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### Malt, Hops, and a New Demographic: A Study of the Forces Behind the Craft Brew Revolution

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**Malt, Hops, and a New Demographic: A Study of the Forces  
Behind the Craft Brew Revolution**

By

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A Thesis Submitted to

Department of Economics

Skidmore College

In Partial Fulfillment of the Requirement for the B.A Degree

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## **Abstract**

This paper examines factors associated with the recent rise in demand for craft beer, referred to by many as the “Craft Brew Revolution”. Using data for the number of brewery permits issued in each state by the Alcohol and Tobacco Tax and Trade Bureau (TTB), I look at demographic characteristics associated with areas that have seen an increase in demand for craft beer. The paper also focuses on the influence the Internet has had on changes in demand within the beer industry, by analyzing the correlation between the number of breweries and online search behavior collected through Google Trends. Results from the study suggest that the exponential increase in the number of breweries in the United States since 2009 is the result of craft beer’s ability to appeal to both millennials and consumers with higher levels of income. The implications of these findings are not exclusive to the beer industry, and shed light on a change in demand toward more local and specialized products taking place across many markets, especially within the food industry.

## **I. Introduction**

Since prohibition, the market for beer has trended towards consolidation and a reduced number of firms offering extremely similar products. A great change has been fermenting over the past decades, and in recent years the krausen has settled as the industry has undergone drastic changes. There has been an exponential increase in demand for craft brewers, who produce on a much smaller scale than the traditional brands who have dominated the market since the passing of the twenty-first amendment. Craft brewers differentiate themselves as small and independent brands with annual production of under six million barrels, and a focus on the use of traditional and innovative brewing techniques and ingredients (Brewer's Association). This study seeks to understand the forces behind the "Craft Brew Revolution" (Toro-Gonzalez et al., 2014) by analyzing the demographics that have taken most to the evolution of the industry in recent years, as well as the motivating factors that have driven the change in demand.

The rise in popularity of the craft segment of the industry for beer parallels a greater change in consumer demand that is taking place across many markets, as consumers are becoming more interested in brands that offer an alternative to macro producers with a national presence and widespread distribution. The food industry serves as an excellent example of a market experiencing similar changes as the beer industry, with the great increase in the number of farmers' markets and locally sourced offerings. Many attribute this change to the increased buying power of millennials, individuals born between 1981 and 1997, who are more conscious of what they are consuming and the brands they are supporting than previous generations (Roderick, 2015). The increased use of the Internet to inform purchasing decisions is another possible explanation for the change in consumer behavior, since customers have greater access to information about products and their qualities, as well as the producers who are being supported by the purchase of said

products, than ever before. An understanding of the reasons why demand for beer has changed so rapidly in recent years also sheds light on possible explanations for the greater change in consumer demand taking place across many industries.

One of the most notable changes in the beer industry as a result of the trend towards more localized products is the number of producers in the market. This study uses data for the number of brewery permits issued by the Alcohol Tobacco Tax and Trade Bureau (TTB) in each state from 1994-2014 as a means of quantifying the number of craft producers throughout the country. For years, the most profitable breweries have tended towards consolidation and increasing the scale of operations to reduce the cost of production and increase market share, resulting in a great reduction in the number of breweries throughout the country. The advent of craft brewing has slowly increased the number of breweries, and in recent years the numbers have grown at an unprecedented rate. Growth is not exclusive to any one particular region, but is a phenomenon that is taking place in nearly every state, indicating a nationwide increase in the popularity of craft beer. In order to better understand the types of consumers that have contributed to the increased demand for craft beer, the study looks at state level characteristics associated with the rise in the number of breweries.

The study also contains a particular focus on the role the increased use of the Internet by both producers and consumers has had on the structure of the industry. Data from Google's analytic tool Google Trends, including the frequency of search for "craft beer" and other relevant terms, has also been included to better understand the influence Internet search trends have had on the demand for beer. Mass producers have traditionally relied on extensive spending on advertising and marketing to create an image associated with their brands to account for products that are almost identical to the offerings of competitors. Craft brands have taken an entirely different

approach, relying heavily on the rich tradition of brewing and the myriad of different beers that history has to offer to compensate for their limited budgets and high costs relative to mass producers. The rise of the Internet has made this strategy more effective than ever, since brands can reach a global audience at incredibly low costs. Advertising through the Internet also allows for extremely specialized marketing, and firms can target a particular segment of customers with greater ease than any other time in history. Consumers are increasingly using information available online as a means of researching potential purchases, which decreases the risk associated with trying new products. There is likely a correlation between the increased availability and use of the Internet and the recent rise in demand for craft beer.

As a way of understanding the forces that have inspired the recent change in demand within the beer industry, this study uses a fixed effect regression to correlate the number of breweries in a state to the area's demographic makeup, including income, the number of young adults, and population. An understanding of the types of consumers associated with the most recent spike in demand for craft beer provides valuable insight into the types of consumers that have motivated the change in demand to value more localized and specialized products. The study also uses a fixed effect regression that includes Google Trends data to explore the hypothesis that the Internet has played a vital role in the change in demand, by analyzing the correlation between online search behavior and the number of breweries. Analysis is compared before and after 2008, since when the number of breweries has been rapidly increasing, to see changes in demographic that may have contributed to the most recent increase in demand.

Findings show the demographics associated with high concentrations of breweries have changed greatly since demand for craft beer has significantly increased. Prior to 2008, there was a negative correlation between a state's median annual household income and the number of

breweries, as well as the population of young adults age 20 to 29 and the number of breweries. After 2008, the number of breweries is found to be positively correlated with a state's income level and the population of young adults. There is also a correlation between the number of breweries in the United States and the increased use of the Internet to research the term "craft beer" and reviews for beer. While there is no evidence of causality between Internet usage and the rise of craft beer, findings suggest the Craft Brew Revolution has been facilitated by the Internet's ability to attract a new demographic of clientele to the industry. The increased appeal of craft brands to younger consumers with higher income levels is found to be one of the main driving forces behind the recent rise in demand for craft beers. Based on the evidence, it is also likely these consumers are the demographics that have inspired the recent rise in demand for more local and specialized goods.

This study makes numerous contributions to current literature. As one of the first studies to examine the demographics associated with the increase of craft breweries, this paper provides insight into the types of consumers who have gravitated towards the craft segment. This study is also one of the first to explore the role the Internet has had on the recent change in demand. While previous work has explored the correlation between the use of the Internet and the performance of craft brands (Clemons et al., 2006), none have looked into the effect increased use of the Internet has had on the industry as a whole

The structure of the rest of the paper is as follows: Section 2 summarizes the history of beer in the United States. Section 3 reviews literature related to the beer industry, with a particular focus on the rise in popularity of craft brands. Section 4 outlines the data collected for this study. Section 5 explains the methodology and means of analysis. Section 6 reports the results of empirical

analysis. Section 7 discusses the findings and their implication. Section 8 provides concluding remarks, as well as the limitations of the study and suggestions for future research.

## **II. History of Beer in the United States**

In order to better understand the current changes taking place in the industry for beer, one must know the history of beer in the United States and the evolution of the industry. This section will summarize the history of the United States beer industry and the recent rise of craft brewers.

Beer has been a component of the American way of life since the pilgrims first settled in Plymouth Rock in 1620. With the original intention of landing in Virginia, the pilgrims changed their route to the shores of Massachusetts due to a depletion in supplies, particularly beer, as noted in a pilgrim diary that reads “Our victuals are being much spent, especially our beer” (Elzinga, 2013). The process of brewing as it is known today did not originate until the middle of the nineteenth century with the influx of German immigrants, who were extremely knowledgeable of the art of brewing.

In 1919 the eighteenth amendment was ratified, banning the manufacture, sale, and transportation of intoxicating beverages within the United States. Prohibition resulted in the closing of many breweries throughout the country, and planted the seeds for the current structure of the industry. The twenty-first amendment in April of 1933 repealed the prohibition of alcohol, with only thirty-one breweries remaining in the country, including current market leader Anheuser-Busch. By 1934 the number of breweries increased rapidly to 756, but 100 of these breweries closed within five years (Elzinga, 2013). The trend towards a decrease in the number of breweries continued for decades, with major breweries producing larger quantities and distributing to a wider market.



The tendency towards mass production and widespread distribution paved the way for the emergence of the craft segment, which was pioneered by Fritz Maytag in 1965. Maytag, heir to the Maytag appliance company, purchased a controlling share of the producers of his favorite beer, Anchor Brewing, when he learned the company was planning to shut down. Since the small operation could never compete with major producers as far as costs, he knew he would have to charge a price higher than the competition. Maytag devoted himself to learning the craft of brewing in order to make a product so superior in quality consumers would be willing to pay the premium price. Maytag's mentality is the foundational inspiration for the many craft breweries that would follow in years to come.

The craft segment also greatly benefited from a new piece of legislation passed by President Jimmy Carter in 1976 that legalized home brewing throughout the country (Murray 2012), which opened a new outlet besides traditional breweries where aspiring brewers could learn and gain experience with the brewing process. This change facilitated the entry of new firms into the market, and in many ways made the Craft Brew Revolution that is taking place today possible. During the 1980's, the craft segment of the industry experienced significant growth with the opening of many new breweries as a result of the legalization of home brewing. In 1975 there was only one specialty brewery in the country, but by 1990 that number rose to 269 (Elzinga, 2013). With a more widespread understanding of the potential for better quality and variety in the market for beer, craft brewers began to promote the benefits of the new styles being introduced and the reasons for the premium price.

While the beginning of the Craft Brew Revolution was just taking root, larger producers throughout the country were moving in a completely different direction. As the number of craft breweries was increasing, the number of traditional breweries was decreasing at an alarming rate.

In 1965, when the first craft brand began its operation, there were 126 traditional breweries in operation. By the end of the 1980's, that number had dropped to 29 (Elzinga, 2013). The traditional producers that continued to operate were gaining market share at an unprecedented rate by focusing on marketing campaigns that establish an identity for their products, and differentiated themselves based on brand image. The massive advantage in budgets for advertising held by larger firms left smaller brands unable to compete, resulting in the closing of many breweries in competition with dominant brands. The strategy has continued to be employed even in modern times, and serves as one of the greatest differentiators between the craft and domestic segments of the industry.

Craft brands turned to an alternative form of advertising to traditional media outlets to account for their limited advertising budgets. Craft brands have traditionally relied on organic advertising and word of mouth to promote their products, the most influential medium in recent years being the Internet. Through the worldwide web, craft brands are able to advertise at a portion of the cost incurred through traditional advertising mediums, such as television. Rather than spend the high price of traditional media streams to develop an image associated with a particular beer, craft brands have used the Internet to spread information about the products they offer and how they differ from alternatives in the market. The approach allows consumers to learn more about the product they are contemplating and the reason for the premium price, which in turn reduces the risk associated with trying a new product. Current trends suggest the craft beer sector will continue to grow in years to come even though overall demand for beer continues to decrease. Craft and imported beer sales in the United States grew significantly in 2015, at a rate of 12.8 and 6.2 percent, and represent 12.2 and 15.9 percent, respectively, of total beer production. Despite growth, domestic brands still dominate the market with 71.9 percent of total production (Brewer's Association).

The history and nature of the beer industry justify the use of brewery count by state as a measure of a regions affinity for craft beer. Large producers operate on a grand scale, and the number of breweries they operate is relatively minimal compared to the total number of breweries in the country. In 2005, there were a total of 21 traditional breweries throughout the country, a mere 1.5 percent of the grand total of 1,367 breweries (Elzinga, 2013). Since the middle of the twentieth century, almost all of the new breweries have been established by import or craft brands.

### **III. Literature Review**

Literature relevant to craft beer is abundant and can be divided into three categories: possible reasons for the rise of craft beer, elasticity of demand for beer, and the Internet's effect on the number of craft breweries.

#### Possible Reasons for the Rise of Craft Beer

Analysis of current literature regarding the beer industry gives rise to possible explanations for the recent growth of the craft segment. One possibility is that craft brands offer variety in a market trending towards commoditization. The major advantages in costs of production held by larger producers have reduced the number of firms in the industry, as well as the number of offerings available to consumers. Economic knowledge has long known variety is a major contributor to welfare in the market, especially in regards to international trade (Broda and Weinstein, 2004). Broda and Weinstein (2004) showed how the introduction of variety has contributed to welfare within the United States by reducing the price of imports. According to their argument, if consumers wish to attain, variety but the country cannot provide such variety due to limitations in the cost of production, the country benefits from the increased number of offerings made available through international trade. Their study uses disaggregated import data from 1972-2001 to estimate

the effect that increased variety has on welfare by constructing an aggregate price index and estimating what prices would have been without the introduction of alternatives. Results find prices have decreased 1.2 percent faster per year than they would have with without variety, and suggest the introduction of variety does in fact improve welfare.

Contrary to what would be expected from the results of Broda and Weinstein (2004), the introduction of variety to the market for beer has resulted in an increased price for those wishing to experience substitutes. The contradiction shows how price is only one measure of value, and consumers consider many other factors that contribute to their welfare. If a product is specialized to meet individual demands, then it could potentially be more valuable to a consumer than a cheaper alternative. In this type of situation, price becomes less significant when comparing the value of different goods. A product that is more in line with a particular set of demands will be seen as more valuable than any other product, and the consumer may be willing to pay a higher price.

The increased use of online search to make informed purchasing decisions has greatly reduced the risk associated with paying a premium to experience variety. Consumers can research, compare, and review a particular beer before even realizing the product's effect. Clemons et al. (2006) explores the effect increased use of online reviews has had on craft brewery sales by comparing the relationship between online reviews for individual beers and company sales data. The study builds off the understanding of a relationship between information availability and product proliferation to show how with an increased variety of products available in the market, the informedness of the consumer is a decisive factor in determining his or her willingness-to-pay (Clemons et al., 2006). In order to account for the premium associated with differentiation, the customer must have more access to information that informs the decision making process. Online

reviews provide consumers with the confidence to know a premium product is worth the increased price. Data used for the study consists of online reviews from Ratebeer.com from 2000-2004 and sales data from the Association of Brewers for 300 craft breweries from 2000-2003. An OLS regression is used comparing sales growth to the mean and standard deviation of online ratings, as well as a few other control variables. The findings reveal a significant correlation between the mean of ratings for particular beers and sales growth for the producer. The results also suggest the dispersion of ratings is as important as the mean for premium priced products, and a company stands to experience greater benefits by offering a product that some consumers love as opposed to a product that a wider range of consumers moderately enjoy (Celmons et al., 2006). Online reviews have helped to create a market for differentiated products that appeal to a specific consumer as long as they are well enough informed about the difference.

The data used for the study does provide some limitations that prevent me from following their idea for this study. The online reviews used are for specific beers while sales data is for the company as a whole. The discontinuity means there is no way to distinguish whether sales grew as a result of positive reviews or vice versa. The authors are even sure to explicitly state they do not want to claim that the Internet has made a contribution to the growth of craft beer, rather that brands within the craft beer industry have utilized the Internet to establish themselves and induce growth (Clemons et al., 2006). This does not mean future research could not explore if the Internet has contributed to the growth of craft beer, just that the conclusion could not be justified by the data and approach being used. If future research were to examine the effect the Internet has had on craft beer sales, it could provide insight into the way increased information availability has influenced consumer demand.

### Elasticity of Demand for Beer

With the increased amount of information available to consumers, changes in consumer preference should reflect a decrease in price elasticity for informed consumers. There is a great deal of current literature that explores elasticities associated with demand for beer that provide insight into the current state of the market. Some discrepancies do exist between studies, but an understanding of these differences sheds light on how information availability can influence a consumer's willingness-to-pay.

Bray et al (2009) estimates package-specific, own- and cross-price elasticities of demand for beer to explore the effect volume-based discounts have on sales. The study uses supermarket scanner data from InfoScan Retail Tracking covering 64 United States markets from 1995-1999 for the top 100 selling individual beer varieties. Use of supermarket data means the findings only represent a very specific segment of the market, since a great majority of craft brands are rarely found on supermarket shelves. The data is further refined to only include top selling brands available in every market included in the study, so the final data only considers 25 brands. The brands included are exclusively domestics and imports, so findings only shed light on the behavior of non-craft beer consumers. Using standard consumer demand theory and the theory of rational addiction, the study estimates a regression with sales as a function of price, package size, and available substitutes. The results find demand for a specific brand is highly price elastic, while cross price elasticities were often greater than one (Bray et al., 2009). Findings suggest consumers are reluctant to try new brands no matter what the price, but will change the quantity purchased of their favorite brand in order to receive the lowest price. Variety is of no concern and consumers want the greatest quantity for the lowest price. One interesting finding was that the volume sold decreased when prices were standardized to match the price of 12 or 24-packs, which suggests

consumption of non-craft beers is not driven by individual desire but a need to maximize the value of a purchase. If this is the case, the market does not seem concerned with variety and will consume a particular product at a quantity that carries the lowest price.

The need to find the lowest price is completely understandable if a consumer has no other indicator of value, but price alone cannot adequately portray value to every customer. A lower price may lead a consumer to consider a product, but an informed consumer will seek additional information before proceeding with a purchase. As the availability of information expands and consumers can tailor purchases to better fit individual demand, one should not be surprised if customers become more willing to pay a premium for a product believed to offer greater value. The phenomenon shows how the introduction of variety can increase prices while still increasing consumer welfare. Customers may not be getting the cheapest product on the market, but the good is seen as a better value in the end.

More recent studies regarding elasticity of demand for beer seem to better understand how consumers of craft beers respond differently to price fluctuations. Toro-Gonzalez et al. (2014) proposes there are horizontally differentiated products within the market for beer that respond differently to changes in price. Their approach follows a similar structure as Bray et al (2009), but distinguishes between the separate markets for craft, imported, and domestic products. The study uses scanner data from Dominick's supermarket in Chicago from 1991-1997, and includes all 12-ounce unit sales including domestic, import, and craft beers, a much wider array of products than in Bray et al. (2009). Using a utility function that assumes utility varies as a function of price per unit, product characteristics, and consumer's tastes as a basis, the study estimates own-price, cross-price, and income elasticities for each of the 3 distinct markets for beer. Regression results shows demand for beer is inelastic in regards to price, and consumers do not substitute across the

horizontally differentiated markets (Toro-Gonzalez et al., 2014). Consumers of American lagers were found to be the least price responsive, which supports evidence that domestic consumers prefer brand loyalty over variety. Craft consumers were found to be more responsive to price, and willing to adjust the quantity consumed to account for changes in price. The results confirm the hypothesis that the decision to consume craft beer is driven by more than just price, and there are many other factors that indicate value for the consumer.

The study suffers from similar problems as Bray et al. (2009) in regards to the data used, likely due to the difficulties in collecting relevant data for this type of study. Data is limited to one chain of supermarkets in the Chicago area from nearly two decades before the time of the study. The findings cannot be taken as representations of the entire market, but do still provide progress in terms of understanding the market for beer. The data represents a similar time period as Bray et al. (2009), so comparing the two makes for a very interesting analysis of how the market changes when differences between consumers of craft, domestic, and imports are taken into consideration. Domestic producers are more driven by price, and tend to increase quantity purchased to receive a lower price. Bray et al. (2009) even mentions the effect this mentality has on society as a whole by highlighting the adverse effects associated with excessive alcohol consumption. Craft consumers seem to behave quite differently, and make decisions based on more information than simply price. The former market sees value in quantity; the latter sees value in choice.

An interesting point mentioned by Toro-Gonzalez et al. (2014) is how the increased demand for craft beer is consistent with a greater change in demand for the food industry as a whole, as consumers grow increasingly more interested in local products and a wider range of products and tastes. This change is especially noticeable among millennial consumers, who represent the first generation to have grown up during the Internet age. Millennials know more about a brand's story



and product attributes than previous generations ever did, which has created a unique set of demands. Price is no longer seen as the sole indicator of value, and people are willing to pay a premium to increase variety. The influx of millennials into the market for beer could very likely be one of the driving forces behind the changes in demand within the industry, and the effect will only intensify as younger generations reach legal drinking age.

### The Internet's Effect on Craft Beer Production

A study released in March of 2016 by XenoPsi, an independent marketing firm, confirms that consumers are increasingly using the Internet as means of informing purchasing decisions. The study found that the use of smartphones when at the shelf in a store is rising as one of the main factors that contribute to the purchasing decision made in retail outlets. The study was conducted through a 12-minute online survey, exclusive to adults over the age of 21, who own a smartphone and had purchased beer at a retail store within 2 weeks prior of taking the survey. Results found that 21 percent of respondents claimed using a smartphone to read about a beer online motivates the decision to purchase a product, the fourth most popular response behind a recommendation from a friend or family, the price, and a promotion in the store. While online information is not the most significant factor that goes into the decision making process, the types of consumers who confirmed this strategy in making a decision were, on average, younger consumers, which shows the use of the Internet when making decisions should only increase as time progresses. As younger generations reach legal drinking age, the use of smartphones at the shelf will likely become one of the main contributing factors to a decision. Smartphone users at the shelf were also found to be more affluent, more likely to try new brands or styles, and to prefer craft brands. These findings seem to confirm the hypothesis that the increased availability of information on the Internet has reduced the risk associated with paying a premium for craft brands.

The main limitation of the study is the type of consumer that is taken into consideration. Since respondents must own a smartphone, they represent a clientele that is more technologically connected. They were also willing to complete a 12-minute survey about the process of purchasing beer, so are most likely consumers that are more passionate about beer. The findings do not accurately capture the mentality of the entire market for beer, but rather more technologically advanced consumers who are relatively more invested in their consumption of beer. Despite these flaws, the study does provide convincing evidence that the Internet is rising as a means for consumers to decide which beer seems the best fit for their needs, and consumers who use the Internet in the decision making process gravitate towards craft brands.

In order to further explore the effect of the Internet and increased availability of information on demand for beer, one must find some way to measure online activity. Stephens-Davidowitz (2014) utilizes a unique approach to measure such activity, which is the use of Google Search data to analyze trends among users. His study uses search data to estimate the effect racial animus had on voter behavior during the 2008 presidential election. Since there are many difficulties with collecting data regarding individual bias, such as the fact people tend to lie on surveys, there is no easy way to quantify a particular regions racial animus. By analyzing online search data, researchers are able to see patterns among specific regions and develop an understanding of cultural trends. The study analyzes the frequency of a number of racially charged search terms within a specific region from 2004-2007, and finds each region's racially charged search rate. The rate is then compared to Barack Obama's vote shares in 2008, using results from the John Kerry election in 2004 as a proxy, to see the effect racial animus played in voters' decisions. Results indicate that there is a correlation between an area's racially charged search rate and voting behavior. There was a negative correlation between the rate and Obama's vote share in 2008, with

a 1.5 percentage point decrease in vote share with every standard deviation increase in the rate. Results were then compared to the 2012 election, and confirmed a similar pattern that suggests racial animus had a negative impact on Obama's vote share. While there are some flaws with the method, a major one being that there are many unaccounted for factors that may have influenced changes in voter share, the findings do successfully show how search data can be used to model trends within a specific region.

The method could easily be adjusted to examine the influence online search trends have had on the number of craft breweries. I propose that the recent increase in demand for craft beer has been driven by increased use of Internet resources to guide purchasing decisions. As consumers begin to use the Internet to research products, they become more informed about the product being considered as well as alternatives in the market. With an increase in information comes an increased array of demands, and craft brands have learned to use the Internet as a cost effective marketing platform that can share the information they hope to convey to consumers. As an area's frequency of searches related to craft beer increases, there should be an increase in demand for craft brands. This approach will show if the increased availability and use of the Internet to consumers have contributed to the rise in the number of breweries.

Current literature on the beer industry is abundant in regards to the structure of the market, especially in regards to elasticity, but there is a lack of research that explores the driving forces behind the change in demand within the market. The factors that affect demand for beer seem to vary depending on the market being considered. For domestic beers, price and associations with the brand are the most decisive factors. Consumers will buy more if there is potential to receive a lower price for their favorite brand, so producers have been motivated to reduce costs and minimize the variety of products offered. The lack of variety has created a segment of the market willing to

pay a higher price to experience different products, as seen with the horizontally differentiated segments observed in Gonzalez et al. (2014). Craft consumers seem heavily influenced by information available on the Internet when making a purchase, and the widespread use of the Internet and smartphones may be associated with the rise of the craft segment. Consumers who are more technologically connected also seem to have different buying habits than traditional beer consumers. In order to further explore the types of consumers that have influenced the rise of craft beer, I will look at the influence demographic variables and online search trends have had on demand for beer. To my knowledge, this will be one of the first studies to analyze the demographics associated with the change in demand. The change parallels a greater shift in consumer preference occurring in many industries, and an understanding of the forces behind the Craft Brew Revolution could provide a better understanding of why this change is taking place.

#### **IV. Data**

The Alcohol and Tobacco Tax and Trade Bureau (TTB) provided data for the number of breweries from 1994-2014. While the statistics are not exclusive to craft breweries, they do provide excellent insight into the increased number of firms entering the industry. Domestic producers rely on economies of scale to minimize the cost of production and maintain low prices, and do so by producing large batches in a small number of facilities. In 2005, large producers accounted for less than two percent of the total number of breweries in the United States (Elzinga, 2013). Craft producers on the other hand, pride themselves on production in smaller batches to maintain the quality of the product. Breweries often start with limited production capacity, and expand as demand increases. It is not uncommon for firms to open additional breweries with relatively limited production capacity compared to domestic competitors in areas throughout the country

where demand is high and shipping is expensive in order to expand distribution while maintaining the integrity of the product. Due to the nature of the industry, an increase in the number of breweries is seen as a signal for increased demand for craft beer in a particular region.

The total number of breweries in the United States ranges from 682 in 1994 to 4,938 in 2014. Brewery count increases across every year in consideration, except for a consistent decrease from 2000 through 2003, and 2005. The number of new breweries each year increases from 2009 to 2014, with the sharpest increases from 2010 to 2014. Over these five years, there is an average of 562 new breweries every year. There is also a period of significant increase from 1994 to 1998, but this growth is followed by a general decrease over the next six years. At the state level, the number ranges from three to 654, excluding the seven states with no breweries in 1994. By 1998 every state except Missouri contained at least three breweries. Before 2008, the number ranged from three to 310. By 2014 every state contained a number of breweries, with the minimum being 10 in North Dakota and Missouri. California has consistently led the country in the number of breweries, with 127 in 1994 and 654 in 2014. 48 states had under 55 breweries in 1994, but by 2014 over half of the states had more than 50 breweries, 16 containing over 100. The numbers show how many breweries have opened in the recent decades, and how widespread the growth has been.

Demographic data was collected from the United States Census Bureau, and includes median household income and population estimates at the state level. Data regarding median household income was only available through 2013. Since the legal drinking age in the United States is 21, population data is restricted to focus mainly on the population of adults of legal age. Due to difficulties in collecting the exact population estimates for adults who are 21 and older, the estimations of population used are for individuals age 20 and older. In order to quantify the number

of young adults in each state, which this study, along with current literature, believes is a contributing factor to the growth of craft breweries in an area, data was also collected on the number of individuals in each state between the ages of 20 and 29. The United States Census Bureau only provides data separated between age ranges, and no data set was available exclusively for population between the ages of 20 and 29. To account for this, data was collected for population estimates between the ages of 20 and 25, in addition to estimates for state's population between the ages 26 and 29. The two sets of data were then combined using the sum function in Microsoft Excel.

As a means of measuring the online tendencies of consumers, data for specific search terms was provided by Google's analytic service Google Trends. The service measures the frequency of selected search terms relative to the total number of user searches in the selected region over the given time. Data includes the frequency of search for the term "craft beer" in states with data available from 2004-2014. This data was of limited availability and could only be located for a total of 29 states. Google adjusts the data by region to allow for the comparison of search frequency across terms for a given region and time. To do so, Google takes the frequency of search for the selected term and scales the data according to the total number of searches made for the region and time period in consideration. The measurement is then scaled on a scale from zero to 100, zero being the lowest search frequency and 100 being the highest. Reports are only available for a single state at a time, so data sets were acquired individually and later combined in Microsoft Excel. Data is tracked and scaled on a weekly basis, which is not compatible with the annual numbers used throughout the rest of the study. To compensate for this difference, the annual search frequency was found by averaging the annual weekly frequency for each state using pivot tables in Microsoft Excel. Due to the method employed by Google in scaling the data, making comparisons across

states is very difficult and not necessarily accurate. The scale varies depending on the total number of searches in the given region, which likely varies greatly across different regions. This difficulty was disregarded for the sake of this analysis.

## V. Methodology

Empirical analysis was performed using 2 separate fixed effect regressions that correlate the number of breweries in a state for the given year to demographic variables, while controlling for population. The first regression, Regression 1, tests for the correlation between the number of breweries and demographic variables for each state. The second regression, Regression 2, performs a similar test with the addition of a variable to measure online search behavior for each state.

Regression 1 can be represented as:

$$(1) \quad \ln \text{Breweries} = \beta_0 + \beta_1 * \ln \text{Income} + \beta_2 * \ln \text{YoungAdults} + \beta_3 * \ln \text{Population} + \beta_4 * \text{DummyYear} + \varepsilon,$$

where  $\ln \text{Breweries}$  is the log of the number of breweries in a state,  $\ln \text{Income}$  is the log of the average annual household income for a state,  $\ln \text{YoungAdults}$  is the log of the population age twenty to thirty years old for a state,  $\ln \text{Population}$  is the log of a state's total population age twenty and older to control for the number of legal drinkers in the state, and  $\text{DummyYear}$  is a dummy variable used to control for the general increase in the number of breweries over time. Since data was collected in numeric form, the log was calculated by generating a variable in Stata. The variables I am concerned with are  $\beta_1$  and  $\beta_2$ , which measure the effect income and the number of young adults, respectively, has on the number of breweries in a state. I estimate there to be no correlation between income and the number of breweries ( $\beta_1$ ), since the rise in demand for craft beer is not the result of wealthier consumers beginning to buy craft brands, but because of a change in

consumer preference. I believe there will be a significant positive correlation between the number of young adults in a state and the number of breweries ( $\beta_2$ ), since millennial consumers are believed to be a contributing factor in the evolution in consumer demand to favor smaller, more localized brands. States with a greater population of young adults, thus more millennial consumers, should have a greater number of craft breweries.

Since there has been an incredibly rapid rise in the number of breweries since the year 2009, the regression was also performed over two separate time periods: 1994-2007 and 2008-2014. For reasons discussed further in the results section, the period of growth known as the “Craft Brew Revolution” mainly refers to growth after 2008. Regression results from the two time periods were then compared using a two-sample t-test.

Since I hypothesize the increased use of the Internet has been a contributing factor to the growth in craft breweries, since producers use the web as a means to advertise their products and consumers use it to make more informed purchases, a second fixed effect regression is used to examine the correlation between online search patterns and the popularity of craft beer in a given region, while still accounting for the demographic variables in consideration. Regression 2 is structured similarly to the one above, with the addition of a term to account for Google Trends data related to craft beer. The regression can be represented as:

$$(2) \lnBreweries = \alpha_0 + \alpha_1*\lnIncome + \alpha_2*\lnYoungAdults + \alpha_3*GoogleTrend + \alpha_4*\lnPopulation + \alpha_5*DummyYear + \varepsilon,$$

where  $\lnBreweries$ ,  $\lnIncome$ ,  $\lnYoungAdults$ ,  $\lnPopulation$ , and  $DummyYear$  represent the same variables as in Regression 1, and  $GoogleTrend$  is the scaled frequency of Google searches for “craft beer” within a state. For this regression, I am concerned with terms  $\alpha_1$ ,  $\alpha_2$ , and  $\alpha_3$ .  $\alpha_1$  and  $\alpha_2$  are the same as  $\beta_1$  and  $\beta_2$  in the Regression 1, measuring the correlation between the number of



breweries to income and the population of young adults, respectively. I expect there to be no significance for  $\alpha_1$  and a significant positive number for  $\alpha_2$ , for the same reasons as were presented for Regression 1.  $\alpha_3$  is a measure of the correlation between a state's scaled search frequency for "craft beer" and the number of breweries. Since I believe the increased use of the Internet to inform purchasing decisions has inspired more consumers to purchase craft beers, I expect there to be a positive correlation between a state's frequency of Google searches for "craft beer" and the number of breweries ( $\alpha_3$ ). This regression was also performed over two separate periods, 2004-2007 and 2008-2014, for the same reasons as explained for Regression 1, and results from the two periods were compared with a two sample T-Test.

To further understand the Internet's influence on the number of breweries in the United States, a graphical analysis of the correlation between the search frequency for several search terms related to craft beer from 2004-2015 in the United States and the number of breweries was also performed. To explore the early phase of the tendency away from large-scale brewers, searches for the terms "microbrewery" and "brewpub" were compared to "craft beer". These terms were selected because they are often used interchangeably to describe what we have referred to throughout this paper as craft beer. Microbrewery is another way of describing craft beer that was more widely used in the earlier days of craft brewing, and the term represents a more classic way of describing the craft segment. A brewpub is a place where food is served with on-premise consumption of beers that are produced by the restaurant, often with the brewery located in the same facility as the restaurant (Elzinga, 2013). As a way of exploring the hypothesis that there is a correlation between the increased use of the Internet to inform purchasing decisions and the rise of craft beer, data was collected analyzing search frequency for "beer reviews" and "brewery reviews", since searches

for these terms suggest online users are using the Internet to learn more about the value offered by different beers and breweries.

Frequency of search for the term “farmer’s market” was also analyzed in comparison to craft beer, since the increased popularity of farmer’s markets is attributed to the change in consumer preference in the food industry that has been mentioned throughout this paper. The comparison of these two terms is meant to see if the behavior of online consumers across these two markets bear some similarities, and the possibility that the recent rise of craft beer parallels the greater trend towards more localized and regional products.

The frequency of search for these terms was analyzed using the Google Trends webpage, and the resulting graphs were recorded as a source of data. Graphical analysis is performed using the application provided on Google Trends’ website.<sup>1</sup> The site provides a visual representation of the scaled frequency for each search over the time period in consideration. Since the visualizations cannot be downloaded, the image was captured using a screenshot. The data provided was then analyzed using visual analysis to further understand trends.

## **VI. Results**

Results from the analysis vary between the two regressions, but provide similar insight when comparing results before and after the year 2008. Findings suggest higher income consumers and the increase of millennials reaching legal drinking age have driven the recent rise in demand for craft breweries. This section will first summarize results from the graphical component of analysis and the results for Regressions 1 and 2.

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<sup>1</sup> <https://www.google.com/trends/>

Graph 1 shows the total number of breweries in the United States from 1994-2014. There is a significant increase from 1994-1998, but growth flattens through 2009. Since 2009, the number of breweries has consistently increased at an exponential rate. When these numbers are compared to Google Trends data for searches for “craft beer” in Graph 2, there is seen to be an interesting correlation between an increased search for “craft beer” and the number of breweries. While these results do not imply the Internet had any role in the rise in number of breweries, the comparison to searches for microbrewery and brewpub show that the craft beer movement since 2009 is different from the traditional mentality towards small producers. Terms microbrew and brewpub have had relatively constant search frequency since 2004, and actually outnumber searches for craft beer until around 2008. After 2008, there is a great increase in the frequency of search for craft beer. This increase shows there is some similarity between the use of the term craft beer and the number of breweries, which suggests the recent rise in demand is driven by a different demographic than those who originally gravitated towards the craft segment. Graph 2 also shows seasonality in searches, with consistent spikes in the month of May. Seasonality is most likely explained by the fact American Craft Beer Week, an annual celebration throughout the United States, is held in May. Increased searches for “craft beer” during this time are possibly due to individuals who are unfamiliar with the term, and want to learn more after seeing it used in restaurants and other locations. Seasonality shows searches for “craft beer” are not a consistent phenomenon, and may reflect new potential consumers who are just becoming exposed to the term.

Data from Google Trends also shows an increase in the use of search engines as a means of finding reviews for specific beers and breweries, providing some evidence that the Internet has allowed consumers to make more informed purchasing decisions. Graph 3 shows the frequency of Google searches for the terms “beer reviews” and “brewery reviews”. Searches for “beer reviews”

declined from 2004 through 2007, with the exception of a large increase in September of 2006. Starting in 2007, the number of searches begins to increase significantly through 2011. An interesting point to note is that the rise in searches for “beer reviews” in 2007 coincides with the release of Apple’s iPhone, which many consider to be one of the smartphones to have a web browser that was intuitive enough to be widely used by general consumers.<sup>2</sup> This could likely signal the dawn of consumers using smartphones to inform decisions regarding beer purchases. Since 2011, the trend has been towards a reduced number of searches for “beer reviews”, likely due to the increased use of mobile applications as a means of reviewing and researching beers. Untappd is a mobile application that allows consumers to track and review beers they consume over time, and also includes a social media component that enables users to share their opinions across a vast network of fellow beer drinkers. Graph 4 shows the frequency of Google searches in the United States for “Untappd”, which has increased steadily since the applications release in October of 2010. The correlation between an increase in searches for “Untappd” and a decrease in searches for “beer reviews” supports the hypothesis that consumers are increasingly using mobile applications as a means of reviewing beer purchases, and the Internet is still rising as a means of informing purchasing decisions.

The seasonality of search trends for “beer reviews” and “Untappd” also provides interesting insight into the types of consumers that search the different terms. Since 2007, searches for “beer reviews” have consistently increased in December, likely to inform the purchase of specialty

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<sup>2</sup> Sass, J. (2011, June 28). The iPhone Turns Four: How It Has Changed Us. *Forbes*. Retrieved from <http://www.forbes.com/sites/forbesleadershipforum/2011/06/28/the-iphone-turns-four-how-it-has-changed-us/#693b6228309c>

products for gatherings during the holiday season. Searches for Untappd are more constant, but show a relatively consistent increase in the months of July and August, likely due to increased consumption during the summer months. The differences in seasonality suggest searches for “beer reviews” are performed by consumers looking to purchase a unique product during a specific time of the year, while more consistent consumers perform searches for “Untappd”. As more Internet users become consistent craft beer consumers, one would expect a decrease in seasonal search trends and more consistent searches.

Search trends for “brewery reviews” show more consistency in recent years than those for “beer reviews”, and seasonality reaches a peak in the summer months of July and August. Search frequency also decreased from 2004 through 2006, but has consistently risen from 2007 to the present, likely because search engines remain the primary means of researching information on breweries. An interesting difference is observed when the search term is changed to “local breweries”, since search frequency declines through 2008. When the term “local” is added, the data comes to more closely resemble the trend in the number of breweries throughout the United States, increasing greatly from 2009 through the present. These results support the possibility that there is a correlation between consumers driven by the term “local” and increased demand for craft breweries.

Graph 5 shows the scaled frequency of Google searches for Farmer’s Market compared to searches for craft beer. The spikes in data are due to the seasonality of farmer’s markets, which can only operate in warmer times of the year due to weather restrictions. Searches for farmer’s markets have been increasing relatively steadily since 2004, while craft beer has only seen significant growth since 2009. The results suggest the food industry has been experiencing a continual trend towards a preference for local products, which could have influenced consumers

who have recently gravitated towards the craft segment. While there is no definitive evidence to validate this claim, the results lead me to believe the shift in consumer preference within the food industry has influenced buying patterns in the beer industry, hence the delay between rising local food searches and the rise of craft beer searches.

Results from Regression 1 vary when different periods of time are considered, which suggests the demographic of craft beer consumers has changed greatly since 2007. Table 7 shows the results from Regression 1 over the period from 1994-2014, and finds a significant negative correlation between median annual household income and the number of breweries in a state ( $\beta_1$ ). For every 1 percent increase in annual income within a state, the number of breweries decreases by 32.3 percent. While there is no significance between brewery count and the population of young adults age 20-29 ( $\beta_2$ ), the negative coefficient suggests young adults are not a demographic that heavily consumes craft beer.

Similar results are found when examining the period from 1994-2007 (Table 8), with the number of breweries having a negative correlation with annual income and the population of young adults ( $\beta_1$  and  $\beta_2$ ). Only income is found to have a significant correlation, with a 36.3 percent decrease in breweries with every 1 percent increase in annual income. Results differ greatly when considering the period from 2008-2014 (Table 9), with a significant positive correlation between the population of young adults and the number of breweries in a state ( $\beta_2$ ). Results suggest millennials have played a huge role in the increased number of craft breweries over this time, with a 111.6 percent increase in the number of breweries with every percentage increase in population of young adults. While no significance is found, this period also shows a positive correlation a state's income and the number of breweries ( $\beta_1$ ). Results from the two sample T-test between these two periods find values of 45.288 for annual income and 61.438 for population of young adults,

confirming significant variation between the two samples. Although these values are extremely high, they are understandable considering the difference between signs for the two samples and the large number of observations.

Results from the Regression 2, which accounts for data from Google Trends, find somewhat different results from Regression 1 when the entire period of data from 2004-2014 is considered (Table 10). Frequency of search for “craft beer” is not found to have any significant impact on the number of breweries in a state ( $\alpha_3$ ), but this could also be the result of limitations in the quality of Google Trends data, which will be discussed further in the discussion section. A significant positive correlation is found between median annual household income and the number of breweries in a state ( $\alpha_1$ ), with a 61.4 percent increase in number of breweries with every 1 percent increase in income. The difference is likely due to the limitation of the data set to only 29 states with sufficient Google Trends data, mostly being states with higher income levels. The mean of income for the data set for Regression 2 is 50,285 dollars, significantly higher than the mean of 44,112 dollars when all states are included. A significant negative correlation is found for population of young adults ( $\alpha_2$ ), with a 143.0 percent decrease in the number of breweries with every percentage increase in population of young adults.

A similar change in results as in Regression 1 is found when comparing the time period before and after 2008, which further confirms the Craft Brew Revolution is related to a new demographic of consumers demanding craft beers. From 2004-2007 (Table 11), a negative correlation is found between both income and population of young adults and the number of breweries ( $\alpha_1$  and  $\alpha_2$ ). Only young adults have a significant correlation with brewery count, decreasing by 251.2 percent with every percentage increase in population of young adults. A significant positive correlation is found between breweries and frequency of Google search for “craft beer” ( $\alpha_3$ ), but the coefficient

of 0.006 is of little significance when compared to results for other variables. Results from 2008-2014 (Table 12) find a positive correlation between both income and young adults and the number of breweries ( $\alpha_1$  and  $\alpha_2$ ), but only income is found to have significance, increasing the number of breweries by 46.4 percent with every percentage increase in income. T-test results between the two samples comparing the coefficients for income and young adults find values of 27.380 and 21.100, respectively, confirming the significant change in demographic that has taken place since 2008.

## VII. Discussion of Results

While there is a lack of quantitative evidence to confirm the Internet has played a role in the evolution of the beer industry, Google Trends data shows there is a correlation between online search trends and changes within the industry. The regression component of this study finds the growth of craft breweries since 2008 has concentrated around a different demographic than during previous periods. Breweries were traditionally located in lower income areas with an older population, but have recently moved to areas with a higher income and a greater population of young adults.

The correlation between an increase in the number of breweries and the rise in frequency of searches for the term “craft beer” (Graphs 1 and 2), while searches for “microbrew” and “brewpub” have remained relatively constant, supports the claim that craft brands have grown in recent years as a result of increased exposure to different segments of the market. The use of the Internet as a means of reviewing beers and potential purchases has also clearly increased in recent years, whether through review website or more personalized applications, a trend that parallels the increase in breweries throughout the country. The use of the Internet to review beers and breweries



has likely been facilitated by the widespread use of smartphones, and the difference between searches for “brewery reviews” and “local breweries” (Graph 5) provides further evidence the recent rise in demand for craft brands parallels the change in consumer demand to prefer more localized products. Craft breweries have been able to target a segment of the market willing to pay a premium price in order to purchase products that are more specialized to an individual’s preference. Although none of these results confirm causality that the use of the Internet has led to increased demand for craft brands, they do clearly show there is a correlation between use of the Internet and the rise of the craft segment.

Regression results provide strong evidence that the increased number of craft brands since 2008 is correlated to the market being able to reach a new segment of the population. Craft brands historically centered on an older population with lower income levels, but are now benefiting from the appeal to younger consumers and higher income areas. One likely explanation is the increased number of millennials reaching legal drinking age and having the ability to purchase beer. While it is true younger demographics are more price sensitive and may favor domestic brands, which offer greater quantities for a lower price, demand for craft brands should only intensify as millennials grow older and achieve higher levels of income. As craft brands gain more prominence in the general marketplace, it will be interesting to observe the buying habits of future generations as they reach legal age. Will these generations follow the trend of high consumption at a low cost or will they embody the craft mentality and decrease consumption to experience greater quality?

The appeal of craft beer to higher income levels is another interesting finding of this study, which is likely due to the ability of craft brands to compete with more expensive alternatives such as wine and liquor. Higher income levels have traditionally been known to consume less beer and greater quantities of alternatives, particularly wine. Since craft brands offer a wider variety of

products than domestic competitors, which almost exclusively sell variations of the American lager, craft beer can appeal to a wider range of palates. The high price associated with craft brands also contradicts the stigma of beer being associated with lower income and more blue collar demographics, which may have been a deterrent for consumption by some individuals of higher income levels. There are many 22-ounce bottles of craft beer that carry a price and alcohol content comparable to standard bottles of wine.

The lack of correlation between Google Trends data and the number of breweries is likely due to the difficulties associated with Google's method of scaling data within a state. Since the scaled data is a function of the total search volume within a state, it is nearly impossible to compare data across states. The total number of searches will vary from state to state, so the scaled value that is calculated has no true meaning when comparing the frequency of search between states. The inclusion of this regression is mainly a model of a potential strategy to correlate beer demand with online search trends, and raw data from Google would have to be used to obtain a meaningful result.

## **VIII. Conclusion**

Based on the findings of this study, the rise in demand for craft beer is most likely due to the ability of craft brands to appeal to new markets that are not traditionally associated with consumption of craft beer. Despite significant growth of the craft segment in the past decade, domestic brands still account for the vast majority of beer sales in the United States, which suggests the majority of beer drinkers have not changed their preference. Craft brands have likely grown because of their appeal to consumers with higher income levels who traditionally consume more expensive alternatives to beer, as well as less price sensitive millennial consumers who support

the local and non-corporate ideals promoted by craft brands. The growth of the Internet and more widespread use of smartphones have likely facilitated the ability to reach these segments of the market, by allowing for more cost effective and specialized marketing campaigns. Consumers also have a greater deal of information available when making purchasing decisions, which can reduce the risk associated with the premium paid for craft brands. Producers of craft beer should use these findings to further refine their marketing approaches. The Internet serves as a great medium to target higher income levels and millennial consumers who are more technologically connected than older generations, and can be utilized at a much lower expense than traditional media outlets dominated by domestic producers.

The results do not only apply to producers of beer, but also other industries that have seen a trend to favor more local and specialized products. The use of the Internet as a means of advertising allows small brands with limited budgets to target consumers that have the most potential to promote growth. Younger, more affluent consumers are willing to pay the premium associated with specialized products, and are often very exposed to Internet trends. The trend towards more localized products also serves to benefit lower income demographics, even though they cannot afford the premium associated with specialty brands. Changes among premium priced brands in the market often inspire changes within lower priced segments of the market, as these brands must find a way to increase quality to retain business from consumers with greater buying power. A great example of this effect is being seen in the market for fast food, where market leader McDonald's is pioneering foods without preservatives as a means of combatting losses in

revenue.<sup>3</sup> This change has also been realized in the beer industry, as domestic producers have increased their product offerings to compete with losses of market share to craft brands.

The key limitations of this study are the result of limited availability of data. While the number of breweries serves as a nice basis for a measuring the popularity of craft beer, it is far from a perfect metric. There are also difficulties with correlating the number of millennials with brewery count for an area, since millennials were not of legal drinking age until the year 2002. Even then, only a select portion of the millennial age group would have the ability to influence the market for beer, making studying their effect on the beer industry quite difficult. The limited availability of Google Trends statistics, due to Google's method of scaling the numbers and the fact data is only available for 29 states, leads to additional issues with studying the effect the Internet has played on the change in demand. Since analysis must account for the limited number of states with available data, it also provides some skewed results that do not provide accurate insight into the forces behind the entire market for beer.

Future research should look to use data that provides insight into not only the number of breweries, but also the amount of beer produced or purchased in each state. This type of analysis would provide a more robust picture of the amount of beer being consumed in each region, and not just the number of producers. Another possibility for future research could provide more insight into the demographics of consumers, and analyze the correlation between demand for craft beer and other factors rather than just income and the population of young adults, such as a state's political affiliation. Doing so could provide a better understanding of the exact demographics that have driven the Craft Brew Revolution. This approach could also be extended to other industries

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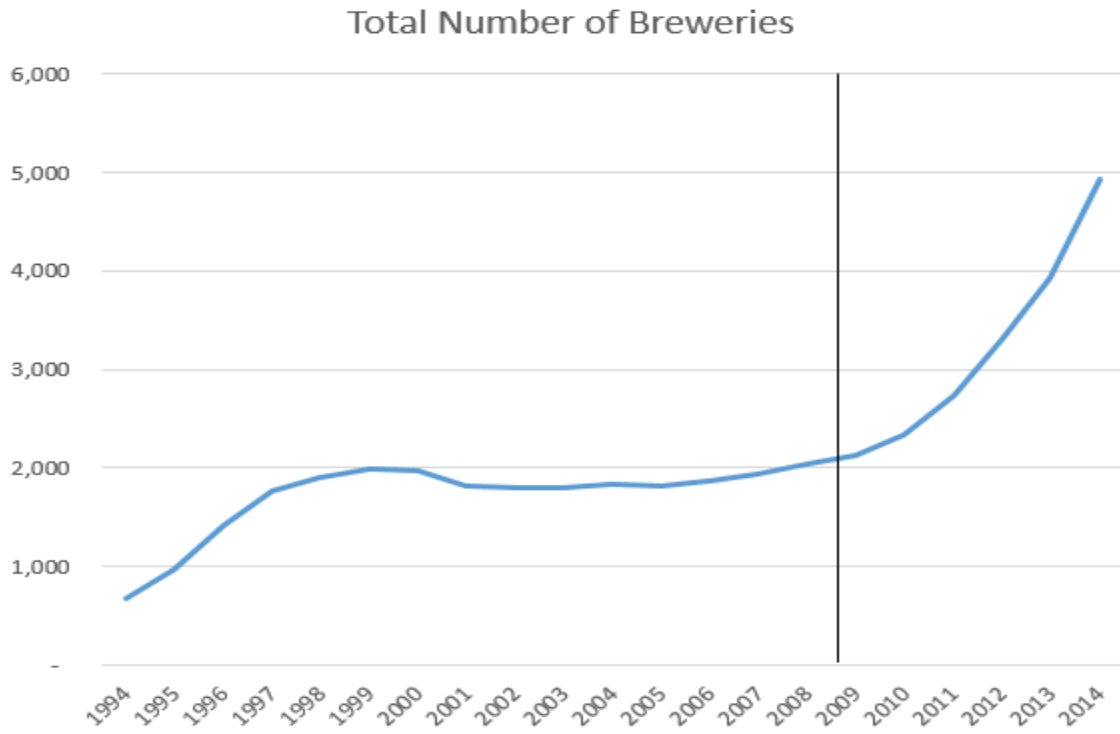
<sup>3</sup> Almendrala, A. (2016, April 29). McDonald's Is Stripping Artificial Preservatives From Their McNuggets. *Huffington Post*. Retrieved from [http://www.huffingtonpost.com/entry/mcdonalds-is-stripping-artificial-preservatives-from-the-mcnugget\\_us\\_5723a5eae4b01a5ebde58ff4](http://www.huffingtonpost.com/entry/mcdonalds-is-stripping-artificial-preservatives-from-the-mcnugget_us_5723a5eae4b01a5ebde58ff4)

besides beer that have seen a change in consumer demand with the rise of more localized products provided by smaller firms. One final direction would be to analyze the social impact of brewery openings in the surrounding region, to see what impacts the increased number of suppliers has had on the community as a whole. One possibility would be to study the number of arrests for driving while intoxicated in regions surrounding new breweries, another being the effect on employment and income for areas with new breweries. An analysis of the social impact would provide insight into future policies that should be enacted to account for the change in the structure of the industry.

# Appendix

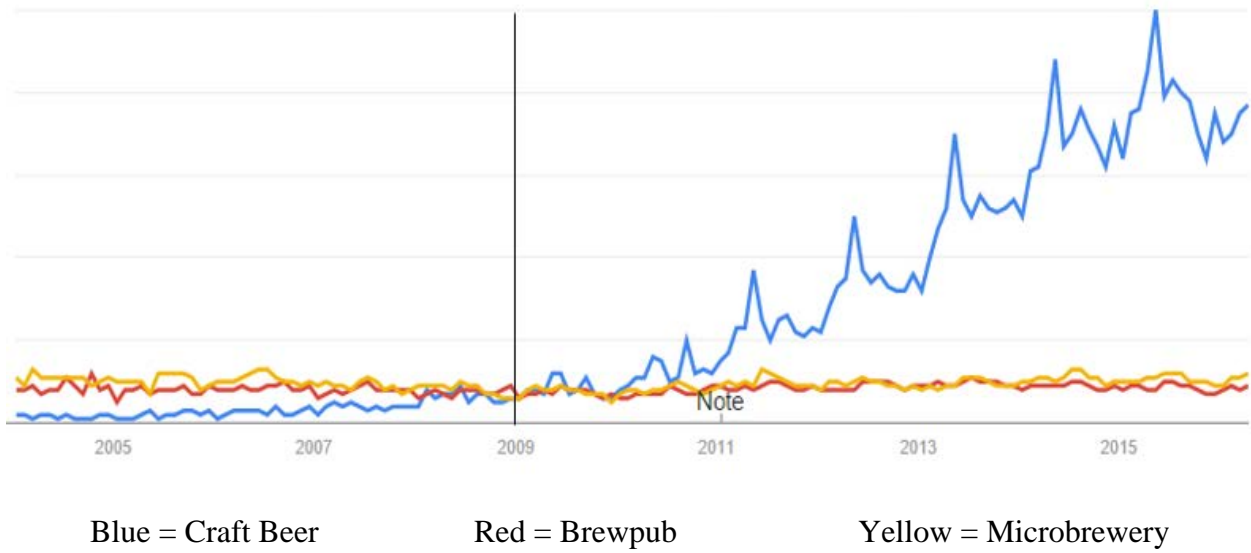
Graph 1

Total Number of Breweries in the United States 1994-2014



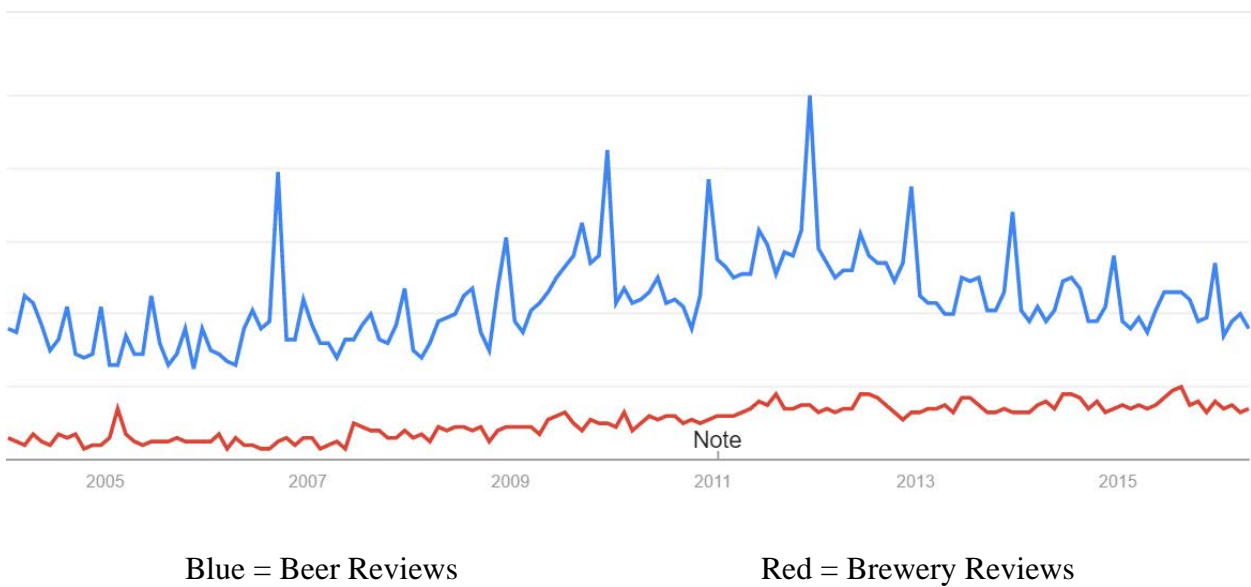
Graph 2

Google Trends Search Frequency for Craft Beer, Brewpub, and Microbrewery



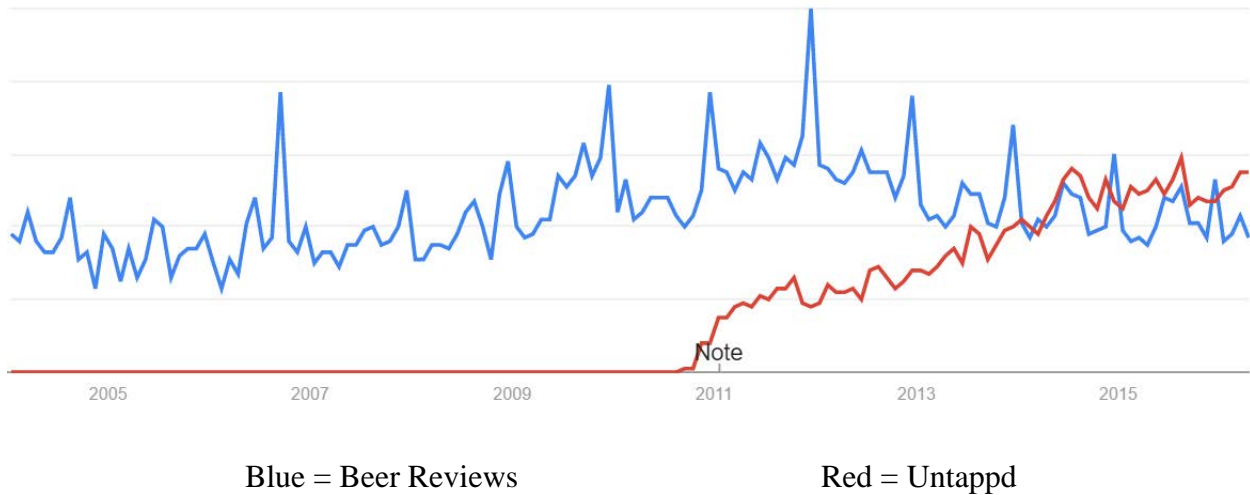
Graph 3

Google Trends Search Frequency for Beer Reviews and Brewery Reviews



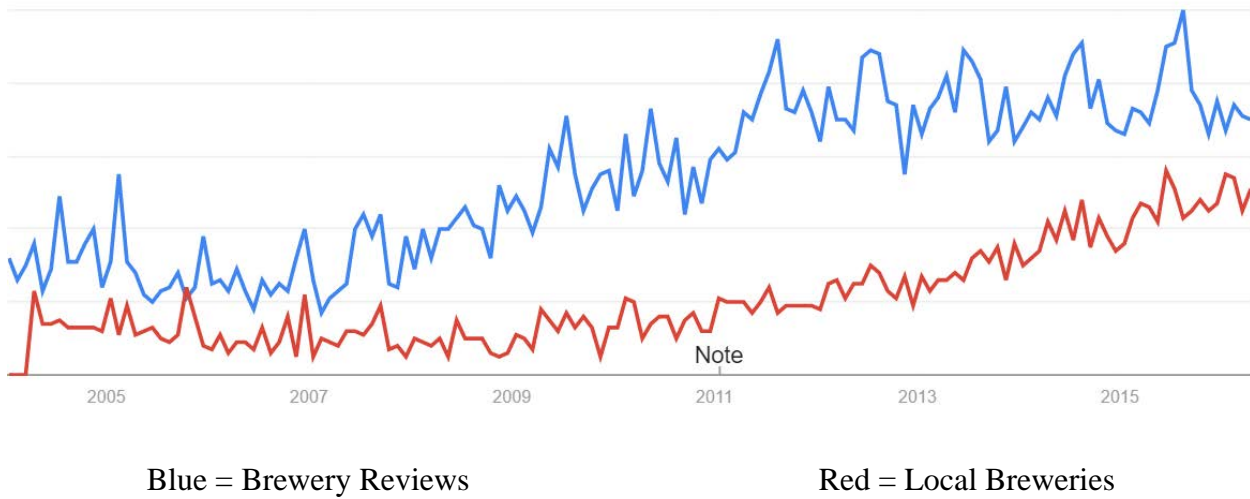
Graph 4

Google Trends Search Frequency for Beer Reviews and Untappd



Graph 5

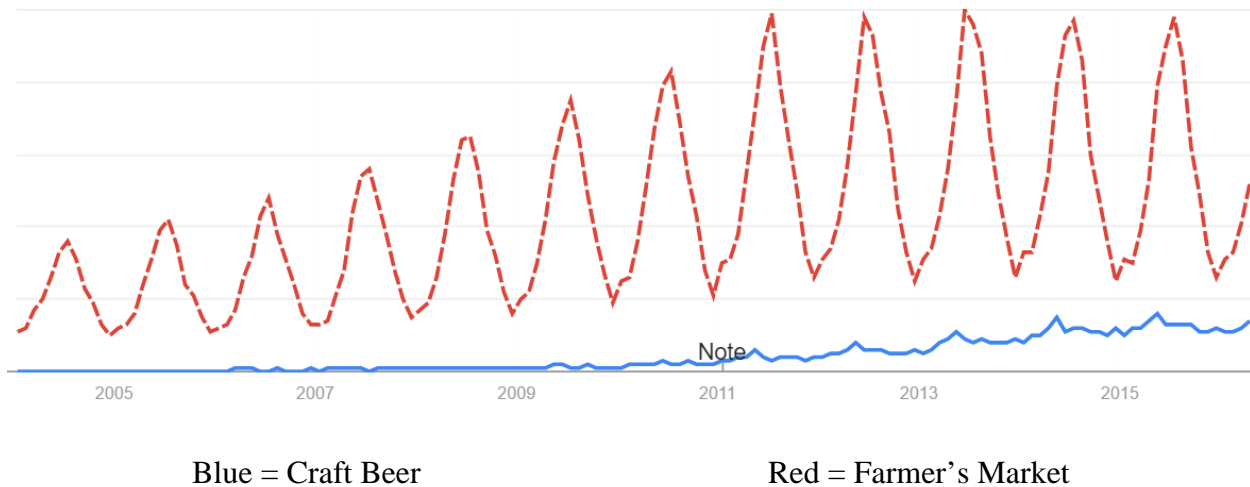
Google Trends Search Frequency for Brewery Reviews and Local Breweries





Graph 6

Google Trends Search Frequency for Farmer’s Market and Craft Beer



Blue = Craft Beer

Red = Farmer’s Market

Table 1

Summary Statistics for All States 1994-2014

| VARIABLES     | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---------------|----------|-------------|-----------|------------|------------|
| State         | 1,071    | 26          | 14.73     | 1          | 51         |
| Year          | 1,071    | 2004        | 6.058     | 1994       | 2014       |
| Breweries     | 1,048    | 42.90       | 58.64     | 3          | 654        |
| Income        | 1,020    | 44,112      | 9,203     | 23,564     | 71,836     |
| YoungAdults   | 1,071    | 798,159     | 921,848   | 58,659     | 5,847,000  |
| Population    | 1,071    | 4,188,000   | 4,586,000 | 327,539    | 28,580,000 |
| lnBreweries   | 1,048    | 3.188       | 1.058     | 1.099      | 6.483      |
| lnIncome      | 1,020    | 10.67       | 0.211     | 10.07      | 11.18      |
| lnYoungAdults | 1,071    | 13.08       | 1.031     | 10.98      | 15.58      |
| lnPopulation  | 1,071    | 14.75       | 1.035     | 12.70      | 17.17      |

Table 2

## Summary Statistics for All States 1994-2007

| VARIABLES     | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---------------|----------|-------------|-----------|------------|------------|
| State         | 714      | 26          | 14.73     | 1          | 51         |
| Year          | 714      | 2001        | 4.034     | 1994       | 2007       |
| Breweries     | 694      | 33.91       | 42.26     | 3          | 310        |
| Income        | 714      | 41,149      | 8,090     | 23,564     | 68,059     |
| YoungAdults   | 714      | 769,151     | 882,230   | 58,659     | 5,329,000  |
| Population    | 714      | 4,012,000   | 4,365,000 | 327,539    | 25,770,000 |
| lnBreweries   | 694      | 3.015       | 1.006     | 1.099      | 5.737      |
| lnIncome      | 714      | 10.61       | 0.197     | 10.07      | 11.13      |
| lnYoungAdults | 714      | 13.04       | 1.036     | 10.98      | 15.49      |
| lnPopulation  | 714      | 14.71       | 1.035     | 12.70      | 17.06      |

Table 3

## Summary Statistics for All States 2008-2014

| VARIABLES     | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---------------|----------|-------------|-----------|------------|------------|
| State         | 357      | 26          | 14.74     | 1          | 51         |
| Year          | 357      | 2011        | 2.003     | 2008       | 2014       |
| Breweries     | 354      | 60.53       | 78.88     | 3          | 654        |
| Income        | 306      | 51,026      | 7,837     | 35,078     | 71,836     |
| YoungAdults   | 357      | 856,174     | 995,127   | 79,403     | 5,847,000  |
| Population    | 357      | 4,539,000   | 4,987,000 | 388,110    | 28,580,000 |
| lnBreweries   | 354      | 3.528       | 1.075     | 1.099      | 6.483      |
| lnIncome      | 306      | 10.83       | 0.152     | 10.47      | 11.18      |
| lnYoungAdults | 357      | 13.16       | 1.018     | 11.28      | 15.58      |
| lnPopulation  | 357      | 14.83       | 1.033     | 12.87      | 17.17      |

Table 4

## Summary Statistics for States with Google Trends Data 2004-2014

| VARIABLES     | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---------------|----------|-------------|-----------|------------|------------|
| State         | 330      | 15.50       | 8.669     | 1          | 30         |
| Year          | 330      | 2009        | 3.167     | 2004       | 2014       |
| Breweries     | 330      | 75.26       | 82.04     | 6          | 654        |
| Income        | 300      | 50,285      | 7,484     | 35,610     | 71,836     |
| YoungAdults   | 330      | 1,246,000   | 1,086,000 | 107,835    | 5,847,000  |
| GoogleTrend   | 319      | 14.47       | 12.35     | 0          | 70.10      |
| Population    | 330      | 6,546,000   | 5,346,000 | 551,950    | 28,580,000 |
| lnBreweries   | 330      | 3.894       | 0.924     | 1.792      | 6.483      |
| lnIncome      | 300      | 10.81       | 0.145     | 10.48      | 11.18      |
| lnYoungAdults | 330      | 13.76       | 0.738     | 11.59      | 15.58      |
| lnPopulation  | 330      | 15.43       | 0.733     | 13.22      | 17.17      |

Table 5

## Summary Statistics for States with Google Trends Data 2004-2007

| VARIABLES     | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---------------|----------|-------------|-----------|------------|------------|
| State         | 120      | 15.50       | 8.692     | 1          | 30         |
| Year          | 120      | 2006        | 1.123     | 2004       | 2007       |
| Breweries     | 120      | 52.82       | 53.79     | 6          | 310        |
| Income        | 120      | 48,247      | 6,955     | 35,610     | 68,059     |
| YoungAdults   | 120      | 1,200,000   | 1,038,000 | 107,835    | 5,329,000  |
| GoogleTrend   | 116      | 6.114       | 4.805     | 0          | 21.43      |
| Population    | 120      | 6,285,000   | 5,100,000 | 551,950    | 25,770,000 |
| lnBreweries   | 120      | 3.606       | 0.848     | 1.792      | 5.737      |
| lnIncome      | 120      | 10.77       | 0.140     | 10.48      | 11.13      |
| lnYoungAdults | 120      | 13.73       | 0.738     | 11.59      | 15.49      |
| lnPopulation  | 120      | 15.39       | 0.736     | 13.22      | 17.06      |

Table 6

Summary Statistics for States with Google Trends Data 2008-2014

| VARIABLES     | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---------------|----------|-------------|-----------|------------|------------|
| State         | 210      | 15.50       | 8.676     | 1          | 30         |
| year          | 210      | 2011        | 2.005     | 2008       | 2014       |
| Breweries     | 210      | 88.08       | 92.16     | 7          | 654        |
| Income        | 180      | 51,644      | 7,534     | 38,591     | 71,836     |
| YoungAdults   | 210      | 1,272,000   | 1,115,000 | 113,179    | 5,847,000  |
| GoogleTrend   | 203      | 19.25       | 12.80     | 1.135      | 70.10      |
| Population    | 210      | 6,695,000   | 5,489,000 | 581,120    | 28,580,000 |
| lnBreweries   | 210      | 4.059       | 0.927     | 1.946      | 6.483      |
| lnIncome      | 180      | 10.84       | 0.143     | 10.56      | 11.18      |
| lnYoungAdults | 210      | 13.78       | 0.739     | 11.64      | 15.58      |
| lnPopulation  | 210      | 15.46       | 0.732     | 13.27      | 17.17      |

Table 7

## Regression Results for All States 1994-2014

| VARIABLES       | (1)<br>lnBreweries   |
|-----------------|----------------------|
| lnIncome        | -0.323**<br>(0.127)  |
| lnYoungAdults   | -0.272<br>(0.185)    |
| lnPopulation    | -0.207<br>(0.240)    |
| 1995.year       | 0.377***<br>(0.0439) |
| 1996.year       | 0.765***<br>(0.0447) |
| 1997.year       | 1.020***<br>(0.0471) |
| 1998.year       | 1.135***<br>(0.0506) |
| 1999.year       | 1.169***<br>(0.0541) |
| 2000.year       | 1.178***<br>(0.0576) |
| 2001.year       | 1.085***<br>(0.0594) |
| 2002.year       | 1.072***<br>(0.0600) |
| 2003.year       | 1.067***<br>(0.0623) |
| 2004.year       | 1.130***<br>(0.0646) |
| 2005.year       | 1.138***<br>(0.0682) |
| 2006.year       | 1.178***<br>(0.0728) |
| 2007.year       | 1.225***<br>(0.0775) |
| 2008.year       | 1.268***<br>(0.0787) |
| 2009.year       | 1.326***<br>(0.0778) |
| 2010.year       | 1.404***<br>(0.0800) |
| 2011.year       | 1.561***<br>(0.0819) |
| 2012.year       | 1.779***<br>(0.0849) |
| 2013.year       | 1.986***<br>(0.0872) |
| Constant        | 12.05***<br>(2.777)  |
| Observations    | 997                  |
| Number of State | 51                   |
| R-squared       | 0.756                |

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 8

## Regression Results for All States 1994-2007

| VARIABLES       | (1)<br>lnBreweries   |
|-----------------|----------------------|
| lnIncome        | -0.363**<br>(0.175)  |
| lnYoungAdults   | -0.371<br>(0.252)    |
| lnPopulation    | 0.190<br>(0.364)     |
| 1995.year       | 0.366***<br>(0.0447) |
| 1996.year       | 0.747***<br>(0.0469) |
| 1997.year       | 0.999***<br>(0.0510) |
| 1998.year       | 1.112***<br>(0.0567) |
| 1999.year       | 1.141***<br>(0.0625) |
| 2000.year       | 1.148***<br>(0.0681) |
| 2001.year       | 1.051***<br>(0.0709) |
| 2002.year       | 1.035***<br>(0.0721) |
| 2003.year       | 1.028***<br>(0.0757) |
| 2004.year       | 1.089***<br>(0.0794) |
| 2005.year       | 1.096***<br>(0.0850) |
| 2006.year       | 1.135***<br>(0.0920) |
| 2007.year       | 1.181***<br>(0.0991) |
| Constant        | 7.951**<br>(4.028)   |
| Observations    | 694                  |
| Number of State | 51                   |
| R-squared       | 0.678                |

Standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 9

## Regression Results All States 2008-2014

| VARIABLES       | (1)<br>lnBreweries   |
|-----------------|----------------------|
| lnIncome        | 0.263<br>(0.211)     |
| lnYoungAdults   | 1.116***<br>(0.387)  |
| lnPopulation    | -0.264<br>(0.817)    |
| 2009.year       | 0.0536*<br>(0.0275)  |
| 2010.year       | 0.156***<br>(0.0333) |
| 2011.year       | 0.286***<br>(0.0377) |
| 2012.year       | 0.476***<br>(0.0438) |
| 2013.year       | 0.661***<br>(0.0504) |
| Constant        | -10.46<br>(10.83)    |
| Observations    | 303                  |
| Number of State | 51                   |
| R-squared       | 0.815                |

Standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 10

Regression Results for States with Google Trends Data 2004-2014

| VARIABLES       | (1)<br>lnBreweries    |
|-----------------|-----------------------|
| lnIncome        | 0.614***<br>(0.187)   |
| lnYoungAdults   | -1.430***<br>(0.469)  |
| GoogleTrend     | 0.000804<br>(0.00160) |
| lnPopulation    | 0.361<br>(0.549)      |
| 2005.year       | -0.0200<br>(0.0314)   |
| 2006.year       | -0.0262<br>(0.0370)   |
| 2007.year       | 0.00504<br>(0.0424)   |
| 2008.year       | 0.0726<br>(0.0456)    |
| 2009.year       | 0.146***<br>(0.0475)  |
| 2010.year       | 0.215***<br>(0.0509)  |
| 2011.year       | 0.372***<br>(0.0550)  |
| 2012.year       | 0.576***<br>(0.0634)  |
| 2013.year       | 0.750***<br>(0.0749)  |
| Constant        | 11.20<br>(6.790)      |
| Observations    | 290                   |
| Number of State | 29                    |
| R-squared       | 0.862                 |

Standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1



Table 11

Regression Results States with Google Trends Data 2004-2007

| VARIABLES       | (1)<br>lnBreweries     |
|-----------------|------------------------|
| lnIncome        | -0.399<br>(0.286)      |
| lnYoungAdults   | -2.512**<br>(1.254)    |
| GoogleTrend     | 0.00620**<br>(0.00297) |
| lnPopulation    | 1.093<br>(1.357)       |
| 2005.year       | 0.0158<br>(0.0269)     |
| 2006.year       | 0.0610<br>(0.0436)     |
| 2007.year       | 0.128**<br>(0.0566)    |
| Constant        | 25.65*<br>(13.04)      |
| Observations    | 116                    |
| Number of State | 29                     |
| R-squared       | 0.168                  |

Standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 12

Regression Results for States with Google Trends Data 2008-2014

| VARIABLES       | (1)<br>lnBreweries    |
|-----------------|-----------------------|
| lnIncome        | 0.464**<br>(0.224)    |
| lnYoungAdults   | 0.147<br>(0.636)      |
| GoogleTrend     | 0.000190<br>(0.00169) |
| lnPopulation    | 0.312<br>(0.949)      |
| 2009.year       | 0.0556**<br>(0.0268)  |
| 2010.year       | 0.146***<br>(0.0343)  |
| 2011.year       | 0.285***<br>(0.0380)  |
| 2012.year       | 0.480***<br>(0.0465)  |
| 2013.year       | 0.646***<br>(0.0587)  |
| Constant        | -8.151<br>(13.02)     |
| Observations    | 174                   |
| Number of State | 29                    |
| R-squared       | 0.895                 |

Standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

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