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Measuring Market Power in the Japanese Beer Industry

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Abstract

We investigate various characteristics, including firm-level panel data, of the Japanese beer market over time (over 30 years) to determine the level and nature of competition. Next, we conduct two sets of regressions using market share and firm-level accounting data in a variation of Boone's (2008) measure of competition. While traditional indicators (very high market concentration, little or no overt price competition) suggest that Japanese beer firms do not compete, Boone-style regressions yield strong evidence of competitive behavior.

Keywords: New Empirical Industrial Organization, Beer, Monopoly Power, Collusion

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1. Introduction

The beer industry is a popular topic to investigate. It is a fairly well-understood product which seemingly exhibits little change over the years, unlike say, semiconductors, which are being reinvented every two years or so. It is a widely consumed product and often included in demand elasticity studies. At the same time, it is an addictive alcoholic beverage often "sin-taxed" quite heavily. This makes it an interesting topic in public finance. Lastly, in some countries, indeed, internationally, it is an industry which is dominated by several large firms, which makes it an ideal focus of study in industrial organization.

Despite these observations, the beer industry in Japan seems to be very much understudied, at least in any rigorous, empirical work.[1] This is even more puzzling given the fact that in many ways the Japanese beer industry represents a near-textbook example of a potentially collusive oligopoly. Approximately 99% of the domestic market is captured by four firms.[2] Imported beer is tiny, amounting to 33,706 KL in 2008 (Source: Japan Trade Statistics, *Gaikoku Boueki Gaikyou*).[3] As total consumption of beer in Japan was approximately 5,813,000 KL in 2010 (and 5,981,000 in 2009) (source: Kirin Institute of Food and Lifestyle), imports are only approximately 0.6% of the market.[4] Thus, with such a closely held market, application of either traditional or more recent methods empirical industrial organization seems warranted.

This paper aims to fill that gap. The next section will briefly describe some characteristics of the Japanese beer industry. Section 3 will discuss empirical methods for assessing market structure and power in oligopolistic settings, with emphasis on the so-

[1] There is a great deal of business, marketing and management literature on the Japanese beer industry in the Japanese language, yet more empirical work, in English or Japanese, appears scarce. This paper is an extension of a working paper Parsons (2007) which used several alternative (and older) market power measures.

[2] The four largest firms are: Kirin, Asahi, Sapporo, and Suntory. In May 2003 the Okinawa-based Orion Beer company acquired the licensing rights to produce (at its only plant) and sell Asahi Super Dry. (Source: Orion homepage, www.orionbeer.co.jp, accessed October 23rd, 2006.)

[3] Moreover, when discussing major foreign brands one encounters in Japan, it is of interest to note that, for example: Kirin produces Budweiser under license in Japan and has exclusive importing rights for Heineken and Pilsner Urquell; Sapporo imports Guinness; Asahi imports Miller "Special", Bass Pale Ale, and Tsingtao and brews Lowenbrau in Japan.

[4] For those interested in such statistics, this works out to 52 liters per Japanese (15 and over) per year (based on October 1st, 2010 population statistics at www.stat.go.jp).

called NEIO or New Empirical Industrial Organization approaches summarized in Bresnahan (1989) and the more recent Boone (2007, 2008a, 2008b) method. Section 4 will present econometric evidence on the degree of competition based on tests developed by Boone (2008). The results of these regressions based on market shares and firm-level accounting data suggest that, contrary to *prima facie* evidence of little competition and monopoly power by traditional indicators, the Japanese beer industry is characterized by vigorous competition. Section 5 will conclude with a summary of the main findings, and discuss remaining puzzles.

2. Industry History and Characteristics

Around 1870, shortly after the Meiji Restoration, foreigners began making beer in Yokohama, Japan. The "first and largest" foreign beer brewery in Japan, Spring Valley Brewery, was established at that time by a naturalized American, William Copeland, who was trained in his native Norway.[5] Later, many small domestic breweries grew and imported beer volume fell. Many of these domestic start-ups were formerly *sake*-producing families who decided to diversify. After much organizational and technological change in the ensuing 80 years or so, three major brewers eventually emerged in the post-war period: Asahi, Sapporo and the largest, Kirin, formerly "The Japan Brewery", whose first brewery was established on the very grounds of William Copeland's Spring Valley.

In 1964, whisky maker Suntory entered the beer market. Also, the Okinawa-based Orion beer corporation was established in 1957. However, Orion supplies less than 1% of the national market, the large majority of those sales occurring in the local Okinawa market. In 1994, a major legislative change was enacted which removed considerable barriers to entry in the brewing industry. Previously, brewers had to produce a minimum of 2000 kiloliters (kl). This was reduced to a relatively miniscule 60 kl per year. As one might expect, Japan's own micro-brew (or in Japanese, "regional beer" or *ji-biiru*) boom

[5] Most of the history in this section is from a brief, but excellent history of the Japanese beer from its Meiji beginnings to present found in Fuess (2006).

ensued. Having said that, after 18 years of deregulation, Japanese *ji-biiru* still only represents less than 1% of total national sales.[6]

Another interesting feature of the retail Japanese beer market is that all four major brands are typically sold for exactly the same price right along side each other. While there will be small price differences (a few yen) across different retail outlets, and occasionally one beer will be priced on sale a few yen less one week in the same store, there is virtually no price competition among these four major brewers. [7] While this by no means guarantees collusion, as numerous game-theoretic based models have shown, it is at least suspicious. [8] Thus, the lack of any significant price competition and the tremendous stability of market players (and shares to some extent) make the Japanese beer industry an excellent case study for testing the existence of market power.

Though price competition seems largely non-existent, *non-price competition* may be considerable.[9] Massive advertising campaigns attempting to maintain or shift brand loyalty are common. Perhaps the largest industry shift in the last 30 years (prior to 1994) was the introduction of Asahi's Super Dry in 1987 which did indeed shake up market shares (as seen in Table 1). Super Dry captured a large segment of (at that time) consumers in their twenties who didn't want to drink their "father's beer", which was for the most part Kirin. (See Craig, 1996.) Even then however, price competition did not seem to materialize (see Tables 2 and 3). As such, examining movements in market shares and relative profits is the main focus of this paper.

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[6] See http://www.craftbeerassociation.jp/jpcraftbeermarket.html for a short history.

[7] Several important caveats must be made. The above stylized fact applies more to the period of this study than to price behavior in more recent years. Also, like brewers around the world, Japanese brewers also produce a variety of beer products, e.g. darker beers, diet beers, seasonal beers, etc. However, even in this case, price competition across the same product is rare. For example, a low-calorie beer by Asahi and low-calorie beer by Kirin will often be exactly the same price, sitting side-by-side on the shelf. And though a variety of beers exist in Japan, by far the bulk sold are lager-style beers, which differ (relatively speaking) very little.

[8] It has been claimed (Lewis et al, 1993, p. 39) that the Ministry of Finance (MOF) "sets prices…" and "…consistently protected the weakest brewer from competition." Obviously, if true, this would have a huge impact on our understanding of the competitive nature of the market. Having said that, if the government presence is more of a facilitating nature, then studying the interactions, through price and quantity behavior, particularly under cost changes is still of great interest. In any event, as we have not found any other citation which makes such claims, this paper will work under the assumption that prices (or market shares) are not set by the MOF.

[9] See Gifford (1987) for a discussion of non-price competition.

Table 1 shows the market shares from 1965 to 1998. The econometric analysis that follows is also based on the same time series of data, for reasons which will be explained shortly. Four major (and one minor) firms account for approximately 99% of the market. As one can see, Kirin has historically been the market leader, accounting for over 60% of the market in 1979.[10] Asahi and Sapporo follow, with the whisky maker Suntory, with its flagship beer "Malt's", capturing only around five or six percent in more recent years.[11]

(Insert Table 1 around here)

Thus, these market shares, despite the inconsistent nature of the calculations (see notes at bottom of Table 1 and the Appendix), are a strong indication of high concentration, as well as demonstrate the shake-up that has occurred since the advent of Asahi Super Dry in 1987. In 1988, Kirin's market share decline is clearly Asahi's gain. While other new beers have been introduced by the big four before, and many since, none have caused any major shift in market shares like that brought about by Super Dry. Also, note that while the market is dominated by four firms, Suntory is not a publicly listed company. Thus, the same financial reports data used in this paper for the other three firms is not available for Suntory. As such, similar market share and other variables could not be constructed for Suntory and our econometric analysis is restricted to the three major firms, Kirin, Asahi and Sapporo.

While more recent data is available, for this study, data is only included until 1998. Two huge industry changes account for the exclusion of more recent years. The

[10] It has been claimed (Craig, 1996) that Kirin's market share reached such a height in the 1973 that Kirin is said to have stopped all advertising from 1974 to 1978 for fear of being labeled a near monopoly and becoming the subject of Japanese anti-trust action. If true, this certainly suggests possible tacit or 'facilitated' collusion, or at least a fear of action by the Japanese Fair Trade Commission, which should be factored into firm behavior. Alas, inspection of the annual reports (the same official reports used for the financial variables in this study) show rising advertising expenditures for Kirin throughout the 1970s and beyond, often increasing by more than 10% a year.

[11] It should be noted that while Suntory is historically a whisky maker, the other beer companies all make whisky and/or other alcoholic beverages as well. Perhaps, more importantly, all four major companies also are the major producers of non-alcoholic juices, canned coffee, sports drinks, etc. While we abstract from this important point in this paper and focus on the beer market, one must not forget that these firms are not only the "Budweiser, Heineken and Lowenbrau's" of Japan, but simultaneously the Coke and Pepsi corporation equivalents. These products also have very little price competition.

first change is the tax-avoiding innovation in 1995 of so-called *happoshu*, which is a low-malt, beer-like beverage. As the definition of beer and the associated tax rates of beer and beer-like products are based on its amount of malt, by making a beer-like product with lower malt content, a much lower tax rate applies. Thus, the industry has exploded with each of the major brewers (and many tiny ones) producing its own lines of various low-malt *happoshu*, though for the first few years, *happoshu* sales were still quite small. So, in Table 1, we see that Kirin has clearly lost its position in the official beer category. However, in low-malt beers, which now account for roughly 30% of all beer and *happoshu* sales combined in 2009 (http://www.brewers.or.jp/contents/pdf/fact2011.pdf and Japan Market Share Dictionary, various years), Kirin is the market leader. In combined beer and *happoshu* Asahi has taken the lead. Each of these new classes of beers has its own tax rate, and accordingly, very different prices and market shares across firms. These prices and market shares varied substantially over the late 1990s and early 2000s. As such, any analysis of multiproduct firms would become far more complex. Indeed, most market structure methods, including the Boone's (2008) method used in this paper, are most appropriate for markets with relatively homogenous goods. This was certainly the case in the pre-*happoshu* days. Thus, we have, for this paper, truncated the data.

The second reason that analysis is truncated in 1998 is due to a change in regulation related to entry into the market. As explained above, prior to 1994, a company had to brew 200,000 kl per year in order to be legally established as a beer brewer. In 1994, this minimum threshold and obvious barrier to entry was reduced dramatically to a mere 60 kl per year. Thus, there was a boom in small, local brewers and a change in the nature of the industry to a larger variety of beers. Having said that, small brewers, though they number of 200 or so, are still a tiny portion of the market. For these two reasons, the analysis ends in 1998 while *happoshu* was still small and local brewers just started to enter the market.

If one calculates the Herfindahl-Hirschman Index (HHI) from Table 1, we find that the index values are quite high and might set off warning flags in the US Federal

Trade Commission or Department of Justice, with the HHI over 4000 in 1979.[12] This alone, however, is by no means sufficient evidence of collusion, implicit or otherwise.

The other remarkable feature in the Japanese beer industry is price stability, across brands, but also over time. Tables 2 and 3 show the evolution of prices of domestic beer at both the retail and wholesale level. Month to month there is virtual no change in the nominal prices. Many (but not all) of these (typically upward) shifts in price are due to changes in the (beer) tax rate.[13] This stability, marked by pronounced jumps when tax changes occur, appears to offer us a potential experiment for testing market power and possible cartel-like behavior, though for reasons explained below, is still insufficient.

(Insert Tables 2 and 3 around here)

Beer Taxes and Prices

Beer taxes in Japan are very high and this accounts for much of the high price premium in Japan. The tax is a specific tax, so that for example in 1994, the beer tax was 220,000 yen per kiloliter, or 220 yen per liter. As a can of beer in Japan is typically 350 ml, this amounts to 77 yen tax per can. As any of the main beer labels sold by Kirin and the rest typically costs a little over 200 yen (more than two US dollars), this amounts to an *ad valorem* tax of over 60%. By comparison, the equivalent tax rates on beer (per 350 ml can) in other countries are approximately: France, 5.3 yen, Germany 3.8 yen, US (NY City) 7.6, and UK 44.5. (Source: Japan Brewers Association of Japan, www.brewers.or.jp.) However, even without the 77 yen tax, Japanese prices are approximately 50% higher than a typical US or European beer, which often sells for less than a Euro, or even less than a US dollar.[14] It has been argued that high (imported and

[12] In the US beer market, even at perhaps the peak of industry concentration in the early 1980s, the five-firm concentration ratio was 83% in 1983 and the HHI less than 2000 (Tremblay, 1987). This has no doubt fallen considerably with the massive micro or craft beer wave that has swept the industry since then.
[13] See Parsons (2007) for price responses to tax rate changes.
[14] In December 2012, a 335 ml can of Budweiser sold for about $1.00 in a retail liquor store in New Jersey, while Kirin, Asahi, etc. cost about 210 (or 133 yen *sans* the beer tax) yen in a small retail liquor store in Yokohama, Japan. At 82 yen per dollar, this implies a whopping 62% deviation from purchasing price parity. Sazanami, Urata and Kawai (1995) looked at price differentials for many Japanese goods including beer and found an over 40% price differential in beer. Thus, the non-tariff barrier seems very persistent.

otherwise) costs of beer ingredients explain the higher costs of beer in Japan, though Sazanami, Urata and Kawai (1995, p. 23) find this unlikely and other non-tariff barriers the more likely culprit.

But, if indeed, there is collusion, where do the profits go? It has been observed that Japanese firms (including Japanese beer firms) have large cross-shareholding across firms which discourages dividend payouts (see Flath, 2005). In such cases, surplus profits (retained earnings) may be reinvested into more capacity, new product development or advertising.[15] While beyond the scope of this paper, this is something worth exploring further.

Despite casual empiricism which suggests at least implicit collusive behavior, demonstrating that that is indeed the case can be exceedingly difficult, if not impossible. Simple Bertrand models with two-firms show that they could be engaged in bitter marginal cost pricing. At the same time, duopoly Cournot models show us that pricing far above marginal cost can occur, even without collusion. The classic paper on retail gasoline stations (Slade, 1987) demonstrates how difficult it can be to prove collusion even when very detailed price data is available. The next section briefly discusses some related papers in recent empirical IO and then describes the method this study will employ.

3. Empirical Methods in Industrial Organization

Since the New Empirical Industrial Organization (NEIO) literature began to gain ground in the mid- to late 1980s, as summarized in Bresnahan (1989) and Hyde and Perloff (1995), the previous Structure-Conduct-Performance (SCP) paradigm as an approach to measure industry behavior and market power began to lose appeal. One aspect of the SCP approach which was considered problematic was the use of accounting

[15] The argument here is that firms, rather than individuals, hold a significant portion of each other shares, and unlike people, may not demand dividend payouts. Relatedly, historically, the big three brewers all have their "main" bank, who both provides loans and holds significant shares in the beer company. For example, in the 1980s Sumitomo Bank was Asahi's main bank.

profits to assess price-cost differentials.[16] The NEIO approach works on the assumptions that: marginal costs are unobservable and most probably impossible to estimate; estimating behavior from cross-section samples of industries is not promising as each industry is unique, and; individual firm conduct and industry conduct themselves were parameters to be estimated. Thus, the field has moved in a different direction. One approach is to estimate more detailed behavioral equations, supply and demand, for the industry using time series data on prices, quantities and various costs of inputs as well as various demand shifters and dummies. Porter's (1983) study of the railroad cartel is classic in this regard. While this method may also be a promising line of research for the Japanese beer industry, the data requirements for such estimation are large, so for this first investigation we have selected a less data-intensive approach.

Another NEIO method popular for testing market power, especially in markets where the good is taxed, can be seen in the seminal work on the US cigarette industry by Sumner (1981). The basic idea is that as cigarette (per unit excise) taxes in the US vary across states, as do prices, one can construct a panel of data where both prices and tax rates are changing unevenly over time and across states. One can use fixed effect dummies or conduct the estimate in first differences thus obviating the need to know the marginal cost for the industry. As the tax is a specific tax, there is (or should be) a direct link between the tax rate and price movements.

Other work has improved some of the weakness of this panel approach strategy (see Ashenfelter and Sullivan, 1987 and more recently, Delipalla and O'Donnell, 2001), where the authors not only use a cross-section of prices and tax rates which vary over the sample and time, but also exploit the fact that cigarettes have both specific and *ad valorem* taxes applied to them, both of which may vary across countries.

Unfortunately, the Japanese beer market does not have the luxury of such rich data. While beer prices in Japan do actually vary slightly across prefectures presumably for a combination of income, distribution, and even perhaps consumer preference reasons, the tax rate does not vary across those regions. Nor is there an additional *ad valorem* tax

[16] In general, looking at overall accounting profits as an indicator of monopoly power, and whether the firm is efficient has long been problematic.

on beer (aside from the 5% consumption tax, which is included in the price survey data). Thus, we are severely restricted as to the methods we can employ.

In a working paper, Parsons (2007), various methods were employed, including examining how wholesale and retail prices responded to various beer tax hikes. But due to problems with reliable price data and also with theoretical priors which differ across modeling assumptions (e.g. linear vs. CES demand), these efforts produced mixed results. In particular, obtaining reliable price data for the beer (or any) market is fraught with problems. The wholesale prices likely do not capture the often complex rebates and other methods used by beer producers and their retail outlets. Also, retail price data as found in the Japanese CPI data is suspiciously stable from month to month and even year to year. While true there are few price wars in the Japanese beer market, in reality, the prices to tend to fluctuate somewhat. However, beer CPI data are typically flat over time (unless there is a tax change). And, of course, CPI price data is for the industry as a whole, with no firm breakdown. Therefore, this paper will adopt a new approach developed by Boone (2008) which uses readily available firm-level accounting data and individual firm market shares.

4. Boone's (2008) "New Way to Measure Competition"

In a series of papers (Boone, van Ours, van der Weil, 2007; Boone; 2008a; Boone 2008b), a new measure of competition was developed in response to the weaknesses of the PCM measure. In particular, while under most models, with more competition, the PCM falls, there are other models (Stiglitz, 1989, for example) that predict that PCM will *rise* with more competition. Boone's new measure, "relative profit differences" (RPD), however, yields testable hypotheses which are valid over a broad class of models (Cournot, Bertrand, *inter alia*) and under a variety of assumptions. The RPD measure rises when there is more competition under nearly any modeling assumption. Thus, the empirical researcher need not know the underlying firm behavior to measure the degree of competition and how it is changing over time.

Also, like the PCM measure, the data needs are not demanding. For the purposes of this industry study, where accurate price data is not available, the Boone method is preferred. Finally, the Boone method applies especially well to industries where firms produce a homogenous good (Boone 2008a). This assumption is reasonable for the Japanese beer industry.

The basic intuition for the Boone's RPD method is as follows. Suppose we have three firms in an industry, with varying levels of efficiency.[17, 18] Next, consider the profits of each firm, π", π' and π where (") denotes the most efficient firm, (') the next most efficient and "no apostrophe" the least efficient firm. Boone shows that as competition increases, profits of the most efficient firm will rise more than the least efficient firm. And, moreover, this difference in profits will be greater than the difference between the second most efficient firm and the least efficient firm. So, we can express the RPD as follows:

(I)

$$\frac{(\pi"-\pi)}{(\pi'-\pi)}$$

This measure, the RPD, should rise as more competition "punishes" the less efficient firms.

However, to implement this measure, one needs to know which firm is most and least efficient. Though Boone (2008a) offers such data strategies, we could not identify a consistently least efficient firm over the time horizon. Thus, we chose to adopt an econometric approach similar to Bikker and van Leuvensteijn (2008) in which they regress market shares on a proxy for relative marginal costs (here using average variable costs, i.e., "cost of sales" divided by quantity). A second approach that they use and we also employ here is to regress relative profits on the same proxy for marginal costs. The Boone intuition remains: inefficient firms are punished and firms that become more

[17] This is generalizable to many firms.

[18] As an aside, Tremblay (1987) found that the massive consolidation of the US brewing industry from 369 firms to 33 from 1950 to 1983 brought about significant cost gains from scale economies. He argues that most of these cost reductions occurred in the 1950s, however, when significant increases in technology were also occurring. If any economies of scale (or technological) gains occurred in Japan, it also seems very likely that they occurred much earlier than the sample studied here. Having said that, there would be more economies of scale in the US than in Japan, where breweries/plants are one-tenth the size of the US plants.

efficient (through lower (relative) costs) are rewarded, through either higher market shares or higher (relative) profits.

So, the simple regression with market shares becomes:

(II)

$$Market\ share_{it} = \alpha + \beta \left(\frac{mc_{it}}{mc_{jt}}\right) + \varepsilon_{it}$$

where MC is proxied by TVC/Q. (All data and sources are described in detail in the Appendix.) The letter *i* is firm *i*, where *i* does not equal *j*. In this paper, there are three firms and thus we have six (6) cross sections. The year of the data is *t.* For relative profits, we have:

(III)

$$\frac{\Pi_{it}}{\Pi_{jt}} = \alpha + \beta \left(\frac{mc_{it}}{mc_{jt}}\right) + \varepsilon_{it}\ .$$

If we allow for fixed effects, or firm dummies, then the specification for relative profits becomes:

(IV)

$$\frac{\Pi_{it}}{\Pi_{jt}} = \beta \left(\frac{mc_{it}}{mc_{jt}}\right) + \Sigma\lambda_i Dummies_{it} + \varepsilon_{it}$$

with an analogous fixed-effects version for the market share regression. For this very simple regression, the chance of omitted variable bias is high. However, the various dummy coefficients capture the idiosyncratic firm-effects and mitigate this concern to some extent.[19] Still, the proxy for marginal cost is quite poor, so we may attempt some Instrumental Variables (IV) estimations in the future, possibly using a supply-side price, such a barley or hops.

Results are presented in Tables 4 through 7.

(Insert Tables 4 through 7 around here)

[19] This can be seen in the increase of the Adjusted R^2 from EQ. 1 to EQ. 2 in Table 4.

EQ.1 of Table 4 is the Market Share regression on the relative marginal costs proxy, with no fixed effects (EQ. 1). The key parameter is the coefficient of "RelBM" (Relative Boone Measure, the MC proxy). Its value is negative, significant and large, suggesting strong competition, at least reflected by market share movements. Still in Table 4, EQ.2 conducts the same regression with firm-specific dummies (three dummies and no constant), and again we get a negative, significant coefficient estimate. Note, after inclusion of the fixed effects, the "Boone" response parameter is about half the value of the previous result. We then conduct a Wald test to determine if these three coefficients (for Asahi, Kirin, and Sapporo) are simultaneously equal. Based on the F-statistics, we definitively (beyond 5% level of significance) reject that null hypothesis. However, a second Wald test fails to reject the null hypothesis that the coefficients for Asahi and Sapporo are identical. This leads us to believe that there are interesting, idiosyncratic (firm-specific) aspects to the evolution of their respective market shares, not entirely captured by the Boone Measure. Indeed, one could even argue that, for this industry and that time-period, these (firm-specific) effects are important, and need to be included in order to obtain a more accurate value for the Boone Measure impact on market shares. In any case, the main parameter of interest remains negative, as predicted by the theory.[20]

In EQ.3 we include three additional variables. These are firm effects interacted with the RelBM. Here the evidence confirms the negative sign for the coefficient of the RelBM variable.[21] We again use Wald tests in EQ. 3 and we definitively reject the two following null hypotheses: first that the three firm-specific intercepts are simultaneously equal, and second that the three firm-specific slopes are identical. Again, this confirms the importance of idiosyncratic firm-behavior when estimating the Boone Measure impact on market shares.

In Table 5, we have the same general specification as in Table 4, but conduct two-stage least squares (2SLS) to correct for possible endogeneity of the left-hand side variable. The lag of the RelBM measure was used as an instrument for EQ. 4, the lag of

[20] We thank the editor for suggesting these additional tests. All additional Wald test results are available upon request.

[21] We also ran these regressions in log-log form (available upon request). These yielded either -3, or -2 (with fixed effects) as market share elasticities with respect to relative marginal cost. This implies that a fall in *relative* costs (efficiency gain) of 1% results in a 2 or 3% market share gain. This is a large response, but in this industry costs (labor, water, etc.) do not vary much.

RelBM as well as the three firm dummies are used in EQ . 5 and RelBM (-1) and all six dummies are used in EQ. 6. Both the parameter estimates and level of significance showed little change. As such, we will show only OLS (all corrected using Newey-West) for all remaining results.[22] As in Table 4, the F-statistics from the Wald tests definitively reject the two null hypotheses that the firm-specific intercepts, and that the firm-specific slopes are simultaneously identical.

Table 6 displays the results for Relative Operating Profits (per unit) on the proxy for relative marginal costs without fixed effects (EQ. 7) and then with fixed effect (EQ. 8). The "Boone" parameter is again negative and significant. Naturally, the size of the parameter differs from the Market Share regressions as the units of the left-hand side variables are different. But, the results are strong and consistent and suggest competition as seen through both market share "rewards" or through profits. We conduct a Wald test to determine if these three coefficients (for Asahi, Kirin, and Sapporo) are simultaneously equal in EQ. 8. Based on the F-statistics, we again reject the null hypothesis.

EQ.9 in Table 6 shows the results with the interaction dummies. Here the results are stronger than in the Market Share regressions, with all three estimates negative and significant. Interestingly, in EQ. 9, we cannot reject the null hypothesis that the three firm-specific intercepts are simultaneously equal (p-value = .32), and we also cannot reject the null hypothesis that the firm-specific slopes are simultaneously identical (p-value = .45). We tentatively conclude that the Boone Measure's impact on Relative profit is negative (as predicted by the theory), and relatively firm-independent with a value around negative 3.77 (from EQ. 7) or ranging from -2.36 to -4.32 (from EQ. 9). Obviously, the Adjusted R-squared increases as we go from EQ. 7 to EQ. 9, because the additional independent variables have estimated coefficients whose t-values (in absolute value) are greater than 1.

Lastly, in Table 7, in order to test for the robustness of the results from Table 6, we present results for relative profits on the relative MC proxy *and the addition of market share as another right-hand variable*. With and without fixed effects, the Boone measure is still negative and significant. We also conduct a Wald test to determine if these three coefficients (for Asahi, Kirin, and Sapporo) are simultaneously equal in EQ. 8. Based on

[22] Additional 2SLS results, for other specifications, are available upon request.

the F-statistics (p-value = .0047), we clearly reject that null hypothesis. Results are mixed in the third (EQ. 12) specification including interacted dummies. First and most importantly, we note that the coefficient for additional right-hand side variable, Market Share, remains significant and positive. We also observe that the two coefficients concerning Asahi are no longer statistically different from zero. The data do not provide us with an obvious explanation for this. For Table 7, EQ. 12, the F-statistics from the Wald-tests definitively reject the two null hypotheses that the firm-specific intercepts are identical, and that the firm-specific slopes are identical, (with P = .004 and P = .0029 respectively). Again, this shows the importance of the firm-fixed effects for our estimations.

5. Conclusion

In this paper, we have assembled market shares, operating profits per unit and average variable costs per unit for the three major brewers (approximately 90% of the market) over more than 30 years in an attempt to determine the nature of competition in the Japanese beer market. Despite strong *prima facie* evidence of little competition (high industry concentration, little price movement), our results suggest the contrary. Competition is vigorous and firms do get rewarded (or punished) through higher relative profits and/or market share gains.

The results here highlight the advantage to using the recent Boone measure when ideal price data is not available. It also offers an alternative method to measure market power even when price data is available, as a robustness check. Naturally, if detailed and reliable price data for the Japanese beer industry becomes available, more traditional PCM methods could also be employed.[23]

A more general question one might ask is: if the Japanese beer market is so competitive, why is beer so expensive, even after accounting for tax differences? This question can and should be explored more, but three possible explanations are offered here. First, as Japanese factories are typically one-tenth the size of those in the US, scale

[23] For a detailed study of price behavior in beer in the UK, see Pinkse and Slade (2004).

economies could be a partial explanatory factor. Second, while labor and capital costs are on par with those in the US, other material inputs may not be. Energy costs are much higher in Japan, and some of the main ingredients (hops are mostly imported; grains are sourced both domestically and from abroad) are imported at Japan's notoriously high agricultural prices. Third, while it appears that the firms are competing vigorously, and rewarded for cost (and other) innovations, this does not seem to be translating to lower prices, at least in the period of this study. If there are indeed excess profits, whether they are plowed back in cost-cutting methods, or less directly beneficial advertising wars and minor, new product development is something that needs to be investigated more.

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Appendix: Data

Market share data in Table 1 and that used in the regressions are calculated by the authors as actual *production* in kiloliters in one year, from the individual firm "General Survey…" (see below) divided by the total *shipments* of beer (again, in kiloliters) found in the Census of Manufactures volumes. As such, the numerator is production and the denominator uses shipments, which is less than ideal. But, because very little inventory in beer carries over to the next (far less than one percent) year, this should not present a problem. (The General Surveys have firm level "sales", but again this is slightly different.) Because Suntory is not a listed company, no firm level production or sales is available, and thus very unfortunately, cannot be included in the analysis. However, Suntory's shipments are included the Census data in the aggregate with the other major and minor firms, because it must respond to the Census survey. As such, total market volume is known.

The accounting data was made real using overall economy-wide GDP deflators for Japan. (Officer and Williamson, 2012)

All other data used to construct variables below were taken from *Yuuka Shouken Houkoku-sho Souran*, the General Survey of Financial Statements. These are bi-annual financial reports that listed stock companies must submit to the government.

The proxy for the Boone measure of efficiency was Variable Cost divided by Output. Here, output is kiloliters of beer produced (not shipped, so there is a slight difference from the data used for market shares) in one year. Average variable cost (AVC) is used, as suggested by Boone, as a proxy for Marginal Cost, which should strongly co-vary with AVC over time. The Variable (Operating) Profits are, as suggested by Boone (2008a), Total (annual) Revenue minus Cost of Sales. Unfortunately, we do not have the breakdown of total revenue or costs of sales for beer sales only, and this reflects revenue from all products, of which beer is, by far, the largest. "Operating profit per unit" is operating profit divided by quantity (kiloliters produced).

Table 1: Market Share of Three Largest Firms

Year	Kirin	Asahi	Sapporo	Total of Three
1965	0.475	0.235	0.253	0.964
1966	0.507	0.210	0.234	0.951
1967	0.492	0.211	0.249	0.952
1968	0.476	0.177	0.226	0.880
1969	0.497	0.169	0.216	0.883
1970	0.565	0.166	0.232	0.963
1971	0.579	0.139	0.217	0.935
1972	0.596	0.130	0.210	0.937
1973	0.632	0.133	0.208	0.973
1974	0.628	0.124	0.196	0.947
1975	0.599	0.126	0.200	0.925
1976	0.576	0.101	0.166	0.843
1977	0.631	0.116	0.199	0.945
1978	0.558	0.100	0.176	0.835
1979	0.592	0.099	0.180	0.871
1980	0.602	0.103	0.191	0.895
1981	0.600	0.095	0.192	0.887
1982	0.590	0.091	0.189	0.870
1983	0.571	0.092	0.188	0.851
1984	0.579	0.090	0.185	0.854
1985	0.598	0.092	0.194	0.884
1986	0.552	0.092	0.193	0.837
1987	0.517	0.113	0.188	0.818
1988	0.454	0.190	0.189	0.832
1989	0.447	0.219	0.175	0.840
1990	0.476	0.229	0.175	0.880
1991	0.470	0.220	0.173	0.863
1992	0.471	0.222	0.174	0.866
1993	0.455	0.218	0.173	0.845
1994	0.444	0.240	0.171	0.855
1995	0.441	0.241	0.177	0.859
1996	0.425	0.287	0.183	0.895
1997	0.387	0.321	0.182	0.890
1998	0.439	0.376	0.181	0.996

Notes

1. Shares are the ratio of firm production over total market shipments.
2. See the appendix for more details on the sources of data.
3. Suntory is typically 5-6% and Orion and other micro-breweries combined are less than one percent. See appendix for details.
4. While this calculation tracks the Japan Market Share Dictionary (JMSD) data fairly well, this sometimes yields perverse results, as seen in the 1998 data which implies 99% of the market being supplied by the top three alone.

Table 2. Retail Price in yen of 633 ml bottle of beer (not dining out)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1979	215	215	215	215	215	215	215	215	215	215	215	215
1980	215	215	215	225	240	240	240	240	240	240	240	240
1981	240	240	240	240	265	265	265	265	265	265	265	265
1982	265	265	265	265	265	265	265	265	265	265	265	265
1983	265	265	265	265	265	265	265	265	265	284	285	285
1984	285	285	285	285	310	310	310	310	310	310	310	310
1985	310	310	310	310	310	310	310	310	310	310	310	310
1986	310	310	310	310	310	310	310	310	310	310	310	310
1987	310	310	310	310	310	310	310	310	310	310	310	310
1988	310	310	310	310	310	310	310	310	310	310	310	310
1989	310	310	310	300	300	300	300	300	300	300	300	300
1990	300	300	320	320	320	320	320	320	320	320	320	320
1991	320	320	320	320	320	320	320	320	320	320	320	320
1992	320	320	missing	missing	missing	missing	missing	missing	missing	missing	missing	missing
1993	320	320	320	320	320	320	320	320	320	320	320	320
1994	320	320	320	320	330	330	330	330	330	330	330	330

Souce: Kouri Bukka Toukei Chousa Nenpou, various years
(Retail Price Survey)
www.stat.go.jp
note: Cells in gray represent periods in which a tax hike on beer occurred; prices include taxes.

Table 3. Wholesale Price Index of Beer (Bank of Japan, 1990=100)

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1979	74.8	74.8	74.8	74.8	74.8	74.8	74.8	74.8	74.8	74.8	74.8	74.8
1980	74.8	74.8	75.8	79.1	81.0	81.0	81.0	81.0	81.0	81.0	81.0	81.0
1981	81.0	81.0	81.0	81.0	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7
1982	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7
1983	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	95.4	95.4	95.4
1984	95.4	95.4	95.4	95.4	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
1985	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
1986	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
1987	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
1988	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
1989	100.9	100.9	100.9	96.8	96.8	96.8	96.8	96.8	96.8	96.8	96.8	96.8
1990	96.8	96.8	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7
1991	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7
1992	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7
1993	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7
1994	100.7	100.7	100.7	100.7	104.6	104.6	104.6	104.6	104.6	104.6	104.6	104.6

Source: Bank of Japan, Wholesale Price Indexes (Bukka Shisuu)

Table 4. Market Shares on Relative MC Proxy (OLS estimates, 1965-1998)

Independent Variables	EQ. 1	EQ. 2	EQ. 3
C	0.97	*	*
	[5.33]		
RelBM	-0.66	-0.3	*
	[-3.97]	[-3.48]	
Asahi	*	0.52	0.96
		[5]	[10.38]
Kirin	*	0.81	0.66
		[10.39]	[3.76]
Sapporo	*	0.48	0.25
		[5.73]	[6.25]
RelBM*Asahi	*	*	-0.69
			[-8.51]
RelBM*Kirin	*	*	-0.14
			[-.76]
RelBM*Sapporo	*	*	-0.06
			[-1.52]
Adj. R^2	0.23	0.9	0.92
S.E. Regression	0.15	0.05	0.049

Notes:
t-values are in brackets. Newey-West HAC standard errors & covariance.
EQ. 1: no fixed effects; EQ. 2 and EQ. 3: fixed effects.
Number of observations: 204 (34 years, 3 firms, 2 obs. per firm.)
RelBM is the proxy for the relative marginal cost.

Table 5. Market Shares on Relative MC Proxy (2SLS estimates, 1965-1998)

Independent Variables	EQ. 4	EQ. 5	EQ. 6
C	0.97	*	*
	[5.08]		
RelBM	-0.67	-0.31	*
	[-3.78]	[-2.98]	
Asahi	*	0.52	1.06
		[4.26]	[7.91]
Kirin	*	0.82	0.62
		[8.81]	[3.15]
Sapporo	*	0.48	0.24
		[4.89]	[6.37]
RelBM*Asahi	*	*	-0.78
			[-6.65]
RelBM*Kirin	*	*	-0.1
			[-.47]
RelBM*Sapporo	*	*	-0.05
			[-1.26]
Adj. R^2	0.23	0.9	0.92
S.E. Regression	0.15	0.05	0.049

Notes:
t-values are in brackets. Newey-West HAC standard errors & covariance.
EQ. 4: no fixed effects; EQ. 5 and EQ. 6: fixed effects.
Number of observations: 198 (33 years, 3 firms, 2 obs. per firm.)
RelBM is the proxy for the relative marginal cost.

Instruments: RElBM(-1) (for EQ.4); RElBM(-1), Asahi, Kirin, Sapporo (for EQ.5); and Asahi*RElBM(-1), Kirin*RElBM(-1), Sapporo*RElBM(-1), Asahi, Kirin, Sapporo (for EQ.6)

Table 6. Relative Profit on Relative MC Proxy (OLS estimates, 1965-1998)

Independent Variables	EQ. 7	EQ. 8	EQ. 9
C	5.09	*	*
	[5.65]		
RelBM	-3.77	-3.4	*
	[-4.56]	[-5.23]	
Asahi	*	4.62	3.44
		[6.24]	[3.03]
Kirin	*	5.53	6.4
		[8.4]	[4.02]
Sapporo	*	3.99	4.22
		[6.46]	[7.75]
RelBM*Asahi	*	*	-2.36
			[-2.4]
RelBM*Kirin	*	*	-4.32
			[-2.62]
RelBM*Sapporo	*	*	-3.65
			[-6.41]
Adj. R^2	0.27	0.75	0.76
S.E. Regression	0.78	0.45	0.45

Notes:
t-values are in brackets. Newey-West HAC standard errors & covariance.
EQ. 7: no fixed effects; EQ. 8 and EQ. 9: fixed effects.
Number of observations: 204 (34 years, 3 firms, 2 obs. per firm.)
RelBM is the proxy for the relative marginal cost.

Table 7. Relative Profit on Relative MC Proxy and Market Share (OLS estimates, 1965-1998)

Independent Variables	EQ. 10	EQ. 11	EQ. 12
C	5.09	*	*
	[5.65]		
RelBM	-.97	-2.37	*
	[-1.92]	[-3.52]	
Market Share	4.22	3.41	4.89
	[10.27]	[3.3]	[4.53]
Asahi	*	2.87	-1.24
		[3.46]	[-.97]
Kirin	*	2.76	3.16
		[2.83]	[2.14]
Sapporo	*	2.35	2.98
		[3.24]	[5.07]
RelBM*Asahi	*	*	1.01
			[1]
RelBM*Kirin	*	*	-3.62
			[-2.55]
RelBM*Sapporo	*	*	-3.34
			[-5.96]
Adj. R^2	0.77	0.79	0.82
S.E. Regression	0.44	0.42	0.38

Notes:
t-values are in brackets. Newey-West HAC standard errors & covariance.
EQ. 10: no fixed effects; EQ. 11 and EQ. 12: fixed effects.
Number of observations: 204 (34 years, 3 firms, 2 obs. per firm.)
RelBM is the proxy for the relative marginal cost.