Entry and Competition in the U.S. Brewpub Industry

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ABSTRACT

This paper examines product differentiation and market structures in the U.S. brewpub industry. The beer market in the U.S. has made a massive transition from macrobreweries to microbreweries in the last 40 years. Brewpub restaurants are characterized by whether they are single- or multi-establishment restaurants. Using data from 2002 through 2014 we investigate how entry behavior of firms is affected by the existence of opposite-type brewpubs in the market. Preliminary results indicate that, while controlling for market characteristics such as population size, the existence of an opposite type has a negative effect on entry to the market. These effects are diminished as the number of opposite-type firms' increases.

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INTRODUCTION

In the last 40 years the brewpub market has burgeoned from nonexistence. The explanations for this growth vary from tax incentives to a demand taste arising from Californian wine lovers; regardless, the market appears here to stay. A few interesting features of the brewpub market are that it is plausible to believe the markets for this product are relatively small, and that there are two major types of brewpubs. The first is a multi-establishment brewpub, or "chain" brewpub. The second is a single-establishment, independently owned brewpub. These two distinct types allow us to look at the effect that these imperfect substitutes have on one another.

A generally held belief by economists is that as the number of firms in a market increase, prices converge to a competitive level. However, this convergence depends greatly on many factors including the problem of separating out demand and other strategic components. Several studies, including Bresnahan and Reiss (1987, 1991) and Xia and Orazem (2011), have developed econometric models addressing the relationship between market structure and the entry decisions of firms. Bresnahan and Reiss define profits by multiplying market size by profit variables then subtracting fixed costs, with each of these three elements defined as a reduced form linear function. Alternative studies such as Mazzeo (2002) and Greenstein and Mazzeo (2006) construct a model of entry based on market characteristics and different types of firms. It is their work which we will follow closely throughout this paper. This paper proceeds as follows: section II discusses relevant literature, III discusses the data, IV sets up a theoretical framework, V discusses results, and VI concludes.

LITERATURE REVIEW

Considerable prior research has been conducted to develop empirical models of market structure and firm entry. An obstacle to studying entry behavior is that prices and costs are often unknown. By observing the conduct of a market, certain market characteristics can be determined and profitability can be inferred. Entry behavior can be modeled from these observations even when costs and prices are unknown. Previous studies have examined the entry behavior of firms in oligopoly markets using this method.

Bresnahan and Reiss (1991) devise such an entry model when prices and costs are unobservable. In order to examine the effect of firm entry on market conduct, they develop a measure of the market size needed to support a given number of firms. This measure— the demand entry threshold— can be observed when prices and costs cannot. The demand entry threshold ratio compares change in market demand with change in the equilibrium number of firms. It is expected that the greater the number of firms in a market, the larger the market size needs to be to accommodate increased competition. Increased competition reduces a firm's pricing power and thus a larger market is needed for the firm to recover its fixed costs. Bresnahan and Reiss specify a reduced form profit function due to unobservable costs and prices. They use an ordered probit model with the number of firms as the dependent variable to determine the threshold market size for the first five entrants in a given market. The second and third entrants notably increase the level of competition. After the third entrant, however, the threshold market size and therefore the level of competition, does not increase greatly. Like Bresnahan and Reiss (1991), we use an ordered probit model with the number of firms as the dependent variable.

Difficulties of the model used in Bresnahan and Reiss's study are the necessity of isolated markets and the assumption of firm homogeneity. The majority of prior empirical models of firm entry also adopt the assumption that firms are identical. Berry (1992) develops a model in which there is heterogeneity among potential entrants. Heterogeneity among firms can take a variety of forms, including differences in costs and product attributes. The manner by which heterogeneous firms differ can influence characteristics of the market, such as Bresnahan and Reiss's observed relationship between the size of the market and the number of firms it is able to support.

The inclusion of firm heterogeneity in Berry's model makes it more complex than Breshnahan and Reiss's. Berry's model identifies not only the number of firms, but also varying characteristics of firms. Determining the equilibrium number of firms increases in difficulty in this case as there are often multiple equilibria. The approach used by Greenstein and Mazzeo (2006) eliminates the issue of multiple equilibria. They use a Stackelberg game to model firm entry, which indicates that firms make moves sequentially rather than simultaneously. This allows for firm heterogeneity as well as a unique equilibrium. The Stackelberg specification means that more profitable firms will move first and equilibrium is reached when no more potential entrants want to enter the market at each stage.

Greenstein and Mazzeo examine entry behavior based upon whether a firm is established locally or nationally. This heterogeneous firm characteristic may affect consumer demand and firm profitability. They utilize reduced form profit functions for local and national firm types, including the number of same-type firms in the market for each. These functions allow for the entry of one type of firm to affect the profits of same-type and opposite-type firms differently. Similar to Bresnahan and Reiss, they find that the first entrants in a market have a greater effect on competition than later entrants. They also determine that entry of a similar type decreases profits much faster than entry of a dissimilar type. Because we examine heterogeneity among potential market entrants (single- or multi-establishment firms),

we use ideas presented by Greenstein and Mazzeo (2006) and Berry (1992), as these studies similarly include varying characteristics among firms.

Firm heterogeneity is particularly important in analyzing single- and multi-establishment entry behavior. A firm's cost of entering and operating influence its profitability and therefore entry behavior. Multi-establishment firms may be able to share operating costs while single-establishment firms cannot. Local market demand is another factor influencing firm profitability and market characteristics. The inclusion of demand determinant variables accounts for the variation in local demand across markets. For the brewery industry in particular, Tremblay and Tremblay (2005) state that possible demand determinants are consumers' income and consumption levels, the price of beer and the price of substitutes and complements. Carroll and Swaminathan (2000) also suggest that consumers prefer firms that are small and locally established, rather than large more expansive firms.

DATA

Sources

Defining the market for brewpubs is the most difficult task in determining their entry thresholds. Some brewpubs specialize in selling beer at other locations. However, to be classified as a brewpub it must sell 25% or more of its beer on-site. In a recent publication Bart Watson estimates conservatively that 90% of brewpub volume is sold on-site.[1] Given this information, it is reasonable to assume the market for brewpubs is localized.

The data for this paper comes from two sources: The New Brewer Magazine and the United States Census Bureau. The first is cross-sectional information about the presence of brewery restaurants. The New Brewer Magazine reports the presence of a brewpub operating in a given city across the United States, along with brewery production level. The data are reported every three years. As such, we have information for the years 2002, 2005, 2008, 2011, and 2014. The second source of data is estimates of demographic information, such as population and median income that are used as control variables for each of the five years. These estimates are obtained from the American Community Survey via the United States Census Bureau.

Sample Construction

We construct a sample of every city in the United States with at least one brewpub in 2002, 2005, 2008, 2011, or 2014. This gives 1139 raw observations in the sample. Table I gives the number of observations with 1, 2, or 3+ brewpubs operating in the United States over the sample. Between 27 and 46% of the samples have zero brewpubs at some point, however the number of observations with zero brewpubs decreases over the time period.

A major difference in how brewpubs may attract customers has to do with their ownership structure. Many brewpubs may be part of a "chain" or have multiple locations in the same or different cities; others may be stand-alone. We classify brewpubs that operate in only one location as single-establishment firms, and those that operate in many locations as multi-establishment firms. Table II summarizes the breakdown of single- and multi-establishment brewpubs in 2002 and 2014.

[1] https://www.brewersassociation.org/insights/microbrewery-tap-room/

It is worth noting that in cities with fewer brewpubs operating the brewpubs tend to be single-establishment entities. For instance in 2002 there are 368 markets with only one single-establishment brewpub, but only 78 cities with one multi-establishment brewpub.

Finally, we must incorporate differences in market structures for each year; for this, we use the combined data from the American Community Survey. When county subdivision data was unavailable, county level data was used. In order to control for market size, we present *Population,* which is the population in millions, *Family Households,* which is the percentage of households that house a family, *Age*, which is the average age of people in the city, and *Median Income*, which is the average household income in tens of thousands of dollars. In order to account for city composition, we use *Male,* which is the percent of the population who are male, *High School,* which is the percentage of the population that obtained a high school degree or greater, and *German* and *Irish*, which denote the percentage of residents who are German and Irish respectively. Finally, to account for costs we present *Food Prep Wage*, which is the average wage for jobs involving food cooking and preparation in thousands of dollars, and *Area*, which is the land area in square miles for each city. Table III describes the summary statistics for the control variables.

EMPIRICAL ENTRY MODEL

Because prices and costs are unknown, a reduced form profit function is estimated. The function is of the following form:

$$\pi_m(N_m, w_m) = N_m\beta + w_m\gamma + \varepsilon_m$$

where w_m are market characteristics, *m* is an isolated market, and N_m is the number of firms that have entered. If the level of competition in market m is reflected by N_m, the equilibrium number of firms in market m is given by:

$$N_m = 0 \quad \text{if} \quad \pi^1{}_m + \varepsilon_m < 0$$

$$N_m = N \quad \text{if} \quad \pi^N{}_m + \varepsilon_m \geq 0 \quad \text{and} \quad \pi^{N+1}{}_m + \varepsilon_m < 0$$

where the profit of firm N is a function of N_m, w_m. This assumes that each market contains the maximum number of firms such that each firm is profitable. The inclusion of $w_m\gamma$ accounts for some of the exogenous characteristics that vary between markets and market structures. ε_m contains some of the unobservable determinants of firm profitability.

The probabilities of observing N firms in market m are estimated using an ordered probit model. This model computes probabilities from a normal cumulative density function, assuming the error term is independent and identically distributed and normal across markets. The probabilities of observing N firms in market *m*:

$$P(N_m = 0) = 1 - \Phi(\pi^1{}_m)$$

$$P(N_m = 1) = \Phi(\pi^1{}_m) - \Phi(\pi^2{}_m)$$

$$P(N_m = 2) = \Phi(\pi^2{}_m) - \Phi(\pi^3{}_m)$$

$$P(N_m \geq 3) = \Phi(\pi^3{}_m)$$

This framework can be modified to apply to heterogeneous firm types; single- and multi-establishment. Firms with a single-establishment are specified as Y, and firms with multi-establishments specified as X. In this case, different reduced-form profit functions are needed for each firm type.

The function for single-establishment firms:

$$\pi_{Ym}(N_{Xm}, w_m) = N_{Xm}\beta_X + w_m\gamma + \varepsilon_m$$

Where π_{Ym} is the profit of single-establishment firms and N_{Xm} is the number of multi-establishment firms.

The function for multi-establishment firms:

$\pi_{Xm}(N_{Ym}, w_m) = N_{Ym}\beta_Y + w_m\mu + \delta_m$

Where π_{Xm} is the profit of multi-establishment firms and N_{Ym} is the number of single-establishment firms.

A market with both single- and multi-establishments implies the following:

1. The profit for both types is greater than zero.
   $\pi_X (X, Y) > 0$
   $\pi_Y (X, Y) > 0$
2. Additional firms of either type will not increase profits.
   $\pi_X (X, Y+1) < 0$
   $\pi_Y (X+1, Y) < 0$
3. The number of single- and multi-establishments is at the profit-maximizing combination.
   $\pi_X (X, Y) > \pi_Y (X-1, Y+1) > 0$
   $\pi_Y (X, Y) > \pi_X (X+1, Y-1) > 0$

EMPIRICAL RESULTS

The model of differentiated entry used in this paper allows for up to three firms of each type in the market yielding nine possible alternatives. The estimates of the model using ordered probit are presented in Tables IV and V. Because of this model selection, the magnitude of the coefficients is not readily interpretable, but the sign is. The variables for the controls have already been defined but we have six new variables: *Multi-Competitor 1,* the effect of the first multi-establishment competitor on single-establishment brewpubs; *Multi-Competitor 2,* the effect of the second multi-establishment competitor on single-establishment brewpubs; *Multi-Competitor 3,* the effect of the third multi-establishment competitor on single-establishment brewpubs; *Single-Competitor 1,* the effect of the first single-establishment competitor on multi-establishment brewpubs; *Single-Competitor 2,* the effect of the second single-establishment competitor on multi-establishment brewpubs; *Single-Competitor 3,* the effect of the third single-establishment competitor on multi-establishment brewpubs.

Looking at the coefficients on our control variables first, we see that for single- and multi-establishment firms having a greater population increases entry as shown by the coefficient on *Population.* However, this effect is greater for multi-establishment brewpubs than single-establishment brewpubs. Having an older population also increases probability of entrance, although at a decreasing rate. This effect is less significant for single-establishment firms. One possibility for this trend is that single-establishment brewpubs may be viewed as more "trendy" and therefore not more likely to enter cities that have older populations. Similarly, median income increases entrance for multi-establishment firms but appears to be unimportant for single-establishment firms. Other control variables have plausible signs but are not statistically significant.

Turning to our variables of interest for multi-establishment brewpubs first, we can see that for all years all of the coefficients are negative and strongly statistically significant. It should be pointed out that for all years the effect on entry of an additional single-competitor brewpub diminishes. Therefore, the entrance of the first single-establishment brewpub has the greatest negative effect on entry. In addition,

as the market has grown across the board, the effect of single-establishment firms appears to be growing. This may suggest that consumers are finding a preference for "niche" or original brewpubs.

For the variables of interest for single-establishment brewery restaurants, the coefficients are all negative, however the effect of a third multi-competitor in the market appears to have no effect on the entry of a single-establishment firm. In addition, the coefficients, in general are smaller than those from the multi-establishment model, indicating that the presence of multi-establishment firms is not such a large barrier for single-establishment firms. Taken with other results this may suggest that in some ways, multi-establishment firms open up a market to the idea of brewpubs, but are not such a strong detriment to single-establishment firm entry. Conversely, it could indicate that once a market has a desire for the product, it can be profitable for single-establishment firms to enter.

Since the coefficients of the ordered probit can only be interpreted in terms of sign and significance, projected probabilities can be calculated to give a better idea of the effect that opposite-type firms have on entry. These probabilities are given in Table VI for multi- establishment firms and in Table VII for single-establishment firms. As can be seen from the tables, these probabilities are similar in significance to the ordered probit coefficients.

We can see that going from zero multi-establishment firms in the market to one firm decreases the probability of single-firm entry by about 20–35%. However, the addition of a second multi-firm only decreases the probability of entry by about 10–20%, and the addition of a third does not significantly change the probability. For multi-establishment firms, going from no single-firms to one single-firm decreases the probability of entry by 40–45%. The addition of a second single-firm decreases the probability of entry by 30–40%, and the addition of a third by 25–35%.

CONCLUSION

This paper looks at the brewpub industry which is characterized by endogenous product choices and results in an oligopoly structure. We characterize restaurants as imperfect substitutes: single-establishment and multi-establishment firms. The first unsurprising conclusion is that the existence of one firm of an opposite type makes the market less attractive for entry, but that this effect weakens as additional opposite-types are added. In the case of the single-establishment firms, the third or greater multi-establishment firm had no statistically significant effect on entry. This may be due to the fact that having a greater presence of brewpubs indicates some unique factor of the market not captured in demographic variables indicating high profitability.

Table 1: Number of Operating Brewery Restaurants in the Market

	Year				
Operating	*2002*	*2005*	*2008*	*2011*	*2014*
0	527	497	494	451	229
1	446	476	504	519	605
2	92	10	84	114	176
3+	74	65	57	55	129
Total	1139	1139	1139	1139	1139

Table 2: Number of Single- and Multi-Establishment Brewpubs in a City

2002 Data

	Multi-				
Single-	*0*	*1*	*2*	*3+*	*Total*
0	526	78	12	1	617
1	368	31	8	6	413
2	49	8	7	3	67
3+	16	14	8	4	42
Total	959	131	35	14	1139

2014 Data

	Multi-				
Single-	*0*	*1*	*2*	*3+*	*Total*
0	229	92	13	8	342
1	513	36	4	4	557
2	127	20	2	3	152
3+	43	22	14	11	88
Total	912	170	31	26	1139

Table 3: Summary Statistics

Variable	*Mean*	*Max*	*Min*	*Std Deviation*
Population	101,609.50*	3,196,112	24	257,818.50*
Percent Male	49.1523	67.4	40.1	2.4104
Median Age	38.9953	64.5	20.3	7.0703
Percent White	82.1641	100	7.3	15.7849
Percent HS Graduate	89.0757	100	59.4	5.989
Percent Bachelor's Degree	31.6266	82	0	14.4242
Median Income	34,245.91	100,015	5334	10,921.72
Percent Family Households	62.9684	85.4	27.4	9.4401
Area	82.7646	12,770	0.2	433.6761
Food Prep Wage	18278.64	20,920	17,270	512.1576

Table 4: Effects on Multi-Establishment Brewpub Entry

	2002	2005	2008	2011	2014
1 Single-Competitor	-1.994646***	-2.238499***	-2.127277***	-2.305104***	-2.364982***
	[.1527168]	[.1546523]	[.1581495]	[.1600471]	[.1415447]
2 Single-Competitors	-1.520472***	-1.579767***	-1.725274***	-2.073357***	-2.162151***
	[.230648]	[.2086464]	[.2398515]	[.2612599]	[.1693141]
3+ Single-Competitors	-1.171979***	-1.331405***	-1.728119***	-1.882323***	-1.286602***
	[.250825]	[.4012608]	[.4024685]	[.3719749]	[.1808514]
Area	-2.723885	-6.632886	-11.48521	-2.815278	-1.237387
	[5.312899]	[5.021671]	[9.235255]	[-2.815278]	[1.802138]
Food Prep Wage	1.953808	1.107807	1.496762	3.041081	1.191359
	[2.557272]	[2.171702]	[2.145289]	[2.768311]	[2.141799]
Family Households	-1.673245***	-1.420054*	-2.145638***	-2.287727***	-2.603119***
	[.7417407]	[.7677883]	[.8281088]	[.735028]	[.6819877]
High School	1.859775	-0.0678602	-0.8701056	1.435303	0.8973149
	[1.637453]	[.1418377]	[1.749657]	[1.701071]	[1.544676]
Bachelors	0.2070373	1.182927*	1.234551	1.309582*	1.393911**
	[.8690932]	[.665401]	[.8249488]	[.7432752]	[.6817915]

Male	-3.686781	-3.663935	-0.6860394	-3.39366	-3.456196
	[3.477061]	[3.579062]	[2.754134]	[2.371154]	[3.185094]
White	-.8872411*	-0.2009957	0.1202813	-0.3975506	-.0831387**
	[.5127286]	[.4812006]	[.5504918]	[.5091917]	[.0377877]
Median Income	15.95068	-4.143054	-3.143765	-8.937985	-5.192739
	[12.35018]	[9.923169]	[10.08057]	[8.89185]	[7.697271]
Age	0.3167441***	0.255573***	.3957675***	.3639928***	.2693696***
	[.1120562]	[.0960298]	[.0959751]	[.0865616]	[.0861037]
Age 2	-0.0047356***	-0.003597***	-.0054638***	-.0048537***	-.0036521***
	[.0015854]	[.0013299]	[.0013417]	[.0012049]	[.0011107]
Population	1.357867***	1.721886***	1.79402***	1.72852***	.9325027***
	[.3535816]	[.4149442]	[.4400733]	[.3466059]	[.2081376]
Population Density	0.8774485	-6.216774	10.20331	12.91944	-4.271464
	[10.00944]	[11.24727]	[9.517688]	[10.3468]	[9.421578]
Observations	612	641	645	688	910

*Notes: *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level. Robust standard errors in brackets; Regional fixed effects used but coefficients not reported.*

Table 5: Effects on Single-Establishment Brewpub Entry

	2002	*2005*	*2008*	*2011*	*2014*
1 Multi-Competitor	-1.453493***	-1.72568***	-2.225749***	-2.090863***	-1.269762***
	[.1918319]	[.1859899]	[.2127808]	[.1993868]	[.1523016]
2 Multi-Competitors	-.7552923**	-1.079141***	-1.105805***	-1.673597***	-.6736324**
	[.3397825]	[.3494333]	[.4196246]	[.4642845]	[.3282711]
3+ Multi-Competitors	-0.6191974	-0.6776619	-0.4589722	-0.820417	-.6606924*
	[.5183687]	[.66107]	[.4648558]	[.556839]	[.3979605]
Area	5.516204	14.93302***	2.248311	-0.309196	-0.7175007**
	[4.604034]	[5.282778]	[2.52608]	[.4508646]	[.3435478]
Food Prep Wage	1.181679	-1.755249	-0.5476458	-0.5636969	-2.179743
	[1.588663]	[1.525776]	[1.629281]	[1.661956]	[1.338527]
Family Households	-2.47325***	-3.00029***	-0.2451977	-3.987974***	-2.787869***
	[.6842631]	[.6851499]	[.2006005]	[.6234031]	[.5082195]
High School	2.562832**	-0.0427267	-0.1789785	1.513273	0.5812036
	[1.172318]	[.0747431]	[1.435748]	[1.080594]	[1.027365]
Bachelors	0.1492004	-0.0621739	1.882156**	0.4806996	0.6923649
	[.7516444]	[.5527079]	[.8127179]	[.6104669]	[.5067713]
Male	-0.2306906	-1.33434	0.672894	-0.8644678	-0.8861731
	[2.332516]	[2.344409]	[2.637504]	[1.928094]	[1.377079]
White	-1.315667***	-.7178763*	-1.018826**	-0.4604572	-0.0500745
	[.4417049]	[.4332904]	[.4908489]	[.3995165]	[.0331812]
Median Income	-20.22192*	7.287636	-25.89279***	-8.851055	-7.982395
	[11.04992]	[9.982306]	[8.535295]	[7.263472]	[7.011846]
Age	0.152475*	-0.0163018	.1637149***	.1299674***	0.0473591
	[.0895692]	[.0120267]	[.0604118]	[.0483368]	[.0417622]
Age 2	-.0022665*	0.0000324	-.0022979***	-.0016236***	-0.0006122
	[.0012122]	[.0000268]	[.0007777]	[.0006124]	[.0005069]
Population	1.555144***	1.375961***	1.149044***	1.603958***	1.471561***
	[.505717]	[.5155797]	[.3983412]	[.3526076]	[.4194847]
Population Density	-14.46097	-9.153527	-5.855287	-0.3228834	-5.293802
	[10.29246]	[11.16351]	[7.892061]	[9.724938]	[7.28708]
Observations	612	641	645	688	910

*Notes: *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level. Robust standard errors in brackets; Regional fixed effects used but coefficients not reported.*

Table 6: Marginal Effects on Multi-Establishment Brewpub Entry

	2002	*2005*	*2008*	*2011*	*2014*
1 Single-Competitor	0.4212806***	.45316***	.4332394***	.4228059***	.4369389***
	[.0202582]	[.0161398]	[.0149711]	[.0184352]	[.0167514]
2 Single-Competitors	.3211322***	.3198069***	.3513678***	.3802984***	.3994653***
	[.0460526]	[.0402754]	[.0444768]	[.0422634]	[.0287048]
3+ Single-Competitors	.2475287***	.2695287***	.3519472***	.3452587***	.2377044***
	[.0538374]	[.0821192]	[.0801018]	[.0683107]	[.0347441]

*Notes: *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level. Robust standard errors in brackets.*

Table 7: Marginal Effects on Single-Establishment Brewpub Entry

	2002	*2005*	*2008*	*2011*	*2014*
1 Multi-Competitor	.2270509***	.3108848***	.3443617***	.3069831***	.2070338***
	[.0271287]	[.0237033]	[.0138897]	[.0176087]	[.0245477]
2 Multi-Competitors	.1179846**	.1944095***	.171087**	.2457196***	.1098353**
	[.0542722]	[.0640561]	[.0661429]	[.0690407]	[.0543661]
3+ Multi-Competitors	.0967252	.1220822	.0710109	.1204546	.1077254
	[.080964]	[.119753]	[.0710109]	[.0827765]	[.0660973]

*Notes: *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level. Robust standard errors in brackets.*

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