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Consumers' Perceptions of Product Quality and Entrepreneurial Survival: Evidence from the Craft Brewery Industry

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Purpose

Most studies of entrepreneurial failure do not have good measures of consumers' perceptions of product quality. As a result, perceived quality in entrepreneurial success is often omitted. The craft brewery industry is comprised of small entrepreneurial firms selling an experience good making it an ideal study setting. Using online beer reviews, we examine how perceptions of beer quality and the size of brewery production influence entrepreneurial success of microbreweries and brewpubs.

Design/methodology/approach:

Using data from the Brewers Association and over 12 million reviews from Beeradvocate.com between 2002 to 2016, we examine the relationship between perceived product quality and firm survival. Perceived quality is measured using online beer reviews. We expect larger microbreweries will survive longer as will breweries with higher perceived quality. We use a conditional log-log hazard model to estimate survival for microbreweries and brewpubs.

Findings: A one standard deviation increase in the beer ratings for a microbrewery is associated with a reduction in the probability of exit by around 26 percent. For brewpubs, such an increase is associated with a reduction in the probability of exit by 19 percent. We also find that larger microbreweries have a lower hazard of exiting.

Originality: Entrepreneurs in the brewing industry start as home brewers before beginning commercial enterprises. Scaling up production is difficult. The initial size of their brewery is an important determinant of their success. Likewise, the perception of the quality of their beer as measured by consumer ratings gives a good market indication about future survival. This research is one of the few studies to examine the influence of perceived quality on firm survival in a growing industry.

Keywords: firm survival, perceived quality, breweries, beer

JEL Codes: L26, L21, L25

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1. Introduction

The craft brewing industry is a recent phenomenon in the United States. Craft breweries began entering the market around 1980 (Tremblay and Tremblay 2005). The recent growth in the brewing industry has been important for economic growth (Malone and Hall 2017, Malone and Stack 2017, Colen and Swinnen 2016). States with fewer regulations inhibiting the growth of craft breweries experienced increases in job growth, tax revenues, and consumer choice (Gohmann 2016, Burgdorf 2018). More than half of the job growth in the beverage industry between 2006 and 2016 was in breweries (Delaney and Haines 2017). Craft breweries make up 23.3 percent of revenue at $26 billion in sales and 12.7 percent of output in the brewing industry (Watson 2018).

The craft brewing industry has seen dramatic changes growing from 150 breweries in 1988 to 1,548 breweries in 2005 and 6,064 breweries in 2017. On net, the United States has seen more breweries opening than closing. From 2010 to 2015, the number of entrepreneurs opening either brewpubs or microbreweries was 2,924 compared with only 363 closings (Watson 2018). What is the key to their success? This paper extends the literature, which primarily focuses on firm revenues, to consider how perceived quality affects the firm's life cycle. This paper examines how perceived quality, quality consistency, and brewery size influence firm survival. We find the results are heterogenous for brewpubs and microbreweries, which the previously literature has lumped together.

Consumer review websites have a significant influence on sales and revenue across many industries. (See, e.g., Chevalier and Mayzlin, 2006, Dellarocas, Zhang, and Awad, 2007, Duan, Gu, and Whinston, 2008, and Zhu and Zhang, 2010, for examples of the importance of consumer reviews in a variety of industries). Instead of revenues, we examine how ratings of perceived product quality, as measured by an online consumer rating website, Beeradvocate.com (referred to as Beeradvocate for the remainder of the paper) influence the survival of these entrepreneurial ventures in this growing industry. Although revenues are an important measure, profits are more important since firms can have both high revenues and high costs. Firms making an economic profit will survive, whereas those operating at a loss will shut down. If profits are not available, then we propose that using firm survival, not revenues, will provide a better measure of the

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importance of online ratings. Ideally, we would look at both revenues and survival. For this study, revenues were not available. We use the average rating for beers at each brewery along with the standard deviation of these ratings each year as measures of consumer perceived quality and consistency of the beers produced by the brewery. Our hypotheses are that lower consumer ratings for beers and more variability in these ratings will be related to brewery failure. We include production data to determine how important brewery size is for survival. Few studies have sufficient data to examine how the consumer's perceptions of the quality of an entrepreneur's product influence the survival of the venture. We close this gap for this specific industry.

We find evidence of increased survival for firms associated with higher perceived quality of their beers and for firms with higher production levels. Product quality consistency, as measured by a lower variance in perceived quality, is also associated with the firm's survival rate. These effects are more prominent for microbreweries which focus on beer production relative to brewpubs which produce both food and beer. Our results could have implications for other markets and may indicate that to survive in emerging niche industries, perceptions of quality and growth are both important factors.

The brewing industry in the United States has historically been a highly concentrated industry (Tremblay, Iwasaki, and Tremblay 2005), but recently has been marked by a rise in a niche market of craft brewers. Whereas large, national brewers such as Anheuser Busch, Miller, and Coors predominantly produced rather homogeneous products of light lagers using adjunct brewing ingredients (such as corn and rice in addition to barley), craft brewers produce beers that are perceived to be more flavorful, using traditional barley ingredients, and fewer adjuncts. The Brewers Association defines craft brewers to be "small," "independent," and "traditional."[1]

Anchor Brewing Company is often given credit as the first craft brewery after it was bought by Fritz Maytag in 1965. New Albion entered in 1976, and several more craft breweries began to enter around 1980, including Sierra Nevada (Tremblay and Tremblay, 2005). The craft brewing industry is a recent phenomenon that was fueled further when in 1979 President Jimmy Carter signed HR 1337 which lifted the prohibition on home brewing beer that had been in effect since the end of Prohibition in 1932. Tremblay and Tremblay (2005) credit this for the increase

in craft brewing entrepreneurship. After the passage of this bill many states started to legalize craft breweries. In the United States, 1.1 million people brew beer at home (Brewers Association 2017). Many brewing entrepreneurs start their brewing business based upon their love of home-brewing. This enthusiasm encouraged by friends who love their beer lead many to take the plunge and start a brewery. Biraglia and Kadile (2017) interviewed members of the Home Brewers Association and found a positive relationship between entrepreneurial intentions and entrepreneurial passion. Kadile and Biraglia (2020) find that positive feedback on the quality of their beers plays an important role in the decision to open a brewery. Further, most brewers in the industry help each other out, paving the way for easier transition from home brewer to brewery (see e.g. Mathias et al. 2018).

Today, there are over 7,400 breweries operating in the United States, the majority of which are craft breweries.[2] The Brewers Association defines craft brewers to be "small," "independent," and "traditional."[3] This dramatic increase in the number of breweries reversed a trend of consolidation and decreasing number of breweries in the US, which had been occurring before Prohibition, and continued after Prohibition ended (Horvath, Schivardi, and Woywode 2001).

The craft breweries we examine in this paper are microbreweries and brewpubs. Microbreweries produce less than 15,000 barrels and sell at least 75 percent outside of the brewery. Brewpubs are restaurant breweries that sell at least 25 percent of their beer on their premises.[4] The distinction has important implications for how ratings influence survival. We discuss these details below.

2. Theory

Entrepreneurial exit occurs for various reasons. Wennberg et al. (2010) argue that entrepreneurs may leave either for success or failure. In particular, they discuss distress sales and distress liquidations as well as harvest sales and harvest liquidations. The beer industry has had its examples of firms harvesting by selling to the larger macro-brewers – those producing greater than 6 million barrels per year. These craft breweries grow and then merge or are bought out by other breweries. Examples of breweries bought out by macro-brewers or spirits and wine companies include Goose Island, Ballast Point, and Red Hook. For most breweries, this path is unlikely. Data from the Brewers Association show that most breweries are small with average annual production in 2016 of 785 barrels for brewpubs and 1,670 barrels for microbreweries.

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This production constitutes 12.7 percent of beer production by volume in the United States. Given these firms are less well-established than larger macro-brewers, word-of-mouth from on-line reviews of their beers may have a significant effect on their sales and survival.

We are interested in brewery survival as a business. Failures may occur in the brewing industry where the brewery is sold to another owner. This type of failure would be a distress sale. These breweries remain in business under new ownership. On the other hand, a distress liquidation occurs when the brewery no longer survives. Wennberg et al. (2010) would define failure as when these breweries have liquidated their assets. We use a similar definition, where failure occurs when a brewery closes and is not reopened under new management.

We can apply the resource based view of the firm (RBV) (Barney 1991) to explain the relationship of perceived quality of output to survival. The RBV posits that a firm's competitive advantage comes from the value of its resources that are rare, non-imitable, non-substitutable, and nontransferable. If the firm has such resources, then this competitive advantage leads to sustainability and survival of the firm. To maintain this advantage, the strategic resource must be heterogeneous and not perfectly mobile across firms. Given free entry into the market and the wide availability of inputs needed to produce beer, we argue that the only non-imitable resource is brewer quality.

Priem and Butler (2001) argue that the value of the resource is determined by the market. As such, value is subjective to the individual consumer and the value of a resource is determined through its marginal revenue product. As a resource becomes more productive, the marginal revenue product increases. The value of a product though is reflected in the demand for the product. In the case of beer, if consumers perceive a beer is of higher quality, then, other things equal, demand will increase. An increase in demand increases the demand for inputs and the value of the resources that give the product its desirable characteristics. Barney (1991) defines resources in the RBV as "assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive and implement strategies that improve its efficiency and competitiveness" (p.101).

Barney discusses three types of resource capital – physical, human resources, and organizational. Physical and human capital resources are most relevant to breweries. Physical capital consists of plants and equipment as well as location. For the breweries of a particular size,

equipment is fairly standard. For microbreweries, most beer is sold off the premise, so the location (microbrewery) may not be important in terms of a place to consume the beer. However, to the extent that the brewery has a tap-room, location can play a role.[5] As such, besides location, there is not likely to be much difference in physical assets that would add value to the product.

Human capital refers to the training and judgement embodied in individual workers particularly the owner, brewer, and manager. Most beers follow the basic *Reinheitstgebot* of using barley, hops, water, and yeast and then possibly add various adjuncts to differentiate their products. None of these inputs are non-imitable or non-substitutable. The differentiation in beer quality then is not from the tangible inputs, but instead is from the skill of the brewer. We can think of this similar to Rosen's (1981) discussion of superstars. He argues that the most talented people tend to earn the most. Some brewers will earn large profits while others will struggle to survive. Many microbreweries are owned by the brewer and thus the strategic resource is not mobile. For example, the Louisville metropolitan area has 17 microbreweries and 15 are at least partially owned by the brewer. Much of the heterogeneity in brewers that give a competitive advantage is reflected in the quality of the beer. Any increase in the demand for the product brought about by increased perceived quality will be reflected in the profits of the brewer/brewery. The output of brewpubs, on the other hand, includes not only beer, but also food, food service, atmosphere, etc. As a result, we expect that the influence of ratings, which are a measure of the perceived quality of the beer, will have less impact on brewpubs since they offer a wider array of products.

i. *Consumer perceptions*

Consumer perceptions matter. Consumers often lack knowledge about product quality, but may have perceptions of quality based on signals from the firm. For example, Kirzner (1997) states that advertising gives consumers information. When consumers purchase a product, they are purchasing the total product including the information from the advertising. This information influences our perceptions of products. Parasuraman, Zeithaml, and Berry (1988) distinguish between quality – the degree of superiority or excellence – and perceived quality which they define as "the consumer's judgment about an entity's overall excellence or superiority." (p.15). These perceptions may differ from actual quality. However, purchase decisions will be based upon these perceptions. Perceptions of quality may also come from expert opinion. Landon and

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Smith (1997) examine the influence of reputation on prices in the Bordeaux wine market. Reputation in this case is based on the quality of past vintages. They use quality measures from *Wine Spectator*. They find that consumers use this information in their purchasing decisions.

Beer, like wine, is an experience good where quality can only be determined after consumption and often purchase decisions are based upon information from other sources – advertising, expert opinion, and word-of-mouth. Word-of-mouth can be from online reviews or a friend's recommendations. For craft beer, a source used by many when purchasing a beer is the rating from websites such as Beeradvocate.com, ratebeer.com, and untapped.com. Here the consumers are using the wisdom of the crowds when purchasing a product they have not tried. If these ratings do influence consumer choices, then we would expect that breweries with higher ratings will sell more beers and be more successful. Likewise, if beers with higher ratings are indeed perceived to be higher quality, this will lead to more frequent repeat purchases and further increase survival rates. One caveat in using ratings is that the beer rater may rate the beers based on more than the sensory aspects. This harkens back to Kirzner (1997) in that consumers are buying the whole product including labels, and when consuming at the brewery/brewpub the quality of service and atmosphere. Our data do not allow us to determine where the rater consumes the beer, so perceived quality may measure more than the beer itself. This is born out to some extent in our results since we separate microbreweries from brewpubs. Brewpubs sell most of their beers on the premises so beer ratings might reflect service, atmosphere of the brewpub, and other locational aspects. Brewpubs also serve food. Our results indicate that ratings have less of an impact on the survival of brewpubs.

Several studies have examined how various online ratings influence sales growth. Clemons, Gao, and Hitt (2006) find that higher beer ratings from ratebeer.com are associated with greater growth. Similar relationships have been found for movie ticket sales (Dellarocas, Zhang, and Awad 2007, Duan, Gu, and Whinston 2008), books (Chevalier and Mayzlin 2006), and automobiles (Chen, Fay, and Wang 2011). Although related to sales instead of survival, these studies can inform our hypotheses.

The importance of word-of-mouth is amplified with online reviews since many individuals can get the word out. Duan et al. (2008) argue that reviews can have two effects. In the first case, a review can be persuasive and influence a consumer's perception of the product's quality. Reviews can also increase product awareness. They argue that the awareness part

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matters more when the reviews are dispersed among many online communities that may be unaware of the product. This argument will not apply when one website has a review for a particular product. If consumers seek out the review of that product, they must know that the product exists. Duan et.al (2008) argue that the volume of online reviews could be a measure of the intensity of the word-of-mouth effect. They expect that both reviews and the number of reviews will have a positive impact on movie box office revenues. They find no statistically significant relationship between ratings and movie sales, but do find that the number of ratings is positively associated with greater sales.

The number of reviews may also follow a dynamic process where past reviews influence future consumption and future reviews. Zhu et al. (2020) find that early ratings receive more attention when the variance of the rating is high. The authors consider the number of helpful ratings votes a review receives relative to the timing of the voting, the current product average rating, the number of ratings, and the variance of ratings. The authors find a positive association with the current product average rating and a negative association with the number of ratings. Suggesting that early ratings matter more than late ratings. Similarly, Wang, Menon, and Ranaweera (2018) find that consumer ratings have an increasing trend unless there is a large variance in ratings or consumer diagnostic ability is low.

The influence of ratings on survival in the online market has been examined by several authors (Wang et al. 2013, Cabral and Hortacsu 2010). Cabral and Hortacsu (2010) find reputational feedback on eBay is related to firm exit. However, in this case, reputation may not be a measure of product quality as much as service quality. Social relations are also important for online stores. Wang et al. (2013) discuss the importance of online social networks for online stores. They find that positive word-of-mouth reviews are related to longer survival for these stores. Hernández-Ortega (2019) finds there could be a U-shaped relationship between online consumer ratings and consumption. If the product does not meet the expectations of the consumer after reading the reviews, then they will decrease their consumption of the product.

A few studies have examined the length of time that a movie is screened. Souza, Nishijima, and Fava (2019) find that good reviews lead to increased number of weeks a movie is screened. Likewise, Legoux et al. (2016) find a positive association between expert reviews and length of movie screenings. The survival of a brewery differs from the length of a movie run in several important ways. First, breweries offer multiple beer styles and vary these offerings over

time. A movie is a fixed product that is usually only consumed once and over time will lose out to other new movies. As a result, the survival of a brewery will be based on the perception of the overall quality of the beers. Likewise, breweries with more reviews are likely to have longer survival since the number of reviews is an indicator of the number of consumers and also may lead to increased product awareness through word-of-mouth.

Hypothesis 1: Breweries with higher ratings will be more likely to survive.

Hypothesis 2: Breweries with more ratings will be more likely to survive.

ii.   *Product variability*

While the average review may be important, Clemons, Gao, and Hitt (2006) find that the dispersion of ratings, which they use as a measure of product differentiation, is also important in predicting sales growth. They make the following argument: Suppose a firm produces three differentiated beers along a continuous spectrum, beers A, B, and C. Suppose customers favor beers on the end of the spectrum, so customers will rate A highly and C low, or they will rate C highly and A low. As a result, the ratings will have greater dispersion the greater the differentiation. They argue that this will lead to greater growth.

For survival, we argue that this will not be the case. First, breweries generally have a flagship beer and a number of standard beers. They then might produce seasonal and special releases on a rotating or one-off basis. If their beers are inconsistent, say that the quality of beer C is low, then the reviews of the brewery's beers will have high variability and if the brewery is producing too many low-quality beers or the consistency of a particular beer varies from batch to batch, then high variability in ratings might lower the probability of survival. Consumers are risk averse and would prefer the brewery with more consistent reviews even if they have the same average quality. We agree that greater product differentiation will be an important determinant of success, but greater dispersion in the ratings is likely to decrease the probability of survival. This dispersion is a measure of consistency with greater dispersion in ratings implying greater inconsistency in beer.

Hypothesis 3: Breweries with more variability in their beer ratings will have lower survival rates.

iii.   *Size*

Size has been documented to be an important factor of firm survival. Dunne, Roberts, and Samuelson (1988) find that most entrant firms in manufacturing industries do not last for 10

years and those that fail tend to be smaller. Manufacturing firms fail when they are young and small. Size matters because of economies of scale advantages. Audretsch and Mahmood (1995) point out that new firms with a size below the minimum efficient scale have difficulty competing with incumbents who have reached the minimum efficient scale. The further firms are from the low-cost production level, the more difficult it is to compete in the long run. This helps explain the growth in the macro breweries

In the past 30 years we have seen an increase in craft brewing. Carroll and Swaminathan (2000) use resource partitioning theory to describe the changes in the brewing industry from 1938 to 1997. They argue that the macro breweries initially grew as these breweries gained economies of scale. These macro-breweries were able to out-compete smaller regional breweries and gain additional market share. This industry change was seen after Prohibition up to the late 1980's. However, the macro producers all produced similar products. Carroll and Swaminathan (2000) give a quote from Eckhardt "If you taste one American beer, you've pretty much tasted them all." (Eckhardt 1999). Resource partitioning theory indicates that the number of small competitors might increase because they can profit from differentiation. As more differentiated products were offered, consumers became more open to a variety in beer styles and were willing to try something besides American light lagers (Williams 2017). This helps explain the growth in the number of craft breweries, but also implies that larger craft brewers will have greater ability to produce differentiated products since they will have multiple systems for production. Macro-breweries have been purchasing microbreweries to expand their product line and take more shelf space from other microbreweries. Mathias et al. (2020) find that after such mergers, the remaining microbreweries cooperate and attempt to enhance the perception of their products being independently produced. Consumer responses to such merger often result in a reduction in the ratings for the newly acquired microbrewery (Frake 2017).

For microbreweries some economies of scale may also be present. Generally, when firms gain economies of scale, they gain these in more areas than just spreading the fixed costs of production. Scale economies can show up not with just lower costs of production, but also lower advertising costs, distribution costs, purchasing costs, and if the brewery invests in larger bright tanks and fermenters, they can gain an economy from the cub-square rule.

Hypothesis 4: Smaller breweries will have lower survival rates.

    iv.   *Microbreweries and Brewpubs*

Lastly, microbreweries and brewpubs are two different types of business arrangements. Brewpubs both brew beer and operate a restaurant onsite. As such, the beer ratings will be influential in the brewpub's survival, but food and other factors influencing the survival of restaurants will also be important. For microbreweries, the only product that matters is the beer. As a result, ratings should have a larger impact on the survival of microbreweries relative to brewpubs.

Microbreweries have on average larger production than brewpubs. Potentially, the decision to become either a microbrewery or brewpub is dependent upon privately held signals about beer quality, which are correlated with actual perceived values of beer quality and production decisions. This unobserved factor would bias estimates if we included microbreweries and brewpubs in the same survival analysis model, a fact ignored by the previous literature. We mitigate this source of bias by studying the two types of firms separately; thereby making the unobservable components more similar.

Hypothesis 5: Ratings will have a larger impact on the survival of microbreweries relative to brewpubs.

3.   Data

The two main sources of data are from the Brewers Association and Beeradvocate.com. The Brewers Association data are obtained by the Brewery Industry Production Survey, which is published in the trade magazine, *New Brewer*. The *New Brewer* includes data from the early 1980s to present. From this magazine, we obtain information on how many barrels each brewer produced each year, the type of brewery (the breweries are classified as contract breweries, brewpubs, regional, or microbreweries), location up to state level, and for some breweries, the year of entry and exit. We examine microbreweries and brewpubs in this study. We have supplemented the entry and exit data with information from the Brewers Association and web searches including newspapers, beerme.com, and other sources on the web such as brewery websites. In some years a brewery might choose not to publish their production data. We fill missing values by using linear interpolation between observed values within the same brewery.

We match the brewery data with data on beer ratings "web-scraped" from Beeradvocate.com. This data source is one of the most frequently used beer rating websites and the ratings provide our measure of perceived quality of products. The Beeradvocate data range from January 1998 to November 2016 with over 12.5 million individual reviews for over 6,900

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breweries across approximately 218,577 beers. However, the number of ratings in the first few years of Beeradvocate were low.[6] To get a more robust estimate of consumers' perceptions of beers we use ratings data from 2002 to 2016. Given that we are interested in survival, we include breweries that opened between 1970 and 2014. We exclude any chain breweries, such as Gordon Biersch or Rock Bottom, since they are following a different business model than the smaller craft breweries. In the past decades, a handful of breweries have been bought by macro producers such as AB-Inbev. We account for these mergers in the analysis by treating these breweries as right side censored. That is, these breweries are assumed to have survived in the absence of the merger.

The ratings from Beeradvocate.com are a measure of perceived quality. For each year, we find the average rating over all beers in a brewery to obtain a measure of the perceived quality of the beer produced. Our main analysis includes breweries with a minimum of 5 ratings in a year. In our robustness checks we find that varying the minimum number of ratings as our inclusion restriction does not substantially change our main results. We also calculate the standard deviation of the ratings as our measure of perceived consistency.

Summary statistics for breweries with at least five ratings in a year are presented in Table 1. These data are for 1,981 microbreweries and 92 failures and for 1,261 brewpubs with 82 failures. Our full data set prior to limiting the number of ratings to at least five, consists of 2,241 microbreweries with 186 failures and 1,550 brewpubs with 291 failures. In 2015, according to the Brewers Association, the number of microbreweries was 3,196 and the number of brewpubs was 2,042. We are missing some data due to our refinements, lack of information on opening year, and lack of availability of either brewery production or rating data on the brewery. Microbreweries produce two and one-half times as much output as brewpubs which generally are smaller. The microbreweries on average tend to be younger since many more microbreweries have opened in the past ten years. For example, the number of microbreweries increased from 1,143 in 2001 to 3,196 in 2016 while the number of brewpubs increased from 1,180 to 2,042 in the same time period. The average standard deviation of the ratings for microbreweries and brewpubs are around 0.49 and 0.48. The last two columns show the averages for firms that survived and those that did not. The surviving firms have significantly higher output, ratings, number of ratings, and later opening years. Microbreweries that did not survive also have a higher standard deviation in their ratings.

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[Insert Table 1 about here]

Previous work shows that state policies and regulations affect craft breweries substantially (Burgdorf 2018, Gohmann 2016, Malone and Lusk 2016). We account for these regulations in our regressions. We include an indicator variable for states that enforce beer franchise laws which restrict when a brewery can cancel, terminate, or fail to renew a contract with a wholesaler to a set of circumstances falling under legally defined "good cause." We also include an indicator variable for whether a state allows brewers to self-distribute. Many states prohibit vertical integration between breweries and wholesalers and instead require brewers to distribute their products through independently owned and operated wholesalers. Gohmann (2016) found that self-distribution states tend to have fifty percent more breweries than states that do not allow self-distribution, and Burgdorf (2018) found franchise laws significantly reduced craft brewery entry and growth. Likewise, we include the inflation adjusted beer excise tax rate (Friske and Zachary 2019, Gohmann 2016). Other variables included are location dummies (one for each census region of Northeast, South, Midwest (omitted category), and West), year of entry, and the number of breweries per capita in the state (as measured by the number of permits issued by the Alcohol and Tobacco Tax and Trade Bureau.

4. Empirical Model

Although breweries open and close on any day of the year, our data uses discrete time exits (year-to-year) rather than continuous time. As a consequence, we use a discrete-time model to estimate survival. Following Bayus and Agarwal (2007) we use the complimentary log-log model, which assumes a discrete time hazard function and can easily accommodate time-varying covariates as well as right hand side censoring. The complimentary log-log model can be seen as an approximation to the Cox proportional hazard model. The parameter estimates of the complimentary log-log are analogous to the proportional hazards assumption as in the continuous-time Cox model. When data are collected as discrete time, but the underlying data are continuous, then the complimentary log-log model is preferred over assuming the data are continuous and using a Cox model or assuming the data generating process is discrete and using a logit specification.

The discrete time hazard function of the complimentary log-log model is given by

$$h(t|X_{it},\beta) = 1-[1-\lambda_0(t)]^{\exp(X\beta+u)} \tag{1}$$

where $\lambda_0(t)$ is the nonparametric baseline hazard, X_{it} is a vector of time-varying characteristics of brewery i at year t, and β is the vector of hazard ratios to be estimated. We account for unobserved firm specific heterogeneity through the error term u_i. This error term is also called the frailty of the model. The error term is assumed to be distributed normal with a mean of zero and a standard deviation σ_i^2. The vector X_{it} includes our variables of interest - perceived beer quality, its standard deviation, and the log of the number of reviews from Beeradvocate, and the log of barrels produced as well as control variables including regional dummy variables, real state beer taxes, the number of breweries per capita, year of brewery opening, and dummies for self-distribution and franchise law states. This empirical model establishes the impact that perceived beer quality and production have on the survival rate of breweries.

The survival model has several advantages over a logit model of firm exit. First, the survival model allows survival duration to affect the probability of exit. Second, the survival model can control for exits due to mergers. An exit due to merger is a form of right-hand side censoring where the firm would have continued to survive in the absence of a merger.

The hazard model is for the hazard of exit. Hazard rates greater than 1 imply an increased the risk of exit. We estimate several specifications of equation 1. All models include the control variables. In addition to controls, Model 1 only includes the Beeradvocate average ratings. Relating to Hypothesis 1, breweries with higher ratings are expected to have a hazard less than one. Model 2 includes the standard deviation of ratings. This model corresponds to hypothesis 3 and the hazard is expected to be greater than one. Model 3 includes both the average rating and the standard deviation of the ratings. This specification allows us to examine if the average rating and the standard deviation of ratings have a separate influence on survival. In Model 4 we include the log of the number of ratings. Corresponding with hypothesis 2 that breweries with more ratings will have greater survival. The number of ratings may be a proxy for brewery size or greater word-of-mouth. In either case, the expected hazard is less than 1. Lastly, Model 5 includes the log of the number of barrels produced which is our measure of brewery size. This inclusion allows us to test hypothesis 5 and the expected hazard is less than one.

The empirical strategy is thus: (1) to determine if perceived beer quality advantages matter, (2) if the variation in beer quality is a reflection of brewery quality or consumer preferences in beer style, and (3) if scale advantages from output productivity matter for survival. We accomplish this by examining if ratings have persistent effects on the hazard of exit when we

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include additional variables. If a positive influence of increased output is not cost related but is simply a change in quantity demanded due to higher quality beer, then beer ratings and production values would be positively correlated with one another. Our estimates would lose some precision due to collinearity and may mitigate the direct effect of these variables on the probability of exit. Finally, we performed a likelihood ratio test to determine whether microbreweries and brewpubs could be pooled. The results indicate that the two samples should not be pooled.

5. Results

i. *Main Results*

Table 2 presents the hazards for microbreweries from the conditional log-log model, equation 1. We convert the exit hazards into the reduction in the risk of exit by subtracting the hazard from 1. Perceived beer quality has a strong association with survival. Column 1 shows that a one-point increase in the Beeradvocate rating is associated with a 91 percent reduction in the risk of exit [1-0.0885 = 0.9115]. A one standard deviation increase in the rating is associated with a 26 percent reduction in the risk of exit [0.9115*.29]. Column 2 shows that the hazard ratio is 5.029 for the standard deviation variable. A one standard deviation increase in its value (0.14) is associated with an increase in the risk of exit by 56 percent [(5.029-1)*0.14]. Breweries with greater variability in the perceived quality of their beers have a higher probability of exit. This finding supports hypothesis 2, but is not robust. When the rating is included along with the standard deviation of the rating (column 3), only the rating is significant. Holding beer quality consistency constant, a one-unit increase in the rating is associated with a 93 percent reduction in the risk of exit. The fourth column includes the log of the number of ratings. The coefficient on the rating is still significant and indicates a one unit increase in the average rating is associated with an 84 percent reduction in the risk of exit. Likewise, a one percent increase in the number of ratings is associated with a 0.4 percent reduction in the risk of exit.

Column 5 includes barrel production. A one percent increase in the production of barrels is associated with a 0.56 percent decline in the risk of exit. The inclusion of production reduces the influence of the ratings on exit from a hazard of 0.157 (84.3 percent reduction in the risk of exit) in column 4 to a hazard of 0.162 (83.8 percent reduction in the risk of exit) in column 5. This small change indicates that the size of production is reflecting economies of scale advantages. Production would need to increase by 149 percent to achieve the same level of

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reduction in the risk of exit as increasing the beer rating by one unit. The standard deviation coefficient remains insignificant. The Akaike information criteria indicates that model 5 is the preferred model.

[Insert Table 2 about here]

Table 3 shows similar results for brewpubs. As expected, the relationship of ratings to exit is smaller for brewpubs, whose business includes a restaurant in addition to brewing beer. For example, comparing the ratings hazard from column 1 in Tables 2 and 3 show that a one unit increase in the rating is associated with a 91 percent reduction in the risk of a microbrewery closing, but only a 47 percent reduction in this risk for a brewpub. A test of the difference between the coefficients between microbreweries and brewpubs shows significant differences in the hazards for ratings. This supports hypothesis 6 that ratings will have a greater influence on microbreweries relative to brewpubs.[7] We find a much lower hazard for ratings for microbreweries. Thus, perceived beer quality, while still important, is only one dimension of quality that people may care about in brewpubs and thus may not influence survival as much as in microbreweries. The standard deviation of the rating is significant in column 5 where a one standard deviation increase in its value is associated with a 40 percent increase in the risk of exit. When we include the log number of barrels produced, we find that each one percent increase in the number of barrels produced is associated with a reduction in the risk of exit by 0.70 percent. As with the microbreweries, the Akaike criteria indicates that the full model, equation (5), is preferred.

[Insert Table 3 about here]

ii.   Robustness Checks

In our sample, we use only breweries with five or more ratings. This restriction allows us to have some variability for our standard deviation measure. However, the cost is a loss of brewery observations. To examine the influence of this constraint on our estimates, we re-estimate the conditional log-log hazard equation using the data for all breweries in our sample and then including the ratings for breweries with one or more through four or more ratings. Tables 4 and 5 contain these results for microbreweries and brewpubs. When we exclude ratings, our sample has 2,241 microbreweries with 186 failures. As we increase the number of required ratings, we see the number of breweries decreases along with the number of failures. Note that

the hazard on the average rating declines monotonically from 0.180 to 0.0885. This decline is not surprising since it indicates that breweries with fewer ratings were less likely to survive. Similar results hold for the brewpubs in Table 7 with the number of brewpubs declining from 1,550 and 291 failures when we do not include ratings to 1,261 and 82 failures with 5 or more ratings.

[Insert Tables 4 and 5 about here]

BeerAdvocate allows reviewers to leave ratings of the beers in several sensory categories. These are smell, taste, look and feel. Not all reviewers leave these ratings. For reviewers who do, we calculate the mean value for each rating by brewery year. One advantage of these measures is that they exclude all other aspects of the brewery such as location, service and other perceptions such as labels on the bottle or can. We include these in our model to predict the hazard of closing using the complimentary log-log model. We also estimate this model using a measure of consumer sentiment based upon the text supplied by the beer rater. For each observation, we calculated how positive or negative a reviewer's comments are use the Syuzhet lexicon, which was developed in the Nebraska Literary Lab. Each word is given a rank on a scale of -1 to 1. The more positive a word is the closer to 1 is the word's rank. The algorithm also accounts for context, such as "not good" to be a negative phrase. We sum up the relative values to the brewery level by year.

Table 6 contains these results. We see a positive association of survival with sentiment for both microbreweries and brewpubs. Good review words are a good indicator that the brewery will survive. A one unit increase in the sentimental value decreases the hazard rate by 4.5 percent for microbreweries and 3.7 percent for brewpubs. When we examine the sensory perceptions of the beer, better taste is associated with greater survival for microbreweries. A one standard deviation increase in the taste rating is associated with a 25 percent reduction in the exit hazard for a microbrewery. For brewpubs, smell is the only sensory perception that is associated with a lower hazard of exit. A one standard deviation in the smell rating is associated with a 24 percent reduction in the hazard of exit.

[Insert Table 6 about here]

6. Discussion and Conclusion

Our data allow us to examine the six hypotheses put forth. Hypothesis 1 posited that breweries with higher ratings will be more likely to survive. In all of the models for

microbreweries, higher ratings were associated with greater survival. For brewpubs, ratings were also significant in most of the models, but not as influential on survival since brewpubs generally serve food. Other attributes of the brewpub can increase the probability of survival when the quality of the beer is lower.

Hypotheses 2, breweries with more ratings will have higher survival, is supported by the results when we the number of barrels produced is excluded. Hypothesis 3 is that breweries with more variability in their beer ratings will have lower survival rates. When we examine the standard deviation of the ratings separately in the regressions, we find support for this hypothesis. However, the results are not robust.

Hypothesis 4 was that smaller breweries will have lower survival rates. The estimated hazards for the log of barrels produced for microbreweries was 0.440 and for brewpubs was 0.163. Larger breweries are associated with a better chance of survival which is similar to Dunne, Roberts, and Samuelson (1988) findings for industries. Bart Watson, chief economists of the Brewers Association, the most common feature of failed breweries is producing too little. Specifically, producing less than 395 bbls.[8]

The influence of ratings on the survival of brewpubs is not as pronounced as for microbreweries, supporting Hypothesis 5. Brewpubs offer food on the premises and often cater to a smaller clientele. Patrons might return to a brewpub with lower quality beer if the food is exceptional or vice versa. A microbrewery with similar quality of beer is not as likely to be able to attract customers in the same way. Alternatively, we can view brewpubs as being two businesses, a brewery and a restaurant. Brewpubs have a higher survival rates when compared to restaurants, which may be due to better quality beer.[9] We must consider ratings from brewpubs as capturing both the quality of the beer and the restaurant experience.

Knowledge about how consumer perceptions of the quality influence survival has been given scant attention in the literature. Our study helps by examining a growing industry with a wealth of online product reviews. We find support for the importance of beer ratings in survival for microbreweries and partial support for brewpubs. We also find that the number of ratings plays a role in survival. The effect may be twofold in that the rating may represent demand in that more ratings imply greater demand or more ratings may also reflect word-of-mouth and thus draw consumers into the brewery. Finally, the size of a brewery is strongly related to survival. Larger breweries have better survival rates.

Our model informs the optimal brewery size in terms of survival. We reestimate our baseline model again with a quadratic function for the number of barrels. For microbreweries, the optimal size is 18,920 barrels. Only 61 of the 1,981 microbreweries have output greater than 18,920 barrels. For the remaining microbreweries, increases in production will be associated with greater survival. Likewise, only 24 of the 1,261 brewpubs have surpassed the estimated optimal size of 11,530 barrels. These results can be useful to new breweries in determining what size their brewery should be. However, as our rating results show, the brewery must also produce high quality beers.

Our study makes several contributions pertaining to quality and survival, but has some limitations. First, we are limited to reviews from Beeradvocate and were unable to obtain data from two other rating sites – ratebeer.com and untappd.com.[10] Untappd has become the dominate rating app in recent years with over 89.1 million check-ins in 2019.[11] Access to their data could allow for greater analysis of beer types on survival. Data limitations aside, the influence of perceptions may vary across industries. It might be useful to examine survival in the restaurant industry based upon reviews from yelp.com. However, as our results show, when we examined microbreweries whose specific product is beer, the reviews had a larger impact than when we examined brewpubs that produce both food and beer. The ability to focus on one product category makes interpretation of quality perceptions a little more straightforward. Future research might also examine how the number of different beer styles influences survival. Is it better for a brewery to specialize in a few styles or to hyper-differentiate and fill all of the holes in the market?

A second limitation is that we are examining and emerging and growing industry. Such results may not apply to a more established industry. An examination of the restaurant industry might be a good start.

For breweries these results have several actionable implications. When opening a brewery, size matters. The optimal size for survival from our analysis indicates that breweries should produce around 18,000 barrels per year. Breweries should also be aware of the ratings of their beers as well as the variability of ratings. They should consider dropping beers with lower ratings. Further, brewers might examine which types of beers are trending with higher ratings. We have seen this strategy in the past few years with the popularity of New England IPA's and West Coast IPA's and the trend away from the earlier popular quadrupel beers. One web article

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reports that ratings are being used to justify business decisions of beer delivery apps.[12] Breweries do monitor reviews and respond to them. Playalinda Brewing Company has an employee who monitors reviews and responds to each one.[13] An interesting extension would examine how breweries that respond to review fare relative to those who ignore them.

Many entrepreneurs enter the brewing industry because they homebrew decent beer, enjoy brewing, and are encouraged by their friends to open a brewery. However, craft entrepreneurs face the artisans' dilemma (Solomon and Mathias 2020), where small independent craft breweries cooperate to compete against microbreweries, but lose some of the distinctive features when success leads to more growth. Since brewing is a business, these entrepreneurs should be cognizant of the importance of quality and size on their survival chances. Once established, consumer ratings can give a good market indicator of the quality of the beer. Brewers can use these ratings to gauge their survival probability. Likewise, size matters. Entrepreneurs starting a brewery might move toward a larger brewing system to improve their chances of survival.

Future research should try to identify how these ratings are used. Ratings can produce changes on both the supply side of beer as well as the demand side. Are suppliers responding to ratings by improving the quality of the beer or removing poorly rated beers from the rotation? Are these rating websites used by consumers ex-ante to choose beers, thereby affecting demand or ex-post to tract the beers they have experienced?

Table 1: Summary Statistics

	Microbrewery						
Variable	**Mean**	**SD**	**Min**	**Max**	**Count**	**Alive Mean**	**Died Mean**
Barrels Produced 1000's	2.58	3.27	0.001	38.36	6,669	2.67	1.33***
B.A. Rating	3.71	0.29	1.58	4.74	6,721	3.73	3.49***
Std. Dev. Rating	0.49	0.14	0.00	1.23	6,721	0.49	0.53***
Number of Ratings	315.72	1231.12	5.00	49,968	6,721	332.55	74.27***
Open Year	2005.06	7.70	1982	2014	6,721	2005.18	2003.63***
Number of Breweries					1,981		
Number of Failures					92		

	Brewpub						
Variable	**Mean**	**SD**	**Min**	**Max**	**Count**	**Alive Mean**	**Died Mean**
Barrels Produced 1000's	0.99	1.17	0.001	23	5,466	1.04	0.57***
B.A. Rating	3.65	0.33	1.66	5	5,479	3.65	3.58***
Std. Dev. Rating	0.48	0.17	0	1.49	5,479	0.48	0.49
Number of Ratings	100.01	489.04	5	16,832	5,479	108.23	26.03***
Open Year	2000.39	7.09	1977	2014	5,479	2000.51	1999.31***
Number of Breweries					1,261		
Number of Failures					82		

***indicate that the difference in the means between breweries that remained alive and those that did not survive is significantly different at the 0.01 level

Table 2: Exit Hazards for Microbreweries from Conditional Log – Log Estimation

	(1)	(2)	(3)	(4)	(5)
Rating	0.0885***		0.0708***	0.157***	0.162***
	(0.0277)		(0.0267)	(0.0605)	(0.0587)
Rating Standard Deviation		5.029**	0.358	0.879	0.678
		(3.809)	(0.272)	(0.492)	(0.393)
Ln(Number of Ratings)				0.557***	0.848
				(0.0557)	(0.105)
Ln(Barrels)					0.438***
					(0.0433)
Open Year	0.981	0.976	0.979	0.978	0.907***
	(0.0161)	(0.0183)	(0.0161)	(0.0161)	(0.0169)
Real Beer Tax	1.145	0.996	1.101	0.807	1.107
	(0.622)	(0.581)	(0.601)	(0.451)	(0.652)
Franchise Laws	1.161	1.237	1.138	1.035	1.236
	(0.272)	(0.305)	(0.268)	(0.230)	(0.347)
Self-distribution	1.388	1.106	1.428	1.815	2.100*
	(0.658)	(0.481)	(0.683)	(0.835)	(0.909)
Breweries Per Capita	0.942	0.920	0.939	0.955	0.931
	(0.0725)	(0.0725)	(0.0718)	(0.0696)	(0.0832)
Likelihood Ratio χ^2	1.21	0.97	2.01*	0.75	1.96*
AIC	922.53	982.16	922.60	886.07	807.36
Observations	6,721	6,721	6,721	6,721	6,669

Data consists of 1,981 breweries with 92 failures (Column (5) has 1,976 breweries and 91 failures). Clustered robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$. Regional fixed effects were included in all models.

Table 3: Exit Hazards for Brewpubs from Conditional Log – Log Estimation

	(1)	(2)	(3)	(4)	(5)
Rating	0.528*		0.565	0.766	0.995
	(0.201)		(0.232)	(0.319)	(0.453)
Rating Standard Deviation		2.135	1.383	1.840	3.355*
		(1.422)	(0.954)	(1.088)	(2.356)
Ln(Number of Ratings)				0.604***	0.828
				(0.0932)	(0.147)
Ln(Barrels)					0.295***
					(0.0553)
Open Year	0.982	0.977	0.981	0.999	
	(0.0200)	(0.0193)	(0.0199)	(0.0187)	
Real Beer Tax	1.549	1.573	1.576	1.252	1.496
	(0.974)	(0.978)	(0.985)	(0.727)	(0.934)
Franchise Laws	1.827	1.854*	1.839*	1.645	2.393***
	(0.670)	(0.666)	(0.675)	(0.539)	(0.774)
Self-distribution	0.548	0.573	0.548	0.669	0.563
	(0.228)	(0.244)	(0.228)	(0.277)	(0.268)
Breweries Per Capita	0.873	0.874	0.874	0.907	0.797**
	(0.0958)	(0.0961)	(0.0966)	(0.0886)	(0.0910)
Likelihood Ratio χ^2	7.39***	8.58***	7.53***	4.38**	12.87***
AIC	853.33	855.23	855.14	843.35	763.08
Observations	5,479	5,479	5,479	5,479	5,466

Data consists of 1,261 breweries with 82 failures.

Table 4: Microbrewery Hazards from Conditional Log-Log Model for Different Minimum Number of Ratings

Model	≥0 ratings	≥1 ratings	≥2 ratings	≥3 ratings	≥4 ratings	≥5 ratings
Rating		0.180***	0.140***	0.126***	0.110***	0.0885***
		(0.0397)	(0.0399)	(0.0332)	(0.0308)	(0.0277)
Northeast	0.772	1.019	0.940	0.941	1.022	0.932
	(0.242)	(0.389)	(0.340)	(0.327)	(0.375)	(0.362)
South	0.621	0.749	0.781	0.876	0.930	0.971
	(0.190)	(0.238)	(0.262)	(0.299)	(0.332)	(0.337)
West	0.912	1.098	1.020	0.857	1.017	0.900
	(0.209)	(0.308)	(0.310)	(0.238)	(0.278)	(0.270)
Open Year	0.967**	0.975	0.976	0.974*	0.975	0.981
	(0.0154)	(0.0169)	(0.0146)	(0.0151)	(0.0157)	(0.0161)
Real Beer Tax	1.051	1.082	0.914	0.968	1.076	1.145
	(0.436)	(0.482)	(0.511)	(0.524)	(0.588)	(0.622)
Franchise Laws	1.182	1.134	1.353	1.183	1.210	1.161
	(0.198)	(0.282)	(0.352)	(0.261)	(0.251)	(0.272)
Self-distribution	0.680	0.766	0.829	1.150	1.266	1.388
	(0.195)	(0.257)	(0.289)	(0.446)	(0.614)	(0.658)
Breweries per capita	0.881*	0.883*	0.905	0.929	0.927	0.942
	(0.0589)	(0.0601)	(0.0599)	(0.0674)	(0.0688)	(0.0725)
Likelihood Ratio χ^2	3.57**	6.03***	4.21**	2.16*	2.48*	1.21
Number of Breweries	2,241	2,121	2,091	2,054	2,027	1,981
Number of Failures	186	132	122	104	99	92
Observations	8,457	7,525	7,327	7,103	6,953	6,721

Clustered robust standard error in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

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Table 5: Brewpub Hazards from Conditional Log-Log Model for Different Minimum Number of Ratings

Model	≥0 ratings	≥1 ratings	≥2 ratings	≥3 ratings	≥4 ratings	≥5 ratings
Rating		0.697	0.658	0.590*	0.600	0.528*
		(0.180)	(0.175)	(0.175)	(0.223)	(0.201)
Northeast	1.289	1.575	1.344	1.348	1.555	1.602
	(0.285)	(0.583)	(0.585)	(0.609)	(0.760)	(0.899)
South	0.872	0.988	1.026	1.135	0.861	0.982
	(0.200)	(0.319)	(0.329)	(0.418)	(0.350)	(0.477)
West	1.173	1.334	1.332	1.128	1.193	1.257
	(0.287)	(0.450)	(0.473)	(0.415)	(0.408)	(0.522)
Open Year	1.013	0.997	1.000	0.974	0.974	0.982
	(0.0108)	(0.0165)	(0.0151)	(0.0199)	(0.0206)	(0.0200)
Real Beer Tax	1.527	1.895	1.804	2.050	2.973	1.549
	(0.548)	(0.841)	(0.952)	(1.317)	(2.217)	(0.974)
Franchise Laws	1.183	1.314	1.214	1.506	1.572	1.827
	(0.273)	(0.377)	(0.356)	(0.496)	(0.466)	(0.670)
Self-distribution	0.819	0.589**	0.491***	0.478**	0.497**	0.548
	(0.176)	(0.141)	(0.120)	(0.139)	(0.160)	(0.228)
Breweries per capita	0.854***	0.865**	0.841**	0.892	0.924	0.873
	(0.0512)	(0.0541)	(0.0648)	(0.0728)	(0.0744)	(0.0958)
Likelihood Ratio χ^2	1.78*	14.07***	10.43***	15.23***	10.07***	7.39***
Number of Breweries	1,550	1,429	1,388	1,336	1,312	1,261
Number of Failures	291	176	152	117	99	82
Observations	9,640	7,195	6,761	6,218	5,899	5,479

Clustered robust standard error in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

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Table 6: Exit Hazards Using sentiment and perceptions of taste, look, smell, and feel

	Micro	Micro	Brewpub	Brewpub
Sentiment	0.955***		0.963***	
	(0.00909)		(0.0124)	
Look		0.762		1.723
		(0.607)		(1.075)
Smell		0.808		0.306**
		(0.803)		(0.172)
Taste		0.196*		0.558
		(0.180)		(0.362)
Feel		0.799		2.033
		(0.723)		(1.664)
Open Year	0.944***	0.978	0.972	0.984
	(0.0155)	(0.0182)	(0.0191)	(0.0196)
Real Beer Tax	0.783	1.051	1.382	1.756
	(0.457)	(0.586)	(0.898)	(1.100)
Franchise Laws	1.112	1.143	1.816	1.958*
	(0.287)	(0.272)	(0.731)	(0.722)
Self-distribution	1.155	1.476	0.523	0.545
	(0.494)	(0.747)	(0.224)	(0.231)
Breweries Per Capita	0.856*	0.958	0.819	0.874
	(0.0743)	(0.0729)	(0.104)	(0.101)
Observations	6,721	6,694	5,479	5,380

Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$. Means (std. dev.) for micros are sentiment 31.88 (26.14); look 3.78 (0.25); smell 3.70 (0.30); taste 3.72 (0.32); 3.70 (0.29). For brewpubs: sentiment 19.01 (19.10); look 3.73 (0.29); smell 3.62 (0.34); taste 3.66 (0.37); 3.64 (0.34). A joint F-test of the senses variables are reject at the 1 percent level for microbreweries and the 5 percent level for brewpubs.

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Frake, Justin. 2017. "Selling Out: The Inauthenticity Discount in the Craft Beer Industry." *Management Science* 63 (11): 3930–43. https://doi.org/10.1287/mnsc.2016.2517.

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[1] https://web.archive.org/web/20180409053557/https://www.brewersassociation.org/statistics/craft-brewer-defined/

[2] https://www.brewersassociation.org/statistics-and-data/national-beer-stats/

[3] https://web.archive.org/web/20180409053557/https://www.brewersassociation.org/statistics/craft-brewer-defined/

[4] https://www.brewersassociation.org/statistics/market-segments/

[5] According to the American Beer Distributors, 93 percent of all breweries make less than 7,500 barrels. https://www.nbwa.org/resources/2015-industry-perspectives-brewery-size.

[6] To assure data quality we sampled a subset of breweries to ensure that we captured all of the reviews for the breweries. We did. Also, we do not use data from alternate websites ratebeer.com and untappd.com because their login structure and terms of use do not allow for scraping.

[7] This result reinforces the need to separate these two types of breweries due to selection bias. Higher quality breweries are more likely to enter as microbreweries instead of brewpubs. Pooling the data would lead to biased results.

[8] https://www.craftbrewingbusiness.com/business-marketing/why-craft-breweries-fail/

[9] https://www.craftbrewingbusiness.com/business-marketing/historic-success-rates-brewing-abnormal-beer-announces-1-million-expansion-six-months-makes-us-muse/

[10] Further, observation on seasonal beers were limited, which force us to aggregate our data to the brewery level instead of performing the analysis at the beer level.

[11] https://www.goodbeerhunting.com/sightlines/2021/2/23/how-untappd-ratings-became-craft-beers-most-fickle-prize

[12] https://www.goodbeerhunting.com/sightlines/2021/2/23/how-untappd-ratings-became-craft-beers-most-fickle-prize

[13] https://brewingindustryguide.com/reviews-taking-the-good-with-the-bad/

Responses to referees

We would like to thank the referees for there thoughtful comments on the paper. The comments for each referee are listed below as well as the corresponding responses. Changes to the text as a result of these comments are highlighted in yellow. The comments centered around three major themes: literature review, policy application towards brewers, and directions of future research. In response, we have included the recommend papers into our existing literature review; we have provided some policy direction toward brewers at the beginning of the conclusion; and we close the paper with areas of future research. We believe the paper has improve as a result of these comments.

Referee(s)' Comments to Author:

Referee: 1

Comments:

Thank you for allowing me to review your work. I found it interesting overall and hope my comments enable you to continue to improve it.

1. Originality: Does the paper contain new and significant information adequate to justify publication?: This paper is very interesting and has significant originality. While some work does exist on the topic, this added value and enriches insight.

Response: We thank the referees for their valuable comments and believe the paper is better as a result.

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: There were some key papers I was expecting to see referenced in here that were not. Makes me wonder how sufficient the lit review is given these are highly relevant:

Response: We have included the following papers in a text to expand the literature review.

Biraglia, Alessandro, and Vita Kadile. 2017. "The Role of Entrepreneurial Passion and Creativity in Developing Entrepreneurial Intentions: Insights from American Homebrewers." *Journal of Small Business Management* 55 (1): 170–88. https://doi.org/10.1111/jsbm.12242.
Frake, Justin. 2017. "Selling Out: The Inauthenticity Discount in the Craft Beer Industry." *Management Science* 63 (11): 3930–43. https://doi.org/10.1287/mnsc.2016.2517.

Kadile, V., & Biraglia, A. (2020). From hobby to business: Exploring environmental antecedents of entrepreneurial alertness using fsQCA. *Journal of Small Business Management*, 1-36.

Mathias, Blake D., and Greg Fisher. 2021. "That's Our Beer! Creating the Contentious Category of Collegiate Beer." *Journal of Management*, May, 01492063211008973. https://doi.org/10.1177/01492063211008973.
Mathias, B. D., Huyghe, A., & Williams, D. W. (2020). Selling your soul to the devil? The importance of independent ownership to identity distinctiveness for oppositional categories. *Strategic Management Journal*, 41(13), 2548-2584.

Mathias, Blake D., Annelore Huyghe, Casey J. Frid, and Tera L. Galloway. 2018. "An Identity Perspective on Coopetition in the Craft Beer Industry." *Strategic Management Journal* 39 (12): 3086–3115. https://doi.org/10.1002/smj.2734.

Solomon, Shelby J., and Blake D. Mathias. 2020. "The Artisans' Dilemma: Artisan Entrepreneurship and the Challenge of Firm Growth." *Journal of Business Venturing* 35 (5): 106044. https://doi.org/10.1016/j.jbusvent.2020.106044.

These qualitative studies compliment the quantitative study found in the paper. Specifically, these papers speak about the tradeoff between small independent craft entrepreneurs who are competing against much larger established brands. Collectively, the small craft brewers cooperate to grow the craft beer industry relative to the established big 3 large brewers. In the same vein, their very success and growth makes them appear to be more similar to the macrobreweries who they are competing against.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: I am not an expert on this methodology, but from my research into it and based on talking to a colleague about it, this seems reasonable. I appreciated the added robustness checks being included.

Response: Thank you, we feel this application may encourage others to use similar methods in future work.

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Results were well presented.

Response: Thank you, we have made no changes to the presentation of the results.

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: I believe the disconnect between theory and practice is problematic (with some exceptions) and that the best way to bridge the gap is to better facilitate translation. I just read a new editorial that talked about facilitating translation and think you should explore it / it may help you strengthen what you have here:

Joshua Bendickson (2021) Building entrepreneurship research for impact:
Scope, phenomenon, and translation, Journal of Small Business Management, 59:4, 535-543, DOI: 10.1080/00472778.2021.1905822

Response: We have added some discussion about how brewers can use the result from this paper as follows:

"For breweries these results have several actionable implications. When opening a brewery, size matters. The optimal size for survival from our analysis indicates that breweries should produce around 18,000 barrels per year. Breweries should also be aware of the ratings of their beers as well as the variability of ratings. They should consider dropping beers with lower ratings. Further, brewers

might examine which types of beers are trending with higher ratings. We have seen this strategy in the past few years with the popularity of New England IPA's and West Coast IPA's and the trend away from the earlier popular quadrupel beers. One web article reports that ratings are being used to justify business decisions of beer delivery apps.[i] Breweries do monitor reviews and respond to them. Playalinda Brewing Company has an employee who monitors reviews and responds to each one.[ii] An interesting extension would examine how breweries that respond to review fare relative to those who ignore them. "

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: Paper reads well.

Response: Thank you.

Referee: 2

Comments:

Comment: Elaborate on discussion section and add future directions of research.

Response: We have increased the discussion section to include actionable items that the brewers can take using these results.

Comment: If it is possible to add some perspective of brewer owner on what is the reason for failure, that will add value to the paper.

Response: In an interview with Bart Watson, chief economists of the Brewers Association, the most common feature of failed breweries is producing too little. Specifically, producing less than 395 bbls. This is consistent with the results in the paper. However, it is not clear why these breweries were producing so little. There are several potential reasons: low capacity, low demand, unexpected cost, etc. A part of the interview can be found here (https://www.craftbrewingbusiness.com/business-marketing/why-craft-breweries-fail/). There is also this previous interview from 2013 that includes the chart below of both the incredible growth in the industry over time as well as the leveling out of 3 year survival rates (https://www.craftbrewingbusiness.com/business-marketing/historic-success-rates-brewing-abnormal-beer-announces-1-million-expansion-six-months-makes-us-muse/).

We have made references to these interviews/report in the paper (see the text on page 18 as well as endnotes 8 and 9).
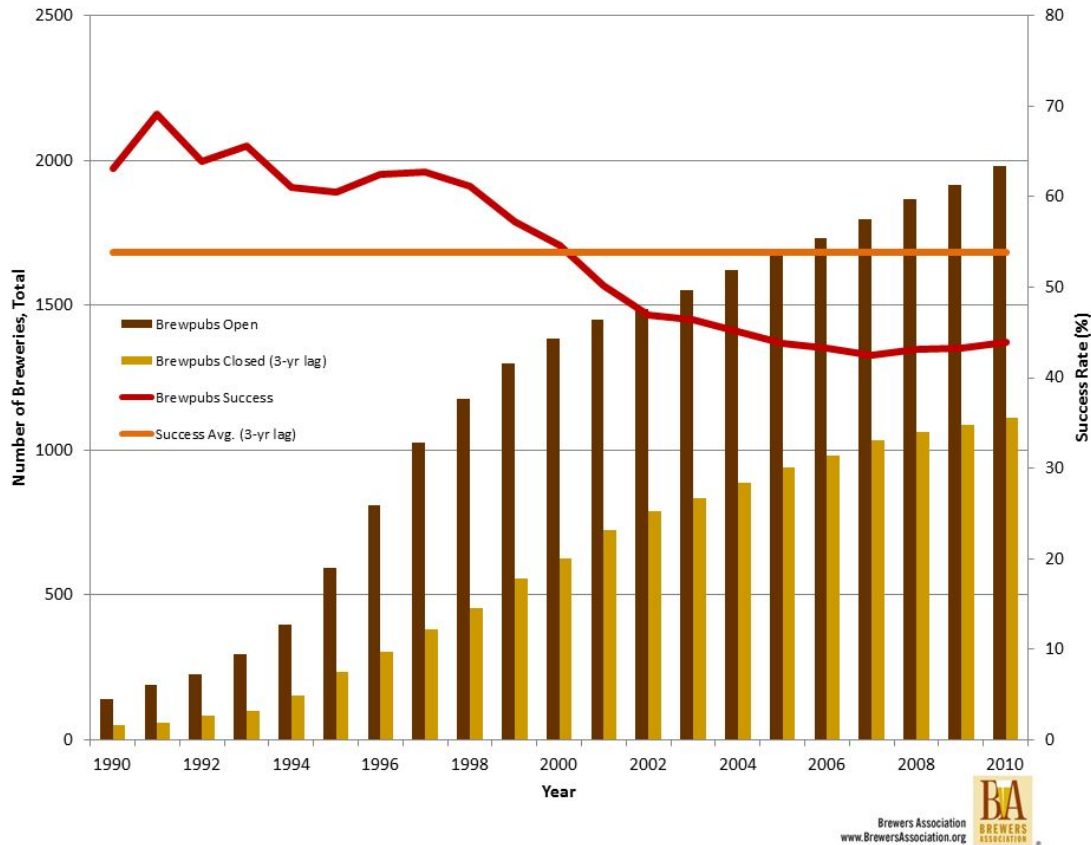
1. Originality: Does the paper contain new and significant information adequate to justify publication?: yes.. This paper has covered an industry having good economic potential.

Response: Thank you, we agree that the craft beer industry remains under explored.

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: Yes.. very well supported with the literature and theory

Response: We have added the following papers as a response to one of the other referee's comments.

Biraglia, Alessandro, and Vita Kadile. 2017. "The Role of Entrepreneurial Passion and Creativity in
        Developing Entrepreneurial Intentions: Insights from American Homebrewers." *Journal of Small
        Business Management* 55 (1): 170–88. https://doi.org/10.1111/jsbm.12242.
Frake, Justin. 2017. "Selling Out: The Inauthenticity Discount in the Craft Beer Industry." *Management
Science* 63 (11): 3930–43. https://doi.org/10.1287/mnsc.2016.2517.

Kadile, V., & Biraglia, A. (2020). From hobby to business: Exploring environmental antecedents of
entrepreneurial alertness using fsQCA. *Journal of Small Business Management*, 1-36.

Mathias, Blake D., and Greg Fisher. 2021. "That's Our Beer! Creating the Contentious Category of
        Collegiate Beer." *Journal of Management*, May, 01492063211008973.
        https://doi.org/10.1177/01492063211008973.

Mathias, B. D., Huyghe, A., & Williams, D. W. (2020). Selling your soul to the devil? The importance of independent ownership to identity distinctiveness for oppositional categories. *Strategic Management Journal*, 41(13), 2548-2584.

Mathias, Blake D., Annelore Huyghe, Casey J. Frid, and Tera L. Galloway. 2018. "An Identity Perspective on Coopetition in the Craft Beer Industry." *Strategic Management Journal* 39 (12): 3086–3115. https://doi.org/10.1002/smj.2734.

Solomon, Shelby J., and Blake D. Mathias. 2020. "The Artisans' Dilemma: Artisan Entrepreneurship and the Challenge of Firm Growth." *Journal of Business Venturing* 35 (5): 106044. https://doi.org/10.1016/j.jbusvent.2020.106044.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Yes.. a large set of data is taken and analysed.

Response: Thank you, we feel the data adds to the contribution. We are able to use both numerical and text measures of quality due to the type of data used.

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: I find that the discussion and conclusion section is a little brief and need little elaboration.

Response: We have increased the discussion section to include actionable items brewers can used as a result of this research. We have also increased the discussion with respect to future research. We have copied these two new parts of the paper below for your convenience.

"For breweries these results have several actionable implications. When opening a brewery, size matters. The optimal size for survival from our analysis indicates that breweries should produce around 18,000 barrels per year. Breweries should also be aware of the ratings of their beers as well as the variability of ratings. They should consider dropping beers with lower ratings. Further, brewers might examine which types of beers are trending with higher ratings. We have seen this strategy in the past few years with the popularity of New England IPA's and West Coast IPA's and the trend away from the earlier popular quadrupel beers. One web article reports that ratings are being used to justify business decisions of beer delivery apps.[iii] Breweries do monitor reviews and respond to them. Playalinda Brewing Company has an employee who monitors reviews and responds to each one.[iv] An interesting extension would examine how breweries that respond to review fare relative to those who ignore them. "

"Future research should try to identify how these ratings are used. Are suppliers responding to ratings by improve the quality of the beer or removing poorly rated beers from the rotation? Are these rating websites used by consumers ex-ante to choose beers or ex-post to tract the beers they have experienced?"

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society

(influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: Further directions of research should have been provided.

Response: We have included further directions for research and have reported the text in the data within our response to bullet point 4.

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: Regular editing is needed

Response: We have edited the paper.

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i https://www.goodbeerhunting.com/sightlines/2021/2/23/how-untappd-ratings-became-craft-beers-most-fickle-prize
ii https://brewingindustryguide.com/reviews-taking-the-good-with-the-bad/
iii https://www.goodbeerhunting.com/sightlines/2021/2/23/how-untappd-ratings-became-craft-beers-most-fickle-prize
iv https://brewingindustryguide.com/reviews-taking-the-good-with-the-bad/