which decreases the SCP price per unit and in consequence makes their products economically more attractive. It has also been suggested that sugar-using firms may increase price per unit by repacking candy into smaller bars sold at similar prices (Trejo-Pech et al., 2020). By decreasing the size of the candy bars, this would have the impact of increasing the SCP price per pound. From a more general standpoint, product *Weight* is also included as a control variable since the data is a panel of SCPs ranging from candy bars to sucrose-sweetened soft drinks and it is likely SCP prices vary by product-types which also have different weights. Given these relationships between SCP weight and price per pound, we expect that as the package size increases (decreases), the SCP price per pound will decrease (increase) (Table 1).

Given previous research (Trejo-Pech et al., 2020) found that sugar-using firms become more profitable as US sugar prices increase relative to world sugar prices, it is possible sugar-

[2] As will be explained later in this document, some variables are lagged with respect to SCP prices. To facilitate the exposition in this section, equation (1) shows a contemporaneous relationship between the dependent variable and all explanatory variables.

using firms pass higher sugar prices on to consumers. On the other hand, since sugar represents a small fraction of SCP costs (Triantis, 2016), it is also possible that they do not have an impact on SCP prices and are not statistically significant in the model. Therefore, we hypothesize US sugar prices will either not be significant in the model or else will be significant and positive (Table 1).

The estimated coefficient on the percentage of the product's weight that is sugar (*%Sugar*) will indicate whether products of a higher sugar content are priced higher than products that have a lower sugar content. Similar to the reasons *Weight* is included as an explanatory variable, *%Sugar* is also a control variable given there is a diverse panel of SCPs considered in the analysis. It is likely SCPs characterized by different percentages of sugar are priced differently. However, we are uncertain whether more highly sweetened products are generally priced higher or lower (Table 1) and whether that might explain pricing of SCPs rather than another variable such as changes in the price of sugar.

3.2 Firm Financial Performance

Pricing modeling improves when in addition to cost and demand considerations (i.e., package size, sugar content, and sugar price), aspects of the brand's marketing strategy such as a firm's competitive positioning are included as explanatory variables (Rao, 1993). Firm's size, sales growth, and past financial performance proxies are considered in this study to control for a firm's competitive positioning.

Sales growth is one of the most preferred financial ratios by equity analysts covering publicly traded firms (Trejo-Pech et al., 2015). Firms in the sample would likely consider sales trends when pricing their products. It is hypothesized that one-quarter lagged year-to-year sales growth (*SalesGrowth*) will positively influence pricing decisions in the current quarter (Table 1).

It is plausible that when sales are growing, firms may increase prices to test whether consumers are still willing to pay higher prices (i.e., positive sales growth may signal underpricing). In contrast, when sales are decreasing, firms may decrease prices to incentive purchasing and avoid further sales growth deterioration.

Publicly traded firms' profitability is highly scrutinized every quarter by equity analysts and investors because profitability and market equity value are directly related. Consistently, surveyed chief financial officers (CFOs) rank earnings as the single most important financial metric they care about. Further, CFOs have strong incentives to meet or exceed earnings thresholds (Graham et al., 2006). Failure to meet capital market's earnings thresholds may place firms under financial pressure. Trejo-Pech, Weldon, and Gunderson (2016), for instance, find that agribusinesses failing to meet earnings thresholds tend to manipulate earnings to get back on track. It is expected that not meeting earnings thresholds on a given quarter influences the SCP pricing decision in the following quarter. However, it is difficult to predict the direction of price changes firms may create to increase profits because it would depend on margin levels, non-recurrent expenses during the current quarter, or product-price elasticities, among other factors. Following Zang (2011), we build a binary variable with a value of one for firms that reported lower EPS relative to the previous quarter or barely higher EPS relative to the previous quarter (e.g., $EPSthreshold_{t-1} = 1$ if $EPS_{t-1} - EPS_{t-2} \leq \$0.02$, 0 otherwise). This lagged EPS threshold (*EPSthreshold*) is expected to affect pricing decisions either positively or negatively in the current period (Table 1).

Larger firms might be better positioned than smaller firms for pricing decisions and price negotiations with retailers since they might afford higher advertising expenditures, better trained sales force, higher R&D, and in general, have larger resources. Thus, it is hypothesized that firms

with a higher market valuation will be more likely to exercise their market power and have higher SCP prices than firms with lower market valuation (Table 1). Therefore, we include a variable regarding the size of the firm relative to other firms in the sample (*LargeMarketVal*). *LargeMarketVal* is a binary variable equal to one if a firm ranked in the top 33% of firm market value sizes of all firms in the sample and zero otherwise. Firm market value size is defined as total assets minus common equity plus market capitalization, where market capitalization equals the stock price multiplied by the number of shares outstanding during the fiscal quarter.

Table 1. Variables, Definitions, and Hypothesized Signs

Variable	Description	Units	Expectation
Dependent variable:			
SCPprice	Sugar-containing-product (SCP) price per pound*	$/pound	NA
Explanatory variables:			
SCP Characteristics			
Weight	SCP's total weight including packaging	pounds	–
%Sugar	Percentage of sugar contained in SCP	%	+/–
SugarPrice_QL1	One quarter lagged U.S. wholesale refined beet sugar price*	$/pound	+ / NS
SugarPrice_Q	Quarterly U.S. wholesale refined beet sugar price*	$/pound	+ / NS
Firm Financial Performance			
SalesGrowth	One quarter lagged year-to-year sales growth	% (Δ in revenues)	+
EPSthreshold	One quarter lagged binary variable equal to 1 for firms reporting lower earnings per share (EPS) relative to the previous quarter or barely higher EPS relative to the previous quarter[1]	1, 0	+ / –
LargeMarketVal	Binary variable equal to 1 if a firm ranked in the top 33% of firm market value size out of all firms in sample[2]	1, 0	+
Macroeconomic Condition			
Recessions	Binary variable equal to 1 if we were in a recession	1, 0	–

Notes: [1]EPSthresholdt = 1 if $EPS_t - EPS_{t-1} \leq \$0.02$, 0 otherwise; [2]Firm market value size is defined as total assets - common equity + market capitalization, where market capitalization equals the stock price multiplied by the number of shares outstanding during the fiscal quarter. *Prices were adjusted for inflation using the Consumer Price Index. NS stands for not significant. NA stands for not applicable.

3.3 Macroeconomic Conditions

The macroeconomic condition of recessions (*Recessions*) was used to account for macroeconomic conditions present in the sample time-period. If the US was in an economic recession according to the National Bureau of Economic Research (2021), *Recessions* was equal to one (and was zero otherwise). The US was marked as being in an economic recession from the fourth quarter of 2007 through the second quarter of 2009 and in 2020. It is hypothesized that firms will lower their prices during a recession to entice consumers to still purchase SCPs (Table 1).

4. Econometric Model

A fixed effects panel regression was estimated to determine factors influencing SCP prices. The dependent variable is SCP price per pound (*SCPprice*) expressed in 2020 Consumer Price Index (CPI) adjusted dollars (U.S. Bureau of Labor Statistics, 2021). This was calculated by dividing SCP CPI adjusted prices by the total pounds in each product's package. Expressing SCP price on a per pound basis standardizes prices across product categories and uses the same units for both output and input prices (i.e., sugar prices are by industry convention expressed in $ per pound). SCP price is modeled as a function of SCP characteristics, firm financial performance, and macroeconomic conditions. Equation (2) shows the model:

$$(2) \qquad ln(SCPprice)_{i,t}^{SCP} = \beta_0 + \beta_1 \cdot ln(Weight)_{i,t}^{SCP} + \beta_2 \cdot ln(\%Sugar)_{i,t}^{SCP} + \beta_3 \cdot ln(SugarPrice)_{i,t}^{SCP} + \beta_4 \cdot SalesGrowth_{i,t-1}^{F} + \beta_5 \cdot EPSthreashold_{i,t-1}^{F} + \beta_6 \cdot LargeMarketVal_{i,t}^{F} + \beta_7 \cdot R_{i,t}^{ME} + a_i + e_{i,t}$$

where subscript *i* represents the uniquely identified SCP and *t* is a calendar quarter, and superscripts represent characteristics associated with the SCP (*SCP*), SCP firm (*F*), and macroeconomic conditions (*ME*). SCP characteristics include SCP weight (*Weight*), the percentage of sugar in the SCP (*%Sugar*), and the wholesale refined beet sugar prices (*SugarPrice*). To facilitate the interpretation of results (i.e., have parameters estimated as elasticities) the natural log (ln) of the SCP characteristic variables was used in equation (2). SCP firm financial performance variables include sales growth (*SalesGrowth*), the earnings per share (EPS) proxy (*EPSthreshold*), and the variable regarding the size of the firm relative to other firms in the sample (*LargeMarketVal*). While a_i in equation (2) captures firm fixed effects, annual time fixed effects were not able to be utilized due to lack of variation annually in the panel. Therefore, we also controlled for the macroeconomic condition of recessions (*Recessions*). Complete variable description appear in Table 1.

Our null hypothesis is that wholesale refined sugar prices do not impact retail SCP prices ($\beta_3 = 0$). If we fail to reject the null, then sugar prices do not have a relationship with SCP prices. Meanwhile, if we do reject the null hypothesis ($\beta_3 \neq 0$), then sugar prices have an impact on SCP prices. Equation (2) is estimated under two specifications of *SugarPrice* to test the null hypothesis. In the first specification, *SugarPrice* is the quarterly sugar price, and in the second specification, *SugarPrice* is the one-quarter lagged sugar price, relative to the time-period SCP prices were collected. This was done to determine whether SCP firms price their products based on current sugar prices or previous (lagged) sugar prices. If sugar prices do affect SCP prices, it is likely they do not instantly change. Thus, we suspect any relationship between sugar prices and SCP prices would be lagged by one-quarter. To keep the notation simple, equation (2) shows only the current price specification.

To estimate the panel fixed effects regression in equation (2), the *xtreg* command in Stata with the *fe* specification was used (StataCorp, 2017). Multicollinearity was examined using the *coldiag2* command. Heteroskedasticity was examined using the *xttest3* command and was accounted for using the *vce*(*robust)* option.

5. Data

Starting in 2008, the ASA created an annual database of SCPs. To qualify as a SCP, the product's primary sweetener must be sugar and the product must contain at least a minimum of 10% sugar by product weight. Annually (typically in June), the ASA collects data from grocery stores in the metropolitan Washington, D.C., area on a variety of SCPs. They collect the SCP prices as well as information from the respective products such as the product's net weight and information from the nutritional facts panel such as serving size, servings per container, and grams of sugar per serving. Previous research has also used hand-collected data to estimate the pass-through effects of taxes on sugar-sweetened beverages (Cawley et al., 2021).

For this analysis, only publicly traded companies with available financial accounting and stock price data in the Wharton Research Data Services database (WRDS) were analyzed since firm financial performance was controlled for in the analysis. Firm financial data was obtained specifically from WRDS's Compustat Capital IQ Fundamentals Quarterly module, with the following items used to calculate financial variables in the model: total assets, total revenue, total equity, stock price, number of shares outstanding, and earnings per share. Thus, we have a panel of data by firm and product type ranging from 2008 through 2020 with the exception of 2011 when the ASA did not collect data.

The complete list of SCPs in the analysis, by firm and by year, appears in Appendix A. The firms in our analysis, and examples of their SCPs used in our analysis, are the following:

Tootsie Roll (Junior Mints), The Hershey Company (e.g., Milk Duds, Hershey Bar, Hershey Bar with Almonds), Unilever (e.g., Klondike bars, Ben and Jerrys ice cream), The J.M. Smucker Company (e.g., Pillsbury cake and frostings), Pinnacle Foods and Conagra (e.g., Duncan Hines frosting and cake mixes), PepsiCo, Inc. (e.g., Pepsi Throwback, Quaker corn bread), Mondelez (e.g., Oreos), Kraft (Jello-O), and General Mills (e.g., Betty Crocker cake mixes and frostings). Appendix A also shows summary statistics by SCP firm (Table A1).

Summary statistics for the variables used in equation (2) appear in Table 2. There are a total of 379 observations in the sample. SCP prices were collected directly from the SCPs appearing in the grocery stores and, for this study, were adjusted for inflation using the CPI series published by the US Bureau of Labor Statistics (2021) with August 2020 as the base year (i.e., the last month SCP prices were collected in the database). SCP price was then standardized by dividing it by the SCP's net weight (in pounds). This is the dependent variable in the analysis, *SCPprice*. The average SCP price per pound (*SCPprice*) was $6.22/lb with a minimum price of $0.55/lb (Pepsi Throwback and Mountain Dew Throwback) and a maximum price of $17.95/lb (Hershey York Peppermint Pattie) (Table 2).

5.1 Sugar-Containing-Product Characteristics

The SCP weight (*Weight*) is equal to the net weight of the SCP, which is found on the package of the SCP. The average weight was 1.17 pounds with the minimum SCP weight being 0.86 pounds (General Mills Betty Crocker muffin and quick bread mix-cinnamon streusel) and the maximum SCP weight being 9 pounds (Pepsi Throwback and Mountain Dew Throwback). The percentage of sugar (*%Sugar*) in each SCP was calculated from the weight of sugar in the product provided on the nutritional facts panel (in pounds) divided by the SCP weight provided on the package

label (in pounds). The average percentage of sugar in SCPs was 48%, the minimum was 12% (Pepsi Throwback), and the maximum was 99% (Tootsie Roll Junior Mints).

Table 2. Summary Statistics of Sugar-Containing-Product (SCP) Prices, SCP Characteristics, Firm Financial Performance, and Recessions

Variable	Mean	Std. Dev.	Min.	Max
SCP Price per Pound (Dependent Variable)				
SCPprice	6.218	4.69	0.553	17.95
Sugar-Containing-Product Characteristics				
Weight	1.17	1.994	0.086	9.000
%Sugar	0.482	0.181	0.118	0.988
Quarterly SugarPrice	0.330	0.053	0.233	0.440
Quarterly-Lagged SugarPrice	0.324	0.069	0.238	0.436
SugarCostPackage	0.159	0066	0.027	0.435
Firm Financial Performance				
SalesGrowth	0.031	0.100	-0.131	1.138
EPSthreshold	0.393	0.489	0	1
LargeMarketCap	0.348	0.477	0	1
Firm Market Valuation (in billions $)	5.501	5.878	1.525	270.242
Macroeconomic Factors				
Recessions	0.169	0.375	0	1

Notes: Observations=379

Two different US wholesale refined beet sugar prices were considered for analysis and both were adjusted for inflation using the CPI[3]. Equation (2) was estimated using wholesale refined beet sugar prices in the quarter and one-quarter lag of the time the SCP prices were collected. Both wholesale refined beet sugar prices averaged around 33 cents/pound and ranged from around 23 cents/pound to 44 cents/pound. Figure 1 shows the annual relationship of

[3] U.S. wholesale refined beet sugar prices are in Table 5, available at: https://www.ers.usda.gov/data-products/sugar-and-sweeteners-yearbook-tables/

wholesale refined beet sugar prices per pound and SCP prices per pound as well as the percentage of sugar in each product. As shown by Figure 1, sugar prices represent a small percentage of the SCP price.

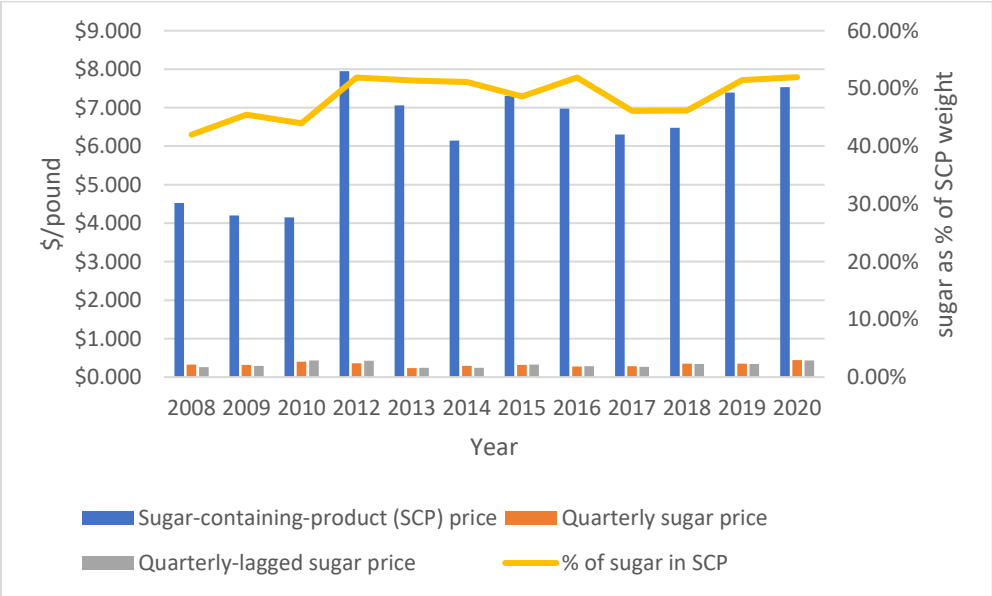

Figure 1. Annual SCP Prices, Sugar Prices, and Sugar Share of SCP Weight

Total sugar costs in the package per pound (*SugarCostPackage*) were also computed by multiplying *%Sugar* by the quarterly *SugarPrice*[4]. The average total cost of sugar across all SCPs was 15.9 cents/lb, with a maximum of 45 cents/lb (Tootsie Roll Junior Mints) and a minimum of 2.7 cents/lb (Pepsi Throwback) (Table 2). Meanwhile, the average SCP price is $6.22/lb. Thus, the percentage of the cost of sugar across SCPs is only 2.56% of the total SCP price despite the fact that sugar consists of 48% of the SCP's weight. Figure 2 below shows this relationship from 2008-2020.

[4] Note that *SugarCostPackage* is not included in the regression since *%Sugar* and *SugarPrice* are included instead.

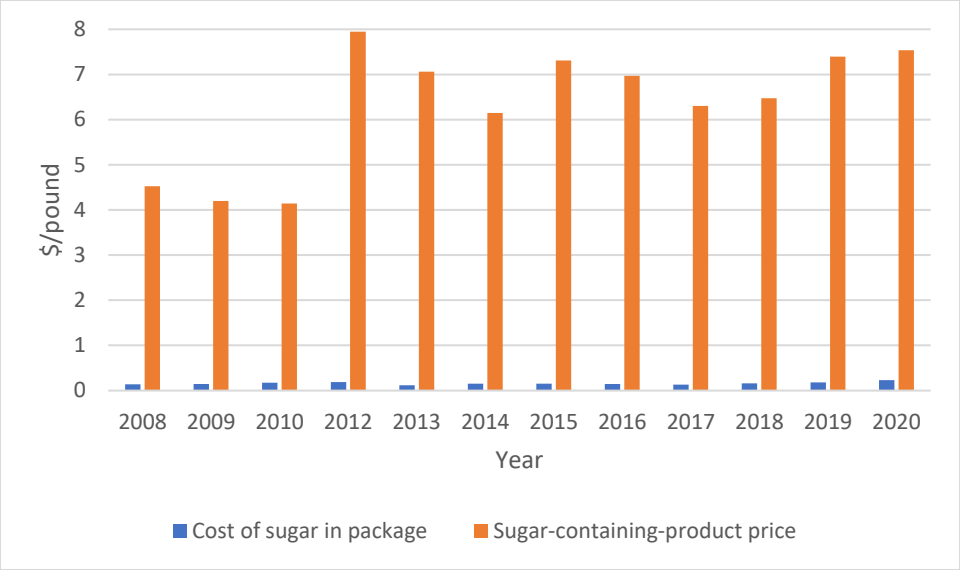

Figure 2. Cost of Sugar in the Sugar-Containing-Product (SCP) versus the SCP Price

5.2 Firm Financial Performance

Sales growth (*SalesGrowth*) was calculated by first accumulating last-trailing-twelve-months (LTTM) revenues per quarter and then applying the formula (LTTM $revenues_{t-1}$ / LTTM $revenues_{t-5}$)-1. The average one quarter-lagged annual sales growth for the firms in the sample was 3.1%. The lowest sales growth was -13.1% (Mondelez) and the maximum sales growth was 114% (Kraft).

EPS threshold (*EPSthreshold*) was calculated as in Zang (2011), $EPSthreshold_t$ is equal to one if $EPS_t - EPS_{t-1} \leq \$0.02$, and zero otherwise, with the 12-months-moving-average basic EPS excluding extraordinary items, reported by Standard and Poor's in the WRDS database. The average EPS threshold was 39% with the minimum being zero for several companies and the maximum being one for several companies. The *LargeMarketVal* was equal to 35%. The average firm market valuation was $5.5 billion with the smallest being $1.5 billion (Tootsie Roll Industries) and the largest being $270 billion (PespiCo Inc.) (Table 2).

5.3 Macroeconomic Conditions

On average, 17% of the SCP sample was collected during a recession (Table 2).

6. Results and Discussion

Table 3 shows the results of estimating equation (2) using quarterly-lagged and quarterly wholesale refined beet sugar prices. Multicollinearity was not an issue in any of the model specifications as the Condition Indexes for all the variables were less than 20 and anything under 30 is considered free of collinearity issues. Both models had very high R^2 values of 0.84.

Table 3. Panel Fixed Effects Regression Results using Quarterly-Lagged and Quarterly Sugar Prices

	Quarterly-Lagged Sugar Price		Quarterly Sugar Price	
Variable	Coef.	SE	Coef.	SE
SCP Characteristics				
ln(Weight)	-0.481***	0.076	-0.480***	0.075
ln(%Sugar)	0.288*	0.142	0.292*	0.141
ln(SugarPrice)	0.081	0.042	0.006	0.075
Firm Financial Performance				
SalesGrowth	0.199**	0.064	0.201**	0.070
EPSthreshold	0.214***	0.023	0.214***	0.030
LargeMarketVal	0.247***	0.038	0.253***	0.038
Macroeconomic Factors				
Recessions	-0.087***	0.025	-0.084**	0.030
Constant	1.336***	0.135	1.251***	0.148
Observations	379		379	
# of groups	55		55	
Min, max obs/group	1, 12		1, 12	
Overall R^2	0.838		0.837	

Notes: The dependent variable is the natural log (ln) of *SCPprice* *P < 0.05, **P < 0.01, ***P<0.001. SE is robust standard error. SCP is sugar-containing-product.

6.1 Sugar-Containing Product Characteristics

Consistently across both model specifications, *Weight* was negative and significant (p<0.001) (Table 3). As predicted, as the weight of the package increased, the SCP price per pound decreased. Across both sugar price specifications, if SCP weight increased by 10%, SCP price per pound decreased by 4.8%. . By evaluating Table A1 in the appendix and micro-analyzing the raw data, it is apparent that within this dataset, this result is likely driven by larger products (e.g., Pepsi Throwback, Oreos, Ice Cream) being cheaper per pound and weighing more than candy (e.g., Tootsie Roll, Hershey candy).

As the percentage of sugar in the SCP (*%Sugar*) increased, SCP prices increased (p<0.05). Across both sugar price specifications, a 10% increase in the percentage of sugar in the SCP results in 2.9% higher SCP prices. This indicates that more highly sweetened SCP are priced higher. Examination of the sample shows that sugar represents the lowest percentage of the product's weight for soft drinks (Pepsi Throwback) and represents the highest percentage of the product's weight for candy (e.g., Tootsie Roll Junior Mints). This result suggests that on a per pound basis, products such as candy, which have a higher percentage of sugar, are priced higher than other SCP categories.

However, when inspecting the coefficient on *SugarPrice*, there is no evidence that sugar prices are associated with SCP prices when using quarterly or quarterly-lagged prices. Thus, we fail to reject the null hypothesis that $\beta_3 = 0$ and conclude that sugar prices do not affect SCP prices. So even though we found that products with higher sugar content are typically priced higher per pound, the change in sugar prices has no discernable effect on the pricing of those products. Ultimately, this indicates that sugar-using firms do not consider US sugar prices when making pricing decisions (i.e., there is no statistically significant relationship between US sugar

prices and US SCP prices). This result provides evidence that US sugar policy does not harm sugar-using firms. This is possible since US sugar costs represent such a small percentage of US SCP prices.

6.2 Firm Financial Performance

For both model specifications, the signs of the estimated parameters for the financial variables, as predicted, are statistically significant. As expected, an increase (decrease) in lagged sales growth (*SalesGrowth*) increases (decreases) current SCP prices. Across both sugar price specifications, a 10% increase in sales growth increases SCP prices by about 2% (p<0.01). It is possible that firms make SCP pricing decisions based on recent sales growth performance. That is, firms increase SCP prices when sales positively grow, to test whether consumers are still willing to pay higher prices, and decrease prices when sales decline, to incentivize purchasing and avoid further sales growth deterioration.

Across both sugar price specifications, SCP prices increase following a quarter when firms do not meet their EPS thresholds (*ESPthreshold*) (i.e., when lagged EPS is lower or barely higher relative to the previous quarter's EPS) (p<0.001). This is expected as EPS in publicly traded firms is highly scrutinized by equity analysists and EPS growth is rewarded by investors. Indeed, financial managers recognize that earnings is the single most important financial metric they care about. This result suggests that not meeting the EPS threshold might put firms into temporarily financial distress causing them to increase SCP prices to increase profits.

Across both sugar price specifications, SCP firms ranked at the top 33% of firm market value size (*LargeMarketVal*) charge consumers higher SCP prices, which could be interpreted as market power positively affecting pricing strategies (p<0.001) (Table 3).

6.3 Macroeconomic Conditions

Finally, results suggest that SCP prices tend to be lower during economic recessions (*Recessions*), as expected. This indicates that sugar-using firms consider the demand for SCPs as somewhat elastic. For example, across both sugar price specifications, if we were in a recession, SCP prices would be lower ($p<0.01$).

7. Conclusions

US sugar policy regulates the amount of sugar domestic producers are allowed to market and the amount of sugar foreign countries are allowed to export to the US. This is done to buffer domestic producers against subsidized foreign sugar that depresses the world market price to levels well below world average sugar production costs (LMC International, 2021). Thus, some sugar-using firms criticize US sugar policy for causing them to pay higher than world sugar prices. However, previous research has documented that despite sugar being the primary ingredient in SCPs, sugar costs typically are only 1-10% of the SCP's price (ASA, 2021; Triantis, 2016). In fact, of the 379 highly sweetened SCP observations in this sample, the average SCP cost of sugar was only 2.56% of its total product price. Thus, SCPs' primary ingredient costs an insignificant amount of the total product price which is consistent across other food groups (USDA, 2021c).

The goal of this paper was to determine if sugar prices were associated with SCP prices while controlling for other SCP characteristics, firm financial performance, and macroeconomic conditions. Results found that firm sales growth, firm historical EPS, firm size, SCP weight, the percentage of sugar in the SCP, and recessions were all statistically significant in determining

SCP prices. However, changes to sugar prices -higher or lower- were not statistically significant in determining SCP prices. Thus, sugar-using firms are not sensitive to US sugar price variation when pricing SCPs. Instead, these firms consider other SCP characteristics, their firm financial position, and macroeconomic conditions when pricing their products. Several factors were found to impact SCP prices; however, sugar price was not one of them. This report provides further evidence that US sugar policy does not harm sugar-using firms.

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APPENDIX A

SUGAR-USING FIRMS IN THE DATASET

Below is the listing of the U.S. publicly traded firms in the dataset used to estimate equation (2). Also included is information on the brands/products included in the SCP dataset by firm, the category of these products, and the years these SCPs by firm appear in the dataset. Table A1 provides a breakdown of the descriptive statistics of the variables used to estimate equation (2) by firm.

U.S. publicly traded firms in the dataset:

(1) Tootsie Roll Industries (TR)

Brand/Products: Junior Mints

Category: Candy

Years in dataset: 2009, 2010, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020

N=10

(2) The Hershey Company (HSY)

Brand/Products: Almond Joy, Bag of Hugs, Bag of Kisses, Bag of Minatare Hershey Bars, Milk Duds, Whoppers, Chocolate syrup bottle, Good & Plenty, Hershey Bar, Hershey Bar with almonds, Hershey cookies and cream bar, Jolly Ranchers, Kit Kat, Jolly Ranchers, Mounds, Payday, Reese's Cups, Rolo, Twizzlers, York Patty,

Category: Candy

Years in dataset: 2008, 2009, 2010, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020

N=212

Company notes: Kit Kat is only sold by Hershey in the U.S. Nestle holds rights to Kit Kat globally. However, Nestles candy was sold to Froneri in March 2018 but Hershey still remains able to sell Kit Kat in the US.

(3) Unilever (UL)

Brands/Products: Good Humor (Breyers), Klondike, Ben and Jerrys

Category: Ice Cream

Years in dataset: 2008, 2009, 2010, 2017, 2018

N=35

(4) The J.M. Smucker Company (SJM)

Brand/Products: Pillsbury cake and frosting

Category: Cake and Muffin Mixes

Years in data: 2008, 2009, 2010, 2012, 2013, 2014, 2015, 2016, 2017, 2018

N=20

Company notes: The SJM products in our list are all Pillsbury. Brynwood Partners (private) bought Pillsbury baking mixes from SJM in July 2018. Thus, we only use the data on Pillsbury mixes through 2018 since SJM sold it off.

(5) Pinnacle Foods (PF)

Brand/Products: Duncan Hines

Category: Frosting and cake mix

Years in dataset: 2013, 2014, 2015, 2016, 2017, 2018

N=10

Company notes: Pinnacle Foods was privately held until it went public in 2013. Thus, we only use data starting in 2013. Also, in 2018 Conagra acquired the Duncan Hines brand from Pinnacle Foods. Thus, Conagra (CAG) is the owner of Duncan Hines in 2019, 2020 in our dataset.

(6) Conagra (CAG)

Brand/Products: Duncan Hines

Category: Frosting

Years in dataset: 2019, 2020

N=2

Notes: Acquired Duncan Hines brand from Pinnacle Foods in October 2018.

(7) PepsiCo, Inc. (PEP)

Brand/Products: Pepsi Throwbacks and Quaker corn bread

Category: Drinks and Cake and Muffin Mix

Years in dataset: 2009, 2010, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020

N=22

Notes: Pepsi throwback uses real sugar so only those drinks were used in our analysis.

(8) Mondelez (MDLZ)

Brand/Products: Oreos (several different flavors included)

Category: Cookies

Years in dataset: 2015, 2016, 2017, 2018, 2019, 2020

N=34

Company notes: MDLZ is a spinoff of Kraft in 2001. Kraft spun off their global growth brands into MDLZ so investors would buy MDLZ stock.

(9) Kraft (KHC)

Brand/Product: Jello

Category: Jello

Years in dataset: 2009, 2010, 2016, 2017, 2018, 2019, 2020

N=12

(10) General Mills (GIS)

Brand/Products: Betty Crocker Cream Cheese Frosting, Betty Crocker Vanilla Cake Mix, Betty Crocker Blueberry Muffin Mix, Betty Crocker Muffin and bread mix

Category: Cake Frosting

Years in dataset: 2008, 2009, 2010, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020

N=22

Table A1. Descriptive Statistics by Firm

	Tootsie Roll (TR)		Hershey (HSY)		Unilever (UL)		Smucker (SJM)		Pinnacle Foods (PF)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
	(min, max)		(min, max)		(min, max)		(min, max)		(min, max)	
SCPprice	5.655	1.634	8.737	4.713	2.493	1.429	2.037	0.473	2.104	0.526
	(3.670, 7.960)		(1.195, 17.951)		(1.395, 6.098)		(0.936, 2.660)		(1.550, 3.101)	
Weight	0.241	0.015	0.419	0.500	2.369	0.973	1.014	0.068	1.041	0.078
	(0.219, 0.250)		(0.086, 3.000)		(1.000, 3.509)		(0.953, 1.141)		(0.953, 1.156)	
%Sugar	0.849	0.052	0.527	0.087	0.154	0.030	0.535	0.092	0.529	0.075
	(0.806, 0.988)		(0.388, 0.882)		(0.123, 0.238)		(0.416, 0.648)		(0.394, 0.631)	
SugarPrice_Q	0.326	0.061	0.330	0.053	0.337	0.040	0.316	0.046	0.288	0.036
	(0.233, 0.440)		(0.233, 0.440)		(0.282, 0.400)		(0.233, 0.400)		(0.233, 0.349)	
SugarPrice_QL1	0.320	0.071	0.324	0.071	0.320	0.070	0.310	0.069	0.279	0.040
	(0.238, 0.436)		(0.238, 0.436)		(0.255, 0.435)		(0.238, 0.435)		(0.238, 0.343)	
SalesGrowth	-0.007	0.016	0.025	0.023	0.045	0.085	0.104	0.161	0.027	0.029
	(-0.033, 0.020)		(-0.028, 0.058)		(-0.092, 0.131)		(-0.046, 0.501)		(-0.004, 0.094)	
EPSthreshold	0.800	0.422	0.335	0.473	0.771	0.426	0.300	0.470	0.700	0.483
	(0, 1)		(0, 1)		(0, 1)		(0, 1)		(0, 1)	
LargeMarketCap	0.000	0.000	0.080	0.272	1.000	0.000	0.000	0.000	0.000	0.000
	(0, 0)		(0, 1)		(1, 1)		(0, 0)		(0, 0)	
Market Valuation	2.147	0.386	23.917	8.452	146.877	43.788	16.235	7.026	8.801	2.068
(in billions $)	(1.525, 2.646)		(12.025, 39.138)		(113.190, 209.846)		4.309, 26.913		(6.087, 11.759)	
Recessions	0.100	0.316	0.175	0.380	0.229	0.426	0.100	0.308	0.000	0.000
	(0, 1)		(0, 1)		(0, 1)		(0, 1)		(0, 0)	
Observations	10		212		35		20		10	

Table A1. Descriptive Statistics by Firm Continued

	Conagra (CAG)		PepsiCo (PEP)		Mondelez (MDLZ)		Kraft (KHC)		General Mills (GIS)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
	(min, max)		(min, max)		(min, max)		(min, max)		(min, max)	
SCPprice	2.375	0.021	0.793	0.468	4.778	1.458	4.990	1.446	2.473	0.693
	(2.361, 2.390)		(0.553, 2.236)		(2.472, 8.167)		(3.332, 7.413)		(1.521, 4.383)	
Weight	1.000	0.000	8.239	2.464	0.911	0.132	0.344	0.073	0.962	0.125
	(1, 1)		(0.625, 9.000)		(0.669, 1.250)		(0.188, 0.375)		(0.750, 1.141)	
%Sugar	0.559	0.020	0.176	0.171	0.433	0.032	0.894	0.000	0.481	0.083
	(0.545, 0.573)		(0.118, 0.705)		(0.326, 0.518)		(0.894, 0.894)		(0.325, 0.573)	
SugarPrice_Q	0.393	0.067	0.326	0.056	0.334	0.053	0.345	0.062	0.343	0.055
	(0.346, 0.440)		(0.233, 0.440)		(0.279, 0.440)		(0.279, 0.440)		(0.233, 0.440)	
SugarPrice_QL1	0.391	0.065	0.316	0.068	0.332	0.052	0.343	0.072	0.339	0.073
	(0.345, 0.436)		(0.238, 0.436)		(0.270, 0.436)		(0.270, 0.436)		(0.238, 0.436)	
SalesGrowth	0.146	0.072	0.010	0.029	-0.032	0.049	0.188	0.446	0.030	0.044
	(0.095, 0.197)		(-0.040, 0.109)		(-0.131, 0.027)		(-0.052, 1.139)		(-0.050, 0.096)	
EPSthreshold	0.000	0.000	0.500	0.512	0.147	0.359	0.583	0.515	0.318	0.477
	(0, 0)		(0, 1)		(0, 1)		(0, 1)		(0, 1)	
LargeMarketCap	0.000	0.000	1.000	0.000	1.000	0.000	0.667	0.492	0.727	0.456
	(0, 0)		(1, 1)		(1, 1)		(0, 1)		(0, 1)	
Market Valuation	30.856	3.026	193.933	49.927	108.292	8.155	95.779	63.893	47.426	9.794
(in billions $)	(28.716, 32.2995)		(114.676, 270.242)		(97.892, 121.451)		(21.045, 171.570)		(32.286, 61.910)	
Recessions	0.500	0.707	0.136	0.351	0.147	0.359	0.167	0.389	0.227	0.429
	(0, 1)		(0, 1)		(0, 1)		(0, 1)		(0, 1)	
Observations	2		22		34		12		22	

APPENDIX B

FIRM STOCK RETURNS, REVENUE, AND COST OF GOODS SOLD

Below is further information on the firms in the model. We have plotted firm stock returns versus the S&P 500 index (i.e., a proxy for the market index) returns. All charts were obtained from the Standard & Poors' Capital IQ database. Since 2008 is the year this study's SCP price data collection started, 2008 is used as the baseline year to normalize returns of firms and the market index (i.e., both firm and index in 2008 starts with 0%). The charts show relative return performance from 2008 to 2020, as available in the database. We have also included the revenue and cost of goods sold charts which show annual accumulated (LTM) revenue (green) and cost of goods sold (COGS) (red) per fiscal quarter, in USD million. Note how the revenue and COGS graphs compare to Figure 2 of the manuscript (Cost of Sugar in the SCP versus the SCP Price). Clearly something costs these companies (COGS) but it is not sugar.

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Figure B1. Tootsie Roll Industries (TR) Stock Returns versus the S&P 500[5]

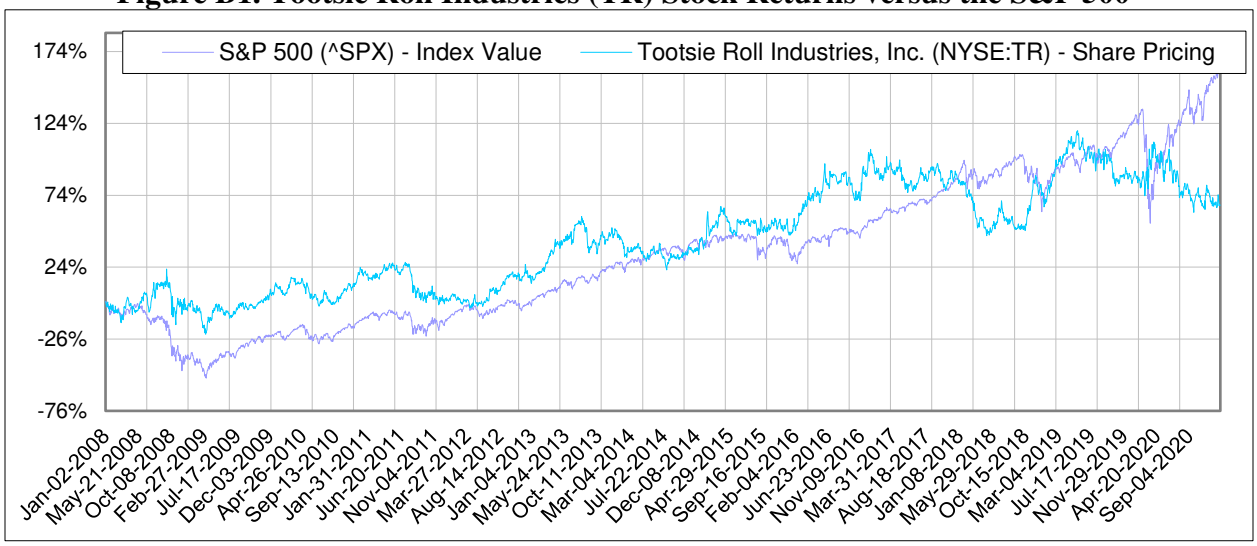
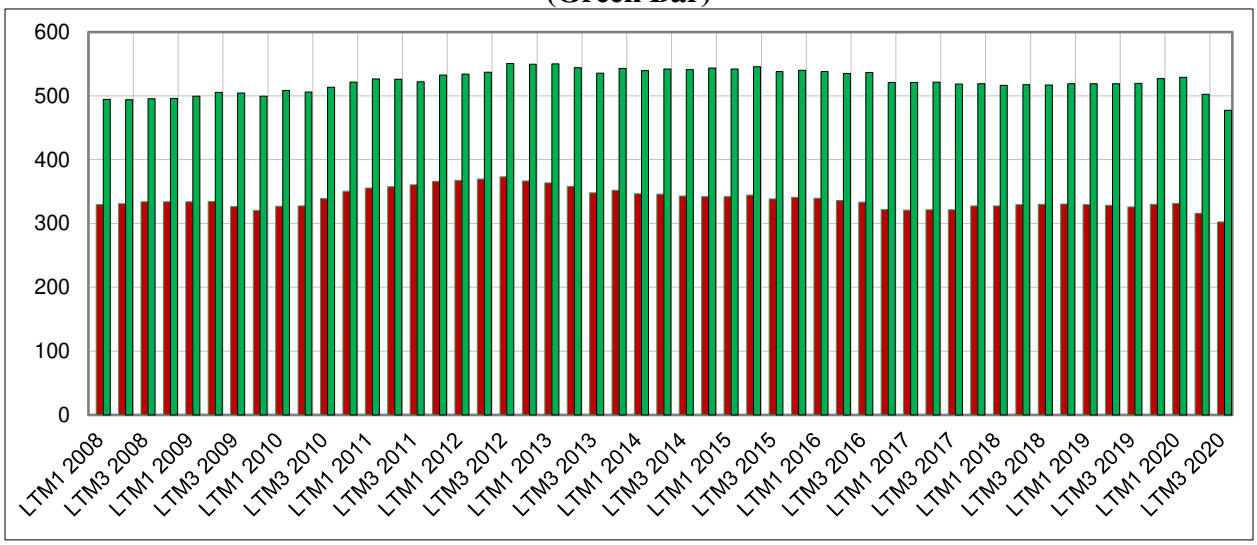


Figure B2. Tootsie Roll Industries (TR) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)



[5] Source for all figures: Standard & Poors' Capital IQ database.

Figure B3. The Hershey Company (HSY) Stock Returns versus the S&P 500

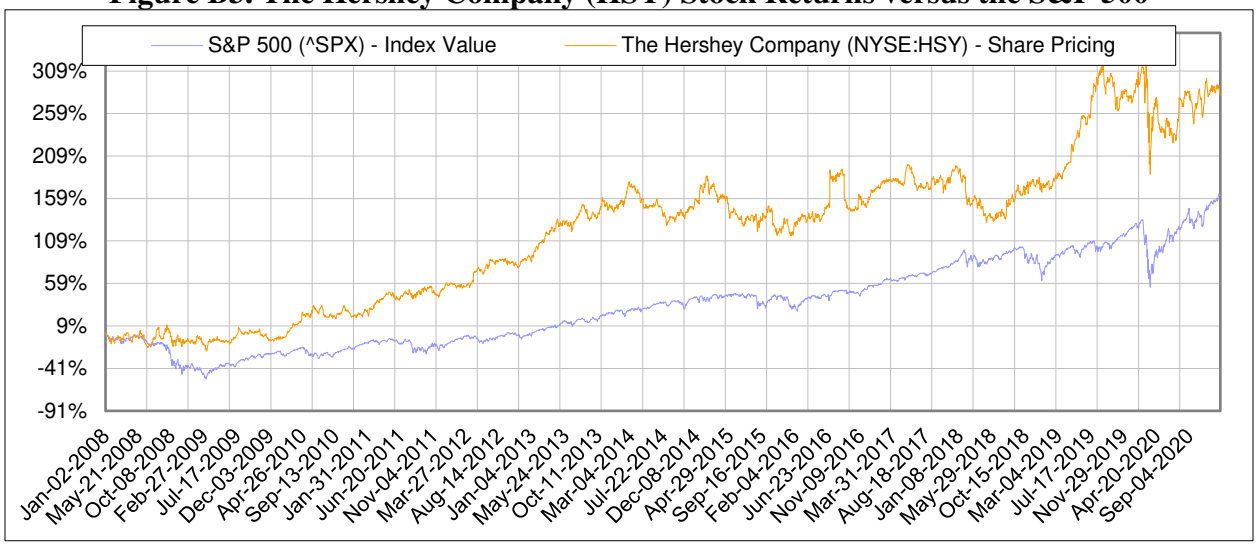


Figure B4. The Hershey Company (HSY) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

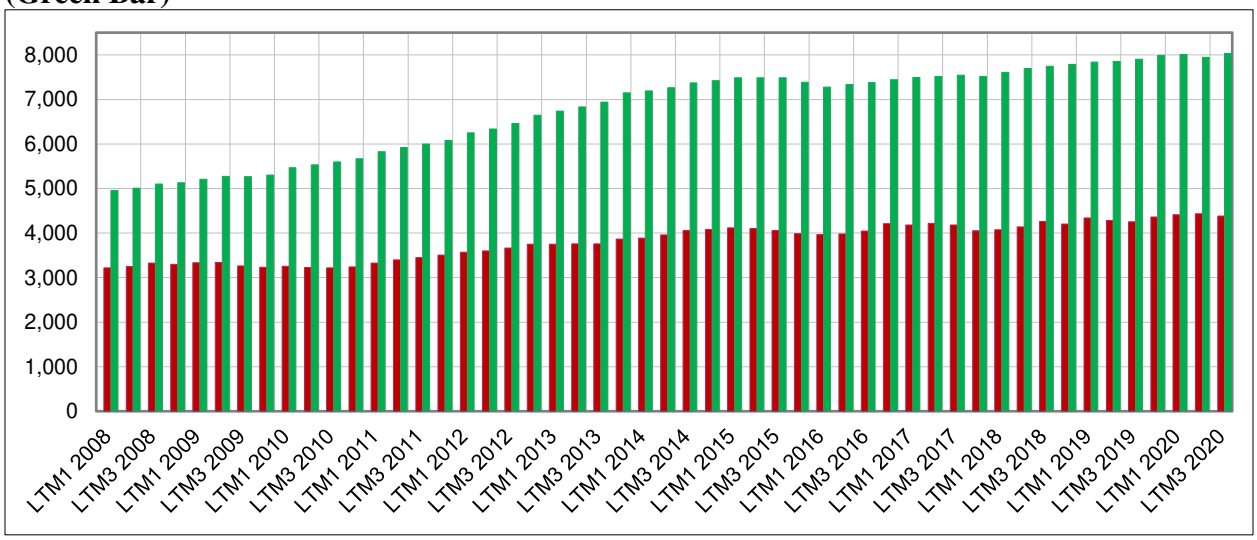


Figure B5. Unilever (UL) Stock Returns versus the S&P 500

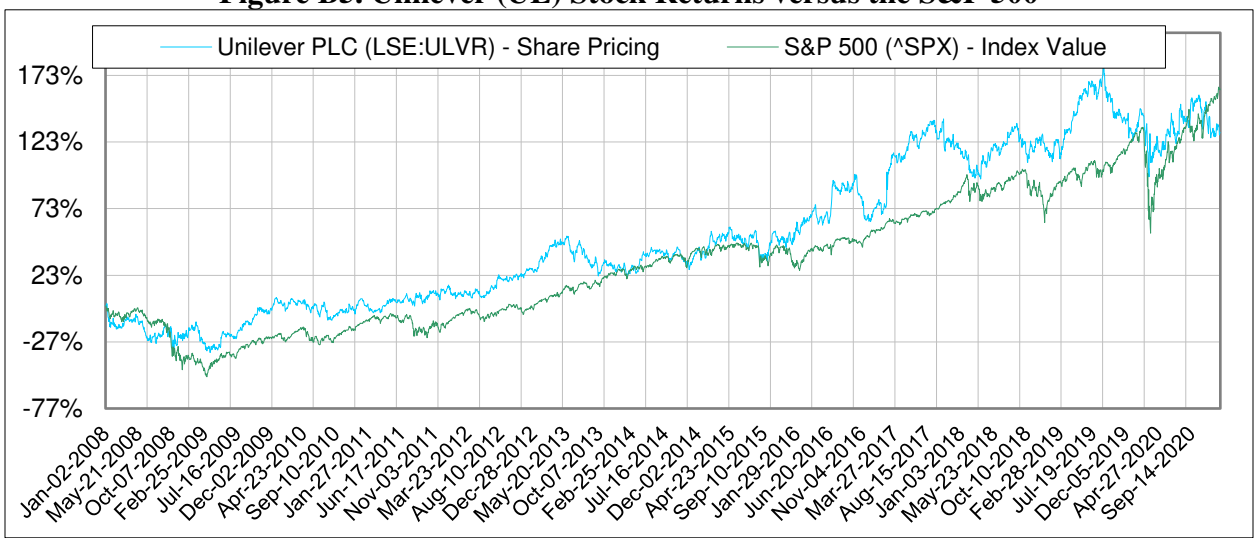


Figure B6. Unilever (UL) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

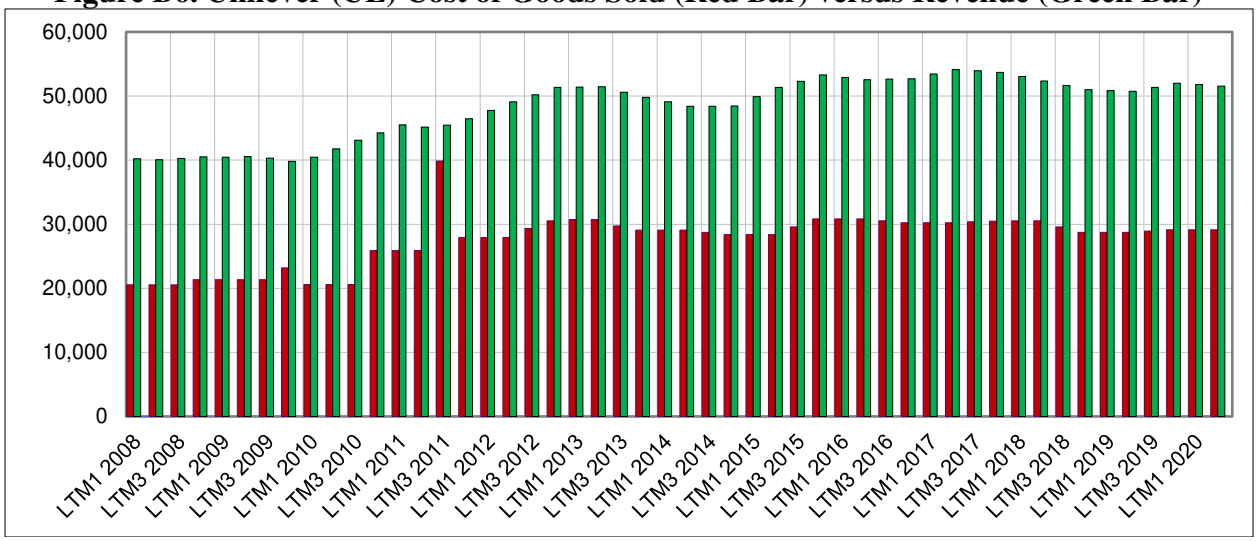


Figure B7. The J.M. Smucker Company (SJM) Stock Returns versus the S&P 500

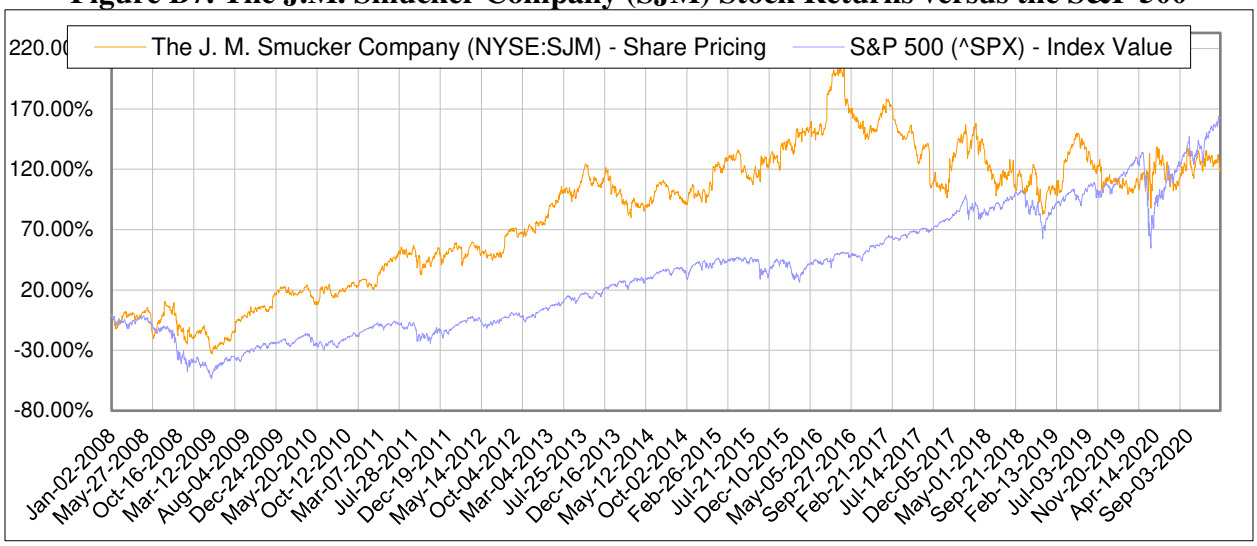


Figure B8. The J.M. Smucker Company (SJM) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

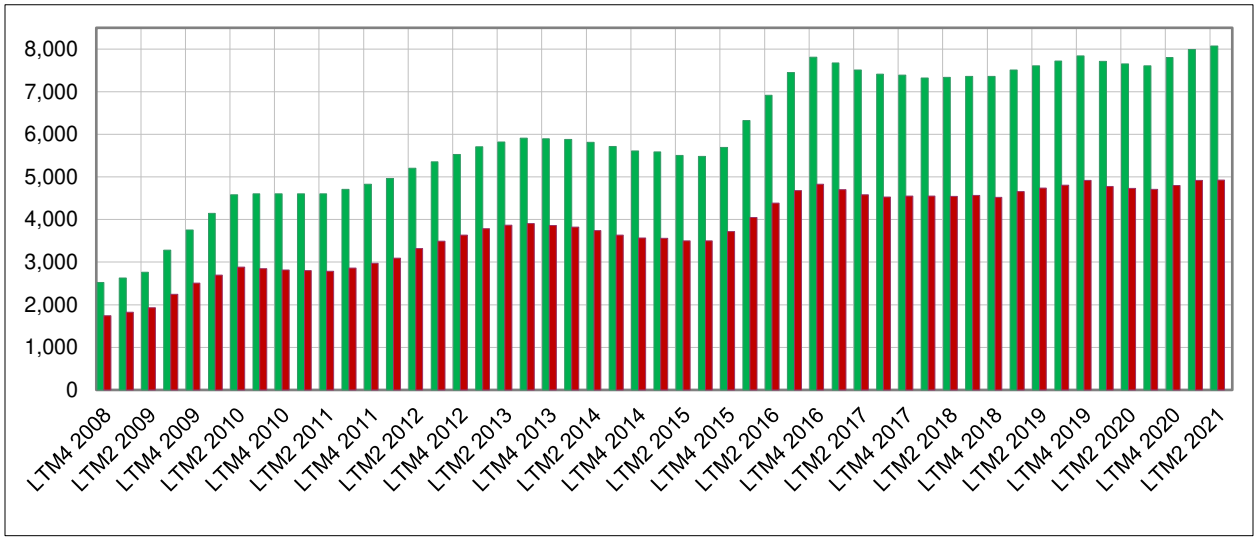
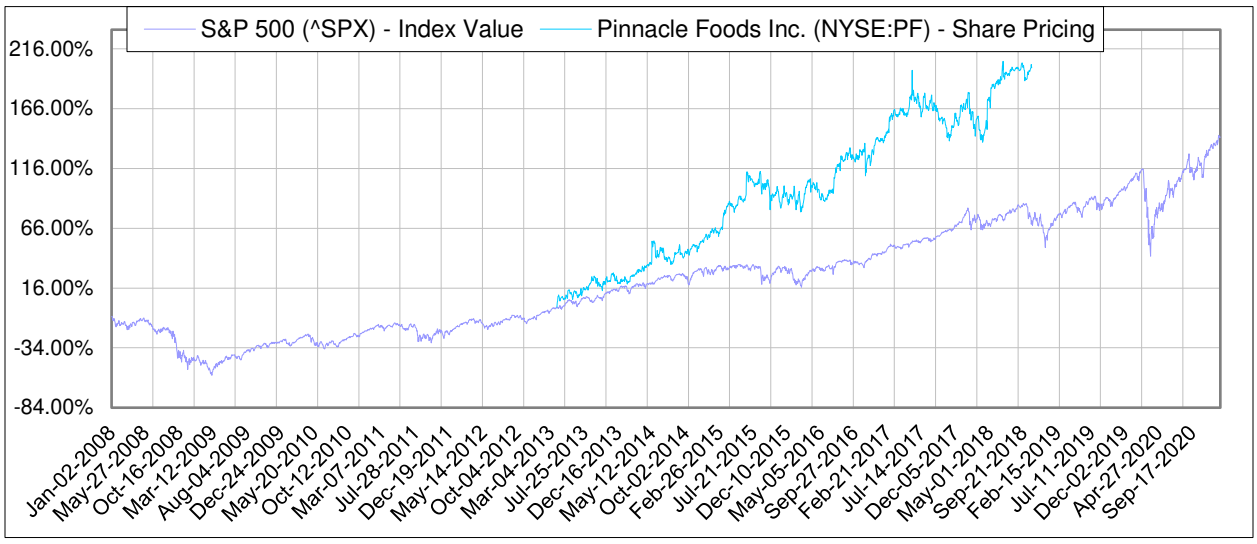


Figure B9. Pinnacle Foods (PF) Stock Returns versus the S&P 500



Note: Pinnacle Foods's equity traded from 2013 to 2018. It is currently part of Conagra Foods.

Figure B10. Pinnacle Foods (PF) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

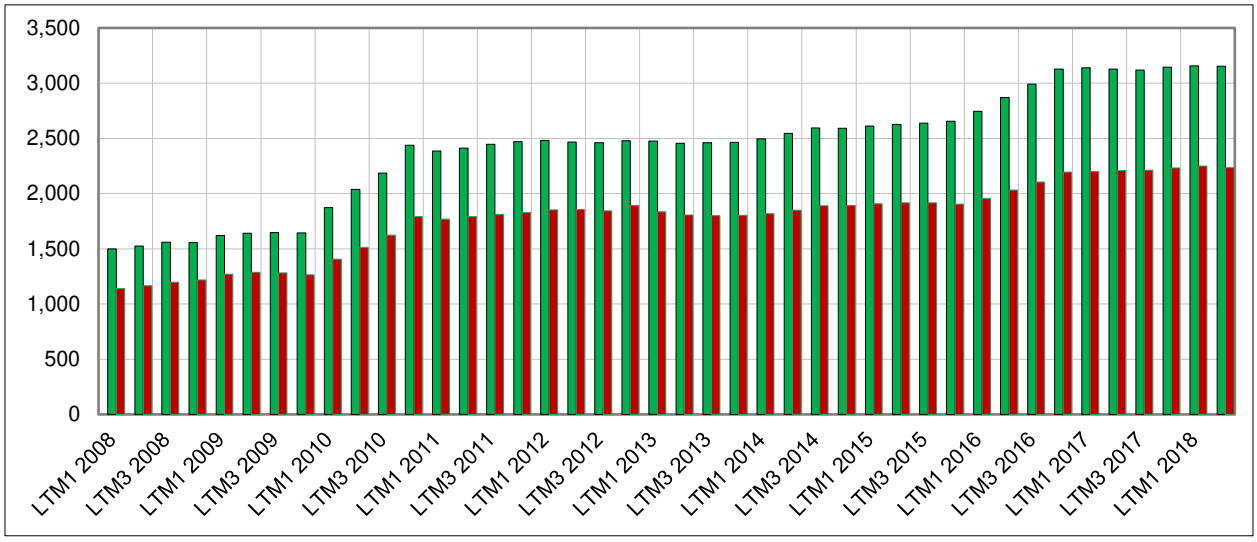


Figure B11. Conagra (CAG) Stock Returns versus the S&P 500

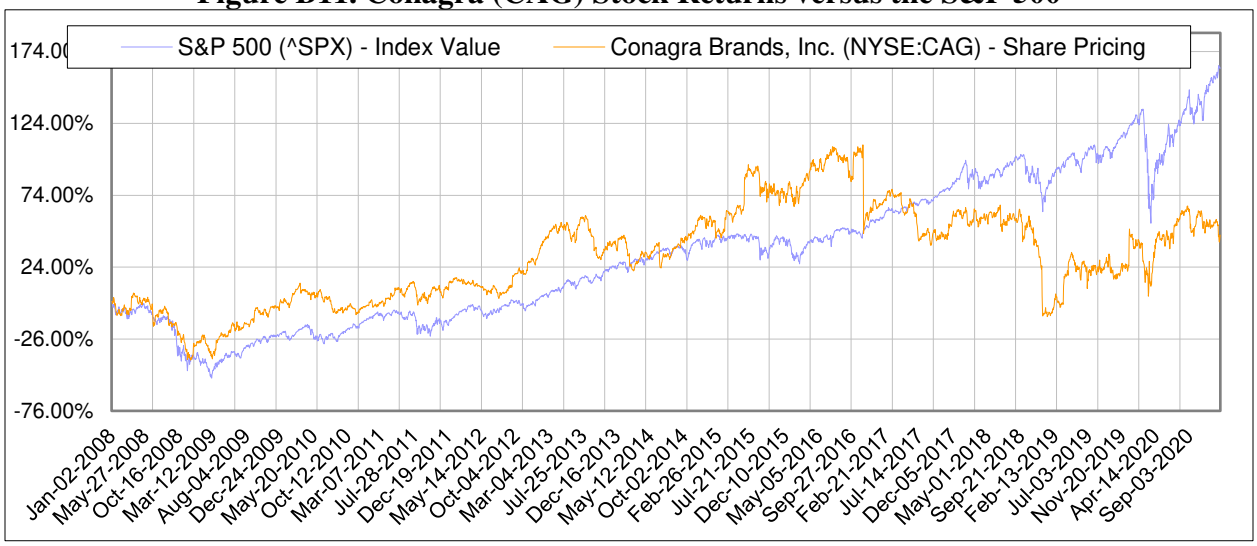


Figure B12. Conagra (CAG) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

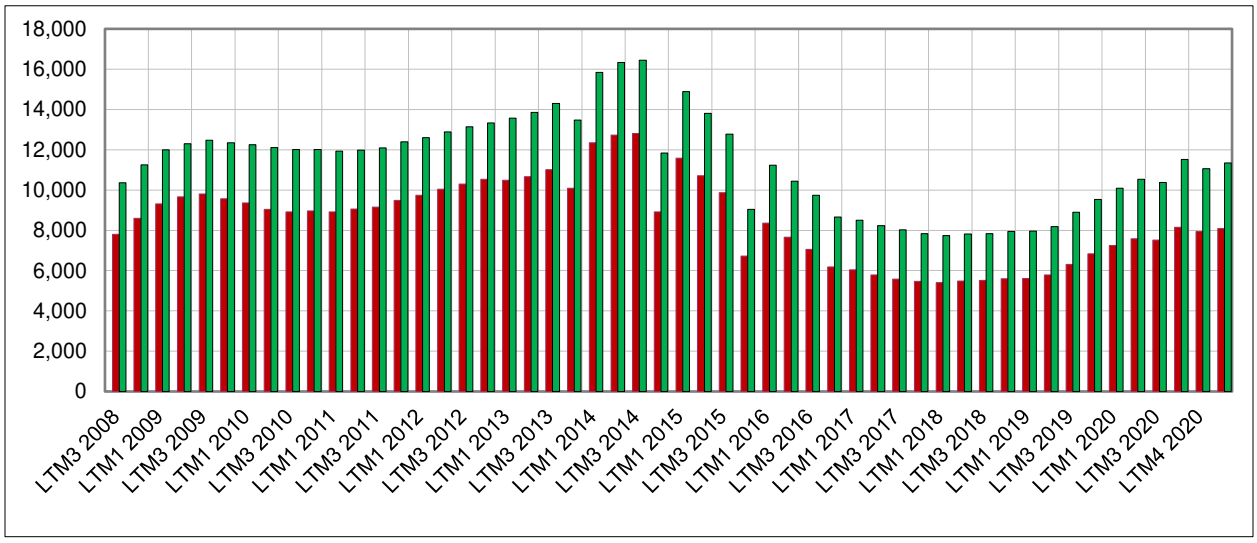


Figure B13. PepsiCo, Inc. (PEP) Stock Returns versus the S&P 500

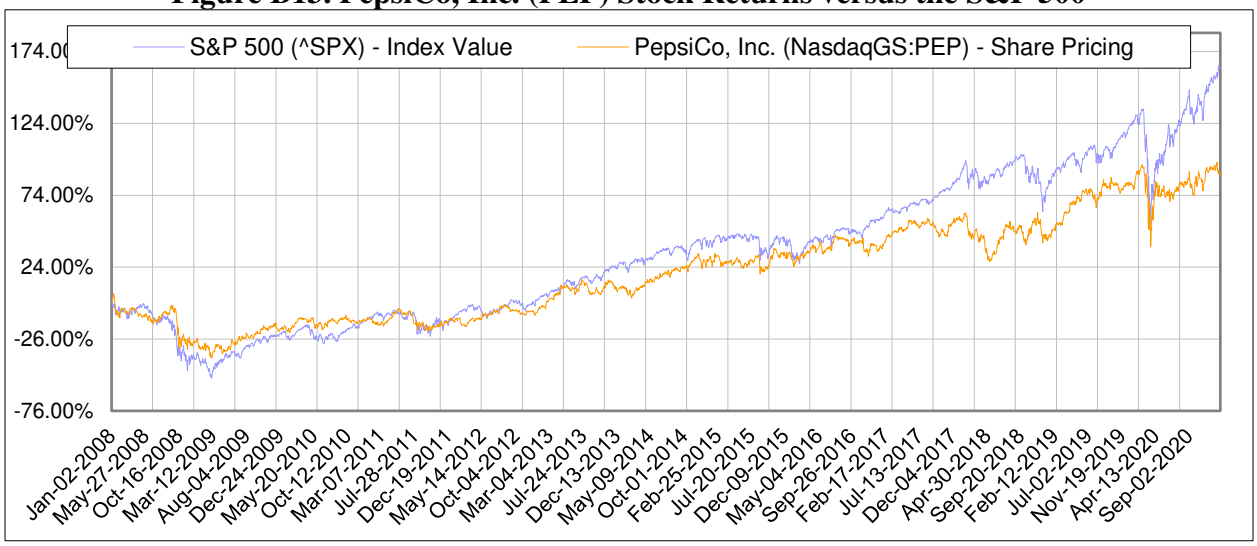


Figure B14. PepsiCo, Inc. (PEP) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

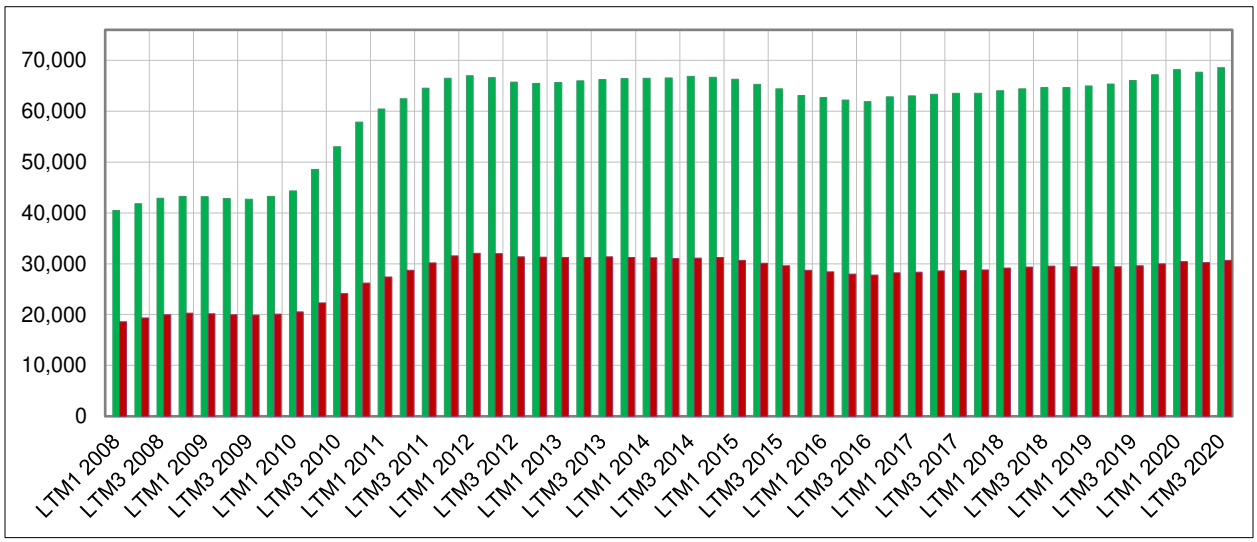


Figure B15. Mondelez (MDLZ) Stock Returns versus the S&P 500

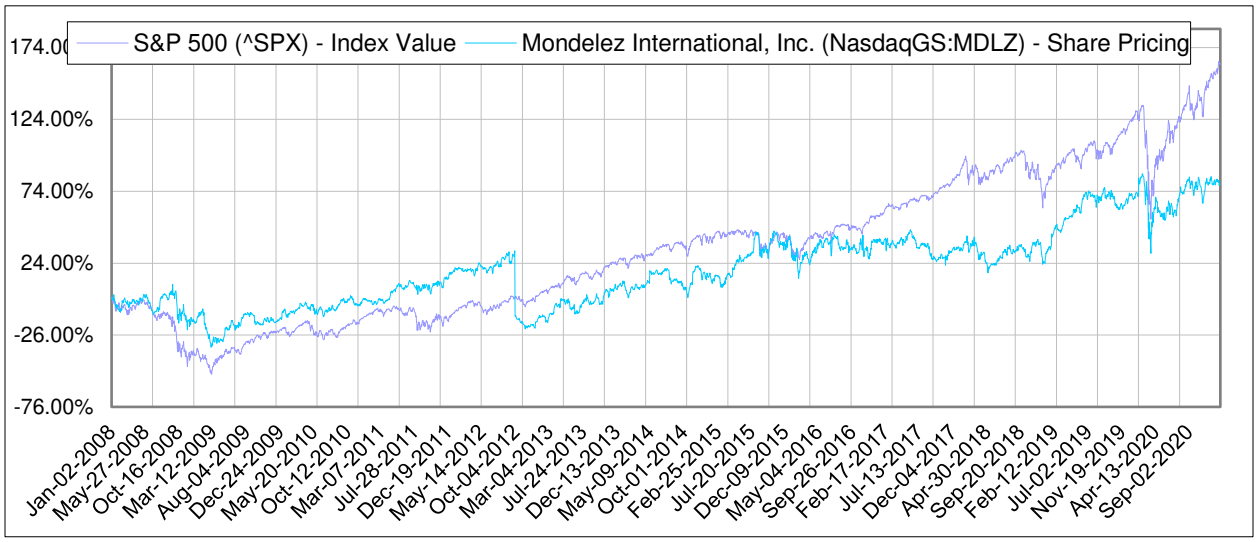


Figure B16. Mondelez (MDLZ) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

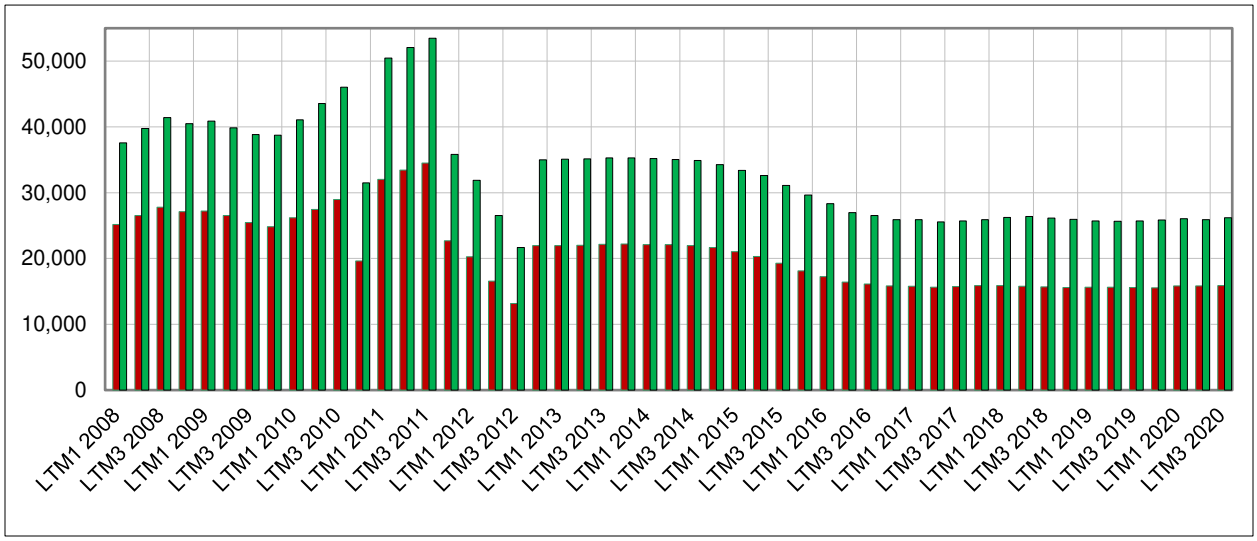


Figure B17. Kraft (KHC) Stock Returns versus the S&P 500

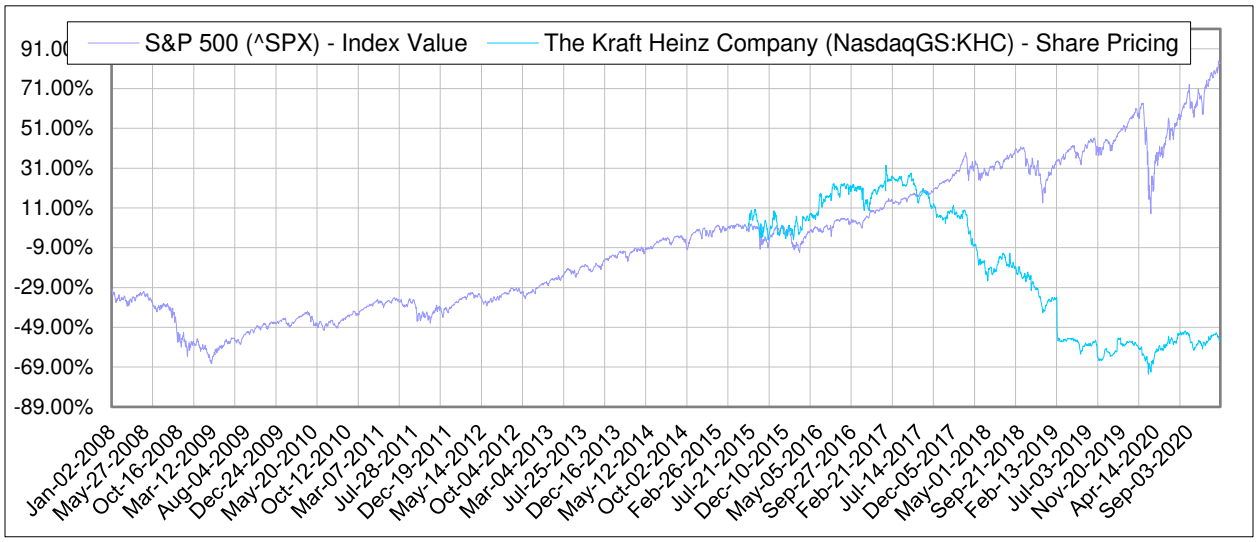


Figure B18. Kraft (KHC) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)

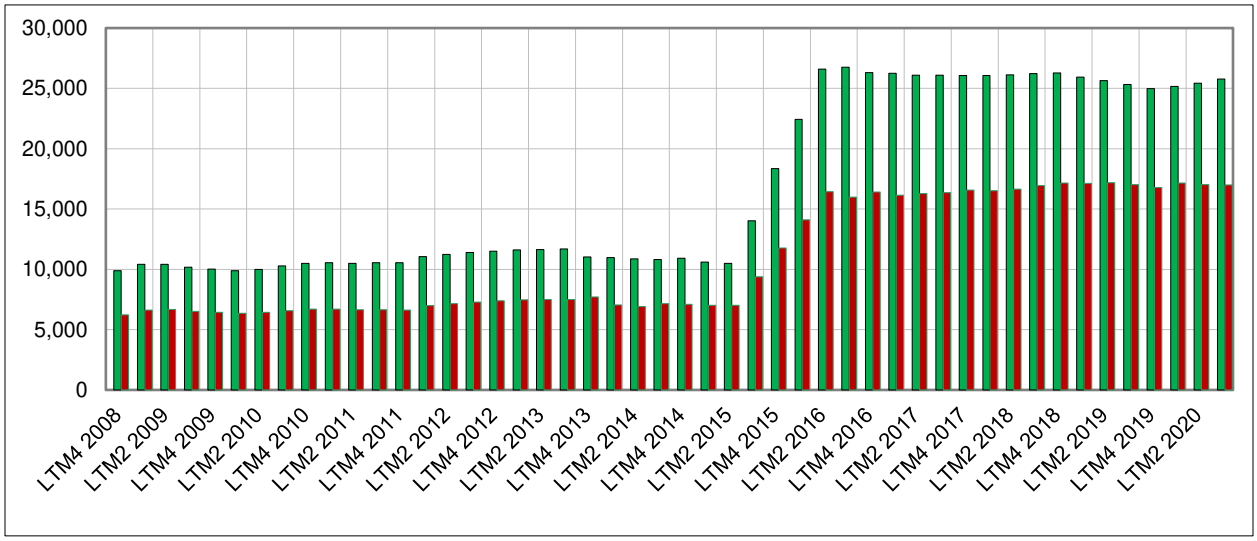


Figure B19. General Mills (GIS) Stock Returns versus the S&P 500

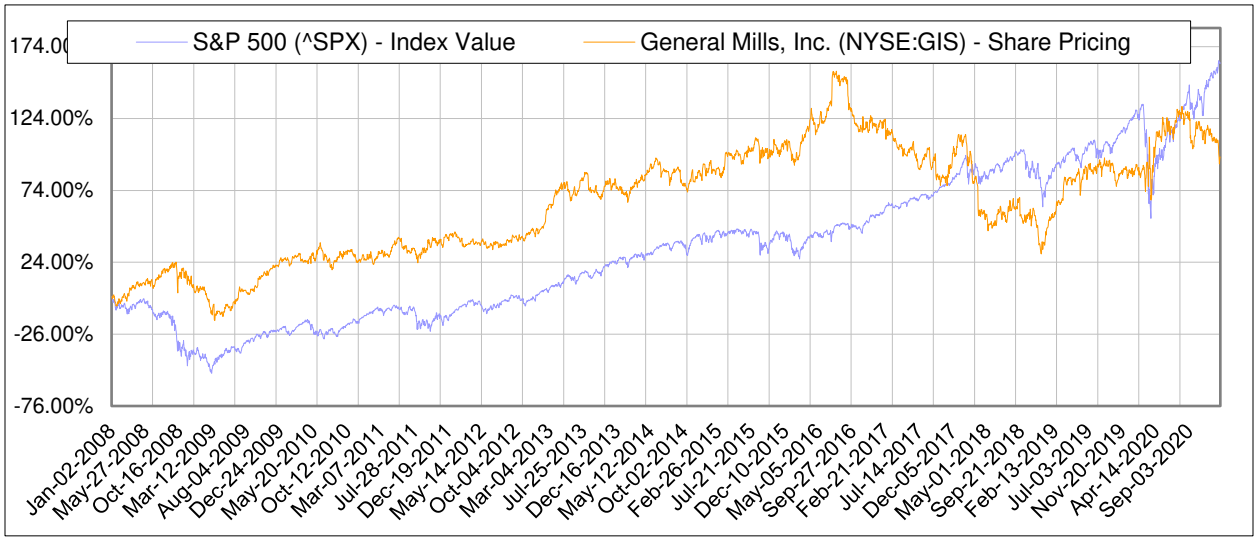


Figure B20. General Mills (GIS) Cost of Goods Sold (Red Bar) versus Revenue (Green Bar)