Beer Leaders Against Craft Brewers: Will Goliath End Up Defeating David in the US?

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Abstract

The last decade has witnessed an unprecedented rise of craft brewers in the American beer industry, with market leaders actively seeking to hamper their growth. In this paper, we set a model with craft brewers and macrobrewers, where leading firms engage in strategic moves to shape market outcomes. The framework results in leaders strategically targeting craft brewers to disadvantage them, and hence crowd them out. On the contrary, non-leading macrobrewers are neither targeted nor hurt. A calibration for the American beer industry in 2019 shows that, even though the emergence of craft brewers in the last years has hurt leaders, strategic moves have allowed them to mitigate its consequences. Specifically, these moves have respectively enabled AB InBev and Molson Coors to prevent further losses of market share of 5.1 and 2.8 points, implying that the craft brewers' market share would have been even 7.9 points higher in absence of strategic moves.

Keywords: beer industry, beer leaders, craft brewers, strategic moves.
JEL codes: L11, L13, L66.

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1 Introduction

One particular characteristic of the American beer industry is the coexistence of two markedly different types of firms. On the one hand, there is a large group of craft brewers whose characterization is consistent with a monopolistic-competition setting: each is negligible and serves the market through a differentiated variety. On the other hand, there is a handful of global companies referred to as macrobrewers. These firms dominate the industry and exhibit typical features of oligopolistic firms: each has substantial market power and focuses on mass products.

Industries where firms of different size coexist entail a stark strategic asymmetry between them. Thus, small firms tend to operate in an environment strategically influenced by the leading firms to disadvantage them (Kwoka and White, 2001). The American beer industry is an example of this, where the success of craft brewers in the last decades has triggered multiple actions by market leaders to hinder their growth.

In this paper, we study the strategic behavior of beer leaders against craft brewers. Based on a model that accounts for the specific features of the beer industry, we show that beer leaders always have incentives to behave more aggressively against craft brewers, and never to accommodate their entry. Our conclusions are illustrated through a calibration exercise for the American beer industry. This shows that, despite the rise of craft brewers in the last decades, strategic moves have allowed AB InBev and Molson Coors to mitigate its harmful consequences.

Our analysis begins in Section 2 by describing some salient features of the beer industry in the US. The disruptive emergence of craft brewers in the last decades has profoundly transformed the market. This primarily occurred due to two factors. The first one is worldwide changes in the demand side, which determined a desire for novelty, variety, and quality in beers. The second factor is the incentives provided by the American government to foster entry of small-scale brewers, including changes in regulation and financial incentives. Only between 2010 and 2019, craft brewers have increased their market share by 10.4 percentage points, whereas the industry leaders lost 12.5 points.

These changes in market structure have resulted in a coexistence of different business models. First, there is a group of macrobrewers that have traditionally focused on producing

massive volumes of lager beer to achieve an efficient scale of production. Additionally, there are craft brewers serving the industry through highly differentiated ales that fill up product niches. Consistent with their small size, craft brewers tend to start operations under significant uncertainty regarding their profitability. Jointly with the low barriers to entry in the industry, this determines simultaneous high rates of entry and exit (Tremblay et al. 2005; Garavaglia and Swinnen 2018).

The rise of craft brewers in the US has prompted several responses by the American beer leaders, i.e. AB InBev and Molson Coors (previously known as MillerCoors). The strategies to accomplish this have been quite broad, ranging from the introduction and acquisition of craft beer brands, to arrangements with distributors to end ties with craft brewers. By deploying these moves, leaders have partially contained the growth of craft brewers and hence kept a dominant position (D'Aveni 2002; Garavaglia and Swinnen 2017; Elzinga et al. 2018).

Based on these empirical facts, we build a stylized model in Section 3 that incorporates some of the distinctive features of the American beer industry. The setup considers an industry comprising craft brewers and macrobrewers competing in prices. The former are characterized as in the monopolist-competition setting of Melitz and Redding (2015), so that craft brewers are described as a pool of ex-ante identical firms with uncertainty about their profitability. By paying an entry cost, each of them can enter the industry with a unique variety and discover its profitability. Eventually, they become heterogeneous, and only the most profitable firms survive and serve the market. As for macrobrewers, they are characterized as heterogeneous oligopolistic firms that are more profitable than craft brewers, and hence always active. Moreover, we distinguish between leading and non-leading macrobrewers, depending on whether a macrobrewer engages in strategic moves.

A leader's strategic move is defined as the strategic use of non-price variables to shape market outcomes in its favor. We formally capture these moves through macrobrewers deciding on a variable that requires sunk costs. This variable is interpreted in a broad way, i.e. a composite variable encompassing all the non-price choices that affect how the market stage is played.[1] To identify the effects of strategic moves, we build on the seminal approach by Fudenberg and Tirole (1984; 1991), which requires comparing the outcomes of two scenarios.

[1] We suppose that this variable acts as a demand shifter. Nonetheless, similar qualitative and quantitative results arise if it acts as a cost shifter.

The first one constitutes a non-strategic benchmark, where each leader's non-price choice is not observed and hence cannot be used strategically. The second scenario considers rivals that condition their decisions on each leader's non-price variable, allowing leaders to strategically influence the conditions under which competition in the market takes place. By comparing outcomes between these two scenarios, we are able to isolate each leader's strategic use of its non-price variable.

The results indicate that each leader engages in strategic moves to strengthen competition and hence crowd out craft brewers. This allows each leader to increase its profit, market share, and markup. On the contrary, leaders never accommodate entry, establishing a clear contrast with typical settings where competition is against a limited number of large followers. The reason is that, since craft brewers operate under free-entry conditions, any strategy to soften competition would end up triggering entry and hence being ineffective.

We also establish that, despite leaders behaving more aggressively, non-leading macrobrewers are neither targeted nor hurt in equilibrium. This arises in our model since the initial increase in competition by leaders has exit of craft brewers as a counterpart, entailing opposing effects on the competitive environment that are perfectly offset. The result rationalizes that leaders can deploy an aggressive strategy aimed at disadvantaging craft brewers, without this necessarily intensifying competition with rival macrobrewers.

In Section 4 we perform a calibration exercise using data for the American beer industry in 2019. The use of the model allows us to bypass the unobservability of data for strategic moves, and show how these moves are ultimately reflected in current market outcomes. Given the empirical evidence of strategic behavior by AB InBev and Molson Coors, we treat these companies as leaders and consider that the data capture an equilibrium with strategic moves. Then, we utilize the model to retrieve outcomes in the counterfactual scenario, where leaders do not strategically decide upon the non-price variable. Through a comparison between the results in each scenario, we isolate the impact exclusively due to strategic moves.

The calibration illustrates that, even though AB InBev and Molson Coors have been affected negatively by the rise of craft brewers in the last decades, their strategic moves have mitigated its detrimental consequences. Specifically, strategic moves have allowed AB InBev to prevent further losses of market share of 5.1 points (35.1% observed vs 30.0% in

the counterfactual), while for Molson Coors this number is 2.8 points (20.0% vs 17.2%). A corollary of this is that, even though craft brewers have been consistently improving their position in the market, the leaders' strategic moves have decreased the craft brewers' potential gains in market share by 7.9 points (25.5% observed vs 17.6% in the counterfactual). In beer sales of 2019, this represents around USD 8.3 billion.

Our paper speaks to a large literature on strategic behavior in the US beer industry. This includes recent articles studying collusion by AB InBev and Molson Coors (Miller and Weinberg 2017; Miller et al. 2020), strategic pricing following mergers (Ashenfelter et al. 2015; Miller and Weinberg 2016; Alviarez et al. 2020), and strategic behavior against craft brewers (Tremblay and Tremblay 2005; Garavaglia and Swinnen 2017; Elzinga et al. 2018).

The closest papers in terms of approach are Alfaro (2020a; 2020b). These articles assume a coexistence of monopolistic and oligopolistic firms in open economies, and analyze the use of country-specific investments to deter entry of small importers and domestic firms. Instead, our focus is on the beer industry, and we contribute to this literature by proposing a setting that captures its idiosyncratic features. In particular, our setup captures the simultaneous presence of beer leaders, non-leading macrobrewers, and craft brewers. Additionally, the framework lends itself to approaching quantitative matters. This feature becomes relevant since strategic moves are rarely, if ever, observable (Sutton, 1996), making calibration exercises and structural approaches appropriate.

2 The American Beer Industry

Two phenomena have characterized the American beer industry in the last decades. The first one refers to a consolidation of macrobrewers, which has resulted in a few global multinationals dominating the market. Simultaneously, a craft segment has been emerging since the 1990s, which prompted strategic responses by the industry leaders. Next, we delve into these facts.

2.1 Market Structure

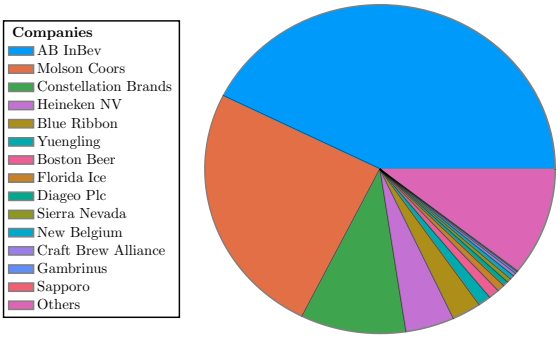
We begin by presenting the distribution of market share in the US beer industry. With this aim, we draw on information from Passport GMID (Global Market Information Database) compiled by Euromonitor for the year 2019.

The dataset covers the main brands sold in the USA, irrespective of whether they are domestically produced or imported. Moreover, the data indicate a brand's market share and the company that owns the right to sell it in the USA. The latter is relevant since a brand is not necessarily sold by the same firm in every country.[2]

Figure 1 presents the value-based market share of any firm having at least 0.1% of share. GMID also defines the category "*Others*", which encompasses more than 8,000 brewers having a market share lower than 0.1%. Despite the large number of brewers operating, the figure reveals that the top firms accumulate the bulk of volume and quantity sold.

Figure 1. *Market Shares - Year 2019*

(a) All Firms



(b) Main Groups

Company	Market Share (%) by Value	by Volume
AB InBev	35.1	41.8
Molson Coors	20.0	24.6
Constellation Brands	12.7	10.6
Heineken NV	5.6	4.4
"Others"	17.6	11.1
Rest of Firms	9.0	7.5

Note: Information from Passport GMID by Euromonitor. "Others" is defined as an aggregate comprising all firms with market share lower than 0.1%. "Rest of the Firms" refers to companies that are neither one of the top 4 firms nor belong to "Others".

AB InBev and Molson Coors are the current leaders in the American beer industry. After a long process of mergers and divestitures, these two firms currently sell the brands formerly produced by the traditional leaders of the market: Anheuser-Busch, Miller, and Coors. They primarily produce mass-market lager to attract as many consumers as possible, and hence exploit scale economies to achieve a low unit cost.

[2] A company can have the right to sell a brand in one country but not in others. For example, AB InBev acquired Grupo Modelo in 2013, which has Corona as one of its main brands. However, the US Antitrust agencies allowed for such a transaction conditional on AB InBev divesting Modelo's US business to Constellation Brands. Thus, Constellation Brands sells Corona in the USA, although AB InBev sells this brand in other countries.

The main brands sold by AB InBev and Molson Coors are presented in Table 1. One striking feature of this table is that each company exhibits a higher quantity-based market share than its value counterpart. The pattern arises since their type of beer (lager), jointly with a more efficient scale of production, translates into lower prices relative to imported and craft beers. Consequently, the importance of these two firms is more significant in volume than in value. This difference is even observed within firms, as occurs with Michelob for AB InBev (a premium lager) and Blue Moon for Molson Coors (a craft beer).

Table 1. *Brands by each Leader - Year 2019*

(a) AB InBev

	Market Share (%)	
Brand	**by Value**	**by Volume**
Bud Light	12.9	16.6
Michelob	5.7	4.5
Budweiser	4.2	5.5
Busch	3.7	5.4
Rest of Brands	8.6	9.8
Total	35.1	41.8

(b) Molson Coors

	Market Share (%)	
Brand	**by Value**	**by Volume**
Miller	6.9	9.2
Coors	6.6	8.7
Blue Moon	1.7	1.1
Keystone	1.3	1.9
Rest of Brands	3.5	3.7
Total	20.0	24.6

Note: Information from Passport GMID by Euromonitor.

Figure 1 also shows the existence of two other firms with a substantial presence in the market: Constellation Brands and Heineken NV. They are the biggest beer importers in the country, and their business models in the US differ from those by AB InBev and Molson Coors. Constellation Brands has traditionally been a company exclusively dedicated to the production and distribution of wine and spirits. It did not enter the beer market until 2013, when it acquired the right to sell the ex Grupo Modelo's brands in the US (e.g., Corona and Modelo). As for Heineken NV, it is the second beer company in terms of world sales, accruing a 12.6% global market share in 2019 (Statista, 2020). It has traditionally focused on European markets, with high success in both Asia and Africa, but its presence in the US is quite modest relative to the largest firms.

Lastly, Figure 1 reveals the significant presence of "Others", which comprises any firm with a market share lower than 0.1%. Throughout the paper, we refer to these firms as craft brewers, consistent with our characterization of the group. This is in line with how the US Brewers Association issues its seal to certify "authentic" craft brewers (i.e., the brewer has to be small in terms of total production and independent). Nonetheless, it is worth noting that other companies also produce craft beer, including large craft brewers (e.g., Boston

Brewing and Sierra Nevada) and macrobrewers (e.g., Blue Moon by Molson Coors). Next, we concentrate on a further description of this group.

2.2 Craft Brewers

The emergence of craft brewers in the last decades has been possible due to several reasons. First, consumption patterns have drastically changed worldwide (Garavaglia and Swinnen, 2017). This arose due to a combination of declining interest in the standardized lagers offered by macrobrewers, and growth in income that enabled consumers to afford more expensive products. Both factors spurred a desire for novelty, variety, and quality in beers, allowing craft brewers to fill up product niches through a wide range of highly differentiated beers.

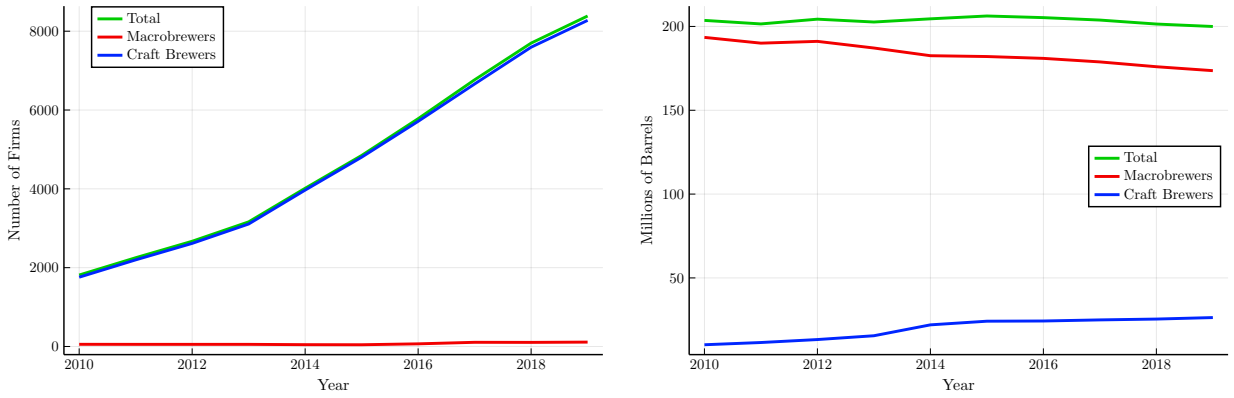
Additionally, changes in American regulations starting at the end of the 1970s prepared the ground for the development of craft breweries (Elzinga and McGlothlin, 2020). Several restrictions hampering entry to the beer industry were lifted (including the prohibition of homebrewing and brewpubs), jointly with government policies favoring small breweries (e.g., reductions in excise taxes).

It is possible to identify two waves of craft beer's rise in the US: one that occurred during the 1990s, and another that is still taking place and has begun in 2010. The latter has had more vigorous, reflected in the number of craft brewers across time: they went from less than 100 in 1988 to 1,509 in 2000, and reached 8,275 by 2019. Instead, the same trend was not exhibited by macrobrewers, whose number has remained relatively stable.

Figure 2 illustrates the patterns observed in the second wave. Figure 2a in particular shows the changes in the number of brewers. It reveals an almost perfect overlap between the increase in total firms and craft brewers, with the number of macrobrewers barely changing. Figure 2b additionally shows that the craft beer market has been growing in importance, despite the stagnation in the beer industry as a whole and the declining interest in macrobrewers' lagers.

Figure 2. *Number of Firms and Market Size: Years 2010-2019*

(a) Number of Companies **(b)** Total Production

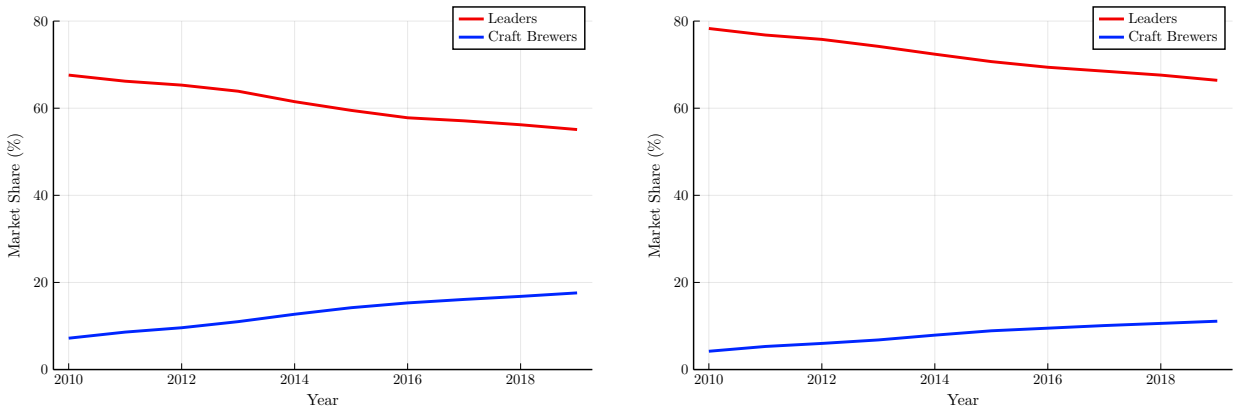


Note: Information from the American Brewers Association and Passport GMID by Euromonitor.

The beer offered by craft brewers and their mode of production starkly differ from those by macrobrewers. Craft brewers produce ales at a small scale, and tailor their style with an emphasis on flavor and quality. Due to this, craft beers tend to exhibit higher prices relative to macrobrewers. This is reflected in a greater market share in value than volume, as it can be observed across years by comparing Figure 3a and Figure 3b. These figures also reveal the increasing importance of craft brewers over time. Their revenue share was 7.2% in 2010, reaching 17.6% by 2019. This increase in 10.4 percentage points contrasts with the 12.5 points that industry leaders lost during the same period.[3]

Figure 3. *Evolution of Market Shares - Years 2010-2019*

(a) Value-based Market Share **(b)** Quantity-based Market Share



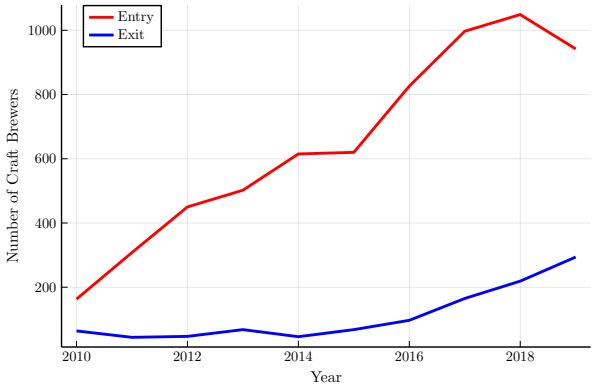
Note: Information from Passport GMID by Euromonitor. Definition of leaders incorporate changes in the rights to sell brands in the USA across time.

[3]Lately, the growth trend in craft beer has exhibited some heterogeneity within the segment. Thus, regional and national craft brewers have been showing some signs of stagnation, while local craft brewers have kept expanding.

Also, craft brewers tend to display some typical features of small firms that the literature has identified since at least Dunne et al. (1988). We highlight in particular the high correlation between the craft brewers' entry and exit (Tremblay et al. 2005; Garavaglia and Swinnen 2018). This occurs since small firms tend to venture into industries with significant uncertainty about their profitability. Consequently, market changes that foster entry determine that, once firms learn their profitability, only the most profitable ones keep serving the market while the rest exit.[4]

This process of entry and eventual exit was observed in the first wave of the rise of craft brewers, with exit taking place at the end of the 1990s and beginning of 2000s (see Tremblay et al. 2005). The second wave still represents a short time span to reveal the pattern clearly, although some emerging signs of it can be appreciated. Figure 4 shows that, after a period of high entry between 2010 and 2014, the number of exiting craft brewers started to rise. Overall, the exit rate went from around 10% in 2010 to more than 20% in 2019.

Figure 4. *Craft Brewers - Entry and Exit*



Note: Information from the American Brewers Association.

2.3 Strategic Behavior by Leaders

It has been widely documented that leaders have engaged in strategic moves to hamper the progress of craft brewers. This has occurred in both the first wave during the 1990s (D'Aveni 2002; Tremblay and Tremblay 2005) and in the second wave that started in 2010 (Schnell and Reese 2014; Garavaglia and Swinnen 2017; Elzinga et al. 2018). Various strategies over time have been identified in the literature. Some of them have even been scrutinized by the US

[4]For a model describing these dynamics in the beer industry, see Horvath et al. (2001).

Justice Department due to antitrust concerns. Next, we outline the main ones. The reader is referred to the articles just cited for further details.

The first strategy, especially prominent during the first wave, was the introduction of own craft beer brands by leaders. Macrobrewers have tended to launch these products hiding their involvement, with the goal of pretending that truly small craft breweries manufactured them. Due to this, they were commonly referred to as "faux" or "phantom" brands. Examples are Shock Top by AB InBev and Blue Moon by Molson Coors. The latter probably represents the most successful case: it has become the top-selling craft beer brand in the American market, and represents Molson Coor's top third brand in terms of its sales.

This strategy was not highly prosperous, with the leaders' craft beer creations contributing little to their sales, except for Blue Moon (Schnell and Reese, 2014). Due to this, leaders have recently adopted a more direct approach: acquiring microbreweries that are relatively successful or show some potential. AB InBev has bought stakes in more than 10 microbreweries since 2010, and nowadays it exhibits a wide craft beer portfolio. One of the most important acquisitions occurred at the end of 2020, when AB InBev bought the total stake in the Craft Brew Alliance. This company has been one of the most successful in the craft beer segment, with a value- and quantity-based market share in 2019 of 0.5% and 0.3%, respectively. Molson Coors has also adopted such a strategy, although to a lesser extent relative to AB InBev. Nevertheless, it has recently started to follow this path more intensively. For instance, it began a partnership with DG Yuengling & Son (one of the top craft brewers), and just performed its fifth craft brewer acquisition (Atwater Brewery).[5]

In addition to competing directly in the market with new products, leaders have also pursued other strategies to crowd craft brewers out. In this respect, it is worth remarking on the attempts to blocks craft brewers from accessing distribution channels. The approach

[5]Heineken NV and Constellation Brands have attempted a similar strategy, but with crucial differences relative to the approach by AB InBev and Molson Coors. Heineken has acquired different microbrewers across the world, including Lagunitas in the American market. Through this company, Heineken got a partial stake in Short's, Moonlight, Independence, Smokehouse, and Southend Brewing (now known as Lagunitas Taproom and Beer Sanctuary). Nonetheless, Heineken has done this with the primary goal of expanding craft beer brands globally, rather than strategically crowding out craft brewers in the American market. As for Constellation Brands, it has performed some acquisitions of craft breweries, although to a lower degree. Even, it has recently sold some of them (e.g., Ballast Point). Constellation's CEO stated that "this decision allows Constellation to focus more fully on maximizing growth for our high-performing import portfolio and upcoming new product introductions, including Corona Hard Seltzer." (https://www.cbrands.com/news/articles/craft-brewer-kings-convicts-brewing-co-to-acquire-ballast-pointis)

for doing this has depended on the regulation of each state. First, most of the states in the US have a three-tier distribution that separates production, wholesaling (i.e., distribution), and retailing. While distributors are independent in these states, more than 90% of the wholesalers concentrate their distribution on brands by either AB InBev or Molson Coors. This has allowed both companies to exert substantial control over the distributors' brand portfolios, which they have used to sell more of their own brands (including their acquired craft beer brands) at the expense of independent craft brewers (Aloi, 2020). In some cases, the influence has even been formal, such as the introduction of financial incentives to reward distributors carrying their brands.[6]

A second way to influence the distribution tier has occurred in states where owning distributors is legal. This has been exploited in particular by AB InBev, which fully integrated its production and distribution activities in key states like California. In this way, AB InBev has become one of the most important beer distributors in the country. And, even when US antitrust has put limits to this practice, AB InBev has found legal loopholes to keep exercising control through partially owning distributors. This has enabled it to influence distributors by, for instance, the choice of managers and keeping veto power over critical decisions.[7]

Finally, both AB InBev and Molson Coors have also actively influenced the retailing tier. This has been primarily done in the largest retail chains through their designation as Category Captains. The job of these agents is to help retailers with the choice and display of brands to maximize the profitability of a product category. Thus, leaders have taken up more shelf space and fostered their own craft beer brands, potentially making retailers retain varieties that were potentially less profitable for them.[8]

[6] See, for instance, Noel (2018), Chapter 9, regarding the programs "100% Share of Mind" by AB InBev and "Fair Share" by Miller.

[7] Concerns about this practice were raised by the National Beer Wholesalers Association in the US. See its comment to the proposed final judgment regarding the merger between AB InBev and SABMiller, https://www.justice.gov/atr/case/us-v-anheuser-busch-inbev-sanv-and-sabmiller-plc.

[8] See, for instance, the Brewers Association report on this regard: https://www.brewersassociation.org/attachments/0001/2999/Category_Management_Case_Study.pdf. For formal evidence on the matter, see Howard (2018).

3 A Model for Beer Leaders' Strategic Moves

In this section, we present a stylized model that captures the so-called "strategic moves" by beer leaders. This term was coined by Schelling (1960), and in the context of oligopoly refers to a leader's actions to gain an advantage in the market. The setting we employ is based on Alfaro (2020b), adapted to the idiosyncratic features of the beer industry and assuming specific functional forms to perform calibration exercises.

To keep the model stylized regarding strategic moves, we formalize these moves through leaders deciding on a non-price variable that requires sinking costs and hence entails commitment. Consistent with Section 2.3, this variable should be understood in a broad way: it gathers all the non-price decisions made before the market stage that eventually affect how this is played.[9]

A leader's strategic use of the non-price variable is isolated by following the approach in Fudenberg and Tirole (1984). This requires comparing two scenarios. The first one is referred to as a sequential-move scenario, where rivals condition their entry and pricing decisions on each leader's non-price variable. The second game, which we refer to as a simultaneous-move game, is a non-strategic benchmark where no firm observes the leaders' decisions.

In relation to American beer, the goal of the model is to rationalize the leaders' aggressive behavior against craft brewers. Specifically, our results show that beer leaders always have incentives to crowd out craft brewers, and never to accommodate their entry. The outcome establishes a clear contrast with settings where competition is against a restricted number of large followers, where accommodating entry can arise under some conditions. This strategy is never optimal for a beer leader, since craft brewers are monopolistic firms governed by free-entry rules—any strategy to soften competition would induce further entry, thereby undermining the ultimate goal of preserving the profitability of the market.[10]

[9] Alternatively, we could assume a Stackelberg-type model, where price is the only choice variable and leaders decide on it before rival firms. However, this allows leaders to influence the conditions of the market without incurring any cost, so that calibration exercises may exaggerate the impact. Furthermore, the evidence previously outlined points out that the beer leaders' strategic behavior against craft brewers occurs through non-price choices.

[10] The logic is similar to Etro (2006).

3.1 Supply Side

We consider a set of firms $\overline{\Omega}$ that can potentially operate in the beer industry. This set can be partitioned into subsets $\overline{\mathcal{C}}$, $\overline{\mathcal{N}}$, and $\overline{\mathscr{L}}$, which respectively comprise "craft brewers", "non-leading macrobrewers", and "leading macrobrewers".

Our characterization of craft brewers is based on a monopolistic-competition setting à la Melitz. Specifically, $\overline{\mathcal{C}}$ comprises a continuum of firms that are ex-ante homogeneous and do not know their productivity.[11] These firms are governed by free-entry rules, and each can explore their possibilities in the industry by paying an entry cost F. If a craft brewer decides to pay F, it discovers its productivity φ and is able to serve the market with a unique variety ω, where productivity is distributed with a continuous cdf G and support $\left[\underline{\varphi}, \overline{\varphi}\right]$.

Moreover, a craft brewer decides whether to serve the market. If it does so, it incurs overhead costs f and produces with constant marginal costs $c(\varphi)$ where $c' < 0$. Given the existence of overhead costs, not all firms can profitably produce for the market—only the most productive ones do it, while the least-productive firms shut down their operations. We denote the total mass of firms paying the entry cost by M^e, and the subset of craft brewers serving the market by $\mathcal{C}$.

Likewise, macrobrewers are considered as a set of heterogeneous oligopolistic firms that impact industry conditions through their choices. Their characterization of costs is the same, irrespective of whether they are leaders or non-leaders. Specifically, macrobrewer ω has some given productivity that defines a marginal cost c_ω, where $c_\omega < c(\overline{\varphi})$ for $\omega \in \overline{\mathcal{N}} \cup \overline{\mathscr{L}}$; in words, any macrobrewer has a lower marginal cost than the most productive craft brewer. We suppose that macrobrewers always serve the market, which is accomplished by assuming that they do not incur overhead costs. Due to this, the set of active leaders and non-leading macrobrewers, denoted by $\mathcal{N}$ and $\mathscr{L}$, coincide with the set $\overline{\mathcal{N}}$ and $\overline{\mathscr{L}}$.

Finally, competition is in prices, and we denote firm ω's price by p_ω. Furthermore, each macrobrewer ω makes a non-price choice z_ω that requires sunk costs $f_z z_\omega$. We incorporate z_ω as a demand shifter, although all the conclusions of the model are identical by embedding it as a cost shifter. In this respect, we simplify the analysis by assuming that $z_\omega := 1$ for any

[11] The results of the model are the same if we assume that craft brewers do not know some parameter that affects their demand. What ultimately matters is that these firms do not know their profitability, irrespective of whether this occurs through the cost or demand side.

craft brewer ω, and incorporate f_z into its overhead cost. The fact that they do not decide upon this variable is without loss of generality, since all the results we derive (including the quantitative ones) are literally identical if they make a choice over it.

3.2 Demand Side

Firm ω's demand is given by an augmented CES that incorporates z_ω as a demand shifter. Formally,

$$Q_\omega := E\mathbb{P}^{\sigma-1}\left(p_\omega\right)^{-\sigma}\left(z_\omega\right)^{\delta}, \tag{1}$$

where $E > 0$ is the industry expenditure, and $\mathbb{P}$ is a price index given by

$$\mathbb{P} := \left[\int_{\omega\in\mathcal{C}} \left(p_\omega\right)^{1-\sigma} \mathrm{d}\omega + \sum_{\omega\in\mathcal{N}} \left(p_\omega\right)^{1-\sigma}\left(z_\omega\right)^{\delta} + \sum_{\omega\in\mathscr{L}} \left(p_\omega\right)^{1-\sigma}\left(z_\omega\right)^{\delta}\right]^{\frac{1}{1-\sigma}}, \tag{2}$$

with $\sigma > 1$ and $\delta < 1$.

The price elasticity of demand for a craft brewer is σ. Instead, for macrobrewers this is $\varepsilon\left(s_\omega\right) := \sigma + s_\omega\left(1-\sigma\right)$, where s_ω is ω's market share and is formally given by

$$s_\omega = \frac{\left(p_\omega\right)^{1-\sigma}\left(z_\omega\right)^{\delta}}{\mathbb{P}^{1-\sigma}}. \tag{3}$$

3.3 Equilibrium

In the following, we state the equilibrium conditions. Their derivations are relegated to Appendix A. Our model exploits the existence of a sufficient statistic for each firm's optimal decision, given by the price index, $\mathbb{P}$.

We begin by characterizing the equilibrium conditions for some given leaders' non-price choices, $\left(z_\omega\right)_{\omega\in\mathscr{L}}$. These conditions apply to both the simultaneous-move and sequential-move scenario. Among the craft brewers that pay the entry cost, there are two choices that each makes at the market stage: whether to serve it, and the price in case it does so. The optimal price of an active craft brewer with productivity φ is

$$p\left(\varphi\right) := \frac{\sigma}{\sigma-1} c\left(\varphi\right). \tag{4}$$

To determine whether a craft brewer serves the market, we make use of its optimal profit if

it becomes active. Craft brewer ω's profit is $Q_\omega \left[p_\omega - c\left(\varphi\right)\right] - f$, and so the optimal profit of a craft brewer with productivity φ is

$$\pi\left(\varphi;\mathbb{P}\right) := \frac{R\left(\varphi;\mathbb{P}\right)}{\sigma} - f, \tag{5}$$

where $R\left(\varphi;\mathbb{P}\right) = \frac{E[p(\varphi)]^{1-\sigma}}{\mathbb{P}^{1-\sigma}}$ is its revenue. Since (5) is strictly decreasing in productivity, there exists a survival productivity cutoff, which is the implicit function $\varphi^*\left(\mathbb{P}\right)$ that solves $\pi\left(\varphi^*;\mathbb{P}\right) = 0$. Thus, among the firms that pay the entry cost, those that have productivity $\varphi \geq \varphi^*\left(\mathbb{P}\right)$ serve the market, whereas those with $\varphi < \varphi^*\left(\mathbb{P}\right)$ prefer to exit and hence avoid paying the overhead cost.

Both decisions by craft brewers can be simultaneously expressed by incorporating that a firm sets an infinite price if it decides not to serve the market. Thus, the optimal price is

$$p^{\mathcal{C}}\left(\varphi;\mathbb{P}\right) := \begin{cases} \frac{\sigma}{\sigma-1} c\left(\varphi\right) & \text{if } \varphi \geq \varphi^*\left(\mathbb{P}\right) \\ \infty & \text{otherwise.} \end{cases} \tag{6}$$

As for the craft brewers' decision regarding whether to pay the entry cost, each does it as long as it anticipates non-negative expected profits. Given a continuum of craft brewers governed by free-entry rules, this entails that a zero-expected-profits condition arises. To define it, notice that the optimal profit under the pricing rule (6) is $\max\left\{\pi\left(\varphi;\mathbb{P}\right), 0\right\}$, which reflects that firms avoid paying the fixed cost if they anticipate negative profits (i.e., if $\varphi < \varphi^*\left(\mathbb{P}\right)$). Therefore, denoting optimal expected profits by $\pi^{\text{expect}}\left(\mathbb{P}\right)$, the zero-expected-profits condition is

$$\pi^{\text{expect}}\left(\mathbb{P}\right) := \int_{\varphi^*(\mathbb{P})}^{\overline{\varphi}} \pi\left(\varphi;\mathbb{P}\right) \, \mathrm{d}G\left(\varphi\right) = F. \tag{7}$$

As for a non-leading macrobrewer ω, its price and non-price decision can be expressed in terms of its market share, s_ω. This is equivalent to expressing its choices as functions of $\mathbb{P}$, since $s_\omega\left(p_\omega, z_\omega, \mathbb{P}\right)$ due to (3). Formally, ω's optimal choices are characterized by the system consisting of equation (3) and the first-order conditions, where the latter establish

$$p_\omega = \frac{\varepsilon\left(s_\omega\right)}{\varepsilon\left(s_\omega\right) - 1} c_\omega, \tag{8}$$

$$z_\omega = \frac{\delta E s_\omega \left(1 - s_\omega\right)}{\varepsilon_\omega\left(s_\omega\right) f_z}. \tag{9}$$

The system identifies non-leading macrobrewer ω's optimal price and optimal non-price variable as functions $p_\omega^{\mathcal{N}}(\mathbb{P})$ and $z_\omega^{\mathcal{N}}(\mathbb{P})$, respectively. The same characterization of leader ω's optimal price holds for a given z_ω, so that (8) determines an optimal price that is a function $p_\omega^{\mathscr{L}}(\mathbb{P}, z_\omega)$.

Finally, the equilibrium condition at the market stage requires that the sum of optimal revenue shares equals one. Exploiting that $\mathbb{P}$ is a sufficient statistic for optimal decisions, this condition is

$$s^{\mathcal{C}}(\mathbb{P}, M^e) + \sum_{\omega \in \mathcal{N}} s_\omega^{\mathcal{N}}(\mathbb{P}) + \sum_{\omega \in \mathscr{L}} s_\omega^{\mathscr{L}}(\mathbb{P}, z_\omega) = 1, \tag{10}$$

where $s^{\mathcal{C}}(\mathbb{P}) := M^e(\mathbb{P})^{\sigma-1} \int_{\varphi^*(\mathbb{P})}^{\overline{\varphi}} [p(\varphi)]^{1-\sigma} \, \mathrm{d}G(\varphi)$, $s_\omega^{\mathcal{N}}(\mathbb{P}) := \frac{\left[p_\omega^{\mathcal{N}}(\mathbb{P})\right]^{1-\sigma}\left[z_\omega^{\mathcal{N}}(\mathbb{P})\right]^{\delta}}{\mathbb{P}^{1-\sigma}}$ and $s_\omega^{\mathscr{L}}(\mathbb{P}, z_\omega) := \frac{\left[p_\omega^{\mathscr{L}}(\mathbb{P}, z_\omega)\right]^{1-\sigma}(z_\omega)^{\delta}}{\mathbb{P}^{1-\sigma}}$.

In summary, the equilibrium in each scenario for a given $(z_\omega)_{\omega \in \mathscr{L}}$ can be pinned down by identifying $\mathbb{P}$ and M^e; with those values, any other equilibrium variable can be determined.

The leader's optimal non-price choice depends on the scenario considered. In the simultaneous-move equilibrium, which represents a non-strategic benchmark, no rival conditions its decision on a leader's non-price variable. Thus, a leader's optimal choice is the same as a non-leading macrobrewer's. Expressing it as a function of ω's market share, this is

$$z_\omega^{\mathrm{sim}}(s_\omega) := \delta \frac{E s_\omega (1 - s_\omega)}{\varepsilon_\omega(s_\omega) f_z}. \tag{11}$$

Instead, in the sequential-move game, rivals condition their decisions on z_ω and determines that leader ω's decision on its non-price variable is

$$z_\omega^{\mathrm{seq}}(s_\omega) := \delta\sigma \frac{E s_\omega (1 - s_\omega)}{[\varepsilon_\omega(s_\omega) f_z][\sigma - s_\omega \varepsilon_\omega(s_\omega)]}. \tag{12}$$

3.4 Model Results

Next, we describe the main conclusions of the model. They come from comparing the solutions in each scenario, which isolates the leaders' strategic motive for their non-price decisions.

In the sequential-move scenario, a leader's non-price variable can influence the decisions of both craft brewers and non-leading macrobrewers. Thus, relative to the simultaneous-move game, a leader faces two options to create favorable conditions for itself. First, it could

strategically use its non-price variable to soften price competition in the market, thereby preserving market profitability. However, this strategy is ineffective. It would provide craft brewers with incentives to enter and explore the industry, eventually undermining the goal of lessening competition. The second option is the one actually pursued, and has the goal of crowding craft brewers out. This consists in a leader strategically using its non-price variable to expand its sales. In this way, the leader strengthens competition, thereby reducing each craft brewer's expected profits and thus inducing exit.

The fact that leaders follow this second strategy formalizes the observation by Kwoka and White (2001) in the introduction of our paper, which points out that small firms commonly operate in an environment strategically influenced by leaders to disadvantage them. Furthermore, it highlights that the strategy can increase each leader's profit, without concurrently imposing a negative externality on their large rivals. This occurs because, even when leaders initially strengthen competition, the crowding out of craft brewers completely offsets the impact on the competitive environment. As a consequence, after a reallocation of sales exclusively from craft brewers towards leaders, non-leading macrobrewers are not impacted in equilibrium. The following proposition, whose proof is incorporated in Appendix B, summarizes the result.

Proposition 1. *The deployment of strategic moves determines that:*

- *each leader increases its profit, revenue, market share, and markup,*
- *fewer craft brewers enter the industry, thereby resulting in a lower market share and revenue for them as a group, and*
- *non-leading macrobrewers are unaffected in equilibrium.*

4 Calibration Exercise

In this section, we numerically illustrate the implications of our results for the American beer industry. The goal is to demonstrate that the leaders' strategic moves have mitigated the negative consequences of the rise of craft brewers in the last decades. To accomplish this, we perform a calibration exercise, whereby we bypass the inherent unobservability of strategic moves in isolation. The analysis makes it possible to provide a sense of the magnitudes

involved by the beer leaders' strategic moves. This is done in particular by quantifying how strategic moves are ultimately reflected in current market outcomes of a specific period.

Specifically, our exercise considers American beer in 2019. Given the evidence of strategic behavior by leaders, we suppose that the information captures the sequential-move equilibrium. In other words, the leaders' non-price choices were made strategically in the equilibrium observed. After this, we utilize the model to retrieve outcomes in the simultaneous-move equilibrium, where market outcomes are determined in a competitive environment not influenced by beer leaders. It is worth remarking that outcomes in each equilibrium account for the rise of craft brewers—they only differ regarding whether leaders deployed strategic moves. Consequently, the difference in outcomes between scenarios should be interpreted as the leaders' losses prevented by engaging in strategic moves.

4.1 Taking the Model to the Data

Our focus is on the impact of each leader's strategic moves on its market share, per-period profit, and markup. The computation requires retrieving each leader's market share in the counterfactual scenario, where rivals do not condition on the leaders' non-price choices. This can be done by obtaining an expression for the quotient of ω's market share in each scenario. Then, using the information of ω's market share in one scenario, it is possible to recover ω's market share in the other scenario.[12]

With this aim, denote leader ω's market share in each equilibrium by $s_\omega^{\text{sim}} := s_\omega^{\mathscr{L}}\left(\mathbb{P}^*, z_\omega^{\text{sim}}\right)$ and $s_\omega^{\text{seq}} := s_\omega^{\mathscr{L}}\left(\mathbb{P}^*, z_\omega^{\text{seq}}\right)$. Evaluating (3) at ω's optimal choices and noticing that (7) pins down the same equilibrium price index in both scenarios, the quotient of ω's market shares is

$$\frac{s_\omega^{\text{seq}}}{s_\omega^{\text{sim}}} = \frac{\left(p_\omega^{\text{seq}}\right)^{1-\sigma}\left(z_\omega^{\text{seq}}\right)^{\delta}}{\left(p_\omega^{\text{sim}}\right)^{1-\sigma}\left(z_\omega^{\text{sim}}\right)^{\delta}}, \tag{13}$$

where $p_\omega^{\text{sim}} := \frac{\varepsilon\left(s_\omega^{\text{sim}}\right)}{\varepsilon\left(s_\omega^{\text{sim}}\right)-1}c_\omega$ and $p_\omega^{\text{seq}} := \frac{\varepsilon\left(s_\omega^{\text{seq}}\right)}{\varepsilon\left(s_\omega^{\text{seq}}\right)-1}c_\omega$ from (8), $z_\omega^{\text{sim}} := z_\omega^{\text{sim}}\left(s_\omega^{\text{sim}}\right)$ from (11), and $z_\omega^{\text{seq}} := z_\omega^{\text{seq}}\left(s_\omega^{\text{seq}}\right)$ from (12). Substituting these expressions into (13),

$$g\left(s_\omega^{\text{sim}}\right) = h\left(s_\omega^{\text{seq}}\right), \tag{14}$$

[12] The approach is based on Alfaro (2020a).

where

$$g\left(s_\omega^{\text{sim}}\right) := \left(s_\omega^{\text{sim}}\right)^{\delta-1}\left(\frac{\varepsilon\left(s_\omega^{\text{sim}}\right)}{\varepsilon\left(s_\omega^{\text{sim}}\right)-1}\right)^{1-\sigma}\left(\frac{1-s_\omega^{\text{sim}}}{\varepsilon\left(s_\omega^{\text{sim}}\right)}\right)^{\delta},$$

$$h\left(s_\omega^{\text{seq}}\right) := \left(s_\omega^{\text{seq}}\right)^{\delta-1}\left(\frac{\varepsilon\left(s_\omega^{\text{seq}}\right)}{\varepsilon\left(s_\omega^{\text{seq}}\right)-1}\right)^{1-\sigma}\left(\frac{1-s_\omega^{\text{seq}}}{\varepsilon\left(s_\omega^{\text{seq}}\right)}\frac{\sigma}{\sigma-s_\omega^{\text{seq}}\varepsilon\left(s_\omega^{\text{seq}}\right)}\right)^{\delta}.$$

Given s_ω^{seq} and parameters (σ,δ), we can always recover s_ω^{sim} by using (14), since there always exists a value s_ω^{sim} that solves (14) and whose solution is unique.[13]

The identification of s_ω^{sim} for each leader ω allows us to obtain the rest of results we are interested in. First, it makes it possible to identify the impact on market-share reallocation between firms, once that the increase in the leaders' market shares is exclusively at the expense of craft brewers. Additionally, we can identify how strategic moves enable leader ω to sustain a higher markup, by taking the quotient of (8) between scenarios. Finally, it allows us to identify the impact on leader ω's gross profits, by taking the quotient between $\pi_\omega^{\text{sim}} := \frac{s_\omega^{\text{sim}}E}{\varepsilon_\omega^{\text{sim}}}\left[1-\delta\left(1-s_\omega^{\text{sim}}\right)\right]$ and $\pi_\omega^{\text{seq}} := \frac{s_\omega^{\text{seq}}E}{\varepsilon_\omega^{\text{seq}}}\left[1-\frac{\delta\left(1-s_\omega^{\text{seq}}\right)\sigma}{\sigma-s_\omega^{\text{seq}}\varepsilon_\omega^{\text{seq}}}\right]$.

Regarding parameters, the computation requires values of σ and δ. As for σ, it is the elasticity of substitution, and Alviarez et al. (2020) conduct a meta-analysis of their estimates in the beer industry. They obtain a median and average value of $\sigma := 4.5$, which we use. Results are not particularly sensitive to this value, with any σ between 3.5 and 5.5 only modifying the prediction of market-share reallocations in up to half a percentage point.

As for δ, it corresponds to ω's revenue elasticity of the non-price variable. Given that the CES entails constant expenditures, this is equivalent to the impact of the non-price variable on ω's market share in elasticity terms. Taking this into account, we calibrate δ to fit, as close as possible to the model, the differences in market shares between firms that are not explained by prices. This provides a value $\delta := 0.55$. Details about the procedure are included in Appendix C.

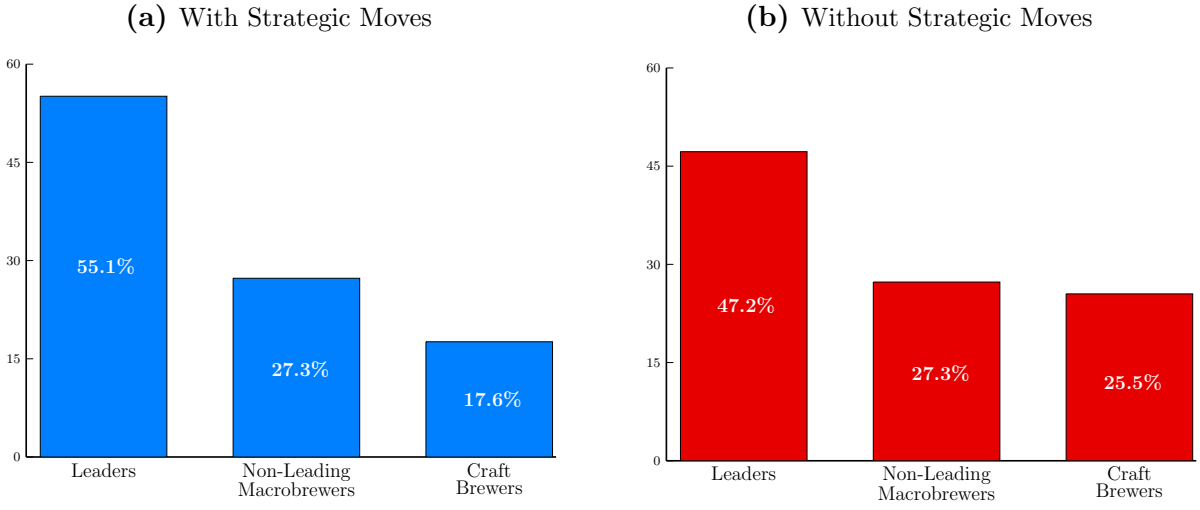
[13] This follows because $h\left(s_\omega^{\text{seq}}\right) > 0$ by definition, and g is continuous and satisfies $\lim_{s_\omega^{\text{sim}}\to 0} g\left(s_\omega^{\text{sim}}\right) = \infty$ and $\lim_{s_\omega^{\text{sim}}\to 1} g\left(s_\omega^{\text{sim}}\right) = 0$, so that a solution exists. Finally, $\frac{\mathrm{d}g\left(s_\omega^{\text{sim}}\right)}{\mathrm{d}s_\omega^{\text{sim}}} < 0$ holds, and so the solution is unique. The proofs are similar to Alfaro (2020a).

4.2 Results

Following the evidence in Section 2, we take AB InBev and Molson Coors as the industry leaders.[14] As for craft brewers, they are taken as the firms belonging to the category "Others" by Euromonitor (see Figure 1), thus comprising any company that has a market share lower than 0.1%. Finally, non-leading macrobrewers correspond to any firm that is neither a leader nor a craft brewer.

In a context where leaders have been negatively affected due to the emergence of craft brewers, our results should be interpreted as the leaders' losses prevented by deploying strategic moves. In particular, we quantify the differences in market outcomes of 2019 if leaders had not strategically affected industry conditions. The results regarding market shares are presented in Figure 5. They reflect that the leaders' strategic moves do not affect non-leading macrobrewers, and instead translate into a reduction in the craft brewers' market share. Specifically, without strategic moves, craft brewers would have had a market share 7.9 points higher in 2019. This represents around USD 8.3 billion in terms of 2019 beer sales.

Figure 5. *Value-Based Market Shares*

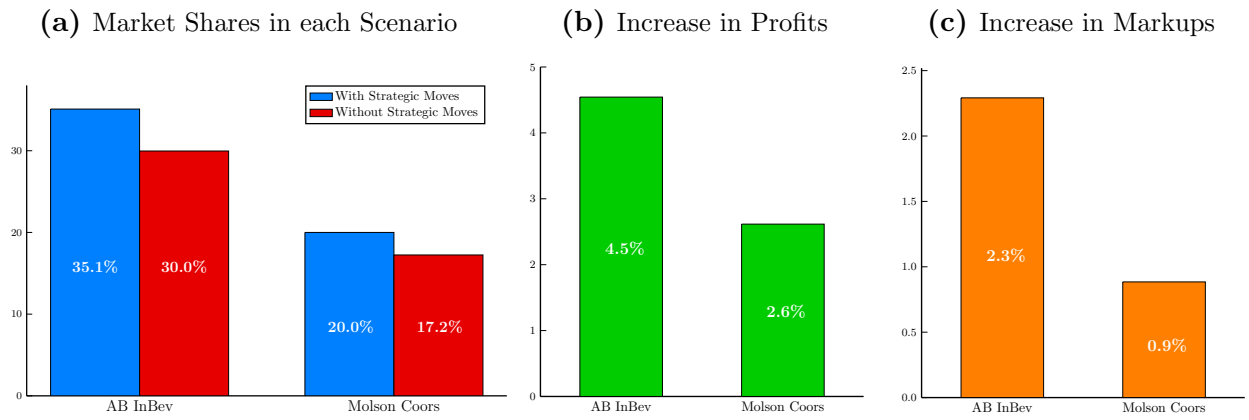


Furthermore, Figure 6a indicates that, out of these 7.9 market-share points, 5.1 were reallocated to AB InBev and 2.8 to Molson Coors. This differential in market-share gains is due to heterogeneity in each firm's size, which affects the magnitude of a leader's impact on market conditions.

[14] Due to the properties of the model, the effects of a specific leader's strategic moves are not quantitatively affected by which companies are taken as leaders. This occurs because the decisions by AB InBev and Molson Coors are identical if we incorporate other firms as leaders (e.g., Constellation Brands or Heineken NV), implying that the same quantitative results arise.

Figure 6b additionally points out that engaging in strategic moves has allowed AB InBev and Molson Coors to respectively prevent a fall in per-period profits of 4.5% and 2.6%. Likewise, Figure 6c indicates that strategic moves have also prevented further declines in markups of 2.3% and 0.9%.[15]

Figure 6. *Impact of Strategic Moves on Leaders' Market Shares, Profits, and Markups*



5 Conclusion

In this paper, we studied strategic behavior by leading firms in American beer against craft brewers. With this goal, we first documented profound changes in the market structure of American beer during the last decades. These changes contributed to the emergence of craft brewers, prompting market leaders to deploy several strategies to countervail its effects and hence sustain a dominant position.

After this, we built a model that accounted for the idiosyncratic features of the beer industry. It was based on a market structure with craft brewers modeled as monopolistic firms, and leading and non-leading macrobrewers modeled as oligopolistic firms. The results highlighted that leaders in this market structure always engage in strategic moves to disadvantage craft brewers and hence crowd them out—entry accommodation never arises, since any strategy to soften competition would induce entry of craft brewers and hence undermine its ultimate goal of keeping market profitability high.

[15] We have also calibrated an alternative model where leaders decide on a non-price variable that reduces marginal cost, rather than acting as a demand shifter. The results are quite similar. AB InBev and Molson Coors respectively prevent losses of market shares of 4.2 and 2.2 points, determining that strategic moves reduce the craft brewers' market share by 6.4 points. The results are available upon request.

This strategy makes each leader compete in the market under favorable conditions, thereby allowing each to increase its profit and sales, and charge a higher markup. The model also demonstrated that a leader's aggressive behavior against craft brewers does not necessarily intensify competition with rival macrobrewers. This arises in our setup since the increase in competition by leaders is perfectly offset by the exit of craft brewers, thus leaving the competitive environment unaffected.

Finally, we performed a calibration exercise for the American beer industry. This illustrated that, despite the rise of craft brewers in the last years, AB InBev and Molson Coors have prevented further losses by deploying strategic moves. Overall, the craft brewers' market share would have been 7.9 points higher in absence of strategic moves.

For future work, we think that the framework proposed could be used to incorporate more complex strategic interactions. Our model determines that leaders only act strategically against craft brewers, but there is evidence of collusion between AB InBev and Molson Coors (Miller et al., 2020). Thus, it would be interesting to explore how the inclusion of strategic behavior among macrobrewers affects our conclusions.

References

Alfaro, M. (2020a). Market structures in small open economies: Evidence from denmark. *Research in Economics 74*(4), 363–378.

Alfaro, M. (2020b). Strategic behavior of domestic leaders under market exploration by small firms. *Mimeo*.

Aloi, B. (2020). Enhancing consumer choice and competition in american beer markets: An analysis of vertical restraints on craft brewer entry and growth. *Mimeo*.

Alviarez, V., K. Head, and T. Mayer (2020). Global giants and local stars: How changes in brand ownership affect competition. *Mimeo*.

Ashenfelter, O. C., D. S. Hosken, and M. C. Weinberg (2015). Efficiencies brewed: pricing and consolidation in the us beer industry. *The RAND Journal of Economics 46*(2), 328–361.

D'Aveni, R. (2002). The empire strikes back. counterrevolutionary strategies for industry leaders. *Harvard Business Review 80*(11), 66–74.

Dunne, T., M. Roberts, and L. Samuelson (1988). Patterns of Firm Entry and Exit in U.S. Manufacturing Industries. *The RAND Journal of Economics 19*(4), 495–515.

Elzinga, K. G. and A. J. McGlothlin (2020). Has anheuser-busch let the steam out of craft beer? the economics of aquiring craft bewers. *Mimeo*.

Elzinga, K. G., C. H. Tremblay, and V. J. Tremblay (2018). Craft beer in the usa: Strategic connections to macro-and european brewers. In *Economic Perspectives on Craft Beer*, pp. 55–88. Springer.

Etro, F. (2006). Aggressive Leaders. *The RAND Journal of Economics 37*(1), 146–154.

Fudenberg, D. and J. Tirole (1984). The Fat-Cat Effect, the Puppy-Dog Ploy, and the Lean and Hungry Look. *American Economic Review 74*(2), 361–366.

Fudenberg, D. and J. Tirole (1991). *Game Theory*. MIT Press.

Garavaglia, C. and J. Swinnen (2017). The craft beer revolution: An international perspective. *Choices 32*(3), 1–8.

Garavaglia, C. and J. Swinnen (2018). Economics of the craft beer revolution: A comparative international perspective. In *Economic perspectives on craft beer*, pp. 3–51. Springer.

Horvath, M., F. Schivardi, and M. Woywode (2001). On industry life-cycles: delay, entry, and shakeout in beer brewing. *International Journal of Industrial Organization 19*(7), 1023–1052.

Howard, P. H. (2018). Craftwashing in the us beer industry. *Beverages 4*(1), 1.

Kwoka, J. E. and L. J. White (2001). The new industrial organization and small business. *Small Business Economics 16*(1), 21–30.

Melitz, M. J. and S. J. Redding (2015). New Trade Models, New Welfare Implications. *American Economic Review 105*(3), 1105–1146.

Miller, N., G. Sheu, and M. Weinberg (2020). Oligopolistic price leadership and mergers: The united states beer industry. *Available at SSRN 3239248*.

Miller, N. and M. Weinberg (2016). The market power effects of a merger: Evidence from the us brewing industry. *Econometrica*.

Miller, N. H. and M. C. Weinberg (2017). Understanding the price effects of the millercoors joint venture. *Econometrica 85*(6), 1763–1791.

Noel, J. (2018). *Barrel-aged Stout and Selling Out: Goose Island, Anheuser-Busch, and how Craft Beer Became Big Business*. Chicago Review Press.

Schelling, T. (1960). *The Strategy of Conflict*. Harvard University Press.

Schnell, S. M. and J. F. Reese (2014). Microbreweries, place, and identity in the united states. In *The geography of beer*, pp. 167–187. Springer.

Statista (2020). Breweries in the usa. data retrieved from Statista.

Sutton, J. (1996). Game theoretical models of market structure. *Mimeo*.

Tremblay, V. J., N. Iwasaki, and C. H. Tremblay (2005). The dynamics of industry concentration for us micro and macro brewers. *Review of Industrial Organization 26*(3), 307–324.

Tremblay, V. J. and C. H. Tremblay (2005). *The US brewing industry: Data and economic analysis*. MIT Press.

Appendices—for online publication

A Derivation of Section 3

Macrobrewer ω's optimal prices, (8), simply follows by the first-order condition, $\frac{\partial \pi_\omega}{\partial p_\omega}+\frac{\partial \pi_\omega}{\partial \mathbb{P}}\frac{\partial \mathbb{P}}{p_\omega}=0$. This provides the well-known formula $p_\omega=\mu_\omega c_\omega$, where $\mu_\omega:=\frac{\varepsilon_\omega}{\varepsilon_\omega-1}$ is ω's markup. The optimal price by a craft brewer with productivity φ, (4), is obtained by using the same formula but with $\varepsilon_\omega=\sigma$.

Regarding the non-price variable in the simultaneous-move game, macrobrewer ω maximizes

$$\pi_\omega\left(\mathbb{P},z_\omega\right):=Q_\omega\left(\mathbb{P},z_\omega\right)\left(p_\omega-c_\omega\right)-f_z z_\omega, \tag{A1}$$

where $Q_\omega\left(\mathbb{P},z_\omega\right):=E\mathbb{P}^{\sigma-1}\left(p_\omega\right)^{-\sigma}\left(z_\omega\right)^{\delta}$. The first-order condition gives

$$\left(\frac{\partial Q_\omega}{\partial z_\omega}+\frac{\partial Q_\omega}{\partial \mathbb{P}}\frac{\partial \mathbb{P}}{\partial z_\omega}\right)\left(p_\omega-c_\omega\right)-f_z=\left(\frac{\partial \ln Q_\omega}{\partial \ln z_\omega}+\frac{\partial \ln Q_\omega}{\partial \ln \mathbb{P}}\frac{\partial \ln \mathbb{P}}{\partial \ln z_\omega}\right)\frac{Q_\omega\left(p_\omega-c_\omega\right)}{z_\omega}-f_z=0. \tag{A2}$$

Using (3) and (8), then $Q_\omega\left(p_\omega-c_\omega\right)=\frac{Es_\omega}{\varepsilon_\omega}$. Moreover, $\frac{\partial \ln Q_\omega}{\partial \ln z_\omega}=\delta$ and $\frac{\partial \ln Q_\omega}{\partial \ln \mathbb{P}}=\sigma-1$, and $\frac{\partial \ln \mathbb{P}}{\partial \ln z_\omega}=\frac{\delta}{1-\sigma}s_\omega$ by using (3). Substituting these expressions into, we obtain (A2).

As for the non-price choice in the sequential-move game, (7) identifies $\mathbb{P}$ irrespective of the scenario considered or ω's choices. Denote this value by $\mathbb{P}^*$. Thus, leader ω maximizes (A1) given $\mathbb{P}^*$ and $p_\omega^{\mathscr{L}}\left(\mathbb{P}^*,z_\omega\right)$, and the first-order condition is

$$\left(\frac{\partial Q_\omega}{\partial z_\omega}+\frac{\partial Q_\omega}{\partial p_\omega^{\mathscr{L}}}\frac{\partial p_\omega^{\mathscr{L}}}{\partial z_\omega}\right)\left(p_\omega-c_\omega\right)-f_z=\left(\frac{\partial \ln Q_\omega}{\partial \ln z_\omega}+\frac{\partial \ln Q_\omega}{\partial \ln p_\omega}\frac{\partial \ln p_\omega^{\mathscr{L}}}{\partial \ln z_\omega}\right)\frac{Q_\omega\left(p_\omega-c_\omega\right)}{z_\omega}-f_z=0. \tag{A3}$$

Substituting in by $\frac{\partial \ln p_\omega^{\mathscr{L}}}{\partial \ln z_\omega}=\frac{\delta s_\omega}{\sigma-s_\omega\varepsilon_\omega}$ and the derivatives stated above for the simultaneous-move case, we obtain (12).

B Proof of Proposition 1

The optimal choices by non-leading macrobrewers, $p_\omega^{\mathscr{N}}\left(\mathbb{P}\right)$ and $z_\omega^{\mathscr{N}}\left(\mathbb{P}\right)$, are not affected in equilibrium, since $\mathbb{P}^*$ is the same in both scenarios. Thus, their quantities supplied are also the same, and so are their revenues and profits. Given that the CES entails constant expenditures, their revenue-based market shares are not impacted either.

The results for leaders (except a leader's markup) can be derived by using Propositions 4.1 and 4.3 in Alfaro (2020b) assuming a closed economy. Even though our model incorporates non-leading macrobrewers, the proofs still hold since they only make use of that $\mathbb{P}^*$ holds in

both scenarios, which is still true in our model. Regarding ω's markup, the result follows because ω's price elasticity of demand is decreasing in its market share and $s_\omega^{\text{seq}} > s_\omega^{\text{sim}}$.

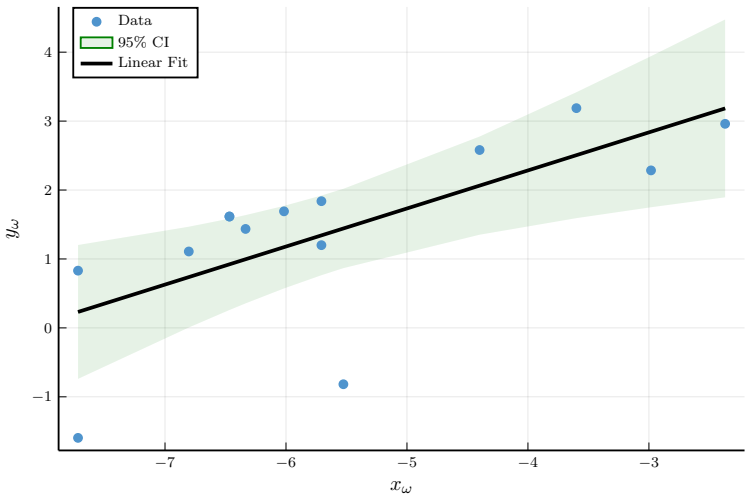
C Calibration of δ

The procedure to calibrate δ is based on that unobserved quality characteristics can be obtained through market shares, by netting out the effect of prices. Thus, δ is calibrated to fit the differences in market shares not explained by prices as close as possible to the model. Formally, this requires expressing (3) in logarithms and adding an error term,

$$\ln s_\omega = (1-\sigma)\ln p_\omega + \delta \ln z_\omega + (\sigma - 1)\ln \mathbb{P} + \varepsilon_\omega. \tag{C1}$$

After this, (C1) is reexpressed by substituting ω's optimal investments in. Investments for leaders are given by (12), whereas non-leaders decide on investments non-strategically and so they are given by (11). The resulting expression requires information on prices, and we use unit values as a proxy. These are derived through information on market shares in terms of sales and quantities, along with total quantities and sales in the industry. Using $y_\omega := \ln s_\omega - (1-\sigma)\ln p_\omega$ as the dependent variable and treating variables that are symmetric for each firm as a fixed effect, the model fit is presented in Figure 7.

Figure 7. *Model Fit - δ*



Note: $\delta = 0.552(0.17)$ with $R^2 = 0.48$.