The Co-Production of American Craft Brewing

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Globalization and centralization of manufacturing have driven the modern economy since the industrial revolution and the development of the assembly line. The core value proposition of conglomeration is simple: combining similar businesses into larger entities increases efficiency in production, relative impact of advertising, and reduces shipping costs, which in turn allows for businesses to offer services to consumers at rock bottom prices (Hefferman 2018). This movement of industry into many brands controlled by a few key players receives strong criticism for its unseen impacts, namely stifling innovation, overly swaying governmental regulations through lobbying, and negatively impacting small businesses and communities. The result has been a cultural backlash in the form of the Buy Local movement (also known more formally as Neolocalism), which encourages consumers to buy goods from smaller entities even if they have to purchase comparable goods at higher prices (Coit 2008). While this movement has received media attention and has found strong roots particularly in more progressive communities, its impact on manufacturing has been mixed at best. In most American goods-producing sectors, market share continues to be dominated by corporate goliaths, with a few notable exceptions, one of which is craft brewing (Thompson 2018). This anomalous case of revitalization within local manufacturing leads to the central research question of this paper: what sociotechnical, cultural, and economic relationships have been the main contributors to success of the American craft brewing industry?

Background

Characterizing the Modern American Brewing Industry

The American beer market was long one of the worst offenders in corporate consolidation: in 2012, Anheuser-Busch InBev and MillerCoors alone controlled 90% of domestic beer production (Thompson 2018). However, by 2016, "the number of brewery establishments expanded by a factor of six, and the number of brewery workers grew by 120 percent" (Thompson, 2018). As of 2019, craft beer now represents close to 25% of all beer sales in the United States, taking in close to 25 billion dollars (Arthur 2020). Before continuing further in this discussion, it is important to note the definition of a craft brewery, which has three main components: size, independence, and brewing method. As defined by the American Brewing Association, craft brewers have to produce less than 6 million barrels of beer per year, and the brewery can have at most a 25% ownership stake held by a beverage industry member that is itself not a craft brewer. Finally, a craft brewery has to use traditional brewing methods, with 50 percent of production volume in all malt beer or adjunct flavor enhancing ingredients (Baginski & Bell, 2011). In 1996, there were 1087 operating craft breweries in the United States, while today more than 6000 are in continuous operation (Reid 2018). The growth of craft brewing, which was more than 4% in 2019, is particularly impressive considering overall beer sales shrunk 2% in the same year, mostly due to the increasing popularity of cider and seltzer based alcoholic beverages. This suggests that craft breweries are actively gaining market share against mass producers, rather than increasing revenue resulting from overall growth in market demand (Reid 2018).

Co-Production Theory

As the interplay between relatively independent social and technical forces provides the best explanation for craft brewing's success, the framework selected for analyzing these forces is co-production theory. Co-production, as described by Sheila Jasanoff, describes a paradigm as the result of the non-temporal and reciprocal interactions between independent technical and social factors (Jasanoff 2004). Within this framework, our technical advances and societal norms are inextricably linked and neither are considered the sole driver of paradigmatic change. As a logical extension of this principle, a co-production analysis has to give attention to both the technical and social factors at play and consider them in an interdisciplinary manner.

A criticism that one might make of co-production's applicability to this topic would be to argue that perhaps the success of craft brewing is more the result of technological determinism or momentum, suggesting that some technological innovation or set of innovations have been the driving force in enabling craft brewers to become competitive with larger distributors. This is partially true, as there have been significant innovations in canning technology, in automating control of ingredient churn, guerilla marketing through social media, and the introduction of new infusion systems that allow for a broader range of flavors especially within American-style India Pale Ales (IPAs) and sours (Didora 2018). However, these innovations only partially explain the success of craft brewing, particularly because these innovations should have almost equal benefit for goliath brewer's craft brands and have not radically changed the economics of beer production, only its flavor (Godard 2018). One could also use a strict social construction-based argument and say that the success is solely due to shifting American cultural attitudes around beer drinking and due to laws from Post-Prohibition-era America that crystallized a difference in standards between mass distributors and local vendors, which have allowed for independent

brewers to create additional revenue streams through taprooms and brewpubs (Nurin 2017). While both of these frameworks have their merits, both of these claims fail to adequately explain the dynamic relationship between the technical and social factors contributing to craft brewing's success, as the key factors developed relatively independently of each other. For instance, the key technical innovations were initially developed as improvements for standard American lager production (Didora 2018), and the laws critical for commercial viability existed long before these innovations were reached (Hefferman 2018). The recent explosion in craft brewing can only be explained as resulting from the complex interplay between independent technology and social forces.

Resource Partitioning Theory

In many traditional economic theories on organizations, a common axiom is that the more centralized and consolidated an industry, the less hospitable that industry is to the emergence and survival of small businesses. Major industry players are able to leverage their substantial liquidity, existing distribution partners, and widespread brand recognition to create high barriers to entry so that entering that market becomes increasingly unviable for newer businesses (Carroll, Dobrev & Swaminathan 2007). In the 1980's, this outcome certainly seemed likely for the brewing industry at large with three major corporations raking in over 80% of total industry revenue. Michael Porter, a professor at the Harvard School of Business who focused on organizational theory, often used brewing as an archetypical example of an inhospitable industry for new businesses, saying that within the brewing industry, " product differentiation is coupled with economies of scale in production, marketing, and distribution to create high barriers to entry" (Baginski & Bell 2011). However, this predicted outcome for the brewing industry has proved largely false. Even though mass market producers have consolidated even

further (with the merger of the SABMiller and MolsonCoors companies), new entrants in beer production have flourished in the past twenty years. This paper will also explore this counterintuitive situation in the context of the resource partitioning theory as described by Carroll, Dobrev, and Swaminathan (2007).

In resource partitioning theory, a product market landscape will eventually converge into a few major competitors offering basic versions of a good/service and representing a large percentage of overall purchases. These "generalists" focus on meeting the needs of the large majority of consumers and utilize economies of scale in production, distribution, and marketing efforts as they vie to be the most competitive entity in the mass market (Baginski & Bell 2011). A result of this focus on mass appeal is that a portion of the population will grow dissatisfied with the typically uniform offerings of the major producers and seek out more specialized offerings. This demand for niche products creates a secondary market that smaller "specialist" ventures will often be able to meet more readily than larger manufacturers. These small businesses, by offering purposely imperfect substitutes for general products, are able to meet a demand without directly competing with the larger manufacturers (Carroll, Dobrev & Swaminathan 2007). While one could suggest that major companies will eventually identify and meet these specialized interests, larger manufacturers are often either less capable or willing to meet these niche needs when compared to smaller businesses due to organizational inertia, a corporate tendency towards standardization, and the sometimes fickle nature of specialized consumer needs.

Technical Factors

IoT Equipment Sensors as Tools for Precision Brewing

Ensuring that a mash grind is done to the proper grade, keeping the fermentation at the correct temperature, reaching the optimum ratios of hops to malt to flavoring ingredients, and reacting to foam overs in packaging are just a few of the many considerations brewers have to keep constantly in mind while a beer is in production. During a classical small-batch brew with traditional equipment, the brewer would need to laboriously inspect every step in the brewing process, relying on their expertise to ensure that the product was correctly made. While this level of expert involvement allowed for the development of many of the classical beer styles and techniques we still utilize to this day, it is impractical and cost prohibitive for any brewery, major or craft, to have this type of inspection done and be able to operate at any degree of reasonable scale (Bandoim 2019). Once breweries began industrializing and producing for mass markets, they started to rely on less manual inspection and more on measuring instruments as they started to operate at scale using heavy machinery and assembly line based manufacturing and packaging. A result of this attempt to produce beer in greater volume was a shrinking variety of styles produced, as national brewers focused on creating the light and watery versions of lagers and pilsners that Americans both preferred for health reasons and were easiest to mass produce. The stronger the flavor profile of a beer style, whether due to specific malts, hops, or flavoring ingredients, the more precise and laborious its production in order to reach a balanced flavor at the end of production. In addition, the greater the volume of beer being produced, the more wasteful the process in terms of both ingredients and energy as high-volume brewing and assembly line packaging typically prioritizes standardized tooling and expediency over

conservation. For instance, high volume brewing typically has to use greater amounts of hops to reach a potent flavor when compared to small batches as the brewer has less control over ingredient quality and addition.

The importance of monitoring the brewing process and the wastefulness of high volume beer production was certainly not lost on American mass producers, as they were originally the only and still are some of the main drivers of innovation in monitoring equipment and techniques. American mass producers were the first to implement internet of things technology and digital monitoring equipment into their systems, recognizing that digital monitoring would give them additional advantage in maintaining quality in massive quantities of fermenting beer (Burkhalter 2019). However, the ability for real time monitoring of all brewing equipment by a single expert and the precision readings offered by digital equipment sensors have proven fundamental to the craft brewing industry. As craft brewers tend to produce many types of beer to keep up with specialist consumer demands, their production lines tend to be generalized as well (Bandoim 2019). In addition, craft brewers often produce more complex beers when compared to mass producers, and these complex beers require very elaborate processes and specific conditions to successfully create. When compared to major breweries, which often have dedicated production lines for individual products, this can leave a lot of variability and risk in the brewing process for craft brewers. As many of these specialty brew styles require unique and expensive ingredients, new craft brewers are often on razor thin margins and having a brew fail can lead to disastrous financial consequences. Maintaining a large staff of brewers to keep tabs on a process is also prohibitively expensive for most new entrants to brewing, meaning that there are typically only a few true experts on site to manage a process (Burkhalter 2019). Digital equipment sensors often are able to be linked to a single dashboard, which allows for a brewer to

keep tabs on all his equipment and brews at once. These digital sensors often have significantly greater precision than their analog counterparts, which provides the brewer greater ability to maintain the specific conditions needed for more specific brews, especially when they are being produced in generalized equipment. An additional advantage of digital sensors is the ability to continuously monitor and account for changes in pressure, temperature, pH balance, carbonation, and many other factors important in brewing (Burkhalter 2019).

Digital Automation in Production and Packaging

Similar to the advantages offered by the inclusion of IoT equipment sensors, automation has provided critical support to craft brewers. Analog automation has existed in the brewing industry ever since it first industrialized with systems for automating bottling being developed in the 1900s. Digital automation only came with the larger digital revolution of the late 20th century, but was wholeheartedly embraced by mass producers, who quickly embraced automation as a way of cutting costs by reducing the human factor in the brewing process, improving flavor, and as a way of gaining better efficiency in terms of ingredient and energy costs (Didora 2018). Humans no longer had to be responsible for manually adjusting rollers to alter the crush of grain or for turning mashers on and off on a certain cycle. Craft brewers took longer to implement digital automation in their processes, as the computers necessary to run and maintain these machines were initially too expensive for local manufacturers to afford. Once the cost of acquiring digital automated equipment was low enough to be a reasonable investment, craft brewers immediately saw it pay dividends in their processes, allowing for a single brewer to be responsible for multiple parallel brews (Bandoim 2019). Digital automation's effect has been particularly important in hopping technology, allowing for greater freedom to add hops continuously and create extremely hoppy IPAs that are major sellers for most brewers (Didora

2018). Digital automation has had an incredible impact on beer packaging, specifically on allowing for real time adjustments in assembly lines based on slow downs. Assembly line slow downs have long been a bane for beer bottling and canning, whether due to a particular beer foaming over or a certain machine shutting down (Bandoim 2019). The main reason these slow downs are so impactful is that the longer the beer is exposed to the air, it will have both greater carbonation loss and lose flavor from oxygen exposure (Bandoim 2019). With automated packaging machines that are able to notify each other of slow downs in real time, the reduction in flavor and texture that results are significantly lessened.

Economic and Social Factors

The Three Tier System and Governmental Regulation

After the end of prohibition in the United States in 1933, states were left to develop a system to regulate what was a highly contentious industry that also had concerns about monopolization and product safety. Many prohibition advocates feared a revival of American saloons, whose reputations for encouraging binge drinking, drunkenness, and prostitution led to the rise of the temperance movement (Sorini 2017). Saloons were often owned by a particular brewer or exclusively served one brewer's products, known as tied-houses. Similarly, during Prohibition, organized crime networks utilized coercion to control the underground speakeasy establishments that were popular in the 1920's (Sorini 2017). Fearful of the perceived negative influences on society that tied-houses and bootleggers had, teetotalers wanted to restrict the power that any individual brewer or distributor could have, and they found allies in the anti-monopolists of the 1930s (O'Brien and Erwin 2020). In an attempt to pre-emptively prevent monopolization within the brewing industry, lawmakers introduced tied-house laws that

prohibited cross-ownership, exclusive partnerships, or vertical integration between industry members, which eventually crystallized into what is now known as the three-tier system (Sorini 2017). The three tier system mandates that an industry member fall into one of three categories: producer, distributor, or retailer. Producers are any member that brew, ferment, and/or package beer, distributors are responsible for transporting product and negotiating with retailers, and retailers which includes supermarkets, liquor stores, and bars (Sorini 2017). An important consideration, and one that will frequently be mentioned in the context of American brewing regulation, is that each state in the US is responsible for regulating its own system, which leads to wide variation in restrictions and limitations that are placed on industry members. The distinction between producers/distributors and retailers however were established fairly universally across the US, and almost all states ended up implementing some form of the three tier system by the mid 20th century (O'Brien and Erwin 2020).

While the three-tier system in its advent was designed to prevent the rise of monopolization within brewing, guarantee product safety, and protect small brewers, it did so with mixed results (Sorini 2017). Restricting producers from direct to consumer sales initially prevented the vertical integration that anti-monopolists feared would happen in the brewing industry, but smaller producers failed to keep up as major producers gained greater brand recognition, improved at their ability to operate at scale, and merged into larger organizations. Smaller producers faced major hurdles both in reaching consumers, as distributors and retailers found more lucrative contracts in catering to the needs of national chains, and in distinguishing themselves from major producers, as they lacked the scale necessary to remain cost competitive in lager and pilsner sales and most consumers were unwilling to pay the premium for more intensive brews (Sorini 2017). In addition, new entrants to the field of brewing were discouraged

from attempting to create new recipes, as bootlegging laws prevented home brewing without a license. Craft brewers became increasingly uncommon, reaching a low point in 1978 with only 42 independent brewery owners operating in the United States (Herz 2014). Recognizing the increasingly homogenized nature of products offered by American brewers and spurred on by a collection of would be homebrewers in California, Jimmy Carter signed a transportation bill in 1978 that deregulated homebrewing and permitted production of up to 100 gallons of beer for non-commercial use (Harry 2020). This deregulation gave Americans the opportunity to hone their brewing craft outside of commercial ventures; it is estimated that in modern times over 95 percent of professional craft brewers began learning through home brewing (Kemp 2017).

While the deregulation of homebrewing allowed hobbyists to learn about craft processes, professional craft brewing was still in stagnation as there was still little financial possibility in the brewing market. The next major breakthrough for craft beer was the deregulation of brewpubs in the state of Washington in 1982 (Kemp 2017). Brewpubs and taprooms allow for brewers to sell their alcohol directly to consumers (DTC) in a controlled environment, and in modern times, are the financial backbone of most new independent brewers, which are unlikely to initially leap into distribution due to having to negotiate contracts and a need to gain local brand recognition first (Sorini 2017). After the initial deregulation in Washington state, brewpubs became legal in some form or another in all 50 states. A key aspect of this deregulation is that many of these states restricted the operation of brewpubs and taprooms exclusively to craft brewers in an attempt to maintain the aspects of the three tier system that prevent vertical integration of distribution and retail (O'Brien and Erwin 2020). As a result of this restriction, craft breweries capitalized on their ability to sell direct to consumers through tasting rooms to

develop an identity as travel and social destinations for people who enjoy getting beer from its source.

Navigating and overcoming regulations, even those designed to protect small producers, are too this day a major consideration for craft brewers. While many states have laxed restrictions on wholesale purchasing direct from producers, many cities and counties have unique sets of limitations they place on brewers and the alcohol industry at large, such as the prevalence of dry counties in the American Southeast that either completely restrict or restrict on Sunday the sale of alcohol. To this day, the American Southeast lags behind other regions in craft brewery density primarily as a result of state, city, and county level restrictions (Baginski & Bell 2011). For instance, even though Charleston, SC has all the typical indicators of a city conducive to craft beer, its brewing scene only recently took off as a result of the city changing laws to allow for beer to be sold alongside food, in a much broader variety of containers, and over the original limit of 6.3% alcohol content (Lee & Lee 2018). As a result of this variability in legislation governing the sale of alcoholic beverages, the local prevalence of craft brewing is influenced just as much by residual restrictions from Post-Prohibition as it is by local demand for product.

Breweries as Investments for Urban Revitalization

With the rise of ecommerce and the digital revolution, the United States' job market has increasingly become one of more creative class and information technology roles instead of traditional manufacturing positions. This shift has brought about a change in the physical requirements of modern companies with many cities suddenly having many large, prominent structures in their downtowns stand empty as they no longer have manufacturers or retailers who require brick and mortar locations (Reid 2018). Finding new residents for these properties often proved challenging for city management, which often led to them becoming derelict and

detrimental to the communities surrounding them. Buildings originally designed to house a certain type of business are often ill suited to the needs of a different resident, and demolition and rebuilding is often more expensive than simply starting from scratch somewhere else (Lee & Lee 2018). Demolishing and reclaiming the land underneath these structures also proved prohibitive for most city governments, which led to a quandary of how to find businesses that need large spaces but are flexible enough to utilize existing space and capable of thriving in oftentimes impoverished areas of cities. The academic term for this style of upcycling existing structures is known as adaptive reuse, and breweries are a natural fit for these requirements. Brewing equipment and taprooms take up a considerable amount of space but have significant adaptability in configuration (Reid 2018). The most frequent customers for taprooms, millennials, are usually far more willing to venture into a distressed area in pursuit of a unique experience than previous generations, and their political beliefs about the importance of recycling and sustainability lead to taprooms having to take minimal effort in redecorating the space they take over. In the early 2010's, Charleston, South Carolina rezoned an industrial park for use by brewers in an area known as "the Neck", which was by far the most dangerous and impoverished area in the city (Lee & Lee 2018). Rather than having to undergo extensive reconstruction and redecoration, most of the brewers decided to incorporate their reused space as a part of their business's identity, such as Fatty's Beer which operates out of a repurposed auto garage. Ten years later, "the Neck" has seen a dramatic increase in average income per resident and business traffic and lower crime rates. The collection of new breweries in the area led to much greater foot traffic for other retail businesses and restaurants, gave the neighborhood a new social identity, and made the area more attractive for new offices for technology companies that want to be located close to a "happening" area of town (Lee & Lee 2018). This scenario of

breweries acting as trailblazers for economic revitalization in distressed areas of cities has proved a common model in recent years. In fact, opening up in old industrial areas close to other breweries is often beneficial to new brewers, as customers tend to want to bar hop between multiple brewers during a night of drinking rather than stick to just one establishment (Reid 2018). For all these reasons, breweries have served as chief investors in urban revitalization and seem likely to continue this role in American cities for at least the near future.

Neolocalism and A Sense of Place

Buy Local, formerly known as neolocalism, is not a formal movement but rather an overarching term for a collection of ideals about consumerism, sustainability, community, and culture that lead to individuals prioritizing purchasing from local producers instead of from national manufacturers (Reid 2018). There are typically four major reasons that individuals cite for this decision to purchase locally: a backlash against mainstream consumerism and sympathy for the plight of American small businesses, a desire for connection with producers, quality of product, and minimizing environmental impact (Coit 2008). Neolocalist ideals have found the largest base of support from mostly progressive and sustainability minded communities. Local products are thought to have greater quality or authenticity because they come from more dedicated craftsmen, and they are thought to have lesser environmental impact because they require much lower energy expenditure in terms of transportation. For instance, the average piece of produce in an American supermarket has typically traveled over 1500 miles before it reaches the end consumer (Reid 2018). Perhaps the strongest reason for purchasing locally is a consumer desire to reconnect with producers and to experience unique products and services. People often have a strong emotional connection to the place they live, and they often want to support people who live in their community rather than send wealth out of their local community. Local

breweries often meet all the stipulations for a “locavore”, as neolocalist subscribers often call themselves. Craft Brewers often incorporate the area they live in to both their products, by using locally sourced ingredients, and into their brand image, by using the names of local places and community members in marketing their products (Lee & Lee 2018).

Millenials and an Evolving Drinking Culture

While they consume only 29% of all beer in America, Millennials are responsible for close to 60 percent of all craft beer purchasing in America (Reid 2018). Millennials cite both a political motivation to support local business and a desire to purchase from sustainable producers as primary drivers in their decision to purchase craft beer (Reid 2018). A statistical analysis by Baginski and Bell, which considered eighteen independent variables that had reasonable association with craft beer consumption over a dataset consisting of cities in the American Southeast, resulted in an predictive equation for number of craft breweries per capita in an area where the determining variables were highly consistent with areas with high populations of Millenials (Baginski & Bell 2011). Reid and Moore also found that the number of craft breweries in an area were correlated with the presence of creative and innovative residents, the number of farmers markets (a proxy variable for strength of neolocalism), and percentage of college educated non-Hispanic white people between the ages of 25 and 44 (Reid 2018). However, Millennial craft beer consumption is not strictly due to their political beliefs, but instead stems from a wide variety of factors. Reid describes a survey where the number one determining factor in Millenial beer purchasing was novel flavors and styles of beer (Reid 2018). Even though there are over 150 major types of beer currently produced in the United States, the product offerings of AB InBev and MillerCoors largely consist of American light lagers and pilsners. Craft brewers, due to their small batch production methods and a desire to maintain diverse offerings at

taphouses, often offer a wide variety of beers such as IPAs, stouts, goses, and Hefeweizens to name but a few. This dissatisfaction with the more traditional offerings of the major manufacturers as responsible for Millenial craft beer consumption pairs well with resource partitioning theory. Millennials in this scenario make up a majority of the specialist consumer population due to their political beliefs and desire for novelty, and the craft beer industry has grown as this population matured into adulthood. In addition to their desire for flavor, Millennials also cite novel experiences and atmospheres as critical for their enjoyment.

The previous paragraph mostly considers young drinkers as Millennials; however, it is important to acknowledge that Generation Z members (Gen Zers) are also reaching adulthood and that their preferences are also important to consider for the future of what beer demand will look like. In terms of their political viewpoints and social conscience, Gen Z largely resembles the Millennials, except that they tend to be even more tolerant on issues of gender, sexuality, and diversity (Iqbal 2018). Gen Zers drink 20% less than even Millennials did at the same age, citing concerns about their future, rising costs, existential dread about the environment, and concerns about having mistakes posted on social media as their main inhibitors to drinking (Iqbal 2018). Gen Zers are less likely to view college and their early years as an opportunity to drink and socialize as obtaining a good job and becoming a homeowner are no longer the givens that they used to be. This more conservative approach to drinking combined with their prevalent concerns about sustainability would suggest that Gen Zers would show greater preference for craft brewing, but this expectation is debatable, due to the relative high cost of craft beer coupled with higher caloric content (Frost 2019). An opinion piece by MolsonCoors notes that Gen Zers spends most of its money on spirits which is a generational first, and that they spend a greater percentage of their money (27%) on light American lagers versus craft beer (21%). (Frost 2019).

MolsonCoors blogger Peter Frost suggests that this is due to Gen Zers preferring light lager for its caloric content, but this could just be as easily due to the facts that Gen Zers largely have less disposable income compared to Millennials, comparing college students to working professionals, and that Gen Zers will turn to craft products down the line.

Co-Production Analysis

The previous sections of this paper attempted to demonstrate that the successful resurgence of local brewing in the United States cannot be described as resulting exclusively from technical or social factors. In this section, that argument will be formalized using the co-production framework, showing that craft brewing's success is the result of the dynamic interplay between relatively independent technical, economic, and social factors.

The best place to start is with America's evolving drinking culture. People's desires have shifted in where they want to drink, what they want to drink, and who they want to make their drink. A constant thread through all the social factors mentioned above is that Americans, especially younger Americans, are looking for ways to feel connected with the places they live. Living in a technology driven and highly volatile economy, people have had to frequently move to new places, had to deal with their hometowns either falling on hard times, or seen long time residents crowded out by job seeking transplants. For each of these groups of people, they feel as though modernity has caused them to lose touch with the place they live, which has caused them to express this desire for a sense of place in their consumption. This loss of a sense of place, an overall sentiment that American culture is becoming too homogenous, and the replacement of local businesses with chain stores are all included in the reactionary political ideals of Neolocalism. These neolocalist ideals have existed for a long time; however, they have

resonated with Millennials, who typically have a strong desire for unique experiences and sustainable consumption. Because of these ideals, Millennials became the specialist consumers that resource partitioning theory considers essential for supporting independent manufacturers in a modern industry.

These ideals were finding their roots in parallel with America undergoing its digital revolution. The innovations that came out of digitization were quickly embraced by brewers as they were able to gain drastically improved control and flexibility in their brewing process. IoT devices allowed for greater precision in brewing and digital automation has allowed for brewing to require less manpower and to be more efficient. The ability to have less people required to have a successful brewing operation is critical for craft brewers who work with limited budgets. The precision offered by digital devices allow for brewers to have greater success with first time brewing attempts, meaning that brewers were empowered to take risks and experiment with new formulas and products without risk of having to finance lots of trial brews without getting a sellable product. This ability to experiment with novel techniques and recipes without severe upfront financial risk allowed for craft brewers to keep up with the Millennial demand for variety and novelty in what they drink. Experimentation eventually allows for lots of brewers to develop signature styles and unique offerings that can only be found at that brewer, which gives consumers a strong sense of local pride in the beer they buy. The precision offered by digital sensors also allows for minimizing ingredient waste in production, which both decreases overhead costs and gives a strong selling point for getting sustainably minded consumers like Millennials to patronize your business. These technical factors allowed for craft breweries to better meet the desire for local uniqueness and variety that new beer drinkers were increasingly demanding. However, this desire for unique and greater variety did not drive the inclusion of

digital sensors and automation in production lines, as these tools were originally adapted for cutting costs by national producers to cut costs on their standard light lagers. Neither could you say that these digital technologies drove the production of greater varieties of beer, because these styles existed long before the introduction of digital products on brewing lines.

While both neolocalist ideals and digital equipment aided brewers, this success would not have been nearly as widespread without economic factors from governmental policies, such as the three tier system, the deregulation of home brewing, and cities providing financial incentives for urban revitalization. Both of these economic factors allowed for explosive and sustainable growth for craft brewers; however, they were only able to work once social ideas and technology progressed to where they are now. The trend towards corporate consolidation continued even after the three tier system and the deregulation of home brewing were made law. Businesses have always been able to repurpose old industrial and urban sites, but it took consumers prioritizing this revitalization before it became commercially viable. The brewpub business model often serves as the primary revenue driver for craft breweries; however, it only reached viability once consumers began to demand greater variety in beer and local breweries had the capabilities to deliver this greater variety to meet specialized consumer demand.

Conclusion

American craft brewing was only able to reach its mainstream success because of several independent factors working together to create a conducive environment, as described by co-production theory. Craft breweries needed for individuals to begin to prioritize uniqueness in the beer they drink and to have the equipment and tools needed to provide a constantly shifting list of offerings. For true commercial viability, they also needed to change or maintain laws to be

able to homebrew and to sell direct to consumers. Looking to how other industries could begin to better support local manufacturers, it seems that having specialist consumers that are willing to pay a premium for unique products is critical, but certainly not the only driving factor. Manufacturers also will need to be empowered to experiment with new techniques without dire financial risk and to be able to sell their products directly to consumers to avoid distribution costs. The future of American craft brewing seems stable, considering that Gen Z is demonstrating similar consumer behavior to Millennials, but only time will tell if local breweries will continue to be able to compete with national producers.

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