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The Economic Impact of Non-Dairy Alternative Milk Beverages on the United States Dairy Industry

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THE ECONOMIC IMPACT OF NON-DAIRY ALTERNATIVE MILK BEVERAGES ON
THE U.S. DAIRY INDUSTRY

BY
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SUBMITTED TO SCRIPPS COLLEGE IN PARTIAL FULFILLMENT OF THE DEGREE
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Abstract

Inspired by the sudden recent incline in and awareness of veganism as well as my own personal involvement in such matters, I sought out to complete an empirical analysis to study the impact of consumer preferences. Originally intrigued by the consumption of meat and its impact on developing countries, I opted for a related topic with better accompanying data. Consumer preferences change regularly with an increasing plethora of reasons behind their decisions. As the guiding force of the demand side of the market, it was vital to study the impact of their choices. My decision to use plant-based milk was meant to be a proxy for consumers who could not consume dairy. To my surprise, the force behind the increase in plant-based milk consumption was not propelled by those with alternative lifestyles but regular consumers who wanted healthier and better-tasting options.

Further analysis has led me to look past consumers themselves and their individual choices to identify the impacts of their choices. This required an intricate look into the United States dairy industry and its composition. What is recorded within the next 45 pages is a delicate web of outcomes spun by the needs of consumers. It branches out into the lives of small dairy farmers who cannot compete with larger farms. It spins out to form a massive web of increasing profit for the plant-based milk industry. It creates a loss in the whole milk sector of the dairy industry only to be filled by the organic and specialty sectors.

While they can be guided into choices through various forms of advertisement, the world has changed since the introduction of modern economics, and consumers are learning to utilize the products that fit their lifestyles. Gone are the days of passive consumption and food pyramids. Information has never been as readily available as it is today, with the help of the internet and independent researchers, and consumers have chosen to use this to their advantage.

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I. Introduction

Every American has undoubtedly seen the famous advertisements quoting “got milk?” that was first aired in 1993. The entire country had been convinced about all of the positive effects of cow milk and other countless milk-based products. We joked about growing tall and strong by drinking at least a glass a day. We incorporated it into breakfast, the most important meal of the day. However, due to recent studies disputing the claims distributed by the dairy industry and increased access to social media and information, there has been a recent shift in consumer preference to alternative non-dairy milk products such as soy and almond milk (also referred to as plant-based milk or Dairy Alternative Functional Beverage (DAFB)). The alternative milk industry has been one the fastest growing industries (valued at 7.37 billion for 2016 and 14.36 billion by 2022), so much so, that the dairy industry attempted to sue over labeling claiming that the term “milk” should not be used to label plant-based products under the Dairy Pride Act.¹ A few consumer groups can be determined such as those who are vegan or who are lactose intolerant and therefore cannot consume dairy products but even when accounted for, the non-dairy industry has grown exponentially and should be analyzed more thoroughly.

While there is a lag, this shift shows that consumers will choose the products that they believe to be best for them. Recent studies have debunked that drinking milk leads to stronger bones and that on the contrary, high dairy consumption has been linked to an increased risk for various types of cancer, diabetes, acne and that the majority of the world’s population cannot digest milk without having a negative side effect due to lactose intolerance². And yet for years, milk has

¹Growth projectile from June 2017 report by the Markets and markets firm and Dairy Pride Act from Garfield, Leanna March 2017 Business Insider Article

² Rosenberg, Martha March 2016 Altnet article

been has been consumed as a staple and was even implemented as part of the school lunch program. It can be assumed that alternative non-dairy options have fared so well because consumers demand these products.

How this shift affects the dairy industry is not fully clear at first. The dairy industry is heavily subsidized by the federal government to offset the high costs of dairy production but most of the subsidies go to a small number of large farms rather than to smaller dairy farmers. A decrease in sales would signify a decrease in profits but the United States still produces over 200 billion pounds of milk every year, with the total being 208,633,000,000 pounds for the 2015 year which was a 1.3% increase from the 2014 year.³ This percent increase is essentially negated when population, in milk production per capita terms, growth is accounted for; which for the U.S. in 2015 was 1.186%, according to the World Bank. The earliest available statistics for the year 1931 recorded a daily national average of 12.08 pounds of milk produced per day per cow, with an estimated 180,515 cows, with a total of approximately 796 million per year. At a per capita rate, this is the estimated equivalence of 6.4 pounds of milk consumed per person for 1931 and has since increased to 655.3 pounds of milk consumed per capita in 2016, though the 2016 estimate includes non-fluid milk and other non-milk dairy products.⁴ The amount of money that has been spent to maintain the dairy industry has been massive. The U.S. dairy industry's spending on advertisement was over a billion dollars (1,105.55 million) starting in 2014, which was almost twice the amount spent in 2013 (592.91 million) and has generally been increasing while the amount lost in sales since 2015 has also been about a billion dollars.⁵

³ USDA NASS Milk Production reports

⁴ Combination of 1931 and 2016 U.S. Census Bureau population data and USDA milk production reports. (1931 population: 124,039,648/ milk production: 12.08 pounds * 365 days* 180515 cows = 795,926,738 pounds) (2016 population: 324,304,407/ milk production: 212,512 million pounds/ 212,512,000,000)

⁵ Schonfield & Associates, Inc (2017). Statista data collection of Schonfield & Associates reports.

But it is safe to say that not all companies who sell milk or other dairy products are at a loss. While new companies have emerged that only sell non-dairy alternatives, major companies are taking this opportunity to branch out. Ben and Jerry's for example, a major ice cream brand that has traditionally used dairy, has recently introduced new flavors made from alternative-milk options and other major household brands are starting to do the same. The losses here seem to fall on the small dairy farmers who do not get as much of the government subsidies and cannot compete with these major alternative companies as well. My thesis will examine the effects of the shift in consumer preference for all parties involved: consumers who not only consume the products but whose taxes go towards the subsidies, the government and USDA who the dairy companies would turn to for aid, the dairy industry and the alternative non-dairy industry. In short, my thesis will focus on data that analyzes consumer household purchases, net profits of both the dairy and non-dairy industry as well as the breakdown of government subsidies. The change in consumer household purchases should show an increased consumption of non-dairy milk beverages which should correlate to increased profit for the non-dairy industry. When government subsidy data is analyzed, it should reveal a decrease in total number of farmers due to the increased competition and volatility of the industry for small farms as well as an increased distribution of government subsidies going towards larger farms. All else constant, if earnings for dairy products fall below the set subsidy price, than larger farms should also see an increase in government subsidy payouts.

The total government dairy subsidy amount has reached almost 6 billion dollars for the last 20 years combined. With the new non-dairy alternatives, consumers have a range of choices but those may come at a price. A decreased demand with the same supply level would lead to a decrease in prices for dairy which would then ensure the government to provide a larger amount in

subsidies. These subsidies are being paid for by taxpayer dollars even when consumer preferences are changing. It could be that certain aspects of dairy industry are becoming obsolete and so an analysis is more than necessary. Consumers deserve to know the truth behind the products they consume and what the impact of their choices really entail.

For my research, I will be using various papers about the dairy and nondairy industries as well as data sources highlighting the profits, losses and costs entailed by these industries and the government. The USDA and National Agricultural Statistics service has available reliable data on milk production and the costs involved within the two industries. The Bureau of Labor Statistics has articles on factors that affect prices of dairy and various other sources has data about dairy subsidies. The Nielsen household surveys contains data on consumer purchases and the breakdown of government subsidies are also readily available through the U.S. Census of agriculture and agricultural resource management survey. Since this is a more recent and current subject, I will be doing a combination of doing a critical review of current articles but will also have to focus on data sources as some of the articles, while useful, are not readily reliable for thesis analysis since they are not published in scholarly journals. To show how rapidly the non-dairy milk industry has grown, I will also compare the data available in previous research with more recent data.

II. Literature Review

In order to understand the impact of dairy-alternative drinks on the dairy market, it is imperative to understand how the dairy industry and government subsidies work. In addition, it is important to note that not all dairy farms enroll in the government's subsidy program but likewise, dairy farms don't always work alone. They sometimes form cooperatives to try to increase net profits and while this sounds like a cartel, it is legal under the 1922 Capper-Volstead Act, which exempts the dairy industry, in this instance, from antitrust laws. Unlike other industries, the dairy industry is very volatile, due to uncontrollable variables such as a region's weather for the year. All of these important factors are taken into account by the related articles.

A. Bolotova

Bolotova (2016) analyzes the effects of cartel-like operations, through agricultural supply management programs, within the dairy industry. To negate the volatility of the dairy industry, private, industry-funded supply management programs are often enacted. The dairy industry is often plagued by the overproduction/oversupply of milk, volatile prices and low returns, even below the costs of production. These voluntary programs are enacted to lower supply in hopes of a profit increase and stable milk prices. The programs such as the herd retirement program, which slaughters herds earlier than planned, and the dairy export assistance program are implemented during all three stages of production based on the program's methods, with the end goal of lowering the milk quantity produced.

Bolotova explains that while cartels operate in oligopolistic markets, dairy farms are allowed to form cooperatives due to the perfectly-competitive nature of the dairy industry. There are many firms/producers, small firm sizes, low barriers to entry and as previously seen, due to

volatile prices, firms are price-takers. With a linear inverse demand and constant marginal cost, the industry output quantity is predetermined and price is a function of output quantity. These assumptions appear to be reasonable if one considers the elastic demand curves of consumers. Should the price of milk increase dramatically, it should be expected that the amount of milk consumed would decrease. In addition, data collected on the dairy industry portray the large number of firms, low barriers to entry and exit and volatile prices.

Bolotova's analysis of the dairy industry before the supply management programs, as expected, notes that because of the overproduction of milk, prices received by dairy producers tend to be below production costs. Various issues arise that prevent the cooperatives from operating efficiently. The cooperatives want to limit the supply of milk into a market that has no use for it but production quantity cannot always be correctly predicted. New technology is always being invented that increases agricultural yield which would increase production but weather conditions also cannot be controlled, and if undesirable, would decrease production. If an individual producer within the cooperative finds the chance to earn a profit, there's not much stopping them from producing outside of the cooperative limit. If the cooperative is selling at a set price, then a non-participating producer can always sell at a lower price, which would therefore cause the cooperatives to lose consumers. While there was a definite profit increase due to increased prices, these were always short-term. Without aid from the government, the dairy industry is already struggling to remain a profitable industry, even before the effects of the non-dairy alternative milk industry are added into the equation.

A theoretical analysis with empirical evidence is used to compare classic cartels with the agricultural cooperatives, including the use of the lerner index to compare a cartel's market power

versus the market power of a dairy cooperative. While this paper did not directly compare the non-dairy alternative market to the dairy industry, it still showed the methods used by the dairy industry to generate profit. If almond milk, soy milk and other alternative plant based milks are competitors of dairy milk, then there should be a downward movement along the supply curve due to decreased demand. However, the price of milk is based on the price of the products created from it, so it not entirely certain how large this movement will be. Logic would entail that consumers who stop drinking dairy beverages would also stop consuming/consume less of other dairy products such as cheese and ice cream but this may not be the case.

B. Wolf & Tonsor (2013)

The dairy industry is often bundled together but of course dairy producers vary greatly and therefore have different preferences. Using the 2012 farm bill proposals as a questionnaire with the best-worst scaling system, Wolf & Tonsor (2013) analyzed Michigan dairy farmer preferences, based on region, farm size, processor and whether the farm was part of a cooperative. Since the great depression, the United States has been involved with the dairy industry in some form or another. The policies have varied from collective bargaining, pooled milk revenues based on minimum prices, direct support of milk prices, consumption, export subsidies, import limitations, and milk deficiency payments. The 2012 farm bill called for protection of income over feed margins for dairy producers, supply control, ending ethanol subsidies and new equations for determining the price of milk. As the volatility of the price of ethanol influences the price of feed, a large quantity of producers are affected since the majority of large farm owners cannot produce their feed themselves and instead purchase it. Following the 2008 recession and the increased volatility in feed and milk prices, new laws were introduced for the 2012 farm bill by the National

Milk Producers Federation (NMPF). While the policies in place at the time could handle the day-to-day of farm life, they did not fare well in the 2008 economic crisis.

Some of the programs and policies already in place include the Federal Milk Marketing Orders (FMMO), Dairy Price Support Program (DPSP), Milk Income Loss Contract Program (MILC), Dairy Export Incentive Program (DEIP) and import restrictions. While some of these programs have been around in some form or another since the great depression, they cannot meet all current farm demands and since this article's publication, some of them have been discontinued. FMMO sets a price floor for the amount that processors can pay dairy farmers for using fresh milk to create dairy goods such as butter and cheese. This has been rather successful but due to the possibility of price manipulation, a newer policy was introduced in the 2012 farm bill to use area surveys of milk farms within FMMO regions to determine the minimum price of milk. The DPSP no longer seems relevant since the support price has been lowered to a price that doesn't interfere the market and has been that way since the 1980's. With this program, farmers could sell butter, cheese and nonfat dry milk to the government credit corporation at predetermined prices, which would reduce the surplus of goods. It helped to reduce some of the volatility associated with milk prices but would not support products outside of the margin, ignored new products and would also offer prices that would not match current market price costs for food. The MILC (2002) set a minimum reference price and offered farmers a portion of the difference if milk prices were below that price. While this program seems reasonable, it is capped to 2.4 million each year so not all farmers can participate and it was biased towards smaller farms who could receive payment for all of their milk produced. Some of the import and export programs have fared better with producers. With numerous import restrictions, the majority of milk consumed in the US is produced there and

a lack of restrictions would lead to a decrease in prices, if US farmers also had to compete against global farmers in the US market. The dairy export incentive program however, levels the playing field for US producers in the global market, offering an incentive to export.

Any of the policy changes would affect not just US consumers and taxpayers but consumers on the global market as well. A cooperative lowering supply to increase prices would affect local consumers but every taxpayer is ultimately affected as farm subsidies are paid with the use of federal taxes. One of the methods that is now being used to reduce the oversupply of milk in the US is global export. Until about 2003, only 5% of the milk produced was exported but this number has grown steadily and was 13% as of 2011. An increased demand from other countries, mainly in Asia, with the inability of previous major export countries to meet these demands has also played a role.

Usually the proposed bills are backed by lobbying dairy farm organizations but this is not representative of the entire dairy farm population as the farmers themselves are rarely ever present when the policies are proposed. Previous papers that have researched farmer preferences, such as with Ohio and Illinois farmers with the Food Security Act of 1985 by Zulauf, Guither, and Henderson, concluded that the act supported larger farms. Financial situation, farm size/type, and education/experience are some of the variables that influenced preferences. In a different study examining the support for free trade within Kansas dairy farm community, by Kastens and Goodwin in 1994, support for free trade varied based on education level, experience, government payments received, level of rented land and total farm wealth, with an increase in the three former variables leading to a decrease in support for free trade and an increase of the two latter variables led to an increase support for free trade. Within any paper examining policy preference, it is

assumed to farmers/producers would act based on self-interest, favoring the policies that are most beneficial to them.

The difference with this study, apart from the policies being used a basis, is the method used. Previous studies analyzing dairy farmer preferences used the approve/disapprove method or the Likert-scale. Wolf and Tonsor instead used the Best-Worst Scaling method, which given a choice of 3 or more options, allows one choice to be chosen as the worst option and one choice as the best option. The reasoning in this context, that the scale is easier to understand, free of scale bias, requires a trade-off and is not subjective and it seems to be a perfect option for evaluating farmers who all have different backgrounds. In total, there were eight sets of questions which included seven different policies from the 2012 farm bill. The first seven sets of questions contained 3 policies and the last set contained all 7 policy options essentially asking farmers to choose which policy would be the most or least beneficial to their farms. The farmers were also sorted into classes based on similar preferences but preferences varied across the classes and policy choices were assumed to be independent, with the logit model used to generate choice probability.

Of the 2,156 dairy farms in Michigan, the survey was randomly sent to 50% of the farms with a return of 1,102 respondents but only 226 usable surveys. Survey information such as age, farm acre size, crop size, number of livestock, age, education level, overall experience, and dairy cooperative participation history were requested. Seven variables were used: milking herd size, acres operated, percentage of feed purchased, operator age, operator education, solvency position and business organization were used as variables but only herd size had a significant impact. The range of herd size varied greatly from 8 to 5,400 with an average of 300 cows per farm. Of the 226 farm data used, 53% were large farms with 47% operating as small farms. The majority agreed that

removing all dairy policies would not be beneficial to them but a large proportion also agreed that removing ethanol subsidies would be the most beneficial. This is contributed mainly to the larger farms since 54% of them agreed that eliminating ethanol subsidies as the best option. This is ideal as larger farms utilize more feed for their herds, which has a positive correlation to the price of fuel but the smaller farms had other preferences. The bills that the smaller firms believed to be most beneficial to them included implementing margin protection, growth management, competitive price pay and eliminating the DPSP and MILC programs. Farmers have the opportunity to use futures contracts for milk prices but the complexity of this makes the margin protection bill a better option.

While the difference in farm size is apparent to their preferences, only a small sample in Michigan was evaluated. The sample could be assumed to be the general view for all farmers but region and location does play a role in preference. As the authors mentioned, only preferences were examined and not the costs related to those preferences. The farmers made preferences that would be the most beneficial to them in terms of policy enactment but the actual financial impact isn't measured. A further cost analysis comparing the policy effects and market changes on small versus large farmers is still needed.

C. Kirwan (2017)

While the exact subsidies are not determined, in general, Kirwan (2017) concluded that larger farms benefited more from government subsidies, using the 2007 US Census of agriculture and agricultural resource management survey which analyzed 1.5 million farms. Similar to the bias of the MILC favoring smaller farms, large farms received the bulk of the government subsidies but smaller farms received subsidies as the majority of their income even when their net sales were

relatively low. With numerous categories and sale categories, the volatility of the dairy industry also affects the categories farmers are placed in. With relatively low barrier to entries, the USDA has recognized numerous types of farms including small family farms, rural residence farms, retirement farms (whose owners are retirees), residential/lifestyle farms (small size and owner has other occupation), farming occupation farms, low sale farms (sales total less than \$100,000), medium sale farms (sales total less than \$249,000), large family farms (sales total less than \$499,999), very large family farms (sales greater than \$500,000) and non-family farms/cooperatives. A more direct distinction is between small-scale farms (less than \$250,000 in sales) and large-scale farms (greater than \$250,000 in sales).

Since some of the categories are based on total sale prices, farms can change categories each year with larger farms being more stable in their high-sale categories. As expected large-scale farms with more resources have higher production, with 84% of total milk production coming from the 12% of the larger-farms. The small farms made up 88% of the farm population but only produced 16% of the total milk produced. While this data is from 2007, similar trends are assumed that a smaller percentage of large farms make up the majority of the dairy industry in terms of production. Just the year prior in 2006, 45% of small farmers had quit the profession, closing their farms and their milk production. This is understandable as profits, if any, for smaller farms are relatively low, with 55% of farms recorded in 2010, earning less than \$10,000 in sales and only the largest 1.7% of farms earning over 1 million in sales.

Farms who received government subsidies had much better earnings with only 28.5% of them earning less than \$10,000 in sales and 3.8% having more than 1 million in sales. 48.3% of farmers were still within the small-scale category but had better earning ranging from \$10,000 to

\$249,999. The bias against small farms lies in the equation for government subsidies which is automatically beneficial towards larger farms. The subsidy equation is based on the amount of land being used and the number of certain grains/cottons produced. As such, small farms are less likely to apply for subsidies. Only about 20% of small-scale farms receive subsidies while 80% of the large-scale farms, with earnings over \$250,000 earn government subsidies. The percentage received by smaller farms is a higher portion of their income but their net sales are low, with 18% of small farms earning subsidies. With an average payment of \$439 for small farms with net sales of less than \$10,000, \$3839 for mid-sized farms with net sales between \$10,000 and \$249,999, \$20,918 for large farms with net sales of less than 1 million and \$56,962 for large farms with net sales over 1 million, the bias is very clear as well as well the hesitancy of small farms to sign up for government programs.

While the data collected is extensive, it is limited and does not show farm changes as it is not tracked on a yearly basis. However, it provided the necessary information needed to examine the impact of increased subsidy amounts on smaller farms. If further taxpayer dollars are to be used towards the dairy and agricultural industry, then taxpayers should be aware of how their money is being distributed. With their beverage and food preferences, consumers will know who is being directly affected or benefiting from their choices. Using this data set, it becomes clear that should the dairy industry endure more competition, than the small dairy farms would be negatively affected. Net sales are already relatively low and even if government subsidies increase, the majority of that money will go to larger farms instead.

D. Dharmasena & Capps (2014)

The only paper, to my knowledge, that directly compares the non-dairy alternative industry to the dairy industry is that of Dharmasena & Capp (2014). Similar to my thesis, the two authors aim to “develop models that uncover demand for DAFBs for a diverse set of consumers. Specifically, we identify (i) conditional and unconditional factors that affect the volume of soymilk, white milk, and flavored milk purchased; (ii) conditional and unconditional own-price, cross-price, and income elasticities of demand for soy milk, white milk, and flavored milk; and (iii) retail-level pricing strategies for these beverages in the competitive marketplace.” (Page 141). At the time of research, soymilk had been one of the fastest growing beverage categories along with other DAFBs. This sudden growth can partially be attributed to a shift in consumer preferences and the need to make healthier choices. Dharmasena and Capp have also factored in the introduction of the DAFBs to the market, advertising/packaging methods and the range of available flavors. The paper focused mainly on soymilk but does note that that other DFABs such as almond, rice, and coconut milk had experienced similar growth. However, at the time, soy-based products made up 78% of the available of alternative beverage products, within the 5% of overall dairy beverage products. It is important to note that the USDA is accountable for the placement of calcium-fortified non-dairy alternative drinks within the dairy category and with over a billion dollars in sales in 2011, some major brands, such as Silk have become household names.

Using household purchases and demographics from Nielsen’s 2008 survey of 61,400 households, purchases for white milk, soy milk and flavored milk were determined. The results are greater than 61,400 when combined as households had the opportunity to purchase multiple options. 58,268 purchased white milk, 7,729 purchased soymilk and 16,468 purchased flavored

milk. Unit values were determined by dividing liquid ounces produced over expenditures. The study consisted of numerous hypotheses: “ (i) flavored milk and white milk are substitutes for soy milk and so have positive cross-price elasticities; (ii) consumption of each beverage increases with level of education because highly educated consumers are likely to be more knowledgeable about beverages they consume; (iii) high-income households consume more of each beverage; (iv) the presence of children in a household increases consumption of each beverage, and the age of the children present affects the quantity consumed; (v) members of full-time-employed households consume a greater share of milk away from home; (vi) households location in the western United States consume more soy milk than households in other parts of the country; (vii) in terms of racial demographics, whites consume more white milk and flavored milk than other racial groups, and Hispanics consume the least white milk, soy milk, and flavored milk.” (Page 142). The only hypothesis which seems questionable is the regional prediction of western households consuming more soy milk. The western United States, mainly due to California’s production, has the highest milk production and sales.

With income, age, employment status, education level, race, ethnicity, region and presence of children as variables, the Tobit econometric model is applied to negate biases associated with consumer-level data. After running an auxiliary regression with Y as the observed product prices and household income, size and region as variables, prices were imputed for the zero-expenditure observations, a necessity for the Tobit model, to make up for possible missing prices due to a lack of consumer spending during the survey period. With better results, the semi-log model was used with a significance level of .05. The summary statistics for soymilk had a market penetration rate of 12.58%, \$6.04 average price per gallon and 4.63 gallons per household per year with a total of

\$27.96 dollars spent per year. Flavored milk had a 26.8% market penetration rate, \$4.85 per gallon and 3.17 gallons per household for a total of \$15.38 dollars spent per household per year. White milk had a market penetration rate of 95.42% with the average price per gallon at \$3.57 and 27.2 gallons per household with a total of \$97.02. The most significant variables varied for each dairy category but all in all, the above variables were all significant. Younger age groups, part-time employment, higher levels of education, households located in the Western regions, having a female head of household, as well as race contributed to higher levels of soy milk consumption. Black, Asian, and Hispanic households were more likely to purchase and consume soy milk than white, non-hispanic households.

The original hypotheses listed were correct in terms of age, gender, and racial group, as a comparison to the 2002 National Health and Nutrition Examination Survey showed similar results. With cereal as a common breakfast food for children, it is not surprising that presence of children would lead to a higher consumption of white milk. While the majority of white milk produced is in the west, when college and post-grad concentrated populations are considered within California and Washington state, then the lower consumption of white milk is a rational conclusion. In some instances, soymilk and white milk are also considered to be competitors and not substitutes because consumers are not sensitive to product price changes and a soymilk consumer will continue to drink soy milk regardless of the price of white milk. Considering that some soymilk consumers cannot consume dairy, practice diets that do not allow them to do so or simply see white milk as unhealthy, this is not a surprising result. However, there are consumers who willingly choose to use soy and dairy milk as substitutes and consume both. Dharmasena and Capps also denote

marketing strategies and marketing age-target ranges as part of the reason why western, younger, higher educated and college-aged consumers are more likely to purchase soymilk.

As the first study of this nature, Dharmasena and Capps' research has provided the necessary analytical tools required for my own thesis. Since the DAFB market has grown exponentially since the 2008 Nielsen was produced, I will search for newer data but include other DAFBs as well such as almond and coconut milk. While this does show the shift to a preference of soymilk and the examines the variables behind it, it would still be beneficial to see the impact of these preferences. Examining the impact of this shift, with more recent data, with the profit and subsidy payment of the dairy industry will make the economic impact of DAFB on consumers and taxpayers clearer.

III. Data

Using some of the data from the research examined above, the change in consumer preference and relevant effects can be analyzed. The data below analyzes the changes in consumer preference based on the household penetration rate and net sale amount for leading DAFB-producing companies. The effect on the dairy industry will be measured by examining the changes in financial farm demographics, including net sales and the additional efforts taken by the dairy industry such as the increase in advertisement spending. The effect on government subsidies can be examined by examining the changes in the USDA agricultural surveys.

The majority of the data has been obtained from Statista- a company that provides infographics from numerous company and government reports. The sources of these reports have been verified and on the Statista website, all infographics contain a link that directs users to the reports from which the data has been obtained. The Statista graphics being used include data from Nielsen consumer surveys, Berrycart consumer survey data, United States Department of Agriculture Marketing Service reports and reports from the Bureau of Labor Statistics. In addition, the remaining not covered by Statista has been collected directly from the USDA database.

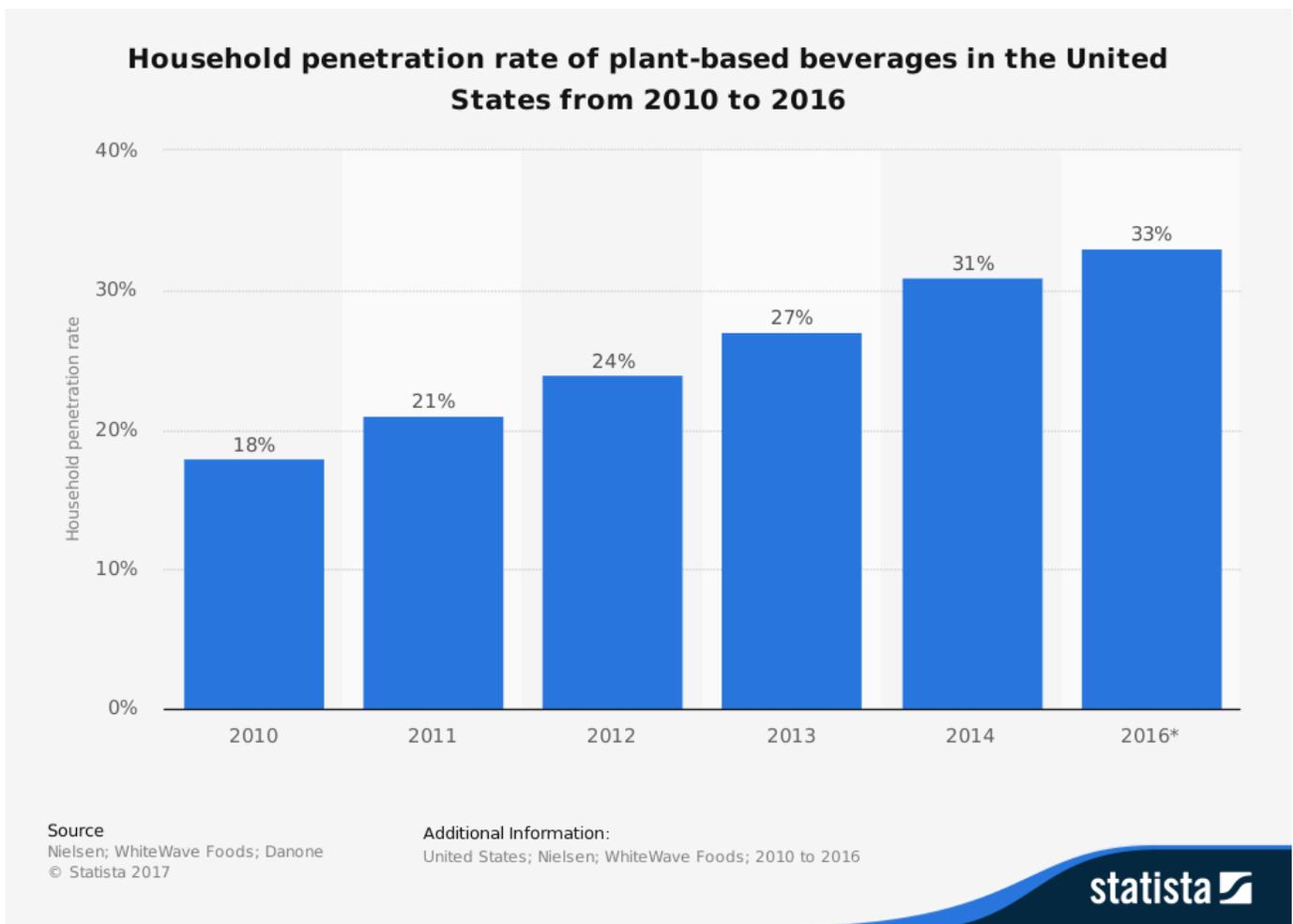
The previous data examined in the literature review includes Nielsen survey data from 2008 as well as 2007 US Census of agriculture and agricultural resource management survey data. More recent survey data will be examined in relationship to the 2007 and 2008 surveys to show changes within the dairy and plant-based milk industry. Since data is continuously collected, the most recent years, 2016 and 2017, are not always included and examined. Regardless, the data included is the most recent data available. The years provided on the x-axis vary but for the most part include the years 2012-2016. For all intent and purposes, 2008 will be used a base year but

certain data begins after that point. For example, in 2008, almond milk which now makes up about 68% of the plant-based milk industry, was overlooked due its relatively low percentage rate within the DFAB industry. This data set also does not attempt to account for all possible variables that influence the changes within both the dairy and plant-based milk industry but as primary substitutes, changes in one industry should have an effect on the other. The data presented here also examines the dairy milk industry as a whole and does not attempt to differentiate between specialty (low-fat,skim, etc) or organic whole milk. Other studies, such as that of Figure 13, has shown that while whole milk has noticed a decrease in sales, specialty and organic whole milk has seen an increase in sales. Further research would examine the dairy industry more closely but for our purposes, plant-based milk is being compared to dairy milk.

IV. Empirical Analysis

In 2008, when the Nielsen household purchase survey was recorded, soymilk made up 78% of the DAFB industry and had an overall penetration rate of 12.58%. With the more recent Nielsen surveys for 2010-2016, the household penetration rate has greatly increased, with the 2016 penetration at 33% almost doubling the 18% 2010 penetration rate. A third of the household surveyed, supposedly representative of the larger population, now purchase plant-based milk beverages.

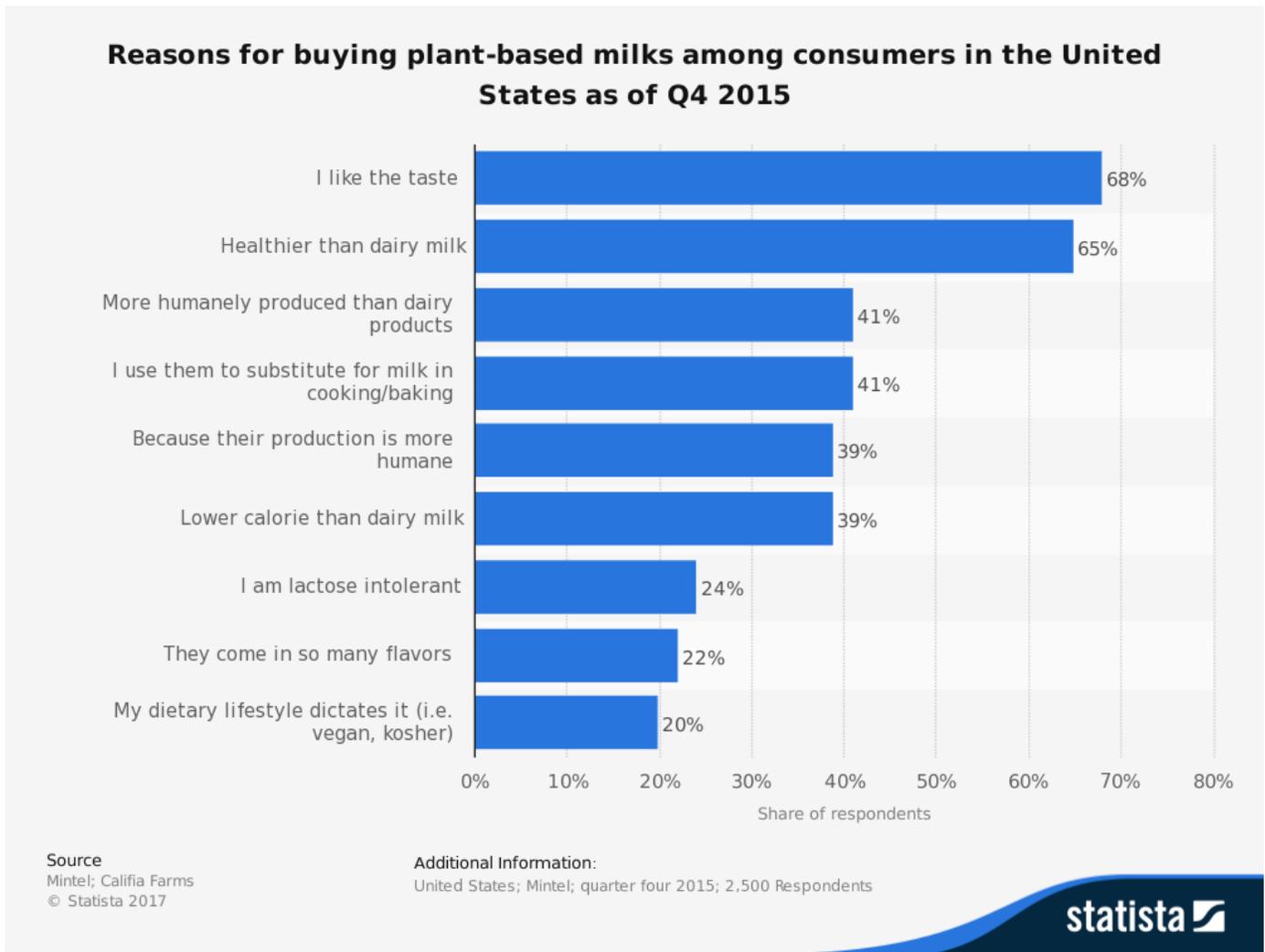
Figure 1



In order to understand this shift in consumer preference, Berrycart, a phone app that provides consumers with offers and cashback for healthy gluten-free, organic, vegan and non-gmo product purchases, in collaboration with Califia Farms, sent out an online/mobile survey, asking consumers to choose their reasons for buying plant-based milk options, with the option of choosing more than one reason. To account for dietary biases, participants were asked to choose whether they were omnivores, flexitarian, pescatarian, vegetarian, unable to mix milk and dairy, or vegan. Surprisingly, the majority of participants (63%) were omnivores and could essentially consume regular dairy. The results become skewed when penetration rate of plant-based milk is examined as a higher percentage of 55% is reported for 2015, when larger studies have showed lower percentages. Even after accounting for the healthier, natural-food type of consumers who would use Berrycart and therefore be presented with the survey, the top reasons for drinking plant-based milks still have an impact. I had predicted that lactose intolerance and dietary preferences such as veganism would be on the list of reasons but the majority of participants (68%) chose to purchase plant-based milks because they liked the taste.

As portrayed in Figure 2, only 24% of participants chose lactose intolerance and 20% of participants chose dietary lifestyles as their reasoning. The survey also shows that consumers care about their health and are actively choosing to purchase products they think is healthy or healthier than the norm (i.e. whole dairy milk). The second highest reasoning at 65% was that participants thought plant-based milk products were healthier than dairy milk. This increased access to information, with the internet and social media, allows consumers to research the products they want to use and make better personal choices.

Figure 2



The Berrycart survey also shows that consumers not only want healthier choices, they want healthier, better-tasting choices. The plant-based milk industry is categorized into one industry as an alternative to dairy milk but there is still some competition within the industry. At the time of 2008 Nielsen survey, soymilk had the highest market penetration rate at 78% but it has since been replaced by almond milk, that consumers might say is an even healthier and better tasting alternative. In less than a decade, the demand for soy milk has plummeted while the demand for almond milk has skyrocketed. As shown in Figure 3 and 4, soymilk has now been surpassed and

now only makes up 297.7 of the 1321.84 million dollars in sales, at a 22.5% rate down from the leading 78% rate in 2008. Almond milk is now the top plant-based milk product, contributing to 67.7% of the total milk substitute sales.

Figure 3

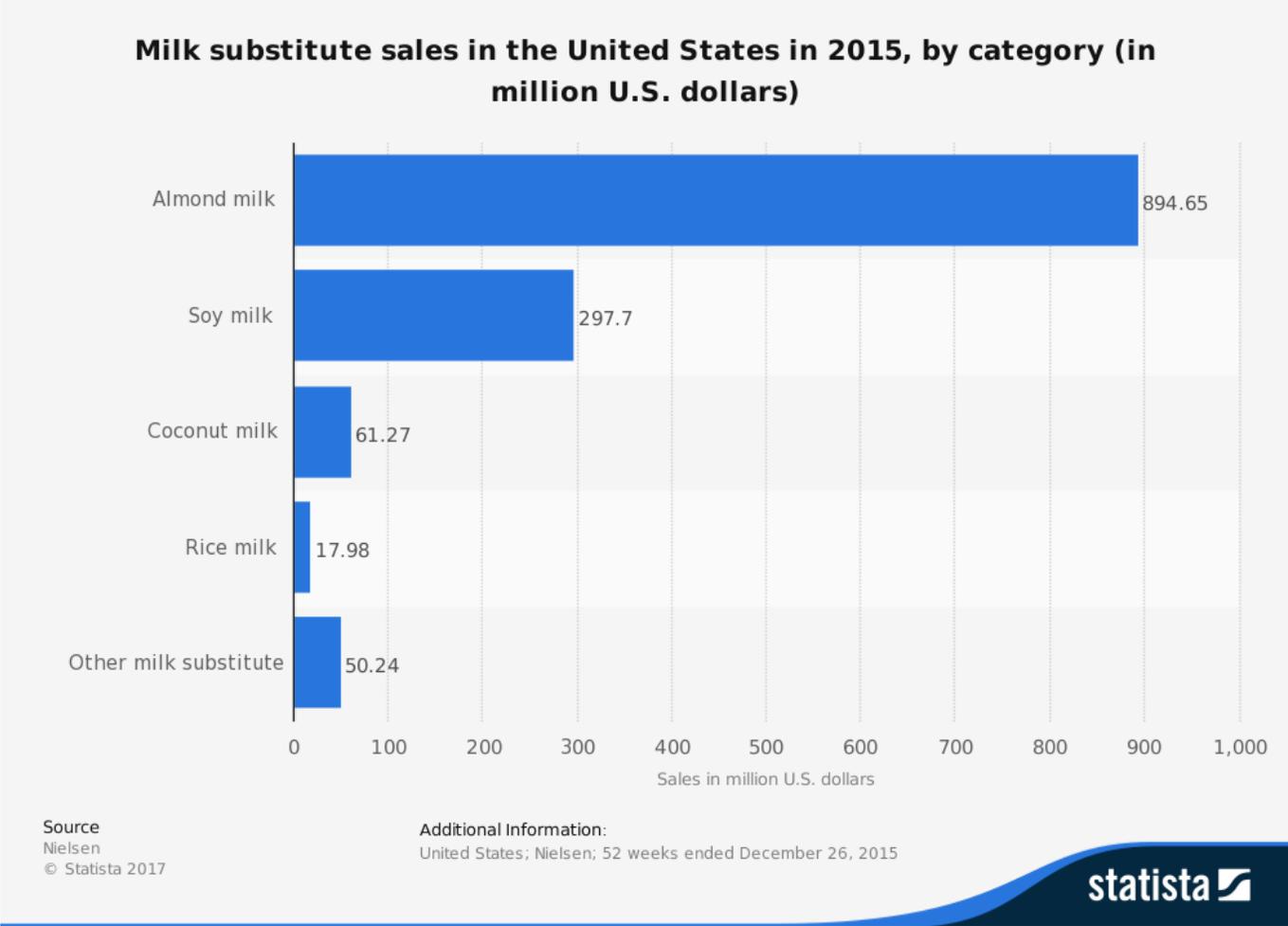
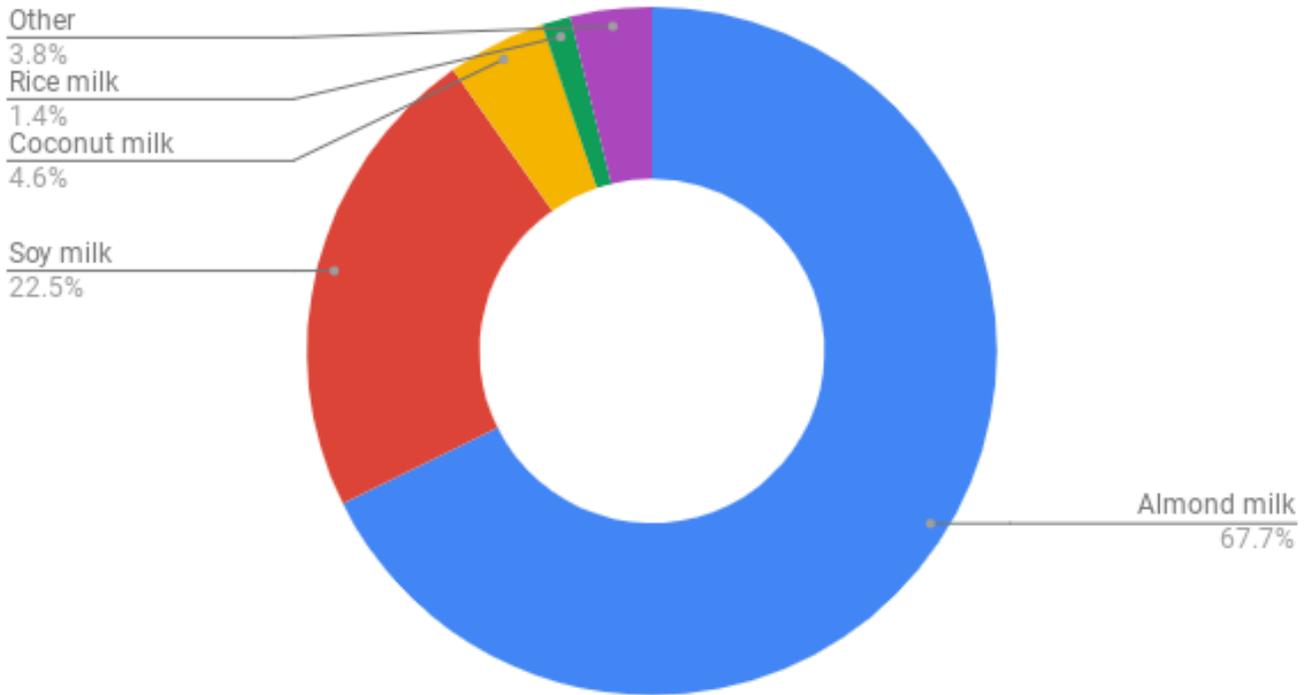


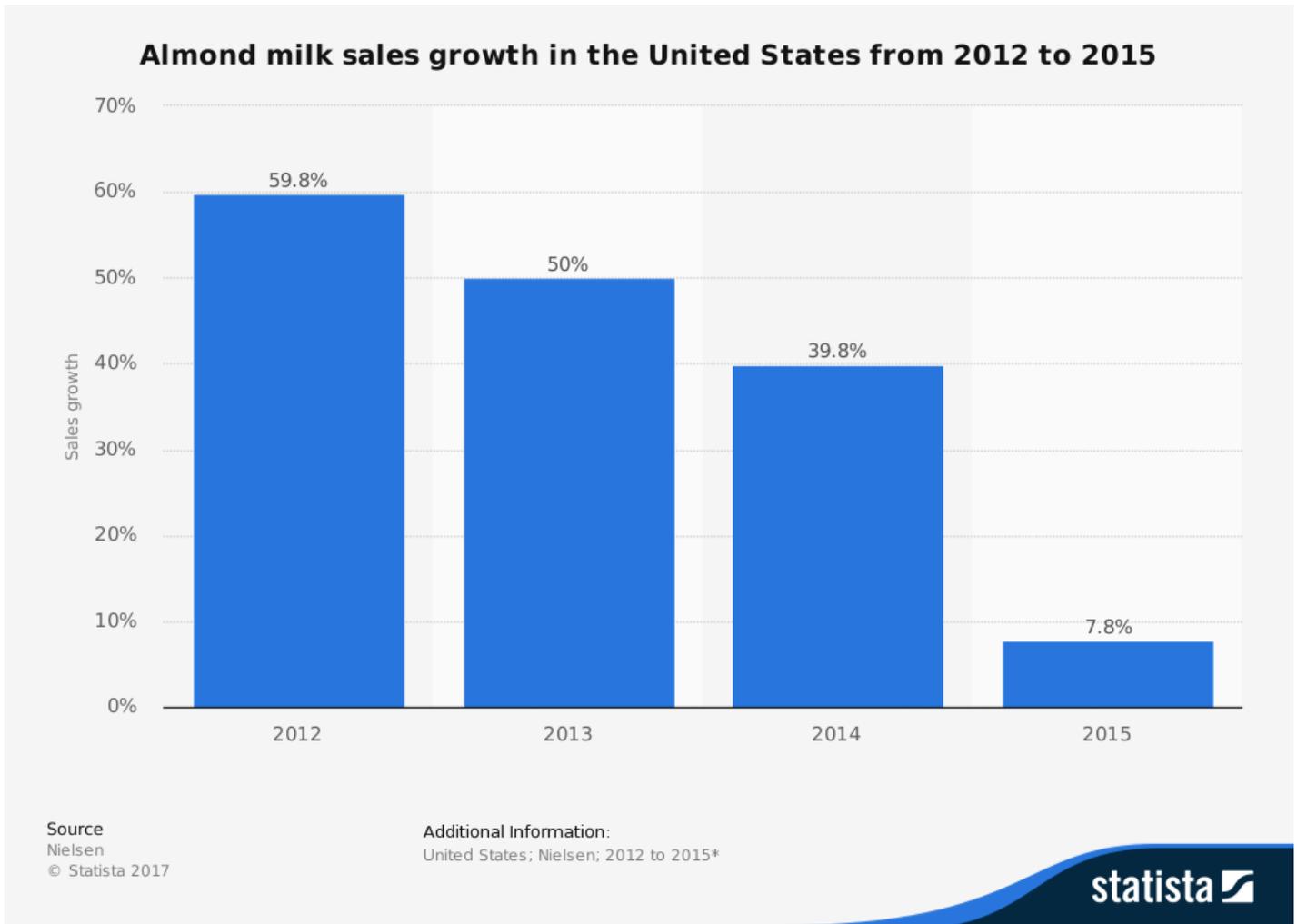
Figure 4

Sales Percentages for Figure 3



As portrayed in Figure 5, similar to the growth of soymilk, the growth for almond milk declines on a yearly basis. With its recent introduction to the market as a milk substitute, consumers were bombarded with alternatives and with time, volatility has decreased. Current consumers may continually purchase almond milk but the room for growth is not as high as when the product was initially introduced.

Figure 5



As substitutes, the growth portrayed in the plant-based milk industry should have a negative impact on the demand for traditional cow milk. This decreased demand should also lead to a lower supply and lower sales for dairy industry. In an effort to compete with the plant-based milk industry, the dairy industry's spending on advertisement has also increased. While there is no exact year to look for, I will maintain the data within the past decade. Plant-based milk options have been around for years but have only recently entered the mainstream market. The year 2008,

around the time the Nielsen survey was produced and explicitly compared dairy milk to plant-based milk will be used as a guideline. With increased competition and a decrease in sales, it is predicted that the farm demographics will have changed as well.

Figure 6

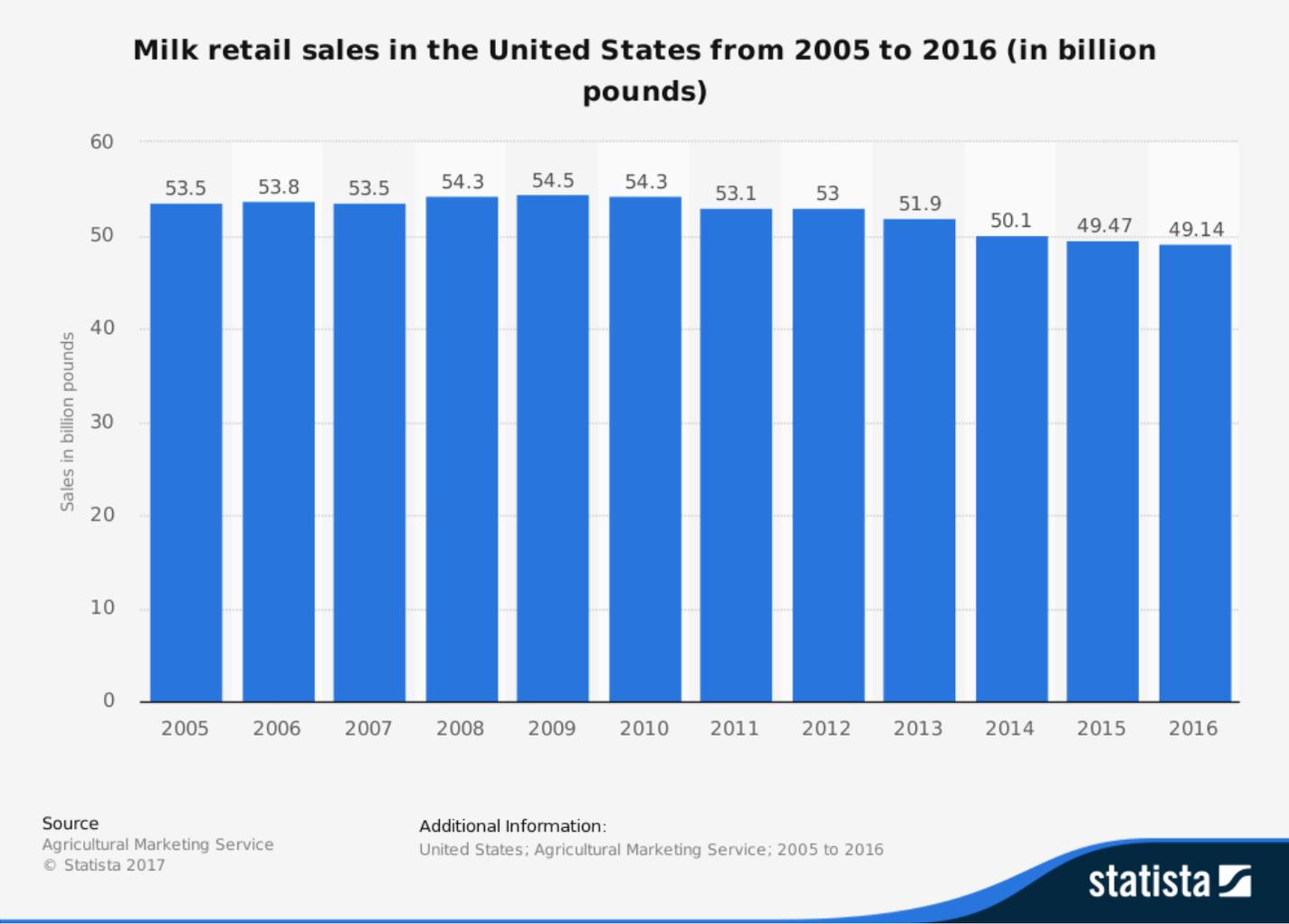
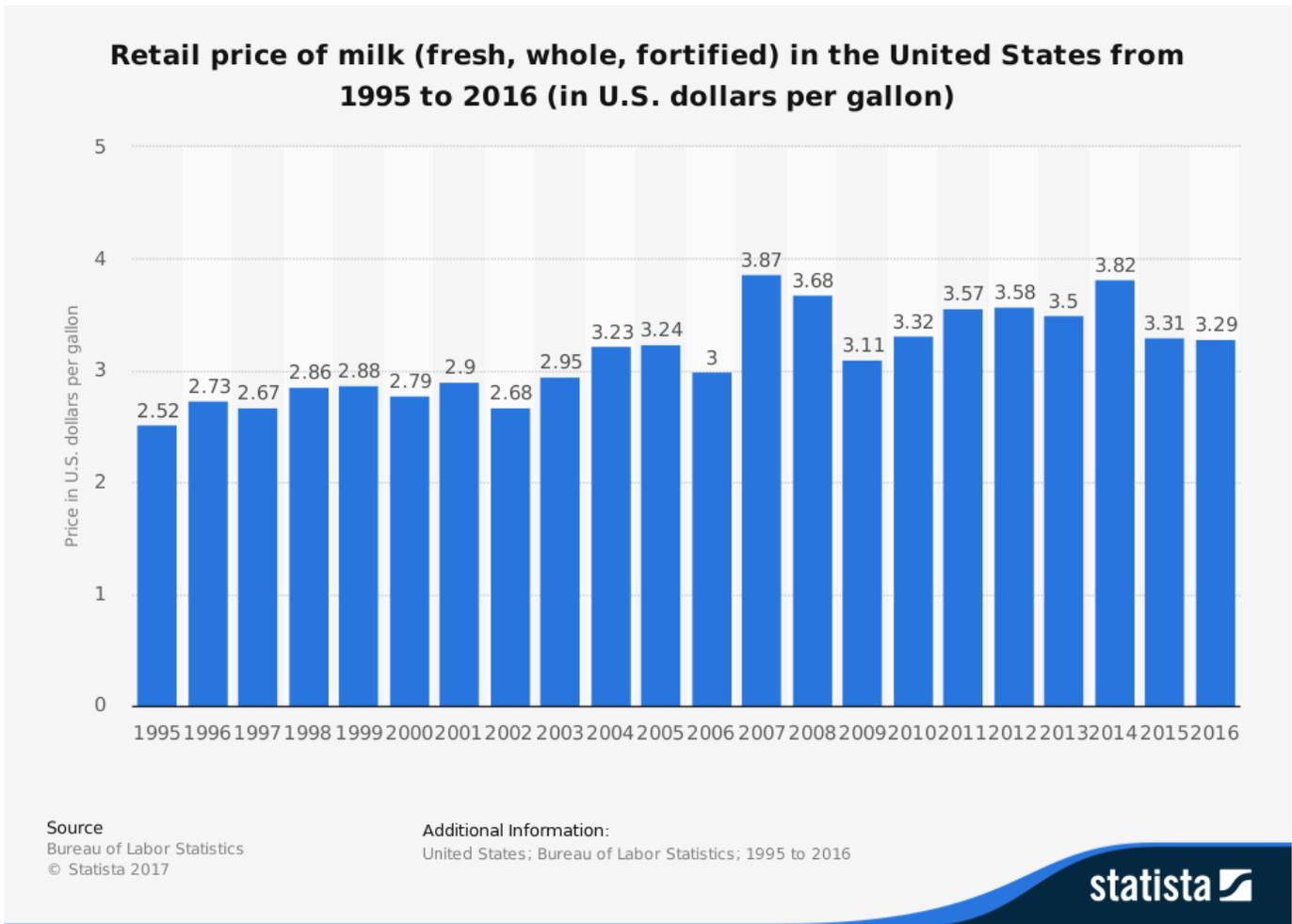


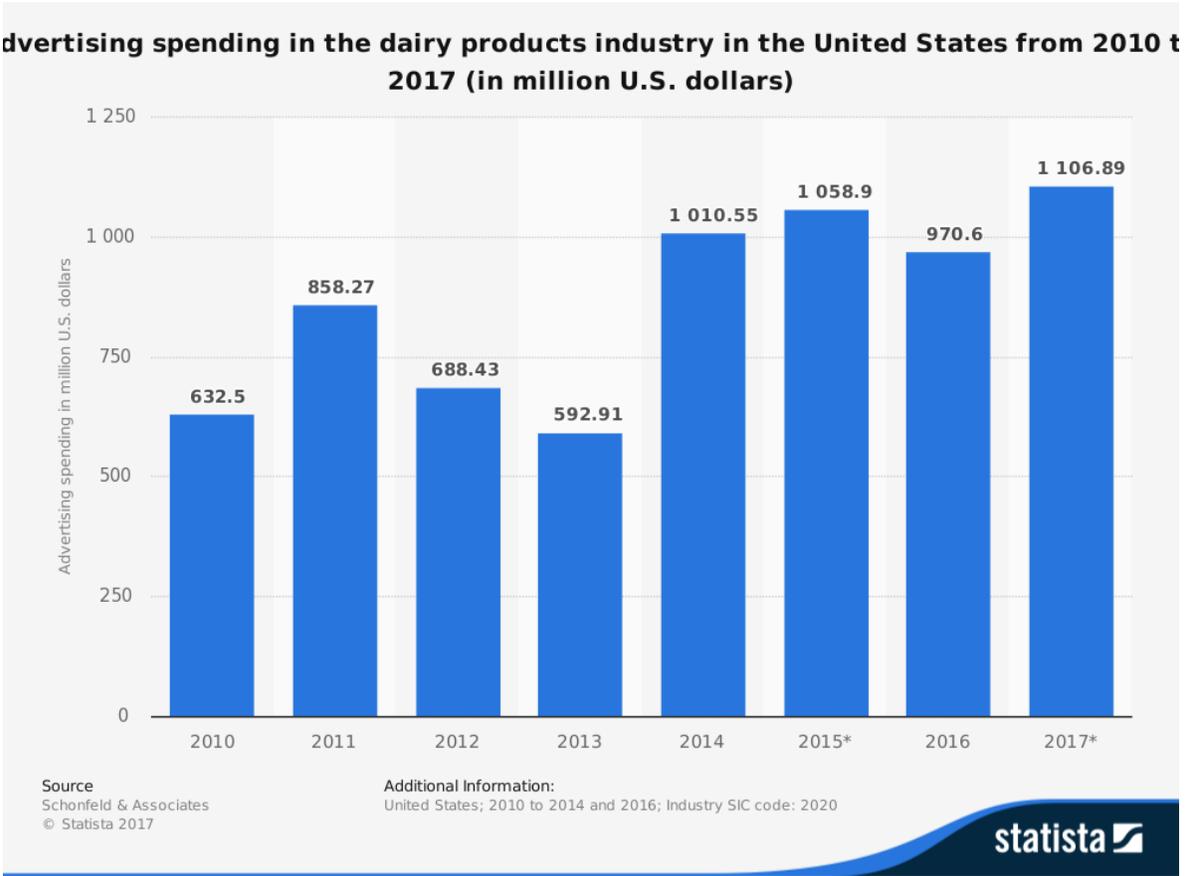
Figure 7



As predicted, starting around 2009, not including the effects of both the stock market volatility and the dairy industry’s volatility, the amount of milk purchased by consumers has decreased. With a positive population growth, the decrease in consumption can be explained by the change in consumer preferences and the introduction of substitute plant-based milk products into the beverage market. Figure 6 contains the data for milk retail sales for the past 12 years and 2016, with 49.14 billion pounds of milk sold is the lowest amount recorded within that timeframe. Figure 7’s data is a bit more extensive going back to 1995. The most recent amount for the retail price of milk is \$3.29 per gallon in 2016. The price of milk has not been that low since 2008 and before

that 2006. When inflation is calculated into the equation, the price of milk for 2016 should have been about \$3.96 per gallon.⁶ The United States dairy industry has not only seen a decrease in sales but a decrease in prices as well which would result in a decrease in overall net sales. These earnings do not include the extra effort taken by the dairy industry in order to compete against the plant-based milk industry.

Figure 8



With the exception of 2015 and 2017 in Figure 8 as these were the forecasted earnings, the dairy industry’s spending on advertising has increased, almost doubling from the 2013 to 2014

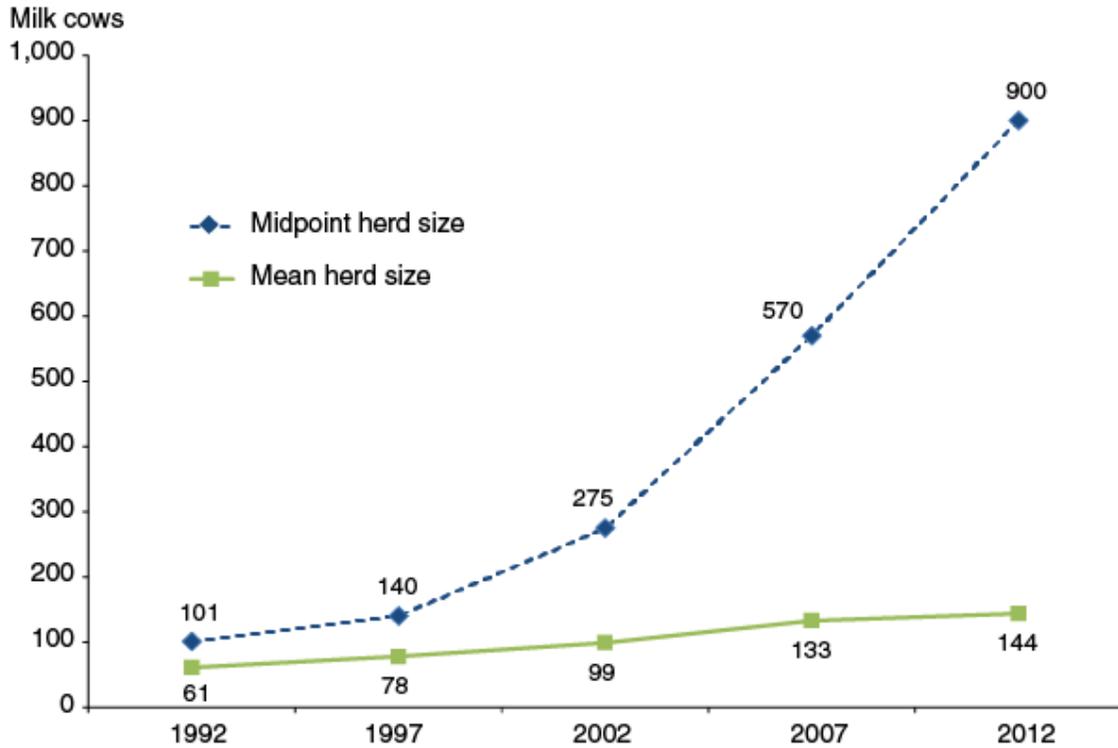
⁶ 2016 milk inflation price calculated by using the United States Department of Labor CPI Inflation calculator. December 1995 and \$2.52 were used as the base year and price based on the recorded value of milk/per gallon in 1995. December 2016 was used as the current year buying power with a resulting calculation of \$3.96.

year. At first glance this might seem within range due to the amount of milk consumed yearly by Americans but milk retail sales have fallen despite the increase in advertising spending. While there is variation with each year, spending had not reached a billion dollars prior to 2014. Milk retail sales had begun to decrease in 2010 but it had been in relatively low increments of .2 billion pounds of milk but the increments increased each year. 1.2 billion pounds decrease for 2011, .1 for 2012, 1.1 for 2013, 1.8 for 2014, .63 for 2015 and .33 for 2016. The year 2014 stands out in particular for simultaneously having the largest decrease rate in milk retail sales, at a 1.8 billion pounds (3.47%) decrease and the largest increase in advertisement (70.44%) at 417.64 million dollars. While the decrease in milk sales have slowed, they still continue to decrease with the last recorded change being a .33 billion pound decrease in 2016. The advertising sale amount however still hovers around a billion dollars per year and have not returned to their lower pre-2014 amounts.

This shift in consumer preference does not affect the dairy industry unilaterally as small dairy farmers feel more of the negative impacts. This isn't entirely due to simply the introduction of the plant-based milk market but economics overall. In the long-run, larger farms have lower production costs, therefore retaining more of their net sales as profit while smaller farms struggle to get by and decrease in number over the years. The USDA data portrays this shift in Figures 9-11. Matched with a higher percentage of government subsidies being put towards larger farms (since government subsidies are based on farm size and grains produced) and increased competition, small farmers face even more hardships. This trend has been examined for the last 20 years and while the total number of farms has grown overall, there is a significant change in the percentage of large farms.

Figure 9

Milk production is shifting to larger herds



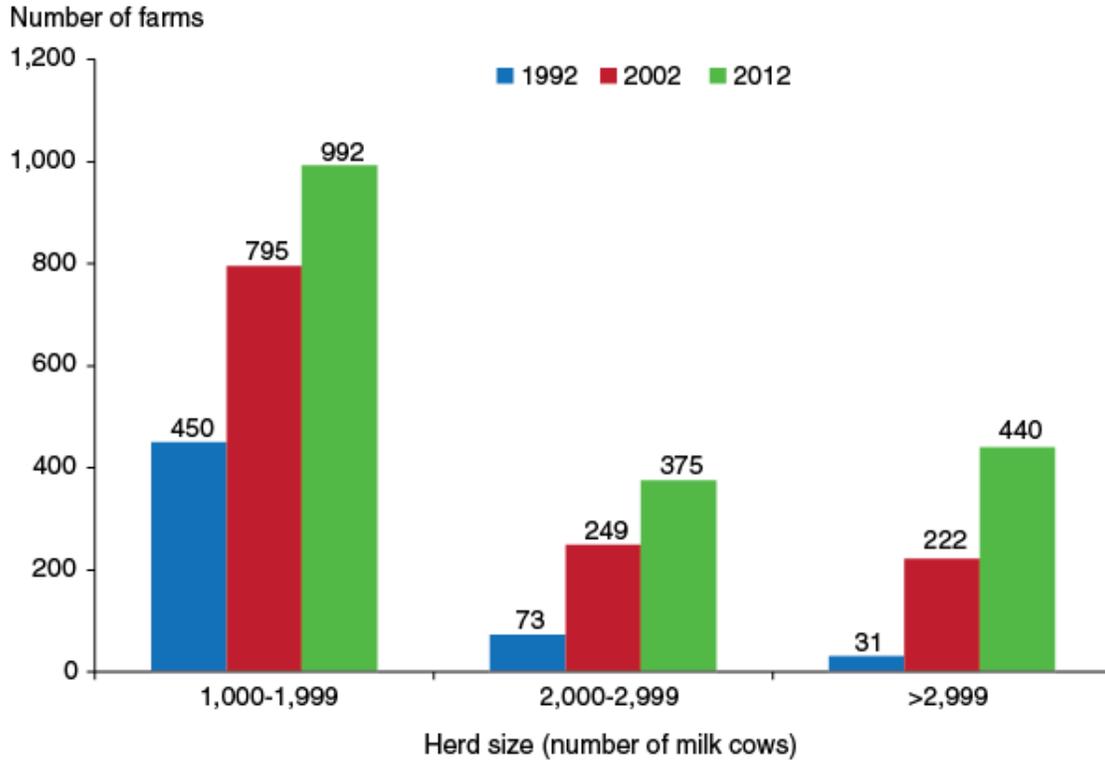
Note: Half of all milk cows are in herds that are larger than the midpoint size, and half are in smaller herds.

Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, Census of Agriculture data.

The midpoint or median line portrayed in Figure 9 shows the increase in herd size over the past 20 years. In 1992, 50% of farms had more than 101 cows and 50% has less but the mean was still somewhat close to the median. For 2012 however, 50% of farms had a large herd size of more than 900 cows yet the average is still relatively low at 144. The average herd is exceptionally small due to the large number of small farms, despite the number of large farms present. Figure 10 contains a breakdown on the number of large farms but these all fall above the median herd size. Nonetheless, the growth of large farms can still be examined.

Figure 10

The number of very large dairy farms has grown rapidly

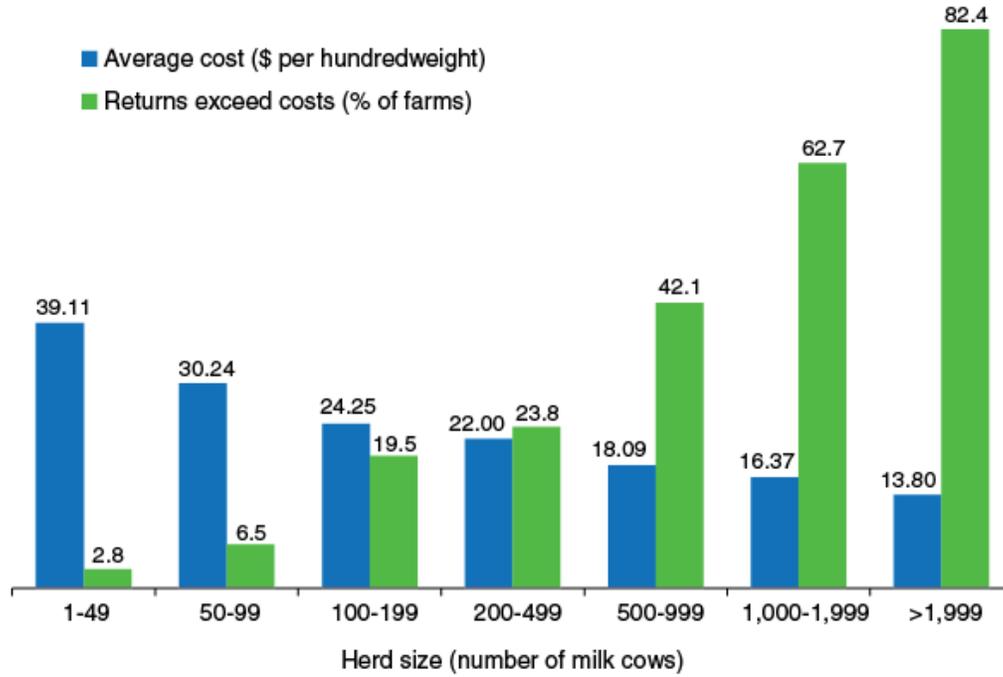


Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, Census of Agriculture data.

Large farms/ larger herd sizes are becoming the new norm and with Figure 11 explains the advantages of such a shift. Those with an average herd size would still be at a loss as the majority of them would not generate profit. The bigger herd sizes, especially greater than 1,999 have lower average costs and the majority are profiting from their sales. The average cost for the smallest farms were 39.11 per hundredweight and only 2.8% made a profit compared to the largest herd category that had an average cost of 13.8 per hundredweight with 82.4% of those farms experiencing profit. All in all, larger farms are on the better end of the spectrum profit-wise.

Figure 11

On average, larger dairy farms realize lower costs and higher profits



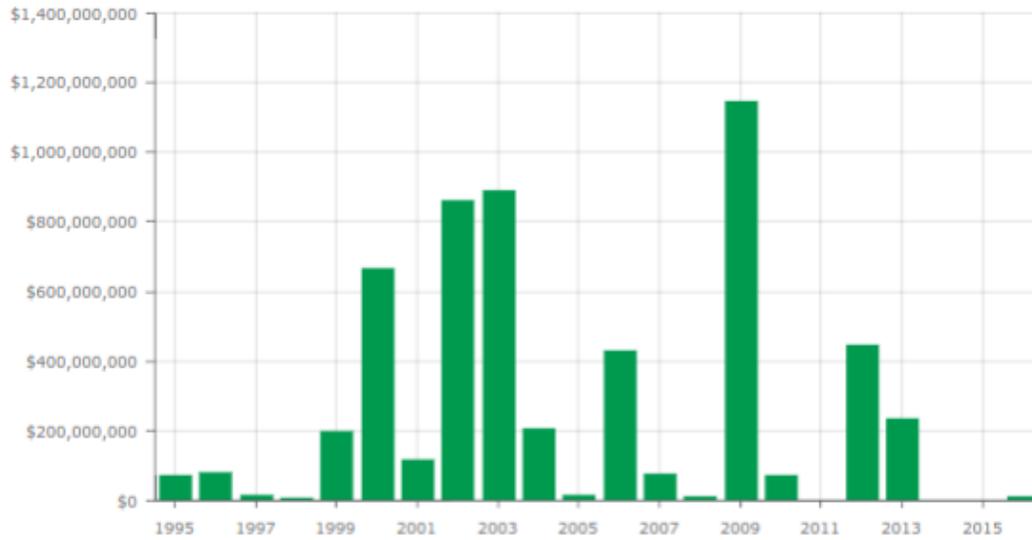
Source: USDA, Economic Research Service using USDA, National Agricultural Statistics Service, Agricultural Resource Management Survey (ARMS).

While there isn't a breakdown of a per capita amount of taxpayer dollars being used for dairy subsidies, the yearly amounts, with a state breakdown is available. As portrayed in Figure 12, the total amount of federal dairy program subsidies for the past 22 years (1995-2016) was 5.6 billion dollars, with an average of approximately 254 million dollars per year. The highest dairy-producing states received the majority of the subsidies with Wisconsin leading in first place, having received 20.7% of the total subsidies, followed by New York at 9%, California at 8.9%, Pennsylvania at 8.3% and Minnesota at 8%. The remaining 45 states received 45.1% of the dairy subsidies.⁷

⁷ EWG's Farm Subsidy Database Figure 13 breakdown. Top regions 1995-2016 state rankings.

Figure 12

Dairy Program Subsidies in the United States totaled \$5.6 billion from 1995-2016.



Programs Included in dairy program subsidies

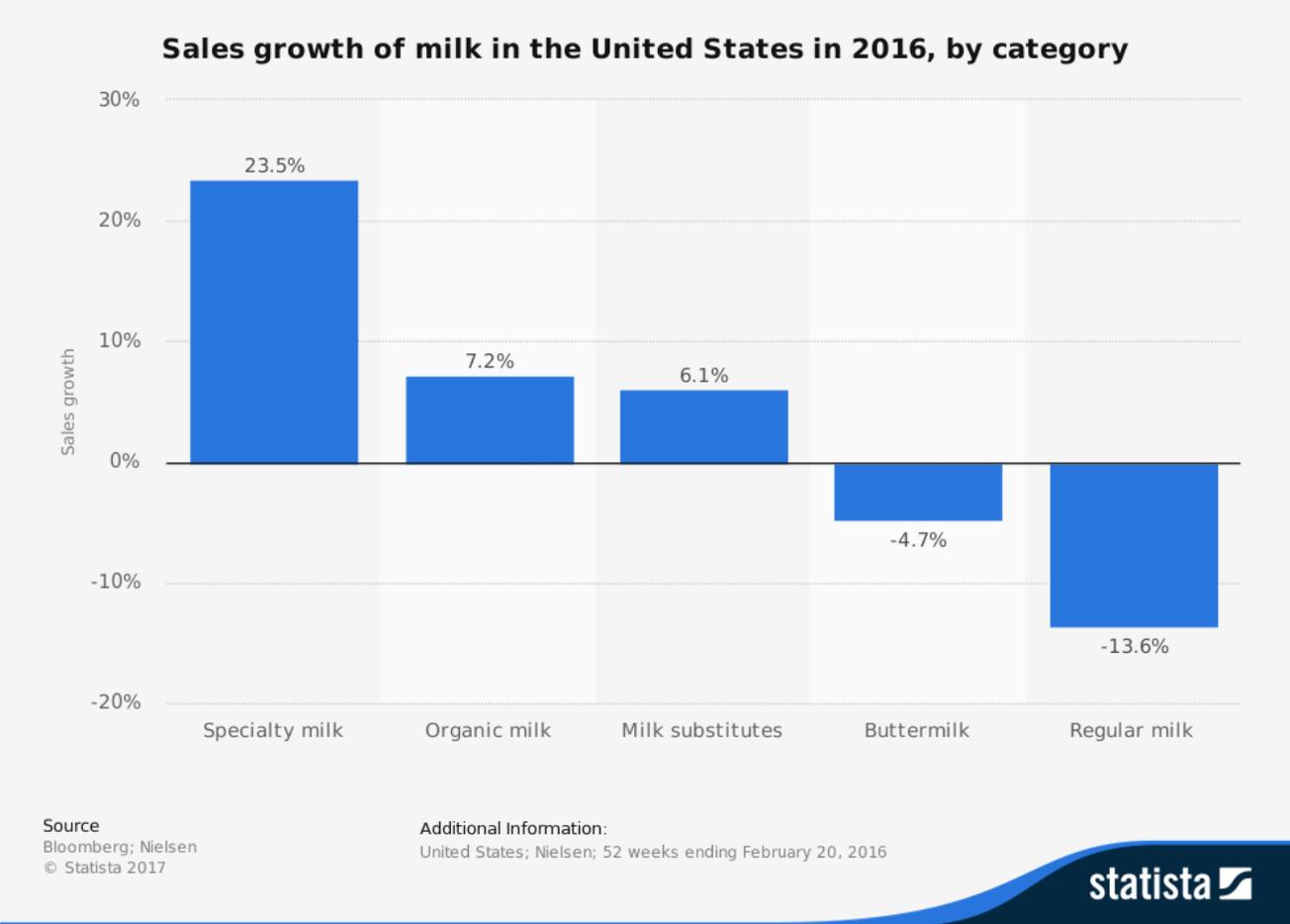
Program	Total Payments 1995-2016
Milk Income Loss Contract Payment	\$3,532,976,375
Market Loss Assistance - Dairy	\$994,714,404
Milk Income Loss Transitional Payment	\$555,991,196
Dairy Economic Loss Assistance Program	\$288,012,204
Milk Marketing Fees	\$171,578,059
Dairy Disaster Assistance	\$21,548,302
Margin Protection Program - Dairy	\$11,092,486
Total Margin Protection Program - Dairy	\$11,092,486
Dairy Indemnity	\$6,185,386
Milk Diversion Program	\$-366
Dairy Termination Program	\$-5,997

The dairy subsidy payments for the most recent years of 2014-2016 are relatively low and below the average. For 2014 year, only \$1,143,645 was distributed with \$1,615,646 for 2015 and \$10,572,942 for 2016. The amount for these three years combined contribute to less than 1% of the of the total dairy subsidy amount for the past 20 years. 2009, however, had the highest yearly distribution rate at \$1,147,694,515 at 20.56% of the total dairy subsidy. This is assumed to be the cause of the 2008 recession as the majority of the dairy subsidies distributed were part of the Milk Income Loss Contract Payment. Since the earliest study comparing plant-based milk to dairy was released for the 2008 year, there is an emphasis on the 2008-2016 year. With the exception of the 2009 year which was abnormally high, there is no trend of a continual increase of subsidy payouts to offset increased competition. The other relatively high years within the 2008-2016 range are 2012 and 2013 but following those years, the subsidy amount decreased once again.

Further research has also demonstrated that while there has been a decrease in general whole dairy milk consumption, there has an increase in sales of other dairy milk categories to make up the difference. Specialty dairy milk such as skim and low-fat milk have seen a 23.5% sales growth for the 2016 year while organic milk has seen a 7.2% increase. Consumers who consume dairy milk are still opting for healthier dairy options foregoing whole milk for organic and specialty drinks. While my research has focused mainly on the comparison of plant-based milk to dairy milk in general, it is interesting to note that while dairy milk consumption has been decreasing, specific dairy milk sectors have been increasing in sales, negating some of the negative effects of competition from the plant-based milk industry. In the end, consumers will still choose the options they have concluded are healthier but seemingly, not all Americans have determined that

plant-based milk is a healthy alternative to dairy milk, when organic and skim dairy milk are available options.

Figure 13



V. Conclusion

Within the past decade, the methods consumers use to obtain information and analyze their product choices have changed greatly. There are an onslaught of social media profiles focusing nutrition and proper diet. The average consumer does not simply rely on USDA guidelines for food consumption. In fact, I cannot seem to recall the last time the food pyramid was mentioned and used as a guideline. Instead, the average consumer can research the products they buy and they are actively choosing the products that they deem healthy. Even more important and previously unaccounted for, is that consumers want products that are both healthier and better tasting than the products currently available in the market. As an alternative to whole dairy milk, consumers have found plant-based milks (mainly almond milk) to be both better-tasting and healthier. However, those who still consume dairy milk have also chosen speciality and organic dairy milk as a healthy alternative to whole milk. Previous research analyzed the variables (such as region, age, race, etc) that led to an increased consumption of plant-based milks. As an extension, the effects of this shift in consumer preference has been analyzed to determine how the dairy industry has been affected along with the associated government dairy subsidies.

Plant-based milk products have been used for centuries but their recent entry into the mainstream market has produced a noticeable effect. Within the past decade, the plant-based milk industry has grown exponentially, now making up 8% of the overall beverage industry. Almond milk alone now contributes to 5% of the overall amount beverage industry. The industry is competitive even intra-industry as just 5 years ago, soymilk had been the leading plant-based milk product only to be replaced by almond milk. Less than a decade ago in 2008, only 12.58% of

Americans households chose to purchase soymilk and now the penetration rate has increased to 33%.

Due to its substitutive nature, the rise of plant-based milk sales has contributed to a decrease in the consumption of whole dairy milk. The price of milk decreased to \$3.29 in 2016, below its expected price. Annual dairy consumption started to decrease in 2009 from 54.5 billion pounds to 49.16 billion pounds in 2016. This consumption decline continues even as the dairy industry increases advertisement spending and attempts to push the dairy act into law which would remove plant-based milk from the “milk” category. Just between 2013 and 2014 alone, the amount spent on advertising nearly doubled as the dairy consumed for that year divided by 1.8 billion pounds. Due to the increased consumption of specialty and organic dairy milk products, some of the negative effects have been negated minimizing the annual dairy consumption decrease. The dairy industry has suffered as a whole but smaller farms bear the grunt. Larger companies have lower production costs, receive higher amounts of government subsidies and can more easily switch to the production of plant-based milk and specialty/organic dairy milk products.

What seemed to be a personal consumption preference has instead become the rise of a growing plant-based milk industry in competition with an industry that has partially been the core of the American diet since the 1930s. This research has shown that consumers care about their health and are willing to make adjustments to their diet to adapt to healthier lifestyles as long as the products on the market are both healthy and taste good. It has shown the impact the plant-based milk industry has had on the long-standing dairy industry and how farmers are disproportionately affected. However, data showing the recent sales information, has indicated that while consumers

are buying more plant-based milk and less dairy milk, they are still choosing to purchase specialty and organic dairy milk.

As the dairy industry tends to be volatile even without competition, further research needs to be done that accounts for those variables. Newer data needs to be examined including the 2017 agricultural census which is released every 5 years, since the plant-based milk industry has grown exponentially. The non-census data, such as the consumer data from berrycart should be reconducted with a larger size as the participation amount was only 2,500. Forecasts were also common, showing the continuous decline in milk consumption and increased plant-based milk consumption but only patience can counteract or confirm them. Tax data in relation to the dairy program payouts were also limited. In addition, with more time and better data, a study could be done that analyzed all aspects of the dairy vs plant-based milk industry. I focused mainly on plant-based milk versus dairy milk but in future research would incorporate specialty and organic whole milk into my analysis.

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