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The Italian Beer Market and Determinants of Italian Craft Beer Prices: An Empirical Analysis Using a Hedonic Regression Model

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ABSTRACT

This thesis analyses the Italian beer market, focusing on the craft movement and, through hedonic regression models on STATA, studies the main factors influencing the price of Italian craft beer. In particular, it analyses the impact of the intrinsic characteristics of beer and the reputation of each brewery on price trends over time. This type of study on the beer market still remains relatively underdeveloped, making this research an interesting starting point to enrich the economic literature on the subject.

The construction of the dataset for the regression models was carried out using four official price lists from 2021 to 2024, belonging to the supplier Timossi. In addition to the data from the price lists, information on the intrinsic characteristics of each beer (alcohol content, degree of bitterness, style, serving temperature etc.), as well as characteristics relating to the individual brewery, such as size of cellar, size of brewhouse, region of production, annual turnover and the cumulative number of awards won (reputation indicator) were integrated. Information was collected from specialized sources, including brewery websites, Italian beer guides and the Italian digital business register (Telemaco).

Econometric price models show that the alcohol content index (ABV) and beer format have a positive and significant impact in determining price. As regards beer styles, Amber Ale, American Ale, European Ale and Lagers & Pilsners are significantly cheaper than IPAs, as are Strong Belgian Ale. In contrast, serving temperature, color, type of fermentation and absence of gluten do not significantly influence the price.
Regarding awards, a surprising result emerged. Contrary to our hypothesis, the awards obtained by each brewery would seem not to have a positive and significant influence on the price of beers, but even a negative impact. By consulting Lorenzo da Bove, Italy's leading expert on craft beer, it emerged that awards do not act as a lever to increase the unit price of beer, but rather promote the notoriety of the brewery, stimulating an increase in production and sales. Therefore, companies tend to decrease prices in order to increase the quantity sold, thus explaining the slightly negative and significant coefficient observed in the price model.

This interpretation led to the development of a new econometric model to evaluate the impact of awards on the annual quantity of beer produced or sold. However, given the absence of direct data on quantity, annual revenue was used as the dependent variable.
The results show a positive, but not significant effect of awards on revenue. Furthermore, the time dummies show extremely high regression coefficients, describing an annual increase in turnover of about 12.5% on average, which cannot be attributed exclusively to inflation in the period, but includes broader dynamics and effects. This result is due to the fact that the sample used for the analysis consists exclusively of top-quality breweries, all of which are characterized by awards and significant growth in revenue over this period taken as the basis for the study.

Consequently, the time dummies capture the average growth of these specific high-performing companies and not of an entire sector, making it difficult to isolate the effect of awards on revenue.

Therefore, in order to isolate this effect, it would be necessary to have a group of breweries without awards, so that a direct comparison could be made between award-winning and non-award-winning breweries and to see the different impact of awards on their turnover. This approach could be an interesting starting point for future developments of this thesis.

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INTRODUCTION

The goal of this thesis is to analyze the beer market in Italy, describing its current state and the competitive dynamics governing it. Since in recent years the craft beer movement has influenced demand in a not indifferent way, also changing consumer preferences, the analysis was carried out with a qualitative and quantitative focus on craft breweries, with the help of hedonic regression models to study the main determinants of the price of Italian craft beer.

The first chapter introduces the historical and cultural context of beer, analyzing its origin and evolution over the centuries.

The second chapter provides a detailed explanation of all the stages that make up the beer production process. Both the individual processes and the ingredients involved in each stage of production are analyzed, together with their ability to influence the finished product in different ways. This chapter also discusses the main differences in the production process between craft and industrial beers, the environmental impact of beer production and possible solutions to reduce it.

The third chapter focuses on the global beer market. An in-depth analysis of the market in America, Asia, Europe, Africa and their major beer-producing countries is conducted. For each of these countries, an overview of how the craft beer movement began, together with the legislation regulating the market, is given.

The fourth chapter focuses on the beer market in Italy. After an analysis of Italian legislation, specific data on production and consumption, imports and exports, main competitors, distribution channels, suppliers and the craft movement are provided and discussed. In addition, in order to provide a more complete view of the competitive dynamics in a particular market such as the beer market, this chapter provides the main evidences that emerged from interviews conducted in person with 3 experts in the craft beer sector in Italy: Lorenzo Da Bove (Kuaska), Andrea Camaschella and Eugenio Signoroni.

The fifth chapter proposes an econometric analysis performed on STATA (a statistical software package), with the aim of giving a quantitative view to the qualitative one previously provided by the interviews. In particular, the objective of the econometric models constructed is to estimate the factors that influence the price of Italian craft beer, with a particular focus on the impact over time of the awards obtained by each brewery, both on the price of beers and on breweries' revenue.

Finally, the last chapter summarizes the results of the study and proposes possible future developments.

1 THE ORIGINS OF BEER

The contemporary word "beer" comes from Old English "*bēor*," which derives from Common Germanic. The etymology of the word is debated: some of the main theories are that the word for beer comes from the Proto-Germanic word *beuwoz*, derived from *beuwo* – meaning “barley” and, according to others, beer comes from the Latin infinitive *bibere* meaning “to drink.”[1].

As can be seen by its etymology, beer is one of the oldest drinks in the world and brewing has been a human activity ever since the beginning of urbanization and civilization in the Neolithic period. Beer is not only a product valued for its physico-chemical properties (i.e., quality), but also for its deep connection with religious, cultural, and culinary traditions. For this reason, brewing history is not only a story of scientific and technical progress but it also reflects the lives of the people themselves, their governance, economy, rituals, and everyday experiences. It encompasses grain markets and the art of alchemy.[2]

Beer is made of four principal ingredients: hops, yeast, water, and grain, all significantly contributing to its flavor, aroma, and quality. Hops, the female flowers of Humulus lupulus’, offer bitterness, taste, and fragrance. Yeast, which is essential for fermentation, contributes to beer's distinct flavor and aroma. Also Water plays a key role, as its mineral level directly affects the taste of the beer. Finally, the various grains contribute unique flavors and aromas, further enhancing the character and profile of the beer.[3]

1.1 The History of Beer and Early Brewing

The earliest signs of grain-based fermented drinks are mostly found in regions where grain farming first became widespread, such as the Fertile Crescent (modern Israel, Jordan, Syria, Turkey, and Iraq), Mesopotamia, and Egypt. However, the oldest evidence for these beverages comes from China. In the 1980s, archaeologists working in north-central China at Jiahu, the site of a Neolithic village occupied between 9,000 and 7,600 years ago, found evidence of a remarkably sophisticated society. From the very beginning, the Jiahu people used ceramic vessels, and chemical tests on some of the oldest vessels found by archaeologists have found traces of a fermented drink made from rice, honey, and fruit.[4], [5]. Outside of China, it has been noted that by the early fifth millennium B.C., the inhabitants of southern Mesopotamia, particularly in the region of Sumeria located in the fertile area between the Tigris and Euphrates rivers, were producing a form of "beer." In fact, during archaeological excavations in Mesopotamia, a clay tablet dating back to 6000 B.C. was found, containing one of the oldest recorded beer recipes. Even at that time, the Sumerians recognized the value of beer as a form of currency, and in the city of Uruk, people would trade grain and beer for scarcer resources, such as wood, metals, and even precious stones.[6]

The Sumerians had different words for beer from *sikaru* to *dida* to *ebir* (which meant `beer mug') and they considered the drink as a gift from the gods to promote human happiness

and well-being. The original brewers were women, the priestesses of Ninkasi, who used to brewed beer at home as part of their preparation of meals. Beer was made from *bippar*, a twice-baked barley bread, which was then fermented. By around 3,000 BCE, Under Babylonian rule, Mesopotamian beer production increased dramatically and were produced more than 20 different types of beer. In Babylon, beer held a special status, it was considered a divine gift from the gods and a symbol of wealth. The importance of beer in society was reflected in the Code of Hammurabi, the famous set of Babylonian laws, which mandated a daily beer ration for citizens. The amount of beer each person received depended on their social standing, and in some cases, beer was even used as payment for labor instead of money. However, Babylonian beer was very different from what we know today.[7]

In fact, since they had no way of filtering it, the beer was thick, resembling porridge, and difficult to drink. To solve this issue, the Babylonians became the first to use straws, making the drinking process easier and more practical.[8]

After the Babylonians, beer production started to spread to ancient Egypt. All ranks of society, male and female alike, drank beer. It is said that Ramses III, one of Egypt's greatest pharaohs, found beer to be such a noble drink that he and his guests drank it in golden cups. At the height of the Egyptian Empire, beer was the drink of choice for both festive and ordinary dining occasions. Only after Egypt had been conquered by the Roman Empire, wine became widespread, and the Egyptian elite started to prefer wine over beer. However, even then, beer remained the drink of choice for the Egyptian population.[6]

Beer brewing traveled from Egypt to Greece (as is known from Greek word for beer*, zythos* from the Egyptian *zytum*) but did not find the same receptive climate there. The Greeks favored strong wine over beer, as did the Romans after them, and both cultures considered beer a low-class drink of barbarians.[7]

Romans learned brewing techniques from the Egyptians. However, the Romans generally drank only wine, and they generally despised beer and its drinkers, whom they referred to as 'barbarians' and 'uncivilized' people. In other European regions, which are now associated with wine, people drank not wine but beer for thousands of years. For example, in what is now France, Spain, Portugal, and northern Italy, people drank beer, not wine, in the millennia before the advent of the Roman Empire. With the Roman conquest of Europe, the culture and production of wine spread to northern Italy, southern Gaul (modern France), the Iberian Peninsula (Spain and Portugal), and eventually northern Gaul (northern France and Belgium). In many of these regions, wine started to replace beer, particularly among the upper classes. However, some Celtic tribes continued to drink beer, especially in the more remote northern parts of the Roman Empire. In areas with strong Germanic influence, like Britain, Belgium, and Germany, where wine was harder to come by, beer remained a popular beverage throughout Roman rule.[6]

In the fifth century, as the Germans took control of much of the Western Roman Empire, beer regained popularity. The early Germanic tribes were heavy beer drinkers, and after centuries of wine-drinking rulers, beer-drinking leaders returned, ending the Roman view of beer as uncivilized. However, beer production remained largely a domestic task, handled by women, until Emperor Charlemagne began to influence the process. Charlemagne is considered the Father of Europe, and his rule the beginning of early modern Europe. He came to power on the eve of the ninth century, drawing up rules on how towns should be organized. Brewers factored prominently in his "ruling hierarchy.". One of his main societal

contributions was the establishment of monasteries as centers for brewing. Initially, most monasteries were in Southern Europe, where the climate permitted the monks to grow grapes and make wine for themselves and their guests. However, when later monasteries were established in the northern regions of Europe, where the cooler climate made it easier to grow barley instead of grapes, the monks started to brew beer instead of wine. This led, throughout the early Middle Ages, to the spread of the principle of "monastic brewing" through the British Isles and to many parts of Germany and Scandinavia where the so called 'monastery pubs', became a useful source of revenue [6]

Around 1000 CE, German monks introduced hops (*Humulus Lupulus*) into brewing, revolutionizing monastic beer production. Hops not only added a bitter flavor to balance the sweetness of malt but also acted as a natural preservative, extending beer's life. Before hops, beer had to be consumed fresh and locally, with only strong, high-alcohol beers able to be transported. Hops allowed beer to be shipped over longer distances, fostering wider trade.

All the early monastery beers fell under the very general category of ales, i.e., beers fermented at room temperature, mainly using the yeast *Saccharomyces cerevisiae*, the same species used in baking bread and fermenting wine, but occasionally adopting wild yeasts. During fermentation, the yeast rises to the top of the liquid, forming a dense froth. The longest continuously operating brewery in the world was born as a monastic enterprise. The Bavarian Weihenstephan brewery in Freising, currently state-owned, started brewing beer the auspices of the Benedictine Weihenstephan Abbey[5]

Together with the emergence of commercial breweries, many government regulations were implemented. In 1487, in Munich the first famous brewing law was actually enacted; this was the so-called "Reinheitsgebot" (or "Purity Law"), which survived until 20 years ago. The "Reinheitsgebot" stipulated that only barley, hops, and pure water could be used to produce beer[6]

In 1813 , an important innovation was the discovery of a new beer production process called 'lagering'. Lager beer is made using a bottom-fermentation process, where yeast settles at the bottom of the vessel. Before this, beer used top fermentation, with yeast rising to the top. By 1818, scientists understood that beer fermentation had two phases: sugar turning into alcohol and carbon dioxide, followed by beer "ripening." Brewers Gabriel Sedlmayr and Anton Dreher developed the lagering process, using slow-fermenting yeast and cold storage, creating the clearer, brighter "lager" beer. By the mid-1800s, brewing schools emerged, and yeast was identified as key to fermentation thanks to a French scientist Louis Pasteur. In the 1860s, while investigating the causes of "diseases" affecting wine, Pasteur developed the so called "pasteurization" method. He discovered that heating wine to a specific temperature and then rapidly cooling it could significantly extend its shelf life by destroying pathogens in the wine. Later on, he applied this same approach to beer in his work Etudes sur la Bière (1876).[6]

While in Germany ales were gradually abandoning in favor of lagers, ales continued to flourish in Belgium. As in Germany, Belgian beer-making was originally a specific competence of monastic brewers. Due to regular political disorders from the sixteenth to the eighteenth century, many of the old foundations disappeared. So, today's Belgian abbey beers are largely brewed either in monasteries that have been re-founded or are simply beers made "in the style" of Belgian abbey beers. One special category of monastic ales includes those with the Trappist designation, i.e. they are brewed in one of six monasteries belonging to the

Trappist Order originated in France in the seventeenth century. For being a small country, Belgium produces an incredible variety of beers and styles, in particular an endless array of ales, even if more lager than ale is nowadays both produced and consumed in the country[5]

Britain has a long history of brewing top-fermented beers, with evidence dating back to 3,200–2,500 BCE at Skara Brae in Scotland. Lagers, however, didn't gain popularity in the UK until the late 20th century. By the 14th century, brewers formed guilds and supplied beer beyond their own establishments, leading to the introduction of "ale conners," officials who tested beer quality and set fair prices. In medieval Britain, spoilage was common until hops became a regular ingredient in the 16th century. By the turn of the eighteenth century, the larger British brewers were producing a new style of ale, known as "porter", which was highly hopped and made from darkly roasted malts. With a typically high ABV of 6 percent or more and made with the aid of early scientific instrumentation such as thermometers and hydrometers, this was the first beer that could be produced and distributed as an industrial product. The economies of scale enjoyed by the large brewers who manufactured it soon made it impractical for individual hostelries to brew their own beer. Barley roasting kilns were traditionally fueled by wood or coal, producing a rather dense, smoky malt. For this reason, porters were heavy and dark beer to drink. The rapid technological advances in the early eighteenth century made clean-burning coke much cheaper and more widely available. This development led to the large-scale production of lighter-colored malts, which became the foundation for a rapidly growing category of pale ales. One of the most notable variations of this trend was the India Pale Ale (IPA), crafted specifically for the expanding British Empire. Brewing beer locally in India's hot climate was impractical, but the market there promised huge potential. However, the long journey to India made it difficult for traditional British ales to survive in good condition. The solution was to slightly increase the alcohol content and significantly boost the hops. This allowed the beer to arrive in India bright, fruity, refreshing, and often slightly sparkling, likely due to secondary fermentation in the barrels from Brettanomyces yeasts. Large quantities of IPA were shipped not only to India but also to Australia.[5]

In Ireland, Irish beer was of poor quality, and for this reason, Arthur Guinnes, founded his own brewery in Dublin in 1759 with the goal of elevating brewing standards. By the end of the century, he shifted his focus to crafting an exceptional porter, which quickly gained widespread popularity and dominated the market. Twenty years later, his successors were producing a very dark "superior porter," which evolved into the "extra stout" version that became internationally famous with its almost black color and slightly roasted flavor. During World War I, British authorities banned the strong roasting of malts to save energy, leading to the collapse of porter and stout production in England. In this way Arthur Guinnes and the British held world supremacy in the market for dark beers. In addition, a taxation system based on ABV (alcohol content by volume) meant that lighter and significantly cheaper beers, marketed as milds and bitters, prevailed in the British market between the 19th and 20th centuries.[5]

Brewing in America began with English and Dutch settler communities in the 17th century. At that time, it was mainly ale production, but in the mid-19th century the arrival of many German brewers, specializing in lager production, changed Americans' tastes. The Germans found ideal brewing conditions in the northern Midwest due to the abundance of ice from

the Great Lakes, which made the fermentation of lager beers easier.[5] In the eighteenth and nineteenth centuries scientific progress with the discoveries and extensive studies on yeasts and the introduction of refrigeration ,had a great impact on the brewing industry, allowing control of the environment within breweries and to achieve a standardized product of quality, throughout the year and at lower cost. In addition, the invention of the “refrigerated iron mold” and the use of steam engines, opened the opportunity for mass production and consumption, accelerating the spread of beer and leading to the industrialization of brewing as a production process.[6]

The First and Second World Wars had a great negative impact on beer production, causing grain shortages and rising raw material costs. Many governments imposed restrictions on alcohol, prompting brewers to shift towards producing alternatives like soft drinks. In USA for example, the “Temperance movement” succeeded in securing a nationwide prohibition on alcohol from 1919 to 1933. During this period, bans were imposed on the sale, production and transportation of alcohol with alcohol content above 0.5 percent. As a result, legal beer production in the United States was stopped for 14 years, with a small phenomenon of illegal beer production, but it remained extremely limited. Overall beer production collapsed, and many American breweries were forced to close their doors or sell their plants and equipment, suffering significant financial losses. Others, hoping that Prohibition was only temporary, tried to adapt their equipment to produce related beverages, such as beer with less than 0.5 percent alcohol.[6]

In 1933, when Prohibition was abolished, demand exceeded reasonable supply, and many poor-quality products entered the market. As a consequence, consumption declined and many brewers closed or merged, leading to an industry increasingly dominated by brewing giants, trend that continues inexorably today.[5]

The impact on the US brewing industry was severe; it was estimated that there were 1,345 active breweries in the USA in 1915. By 1934, 50 per cent had closed.[6]

By the mid-20th century, the legacy of Prohibition led to the dominance of industrial beers, triggering the rise of the craft beer movement in the 1970s. America continued to be the leading producer of beer up to the early 2000s, when China overtook it to become the largest beer market. Modern brewing in China began in 1903 with a German-founded brewery in Qingdao, and German-style lagers still dominate production.[5]

2 BEER PRODUCTION PROCESS AND MAIN INGREDIENTS

2.1 Malting and Brewing process

The beer production process, as previously discussed in the Introduction of the thesis, is a very ancient practice that has not undergone substantial changes over the years, especially regarding its main phases, but rather has been improved, thanks to scientific discoveries and technological advances. The beer production process has four key ingredients that are malt, water, yeast and hops and they play a fundamental role in regulating the taste, aroma and color of beer. The goal of this process is therefore to transform the listed ingredients into an alcoholic beverage, converting the grain starch of cereals into sugar, extracted through water, and then leaving it to ferment with yeast and obtain the final product. The figure below shows the main steps of the beer production process, which will be described in detail from the malting phase to the packaging.

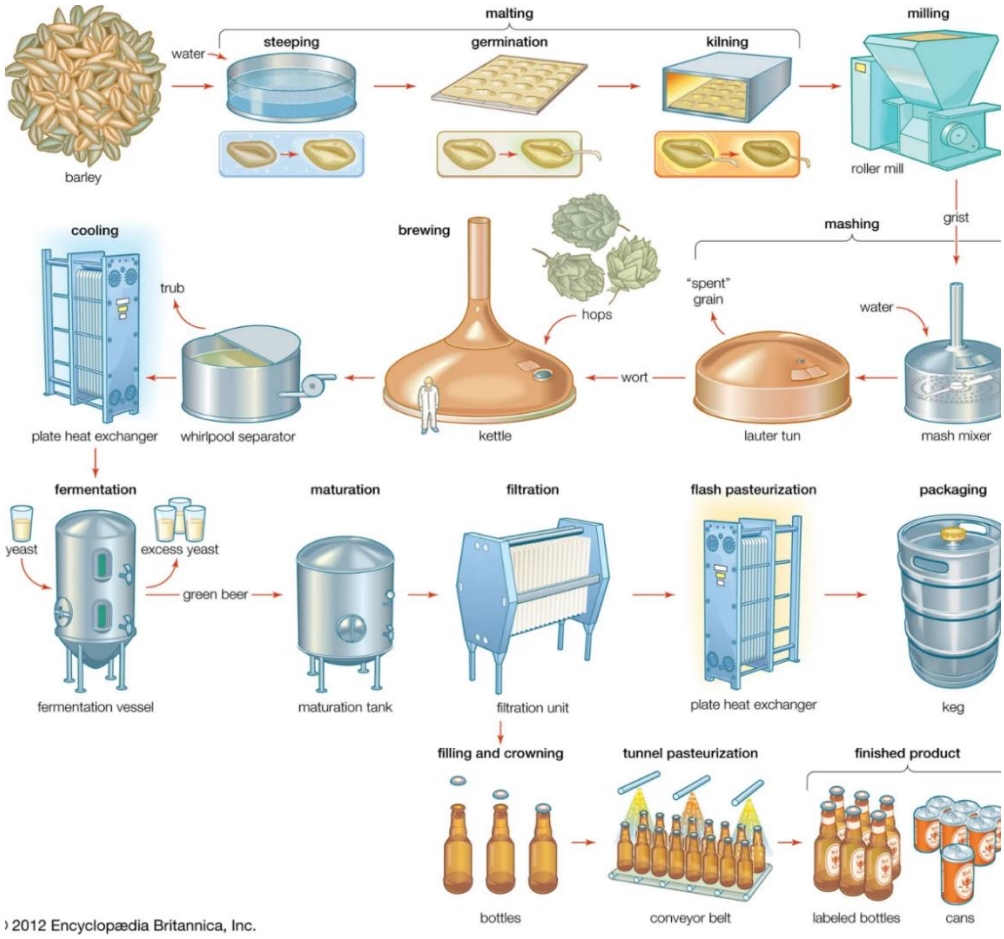

Figure 2-1- Beer Production Process [9]

2.1.1 Malting

The term malt means any grain that has been soaked in water and allowed to germinate and then dried. The first step in beer making process is malting, which is also called “Artificially Induced Germination of Crop”, it is composed of 3 main sub-phases which are steeping, germination and kilning that are fundamental to modify barley to the so-called green malt. To be fermented by yeast, the food reserve of barley, starch, must be converted by enzymes into simple sugars. Two key enzymes, α-amylase and β-amylase manage this conversion. β-Amylase is already present in barley while α-amylase is produced only during germination. Also, for malting purposes, specially selected varieties of barley, which have typically low nitrogen content, are used. The three distinct phases of malting will be described below in detail:

Steeping: This first stage of the malting process involves steeping the barley, harvested with less than 12 percent moisture content, in temperature-controlled water, usually between 12 and 18 °C, for 40 to 50 hours. The goal of steeping is to increase the moisture of the grain up to about 43-46 percent to re-activate the enzymes responsible for its germination. During steeping, the barley is periodically drained and given air rests, allowing the grain to breathe to ensure proper oxygenation. This cycle of steeping and air resting is repeated two or three times over a two-day period to ensure that the embryo is activated as the moisture content reaches around 30-35 percent. As the barley absorbs water, its volume increases by approximately 25 percent, and by the end of the steeping phase, most of the seeds develop a small white root sheath, known as a chit, that breaks through the husk. Once the barley has “chitted” it is removed from the steep to continue the germination process**.**

Germination: Soaking the barley with water activates the root embryo, which forms gibberellic acid and starts the synthesis of α-amylase. This enzyme, together with β-amylase, degrades the starch in the grain into sugars that can be used by the embryo as energy. Other enzymes hydrolyze the cell walls surrounding the starch, turning complex sugars and insoluble proteins into glucose and soluble amino acids, respectively. This process is called modification and becomes more extensive the longer germination takes. Originally, macerated barley was piled in cloths for 24 hours and then laid on the floor to germinate. During respiration, the grain consumed oxygen and produced carbon dioxide and heat; therefore, aeration and temperature had to be carefully controlled by manually turning the grain. Later, large-scale operations incorporated the use of mechanical turners or pneumatic systems, in which the grain was aerated and ventilated with forced air. Some modern malting processes even spray gibberellic acid to accelerate germination, in addition to the use of bromates to control rootlet growth and prevent losses. While traditionally less modified malts were used for lagers and more modified malts for ales, today well-modified malts can be produced for both types. Germination is generally conducted at 14-18°C so that by staying within this temperature range, the full development of key enzymes is allowed.

Kilning: The above discussed germination process is stopped by slow heating and drying the malt through a process called kilning that is fundamental to produce a typical color and aroma in the beer.
Before drying, the malt is called "green malt" and the kilning process lasts about for 24-36 hours removing most of the moisture and leaving about 5% in lager malts and 2% in ale malts. The higher the temperature of the kilning, the darker the malts and more complex in flavor, ranging from roasted to smoky, commonly found in darker beers like stouts. Generally, malts intended for lagers are kilned at lower temperatures and less modified, with lighter colors and more delicate flavors to give pale, straw, or amber-colored beers. Ale malts are developed at higher temperatures to give deeper colors and more robust flavors. The Kilning process has two phases: withering and curing. The moisture content of malt, during withering, comes down to 10% from the original 45% at relatively low temperatures. Curing, on the other hand, takes place at temperatures between 80-105°C and is where higher temperatures will specially build up the color and aroma of the malt. This process can be divided into several temperature steps. Below 40°C, the malt is in the "growing phase," during which enzymes actively break down the grain. Instead, the so called "enzymatic phase" is done between 40°C and 70°C and it is characterized by accelerated degradation. When moisture drops, activity of the enzymes stops, growth ceases, and thus the kilning process is complete.

2.1.2 Milling

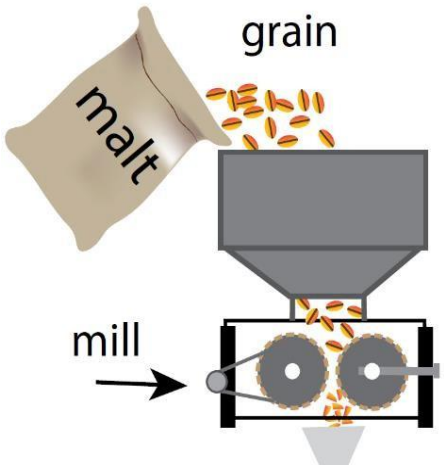

Figure 2-1-Milling process

The process of milling involves crushing dried barley grains between rollers to create a coarse powder known as *grist*. The execution of this process is particularly important because it significantly affects the next brewing steps, such as mashing and lautering, and also influences the overall quality of the beer. In the past, early milling methods relied on manual labor, water, or animal power using stone mills, instead modern brewing employs mechanically driven roller mills. Since in this step is important that the malt hulls are split but not pulverized, the design of these mills, particularly the gap between the rollers, is crucial for achieving the right size reduction of the malt. [9]

2.1.3 Mashing

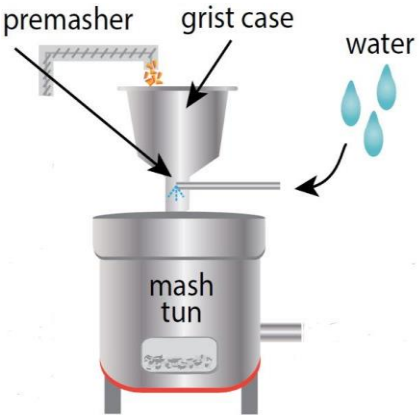

Figure 2-3- Mashing process

During the mashing process, the milled malt, which we earlier referred to as *grist*, is mixed with water at 62 to 72 °C. This provides the conditions in which starch, other molecules, and enzymes are dissolved and rapid enzyme action takes place. The solute-rich liquid resulting from mashing is called the *wort.* Mashing is conducted in a mash conversion vessel or MCV, also called *mash tun*.

The entire process can be divided into 3 steps:

Gelatinization: This is the process where starch molecules absorb water and starch from malt, in the presence of an amylase enzyme, gelatinizes at 60 degrees. Not all grains gelatinize in the same way. Some of them, like barley and wheat, gelatinize easily within the normal mashing temperature range.

Others such as maize and rice must first be cooked in a separate vessel before their addition to the mash.

Liquefaction: The digestion of gelatinized starch is done by amylases through the splitting of *alpha amylase* into 1,4 bonds of *amylopectin* and *amylose*. Because of the digestion of starch molecules, viscosity decreases, therefore enabling *beta amylase* to react with newly formed molecules.

Saccharification: In this process the starch fragments are further broken down to produce glucose, maltose, and maltotriose, which are three distinct types of fermentable sugars.

Modern mashing systems use mixed grinds and mash mixers, which efficiently stir mashing and temperature-programmed vessels. The same equipment is used to mash ale and lager, but they require different temperature programs and grist composition. Most modern breweries practice *high-gravity brewing*, through which highly concentrated worts are made, fermented and afterwards diluted, enabling more beers to be brewed on the same equipment.[9], [10]

2.1.4 Wort separation - Lautering

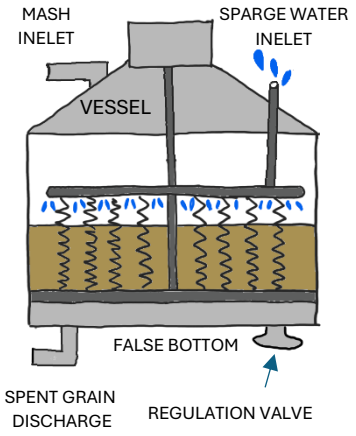

Figure 2-4-Lauter tun

After breaking down the starch in the previous step of mashing, the next step is to separate the liquid extract (*the wort*) from the solid materials present in the mash (*spent grains*); this step, called *wort separation*, it is crucial in brewing and takes place in the so-called *lauter tun.*

The process of wort separation is also called *lautering*, from the name of the vessel in which it takes place and can be divided into 3 subphases:

1) Filling the Later Tun: After the mashing is finished, the contents of the mash tun, consisting of wort and spent grain, are transferred into the later tun that has a bottom with a grid or filter to hold the spent grain.

2) Wort Recirculation: At the beginning of the process, the wort coming out of the later tun is cloudy and contains small particles of spent grain. The wort is then recirculated, and passed back through the spent grains, which act as a natural filter, resulting in a clearer, higher quality liquid.

3) Sparging: Once the wort has clarified, *sparging* takes place. At this stage, hot water is sprinkled over the grains to extract all the remaining sugar, making sure that maximum sugars are recovered. This liquid is then drained and sent to the next stages of brewing.

Specifically, as can be seen from the figure opposite, the later tun is usually composed of:

-*Vessel* that is a large stainless steel or copper tank where the filtration process takes place.

-*False bottom* which is a perforated grid located at the bottom of the tank, which allows the wort to pass through but retains the grains.

-*Sparging arms*, which are systems that evenly distribute hot water over the grains during the sparging phase.

-*Drainage rods or valves* that allow clarified wort to drain from the bottom of the later tun.

-*Outlet pipes or valves* that manage the flow of wort during recirculation and final extraction.

2.1.5 Boiling

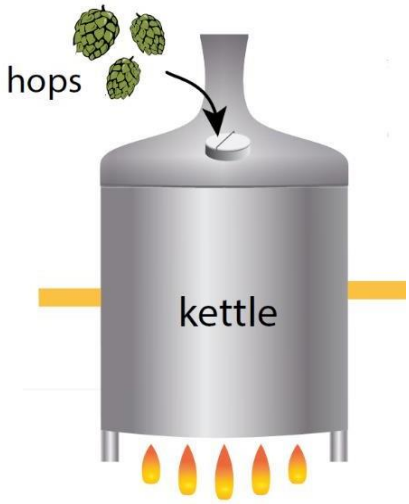

Figure 2-5- Boiling phase

Once the wort has been separated, it is then sent to a kettle, which is conventionally made of copper, to start the boiling process. This procedure is particularly important to halt all enzymes' activities and to obtain the bitterness from the hop's flowers. The boiling process operation typically continues for 60 to 90 minutes, during which up to 20% of the wort volume can evaporate and it is the most energy-intensive stage of brewing. Moreover, in this stage hops and liquid sugar adjuncts such as corn syrup and dextrose are added. The boiling process has some specific purposes.

First, it allows for the isomerization of hop compounds, which is essential for extracting the bitterness that balances the flavor of the beer. Additionally, the high temperature sterilizes the wort, eliminating any unwanted organisms that could interfere with the yeast's work during fermentation. Boiling also helps to dissipate off-flavors, ensuring a cleaner taste in the final product. It removes proteins and lipids that can affect the clarity and stability of the beer, leading to a more visually appealing and stable brew. Lastly, boiling concentrates the wort by evaporating water as steam, which intensifies the flavors and adjusts the wort's extract content.

After boiling, proteins and hop particles, called "*hot trub*," are removed such that the wort is bright and clear before cooling. These operations may be done through either sedimentation or, more commonly, using a whirlpool. In whirlpool, wort is moved in a horizontal, circular flow which settles the solids as a compact mass on the bottom of the vessel. Clarification should be carried out at the hottest temperature possible to achieve maximum removal of trub.[9], [10]

2.1.6 Cooling

Figure 2-6- Heat Exchanger

Before fermentation can begin, the temperature of the wort must be reduced in a process known as cooling. Traditionally, clarified wort was cooled in shallow troughs or by flowing over inclined cooled plates. However, modern breweries use plate heat exchangers, which are enclosed and hygienic systems. In these exchangers, hot wort flows over plates while cold water circulates on the other side in the opposite direction. This setup allows for efficient heat transfer. At this stage, oxygen is introduced to the wort, and the cooled liquid is then transferred to fermentation vessels.

Cooling of wort is performed with modern and very efficient heat exchangers, which are designed specifically to optimize and facilitate heat transfer. The target cooling temperature is linked to the type of beer produced: for Bottom-fermented beers, the wort is normally cooled to a temperature of 5 to 15°C; top-fermented beers instead are cooled in the range between 15 to 18°C. This cooling has to be aseptic and rapid in order to preserve product quality. As the hot wort cools, previously dissolved proteins become insoluble and precipitate to form what is called "cold break". Some brewers argue that this cold break should be eliminated, but in any case the wort is aerated before adding the yeast to begin fermentation.[9], [11]

2.1.7 Fermentation

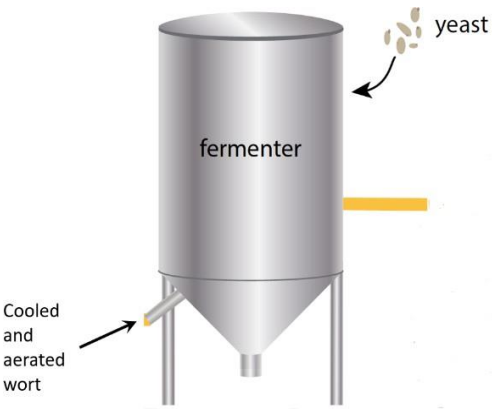

Figure 2-7-Fermentation Phase

The next step is fermentation, which is another crucial phase of the brewing process, during which sugars (both long-chain and short-chain molecules) obtained from starch are converted into alcohol and carbon dioxide (CO_2). This process continues until all fermentable sugar has been converted to alcohol, and after that a certain amount of residual sugar is needed to carbonize the beer during maturation, also called second fermentation.

Yeast is at the heart of this process. It is added, or "pitched," into the wort at a rate of about 0.3 kgs per hectoliter, which is a total concentration of 10 million yeast cells per milliliter wort. This ensures that fermentation proceeds efficiently to produce the desired alcohol content and carbonation level. [9], [12]

There are two types of fermentation, *top-fermenting* and *bottom-fermenting*, the distinction

and naming is derived from the use of different types of yeast and is very important because all styles of beer originate from this main division. High-fermenting yeasts (*Saccharomyces cervisiae*) are used to produce ale beers, while low-fermenting yeasts (*Saccharomyces pastorianus*) are used to produce lager-type beers. Functionally, these yeasts differ in their optimal fermentation temperatures, environmental conditions, ability to ferment different sugars, and finally in their different ability to settle at the end of fermentation.
High-fermenting yeasts operate at higher temperatures ranging from 15 to 25 ° C and ferment very rapidly, naturally bringing spicy, floral, herbaceous nectar and fruit notes to the beer. As mentioned earlier this type of yeast is used to produce beers that fall into the ale category and are named for their typical behavior during the fermentation process. During this stage, in fact, they float on the surface of the wort forming a kind of spectacular foam and slag.
Bottom-fermenting yeasts, on the other hand, act at an optimum temperature between 8 and 12°C, and when they have finished their work they sink to the bottom of the vessel, in which they ferment and give the beers a characteristic sulfurous aroma. Over the course of history, the vessels in which fermentation took place also changed, mainly following technological progress. The open earthenware containers once used, were replaced first by wooden vessels and then by square copper fermenters. Today, most breweries use closed, hygienic fermenters, especially for low fermentation. These large stainless-steel tanks are usually placed outside the brewery and can hold thousands of hectoliters and are equipped with cooling systems to control temperature. Traditionally, fermentation lasted 7 days for ales and up to 3 weeks for lagers. Thanks to modern fermenters, these times have been reduced to 2-4 days for ales and 7-10 days for lagers.[9], [13]

2.1.8 Maturation and Carbonation

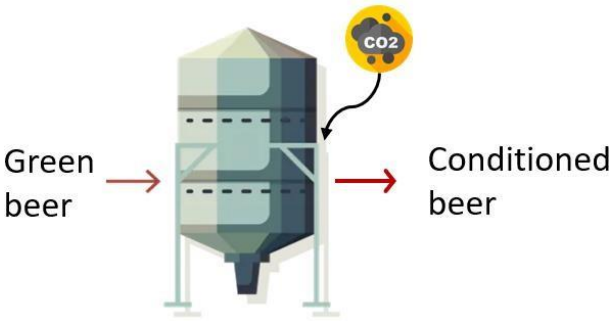

Figure 2-8- Maturation and Carbonation Phase

Maturation, also called second fermentation, is a process that includes all the transformations that take place between the completion of primary fermentation and the removal of yeast. While the primary fermentation is usually completed after 3 to 10 days, most of beers, once the yeast has fermented the sugars, are not ready for immediate consumption. This is due to the presence of certain flavors, produced during the fermentation process, which make the beer not good enough to be drunk. For this reason, beer must be subjected to a maturation process to refine its taste for consumption.
Fermented beer, also called *green beer*, is then transferred to storage tanks or chilled cellars at temperatures ranging from 0 to 3°C f and it remains there for a few days to several weeks.

During this period, the insoluble phosphates, resins, and yeast cells settle at the bottom while the beer matures and develops esters, losing its harsh flavors. At this point a process called "*Chill-proofing*" is often applied to avoid turbidity when the beer is exposed to cold. This process employs proteolytic enzymes, which degrade unstable proteins and ensures that clarity is achieved even at low temperatures. Antioxidants such as ascorbic acid and sulfur dioxide are added at cold storage to prevent oxidation and maintain flavor.
Once that the maturation process is finished, the beer must go through the carbonation phase. This is done either through the "*Krausen*" method where the beer is naturally carbonated by fermenting yeast or by injecting purified CO2. The final dissolved CO2 content is about 0.5%, aiding in foam retention and stability by replacing harmful oxygen. In the Krausening process, roughly 15% of fermenting active wort is added to the beer, wherein the yeasts will be given the chance to ferment residual sugars over a three-to-four-week period. Afterward, the beer undergoes further cold maturation to improve clarity before packaging.[14], [15]

2.1.9 Filtration

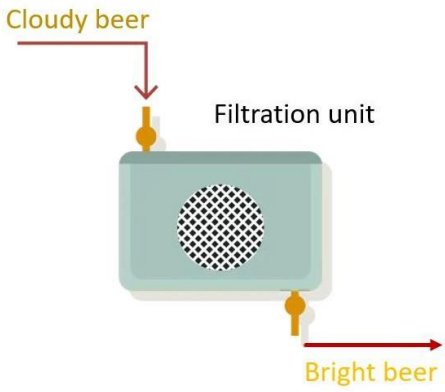

Figure 2-9-Filtration Phase

After the maturation processes, beer is filtered to remove the remaining yeast and precipitated proteins, and also to improve its stability. Normally, filtration is carried out at low temperature, from -2 to -1°C, with counterpressure using carbon dioxide at pressures above the saturation value. There are several filtration systems; each of these systems has certain advantages and disadvantages. Some common types include pressure leaf filters, plate and frame filters, lenticular disc filters, membrane filters, and tangential flow-or crossflow-filters. In these systems, different filter media can be used, among which are diatomaceous earth, cellulose pads, lenticular discs, membranes with calibrated pores, or tangential filtration through organic or inorganic membranes. Porosity, or the proportion of space in a given material that is void, and permeability, which is understood to be the capacity of a medium to allow fluids to pass at given rates, are basic characteristics of filtration media. Once filtration is complete, a bright beer, free of yeast and haze, is obtained.
However, in several traditional beer styles, yeast turbidity is a characteristic of the finished product. Most smaller breweries and brewpubs pack unfiltered beer that, once primary fermentation is complete, is chilled and carbonated and presented directly to the consumer. In these cases, it is important for breweries to take precautions to ensure that fermentation is complete before the unfiltered/unpasteurized beer is packaged, to avoid the possibility of overpressure from post-packaging fermentation. [16]

2.1.10 Pasteurization

The process of Pasteurization is a cooking technique, first discovered by the French scientist Pasteur, used to sterilize beer. The main aim of this process is to reduce populations of microorganisms within the product through destruction of any pathogenic organisms that may be present, hence ensuring that the beer will keep better for years without altering its taste.
As can be seen in *Figure 1-1- Beer Production Process*, there are two primary methods for pasteurizing beer. Bottled and canned beers are pasteurized by passing the filled containers through a long, relatively narrow chamber where hot water is sprayed onto the containers for a defined time before cooling. This spray chamber is called "*tunnel*," and the process is thus called "*tunnel pasteurization*." Since heating in a tunnel would be quite impractical for large containers of beer, such as kegs, beer is heated by passing it through a heat exchanger, where hot water transfers its heat to cold beer over a large surface area. With this method, the beer is heated to 70°C-72°C for about 30 seconds and it is called "*flash pasteurization*," referring to the short time required to complete it.[17]

2.1.11 Packaging

Figure 2-10-Packaging Phase

Once the beer quality reaches its final stages, the packaging process can start. Beer must always be kept under pressure to maintain carbonation and may not be exposed to light and oxygen to prevent off-flavors. Small packages include cans and bottles of up to 2 liters, which are used in selling directly to the consumer; these are normally labeled to make them more appealing. Larger packages instead include kegs and barrels; and are used for serving beer in bars or events where large volumes are needed. The packaging process minimizes oxygen exposure by purging containers with CO2 before and after filling, ensuring freshness. Bottling involves container sanitizing, followed by filling and sealing, then labeling and packaging into distribution cases. The product must be kept sterile, this is extremely important during long-term storage and transportation.

2.2 Differences between Craft Beer and Industrial Beer

Every country has its own legal definition of a craft brewery, with specific regulations that distinguish craft beer from mass-produced beer. In general, the main differences between the two types lie in the production process, scale of operations and the quality of raw materials

used. Craft breweries tend to be more focused on small-batch production, using traditional brewing techniques and high-quality ingredients, while industrial breweries usually rely on large-scale production, efficiency, and consistency. These distinctions significantly impact the taste, texture, and overall quality of the beer.
So more specifically the main differences between craft beer and industrial beer are related to:

Ingredients: Industrial beers are generally made with additives, preservatives, and cheaper ingredients to keep costs down, which can compromise their flavor compared to craft beers. Often, barley malt is partially replaced by corn or rice, which do not contribute much to the taste of the beer but increase the fermentable sugar content. However, this can affect fermentation because of reduced levels of free amino nitrogen, an essential nutrient for yeast. In contrast, craft beers are made with high-quality ingredients, without chemicals or substitutes, and often in small batches. Many breweries also use local ingredients, including products unique to the area or even home-grown barley and hops, to strengthen the connection to the land.[18]

Carbonation: During industrial beer production process, carbon dioxide is usually artificially added to carbonate the beer, whereas, most craft breweries use a simple natural process called secondary fermentation. In this process, yeast ferments the rest of the malt sugars producing both alcohol and carbon dioxide. In this way the CO2 generated during secondary fermentation stays in the bottle longer than in industrial beers and makes this carbonation much smoother and refined. Also, since this carbonation is naturally produced from yeast, it is often said to be more easily absorbed by the human body leading to a different mouthfeel and drinking experience.[19]

Pasteurization and Filtration: Artisanal beers are different from the industrial ones because they are not filtered or pasteurized. Industrial pasteurization, which can be of two types, *tunnel pasteurization or flash pasteurization (see 2.1.10 Pasteurization)*, consists of heating the beer up to 60-80°C. It reduces microbial contamination and increases beer's shelf life but impairs the nutritional and sensorial quality of the beer. The heat stops the transformation of sugars in alcohol, reducing the variety in flavors. In industrial beers, the pasteurization step is followed by a filtration phase, to remove coarse particles, yeast, and haze-responsible compounds. In contrast craft beers are unfiltered and remain cloudy; they have a shorter conservation time (90 days up to one year) and need to be stored under cooler conditions to avoid the development of off-flavors. Large breweries, therefore, need to employ pasteurization and filtration to extend storage time and ensure a uniform taste in every batch.[20]

2.3 The role of ingredients in shaping beer characteristics

As discussed earlier, beer consists of four essential ingredients: water, malt, hops, and yeast. Besides these ingredients, additions can be introduced in the brewing process, such as starch or sugar sources other than malt and also process aids, which are materials used to give the beer the desired characteristics.
To produce a beer that is appealing to taste it is necessary to use quality ingredients, and it is also essential to understand and analyze the impact that each of the ingredients, listed earlier, has on the final product. This will be precisely the goal of the following paragraphs.

2.3.1 Water

Water is present as an ingredient in every beverage on the market, and in beer is the most important ingredient in terms of quantity. In fact, beer is made up of approximately 90-95% water, it takes part in every step of the brewing process, and its chemical and biological composition has a fundamental impact on the characteristics of the finished product. Breweries obtain water both from public networks and from their own wells, and as a result it is often necessary to treat the water. On the one hand it may be necessary to treat raw water to meet legal criteria, and on the other hand drinking water treatment may take place to adapt to the technical requirements of the brewing process.[4]
There are many well-defined criteria for proper brewing water. It must be compliant with regulations such as the World Health Organization (WHO) specifications for the quality of drinking water. In particular, the water should be clean, free of any potentially harmful and pathogenic microorganisms.[21]
Other values of interest are Total water hardness and pH levels.
Total hardness is the total of all alkaline-earth ions, including calcium, magnesium, strontium, and barium. In practice, strontium and barium ions are usually neglected and hence hardness is calculated based on calcium and magnesium levels. Total hardness can be further divided into carbonate hardness and non-carbonate hardness. The normal counter ions for non-carbonate hardness are sulfate, nitrate, and chloride, whereas hydrogen carbonate is the usual associated ion with carbonate hardness.[4]
Conventional measurements of water hardness for a given volume are expressed in parts per million (ppm), while concentration of the metal ions in that water is given as milligrams per liter (mg/l). While the terms hardness and softness may have a degree of subjectivity, the ppm and mg/l scales allow the categorization shown in Table below.

Classification	parts per million (ppm)	milligrams per liter (mg/l)
Soft	less than 100	less than 17.1
Slightly hard	100–200	17.1 to 60
Moderately hard	200–300	60 to 120
Hard	300–400	120 to 180
Very hard	more than 400	more than 180

Table 2-1- Water hardeness classification [5]

Hard water is ideal for brewing stout beers like Guinness, while soft water is more suitable for lighter, hoppy beers such as lagers and pilsners. It is generally preferable to have a supply of soft water for brewing, as it is easier to add minerals to harden soft water than to soften hard water.[5]

The other important value is pH. It is a quantitative measure for the acidity and basicity of aqueous or other liquid solutions. All solutions with pH below 7 are considered to be acids, while solutions whose pH is above 7 are considered basic or alkaline.[22] If the pH level is too acid there could be danger of vessels corrosion, if is too basic it can inhibits the enzymes during mashing phase. For this reason, a pH range of 5.2-5.6 is recommended throughout the entire mashing process since, within this narrow pH range, enzymes are fully active. Once the wort is boiled, the pH tends to drop slightly because of the interactions between the sugars and the hops that are added. The pH further drops during fermentation when the yeast starts the production of alcohol, settling around 4 to 4.5. This decrease in pH is advantageous, as it protects the beer from certain spoilage microorganisms.[23]

In Brew water analysis is important to measure the concentration of various ions that are essential for brewing. These are:
Bicarbonate (HCO_3^-) which maintains alkalinity and increases the pH of brewing water. The recommended level is related to the style of beer that is brewed: for pale beers, it is recommended from 0 to 50 ppm, for amber or malt-forward beers, it is optimal within the range between 50 to 100 ppm, while for darker or roasted beers, 150 to 250 ppm works best.[24]
Calcium ions (Ca^{2+}) that are responsible for lowering pH. Their optimal concentration lies between 50 to 100 ppm. Besides that, calcium enhances oxalate precipitation, which avoids pipe and brew equipment scaling. Lastly, calcium serves as a co-factor in many enzymes involved in fermentation processes and is essential to yeast health, promoting flocculation

(the process through which yeast cells clump together before settling from the beer).[24]
Chloride (Cl^-) which imparts sweetness and fullness to the beer, thus balancing the effects of sulfate. The optimum range of concentration is from 0 to 250 ppm, while higher levels are corrosive to stainless steel.[24]
Iron (Fe^{2+}). Its levels must remain below 0.2 ppm, since such high concentration would give the beer a metallic or astringent taste. Besides that, iron interferes with the conversion of starch during brewing, enhances the color of the wort, promotes staling, and forms deposits.
Hydronium (H_3O^+) which lowers the pH and amplifies bitterness in the beer. It possesses some cationic antibacterial properties, suppressing bacterial growth.
Magnesium (Mg^{2+}). It adds to water hardness and contributes to lowering pH. Good for yeast metabolism, but above 50 ppm will introduce a sour bitterness, and very high levels above 100 ppm will have a laxative effect.
Nitrate (NO_3^-). Its levels should be maintained below 10 ppm, as too high concentrations may signify contamination stemming from agricultural runoff. When present in significant amounts, nitrates can undergo conversion into nitrites, which pose potential health risks.[24]
Sodium (Na^+). It should be in concentrations of between 70 and 150 ppm, it rounds out flavors and gives sweetness to the beer.

2.3.2 Malt

Malt is another of the key ingredients in beer, and after water, it is the most widely used in terms of quantity during the brewing process. Specifically, the word malt refers to any type of grain that has undergone a malting process (discussed specifically in *Section 2.1.1*). Although there are different types of malt such as rye malt, wheat malt, and oat malt, when people talk about beer production, they almost always refer to barley malt. In fact, today, even though the use of unmalted starch sources such as barley, rice corn, or sorghum as additions is becoming increasingly popular, most beers brewed worldwide contain at least 70 % barley malt.[4]
Barley is a grain that can be classified into spring or winter depending on when it is planted and harvested, or into two-row or six-row varieties depending on how the seed rows are arranged on each side of the stem.
As can be seen in *Figure 2-5*, the barley grain consists of three main parts: the embryo, the endosperm, and the seed coat that includes the hulls. The endosperm consists of dead cells filled with starch granules, which provide an energy reserve for the embryo. They provide a source of sugar until the whole plant can grow leaves and start chlorophyll photosynthesis. All cells in the endosperm are surrounded by a cell wall rich in carbohydrates and proteins. Surrounding the endosperm is a triple layer of cells called the aleurone, which comes into play in the production of enzymes during malting. The tegument of the barley seed, on the other hand, consists of 3 layers: the head, pericarp and hulls.[24]

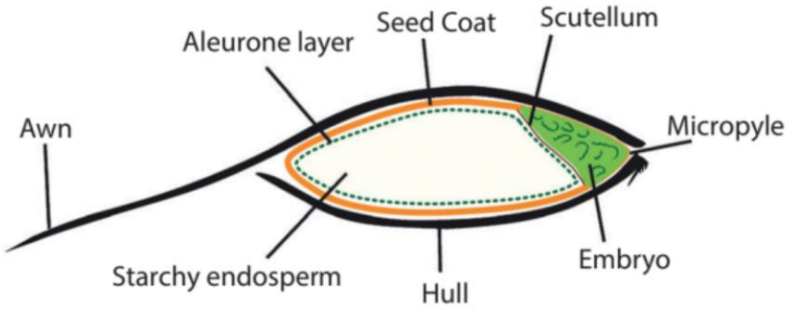

Figure 2-5- Barley seed Rapresentation [25]

As mentioned earlier, malt is an ingredient that plays a fundamental role in shaping the sensory characteristics of beer. Each different type of malt contributes differently to the flavor profile and color of the finished product. In general, malts can be classified into two types: base malts and specialty malts.

Base malts are particularly important in providing the fermentable sugars necessary in the brewing process. They have high diastatic power showing that such malts have the power for converting starches into fermentable sugars. The most common types of base malts are[25]:

• *Pilsner*: Lightest of all malts, pilsner malt finds applications across a wide range of beer styles. The drying process of the malt starts at about 35°C and the temperature is gradually increased to 70-85°C with variable periods of resting. This malt imparts a sort of cereal flavor with hints of acacia honey.

• *Pale malt*: dried at higher temperatures than Pilsner malt, and their flavors are strong, with a pronounced bread crust character.

• *Vienna*: This malt is dried at relatively higher temperatures but still possesses high diastatic power. It has a light caramel flavor with subtle roasted notes.

• Munich: It has a more pronounced caramel flavor than Vienna malt, with aromas of bread crust and cookies without any roasted characteristics. This malt can be used alone in brewing, or it may be combined to add depth to beers brewed using simpler base malts.

• *Smoked* - This type comprises a smoked version of Pilsner malt. Here the smokiness may either be imparted using oak or any other variety of wood during the drying process, or the smoky flavors may be added at the end of malting.

Specialty malts are often used by brewers to enhance the flavor of beer or to achieve particular styles. These malts exhibit distinctive sensory characteristics and are usually added in lower quantities. Specialty malts may be broadly divided into several key categories[25]:

• *Caramel malts,* which are produced through a process that avoids drying the grains post-germination, once starch has been converted into sugar. Subsequently, these malts are exposed to high temperatures that facilitate caramelization. Among the most prevalent types of caramelized malts are Carapils, Caravienna, Caramonaco, Crystal, and Special B.

• *Non-caramel malt* that do not undergo the caramelization process retain some starch, which can still be converted to sugar during production. Examples of non-caramel specialty malts are Aromatic, Melanoidin and Brown malts.
• *Roasted malts* which are prepared at higher temperatures, up to 250°C, develop rich and toasty flavor profiles. These malts are generally added in small quantities; their strong color and flavoring potential can, however, have a huge impact on the quality of beer. Chocolate, Black, Roasted, and Dehusked malts are some of the main categories of roasted malts.

Distinguishing base malts from specialty malts will allow brewers to create a great range of different beer styles by balancing the fermentable base with unique flavor fractions to arrive at the desired beer profile.
Moreover the color of malt is an important factor for the brewer, as it directly affects the final hue of the beer. Determination of color for base and specialty malts will involve a visual method utilizing a comparator in conjunction with a series of colored slides. This comparison provides useful information about the type of malt under consideration. The wort is obtained, in the case of specialty malts, by mixing caramelized or colored malts together with pilsner malts, and the final color is measured by comparing it to a standard colored slide. Where necessary, the malt can be diluted in order to obtain more accurate reading. The final color is expressed in EBC - European Brewery Convention units, as can be seen in the table below.[26]. There are also other methods to measure beer color like SRM and Lovibond, they will be discussed in *Section 2.4.1.2 Appearance*

Type of malt	Colour (EBC units)
Pilsner	< 4.5
Vienna	< 9.0
Munich	< 20
Karapils	< 20
Light caramel	< 120
Dark caramel	< 220
Chocolate	< 1200
Coloured (black)	< 1500

Table 2-2- Some of malt types color according to EBC classification [26]

2.3.3 Hops

Figure 2-6-Hop Cones [27]

Humulus lupulus, commonly known as hops, is a species of flowering plant that belongs to the hemp family of Cannabaceae. It is a dioecious plant, meaning that it has separate male and female plants, and is native to regions in West Asia, Europe, and North America. Given the importance of the female flowers, called hops, Humulus lupulus has become a basic ingredient in the brewing industry and therefore has been widely cultivated almost everywhere in the world.[27]

In 1967, Stevens, in his comprehensive review of hop chemistry, presented a typical analysis of dried hop cones showing the following composition and relative percentages: Resins 15%, Proteins 15%, Monosaccharides 2%, Tannins (polyphenols) 4%, Pectins 2%, Steam volatile oils 0.5%, Ash 8%, Moisture 10%, Cellulose 43%.

Today because of the introduction of the newer superhigh-alpha varieties, the percentage of resins and oils is proportionately higher and talking about beer production process, only the resins, oils, and polyphenols significantly contribute to beer quality.[21]

Hop resins, based on their solubility in various solvents, can be divided into two major classes: hard resins and soft resins. Hard resins are generally considered of little importance in brewing, since they make no significant contribution to either the flavor characteristics or the preservative qualities of beer. Soft resins, however, play a very important role in the development of the bitterness, aroma, and overall stability of beer, and they include compounds known as alpha and beta acids.

The primary compounds responsible for the bitterness of beer are alpha acids, at about 90 percent of the total bitterness that drinkers perceive. Beta acids also take part in the flavor profile of beer, but in a relatively minor way compared to alpha acids. These acids undergo isomerization during brewing, especially during boiling, which enhances their solubility and gives beer its characteristic bitterness. Furthermore, the presence of specific ions like magnesium, carbonate, and chloride apparently would increase hop bitterness, illustrating the complex relationship of water chemistry and hop entities on the flavor profile of beer.[28]

Hops oils play a key role in shaping beer flavor; chromatographic analysis of hops has distinguished more than 300 different compounds that can be grouped into three major categories[21]:

- *The Terpenes*: These are the volatile compounds of hop oils, accounting for about 90 %. They mainly consist of myrcene, α-humulene, and β-caryophyllene, which are mostly evaporated during boiling, and contribute with subtle flavors, especially in dry-hopped beers or those with late hop additions.

- *Oxygenated*: The oxygenated derivatives of terpenes include alcohol, aldehydes, and esters responsible for the characteristic "hop" aroma. Their concentration may be low; however, because of strong aromatic impact, their effect can be maximized by adding hops in the brewing process.
- *Sulfur compounds*: Generally, few in hops, these compounds are undesirable as they negatively affect flavor. Their formation may arise from spraying of sulfur-based fungicides or during the added sulfur in the processing of hops.

Hop polyphenols affect the stability of beer. They coagulate with protein during boiling, hence enhancing clarity of the wort. Aside from stability, these compounds also contribute to shape beer flavor by adding bitterness, body, and "mouthfeel." However they can sometimes cause astringency, which, for some brewers, could be detrimental.[21], [28]In general, hops used in brewing can be divided into 3 macro-categories: Aroma hops, Bittering hops and Dual-Purpose hops.

- *Aroma hops*, are usually used at the end of the boiling process or in so-called “dry hopping.” Dry hopping is a new technique and consists of adding hops after the wort has already been cooled. Aromatic hops have a low alpha-acid content of around 10, this makes it difficult to add a particularly bitter tone to a beer with this type of hop.[29]
- In contrast, *Bittering hops* are rich in alpha acids and thus are the main source of bitterness in beer. In addition, because they are particularly bitter, they also help to stabilize the beer by increasing its shelf life. Talking about hops bitterness, The International Bitterness Unit (IBU), is a quantifiable measure that brewers use to express the bitterness level in beer. Each IBU equals 1 milligram of iso-alpha acid per liter of beer. Most beers range between 1 and 100 IBUs. However, a practical upper limit is reached around 110 to 120 IBUs, beyond which the beer becomes saturated with iso-alpha acids.[30]
- *Dual-purpose hops* are rich in both alpha acids and essential oils. Thanks to their versatility, these hops are employed at any point in the brewing process, from early boiling to late additions and even dry hopping. Citra, El Dorado, Simcoe, and Cascade are among the most popular varieties in Pale Ales and IPAs, where they can provide a dual purpose with respect to bitterness and aroma. They often contribute to the citrus and fruity flavors characteristic of Pacific Northwest hops. These varieties typically contain 8-15% alpha acids.[29]

2.3.4 Yeast

Yeasts are unicellular eukaryotic microorganisms classified within the fungus kingdom. They appeared on earth several hundreds of millions of years ago, and at least 1,500 different species have been described so far. They are estimated to constitute 1% of all described fungal species.[31] Regarding the use of yeasts in the brewing process, the quality of the finished

product is highly dependent on the activity of fermenting yeasts, not only because of their good fermentation yield efficiency, but also because of their influence on the beer's aroma.
As was extensively discussed in *Section 2.1.7 Fermentation*, the most widely used yeast for brewing is that belonging to the *Saccharomyces* species, because it is able to produce a high level of ethanol efficiently and because it can withstand even severe environmental stresses that can occur during the brewing process. Yeasts belonging to the genus *Saccharomyces* can be grouped into two groups: ale and lager yeasts, or respectively in top-fermenting and bottom-fermenting yeasts. This distinction is related to the different yeast's flocculation properties. As a matter of fact, at the end of fermentation, top yeast tends to rise to the surface of the fermented wort, whereas bottom yeast settles to the bottom of the fermentation vessel. Moreover, high fermenting yeasts, operate at higher temperatures ranging from 15 to 25 ° C and ferment very rapidly, naturally bringing spicy, floral, herbaceous nectar and fruit notes to the beer. Bottom-fermenting yeasts, on the other hand, act at an optimum temperature between 8 and 12°C, and they give the beers a characteristic sulfurous aroma.
However today, the brewing industry is characterized by an increasing demand for innovative products, leading to the widespread use of unique regional starter cultures, spontaneous fermentation techniques, and *non-Saccharomyces* yeast strains to enable the development of truly unique and original products. Seeking more complex sensory characteristics, brewers are turning to non-traditional yeasts, particularly those that do not belong to the Saccharomyces genus. Although these yeasts tend to have lower fermentation performance and greater sensitivity to ethanol, they offer simply amazing aromas and flavors. They also find ideal application in low-alcohol, non-alcoholic and light beers.[32]

2.3.5 Adjuncts

From what was said previously, beer is made up of four fundamental ingredients which are water, yeast, hops and malt, without which it is not possible to carry out the production process and obtain a quality finished product. The adjuncts are not part of the ingredients previously listed, as they are not considered fundamental to produce beer. Today, however, within the limits of the uses permitted by law, many countries use adjuncts to produce some types of beer. Countries such as Germany, Norway and Greece, however, strongly prohibit the use of these additional ingredients. For example, in Germany, the Purity Law to which we referred in *Paragraph 1.1 History of Beer*, is still in force and states that the ingredients that can be used for the production of beer are only malt, yeast, hop and water. This law was also inspired by the legislation stipulated in Greece and Norway, which regulate and control the ingredients of beer. In general, the term adjuncts related to the brewing process, means "any carbohydrate source other than malted barley which contributes sugars to a brewer's wort".
Beer's adjuncts can be divided in three specific areas of the brewing process: solid unmalted ingredients, which are generally processed in the brewhouse such us corn, rice, rye, oats and barley; liquid adjuncts (such as syrups), typically added to the wort kettle; and malted grains

beyond barley, including wheat and sorghum.[21]
Beers can also be made with a multitude of adjuncts and flavorings, creating different profiles. Fruit is a common choice and is usually added through fermenting the fresh fruit itself or blending fruit extracts with the finished beer. Cherry, raspberry, and lemon are some of the more common fruits used, imparting unique flavors and aromas. Vegetables are sometimes used to add flavors as well; for example, pumpkin is a common addition to beers brewed in autumn, making the seasonal offering of pumpkin-flavored beers extremely popular among brewers.
Some herbs and spices, such as cinnamon, ginger, coriander, hot pepper, and nutmeg, are generally added during the boil or fermentation to affect flavor. Other popular adjuncts include coffee, tea, vanilla, chocolate, and even biscuits or seafood.

2.4 Beer Styles and their Categorization

As seen from the brewing process, discussed at length in *Section 2.1*, beers are made up of the same basic ingredients, but despite this there are many unique styles of beer around the world. Beer styles are distinguished by color, flavor, strength, brewing techniques, and origin. In general, we can highlight two main groups, based on the type of yeast used during fermentation: *ales* and *lagers*. As mentioned earlier, lagers use bottom-fermenting yeasts, while ales use top-fermenting ones. However, in addition to these two main categories, another has been identified by some classification systems, which is that of so-called *spontaneously fermented* or *mixed* beers. These beers are brewed using wild yeasts or naturally occurring non-Saccharomyces strains that initiate fermentation when exposed to bacteria and microorganisms in the environment.
The following table shows some of the styles withing each of these categories[33].

		STYLE	
CATEGORY	ALES	American Pale Ale	Porter
		India Pale Ale (IPA)	Stout
		Saison	Altbier
		Belgian Strong Golden Ale	Kölsch
		Barley Wine	Bière de Garde
		Scottish Ale	Irish Red Ale
		Bitter	Belgian Dubbel and Tripel
		Witbier	Weissbier
		Pilsner	Bock
	LAGERS	Munich Helles	Munich Dunkel
		Rauchbier	Vienna Lager
		Märzen	Pale Lager
		Amber Lager	Dark Lager
	MIXED	Berliner Weisse	Flanders Red Ale
		Oud Bruin	Lambic
		Gueuze	Gose
		Brett Beer	Straight Sour Beer

Table 2-3 -Different beer styles for each category [33]

2.4.1 Main Attributes of Beer Styles

Drinking a beer is a true sensory experience that goes far beyond the simple need to sip a beverage to quench one's thirst. When drinking a beer, in fact, there is a conscious interaction of all five senses: sight, smell, taste and, in some cases, even hearing. Each sense offers a unique perspective that reveals important aspects of the beer's quality and character. The visual appearance of a beer can indicates the ingredients it contains, what the style of beer is, and how fresh it is. The aroma, determined by the complex nuances of hops, malt and fermentation, shows the character of the beer before you even taste it. On the palate, the taste is deep with different elements that give unique sensations and nuances. Feel, or mouthfeel, is used to describe the degree of body and texture, whether it is light, soft or full-bodied. In some cases, hearing also comes into play when, if you are in traditional environments, you also hear the sound of pouring or clinking of glasses, which makes the experience more pleasant and the atmosphere more beautiful.
The combination and interaction between these sensory qualities explains the degree of craftsmanship of each beer and the subtle differences between one and another.

2.4.1.1 Flavor

Flavor plays a key role in consumer expectations. A beer may look appetizing, but if it tastes bad, the reputation of the brewery is at risk. Beer flavor is a complex synergy of more than a thousand compounds derived from the raw materials and the overall process. How flavor is perceived is a very complex concept because some flavors are dominant and distinguishable on their own, while others are below the limit of perception or occur as combinations of several minor flavors that would be difficult to distinguish. In addition, the perception of aromas is extremely subjective and varies from one individual to another. Different people, in fact, are able to distinguish different concentrations of key aroma molecules.
In brewing, flavors should always be matched true to the type and style of beer. For this reason, flavors not characteristic of a style are considered “off-flavor” and result from variations in raw materials, processes, or microbial contamination. They also develop over time as the beer ages, a process known as “staling.” Exposure of beer to oxygen, high temperatures, and mechanical agitation affect the stability of a product's flavor.[24]

There are three flavor components, taste, aroma, and mouthfeel that are often processed together in the brain to generate a single composite flavor sensation.

The sense of **taste** is the sensory system partially responsible for the perception of taste (flavor). Taste is the perception stimulated when a substance present in the mouth reacts chemically with taste buds located mainly on the tongue. Taste, together with the sense of smell and stimulation of the trigeminal nerve (which registers texture, pain and temperature), determines the taste of foods and other substances.[34]

The main recognized beer flavors fall into several key categories that reflect both the ingredients and the brewing process and are: Sweet, Bitter, Sour, Salty, Umami.[35]

- *Sweet*: Derived primarily from malt, which contributes sweetness at varying levels depending on the type of malt used and the amount of unfermented sugar.
- *Bitter*: Derived from the hops, which contribute bitterness to balance the sweetness of the malt. Different hop varieties contribute various levels of bitterness and may also add floral, citrus or earthy notes.
- *Sour*: Common in styles such as Belgian lambics, Berliner Weisse and Gose, this taste is due to wild yeast strains (e.g., Brettanomyces) or bacteria (such as Lactobacillus and Pediococcus) that add a sour flavor.
- *Salty*: Most associated with the Gose style, which traditionally has a slight saltiness due to ingredients or local water profile.
- *Umami*: Found in some darker or barrel-aged beers, especially those with roasted malts or additions such as soy or mushrooms. This savory quality can be subtle but adds depth.

Aroma, according to neuroscientists, is one of the most important senses we have because it reaches directly to the parts of the brain related to memory, pleasure and recognition. Thus, aroma becomes a key ingredient in beer tasting, as it governs initial and long-lasting impressions. In beer, aroma is perceived through sensory receptors, which respond to physical stimuli such as carbonation and volatile compounds of ingredients such as hops, fruit and malt.[36]
Aroma evaluation has been made possible through the use of trigeminal and olfactory detectors, which provide the taster with the information needed to classify primary aromas, such as fruit, floral notes, and hop volatiles. With experience and training, beer tasters refine their ability to identify complex aroma profiles and create a shared language for accurate identification, from buttery diacetyl to banana-like isoamyl acetate.[36]
Each person's olfactory sensitivity is different, influenced by both our genetic and personal history, which explains why the liking of different beers is so hotly debated among people. The conditions and social contexts in which we find ourselves also have an impact on how aroma affects our overall view of a beer's quality and appeal.

Mouthfeel can be defined as the textural attributes of beer, those that produce a tactile sensation in the mouth. There are three key attributes recognized in the perception of mouthfeel: carbonation, fullness and aftertaste.

- *Carbonation* is almost always the first attribute perceived by the consumer as soon as the beer touches the lips of the mouth. It is perceived as a peculiar stinging or tingling sensation that is more or less intense depending on the amount of carbon dioxide present in a given type of beer. For example, beers pressurized with large volumes of nitrogen have a firm foam and small bubbles, which produce a creamy sensation in the mouth.[37]

- The term *fullness*, on the other hand, refers to the density and viscosity of the beer, as well as its perceived weight and resistance to flow as it is drunk. What contributes to a particular mouthfeel of a beer are the complex sugars, developed during the mashing process, without necessarily increasing the perceived sweetness. Based on fullness, beers can be defined, for example, as “thin” if they are very light or “round” and “syrupy” if they are more viscous and denser.[37]
- *Afterfeel*, finally is the word by which we refer to the final sensation left in the mouth by the beer. Attributes such as viscosity, astringency, dryness, bitterness, greasiness, or mouth-coating characteristics can leave a well-defined sensation that may persist.[37]

2.4.1.2 Appearance

We can say that the consumer, at first impact drinks the beer with his own eyes. The appearance of beer, in fact, is a key feature and one to which much attention is paid. There are 3 characteristics that delineate its appearance: color, foam and haze.

The color of beer is the first thing that catches our attention as soon as it is served. It can range from straw to amber to black and is determined by a few basic factors, listed and described below.

- The type of grain used, and the malt are one of the most critical factors in determining the color of the final product. In the fermentation process, sugars and amino acids are heated and produce melanoidins, which are complex molecules responsible for coloration. A key role in coloration plays the heating temperature in malt production, the higher it is, the darker the color of the beer will be. In addition to grains, some brewers add other ingredients such as coffee, caramel or fruit extracts that can also alter the color and flavor of the beer.[38]
- Although usually overlooked, another factor that largely influences the color of beer is time. As a beer ages, in fact, suspended particles such as yeast and polyphenols settle to the bottom, reducing light reflection giving the beer a darker color. Oxidation also affects the color of beer. In fact, the latter, when subjected to prolonged exposure to oxygen, can take on a particularly dark color, which could signal undesirable aging effects.[39]
- Even if slightly less than the previous factors, the boiling process and the pH levels of brewing water affect beer color. The longer the boiling process, the darker the beer will be at the end of the brewing process. The pH value of the hot water used in the mashing stage changes the color of the beer, in particular, a water with a lower pH will lead to a lighter beer, as some compounds lose pigmentation under acidic conditions.[39]

There are three main methods and scales to measure beer color, that are SRM, EBC and Lovibond.

- *The Standard Reference Method (SRM)* was invented by the American Society of Brewing Chemists in 1950, and today it is the most widely used reference value in America to measure beer color. It is determined by using specialized equipment to pass light through a small sample of beer and recording the decrease in intensity due to absorption. The ideation of the SRM method made it possible to define a measurement scale for beer color ranging from 1 to 80. Very light beers have an SRM value at or very close to 1, while dark beers such as stouts and porters have a much higher value[40].
  The table below relates the SRM range with beer colors and some of the respective styles.

Color	Color Name	SRM Range	Styles
	Pale Straw	**2-4**	Light Beer including Pale/Lite Lager, Pilsner, Berliner Weisse, Witbier, New England IPA
	Straw	**3-6**	Maibock (Helles), Blonde Ale, California Common, Kolsch, Cream Ale
	Pale Gold	**4-8**	Weissbier, Lambic, Belgian Tripel
	Deep Gold	**6-12**	India Pale Ale (IPA), American Pale Ale
	Pale Amber	**8-16**	Saison, English Pale Ale, Irish Red Ale
	Medium Amber	**10-20**	English Bitter (ESB), Belgian Dubbel
	Deep Amber	**13-26**	Double IPA, Biere de Garde, Altbier, Barleywine. Scotch Ale
	Amber Brown	**17-33**	Amber Ale, Vienna Lager, Dark Lager, Marzen
	Brown	**20-39**	Bock, Dunkelweizen, Brown Ale, Brown Porter
	Ruby Brown	**24-47**	Robust Porter, Dopplebock, Irish Dry Stout, Oatmeal Stout
	Deep Brown	**29-57**	American Stout
	Black	**35-79**	Russian Imperial Stout

Table 2-4- Beer Color and SRM Range [40]

- *The Lovibond scale* is the oldest tool for measuring beer color and it is still used today. The Lovibond scale was named after Joseph Williams Lovibond developed the method in 1885. It operates by visually matching a beer sample against a reference color kit with established values on the Lovibond scale. Although the competence of the

Lovibond method is rather limited and SRM and EBC are more reliable alternatives to, it is still a common standard typically applied in product packaging as well as in online stores to denote malt color along with other brewing ingredients.
The formula to convert SRM standard in Lovibond degrees is:
Lovibond = (SRM + 0.6) / 1.35)

- *The European Beer Color (EBC)* method is the European standard for measuring beer color, corresponding to the SRM scale used in the United States. Both methods, EBC and SRM, employ very similar laboratory techniques to determine color, which makes their values closely related in a linear fashion. In fact, the EBC value for a given type of malt is always slightly less than twice the corresponding SRM value[40]. The EBC color is about 1,97 times SRM color: EBC = (1.97 * SRM)

Beer foam, also named head or collar, is the foamy top of the surface and other carbonated beverages created by the rising of carbon dioxide bubbles. This is formed thanks to the interactions between wort proteins, yeast residues, and hop residues, which in turn stabilize the gas bubbles formed by fermentation. During fermentation, yeasts convert the sugars into ethanol and carbon dioxide. This may be due to natural processes in which the beer has undergone secondary fermentation in the bottle or it may also be caused by forced carbonation in which the beer is filtered or pasteurized. The type of grains and additions used during brewing determine the thickness and persistence of the beer head. For instance, wheat would tend to increase foam volume and stability more than barley, and if mashing processes and grain sources are not identical, head retention will also differ. Another factor that is called "lacing" is the foam residue that remains in the glass when the beer head is disappearing. It is composed of the same proteins and hop compounds, and it is sometimes considered as an indicator of beer quality. Besides carbonation, the stability of foam in a beer depends upon the specific compounds present in beer, such as the amphipathic malt polypeptides. The foam-forming polypeptides can be classified based on their hydrophobicity. The greater the hydrophobicity, the greater the foam stability.[41]

Haze is the term used to indicate turbidity in beer but it generally covers all forms of instability in beer in which insoluble material appears. From a technical point of view, there are several different types of haze. The so-called *invisible haze*, which is caused by very small particles that cannot be directly detected by the eye. This type of haze is detected by haze meters that measure turbidity on the basis of the scatter of light at right angles to the incident. The other haze type is *visible haze* that is differentiated into *chill haze* and *permanent haze*. The first one develops when beer is chilled to 0°C but disappears when the beer warms to 20°C, the second one instead is present at all temperatures. Haze can also be differentiated into *biological haze*, which arises from the growth of living microorganisms in the beer, and *non-biological haze*, which is caused by a diversity of colloidally unstable non-living materials in beer. These

materials include proline-rich polypeptides deriving from the storage proteins of grain, polyphenols (oxidized in the presence of transition metal ions such as iron and copper), starch, β-glucan, pentosans, oxalate, and dead yeast or bacteria.[42]

2.4.1.3 Alcohol strength

The strength of a beer is simply the quantity of alcohol in it. This is measured in ABV (alcohol by volume), which indicates the percentage quantity of alcohol present in a given volume of beer. It is calculated by dividing the amount of alcohol in a beer by the total volume of the beer.
Based on the percentage of ABV, beers are usually divided into 4 main categories: non-alcoholic beers, low-alcohol beers, standard beers and high-alcohol beers.

Non-alcoholic beers contain a minimal amount of alcohol and in fact have an ABV index of less than 0.5%.
Low alcohol beers are also called "session beers" and have an alcohol content that varies between 2% and 4.5%. As can be seen from the name "session beers", they are ideal for anyone who wants to drink a lot of beer in a single session without being affected by an excessive amount of alcohol.
The category of *normal beers*, also called standard beers, includes all the most popular and commonly marketed beer brands, such as Heineken, Corona, Peroni, Moretti, Tuborg etc. These beers have an alcohol content between 4.5% and 5.5%.
High alcohol beers, on the other hand, have an ABV above 7%, reaching up to 40% ABV. This category of beer includes beers such as Double IPA, Barleywine, Baltic Porter.[43]
In the table below are listed some of the main important beer styles ordered by Average ABV index.

Beer Style	ABV Min	ABV Max	Average ABV
Scottish Light	2,50%	3,20%	**2,85%**
Berliner Weisse	2,80%	3,80%	**3,30%**
Ordinary Bitter	3,20%	3,80%	**3,50%**
Scottish Heavy (70/-)	3,20%	3,90%	**3,55%**
Bitter (Best Bitter)	3,80%	4,60%	**4,20%**
Dry Stout	4,00%	5,00%	**4,50%**
Pale Lager	4,00%	5,00%	**4,50%**
Porter	4,00%	5,40%	**4,70%**
Pilsner (German Pils)	4,40%	5,20%	**4,80%**
Kölsch	4,40%	5,20%	**4,80%**
Pilsner (Czech Pilsner)	4,20%	5,50%	**4,85%**
Weissbier	4,30%	5,60%	**4,95%**
Straight Sour Beer	3,00%	7,00%	**5,00%**
Irish Red Ale	4,00%	6,00%	**5,00%**
Altbier	4,50%	5,50%	**5,00%**
Amber Lager	4,50%	5,50%	**5,00%**
Dark Lager	4,50%	5,50%	**5,00%**
Vienna Lager	4,70%	5,50%	**5,10%**
American Pale Ale (APA)	4,50%	6,20%	**5,35%**
Flanders Red Ale	4,60%	6,50%	**5,55%**
Lambic	5,00%	6,50%	**5,75%**
Märzen	5,80%	6,30%	**6,05%**
India Pale Ale (IPA)	5,50%	7,50%	**6,50%**
Brett Beer	5,00%	8,00%	**6,50%**
Bock	6,30%	7,20%	**6,75%**
Belgian Dubbel	6,00%	7,60%	**6,80%**
Foreign Extra Stout	6,30%	8,00%	**7,15%**
Bière de Garde	6,00%	8,50%	**7,25%**
Belgian Tripel	7,50%	9,50%	**8,50%**
Belgian Strong Golden Ale	7,50%	10,50%	**9,00%**
Imperial Stout	8,00%	12,00%	**10,00%**
Barley Wine	8,00%	12,00%	**10,00%**

Table 2-5-Beer Styles Ranked by Average ABV (Descending)

2.5 Environmental impact of brewing and circular solutions

The beer production process involves a series of environmental and operational impacts that must be carefully considered. The entire process requires large amounts of resources, including water and energy, and generates not only CO2 emissions, but also waste by-products, which require adequate management. The problems related to the sustainability of the beer production process are listed and analyzed in detail below.

Water consumption: Beer, as discussed earlier, is 90-95% water, and its production requires large quantities of this resource. Typically, it takes up to about 7 liters of water to produce one liter of beer, including cleaning and cooling of the equipment used. Specifically, water depending on the purpose for which it is used can be divided into Brewing water/Brewing Liquor (2.7l/l of Beer), Process Water (2.1l/l), General purpose water (1l/l) and Service Water (0.2l/l).

Brewing water/Brewing Liquor refers to the water used for the fermentation process, and it affects beer in several ways. Specifically, it affects the Ph of the beer and consequently the flavors that are perceived on tasting, it imparts consistency through the sulfate/chloride ratio, and finally it can cause unpleasant flavors if there is chlorine or contaminants present. For this reason, it requires specific treatments. *Process Water*, on the other hand, refers to the water required for sterilization of equipment used in the production process. *General purpose water* is water used for hygiene and general maintenance of the site, while the term *Service Water* refers to water for boiler feed that must be demineralized before use.[44]

Energy consumption: As was discussed in detail in the introduction of this chapter, the brewing process involves a number of energy-intensive operations, in particular malting, wort cooking, pasteurization, and refrigeration, where energy is principally required in the form of heat and electricity.

CO2 Emission: During fermentation, yeasts produce carbon dioxide (CO2) as a by-product, and the heating of ingredients in breweries results in additional greenhouse gas emissions, contributing to climate change.

Waste and By-Products: During beer production process, three main types of by-products are generated, i.e. brewer's spent grain (BSG), spent hops/hot trub, and residual brewer's yeast. Their management is economically demanding and their accumulation in the environment is an ecological issue as well.
Brewer's spent grain (BSG) is formed during the mashing process and removed before the boiling step of the brewing process. It represents about 85% of all residues produced by the brewing industry and as a matter of fact BSG is the main waste generated during brewing process.
Brewer's residual yeast (BSY) is the second largest by-product from the brewing processes and

accounts for a maximum of 15% of the total by-products produced during the brewing processes. BSY is recovered by sedimentation before full maturation of beer at the final stage of the second fermentation and maturation. Hot trub instead is present in minor percentage and this term refers to sediments formed in the brewing process during wort boiling.[45]

In response to the main problems listed above, many breweries, especially craft breweries, are adopting circular economy principles and new cutting-edge technologies to reduce the environmental impact of production. Some of the most effective solutions are:

Reduction and reuse of water resources by implementing water recovery systems and reusing cooling water or treating wastewater for use in other stages of the production process. Doing so not only reduces overall water consumption, but also significantly decreases the load on local water resources.

Energy optimization and renewable sources by improving energy efficiency through the implementation of advanced machinery and equipment, using renewable sources such as solar panels, and producing biogas from organic waste processing.

Use of sustainable Packaging such as reusable glass bottles or recyclable aluminum cans, thus reducing plastic use and minimizing waste and environmental impact.

Carbon Capture and Utilization (CCU) that refers to a range of applications through which CO_2 is captured and used either directly (i.e., not chemically altered) or indirectly (i.e. transformed) in various products.[46]. It is within this context that some advanced breweries are now adopting technology for capturing CO_2 produced in fermentation and reuse it for carbonation of the beer itself or even selling to industrial uses, trying to reduce the total greenhouse gas emission.

Recycling of by-products that can be recovered or enhanced in agro-food, cosmetics, materials, chemical industries, etc. According to recent research, breweries have the potential to become biorefineries, as they can extract various valuable plant compounds, such as carbohydrates, proteins, lipids, phenolic compounds, platform chemicals, and biopolymers. These biomolecules have bioactive and physicochemical properties that can be enhanced through recovery processes and can increase the techno-functionality of final products.[47]
In particular, among the by-products of the brewing process Brewer's Spent Grain(BSG) is often sold as animal feed because of its properties and the essential nitrogen-rich nutrients it contains. In addition, it has been shown that up to 75 percent of soy can be replaced with BSG in dairy cow feed, thus improving digestibility and increasing milk production. It has also been shown to have a positive effect in the diet of lambs, giving them greater body weight and daily gains. Both BSG and Brewer's spent yeast (BSY) can be used in the human diet. In particular, Brewer's spent grain, due to its high dietary fiber content, can be used to enrich foods and would lead to human health benefits, helping in the prevention of some chronic diseases such as cancer diabetes and gastrointestinal disorders. Brewer's residual yeast, on the other hand,

due to its high mineral content can be used for the production of functional food ingredients in the confectionery, dairy and beverage industries.[45]

To bring real-world examples of some of the initiatives described above from a circular economy perspective, reference can be made to the Netherlands, specifically Rotterdam where the Stadshaven brewery has opened. The latter is a facility considered the largest craft brewery in Europe, based on the use of renewable energy and environmental sustainability. To make the Stadshaven brewery modern and sustainable, more than 10 million euros had to be invested, part of which was used to install 1,700 solar panels on the roof to drastically reduce emissions during fermentation operations, which requires the use of a lot of water and high temperatures and, therefore, large amounts of fuel.[48]
Modern processing techniques are also used within the Dutch brewery to minimize water waste. In particular, through collaboration with companies specializing in water treatment, water is collected and purified, then reused in brewing. Even waste from the brewing process, such as wort, is reused thanks to an agreement with Floating Farm, the world's first floating farm established in 2019, located less than 200 meters from the brewery, for which about 2.5 million euros have been invested.[49]
Even large companies are now taking up the idea of circularity. A good example is Heineken in the Netherlands, which for a long time has been working with institutions such as the Naturalis Biodiversity Center and Wageningen University on how to make its breweries more sustainable. Their focus includes water management, sustainable beer production, and lowering carbon emissions. In Italy, Heineken, the country's leading beer producer, reduced its CO2 emissions by 55% between 2010-2018, cut its water consumption by more than a third, while switching to 100% renewable electricity. An excellence for sustainability is HEINEKEN Italy's overall photovoltaic park, started in 2012 with solar panels installed at the Comun Nuovo (BG) and Massafra (TA) breweries, now has about 17,000 panels capable of producing 5.52 GWh of energy each year at full capacity, with an annual reduction of 2,191 tons of CO2.[50]

2.6 Beer and Health

For millions of people around the world, alcoholic beverages are condemned for religious reasons. Alcohol prohibition is imposed, for example, in many Muslim-majority countries, such as Libya, Kuwait, Mauritania, Saudi Arabia, Somalia, Sudan, and Yemen. Among cultures where alcohol is tolerated, the social unacceptability of excessive alcohol consumption is recognized, with the terrible consequences it can have. In these same cultures, moderate alcohol consumption is also often viewed in relation to its nutritional value.
For what concerns beer’s nutritional information, 355 ml of a regular beer contain[51]

- Calories: 153
- Protein: 1.6 grams

- Fat: 0 grams
- Carbohydrates: 13 grams

Some recent studies show that light-to-moderate consumption of alcoholic beverages, in particular beer, may have some health benefits due to its nutritional values, content of proteins, B vitamins, essential minerals, antioxidants (phenolics), ethanol, dietary fibers, and even prebiotics. On the other hand, excessive alcohol consumption has a negative impact on individual's health and society, increasing the likelihood of diseases**.**[52]
Starting from the positive health effect, moderate beer consumption, despite its reputation, may be beneficial for heart health by improving levels of “good” cholesterol (HDL), vascular elasticity, and apolipoprotein A1 levels, thus reducing the risk of cardiovascular disease.[53]
In addition, moderate beer consumption may also lower the risk of developing neurodegenerative diseases, such as Alzheimer's.[54]
Moderate alcohol intake may also benefit blood sugar control. Some studies show that small amounts help maintain more stable blood sugar levels, reducing the risk of type 2 diabetes. On the bone health front, moderate alcohol consumption may reduce the risk of osteoporosis, as evidenced by a 2019 study that found higher bone density in postmenopausal women who drank 2-3 times a week compared to those who did not drink alcohol.[55]
However, to obtain these possible positive effects, it is essential to drink in moderation and not exceed the recommended quantities, thus maintaining a responsible approach to alcohol consumption. As a matter of fact, if there is excessive consumption of beer, the same aspects that were previously considered positive can become negative, increasing the occurrence of diseases such as: cancer, liver failure, cardiovascular disease, diabetes, pancreatitis, infectious diseases, neuropsychiatric diseases, obesity and depression.

3 WORLD ALCOHOLIC DRINKS MARKET: A DEEP DIVE INTO BEER

3.1 Global Alcoholic Drinks Market

The alcoholic beverage market includes all types of alcoholic beverages produced through fermentation and distillation processes. Based on this definition, the market can be divided into 5 product segments: Beer (both craft and industrial), Cider Perry & Rice Wine, Spirits, Wine and Hard Seltzer.[56]

The beer market segment, as we deeply discussed in previous chapters, includes all the beverages produced through malt fermentation, both industrial and craft beers. It can be further divided into alcoholic beers and non-alcoholic beers.

The spirits market involves all the distilled alcoholic beverages produced from fermented sources such as wine, grains or fruit. As matter of fact, a wide range of drinks is part of this segment, such as whisky, vodka, rum, gin, brandy, soju, tequila, as well as various liqueurs and spirits.

The wine market focuses on drinks derived from fermented grape juice and can be further divided into still wines (red, white and rosé), sparkling wines and fortified wines.

The cider Perry & Rice wine market includes fermented beverages made from fruits other than grapes, as well as those derived from grains or other botanical sources.

Finally, *the hard seltzer market* is characterized by alcoholic beverages that combine carbonated water, alcohol and, often, fruit flavors.

Market volume considering both at home (e.g., revenue generated in supermarkets and convenience stores) and out-of-home (e.g., revenue generated in restaurants and bars) amounts to 285.6 bn liters in 2023. The global alcoholic drinks market share by type is shown in *picture 3.1*.[56].

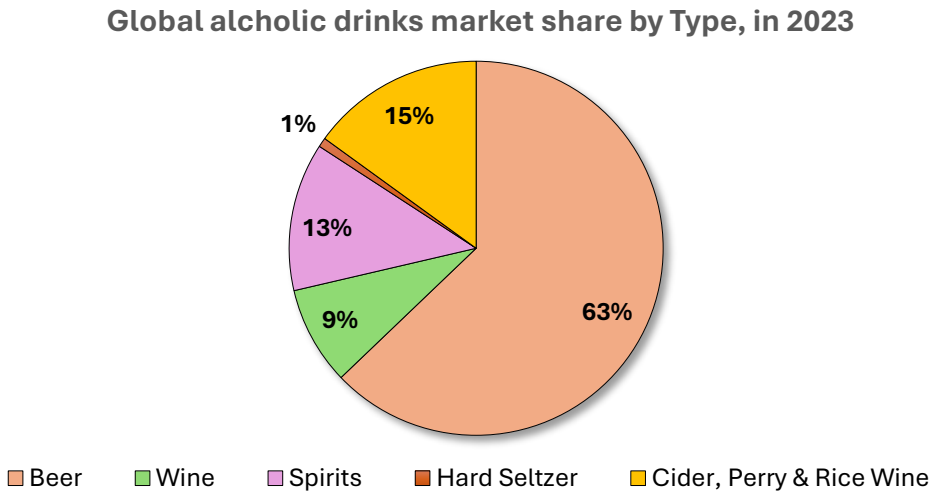

Figure 2-1- Global alcholic drinks market share by type in 2023 [56]

Beer dominates the market with a substantial share of 63%, making it the most widely consumed and economically significant alcoholic beverage globally. This reflects beer's broad appeal across diverse demographics, its strong cultural integration in many regions, and the availability of various price points, from mass-market to premium craft options.

As can be seen from the graph below, global market revenue both at home and out of home accounts for USD 1,614.0 billion and is expected to grow with a CAGR of around 2.68%[56]

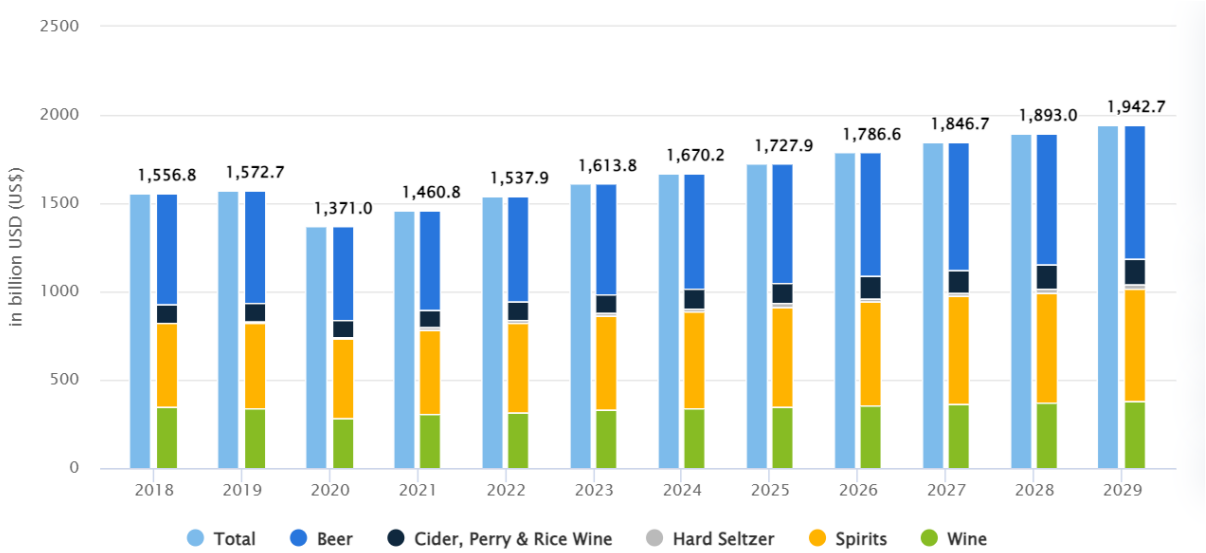

Figure 3-2- Annual Revenue of global alcoholic drinks market from 2018 to 2029 [56]

The most notable decline in revenue occurred in 2020, with total market revenue declining from USD 1,572.7 billion in 2019 to USD 1,371.0 billion in 2020. This significant decline can be attributed to the impact of the COVID-19 pandemic, which caused widespread disruptions in supply chains, closures of retail establishments such as bars and restaurants, and a shift in consumer spending habits. The pandemic likely also spurred changes in market dynamics, such as increased at-home consumption and increased demand for specific product categories, such as hard seltzers, which have gained popularity for their convenience and low alcohol content. After declining in 2020, the market began a steady recovery in 2021 and 2022, with revenue increasing respectively to USD 1,460.8 billion and USD 1,537.9 billion.

There are numerous drivers and trends that influence and guide the revenue and volume growth of the global alcohol market. Some of them are[57]:

Premiumization. Consumers increasingly tend to prefer quality rather than quantity, always looking for new flavors and increasingly sophisticated cocktails or drinks. This phenomenon includes that of craftsmanship. In fact, both craft beers but also craft spirits are achieving notable growth in recent years also with the advent of new technologies and inventions. Additionally, health-conscious consumers are now turning to low-alcohol alternatives, such as

low-alcohol beers and non-alcoholic cocktails. The growing popularity of these products is driving innovation in the industry, with manufacturers introducing new flavors and varieties to meet different customer preferences

Sustainability is certainly the most important trend of recent years in all markets. In the alcohol sector, when we talk about sustainability we refer to CO2 emissions during the production process, but above all to packaging. Consumers are becoming more conscious of the environmental impact of their choices and are seeking brands that prioritize sustainability. This has led to a rise in the demand for organic and biodynamic wines, as well as eco-friendly packaging solutions. Classic glass packaging is increasingly under fire, as it is heavier to transport and therefore associated with higher emissions and requires considerable energy to be produced and recycled. Alternative packaging formats such as paper bottles, bag-in-boxes and aluminum bottles are therefore being tested.

The rise of e-commerce is another of the key factors influencing the alcohol market across the world. Especially with the advent of Covid-19, online platforms have made it easier and more immediate for consumers to purchase a wide range of drinks directly from home without having to physically go to the store. This has led, thanks to social media and digital marketing, to the creation of new sales channels for both established brands and smaller and emerging ones, also allowing the latter to establish themselves in the market.

3.2 World beer market

The beginning of the 20th century was one of the darkest and most difficult periods for the world beer market. The advent of the First and Second World Wars, the Great Depression, the temperance movement and American Prohibition, led to a drastic reduction in beer consumption and production. As a result, many breweries were forced to close due to the shortage of raw materials, the increase in the price of grain and because manpower and machinery were mainly used in the war. After the end of World War II, the number of independent breweries around the world began to decline steadily, with many disappearing completely or being bought out by larger companies, leading to a process of consolidation in the brewing industry. In particular, between 1950 and 1980, the number of breweries in the UK decreased from 567 to 142, while the average size increased accordingly, from 7.4 million liters in 1950 to 48.1 million liters in 1980. Similarly, in Belgium, the number of breweries decreased from 663 to 123 in 1980 while the size increased strongly, from 1.5 million liters to 11.6 million liters. As in Europe, consolidation in the U.S. beer industry continued into the second half of the twentieth century with the number of U.S. breweries decreasing from 407 in 1950 to only 101 in 1980 and the average brewery size increasing from 25.6 million liters to 219.2 million liters.[6]
Furthermore, with this process of industry consolidation, concentration in national markets led to the rise of major corporate players, through a series of mergers and acquisitions (M&As). In fact, in the 1990s, companies such as Heineken (Netherlands), SABMiller (South Africa), and Interbrew (Belgium) made a large number of acquisitions around the world,

buying many of the Eastern European breweries and extending their operations into North and South America (Canada, Mexico, Brazil, and the United States) and China. The M&As carried out by these beer giants shaped the global beer industry, leading to the creation of dominant players with significant market shares worldwide. A clear example is the creation in 2002 of SABMiller plc, headquartered in London, through the merger of South African Breweries (SAB) and the second largest brewery in the United States, Miller. Another example is the foundation of Anheuser-Busch Inbev NV, headquartered in Belgium, which was born from a double merger first in 2004 between the Belgian Interbrew and the Brazilian AmBev and then in 2008 with Anheuser-Busch.[6]
This series of mergers and acquisitions has led over the years to outline the global beer market as it is today. It can be defined as a true oligopoly among the major global giants, which together control about 70% of global beer production. The names and market share of the main giants of the beer industry in 2023 are shown in *Figure 3-3*.

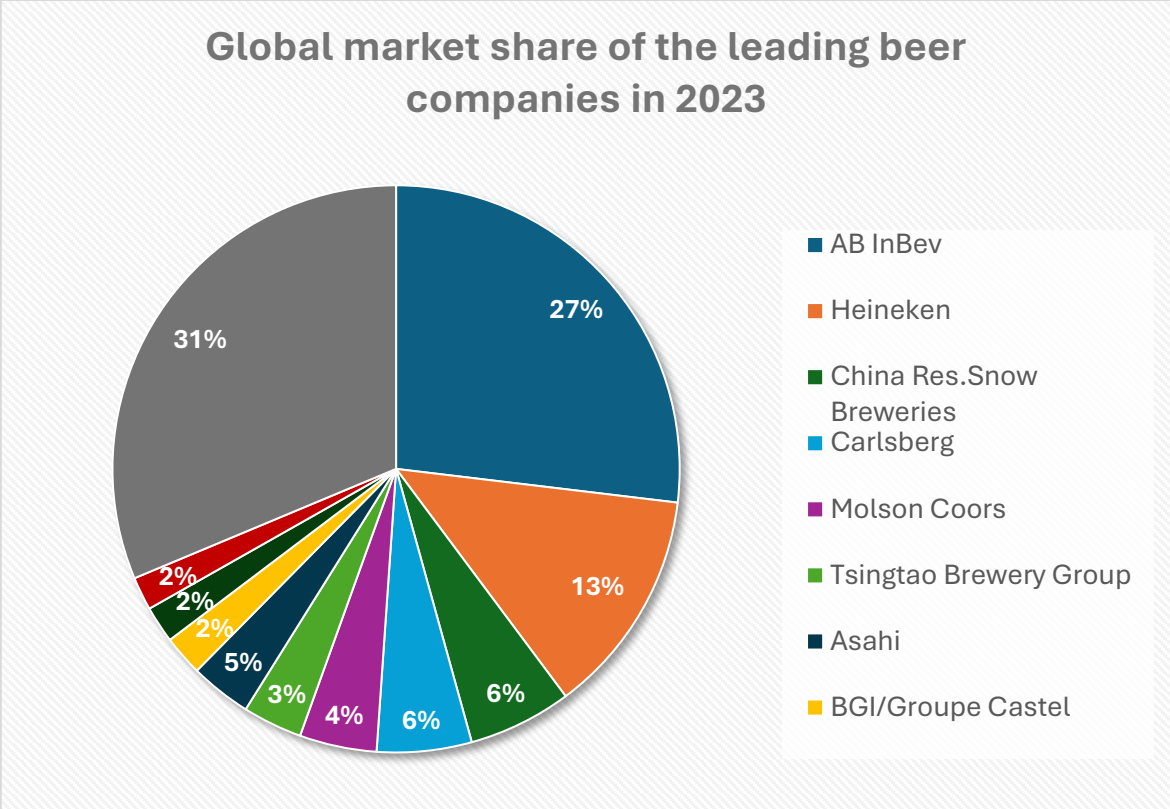

Figure 3-3-Global Market share of beer production in 2023 [58]

Figure 3-4 shows the world beer production from 1998 to 2023. As can be seen from the trend of the graph, production had a continuous growth until 2013 when, also due to the economic crisis, global beer production stood at around 1.95 billion hectoliters/year. Starting from 2018, there was a decline, which reached its lowest level in 2020, due to the spread of COVID-19.

As already described by the data reported in Section 3.1, the Covid-19 pandemic has significantly affected all companies operating in the global alcoholic beverage industry,

causing a decrease in sales volume of 12.83% between 2019 and 2020.[59]
The Covid-19 pandemic had a significant impact on global distribution and production. Disruptions caused by the health crisis resulted in transportation bottlenecks, with delays and logistical difficulties. Many factories had to slow or stop production. In the alcohol sector, this led to severe shortages of essential materials such as aluminum and glass, further exacerbating problems along the supply chain.
Beer was the hardest-hit alcohol category during the lockdown, and particularly the beer markets in Italy, the United Kingdom and Colombia were the ones most affected by the lockdown restrictions. Some brewers have faced legislative challenges, including total bans on the sale of alcohol in India and South Africa and bans on home brewing in Mexico.[60]

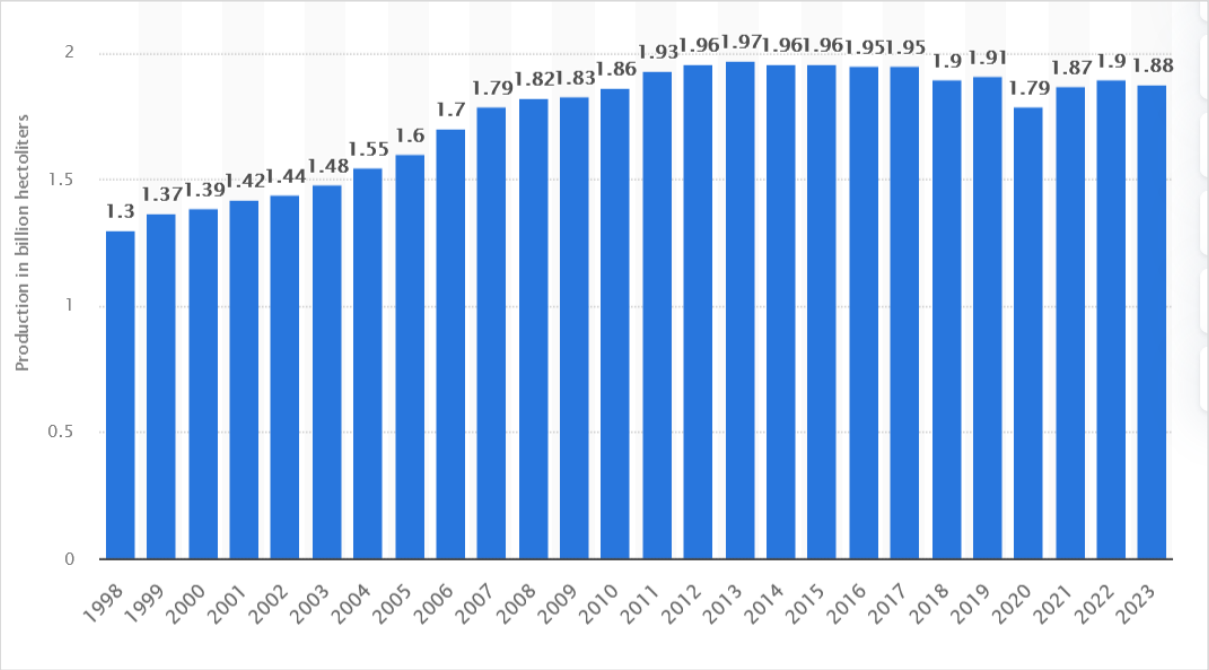

Figure 3-4-Global beer production from 1998 to 2023 [59]

The global beer market size was valued at USD 821.39 billion in 2023 and is projected to grow to USD 1,167.47 billion by 2032, exhibiting a CAGR of 4.03% during the forecast period.[61]
In *Figure 3-5* is shown an analysis of the change in beer production between 2022 and 2023 for each continent in 1000 hectoliters (hl).

In 2023, world beer production fell to 1.88 bn hl, representing a decline of 0.9 % respect to the previous year. In Europe, there was a drop in production volumes of about 9 million hectoliters, and the main contributors to this decrease were the United Kingdom (-3.3 million hl), Germany (-2.9 million hl) and Poland (-2 million hl). As for the Americas, production decreased by 7.2 million hl, with production in North America down by 9.9 million hl and production in South America up by 2.4 million hl. Brazil and Mexico saw an increase of 1.5 million hl and 1.4 million hl, respectively. On the Asian continent, productions increased significantly in both India (+3.8 million hl) and Cambodia (+2 million hl). However, declining

production in Vietnam (-8 million hl), as well as declines of more than 1 million hl in South Korea, Thailand, China and Kazakhstan, eventually led to a decline in total beer production in Asia of 5.8 million hl. Beer production in Africa increased by 4.6 million hl with South Africa recording the most significant growth of 1.4 million hl, Ethiopia and Cameroon both with +1.1 million hl. Finally, Australia/Oceania also recorded an increase of 0.6 million hl. [62]

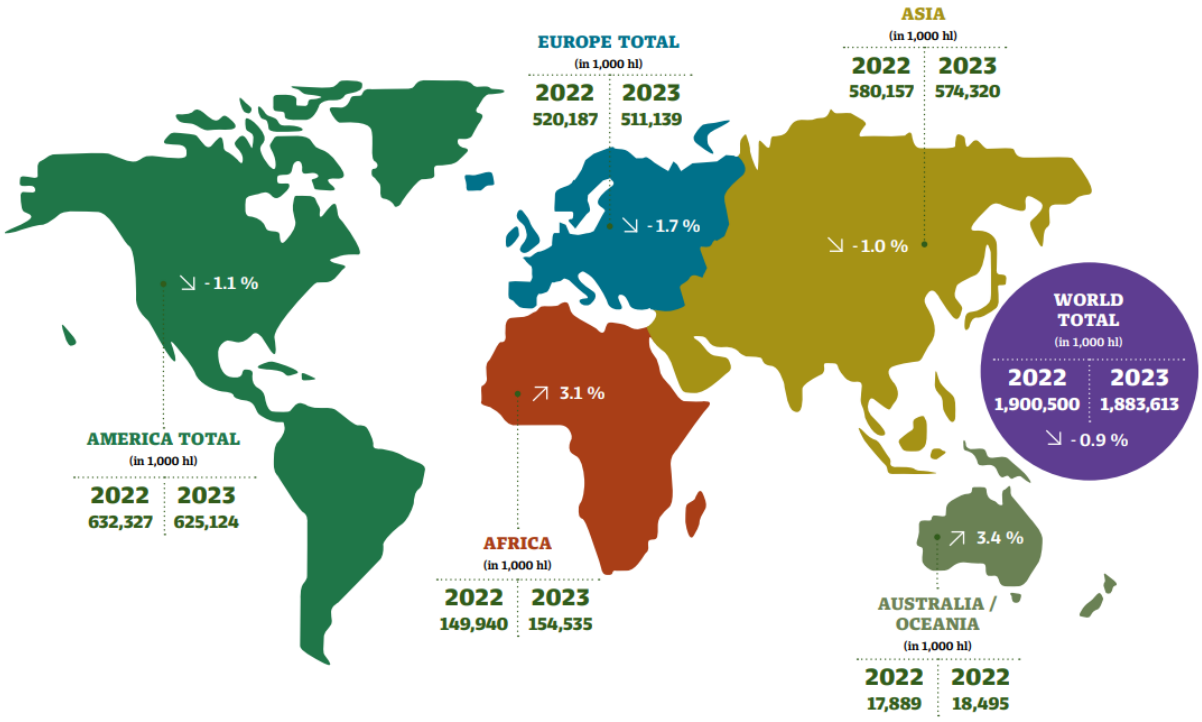

Figure 3-5-Beer production by continent 2022-2023

The chart in *Figure 3-6* highlights the top 10 beer-producing countries worldwide in 2023, measured in million hectoliters. China stands out as the largest producer by a significant margin, with 359.08 million hectoliters, nearly double the output of the second-ranked United States at 193.03 million hectoliters. Brazil and Mexico follow in third and fourth place, emphasizing the importance of beer production in Latin America. Germany and Russia are the leading European contributors, while Japan represents Asia alongside China. South Africa rounds out the list, reflecting Africa's role in global beer production.

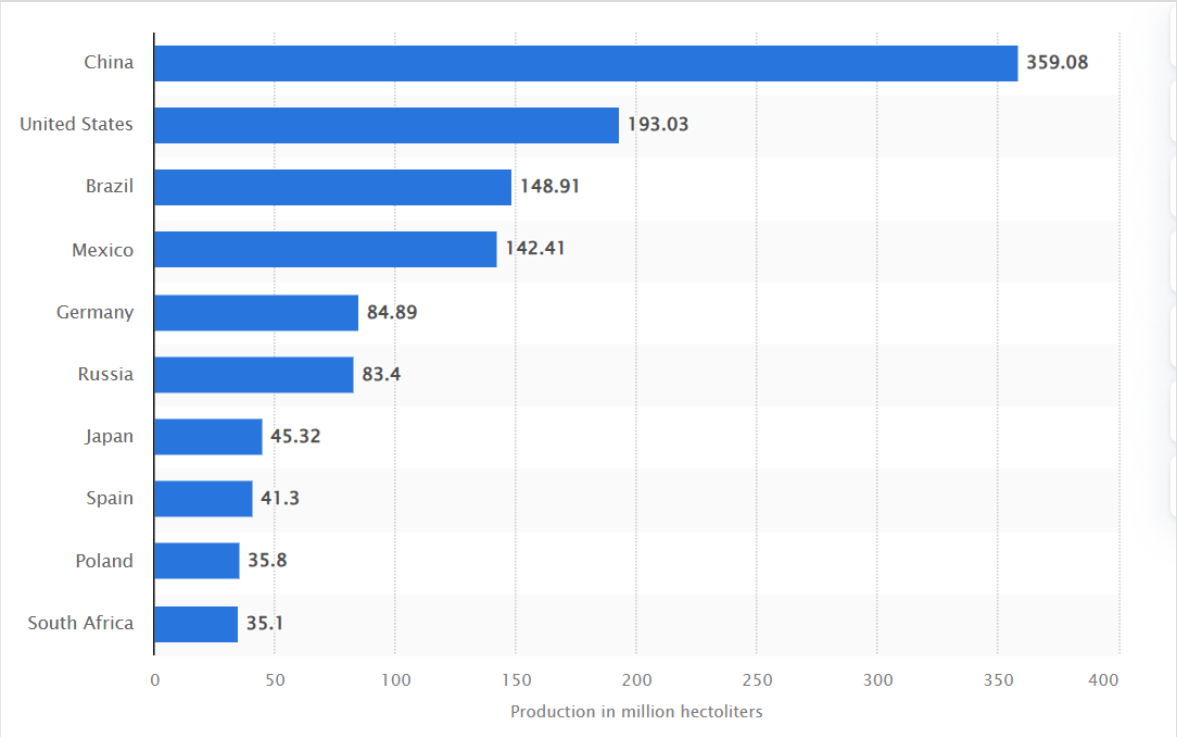

Figure 3-6-Top 10 beer-producing countries worldwide in 2023 [62]

3.2.1 American beer market

As previously discussed, the United States of America, with a production of 193.03 million hectoliters in 2023, is the second largest beer producing country in the world, after China and the first in North America. Their production constitutes just over 10% of global production.
As can be seen from *Figure 3-7* within the continent of the Americas, the USA is followed respectively by Brazil and Mexico, which are the largest beer producers in South America and which together in 2023 produced 291.3 million hectoliters.

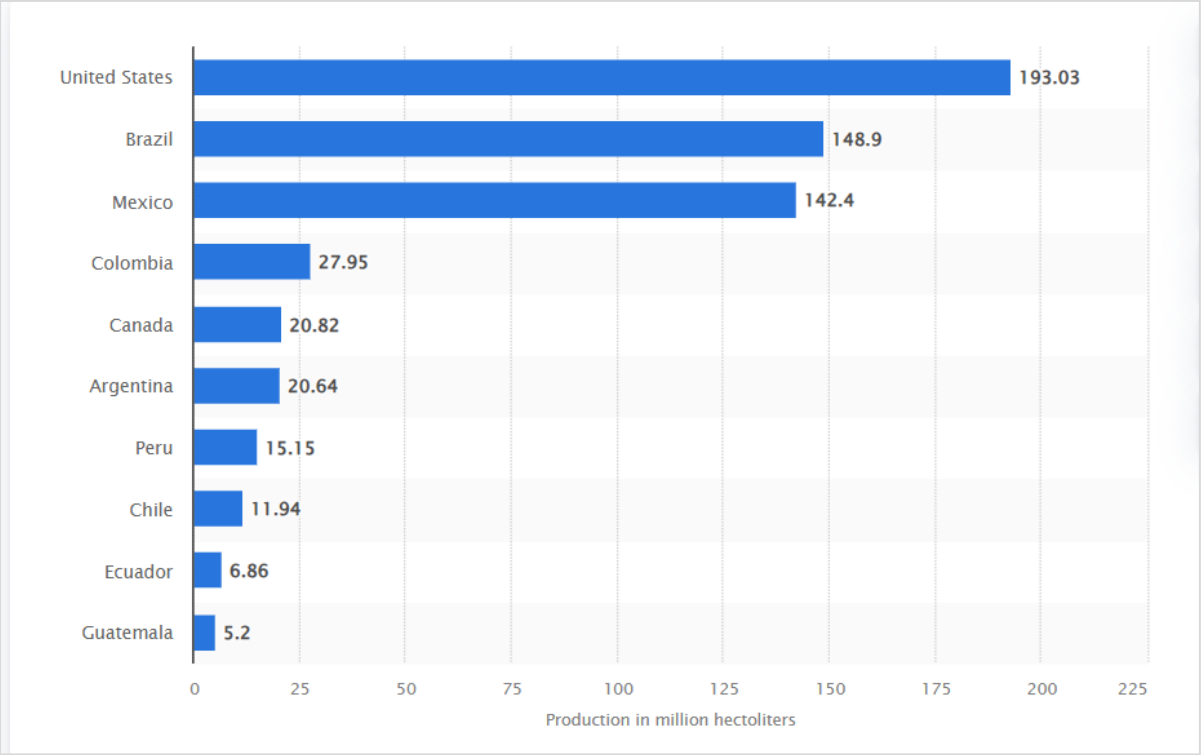

Figure 3-7-Leading countries producing beer in Americas in 2023 [64]

In terms of beer production and number of active breweries in the country, the United States of America, as shown in the graph below, has historically gone through different periods of growth, decline and rebirth.

In the year 1873, the United States reached an all-time high of 4,131 active breweries, marking an era in which beer production was highly decentralized with the presence of small local breweries. Subsequently, a steady decline in the number of active breweries began, mainly due to industrialization and market consolidation, which led to the closure of many small breweries and the prevalence of large companies. The period of maximum decline occurred between 1920 and 1933, in the Prohibition era, in which the production and sale of alcohol was prohibited. In fact, on January 29, 1919, with the ratification of the eighteenth amendment and the drafting of the Volstead Act, the production and distribution of any beverage with more than half a percent alcohol content was illegal. After the repeal of Prohibition, the beer industry quickly recovered. Beginning in the early 1940s, however, brewing activity began to decline as the beer industry consolidated and became dominated by Anheuser-Busch, Miller Brewing Company, Coors Brewing Company, and Pabst.[65]

A significant turning point came in 1978, with President Jimmy Carter signing H.R 1337 into law, making home brewing legal and thus beginning the birth and rise of the craft beer movement. The last decline in active breweries occurred in 2005 and after that a rapid period

of expansion, fueled by the notoriety of the craft beer movement starts. By 2025 the number of active breweries had surpassed the historical number of 1873. Today there are approximately 9,683 active breweries in the US, including taproom breweries, brewpubs, microbreweries, and regional craft breweries.[66]

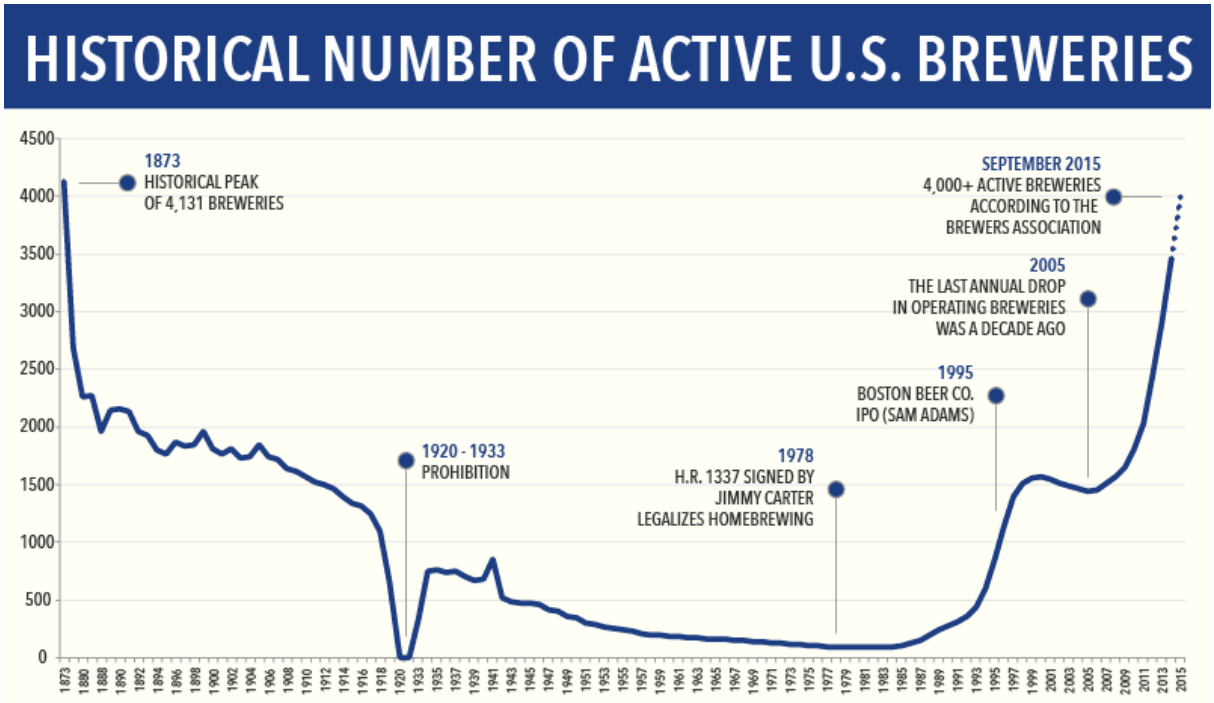

Figure 3-8-Number of active U.S breweries through the years *[67]*

The beer market is growing steadily in the United States, and one of the reasons is the emergence of new brands and innovative flavors. After revenue collapsed between 2019 and 2020 due to Covid-19, the U.S. beer market was valued at 120.6 billion USD in 2023 and is expected to reach about 145 billion USD in 2027.[68]

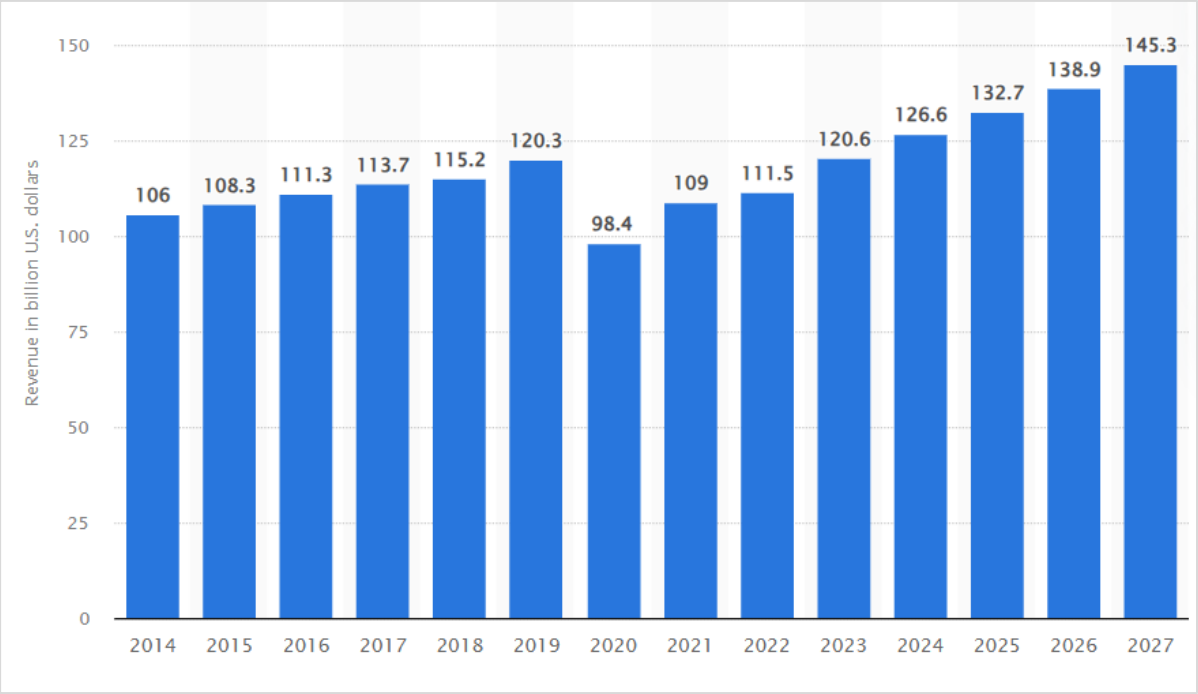

Figure 3-9-Revenue of the beer market in the United States from 2014 to 2027 [68]

The US beer market is characterized by a wide array of brands and a large consumer base with strong preferences for both domestic and imported beer varieties. The growing popularity of craft beer with consumers increasingly favoring the unique offerings of local microbreweries, has been a key factor influencing the market growth in recent years. To meet the diverse demands, the most popular beer styles produced in the US are lager, ale, stout, porter, and IPA. Additionally, premium and super premium beer brands have also gained popularity, further increasing the market demand. The market is competitive, with major players such as Anheuser-Busch InBev and Heineken dominating the scene. While some of the most popular domestic brands among consumers include Bud Light, Coors, Miller Lite, and Budweiser. Continued diversification and innovation within the industry is expected to support the growth trend highlighted in *Figure 3-9*, positioning the beer industry as a vital and dynamic component of the overall U.S. economy.

In South America, the brewing industry emerged in the late 19th century during the period of the Industrial Revolution. In Brazil, beer production and consumer tastes were influenced by Portuguese colonizers, and in this context small regional breweries were established and dominated the beer market until the 1930s. Brazil was the first country in South America to experience a merger between a national brewery and a multinational brewing company, when in 1999, as discussed in *Section 3.2*, through the merger of Companhia Antarctica and Cervejaria Brahma, AmBev was formed, which later merged with the Belgian company Interbrew to form InBev in 2004. Finally, this company became AB-InBev in 2008.[69]

In the late 19th and early 20th centuries, beer in Mexico was mainly imported from the United States, Great Britain, and Germany, remaining a luxury product compared to local beverages such as pulque and mezcal. After the 1910 revolution, the beer industry began to develop thanks to producers in the north and center of the country, who took advantage of their access

to raw materials. In the 1980s, three large companies (Grupo Modelo, Cervecería Cuauhtémoc, and Cervecería Moctezuma) vertically integrated production and replaced imported barley with local barley. The Mexican beer industry changed significantly after Mexico signed the General Agreement on Trade and Tariffs (GATT) in 1986 and the North American Free Trade Agreement (NAFTA) in 1994. Consolidation of the industry continued with Cuauhtémoc's acquisition of Cervecería Moctezuma in 1988, forming FEMSA Cerveza and establishing a duopoly with Grupo Modelo. International alliances allowed access to foreign markets, making Mexico the leading exporter of beer to the United States.[69]

3.2.1.1 Craft beer in USA

In some countries it is relatively easy to identify the beginning of the craft beer movement and America is one of them. According to scholar Elzinga, in fact, the craft beer revolution in America began when Fritz Maytag bought the Anchor Brewing Company of San Francisco in 1965. At the beginning it was a very slow rise, in fact the company had a production capacity of 50,000 barrels, but those sold were only 1000. It took about ten years for the business to become profitable, reaching a production of 7500 barrels. Maytag's winning weapon was to revitalize the company by returning to the traditional practices of beer production present in Europe, where exclusively malt beers and ales were produced. In the following years, the market demand for beer in the world, but also in the United States, changed radically. Some of the factors that played a crucial role in the spread of the craft beer movement were: a growing demand for variety in beer styles, an increase in consumer income and finally the birth of associations specialized in spreading technical information on the culture, art and quality of beer with a particular focus on local products and sustainability. The consolidation of macro-breweries within the industry thus led, starting in 1980, to microbreweries beginning to enter the sector, serving a market niche that had remained unserved due to the homogenization of the industrial beer market.[70]
Additionally, with the enactment of federal excise tax reductions for small breweries in 1977, federal legalization of home brewing in 1979, and state legalization of brewpubs starting in 1982, the entry of microbreweries into the American market was greatly facilitated.
The experience gained from home brewing, and the subsequent taste for craft beer that home brewing has brought about, have led many entrepreneurs to create microbreweries that sell off-premises (i.e., the products are purchased on-premises and consumed off-premises) and brewpubs that sell on-premises (i.e., consumed on-premises). Initially, entrepreneurs faced significant challenges in raising capital, leading them to turn to contract brewing to overcome financial and technological barriers. However, as the market has matured, new sources of funding have emerged that have made it easier for new breweries to emerge. Banks began to support craft startups, while crowdfunding has further lowered the barriers to entry for microbreweries. Additionally, the growing popularity of local beers attracted venture capital funds, which view the craft beer sector as a promising investment opportunity. This financial support has proven to be crucial to the expansion of the craft beer industry in the United States.[70]
In 1985, the number of craft breweries in the United States (37) surpassed the number of macrobreweries (34) for the first time. Entry was robust until the crisis of the late 1990s,

caused by distribution bottlenecks and the production of poor-quality beer by a few enthusiastic but poorly trained entrants. The number of craft breweries peaked at 1625 in 1998 and declined to 1469 in 2000. Since then, the number of craft breweries in the United States has grown slightly until 2010, when it reached 1758. After 2010, however, there has been a resurgence in entry, with the number of craft breweries reaching 9,210 in 2021.[70]
Table 3-1 shows the trend of the total number of breweries operating in the United States of America from 2015 to 2023. Breweries are distinguished not only between craft and non-craft, but craft breweries are also distinguished into Microbreweries, Taprooms and Brewpubs. Brewpubs are places that combine the production of craft beer directly on site with the consumption and sale of it inside the venue. Microbreweries are companies that produce beer that is not consumed on site but is intended for sale to be consumed or sold in pubs, restaurants and shops. They are characterized by small size and low annual production. Finally, a Taproom is a tapping and tasting room within a brewery that aims to offer the consumer a unique and personalized experience. A more detailed explanation of these definitions will be provided in the following paragraph.

	2015	2016	2017	2018	2019	2020	2021	2022	2023
Craft	**4,803**	**5,713**	**6,661**	**7,618**	**8,419**	**8,921**	**9,210**	**9,675**	**9,761**
Regional Craft Breweries	178	186	202	230	240	220	223	261	257
Microbreweries	2,684	3,319	3,956	4,518	1,917	2,003	2,007	2,132	2,092
Taprooms					3,091	3,389	3,643	3,771	3,910
Brewpubs	1,941	2,208	2,503	2,870	3,171	3,309	3,337	3,511	3,502
Large/Non-Craft	44	67	106	107	138	171	174	149	145
Total U.S. Breweries	**4,847**	**5,780**	**6,767**	**7,725**	**8,557**	**9,092**	**9,384**	**9,824**	**9,906**

Table 3-1- Craft breweries vs Non-Craft in USA from 2015 to 2023 [71]

As the table shows, over the past two years, the total number of breweries in the United States has grown from 9,824 in 2022 to 9,906 in 2023, with craft breweries representing a dominant share of the market. In 2023, craft breweries reached 9,761 units, or 98.5% of the total, confirming the central role of this segment. In contrast, non-craft breweries (Large/Non-Craft) recorded a slight decline, going from 149 in 2022 to 145 in 2023, representing only 1.5% of the total. This predominance of craft breweries reflects the continued interest of consumers in local and quality beer, in a market increasingly oriented towards personalized and innovative experiences.[71]

3.2.1.2 Regulations in USA

The Brewers Association (the national organization that represents the interests of small and independent craft brewers in America) defines an American craft brewery as a small,

independent brewery. “Small” means producing 6 million barrels or fewer of beer annually. “Independent” means less than 25 percent of the craft brewery is owned or controlled by a member of the alcoholic beverage industry that is not itself a craft brewer.[72] According to the Brewers Association, the American craft beer industry is comprised of six different market segments: microbreweries, brewpubs, taproom breweries, regional breweries, contract brewers, and alternate owners.[73]

A microbrewery produces fewer than 15,000 barrels of beer per year and sells 75% or more of its beer off-premises. Microbreweries may distribute their products through one of 3 methods: the traditional three-tier system (brewery to wholesaler to retailer to consumer); the two-tier system (brewery acting as wholesaler to retailer to consumer); and direct to consumer through take-out and/or tasting room or restaurant sales.

A brewpub is a hybrid restaurant and brewery that sells at least 25% of its beer on-premises while also providing substantial food and beverage services. Beer is primarily brewed for sale on the premises and is often served directly from the brewery's storage tanks. Where permitted by law, brewpubs may also sell beer to-go or distribute to outside accounts.

A taproom brewery is a commercial brewery that sells 25% or more of its beer on-site without providing significant food and beverage services. Its beer is produced primarily for consumption in the taproom and is often dispensed directly from storage tanks. Depending on local regulations, taproom breweries may also offer beer to-go or distribute to outside accounts.

A regional brewery is a well-established facility that produces between 15,000 and 6,000,000 barrels of beer per year.

A contract brewery company arranges for another brewery to produce its beer, or one brewery contracts another brewery to produce additional beer. The contract company typically handles the marketing, sales, and distribution of its products, while the production and packaging are performed by the contract brewery (often referred to as the "brewer-brewer" in this arrangement).

An alternate owner is a licensed tenant brewery that temporarily takes possession of a shared brewing facility to conduct its own production. Unlike contract breweries, alternate owners are considered the master brewery and have full responsibility for complying with licensing requirements, maintaining records, paying taxes, and obtaining label and formula approvals.

Breweries in the United States must comply with multiple regulations at the federal, state, and local levels. Excise taxes are paid when consumers purchase beer and are included in the price of the product. Before 1978, the federal excise tax on beer was $9.00 per barrel. From 1978 onwards, to encourage growth in the craft beer industry, federal tax credits were introduced for breweries producing less than 2 million barrels, reducing their excise tax rate to $7 per barrel on the first 60,000 barrels.

In December 2017, Congress passed the Tax Cuts and Jobs Act, temporarily reducing the federal excise tax on beer for all breweries and importers. This temporary excise tax reduction was made permanent at the end of 2020 and is valid till today with federal excise taxes following the following progressive system: small breweries, with annual production of less than two million barrels, pay a preferential rate of $3.50 per barrel on the first 60,000 barrels produced. For all other breweries and importers, the rate is set at $16 per barrel for the first six million barrels produced. After that, the standard rate of $18 per barrel applies. This system

provides incentives for small brewers while supporting the overall competitiveness of the U.S. beer industry.[74] At the federal level, breweries need approval from regulators before they can sell their first beer or brand it with their own label. This can sometimes take 100 to 160 days.At the state level, breweries must comply with additional rules. The first step is to receive a license from the state, which regulators can often deny for a variety of subjective reasons, including a belief that the brewery is "physically unfit to carry on the business of brewing," lacks "good moral character," or fails to "demonstrate financial responsibility." A license can also be denied if the state decides that there are already enough breweries in the locality and adding another would be detrimental to the "interest, morals, safety, or welfare" of the area.[75]

According to a study by economists Aaron Staples, Dustin Chambers, and Trey Malone, there are more than 115,000 federal regulations that impact the U.S. beer supply chain. In addition to these federal regulations, state governments impose an average of 10,212 additional regulations, but the regulatory burden at the state level varies dramatically from state to state, with a minimum of 1,177 additional restrictions (South Dakota) and a maximum of 25,399 regulations (California). Because federal regulations serve as the baseline standards that each jurisdiction must adhere to, it takes an average of 125,212 regulations to get a beer license.[76]

Furthermore, as can be seen from the figure below, not only the number of regulations but also the excise tax rates vary between states.

Rates vary widely, from a minimum of $0.02 per gallon in Wyoming to a maximum of $1.29 per gallon in Tennessee. Missouri and Wisconsin rank second lowest at $0.06 per gallon. The third lowest are Colorado, Pennsylvania, and Oregon at $0.08 per gallon. Alaska ranks second highest with its tax of $1.07 per gallon, followed by Kentucky and Hawaii at $0.93 per gallon.[77]

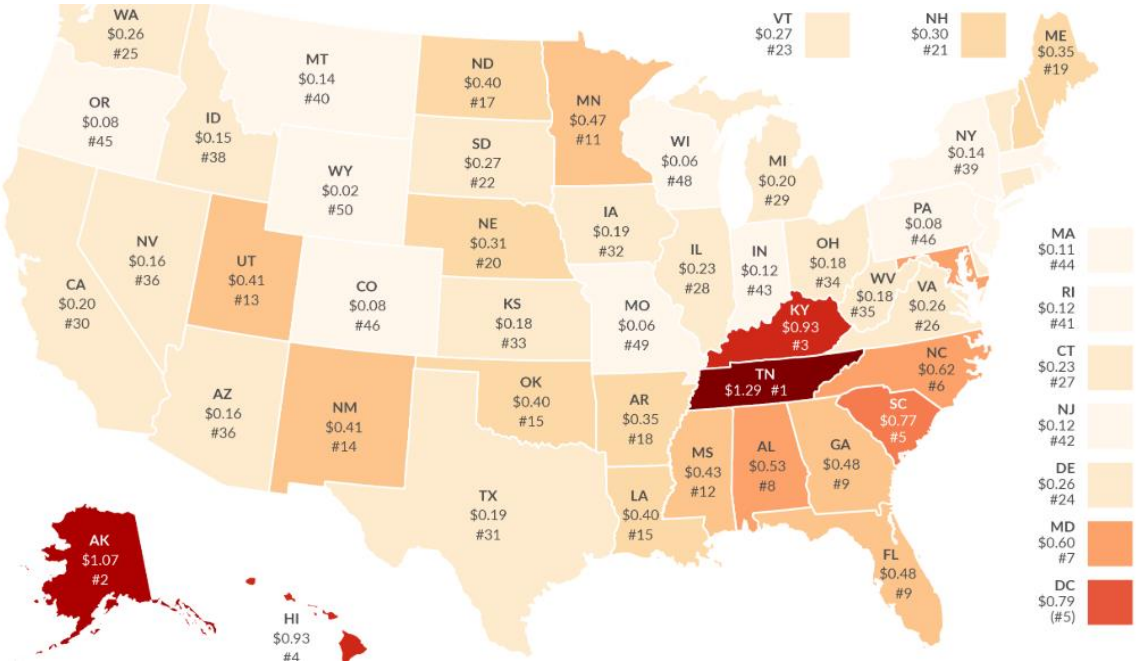

Figure 3-10-State Beer Excise Taxes (Dollars per Gallon), 2023 [77]

3.2.2 Asian beer market

The consumption of beer has increased in Asia in recent years due to the rise in disposable income and an increase in consumer preferences for beer over other alcoholic beverages. Additionally, cultural changes and the adoption of western culture have influenced the perception of consumers toward alcoholic beverages, especially beer.[78]

As can be seen from the graph in *Figure 3-11*, after revenue collapsed between 2019 and 2020 due to Covid-19, the Asian beer market was valued at 190.0 billion USD in 2023 and is expected to reach about 218.2 billion USD in 2029.[79]

The major players engaged in the supply of beer in the Asian market are Asahi Breweries Ltd, Heineken NV, Anheuser-Busch InBev, Carlsberg Group, SABMiller PLC, Kirin Holdings Co Ltd and others. The market is fragmented, as a large number of breweries try to meet the growing demand in the region. The key strategies adopted by the companies include product innovations, expansions, and strategic partnerships to gain a competitive advantage in the market. Mergers and acquisitions are found to be popular in the region among some companies to increase sales and meet consumer demand.[80]

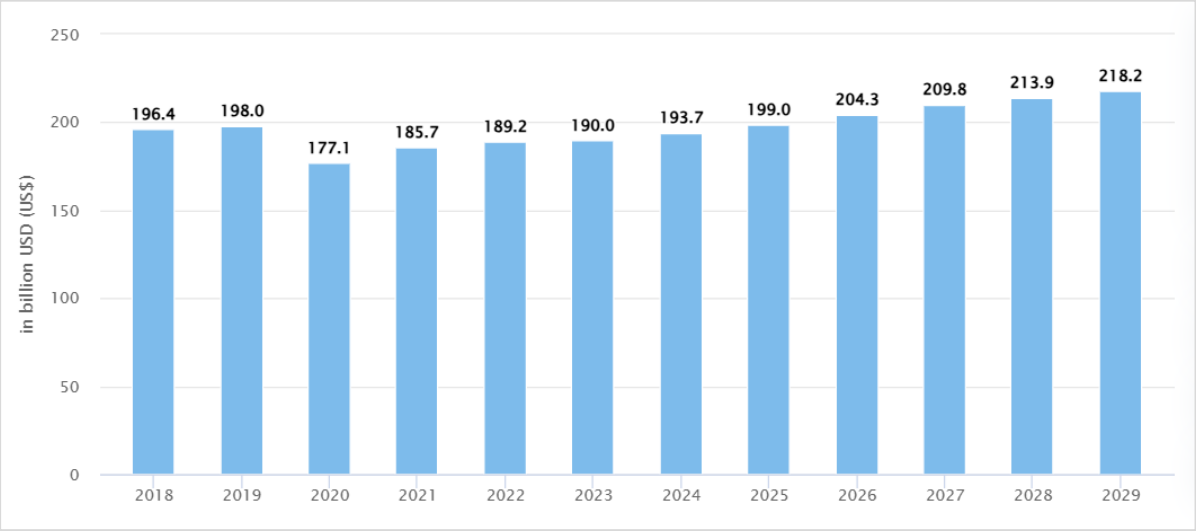

Figure 3-11-Revenue of the beer market in Asia from 2018 to 2029 [79]

In 2023, the total beer production in the entire Asian continent was 574.3 million hectoliters. The graph below shows the top 10 countries in terms of beer production within the Asian territory, and as you can see, China is in first place with 359.08 million hectoliters produced in 2023. Only China with its annual production is the undisputed leader and represents 62.5% of the hectoliters produced in the entire continent, followed by Japan (7.8%), India (6.8%) and Vietnam (5.39%).[81]

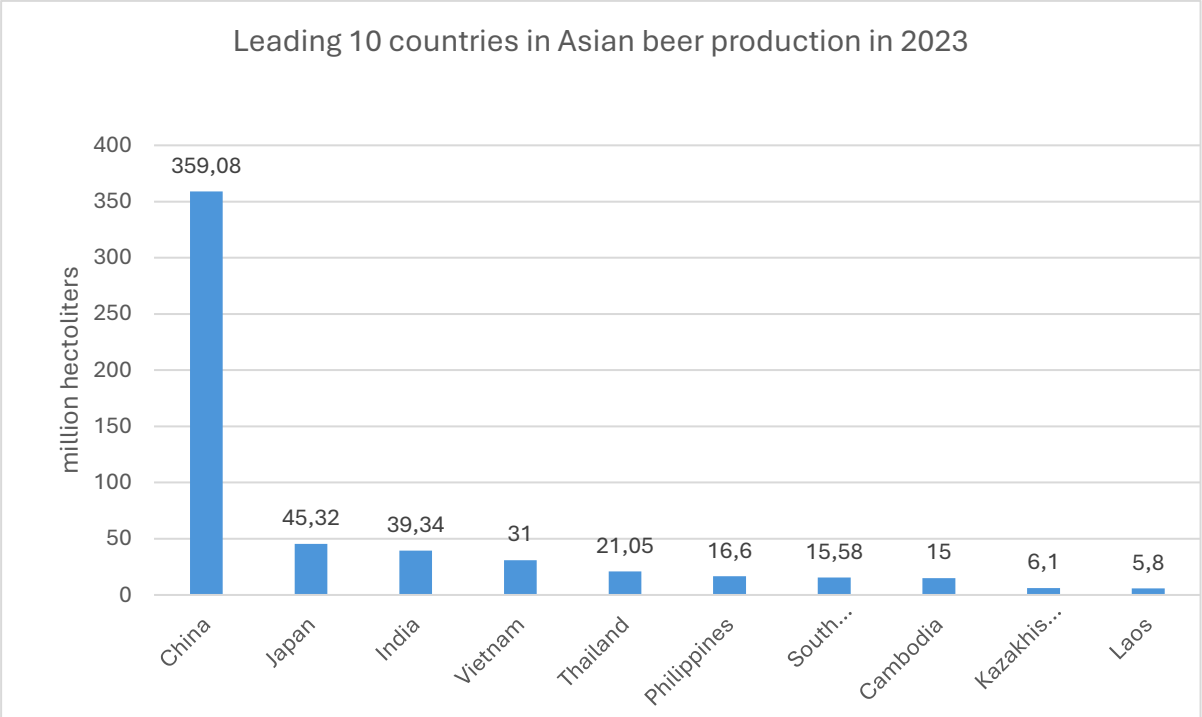

Figure 3-12- Top 10 countries in Asian beer production in 2023[81]

China's beer market is highly consolidated, with the top five companies, CR Snow, Tsingtao Brewery, Anheuser-Busch InBev, Yanjing Beer, and Carlsberg dominating over 70% of the market. As can be seen in the graph in *Figure 3-12*, CR Snow leads with a 23.2% market share, followed by Tsingtao Brewery (16.4%), Budweiser Asia Pacific (16.2%), Yanjing Beer (8.5%), and Carlsberg (6.1%). This high industry concentration leaves limited room for small and medium-sized brands, while international companies face significant challenges in penetrating a market dominated by strong domestic players.[82]

Figure-3-12-Market share by brand in China beer market

Local beer brands benefit from established regional markets, geographically distinct branding, and strong consumer loyalty. For example, CR Snow outperforms competitors in Sichuan, the northeast, and eastern China, while Tsingtao Brewery maintains dominance in Shandong and Shaanxi provinces. In contrast, foreign brands such as Budweiser and Carlsberg have leveraged early market entry, global endorsements, and strategic marketing, such as promoting music festivals, to build their reputation and consumer base. Notably, these international players entered the premium segment earlier than domestic competitors, capitalizing on the market's gradual shift toward higher-end beer since 2015.[82]

As can be seen from the graph in *Figure 3-13*, the most imported beers in China in 2023 are the European ones; first come the German beers followed by Belgian, Dutch and French ones. In particular, drinkers from age 18 to 30 prefer foreign beers and thanks to the increasing level of wealth, they are consuming and paying more attention to high quality beers.[83]

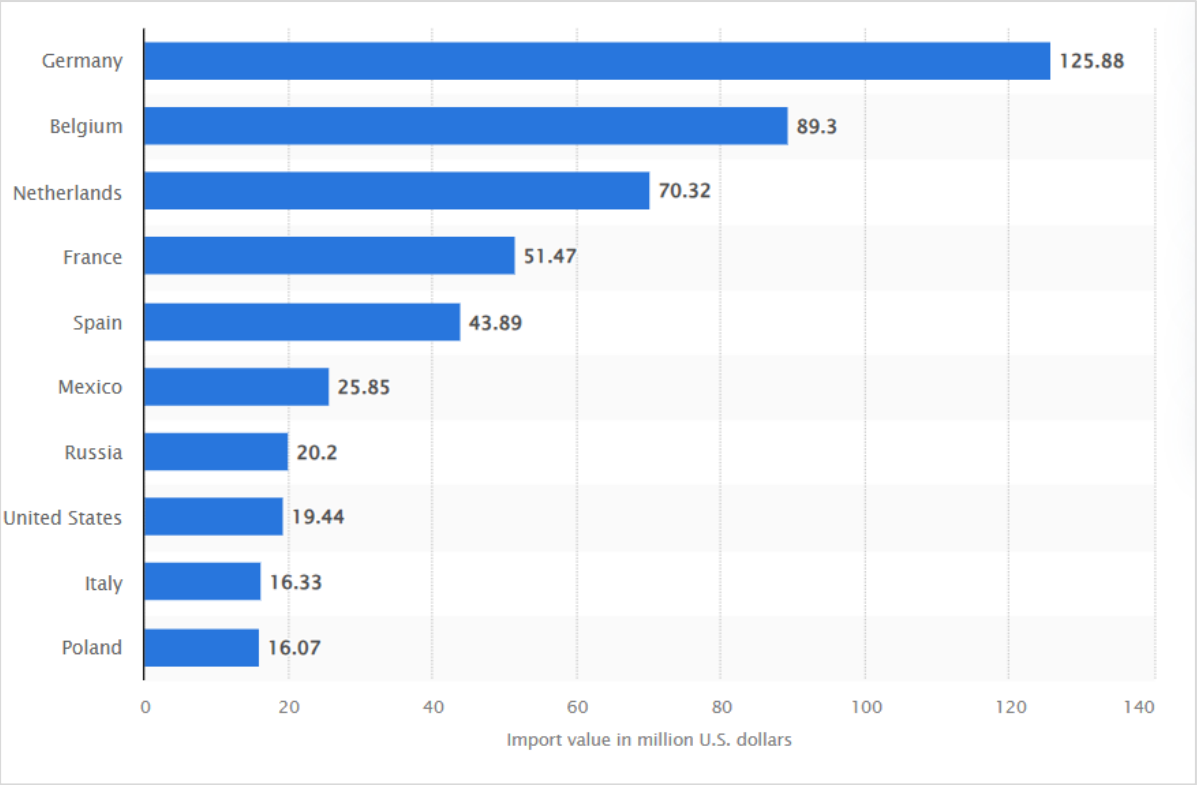

Figure 3-13 -Value of beer imports in China in 2023, by exporting country [83]

3.2.2.1 Craft beer in China

In 2001, after China joined the World Trade Organization (WTO), the Chinese beer market faced a strong consolidation process, characterized by mergers and acquisitions between major international and domestic producers. This phenomenon led to the main producers in the region (China Resources Enterprise, Tsingtao, AB InBev, Beijing Yanjing Brewery and Henan Jinxing Brewery Group) to dominate the entire market. In parallel with this process of consolidation and competition between large industrial beer producers, the craft beer movement emerged and began to conquer a niche of more sophisticated consumers. In fact, starting in 2001, numerous brewpubs began to spread rapidly, not only in large cities such as Beijing, Shanghai and Guangzhou but also in smaller cities such as Kunming, Nanjing, Chengdu and Xi'an.

This development is somewhat similar to the craft beer movement in the United States and the United Kingdom, which emerged in response to the homogeneity of industrial products.[84]

There are several factors that have led to the emergence of the craft beer movement in China. One of these is the increase in purchasing power and urbanization. In the past two decades, disposable income per capita in urban areas in China has grown by about 13% per year, creating a large market for high-quality food and beverage products. Middle and upper-class consumers, increasingly used to a modern Western lifestyle, are frequenting pubs, bars and

nightclubs, where craft beers are emerging as an increasingly popular choice.

Another key element is the adventurous spirit of Chinese consumers and producers. China's long economic shutdown before the 1990s fueled curiosity about exotic products and flavors. Beer consumers are increasingly drawn to new experiences, including craft beers with unique ingredients such as jasmine flowers, oolong tea and sweet potatoes. At the same time, Chinese craft brewers are developing innovative recipes and marketing strategies that integrate local cultural elements, such as using names inspired by historical figures or regional ingredients to convey the characteristics of their beers.[84]
On the supply side, entrepreneurship and investment have played a key role. Many of the early craft breweries in China were started by foreigners frustrated by the limited variety of beers available, such as Great Leap Brewery in Beijing, founded in 2010 by two Americans. Chinese brewers have also begun to enter the industry, encouraged by growing awareness and resources such as China's first home brewing guide published in 2010. Easier access to tools and materials through platforms such as Taobao and trade shows has further fueled the growth of the industry. One notable example is Panda Brew, founded by two Chinese students returning from study abroad, which has raised over $3 million to expand to Beijing and other cities. Finally, another key driver has been the growing interest in food safety in China. Food and beverage quality scandals, including the use of formaldehyde by some industrial brewers, have led consumers to opt for craft beers, which are perceived as more authentic and safer. However, as demand increases and barriers to entry decrease, there is a risk that new producers will not meet high standards of quality and safety, which is crucial to the future of the industry.[84]
There are also important challenges for craft beers in the country. First, regulations continue to ignore the development of the craft breweries and need to be adjusted (more details in the next Paragraph). Second, competition with both international craft beers and national industrial beer brands has increased. Lastly, Chinese craft breweries have difficulty in accessing high-quality ingredients locally. Ideally, craft brewers typically use better-quality barley (lower in protein and other minerals, but rich in starch) than large- scale, mass brewers and better ingredients in general. Importing all the ingredients is necessary and possible, but it has substantially increased craft brewers' variable costs.

3.2.2.2 Regulations

In China, laws related to the beer market can be divided into two categories: production laws and food safety laws. Production laws are regulated by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and by the Standardization Administration of the People's Republic of China (SAC), food safety laws, instead, are implemented by the Ministry of Health (MOH).
As previously mentioned, the legislative system in China seems to continue to ignore the development of craft beer. In fact, unlike the United States, there is no official definition of "craft beer" or a guide and a set of standards for craft producers. The categories of regulations established by AQSIQ, SAC, and MOH are primarily designed for industrial beers. As a result, craft beers are also required to comply with the same regulatory framework, even though it is

not specifically tailored to their unique characteristics. This legislative misalignment significantly slows down and makes it much more difficult for the craft beer sector to establish itself and grow in China. An example of laws that are suitable for mass brewers but not for craft brewers are those that require filtering and pasteurization of bottled or canned beers. These regulations kill off microbiological bacteria and yeast, but they also alter the distinctive flavors of craft beers, preventing small breweries from competing in the mainstream market and pushing them to focus on direct sales through restaurants and brewpubs, where regulations are less stringent.[84]

While this strategy can help craft brewers gain recognition, the lack of industry-specific regulations can lead to long-term difficulties, especially if there is a general tightening of food regulations. For example, after the milk scandal in China, the government imposed much stricter standards, penalizing even small craft brewers who cannot afford the costs of compliance. Additionally, the situation is further complicated by the lack of a strong national association representing craft breweries. Unlike the United States, where the Craft Brewers Association provides support and guidance to both existing and new craft breweries, China has only a few regional associations, such as the Beijing Homebrewing Society, which operate on a limited scale and do not have the influence to impact industry policy yet.

3.2.3 European beer market

The European beer market represents one of the most diverse and dynamic regions globally, characterized by strong traditions, innovation, and the growth of the craft beer movement. Europe is very diverse in terms of beer styles, from traditional German lagers to the Trappist ales of Belgium, and craft beers in Italy. In recent years, while industrial beer consumption in Europe has remained stable, there has been significant growth within the premium and craft segments. Factors such as evolving consumer preferences for quality and unique experiences, alongside a growing focus on sustainability, have shaped these changes.
Europe, with its nearly 512 million hectoliters produced in 2023, is the third largest beer-producing continent after Asia and America.[62]
As can be seen from the chart in *Figure 3-14*, after the revenue collapse between 2019 and 2020 due to the COVID-19 pandemic, the European beer market was valued at 171.1 billion USD. Its value is expected to continue to grow with a CAGR of 2.5 percent to reach a value of 193 billion USD in 2029.[85]

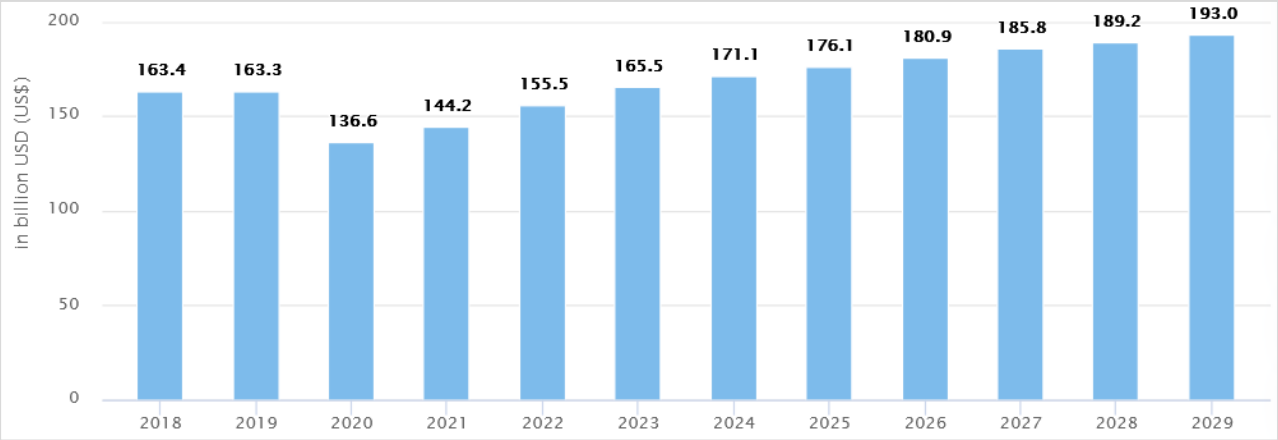

Figure 3-14- European beer market value from 2018 to 2029 [85]

Germany with a production of 84.89 million hectoliters in 2023, ranks first among the countries producing beer in Europe, followed by Russia (83.4 million hl), Spain (41.3 million hl), Poland (35.8 million hl) and England (34.2 million hl).

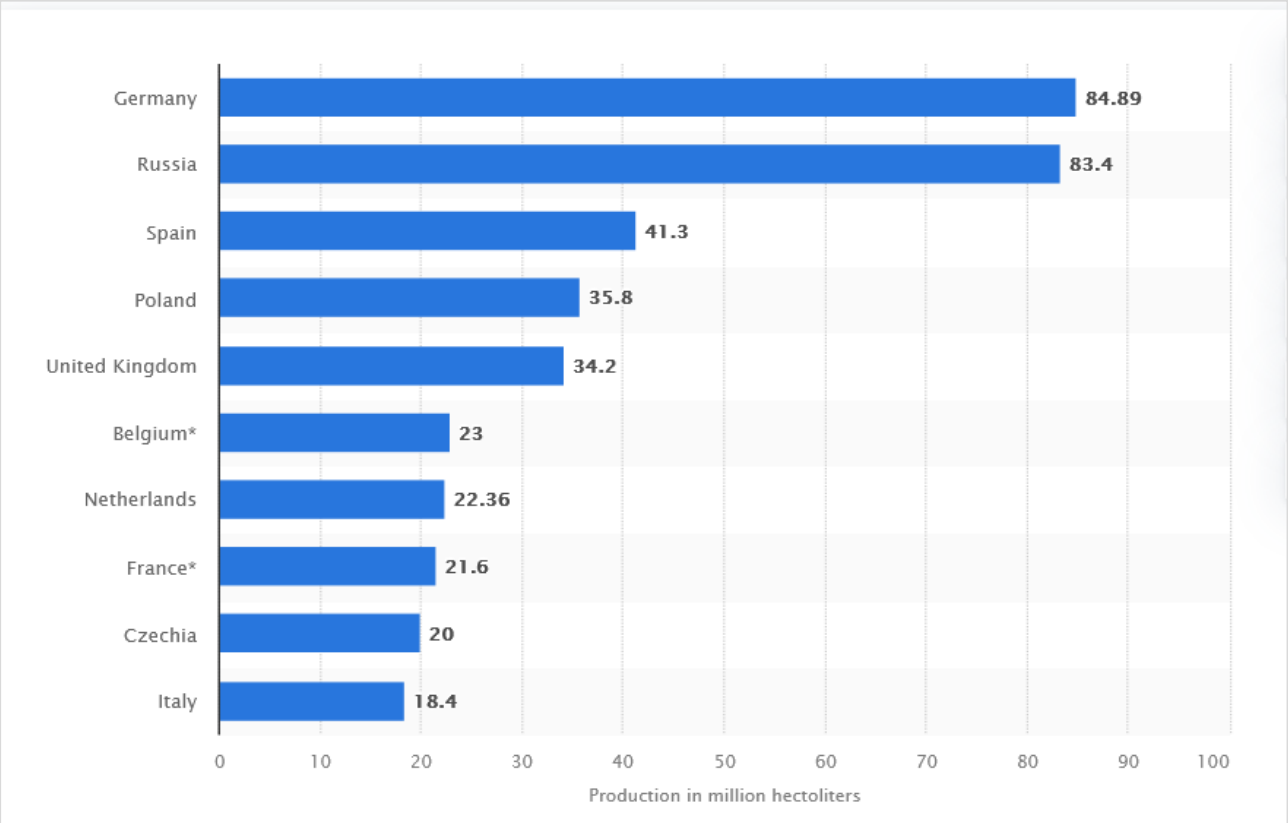

Figure 3-15--Leading 10 countries in Europe for beer production in 2023 [86]

An interesting analysis can be conducted by combining the data on beer production by country from the previous graph with the data on the number of active breweries in Europe in 2023.

The comparison reveals a notable dynamic: France, despite ranking eighth in terms of hectoliter of beer produced, leads the ranking for the number of active breweries, with about 2,500 breweries operating in 2023. It is followed by the United Kingdom with 1,760 breweries, Germany with 1,492, Switzerland with 1,230, and Italy with about 1000.[87]

This finding suggests that the beer industry in France is characterized by significant fragmentation and the prevalence of small-scale or craft breweries, rather than large industrial production facilities. This phenomenon aligns with the national consumption model: in 2023, per capita beer consumption in France was only 33 liters, significantly lower than in other European countries such as the Czech Republic (128 liters), Germany (88 liters), and the United Kingdom (66 liters). This low level of per capita consumption likely reflects a cultural tradition where wine holds a dominant position over beer, both in terms of consumer preferences and national production.[87]

3.2.3.1 Regulations and the Evolution of Craft Beer in Germany and UK

The craft beer movement has developed differently in Germany and England due to differences in legislation, culture, and history between the two countries.
In Germany, the Reinheitsgebot or “Purity Law,” established in 1516, had a significant impact on shaping beer production and it is the oldest beer law. It stated that beer could only be legally marketed in Germany if it contained four ingredients: barley, water, hops, and yeast. Only in 1987, the European Court of Justice decided to abolish the “Purity Law for foreign beers, and today it remains in force exclusively for beers produced in Germany. Critics argue that while the law has ensured high quality and standardization in production, its more recent effect has been to protect German brewers from competition and stifle innovation in beer production (hindering the craft beer movement). German brewers who adopt craft beer styles, in fact, cannot market these products as beer, but must call them with the name of the specific style (IPA or stout, for example) and market them as Biermischgetränke, “beer mixed drinks”.
In the United Kingdom, however, the craft beer movement has developed more easily thanks to a more favorable legislative context, aimed at incentivizing even small brewers. A key milestone was the foundation, in 1971, of CAMRA (Champaign for Real Ale). This organization was created with the aim of preserving traditional British beers, stimulating interest in local products and helping to protect small breweries from the pressures of large companies. The work of CAMRA also created a potential customer base for the rise of new breweries, increasingly perceived by the public as an alternative to mass producers.[88]
Another decisive step was the enactment of the Beer Orders Act in 1989, which came about as a result of a 1989 report by the Monopolies and Mergers Commission (a U.K. government agency) on the supply of beer. These laws were intended to increase competition in brewing, wholesaling and retailing. They aimed to expand consumer choice in pubs by limiting the number of pubs owned by the six largest brewing companies (Allied, Bass, Grand

Metropolitan, Imperial, Scottish and Newcastle, and Whitbread), which accounted for 75 percent of British beer production, and to allow their tenants to sell a cask brand of beer not brewed by them.[89]
The turning point for the craft beer movement in the UK was the introduction of the Small Breweries' Relief in 2002, along with the important role played by the SIBA (Society of Independent Brewers) in advancing the interests of craft breweries and providing support to members through lobbying and quality certification initiatives. The Small Breweries' Relief, also known as “progressive beer duty,” allows small brewers to pay an excise duty rate that is more proportional to their production volume. Above 5,000 hl per year, the excise duty rate increases gradually until it reaches the full standard level for production above 60,000 hl per year.[90]

In addition to these differences in legislation, the number of active craft breweries in the two countries is also a key indicator for assessing the rise of the craft beer movement. England, together with France, is the European country with the largest number of active craft breweries in 2023. Specifically, France has a total of 2300 craft breweries and England 1779; the number of active craft breweries in Germany is only 856.[91], [92], [93]
All these data and information on the number of breweries and the different legislations highlight how Germany, with a traditionalist approach, and the UK, with more flexible regulations and incentives, have developed distinct craft movements. Germany values quality and tradition, while the UK has favored innovation and growth, both converging in offering a genuine alternative to industrial massification.

3.2.4 African Beer Market

The beer market in Africa cannot be compared (as shown in *Figure 3-5*) to that of Europe, America and Asia. In fact, Africa, producing about 154 million hectoliters in 2023, only contributed 8.2% of global beer production. The chart in *Figure 3-16* shows the top 10 countries on the African continent by hectoliters of beer produced in 2023. Leading the ranking is South Africa with 35.1 million hectoliters produced, more than double that of Nigeria and Ethiopia, which follow with 17.73 and 12.67 hectoliters of beer respectively.[94]

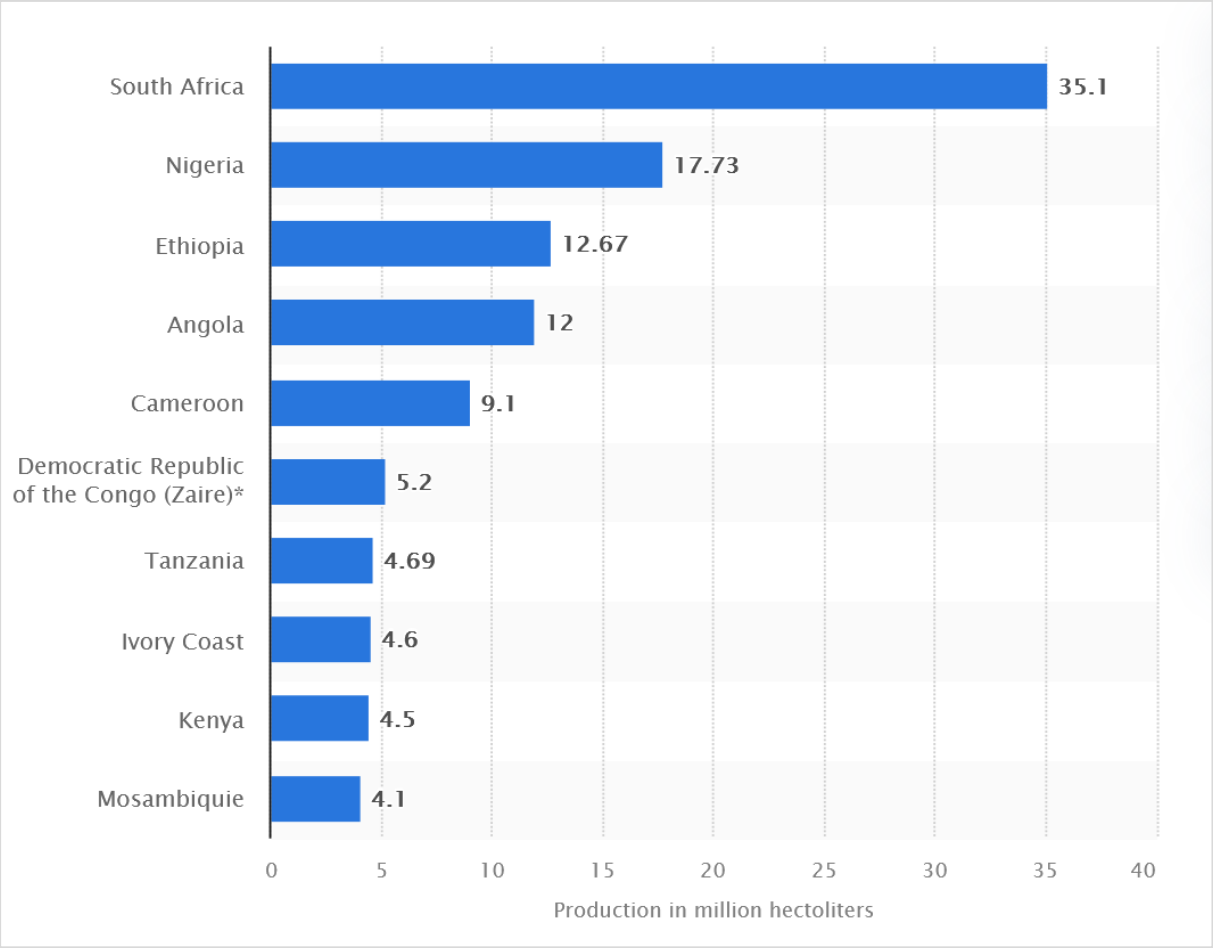

Figure 3-16-Leading 10 countries in Africa for beer production in 2023 [94]

Despite a lower percentage of beer production than other continents, Africa has a very attractive and profitable beer market. Large brewing giants, in fact, including Heineken, Diageo and Anheuser-Busch InBev units such as SABMiller, are investing heavily in the continent to build new breweries and advertise their products. In confirmation of this, Guinness Nigeria, a subsidiary of Diageo, and other major players such as Castel and Heineken, have consolidated their presence by acquiring local brands and existing infrastructure. For instance, Castel had already bought Soboa in Senegal and other companies in Cameroon in the 1990s, while it recently took over five Carlsberg breweries in Malawi. Heineken is also well positioned in strategic markets such as Nigeria, Democratic Republic of Congo, Burundi and Rwanda, consolidating its presence across the continent.[95]

The beer market in South Africa has been valued at 3.5 billion USD in 2023. During the forecast period between 2024 and 2030, the market size is expected to expand at a CAGR of 6.70% reaching a value of 6.0 billion USD in 2030. The expansion of the middle class in South Africa, coupled with urbanization trends, results in increased consumer spending on discretionary items such as beer. Urban areas provide a concentrated market with higher disposable

incomes, supporting the growth of premium and craft beer across the region.[96]

The birth and development of the craft beer movement in Africa has not been very different from that of other countries such as America and England but has only happened on a smaller scale and more slowly. Today there are 215 active craft breweries in Africa, following a large wave of closures that occurred due to the COVID-19 pandemic. In fact, during the period 2020-2021, South Africa was subjected to one of the most severe lockdowns in the world, which included curfews, stay-away orders and bans on the sale of cigarettes and alcohol. These bans lasted a total of 160 days, leading to devastating implications for craft brewers. Historically, the development of the craft beer industry in South Africa has been driven by the presence of a long-established homebrewing community and a small number of homebrewing clubs, most of which operate in the country's major cities. The most prominent are the Wort Hog Brewers in Gauteng, the South Yeasters in Cape Town and the East Coast Brewers in Kwa-Zulu Natal. The activities of these various home-brewing clubs have in fact formed the basis for the incubation of many of the country's newly established craft microbreweries.[97]
he African craft beer industry consists of four main business segments. The first group includes informal homebrewers who produce experimental craft beers for personal satisfaction and often operate from home premises, known as “garage breweries”. The second segment includes unlicensed microbreweries, which are in the process of obtaining alcohol licences and are about to open in the near future. These breweries market their craft beer products at local beer festivals. The third segment comprises the currently licensed and well-established microbreweries; many of them have been established for a long time, while others have only recently entered the market. The fourth segment is contract brewing, which is a sub-segment of the licensed industry. This type of craft brewing is governed by an agreement whereby one microbrewery brews its own beer using the equipment of another brewery.[97]
South Africa’s craft beer sector is heavily influenced by government legislation, regulated jointly by national and provincial authorities. The Liquor Act of 2003 requires microbreweries to obtain licenses from Provincial Liquor Boards, with varying regulations across provinces, including zoning restrictions like a minimum distance from schools or places of worship. Licenses must be renewed annually, and industry growth is supported by associations like Craft Beer South Africa, representing small businesses producing up to 100 million liters of beer per year.[97]

4 ITALIAN BEER MARKET

In recent decades, the beer market in Italy has experienced a significant transformation, characterized by constant growth both in terms of consumption and diversification of the offer. Italy, mainly known for its wine production, always had a lower beer consumption rate than other European countries, such as Germany and the United Kingdom. In recent years, however, beer in Italy has assumed an increasingly central role in the consumption habits of Italians, taking its place alongside traditional products such as wine. The evolution of the market has been driven by a series of key factors: changing consumer tastes, greater attention to quality and zero-mile products, and the progressive affirmation of the craft beer movement. The new trend of craft beer has led to the opening of numerous microbreweries, which have had a significant impact, not only by increasing the variety of beers available, but also by stimulating interest in beer culture and in innovative and sustainable production techniques.
In parallel to this phenomenon, the main players in the industrial market have responded to these dynamics by introducing premium lines and acquiring craft breweries, trying to combine large-scale production with emerging consumer preferences. These developments have made the Italian market very particular and interesting to analyze, in which economic, cultural and marketing elements are intertwined.
This chapter, therefore, aims to analyze the distinctive characteristics of the Italian beer market, examining the main players involved, consumption trends and competitive dynamics. A special focus will be given to the craft beer movement and its impact on the strategies of industrial breweries, highlighting how these transformations have redefined the traditional logic of the sector.

4.1 Regulations

Law No. 1354 of 16/08/1962, consisting of 32 articles, lays down the rules on the Hygienic Regulation of the Production and Trade of Beer.

As stated in the first of the 32 articles, in Italy beer is ‘the designation reserved for the product obtained from the alcoholic fermentation with Saccharomyces carlsbergensis or Saccharomyces cerevisiae strains of a wort prepared with malt, also roasted, of barley or wheat or their mixtures and water, bittered with hops or their derivatives or both. Alcoholic fermentation of the wort may be supplemented by lactic fermentation. Barley or wheat malt may be replaced by other cereals, whether or not broken or ground or in the form of flakes, as well as starchy and sugary raw materials up to a maximum of 40% calculated on the dry extract of the wort.[98]
The second article provides further definitions according to alcoholic strength:

1. The name "non-alcoholic beer" is reserved for a product with a Plato degree not lower than 3 and not higher than 8 and with an alcoholic strength by volume not exceeding 1.2%.

2. The name "light beer" is reserved for a product with a Plato degree not lower than 5 and not higher than 10.5 and with an alcoholic strength by volume higher than 1.2% but lower than 3.5%.
3. The name "beer" is reserved for a product with a Plato degree higher than 10.5 and with an alcoholic strength by volume higher than 3.5%; this product can be named "special beer" if the Plato degree is not lower than 12.5 and "double malt beer" if the Plato degree is not lower than 14.5.
4. When fruit, fruit juices, flavorings, or other characteristic food ingredients are added to the beer, the sales denomination is completed with the name of the characterizing substance.[98]

An important milestone for the craft beer movement in Italy was the introduction of Ministerial Decree 212/2010, which recognized beer as an agricultural product for all purposes and the agricultural brewery as a business engaged in the production and direct sale of agricultural beer. The concept of agricultural beer is inspired by an already established model in the wine sector: a farmer who grows grapes in his vineyards and use them for wine production, can also be directly involved in the processing and sale of the wine produced. The interests and activities of agricultural breweries are regulated and protected by the COBI - Consorzio Italiano di Produttori dell'Orzo e della Birra, which today has more than 90 agricultural breweries spread across the entire peninsula. To produce agricultural beer, companies are required to comply with certain strict rules that are part of COBI's internal regulations. A fundamental requirement for farmers to remain in the agricultural regime, is to produce agricultural beer with a percentage of raw material produced in-house, or in any case within the consortium, of not less than 51%. This percentage rises above 70% for agricultural breweries that are members of the "Birragricola" brand registered by the consortium itself.[99]

Six years after the introduction of Ministerial Decree 212/2010, craft beer was defined in law for the first time, thanks to Art. 35 of Law No. 154 of 28/7/2016. It is defined as: "beer produced by small independent breweries and not subjected to pasteurization and microfiltration processes during production". An independent small brewery is defined as such when it is legally and economically independent of any other brewery, has separate and distinct production facilities from those of other companies in the sector, does not operate using licenses for intellectual property rights belonging to third parties, and has an annual production that does not exceed 200,000 hectoliters, including beer produced on behalf of other companies. Thanks to this law, the designations "craft beer" and "small independent brewery" are protected, making them unavailable to the numerous brands owned by multinational beer corporations.[100]

4.2 Production and Consumption

For the Italian beer market, 2023 can be defined as a year of adjustment and planning. In fact, as can be seen from the graph below, after a decade of uninterrupted success and after the stop imposed by the Covid-19 pandemic in 2020, the beer market experienced a contradictory 2023, marked by price increases all along the production chain axis. However, despite some declining numbers, after a record-breaking 2022, the overall health of the sector is good and shows good resilience, investment, innovation and sustainability.[101]

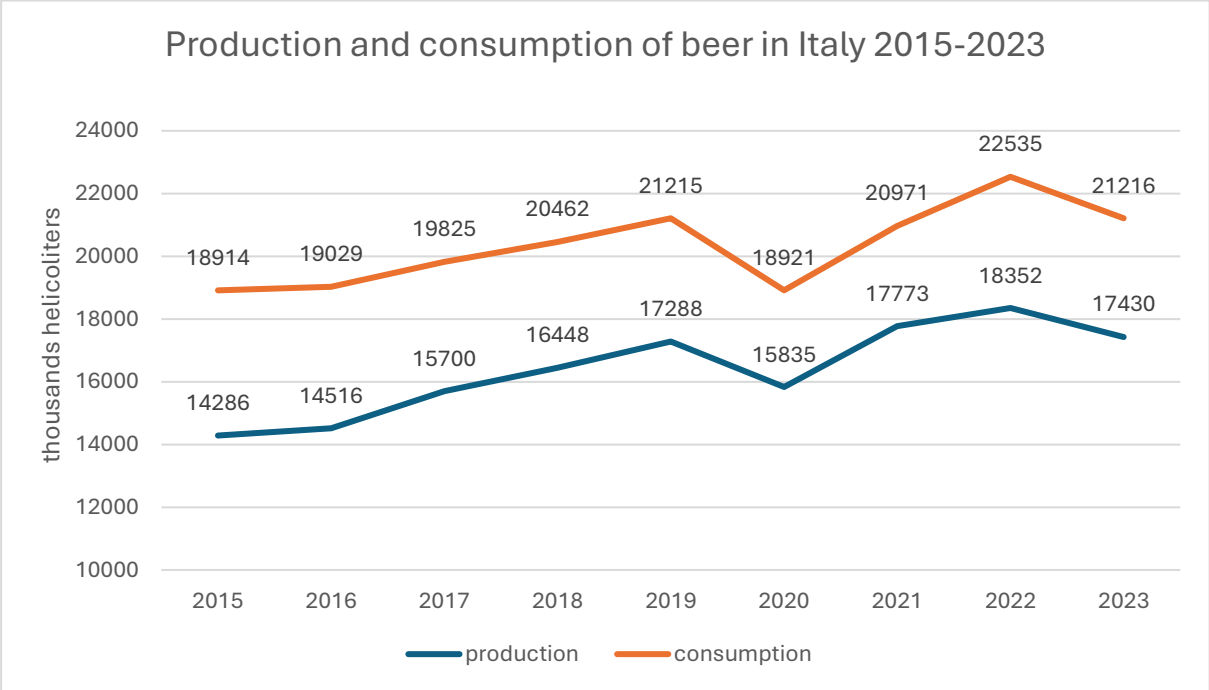

Figure 4-1-Beer production and consumption 2015-2023[102], [103]

Regarding the numbers, beer production in 2023 reached 17.4 million hectoliters, a decrease of 5.02% compared to 18.3 million of the previous year. However, comparing the results with the pre-pandemic period, the production volume of the last year exceeds that of 2019 (17.3 million hectoliters) and is close to the level of 2021, when it stood at 17.8 million. As for consumption, after the historical record in 2022 (22.5 million hectoliters), 21.2 million hectoliters were recorded in 2023, marking a decrease of 5.85%. This value, however, equals that of 2019, which until 2022 represented the all-time high, and exceeds the ones for 2021. Compared to ten years ago (2013), consumption grew by 20.9%, a clear sign of how beer has become an increasingly ingrained element in Italian food culture.[101]
In terms of value, sales increased from EUR 3.8 billion in 2021 to EUR 4.4 billion in 2023, with a CAGR of around 7.61%, mainly driven by the increase in market prices due to inflation.

Therefore, despite the decline in production and consumption volumes in 2023, the beer market revenue in Italy continued to grow, fueled by higher selling prices.

Regarding individual beer consumption, in Italy each person consumed 36.1 liters of beer in 2023, 5.57% less than the 38.2 liters consumed in 2022, but 1.9% more than the 35.4 liters consumed in 2021. These numbers, compared with those of the rest of the European countries, highlight how beer consumption per capita in Italy remains considerably below the European average. Italy, in fact, with 36.1 liters only ranks 23rd in Europe, where the top positions are held by the Czech Republic (128 liters), Austria (99 liters) and Germany (88 liters).[87], [104]

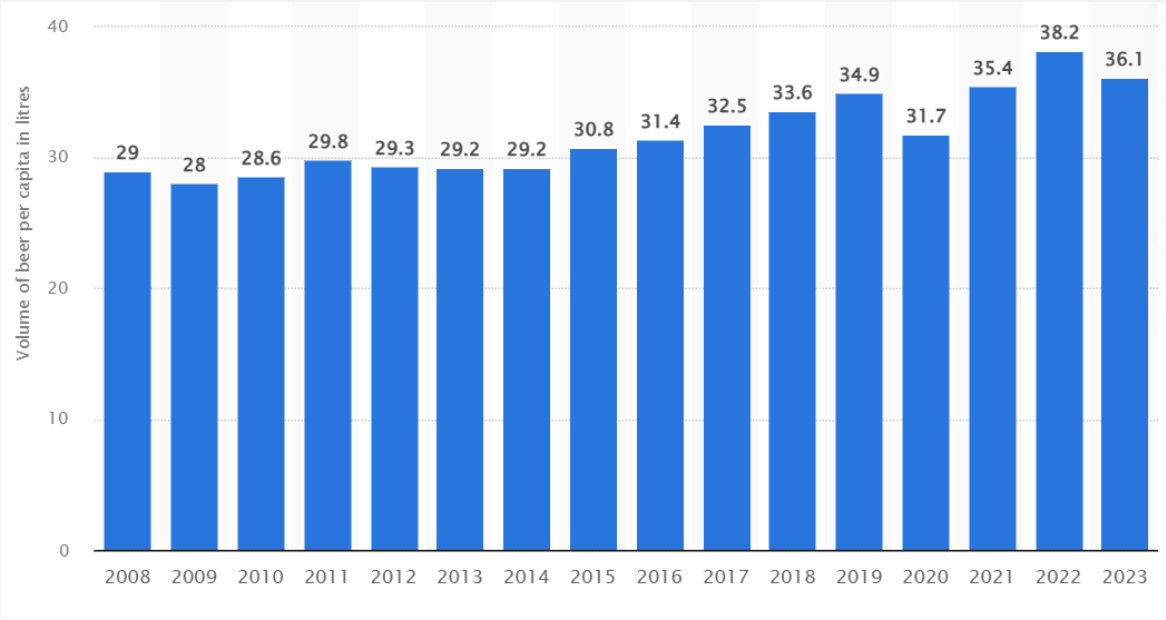

Figure 4-2-Annual volume of beer consumed per capita in Italy from 2008 to 2023 [105]

Italy is not traditionally known for beer production but is widely recognized as the country with the most extensive and diverse wine production in the world. This can be attributed to its history, culture, and climate, with the country's unique geology and lands providing ideal conditions for producing high-quality wines with diverse characteristics. As a matter of fact, analyzing the consumption trend with respect to other alcoholic beverages, wine remains the most widespread alcoholic beverage with a total consumption of 23.5 million hectoliters in 2023 and a per capita consumption of 40 liters. However, as seen in previous graphs beer is shortening the distance, reaching 21.2 million hectoliters with a per capita consumption of 36.1 liters. Spirits, on the other hand, maintain a stable consumption level of 1 million

hectoliters.[101]

	Consumo (milioni di hl.)		Consumo pro capite (in litri)		Variazione %
BEVANDE / *BEVERAGES*	2023	2022	2023	2022	2023/2022
BIRRA / *BEER*	21,2	22,5*	36,1	38,2*	-5,8
ACQUA MINERALE / *MINERAL WATER*	161,0	149,0	273,0	252,0	8,1
VINO / *WINE*	23,5	24,2	40,0	41,0	-2,9
SPIRITI / *SPIRITS*	1,0	1,0	1,0	1,0	0,0

Table 4-1-Consumption of beverages in Italy (Per Capita) *[101]*

4.3 Tax and excise duty

From a fiscal point of view, the Italian beer market is regulated by two main instruments: general taxes on consumption, such as VAT (Value Added Tax), and excise duties, which are a specific tax on the consumption of certain products.

Excise duties are indirect taxes on the sale or use of specific products such as alcohol, tobacco, energy products and electricity. The revenue from excise duties goes entirely to the country to which they are paid. There are common EU rules to ensure that excise duties are applied in the same way and to the same products everywhere in the Union. This helps prevent trade distortions in the single market, ensures fair competition between companies and reduces administrative burdens for companies. Generally speaking, it can be said that the structure of excise duties and minimum rates are set by EU rules and it is up to the Member States to increase the amount of the rates.[106]

In Italy, wine and fermented beverages other than wine and beer are exempt from excise duties. Excise duty is instead levied on other products, such as ethyl alcohol (1035.52 euros per anhydrous hectoliter) and on intermediate alcoholic products taxed at 88.67 euros per hectoliter. Beer is subject to an excise duty regime that has been progressively reduced over the years through budget laws. In particular, the 2017 budget law (article 1, paragraph 48 of law no. 232/2016) provided for a reduction in the rate, which went from 3.04 to 3.02 euros per hectoliter and Plato degree. Subsequently, the 2018 budget law further reduced the amount, bringing it from 3.02 to 3.00 euros, as provided for by article 1, paragraph 514 of law no. 205/2017. Finally, with the 2019 budget law, approved during the XVIII legislature, a new reduction in the rate was established starting from 1 January 2019, setting it at 2.99 euros per hectoliter and degree-Plato. For the year 2022 only, budget law no. 234/2021 (paragraphs 985-987) provided for a further temporary reduction, bringing the excise duty to 2.94 euros per hectoliter and degree-Plato. However, this measure was limited to the year 2022, in fact starting from 1 January 2023, the tax returned to the previous value of 2.99 euros per hectoliter and degree-Plato.[107]

An important milestone for the Craft Beer movement in Italy was June 4, 2019, when the ministerial decree under the budget law introduced a 40% excise duty reduction for small craft

breweries producing up to 10,000 hectoliters per year. In 2022, this reduction was temporarily increased to 50%, before returning to 40% in 2023, with the introduction of further reductions: 30% for breweries producing 10,000-30,000 hectoliters and 20% for those producing 30,000-60,000 hectoliters.
These measures have aligned Italy with broader European trends in support of craft beer production.[107], [108]

As stated before, another important tax is the Value-Added Tax (VAT). In Italy, the VAT (Value Added Tax) applied to beer varies depending on the method of consumption. The standard rate is 22% and applies to the sale of beer intended for domestic consumption, such as purchases made in supermarkets, shops or e-commerce. However, a reduced rate of 10% is applied when beer is served in bars, restaurants or other catering establishments. This differentiation is justified by the fact that on-site serving is included among catering services, which benefit from tax breaks to encourage consumption in these contexts.
The Figure below shows the European situation in terms of excise duty on beer applied in 2023.

Excise duties can be levied per alcohol content (ABV), per degree Plato (°P), or as a fixed amount for defined abv/°P brackets. To make these excise duties comparable, degrees Plato were converted into alcohol content (1°P generates approximately 0.4 abv), and a hectoliter of beer of 5% ABV (about 12°P) has been considered.
As can be seen from the graph below, Finland, the UK and Ireland are the countries with the highest excise duties per hectoliter of beer, €190.25, €121.21 and €112.75 respectively. Italy is positioned in the middle with €36.75 per hectoliter.

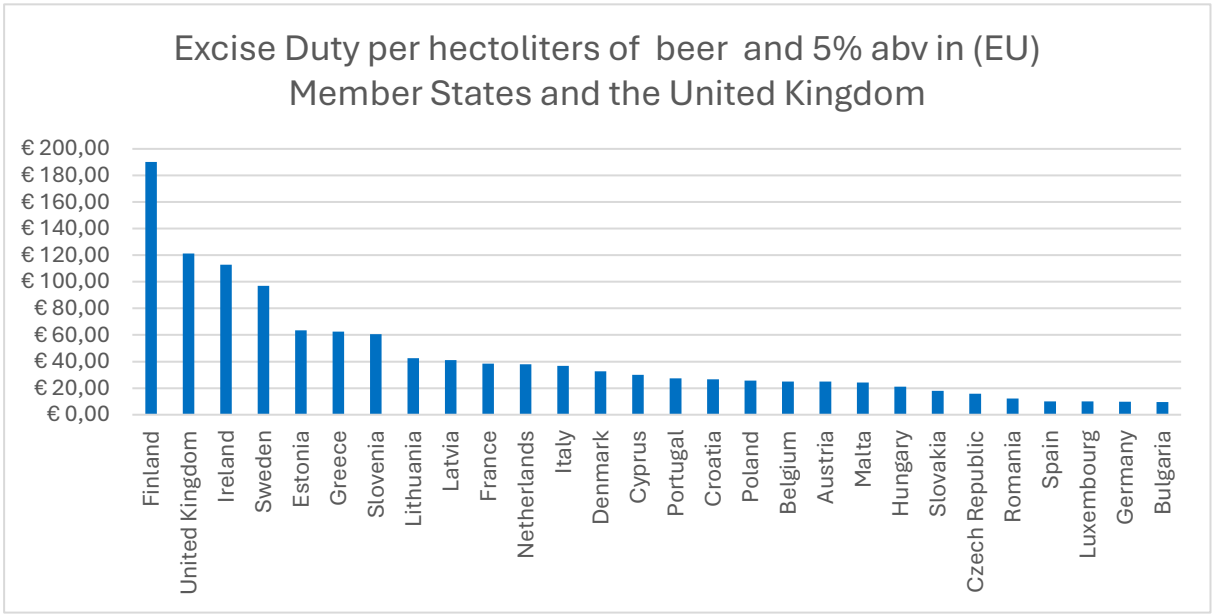

Figure 4-3-Excise Duty per hectoliters of beer in 2023 [109]

An interesting fact emerges from the graph in *Figure 4-4*: although Italy does not have a particularly high tax burden on beer, it is among the European countries with the highest revenues from excise duties, reaching approximately 707 million euros in 2022. With this result, it surpasses countries such as Finland, Ireland and Sweden, which instead in the graph in *Figure 4-3*, were among those with the highest excise duties per hectoliter of beer. The discrepancy is mainly attributable to the different levels of beer consumption in the various countries. Although countries such as Finland, Ireland, Sweden, Estonia, Greece, Slovenia, Latvia and the Netherlands have a higher tax burden than Italy, their consumption is significantly lower. In particular, Italy consumed 22.298 million hectoliters in 2022, while for example Finland, Ireland and Sweden consumed 3.57 million, 4.26 million and 4.76 million respectively.

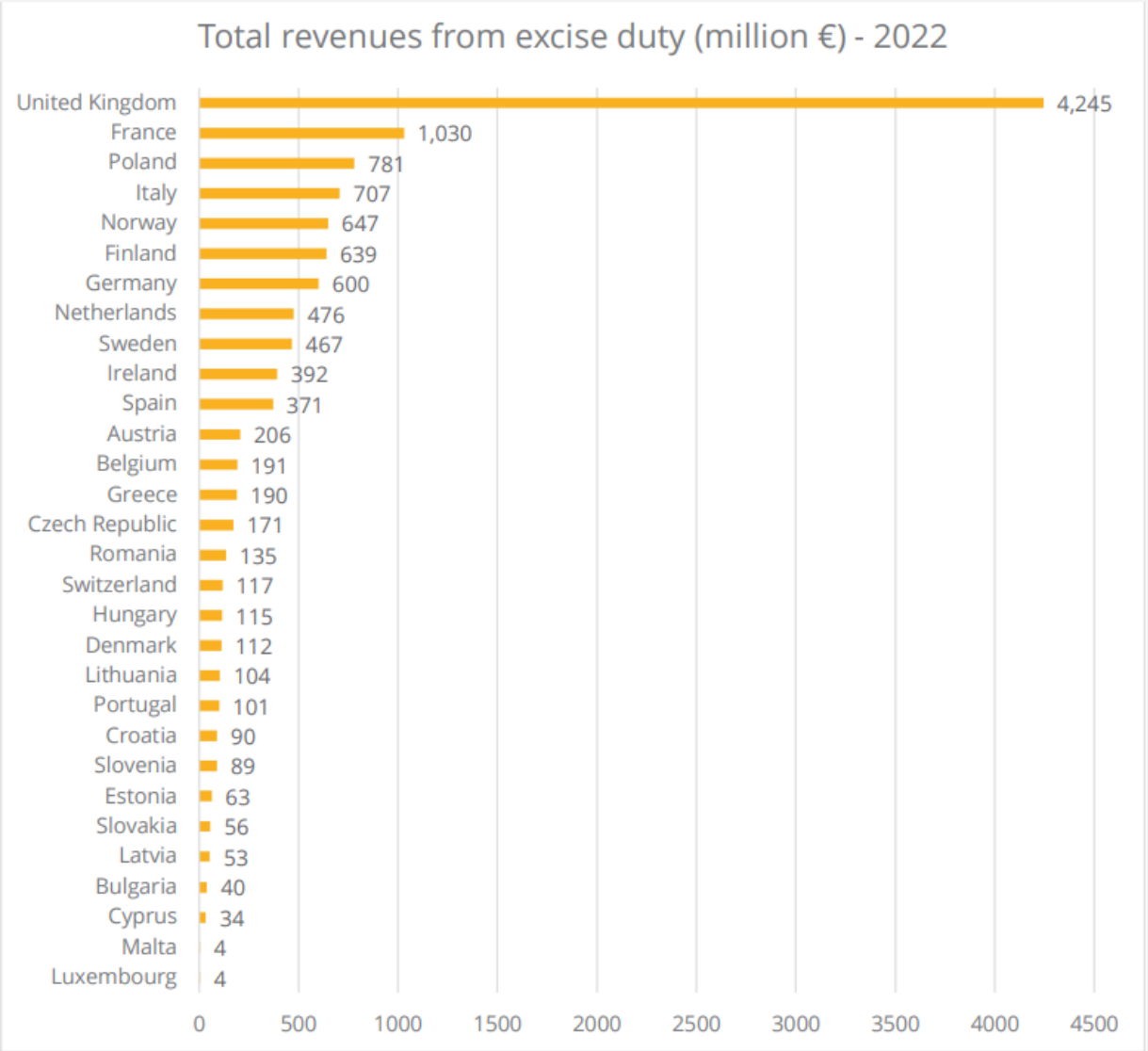

Figure 4-4- Total revenues from excise duty in Europe [87]

4.4 Import and Export

The graph in *Figure 4-5* shows the trend of beer imports and exports in Italy from 2015 to 2023. Imports remain constantly higher than exports, suggesting that Italy is a market more oriented towards the consumption of foreign beer and with a brewing tradition, although growing, not historically rooted as in other countries, including Germany, Belgium or the United Kingdom, whose products often dominate the imported beer market. Despite this, an interesting aspect is the growth trend of exports, which increased from 2,547.26 thousand hectoliters in 2015 to 3,605.91 thousand hectoliters in 2023, recording an overall growth of about 41.5% in less than a decade. This increase highlights a positive perception of "Made in Italy" with greater international visibility of Italian beer brands, especially in the craft and high-quality segment.

Imports show a more moderate growth with an overall growth of about 3.2% from 2015 to 2023. After a slight decline in 2017, with a value of 7,007.47 thousand hectoliters, they start growing again and reach a peak in 2022 with 7,993.19 thousand hectoliters, before suffering a slight decline in 2023.

The COVID-19 pandemic has had a significant impact on both imports and exports. In 2020, in fact, imports recorded a decline of 13.5% compared to 2019, reaching 6,414.09 thousand hectoliters. Similarly, exports decreased by 4.7%, from 3,490.51 thousand hectoliters in 2019 to 3,328.11 thousand hectoliters in 2020. This decline highlights the logistical difficulties and the drop in demand, especially in the Ho.Re.Ca. channel, which was severely affected by the restrictions.[101], [110], [111]

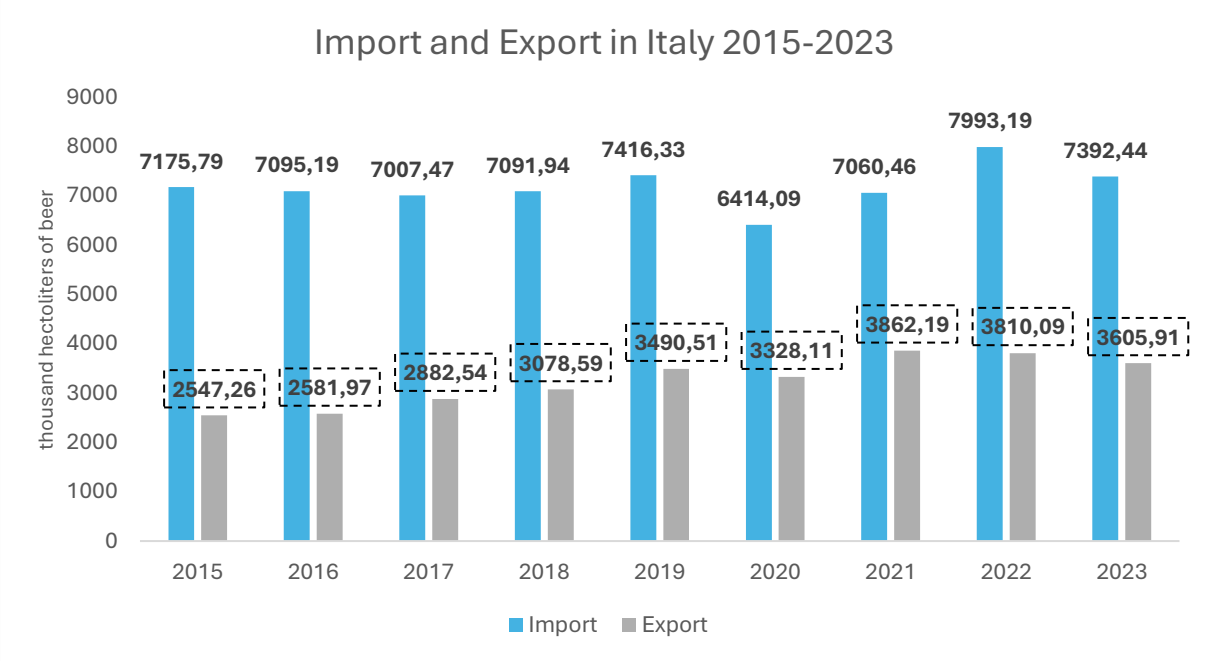

Figure 4-5- Import and Export of beer in Italy 2015-2023 [110], [111]

As ca be seen from the *Table 4-2,* Germany, which has a tax rate four times lower than Italy's, remains the main country of origin of imports, with 41.7% of total imports, followed by Belgium (with a share of 20.7%), the Netherlands (9.8%) and Poland (9.4%). Among the non-EU countries, which globally account for 2.2% of imports, the largest exporter to our country is the United Kingdom, with almost 95 thousand hectoliters out of about 135 thousand of the non-EU totals.

Italian Imports of Beer 2019-2023 (HL)

	2019	2020	2021	2022	2023	% TOT
Germania / *Germany* - D	1.625.319,72	1.568.147,11	2.939.572,29	2.992.467,83*	**3.082.016,43**	41,7
Belgio/Lux / *Belgium/Lux* - B	2.404.418,83	1.887.233,35	962.503,78	1.729.091,97*	**1.531.793,97**	20,7
Paesi Bassi / *Netherlands* - NL	782.241,98	645.525,25	661.954,64	926.814,94*	**725.953,33**	9,8
Polonia / *Poland*- PL	506.635,30	541.570,12	529.647,74	618.867,74*	**697.017,45**	
Danimarca / *Denmark* - DK	386.975,91	385.928,96	455.644,36	510.516,29*	**351.235,49**	
Francia / *France* - F	287.490,77	408.136,76	398.122,80	391.158,45*	**364.754,27**	
Austria / *Austria* - A	187.120,44	148.795,45	151.771,57	190.346,66*	**130.649,23**	
Slovenia / *Slovenia* - SL	189.150,19	252.101,27	288.511,83	127.301,50*	**104.600,96**	
Rep. Ceca / *Czech Rep.* - CZ	78.360,75	53.300,29	69.985,06	57.194,53*	**56.432,04**	
Irlanda / *Ireland* - IRL	58.969,08	49.113,89	31.387,49	40.378,02*	**56.869,04**	
Grecia / *Greece* - GR	19.187,48	18.152,96	58.743,89	2.817,78*	**3.011,50**	
Spagna / *Spain* - E	85.820,34	72.369,16	74.625,35	52.097,58*	**60.769,02**	
Romania / *Romania* - RO	30.823,19	10.336,93	12.714,42	21.866,46*	**39.368,61**	
Svezia / *Sweden* - S	13.395,17	7.418,29	9.813,12	12.001,48	**12.975,87**	26,9
Portogallo / *Portugal* - P	1.434,94	6.920,27	8.957,89	3.491,44	**654,20**	
Malta / *Malta* - MT	938,40	1.525,11	404,59	23.784,85*	**18,40**	
Estonia / *Estonia* - EE	502,45	905,64	392,22	1.359,34*	**39,79**	
Finlandia / *Finland* - FI	175,75	55,89	15,03		**14,10**	
Cipro / *Cyprus* - CY	2.431,12	310,17	449,79	2,85	**0,79**	
Bulgaria / *Bulgaria* - BG	269.928,62	8.342,69	7.117,69	2.371,63*	**3.554,83**	
Lettonia / *Latvia* - LV	1.109,42	936,10	146,36	235,16*		
Slovacchia / *Slovakia* - SLOV	26.910,12	1089,14	802,23	1319,6*7	**0,04**	
Croazia / *Croatia* - CR	175,87	1.153,00	1.732,22	7.367,70*	**4.256,54**	
Ungheria / *Hungary* - HU	3.380,20	699,36	1.431,37	486,*1	**0,24**	
Lituania / *Lithuania* - LT	430,06	1.151,52	1.177,34	1.005,83 *	**1.395,98**	
Tot. U.E. / EU	**6.963.326,10**	**6.071.218,68**	**6.667.625,07**	**7.714.345,80***	**7.227.382,12**	
Messico / *Mexico* - MEX	266.139,93	247.569,07	252.067,57	69.729,41	**219,21**	
Regno Unito / *United Kingdom* - UK	77.620,79	55.721,75	83.413,11	127.748,96*	**93.355,75**	
Cina / *China* - RC	35.453,16	15.696,69	28.023,49	38.487,57*	**33.212,44**	
Svizzera / *Switzerland* - CH	5.066,18	1.926,42	5.412,19	15.807,23*	**6.523,98**	2,2
Giappone / *Japan* - J	2.225,51	1.768,62	330,96	633,91*	**585,46**	
Turchia / *Turkey* - TU				1,21		
Altri Paesi Terzi / *Other Third Countries*	66.500,09	20.188,72	20.398,94	26.437,29*	**31.162,40**	
Totale Paesi Terzi / *Total Third Countries*	453.005,66	342.871,27	392.836,61	**278.845,58***	**165.059,24**	
TOTALE / TOTAL	**7.416.331,76**	**6.414.089,95**	**7.060.461,68**	**7.993.191,38 ***	**7.392.441,36****	

Table 4-2-Italian Imports of Beer 2019-2023 per country[101]

The EU remains a crucial market for Italian beer exports, with EU countries collectively accounting for 27.8% of total exports in 2023. France is the leading destination, receiving 246,871 hectoliters (6.8% of total exports) in 2023, a significant increase compared to previous years. The Netherlands also stands out as an important destination, importing 161,410 hl (4.5%) in 2023, while Romania and Germany have a relatively smaller contribution.

The most significant non-EU market is the United Kingdom, which consistently dominates Italian beer exports, absorbing 1,589,322 hl in 2023, representing a substantial 44.1% of total exports. This underlines the strategic importance of the United Kingdom as a trading partner for Italian beer, even after Brexit. The United States is another important non-EU destination, importing 340,288 hl in 2023 (9.4%), reflecting the growing popularity of Italian beer in North America. Australia, although a smaller market, remains noteworthy, accounting for 40,218 hl (1.7%)

Italian Exports of Beer 2019-2023 (HL)

	2019	2020	2021	2022	2023	% TOT
Francia / *France* - FR	159.265,48	106.564,58	131.806,69	157.128,72*	246.871,28	6,8
Paesi Bassi / *Netherlands* - NL	184.888,06	130.061,29	123.546,30	162.299,97*	161.410,23	4,5
Romania / *Romania* - RO	37.476,69	29.751,16	17.737,61	29.330,85*	38.379,00	1,1
Malta / *Malta* - MT	18.610,47	19.127,96	17.784,24	10.655,31*	14.931,25	0,4
Germania / *Germany* - D	25.562,36	25.126,55	22.157,17	19.383,76*	19.303,12	0,5
Altri Paesi / *Other countries* - UE	443.754,32	583.267,62	622.186,67	484.143,08*	519.875,86	14,4
Tot. U.E. / EU	869.557,38	893.899,16	935.218,68	862.941,69*	1.000.770,74	27,8
Regno Unito / *United Kingdom* - UK	**1.591.495,85**	**1.567.984,84**	**1.813.076**	**1.838.722,23***	**1.589.322,80**	**44,1**
Stati Uniti / *United States* - USA	334.369,77	241.795,18	331.350,15	346.135,87	340.288,50	9,4
Australia / *Australia* - AU	275.652,04	233.389,97	247.041,88	104.691,74	60.218,47	1,7
Albania / *Albania* - AL	76.304,49	76.298,78	135.019,75	160.164,10*	180.307,17	5,0
SudAfrica / *South Africa* - RSA	6.273,45	4.831,52	1.466,85	6.382,05	201,65	0,0
Altri Paesi e punti franchi / *Other Third Countries*	336.858,54	309.909,76	399.019,97	491.054,37*	434.804,26	12,1
TOTALE / TOTAL	**3.490.511,52**	**3.328.109,21**	**3.862.193,69**	**3.810.092,05***	**3.605.913,59****	**100,0**

Table 4-3-Italian Export of Beer per country 2019-2022 [101]

4.5 History of beer in Italy and Industry evolution

The history of the Italian brewing industry is similar to that already seen in other countries. During the first decades of the 20th century, in fact, industry was characterized by strong localization, with fragmented production and limited consumption, while starting from 1950 there was an evolution towards a remarkably concentrated industrial structure. This evolutionary trend can be explained by several factors, including technological progress, several waves of mergers and acquisitions, marketing investments and a purely homogeneous demand.

Technological progress has allowed beer producers to optimize production processes by increasing efficiency and production capacity and at the same time reducing operating costs.

Breweries have become increasingly larger and average production per plant has increased from around 50,000 hectoliters in 1950 to over 500,000 hectoliters in 1990. In particular, two large producers such as Peroni and Dreher have distinguished themselves in recent years, investing in modern plants, automated bottling and packaging lines, more efficient pasteurization techniques and exploiting economies of scale to lower costs and increase competitiveness.

Since the 1960s, the Italian brewing industry has experienced a wave of mergers and acquisitions, which as previously mentioned, have led to a progressive concentration of the market.[112]
The initial acquisitions in the Italian brewing industry were led by large domestic brewers, such as Peroni and Dreher, who absorbed smaller local breweries to strengthen their market position. In the 1970s and 1980s, the industrial landscape underwent a more profound transformation with the entry of foreign multinationals. Heineken acquired historic brands such as Moretti and Ichnusa, consolidating its presence as a global leader, while SABMiller, then part of AB InBev, acquired Peroni in 2003, integrating it into its international network and making it a strategic brand for expansion in Europe. Carlsberg, on the other hand, acquired Birrificio Angelo Poretti, strengthening its presence in the premium segment. These processes of acquisitions and mergers had significant effects on industrial concentration, leading to the closure of many small breweries and the centralization of production in a few large plants, with the large producers, mentioned above, controlling over 70% of the market.[112]

In parallel with technological progress and growing industrial concentration, the main beer producers in Italy have increased their investments in marketing, using tools such as television and sports sponsorships to associate their brands with values of conviviality and tradition. Memorable advertising campaigns, including the slogan "Call me Peroni, I'll be your beer", have helped strengthen the identity of the brands, making them widely recognizable. At the same time, eye-catching packaging and the introduction of new product variants, such as light lagers, have made it possible to attract a wider audience. However, these strategies have favored an increasing homogenization of demand.

Starting in the 1960s, something began to change in the Italian beer industry, with the advent of the craft beer movement. It was in 1996 that, thanks to small pioneers and entrepreneurs, we witnessed the official birth of the first microbreweries. These pioneers, driven by a passion for quality and authenticity, began producing unique beers, experimenting with local ingredients and innovative techniques. Although there had already been various experiments and small productions in the past, six breweries are commonly recognized as the first in Italy: the Birrificio Italiano of Lurago Marinone, the Birrificio Lambrate of Milan, Le Baladin in Piozzo, Beba of Villar Perosa, the Mastro Birraio of Padua and the Turbacci brewery in Lazio**.**[113]
Furthermore, the numerous legislative decrees (discussed in detail in *paragraph 4.1 Regulations*) approved since 2000 have been fundamental to the affirmation and consolidation of the craft beer movement in Italy.

Craft breweries differ from large producers primarily in their manufacturing process, avoiding pasteurization and micro-filtration, which allows them to create beers with richer aromas, flavors, and distinctive characteristics. Early craft brewers introduced non-pasteurized, non-filtered lager beers, offering Italian consumers a novel alternative to standard industrial lagers. They also embraced product differentiation by continuously launching new varieties overlooked by national producers. Unlike large brewing groups, which often associate beer with celebrities or events, craft breweries focus their advertising on intrinsic product qualities, leveraging local promotions, social media, and regional festivals.

4.5.1 Competitors and market share

Currently, the beer market in Italy is characterized by an almost oligopolistic structure, with a few large companies holding most market shares. As can be seen in *Table 4-4*, referring to the hectoliters of beer produced, there are five main companies: Heineken Italia Spa, Birra Peroni Srl, Anheuser-Busch InBev Spa, Carlsberg Italia Spa and Birra Castello Spa, followed by Hausbrandt Trieste 1892 Spa and Birra Lucana Srl.

Brewing Companies	000 hl	market share (%)
Heineken Italia Spa	6797,0	32
Birra Peroni Srl	3765.0	17.7
Anheuser Busch In.Bev Italia Spa	2074.0	9.8
Carlsberg Italia Spa	1129.0	5.3
Birra Castello Spa	929.0	4.4
Hausbrandt Trieste 1892 Spa	35.0	0.1
Birra Lucana Srl	10.0	0.1
Others (Microbreweries and non-member breweries)	1438.0	6.8
Non-member third-parties imports	5039.0	23.8

Table 4-4- Competitors and market share in Italy 2023 [101], [114]

A commonly used indicator to assess the degree of market concentration is the Concentration Ratio (CR), which measures the percentage of the market held by the main companies in the sector. In particular, the CR5 (Concentration Ratio of the top 5 companies) is calculated by adding the market shares (in terms of hectoliters produced or turnover) of the five largest companies in the sector:

$$CR5 = \sum_{i=1}^{5} S_i$$

where $\mathbf{S_i}$ represents the market share of the **i-th** company.

A high CR5 value, for example above 60-70%, indicates a highly concentrated market structure close to an oligopoly, where a few firms dominate the competition and can significantly influence prices and market strategies. In the case of the beer market in Italy, the CR5 is 69.2%, confirming that the sector is highly concentrated in the hands of a few large multinational companies. This implies that competitive dynamics are limited and that smaller firms, such as craft breweries, may encounter difficulties in accessing large-scale distribution channels or in competing in terms of price and production volumes. However, despite this strong concentration, the Italian beer market stands out for its dynamism and attractiveness, characterized by the continuous birth, growth and closure of new craft breweries. This phenomenon is favored by the limited incidence of economies of scale and the high differentiation of the product, elements that allow craft producers to find their own niche within the market. Furthermore, the growing sophistication of the Italian consumer, increasingly oriented towards refined and distinctive tastes, has encouraged the development of beers with unique characteristics, thus contributing to the diversification of the offer.
These aspects will be discussed in greater detail *in paragraphs 4.6 and 4.12*, where the market dynamics will be analyzed with the support of industry experts, in order to better understand the opportunities and critical issues that characterize the Italian beer industry.

Analyzing the individual market macro-players, Heineken Italia Spa is the undisputed leader among beer producers in Italy and in 2023 it had a turnover of approximately 827 million euros. Heineken has been present in Italy since 1974, thanks to the acquisition of Birra Dreher S.p.A., which in 1865 opened its first plant in Trieste. In 1989, Heineken established Partesa, a company specialized in sales, distribution, consultancy and training services for the Ho.Re.Ca channel, which operates throughout the country with 40 logistics centers and manages a distribution activity of over 10,000 products. Heineken currently has four plants in Italy, precisely in Comun Nuovo (Bergamo), Pollein (Aosta), Massafra (Taranto) and Assemini (Cagliari). Thanks to these production centers, it produces approximately 7 million hectoliters of beer every year, 32% of the total beer produced in Italy. In other words, almost one in three beers produced in our country is a Heineken beer. In addition to the Heineken brand, known internationally also thanks to its sponsorship of sporting events such as the Champions

League, the group owns numerous other beer brands, including Birra Moretti, Birra Messina, and Ichnusa. [115], [116]

The second company in Italy for beer production and trade is Birra Peroni S.r.l. which in 2023 had a turnover of more than 583 million euros. It was founded in 1846 in Vigevano and its brand has become iconic and has always been associated with Italian identity. However, like Birra Moretti, Birra Peroni is no longer formally an Italian brand since it has been part of the Japanese Asahi Breweries since 2016. As can be seen from Table 4-3, Birra Peroni is the second beer producer in Italy, with a quantity that exceeds 3.7 million hectoliters per year (17% of the total). Despite the acquisition by a Japanese multinational, Birra Peroni maintains and enhances its Italian identity, through a solid presence on the national territory. The company, in fact, operates through three production plants strategically located along the peninsula, in Padua, Rome and Bari, as well as managing offices in Milan and a malt house in Pomezia. The Peroni brand's offering includes a wide range of products, including Peroni Cruda, Non Filtrata and the Gran Riserva line, in addition to other brands marketed by the company, such as Raffo, Tourtel and Kozel, the latter a Czech beer recently introduced to the Italian market.[116]

In third place in the ranking of the main beer producers in Italy is Anheuser Busch InBev Italia which, with a product portfolio rich in very famous brands, produces in Italy approximately 2.1 million hectoliters of beer per year. Among its brands are the Mexican Corona, the Belgian Leffe and Stella Artois, Beck's and the American Budweiser. The Belgian multinational AB InBev is a world leader in beer, with a total turnover that exceeds 50 billion euros and employs 164 thousand people (of which 12 thousand in Europe) and sells over 500 brands of beers and soft drinks.

Carlsberg Italia and Birra Castello are in the fourth and fifth position respectively in the ranking of the main beer producers in Italy, with production volumes exceeding one million hectoliters per year. Carlsberg Italia, with a production of approximately 1.13 million hectoliters in 2023, represents the Italian branch of the historic Danish brand, known for the Birrificio Angelo Poretti. The latter is among the most recognizable brands in the Italian beer scene, thanks to the particularity of associating numbers with different flavors, symbolizing the number of hop varieties used in the production of each beer. Birra Castello is positioned in fifth place with a production of 929 thousand hectoliters, confirming itself as the first beer producer with entirely Italian capital. Founded in 1997, the company started its business by taking over the old Moretti brewery, developing rapidly in the following years. Today, Birra Castello stands out not only for its production volume, but also for its turnover which exceeds 100 million euros, which highlights its central role in the Italian beer scene.[116]

4.5.2 Craft Breweries: microbreweries and brew pubs

The proliferation of beers made in Italy has been accompanied by a notable growth of microbreweries and brew pubs throughout the country. As can be seen from the graph in *Figure 4-6*, in the last ten years microbreweries have recorded a percentage increase of

70.43% (going from 443 units in 2014 to 755 in 2023), brew pubs have similarly increased by a share equal to 71% (going from 142 to 243 pubs).[101]
Microbreweries are real breweries that produce significant quantities of craft beers that they then resell to third parties. Brew-pubs are places that have both the production unit and areas reserved for the supply and sale of the products they make. Therefore, both production and catering/sales activities are carried out inside them.
With a total of 998 units, Italy is the fourth country in Europe in terms of number of active craft breweries in 2023. It is preceded only by France, England and Switzerland which have respectively 2300, 1779 and 1170 active breweries.[87]
Moreover in 2023, Italian microbreweries and brew pubs produced 450.000 hectoliters of beer (average degree Plato 14), equal to 2.6% of the national production (including an estimated 13,5% of export).[101]

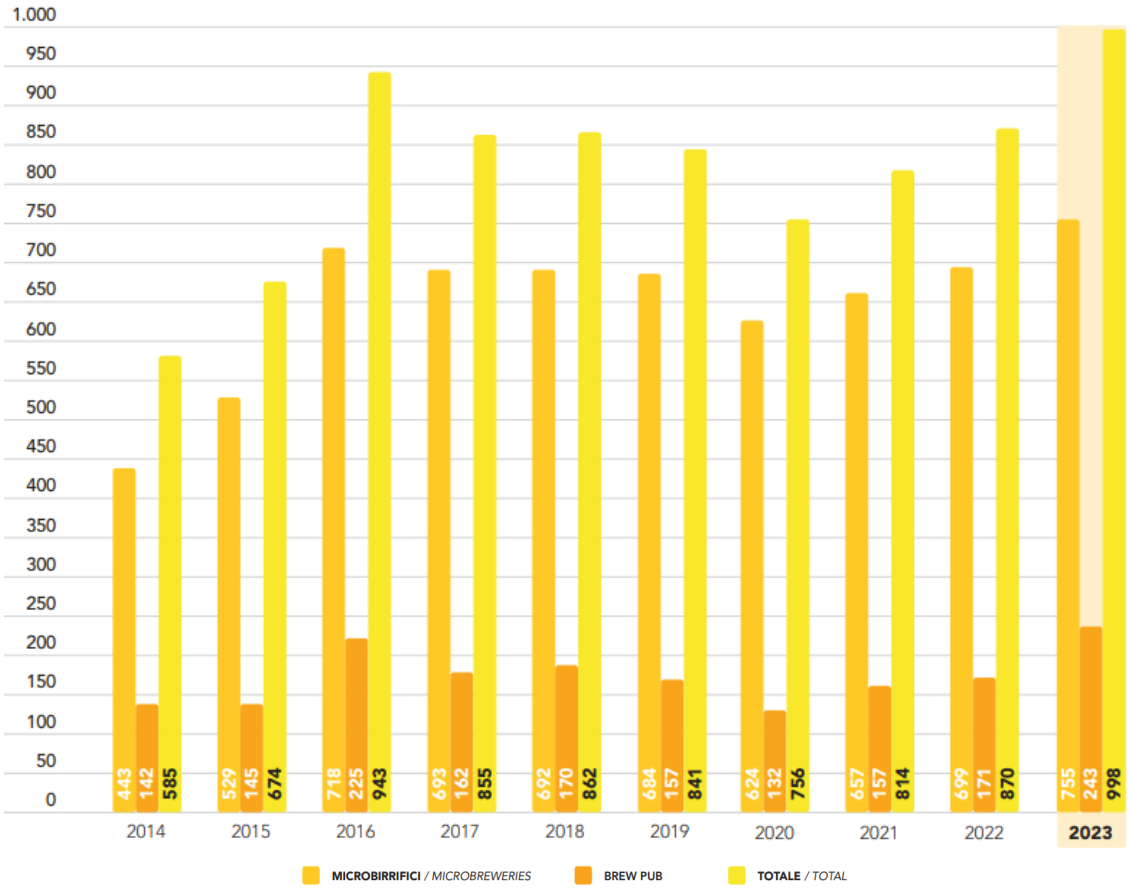

Figure 4-6 -Number of craft breweries in Italy 2014-2023 [101]

Analyzing the geographical distribution of microbreweries and brewpubs in Italy in 2023, shown in *Figure 4-7*, we can see a strong concentration of craft breweries, in some regions compared to others. The regions with the highest concentration of microbreweries are located in the center-north and are Lombardy (115), Veneto (72), Tuscany (70) and Piedmont (61). As for brewpubs, their distribution follows a similar logic, but with lower numbers. Veneto has the lead with 35 brewpubs, followed by Piedmont (32) and Lombardy (30)

Figure 4-7-Geographical Distribution of Craft Breweries in Italy 2023 [101]

4.6 Consumer Preferences

From a survey conducted by BVA Doxa for the Centro Informazione Birra (CIB) of AssoBirra in 2023, it emerges that beer is considered an “inclusive drink” by 9 out of 10 Italians because it is suitable for everyone, without any distinction of gender, age, origin or lifestyle. The 89% of those interviewed consider beer an inclusive drink, appreciated across the board by Generation Z, Millennials and Gen X. Among the main reasons are its global availability (87%) and its ability to foster a relaxed social atmosphere (86%). For 36% of young people, beer is the drink of sharing, also thanks to its low alcohol content (82%) and convenient quality-price ratio (81%). Furthermore, for 60% of consumers, beer represents a link with local traditions and a way to explore cultural diversity through its many varieties.[101]

In 2020, A. Carbone and L. Quinci conducted a study on the Italian beer market [117], trying to analyze consumer preferences through a consumer survey. The aim of the study is, first, to understand which factors influence the choice between craft and industrial beers and secondly, to outline the different consumer profiles that emerge from the analysis of these choices. The consumer survey was carried out via a web questionnaire, using a sample of 356 people. At the end of the interview, a choice experiment was introduced: participants took part in five rounds of simulations, during which craft beer and an industrial beer were presented at different prices. In each round, interviewees were asked to make a choice between the two options, with the possibility of opting for neither of them.

Analyzing the answers to the questionnaires A. Carbone and L. Quinci showed that, as regards gender, men consume beer more frequently and in larger quantities than women (61.9% versus 42.9% weekly consumption), but the average expenditure on craft beer is similar between the two genders. Based on age, however, young people between 15 and 25 drink beer more often (1-2 times a week) and in larger quantities (≈0.5 l) compared to those over 46, who consume rarely and in smaller volumes (≤0.33 l) . As regards places and occasions, beer is consumed mainly during aperitifs or in company (38%) and, to a lesser extent, during social events, meals or on weekends. Pubs are the most popular place of consumption (66.9%), where consumers spend on average more on craft beer (16 euros) compared to other places such as discos and restaurants.

The choice experiment also revealed that craft beer was preferred on average 3.5 times out of 5 rounds, compared to 1.1 times for industrial beer. The willingness to pay (WTP) for craft beer is slightly higher than that for industrial beer (4.3 euros compared to 4.1 euros for 0.33 l).
Through a Cluster Analysis it was possible to outline 5 different consumer profiles:

1. *Expert craft beer enthusiasts* (30% of the sample): Regular consumers, with a strong preference for craft beer and a higher average expenditure than other groups. They tend to frequent pubs and beer shops, avoiding beer-related events.

2. *Curious/eclectic consumers* (23% of the sample): Occasional drinkers, open to trying new types of beer but with limited knowledge of craft brands.

3. *Sophisticated consumers* (12.6% of the sample): They prefer other alcoholic beverages but appreciate craft beers for their quality. They frequent pubs and breweries more than other groups.

4. *Craft beer skeptics* (16% of the sample): Moderately interested in craft beer, prefer industrial beer and show the lowest WTB (Willingness to buy) and WTP (Willingness to pay).

5. *"Beers? No, thanks"* (18.3% of the sample): Not inclined to consume beer, prefer other alcoholic beverages and attend beer-related events for social reasons rather than out of interest in the product.

4.7 Distribution channels

Beer distribution is divided into two main distribution channels: On-Trade and Off-Trade. The on-trade channel, often identified with the acronym HORECA (Hotel, Restaurants, Cafes), represents the distribution system that is based on the sale and immediate consumption of beer in dedicated premises such as bars, pubs, restaurants, hotels or night clubs. Beer is mainly offered on tap or in small bottles, with a price that includes not only the product, but also the added value of the atmosphere and service. In fact, customers go to a bar, restaurant or pub to enjoy the atmosphere, socialize and relax. The environment is fundamental and the experience concerns both the atmosphere and the quality of the drink.[118]
The off-trade channel, represented by the Large-Scale Retail Trade (GDO), refers to the sale of beer for home or personal consumption, outside the point of sale. This type of channel includes supermarkets, hypermarkets, discount stores and retail stores. In these shops the consumer can buy beers in a wide range of formats, such as cans, large bottles or multipacks, often at lower prices than on-trade. The focus is on practicality and convenience, with strong competition based on promotions, offers and pricing strategies. This channel responds to the daily needs of the consumer, prioritizing quantity and availability over the consumption experience.[118] The graph *in Figure 4-8* represents the percentage of beer sales volume between the two types of channels, off-trade and on-trade from 2011 to 2023.
As you can see, most sales are made through the off-trade channel, i.e. supermarkets, hypermarkets and discount stores, which have always had a percentage of sales above 50% since 2011. In 2020, the impact of Covid-19 in Italy hit the beer sector, causing a drastic drop in sales in the on-trade channel, which recorded 10% less than the previous year, due to the prolonged closures of bars, restaurants and clubs. The off-trade channel, on the other hand, showed greater resilience, recording an increase in sales thanks to domestic consumption favored by restrictions and lockdowns.

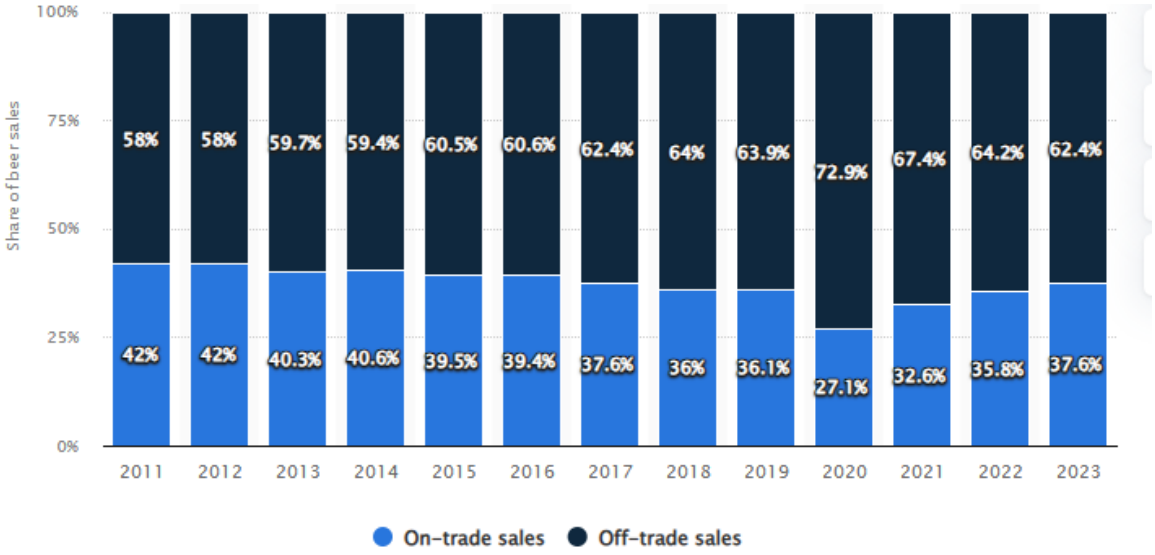

Figure 4-8-On-trade and off-trade share of beer volume sales in Italy from 2011 to 2023 *[119]*

4.8 Packaging

Beer packaging can be considered a part of the beer production process, it not only serves as a means of preserving beer quality and taste but also plays a vital role in capturing consumer attention and increasing sales.

As can be seen from *Table 4-4*, the Italian beer packaging market has a diverse range of options to offer. The most popular type of packaging is the glass bottle, which makes up the majority of the market share (82%). Bottles represent a classic and traditional choice for consumers, also appreciated for their practicality and ease of use. Thanks to technological advances, companies have started to develop increasingly innovative designs and labels, making bottles an even more attractive and distinctive format for the market.

However, in recent years, there has been a growing trend towards cans, which have gained popularity, going from a 5% market share in 2015 to 8% in 2023, thanks to their practicality, portability and the fact that they are easier to recycle than bottles. Additionally, they can have a higher barrier to oxygen and light, providing a longer shelf life for beer; this has made them a favorite choice among consumers, especially for events and outdoor activities. Another type of packaging that is quite widely used in the Italian beer market is the keg. Kegs are mostly used in the hospitality industry, such as bars, restaurants, and pubs, as they offer a convenient option for consumers, who can get a larger quantity of beer at a relatively lower price. With the growing trend of craft beer, kegs have become a favorite option for microbreweries, as they allow them to distribute their beer to a wider audience. Finally, in addition to traditional packaging options, there has also been a rise in the popularity of alternative packaging types,

such as pet bottles and mini-kegs that offer a more sustainable and eco-friendly solution for consumers, as they are lightweight and can be recycled easily.[120]

Tipi di contenitori *Kinds of Packaging*	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fusti / *Kegs*	11,74	11,59	11,57	11,63	11,71	6,25	7,09	10,45	10,93
Bottiglie di vetro *Glass bottles*									
• a rendere *returnable*	6,41	5,78	5,09	4,73	7,78	7,74	2,77	2,92	2,97
• a perdere *non-returnable*	76,59	77,60	78,36	78,79	73,00	78,28	83,02	78,99	78,09
Lattine / *Cans*	5,26	5,03	4,98	4,85	7,46	7,73	7,12	7,64	8,01
TOTALE / *Total*	100	100	100	100	100	100	100	100	100

Table 4-5-Packaging types 2015-2023 [101]

It can also be noted that the Italian market is characterized by a clear prevalence of disposable packaging, unlike other European countries with a high beer tradition, such as Germany, which prefer returnable packaging. Deposit return systems, also called money order refund systems, are a fundamental way to reduce the production of disposable packaging waste, especially in the food and beverage sector. The reuse process occurs as follows: a container, once emptied, must be returned to the supplier so that it can be reused, after a sterilization process. Generally, those who purchase the product under the money order refund system pay a deposit that is returned upon return. This system guarantees the circularity of the life cycle of the materials (plastic, glass and aluminum) that make up beverage containers, preventing them from ending up wasted in landfills, incinerators or abandoned in the environment. Furthermore, it allows saving the energy needed to create new packaging.[121]
Europe's first Deposit Return Scheme was introduced in Sweden in 1984. The system launched in Lithuania in 2016 is considered one of the best in the world, leading to the recovery of 70% of drinks containers in its first year, and 90% in the second year. Deposit Return Systems are already active in 10 European countries, and 12 additional countries have voted in favor of legislation to introduce similar schemes by 2022 or 2023. Nine countries are discussing what type of deposit system to adopt, and how it should be organized. Only the Czech Republic, Bulgaria, and Italy have not yet started a debate regarding the introduction of DRS on their territory.[122]

4.9 Labeling

Labeling laws in the Italian beer market aim to ensure transparency, safety and compliance with national and European regulations. These rules aim to provide consumers with clear information on ingredients, alcohol content, origin and production methods, promoting informed choices. Labels must comply with sustainability standards, including recycling information, and prevent misleading statements to promote legal competition. Finally, they highlight the risks associated with alcohol consumption to raise awareness of responsible use. The following information must be indicated on the label [123]:

- sales denomination - in the case of beer, it is the legal designation provided for in Law No. 1354/1962
- trademark or business name of the producer, importer or distributor.
- alcohol content expressed as a percentage by volume, if the alcohol content is higher than 1.2% by volume.
- list of the ingredients in descending order by weight as recorded at the time of their use in the production of the beer. For beverages with alcohol content above 1.2% by volume such a list is not required, even if more and more brewers are indicating it.
- net volume, expressed in liters or sub-multiples.
- production batch and bottling date
- minimum shelf life or expiration date
- location of the production plant or, if different, of the packaging plant
- any presence of allergens or substances that cause intolerance (sulfites > 10 mg/kg) - the way in which the allergen is highlighted is not specified but usually boldface or another font is used with respect to the other ingredients. In case there is no ingredient list, then the allergen must be specified (for example, "it contains gluten").
- the conditions of storage or use, if necessary for the characteristics of the product, to avoid alterations and changes to the product in terms of sanitation and organoleptic characteristics

In addition to these mandatory indications, the producer has the possibility of reporting optional information, such as nutritional labeling, advice on food pairings, color and information relating to the production method.
In general, labels are designed above all to capture the attention and stimulate the imagination of consumers. For this reason, many breweries, especially craft breweries, give great importance to the design and graphics of their labels.
In 2023 in Riva del Garda, at the “Il Salone dell’Accoglienza”, the most complete international

fair in Italy in the Ho.Re.Ca sector, the “Best Label 2023” competition took place, dedicated to the technical and graphic excellence of Solobirra’s craft beer. Among the 60 original labels that competed in the Best Label 2023 competition, Dario Frattaruolo Design took first place with the graphic project created for Birrificio Badalà, while the second prize went to the Frei und Zeit studio, with the graphic idea by Arno Dejaco, created for Birrificio Viertel Group srl. Bronze medal for Altea Srl with the label by the Creature Theory Agency graphic studio for Birra Artigianale Impavida.[124]

Figure 4-9- Second Best Label 2023 from Birrificio Viertel Group Srl

Figure 4-10- Best lebel 2023 from Birrificio Badalà

4.10 Malt and Hop supply

The development of the brewing sector in Italy has increased the demand for raw materials, with positive effects on Italian agricultural production and the brewing chain.
As can be seen from the graph in *Figure 4-11*, malt production in Italy reached approximately 80 thousand tons in 2023, covering almost 40% of the national requirement for beer production.
Some of the malthouses responsible for malt production in Italy are: the Agroalimentare Sud S.p.A. malthouse in the locality of S. Nicola in Melfi (PZ), the Saplo S.p.A. malthouse in Pomezia, the Agraria La Chiona company in Spello (PG), Euromalto Srl in Acquapendente (VT) and the Agricola La Vallescura company in Piozzano (PC). The first two are also the largest, capable of transforming more than 80,000 tons of barley into approximately 65,000 tons of malt.[125]
In Italy, the largest buyers of malt are large industrial breweries such as Peroni, Heineken Italia, and Birra Moretti, which purchase both Italian and imported malt to meet their production needs. Another growing segment is represented by craft and agricultural breweries, which seek locally produced malt to ensure the quality and traceability of raw materials. The COBI - Consorzio italiano produttori dell' orzo e della birra, which was already discussed in *paragraph 4.1*, brings together over 90 agricultural companies, and is one of the

key players in the craft malt market. This consortium, in fact, promotes the use of Italian malt and fosters collaboration between barley producers and brewers.[126]

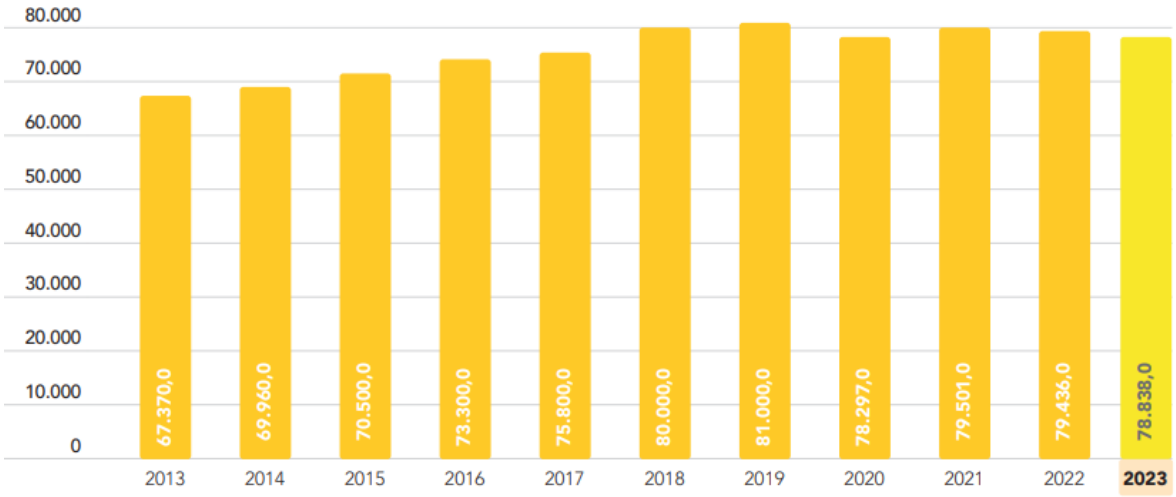

Figure 4-11-Italian Production of Malt (tons) 2013-2023 [101]

However, as can be seen in the table below, most of the necessary malt is still imported from abroad. About 58% of imported roasted malt comes from Germany. Major suppliers of unroasted malt are, instead, France (42%), Germany (32%) and Austria (19%).

TORREFATTO (TONN) / *Roasted (tons)*	2018	2019	2020	2021	2022	2023
Francia / *France* - FR	657,058	1.096,722	680,515	695,332	645,830*	646,210
Paesi Bassi / *Netherlands* - NL	55,933	57,549	41,268	71,050	71,645*	13,915
Germania / *Germany* - D	1.397,498	2.125,615	2.035,454	3.346,042	2.728,677*	2.608,248
Regno Unito / *United Kingdom* - UK	89,950	399,090	237,564	174,950	320,135	351,825
Belgio/Lux / *Belgium/Lux* - B	169,819	585,122	126,799	172,290	534,600*	388,435
Spagna / *Spain* - E				3,999		
Lituania / *Lithuania* - LT					8,000	
Austria / *Austria* - A	195,237	195,271	158,356	99,901*	124,326	51,869
Finlandia / *Finland* - FI						
Ungheria / *Hungary* - HU	30,800	44,000	43,200	19,200	21,138	
Rep. Ceca / *Czech Rep.* - CZ						
Polonia / *Poland* - PL	581,000		150,820	425,440	367,092*	368,723
Stati Uniti / *United States* - USA		2,041				
Sri Lanka / *Sri Lanka* - LKA	1,280					
Altri Paesi / *Other Countries* - UE		0,400			0,675	0,800
TOTALE / TOTAL	3.178,575	4.505,810	3.473,976	5.008,204	4.822,118*	4.430,025

NON TORREFATTO (TONN) / *Unroasted (tons)*	2018	2019	2020	2021	2022	2023
Francia / *France* - FR	53.414,683	54.923,504	51.394,501	46.243,058	53.395,895*	62.420,033
Paesi Bassi / *Netherlands* - NL	445,243	455,285	259,622	180,574	356,201*	369,320
Germania / *Germany* - D	59.683,986	57.656,068	40.915,209	39.138,512	43.724,764*	46.743,901
Regno Unito - UK	1.201,290	1.280,293	661,724	708,905	1.270,789	829,830
Belgio/Lux. - BE	1.154,600	2.906,438	668,403	843,327	1.087,701*	1.158,337
Spagna - ES	78,631	21,480	226,369	2.084,100	2.263,220*	2.740,298
Portogallo - PT	-	-	13,818	-	-	-
Danimarca - DK	3,300	13,033	-	8,800	41,800	-
Finlandia - FI	-	-	-	-	-	-
Polonia - PO	1.078,591	5.294,517	1.088,065	20,000	211,470	805,952
Austria / *Austria* - A	22.877,058	22.179,466	13.289,010	17.400,700	18.603,174*	27.490,379
Slovacchia / *Slovakia* - SLOV	-	-	-	-	-	-
Rep. Ceca / *Czech Rep.* - CZ	3.485,000	1.037,771	21,225	14,900	5,310	3.000,000
Ungheria / *Hungary* - HU	726,540	1.943,680	-	-	5.889,240	659,416
Grecia / *Greece* - GR	-	-	5.374,760	8.706,850	1.129,690*	-
Bulgaria / *Bulgaria* - BG	-	-	-	-	-	-
Croazia / *Croatia* - HR	499,600	-	55,402	2.034,580	3.446,520*	-
Slovenia - SL	-	-	31,367	48,000	53,590	-
Svezia - SE	-	-	23,951	-	-	21,460
Svizzera / *Swisse* - CH	-	-	-	4,650	-	-
Estonia / *Estonia* - EE	-	0,600	-	-	-	-
Romania / *Romania* - RO	-	66,761	-	7,802	-	-
Stati Uniti / *United States* - USA	-	4,082	-	-	-	-
Sri Lanka / *Sri Lanka* - LKA	0,336	0,768	-	-	-	-
TOTALE / TOTAL	144.648,858	147.783,746	114.023,426	117.444,758	131.479,364*	146.238,926

Table 4-6- Italian Imports of Malt 2018-2023 [101]

As for hop cultivation in Italy, most breweries import hops from foreign countries. Europe is the largest producer of hops in the world, has the oldest cultivation tradition and each country is characterized by very specific varietal and quality peculiarities. Germany, in particular,

produces just under half of the entire world's beer hops. As shown in *Table 4-6*, it is not surprising that Germany is the main supplier of hops for the Italian market. In 2023, approximately 72 percent of the hops imported by Italy came from Germany.[101]

However, if until a few years ago hop cultivation in Italy was considered impractical, a significant increase in native production has been observed in recent years, even if volumes remain marginal compared to those of the main producing countries, such as Germany, which dedicates 17,000 hectares to its production. According to recent data published by the Council for Agricultural Research and Analysis of Agricultural Economics (CREA), the area cultivated with hops in Italy has increased from 4.1 hectares in 2015 to 97.5 hectares in 2022, with an increase of 23.7% in the last year. The number of specialized companies has also grown significantly, going from less than 20 in 2015 to almost 200 in 2022, with an average annual growth rate of 55%. This phenomenon, fueled by the interest of breweries in Italian raw materials and the growing demand for zero-mile products, represents a growing trend.[127]

	Luppolo in polvere *Hops Powder*	Estratto di luppolo *Hops Extract*	TOTALE *Total*
Germania / *Germany* - D	1.378,999	2.508,370	3.887,369
Paesi Bassi / *Netherlands* - NL			0,000
Danimarca / *Denmark* - DK		0,001	0,001
Slovenia / *Slovenia* - SL	0,710		0,710
Croazia / *Croatia* - HR		0,003	0,003
Belgio/Lux / *Belgium/Lux* - B	65,917		65,917
Spagna / *Spain* - E	0,080	0,005	0,085
Francia / *France* - F	710,478	712,814	1.423,292
Irlanda / *Ireland* - IRL			0,000
Rep. Ceca / *Czech Rep.*	19,880	9,600	29,480
Polonia / *Poland* - PO	18,145	0,050	18,195
Svezia / *Sweden* - SWE		0,138	0,138
Tot. U.E. / EU	2.194,209	3.230,981	5.425,190
Regno Unito / *United Kingdom* - UK	0,170		0,170
Cina / *China* - RC		0,020	0,020
Nuova Zelanda / *New Zeland* -			0,000
Stati Uniti / *United States* - USA	0,288	0,125	0,413
Altri / *Other*			0,000
TOTALE / TOTAL	2.194,667	3.231,126	5.425,603

Table 4-7-Imports of Hops in Italy - Year 2023 (tons) [101]

4.11 Beer Associations

In Italy, the craft beer scene is supported and represented by two main associations: Unionbirrai and AssoBirra, which play distinct but complementary roles in promoting and protecting the beer sector. Both were created to meet the needs of an evolving market, although they have different goals, compositions and histories.

Unionbirrai is a trade association representing mainly Italian craft breweries. It was founded in 1998, at a time when the craft beer movement was in its infancy and a specific identity for small independent brewers was being formed. Unionbirrai was created with the aim of giving a voice to craft breweries, promoting the culture of quality beer and supporting businesses in the sector through protection and representation activities. This association focuses in particular on small independent breweries that meet the criteria of the legal definition of "craft beer", introduced in Italy in 2016 and discussed in detail in paragraph *4.1 Regulations*. Its main activities include the organization of events and competitions, such as Birra dell'Anno, a prestigious competition that rewards the best Italian craft beers, and participation in trade fairs to promote craft beer nationally and internationally. Unionbirrai also provides technical and legal support to its members, helping them navigate regulatory complexities and develop their businesses. The association's members include breweries, beer firms (companies that design beers but rely on third-party plants for production) and maltsters, united by a commitment to quality and production independence.[128]

AssoBirra, the Association of Beer and Malt Producers, represents a different reality. Founded in 1907, it is the heart of the Italian beer supply chain and brings together the main companies that produce and market beer and malt, integrating industrial and craft brewers in Italy. AssoBirra is a member of Confindustria and of The Brewers of Europe, Euromalt (Comité de Travail des Malteries) and EBC (European Brewery Convention) and through its work it provides employment directly and through its induced activities to approximately 118,000 people**.** This association carries out institutional functions for the beer sector, technological development and promotion of culture, knowledge and responsible consumption of beer. In fact, every year it publishes a report in which beer consumption in Italy is analyzed, through research on the consumption habits of Italians, as well as studies and research on the quality of beer and production technology. The institutional tasks of AssoBirra, on the other hand, focus on the representation of associated companies, both in Italy and abroad, in legislative, legal and trade

union contexts, protecting the interests of the associates towards institutions and stakeholders.[129]

In a constantly growing and evolving sector such as that of Italian beer, these two associations play a crucial role in ensuring the development and diversification of the market. While Unionbirrai protects the identity of craft breweries and promotes creative innovation, AssoBirra represents a point of reference for sector policies and international expansion, helping to create a more integrated and competitive ecosystem.

4.12 Expert Perspectives on the Craft Beer Market

To gain a deeper understanding of the complex dynamics of the craft beer industry and its relationship with the mass industry, a qualitative research approach was adopted. In particular, semi-structured interviews were conducted, an ideal methodology to investigate complex phenomena where insights from key players in the industry are needed. Qualitative interviews allow researchers to capture not only factual information, but also subjective judgements, reasons and experiences that cannot be obtained by quantitative methods.

In this context, the selected interviewees served as privileged observers, a concept emphasized by Piergiorgio Corbetta in his discussion on expert interviews in the book *Metodologia e tecniche della ricerca sociale*. Privileged observers are individuals with specialized knowledge or direct experience in the subject matter under investigation, capable of offering unique insights into industry dynamics, emerging trends, and strategic developments.[130]
In our case, the experts chosen were Lorenzo Dabove, Andrea Camaschella, and Eugenio Signoroni, which are leading names in the beer industry, each with its own perspective on industry evolution and challenges. Their background and long involvement in the sector make them ideal sources for learning about the evolution of the craft beer market, from consumer preferences to competitive strategies.

Lorenzo Dabove, also known as Kuaska, is an international judge and taster, and among the leaders in promoting craft beer culture in Italy with a focus on Belgian beers and traditional lambic. Andrea Camaschella is the editor of Fermento Birra Magazine and a professor at University of Gastronomic Sciences of Pollenzo. Eugenio Signoroni has edited the Guida alle Birre d'Italia and Osterie d'Italia for Slow Food Editore since 2010 and has managed Slow Food Planet, an app that describes how to live Slow in the entire world, since 2014.

The following key themes emerged from the interviews, providing important insights into the complexities of the Italian beer industry.

Market trends: between variety, simplicity and territorial identity

A common theme that emerged from the interviews is the growing diversification of the beer market. Lorenzo Dabove highlights how the revolution that began in 1996 marked the transition from a uniform vision of beer, dominated by industrial products, to a rich and innovative variety. *"Beer doesn't exist, but beers do,"* he says, underlining the importance of the brewer's personality as a distinctive element. Kuaska, in fact, describes the craft brewer as an artisan in the purest sense of the term. "*The product is an extension of the brewer's personality,*" he explains. This concept clearly distinguishes it from industry, where production is mechanized and standardized. Craft beer, on the other hand, is characterized by its uniqueness, reflecting the philosophy and creative flair of the producer. In this regard, he cites Teo Musso, a pioneer of Italian craft beer, as an example of a visionary brewer capable of bringing innovation to the sector.

The advent of craft beer has educated consumers, transforming them from simple occasional drinkers to curious and aware connoisseurs. Kuaska emphasizes that the change has been epochal: *"Once upon a time, no one would have asked why a beer had a coffee aroma. Today, the consumer wants to know, asks questions, is curious."* This new approach has also changed the places and methods of consumption: craft beer has become the protagonist in craft venues, where it is offered in combination with high-quality foods, often zero miles, with a view to enhancing biodiversity. Andrea Camaschella and Eugenio Signoroni also highlight a change in consumer tastes. Camaschella observes that, in recent years, there has been a growing search for simple but well-made beers, capable of combining immediacy and quality. Signoroni confirms this trend, noting how the immediacy of taste is particularly appreciated today, both in the artisanal and industrial sectors. However, both highlight the persistence of a niche of enthusiasts who continue to prefer beers with a strong character, such as extremely bitter or acidic ones. The connection with the territory is another key element. Dabove describes how Italian breweries have valorized local ingredients, from fruit to native cereals, creating unique products that tell the story of Italian biodiversity. Signoroni, and especially Camaschella, note that despite the growing interest in Made in Italy, the sector faces infrastructural limitations. *"Italian raw materials are not yet 100% available,"* says Camaschella, explaining that hop cultivation and the presence of malt houses in Italy are still insufficient. Many breweries rely on foreign malt houses, limiting the possibility of creating a completely local product. However, he suggests that the use of local ingredients, such as fruit and spices, can represent a valid alternative to valorize the Italian identity.

The success of a craft brewery: between passion and entrepreneurship

The three experts interviewed were asked what, in their opinion, are the factors that determine the success of one microbrewery compared to another.

Kuaska argues that the difference between success and failure lies in the ability to understand that making beer is not just an art, but a business in all respects. According to him, there are two key factors for the survival and success of a craft brewery. The first is the awareness of being an entrepreneur: *"The entrepreneur must not only be the one in a suit and tie,"* he says,

referring to the American examples of young producers with a rebellious spirit, but with a clear business strategy. It is not enough to make quality beer, you have to manage marketing, budget, distribution and sales strategies. "*Many have failed and are failing because they don't do their math well."*
The second factor is the quality of the product and the ability to stand out from the industry. According to Dabove, large industrial breweries are formidable adversaries, capable of rapidly adapting and confusing consumers with lines of beers that imitate the craft style, while maintaining industrial processes. *"What's coming to the market now? Unfiltered beers, 7 hops, 5 hops, with packaging similar to ours."* However, the weak point of industrial beers, according to him, is their standardized and uncharacteristic taste: *"We make beers that taste of a lot, they make beers that taste of nothing."*

Signoroni and Camaschella also find themselves in Kuaska's statements. According to Camaschella, the success of a craft brewery depends on a balance between passion and entrepreneurial ability. *"Passion is necessary, but it's not enough on its own,"* he says. Many breweries have opened with enthusiasm, but without a clear business strategy, and then found themselves in difficulty. On the contrary, companies like Baladin have shown how an entrepreneurial vision can make the difference, building solid distribution networks and a constant presence on the market. Signoroni attributes the initial growth of the craft movement in Italy to the individual passion of brewers. "*We are in the order of eight to two: eight passion, two business*," he says, describing how many breweries were founded without a clear economic evaluation. However, he acknowledges that in recent years some producers have adopted a more entrepreneurial approach, focusing on product quality and distribution capacity. These elements, along with the ability to propose something distinctive, are, according to Signoroni, the pillars for the success of a microbrewery.

The challenges of the craft sector and the competition with the industry

According to Camaschella, distribution represents one of the major difficulties for Italian craft breweries. He describes a market dominated by large industries, which use aggressive strategies to consolidate their control. "*Multinationals can offer discounts, gadgets and draft lines to venues, making it difficult for small breweries to compete,*" he explains. However, he cites examples such as Baladin, which has built an independent distribution network to guarantee its presence on the market, but this is very complex and difficult to achieve. Another challenge according to Camaschella but also according to Kuaska, is represented by the "crafty" strategies of large industries, which imitate craft beers through premium lines. Products such as Moretti Grand Cru or Peroni Non Filtrata exploit the aesthetic and taste language of craftsmanship to confuse consumers. "*Large industries play on creating confusion in the consumer, disguising industrial products as artisanal*," he says.

Signoroni also believes that one of the critical points is the limited access of craft breweries to the main distribution channels, such as large-scale retail trade and the HORECA (hotel, restaurant, café) sector. *"We are still in prehistory,"* Signoroni comments, underlining how

craft beer is still relegated to specialized venues and dedicated pubs. This exclusive positioning, although useful for preserving a high-quality image, limits the expansion of the sector.

As for the relationship and competition with the industry, Signoroni describes the period between 2015 and 2020 as a time of opportunity and threat: the craft movement had the potential to erode market share from large industries, but the latter reacted quickly, expanding the range of products and introducing "premium" or "crafty" lines that imitate the characteristics of craft beers*. "The possibilities of the industry are infinite compared to those of craft breweries,"* he says, adding that the inability of the craft world to develop effective strategies has contributed to the current situation, which he calls a "defeat for the craft world."

For both Camaschella and Signoroni, another major challenge for the craft sector is its communication limitations. *"Craft beer is perceived as something elitist, reserved for a few,"* explains Camaschella, criticizing a communication that is often self-referential and difficult for the public to perceive. *"Craft beer must come out of its tower and learn to communicate with the general public,"* he continues. Signoroni emphasizes the need for a "normalization" of the product, that is, the transition from a perception of exclusivity to greater accessibility, without however giving up the identity and quality that distinguish the sector.

Future outlook: consolidation and diversification

Dabove expresses contrasting opinions on the future of the sector. On the one hand, he recognizes that craft beer has run faster than expected, achieving extraordinary results in a relatively short time. On the other hand, he fears that this growth could slow down due to external factors, such as the decline in consumption among young people and the growing popularity of other drinks, such as cocktails and hard seltzer. However, he remains optimistic that the sector can consolidate, provided that craft breweries continue to invest in quality, communication and the valorization of their territorial specificities.

Looking to the future, Camaschella believes that the sector still has potential, but only if it can overcome its current weaknesses. The ability to innovate, build solid networks and valorize the territory will be key elements to ensure a sustainable future.

Signoroni is confident that the craft movement can consolidate, but only if it overcomes some critical issues. *"The issue is finding a way to expand your market and grow that 3%,"* he explains, referring to the market share currently held by craft beers in Italy. A key strategy will be the "normalization" of the product, that is, the transition from a perception of exclusivity to greater accessibility, without sacrificing the identity and quality that distinguish the sector. Signoroni proposes a mixed model for the future, in which a few breweries follow Baladin's entrepreneurial approach, while many others focus on territorial roots. *"What should work is a model of local breweries, strong in their territory,"* he says, citing the example of the

American market, where regional breweries dominate without trying to compete on a national scale.

The themes emerging from the interviews have provided valuable inputs for the development of an econometric analysis in STATA, which will be explored in detail in the following chapter. This analysis aims to identify the factors influencing the evolution of craft beer prices over time and the performance of breweries, ultimately determining the success of one brewery compared to others.

This study will adopt a multi-temporal perspective, analyzing both time-variant and time-invariant factors influencing craft beer prices. Specifically, as a time-variant variable, the impact of each brewery's reputation on the prices of the beer it markets will be examined. Reputation will be measured based on the number of recognitions received in specialized guides and magazines, as well as awards won in annual brewing competitions. It is hypothesized that reputation, defined as the number of awards obtained by each brewery, positively influences price. In other words, breweries that accumulate a higher number of awards over time and, consequently, build a stronger reputation will have a greater ability to set higher prices compared to others. At the same time, the analysis will evaluate the role of beer-specific intrinsic characteristics, which are time-invariant, influencing pricing dynamics. These characteristics include alcohol content (ABV), serving temperature, beer style, color, packaging, and bitterness.

5 HEDONIC MODEL FOR ITALIAN CRAFT BEER

The so-called hedonic pricing technique relates the price of a differentiated product to its specific attributes. In other words, it breaks down explicit market prices into implicit prices of individual product characteristics. The hedonic pricing method originates in agricultural economics, when Frederick V. Waugh (1928) published his pioneering article on the qualitative factors that influence the prices of vegetables. Specifically, he used the regression method to study the price of asparagus in the Boston market according to three qualitative parameters: color gradation, stem size, and tip uniformity. His aim was to determine which of the three characteristics was the most relevant for consumers in their purchasing decisions for vegetables. The concept of the "hedonic pricing method" was first introduced by Court (1939), with a study on the variation of prices in the automobile market in relation to performance characteristics [131],[132].
Subsequently, the hedonic pricing technique has been widely used to analyze durable goods, such as housing (e.g., the study published by Can in 1992 [133]), automobiles (e.g., Murray and Sarantis' 1999 paper [134]) and personal computers (e.g., the work done by Berndt and Griliches in 1990[135]), which lend themselves to this kind of analysis being highly differentiated and with easy-to-identify characteristics. However, in the last decade hedonic price analyses have also been performed for some non-durable goods, especially wine. Unlike wine, which appears in economic literature with many studies (e.g., Nerlove, 1995; Lima, 2006; Benfratello et al., 2009; Michis and Markidou, 2013), beer has been the subject of relatively little research using hedonic methods to price it.

In hedonic regression models on wine, we often find variables related to sensory attributes (such as firmness), objective attributes (such as grape variety) and chemical attributes (such as alcohol content). These attributes have often been used to study the effects of reputation on prices. A similar approach can be adopted in the study of the beer market. In this context, objective characteristics may include the style and country of origin of a given beer or brewery, while sensory characteristics may include elements such as color and serving temperature. Chemical attributes, on the other hand, may concern alcohol content and caloric value. Furthermore, even in the beer sector, the reputation of certain beers or breweries can be analyzed through, for example, the annual awards and recognitions obtained, during festivals or directly in guides, competitions and dedicated publications, such as "La guida alle Birre d'Italia" and the "Birra dell'anno" competition by Unionbirrai. The thesis has precisely this objective by trying to understand if the reputation of a brewery influences the prices of craft beers and how, together with the intrinsic characteristics of the beers marketed.

5.1 Literature Review

Ruttanajarounsub (2007) [136]examined the U.S. beer market, identifying advertising expenditures, beer type, and country of origin as significant factors, with non-neighboring

countries exerting a positive price effect and neighboring countries a negative one. In Chile, Cerpa and Melo (2011)[137] found that packaging, alcohol content, consumer ratings, and beer type influenced prices, with Easter Island beers and craft beers commanding the highest premiums.

Smith et al. (2016)[138] demonstrated that consumer ratings and alcohol content significantly impact beer prices, with a 10-point increase in ratings leading to a $0.50 rise per unit. Wieczorek and Czupryna (2021) highlighted the importance of fermentation type, beer quality (ratings, reviews, awards), and primary ingredients in the Polish beer market. More recently, Michis (2022)[139] proposed regression models accounting for sensory, objective, and chemical attributes of beer, addressing the endogeneity between consumer ratings and prices through instrumental variables.

As previously said, the analysis presented in this thesis expands the existing literature by examining the key determinants of Italian craft beer prices from a multi-temporal perspective, incorporating both time-variant and time-invariant variables. Specifically, it investigates the influence of dynamic elements, such as the awards received by breweries over time, considered as indicators of reputation, alongside intrinsic beer characteristics that remain constant over time, including alcohol content, serving temperature, style, and color, in determining beer prices. By integrating these aspects, the analysis aims not only to provide a deeper understanding of the mechanisms underlying price formation in the Italian craft beer market but also to identify the key factors contributing to a brewery's success.

5.2 Data Description

In order to develop hedonic regression models on craft beer prices in Italy, the information used was collected through the analysis of various published sources, such as economic reports, price lists and guides to the Italian brewing industry. The starting point for the construction of the database was an interview with one of the experts in the Italian craft beer sector, namely Lorenzo Da Bove, aka Kuaska. Through Kuaska, in fact, it was possible to get in touch with an important Italian supplier of alcoholic beverages, Timossi Beverage & Food Solutions. Thanks to this contact, four price lists were obtained for the years 2021-2024, containing the prices of craft and industrial beers marketed by the company throughout Italy. Timossi is an Italian company specializing in distribution and services for the food & beverage sector, with a consolidated experience of more than 70 years. It was founded in 1952 in Serra Riccò, in the province of Genoa and started its activity with the commercialization of local products, progressively evolving into a reference reality in wholesale distribution.

Currently, Timossi offers a wide range of services from the distribution of products for the HoReCa and Super HoReCa sector to training and consultancy for operators in the sector. The company's distribution coverage is very extensive, with a network of over 30 agents operating daily in the provinces of Genoa, Savona, Imperia, La Spezia and Alessandria, while wholesale

distribution reaches the entire national territory, and the company currently has annual revenues of approximately 50 million euros.
Each price list supplied by Timossi provides a wide selection of beers, including both craft and industrial products. For each of the beers, the following data is included in the price list: a unique identification number of the article, the packaging format (e.g. 33 cl bottle, 33 cl can, 75 cl bottle, etc.), the gross price, which represents the total cost of a box or case, including VAT but excluding specific taxes and excise duties, the value of the taxes applied to each box , the number of units contained within each package, and the net price, i.e. the final cost including both VAT and taxes and excise duties. Finally, the price list provides the unit price (*BeerPrice*), which indicates the cost of each bottle or can inside the package, including VAT and taxes. From the price lists for the various years, industrial beers were excluded and, given the objective of our analysis, only craft beers were considered, resulting in a single database with a total of 456 observations (114 items) from 2021 to 2024, provided by 14 different craft breweries. In addition, the unit price including VAT but without taxes (*BeerPriceNoTax*) was also calculated.

Variable	Mean	Standard deviation	Min	Max
Lordo	34.733	10.964	19.6	72.1
Tasse	1.192	0.587	0.506	3.978
Netto	35.903	11.227	21.020	73.230
BeerPrice	3.153	1.501	1.75	8.25
BeerPriceNoTax	3.052	1.462	1.633	7.968

Table 5-1-Descriptive statistics: Prices and excise

Building upon this database, additional information on the specific characteristics of each beer and brewery was collected from online shops, brewery websites, or direct contacts with the breweries. Some of the data gathered are alcohol content (ABV), serving temperature, type of fermentation, color, style, bitterness index (IBU), EBC index, Plato degree, origin region, brewhouse and cellar capacity, year of establishment, cumulative number of awards received by the brewery, and annual revenue. As can be observed, all the variables are time-invariant except the number of awards and revenue, which are time-variant.

Alcohol content is reported in the database as percentage by volume and is used as a numerical variable in the econometric analysis (ABV).

Variable	Mean	Standard deviation	Min	Max
ABV	6.044	1.283	3.6	10

Table 5-2-Descriptive statistics: ABV

Grado Plato (°P) is a unit of measurement used to express the concentration of extract (primarily sugars) in *wort* before fermentation in the brewing process. The Plato value for each item in the database was obtained from brewery websites where available.

Variable	Mean	Standard deviation	Min	Max
Gradoplato	13.9	2.761	8.8	23.5

Table 5-3- Descriptive statistics: Grado Plato

The serving temperature is expressed as a range. For beers and breweries without this information, two other sites were consulted: www.cantinadellabirra.it and www.fermentobirra.com. Within the database, 4 temperature intervals were created and for each of them a dummy variable (servicetemp_dum) was constructed.

Variable	Temp. Interval	Frequency	Percent	Cum.
Tservice_dum1	10-13 °C	40	8.77	8.77
Tservice_dum2	4-6 °C	108	23.68	32.46
Tservice_dum3	6-8 °C	220	48.25	80.70
Tservice_dum4	8-10 °C	88	19.30	100.00

Table 5-4-Descriptive statistics: Service temperature

For what regards fermentation, it can be of three types: top, bottom and hybrid/spontaneous. Also in this case, dummy variables are used as an additional explanatory variable (*fermentation_dum*).

Variable	Fermentation Type	Frequency	Percent	Cum.
fermentation_dum1	Bottom	60	13.16	13.16
fermentation_dum2	Hybrid/Spontaneous	16	3.51	16.67
fermentation_dum3	Top	380	83.33	100.00

Table 5-5- Descriptive statistics: Fermentation Type

Bitterness is measured as IBU (International Bitterness Unit) and so through a numerical variable (IBU). The bitterness value was obtained from brewery websites, and when not available, the websites www.cantinadellabirra.it and www.fermentobirra.com were consulted. However, the IBU value was not found for all beers, and in such cases, it was considered a missing value.

Variable	Mean	Standard deviation	Min	Max
IBU	31.758	15.124	9	78

Table 5-6-Descriptive statistics: IBU

In the dataset there are different types of packaging: 33 cl bottles, 37.5 cl bottles, 75 cl bottles and 33 cl cans. For this reason, the dummy variable (*packaging_dum*) was constructed to include this information in the regression.

Variable	Size	Frequency	Percentage	Cum.
packaging_dum1	33 cl bottle	271	59.43	59.43
packaging_dum2	33 cl can	105	23.03	82.46
packaging_dum3	37,5 cl bottle	12	2.63	85.09
packaging_dum4	75 cl bottle	68	14.91	100.00

Table 5-7-Descriptive statistics: Packaging size/type

Since each brewery records styles with similar but different names, the names assigned to each beer in the database were established by grouping styles into broader categories to avoid having an excessively large number of classifications given the number of observations available. Category names were chosen by taking inspiration from the categories provided in the 2021 BCJP guidelines. The Beer Judge Certification Program, inc. (BCJP) is an international organization that certifies judges of beer and other related fermented products and provides guidelines for craft beer styles. This approach resulted in 11 categories in total (*style_dum*)

Variable	Style Macro (BCJP)	Frequency	Percentage	Cum.
style_dum1	Amber Ales	48	10.53	10.53
style_dum2	American Ales	68	14.91	25.44
style_dum3	Belgian Ales	76	16.67	42.11
style_dum4	British Ales	24	5.26	47.37
style_dum5	European Ales	44	9.65	57.02
style_dum6	Ipa	104	22.81	79.82
style_dum7	Lagers and Pilsners	28	6.14	85.96
style_dum8	Porter and Stouts	8	1.75	87.72
style_dum9	Sour and Wild Beers	24	5.26	92.98
style_dum10	Spiced Beers	8	1.75	94.74
style_dum11	Strong belgian ale	24	5.26	100.00

Table 5-8-Descriptive statistics: Beer Styles

Beer color can be of four types: light, light amber, deep amber and dark. Each category has a dummy variable (color_dum). The color has been taken from the brewery website or from www.fermentobirra.com

Variable	Color	Frequency	Percentage	Cum.
color_dum1	deep amber	64	14.04	14.04
color_dum2	light amber	124	27.19	41.23
color_dum3	light	248	54.39	95.61
color_dum4	dark	20	4.39	100.00

Table 5-9-Descriptive statistics: Beer color

Another information included in the database is the region where the brewery is located, which corresponds to the geographical area where a specific beer from the price list is produced. A dummy variable (*Region_dum*) is created for each region. Among the 14 breweries analyzed, 4 are located in Piemonte (Birrificio Canediguerra, Birrificio Baladin, Birrificio Carrù, and Birrificio della Granda), 4 in Liguria (Maltus Faber, Birrificio Nadir, Birrificio del Golfo, and Birrificio Argo), 2 in Umbria (Birrificio dell'Eremo and Birrificio Flea), 1 in Veneto (Birrificio Mastino), 1 in Lombardia (Birrificio Vetra), 1 in Marche (Birrificio dei Castelli), and 1 in Emilia-Romagna (Birrificio Ca' Del Brado). This distribution is presented in the graph below, *Figure 5-2* instead represents the number of beers per region.

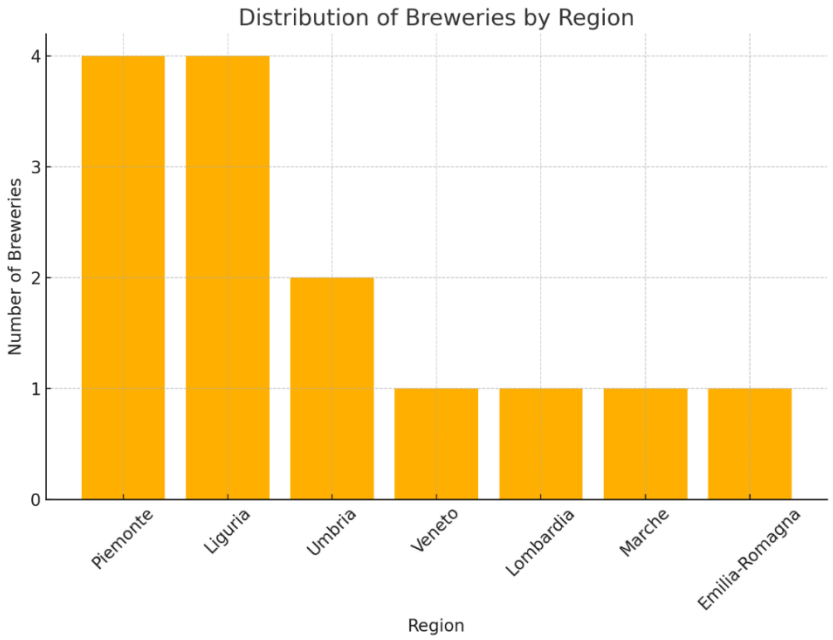

Figure 5-1- Number of breweries per region

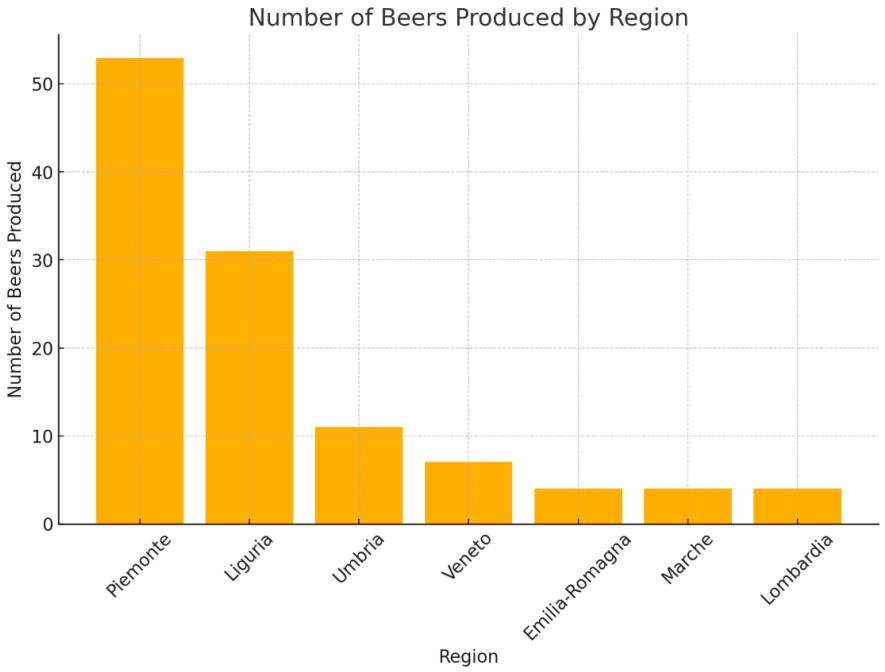

Figure 5-2-Number of beers produced by region

Characteristics of the craft brewery such as cooking room dimension and Basement dimension are numerical variables, expressed in hectoliters (*CookingRoomDimhl* and *BasementDimhl*).

Variable	Mean	Standard deviation	Min	Max
CookingRoomDimhl	24.833	12.852	9	50
BasementDimhl	783.421	1053.818	50	3400

Table 5-10-Descriptive statistics: Breweries dimension

As a reputation indicator for each brewery in the database, it was decided to use the cumulative number of awards obtained by each brewery since the beginning of its production activity. In particular, the awards received in the “Guida alle Birre d'Italia” (published every 2 years since 2009) and in the “Beer of the Year” competition organized by UnionBirrai every year, were taken into account.

Variable	Mean	Standard deviation	Min	Max
BreweryAwardsCum	20.17	21.17	0	76

Table 5-11-Descriptive statistics: Cumulative number of breweries awards

The acquisition of revenue data for individual breweries for the years 2021 to 2024 proved to be particularly complex. In contrast to other variables investigated, information in this regard is not publicly disclosed on the websites of breweries or any other sites. Also, the majority of breweries examined fall under the category of agricultural enterprises, which are not required to disclose their financial statements, which again made it even more difficult to find such information. Following an extensive research process, the revenue data were obtained through Telemaco, an online service managed by InfoCamere on behalf of the Italian Camere di Commercio (Chambers of Commerce), providing access to the Business Register and balance sheets of limited liability companies. Through Telemaco, it was possible to acquire the financial statements of 10 out of 14 breweries, as only these companies are registered as corporations. In contrast, the other 4 breweries, being partnerships, were not available in the Telemaco database. With respect to the data timeline, it was possible to retrieve information up to 2023, as the 2024 financial statements had not yet been filed at the time of consultation.

For the 4 breweries unavailable on Telemaco, there was a need for a direct approach via telephone communication. Two of them cooperated and offered the information requested, but the other two, due to privacy reasons, chose not to share their revenue data.
In particular, the owner of Birrificio del Golfo, one of the two breweries that share with us the data, explained that in 2017 the brewery had been purchased by another company, changing from a partnership to a limited liability company. However, by accessing the financial statements of this new purchasing company, we found that, in addition to carrying out craft beer production and sales activities, it also carries out management services in the catering sector. For this reason, it was decided not to consider the turnover found in the financial statements, as it is believed that it may also contain revenues relating to other activities other than beer production. In conclusion, the analysis made it possible to obtain revenue data for 11 out of 14 breweries for the period 2021-2023, still representing a significant sample for the study

Variable	Mean	Standard deviation	Min	Max
AnnualRevenue	2691789	3090083	86071	9699620

Table 5-12-Descriptive statistics: Annual revenues

Table 5-13 shows the annual revenue trend of several Italian craft breweries examined between 2021 and 2023, highlighting the average annual growth (CAGR). Overall, the beer market (craft and industrial) grew by 7.61%, going from 3.8 to 4.4 billion euros, signaling a positive trend.
Among the breweries analyzed, some recorded significant growth, such as Canediguerra (+14.32%) and Cà' del Brado (+14.33%), while others showed more modest increases, such as

Argo (+2.10%) and Mastino (+5.34%). Birrificio Nadir is the only one to record a contraction in turnover with a negative CAGR of -11.35%. Baladin and Flea, among the breweries with the highest sales volumes, maintained solid growth, respectively 11.99% and 10.64%. However, as previously stated, turnover data for Birrificio dei Castelli and Maltus Faber are unavailable, while those for Birrificio del Golfo were excluded from the analysis.

	Revenue 2021	Revenue 2022	Revenue 2023	CAGR %
Birrifico Baladin	7,734,497.00 €	8,851,163.00 €	9,699,620.00 €	11.99%
Birrifico Flea	5,952,190.00 €	6,209,945.00 €	7,286,179.00 €	10.64%
Birrifcio della Granda	1,450,000.00 €	1,800,000.00 €	1,700,135.00 €	8.28%
Birrificio Canediguerra	1,186,671.00 €	1,522,808.00 €	1,550,836.00 €	14.32%
Birrifcio dell'Eremo	1,085,875.00 €	1,291,616.00 €	1,300,705.00 €	9.45%
Birrificio Vetra	645,150.00 €	875,302.00 €	888,354.00 €	17.34%
Birrificio Mastino	659.937,00 €	710,877.00 €	732,458.00 €	5.34%
Birrificio Carrù	357,154.00 €	435,653.00 €	442,012.00 €	11.25%
Birrificio Cà' del Brado	208,829.00 €	246,272.00 €	272,951.00 €	14.33%
Birrificio Argo	244,140.00 €	307,194.00 €	254,489.00 €	2.10%
Birrificio del Golfo	missing data	missing data	missing data	missing data
Birrifico Nadir	109,514.00 €	113,421.00 €	86,071.00 €	-11.35%
Birrifico dei Catelli	missing data	missing data	missing data	missing data
Birrificio Maltus Faber	missing data	missing data	missing data	missing data
tot beer market revenues (craft and non-craft breweries/firm)	3.8 billion €	4.1 billion €	4.4 billion €	7.61%

Table 5-13- Craft Breweries annual revenue 2021-2023

5.3 Regression models

5.3.1 Regression models on beer prices

To understand the factors that influence the price of each beer, it was necessary to build regression models on STATA. In particular, to analyze the impact of the awards received by

breweries, used as indicators of reputation, on the price, a fixed effects model for each brewery was adopted. This means that, using this model, the analysis was conducted at the individual beer level within the database while controlling for brewery fixed effects.

A fixed effects model is an econometric technique used to perform analyses on panel data, i.e. a dataset that collects observations on multiple units over time, in our case over a 4-year period from 2021 to 2024. For our analysis, a fixed effects model for each brewery was used because it allows us to eliminate the bias resulting from structural differences between breweries, such as general product quality, branding and location. Furthermore, only the variations within each brewery are analyzed by comparing the brewery with itself at different points in time. By using this model, we should be able to isolate the true impact of awards received on the price of each brewery's beers.

The first regression model that was constructed is as follows:

$$log_{pnotax} = f\left(\begin{array}{c} BreweryAwardCum, ABV, packaging\_dum, color\_dum, style\_dum, \\ fermentation\_dum, brew\_dum, glutenfree\_dum, Tservice\_dum, \end{array}\right)$$

To explain the variations in beer prices, measurements concerning the following aspects of beer have been used as explanatory variables: chemical characteristics (fermentation type, ABV), sensory characteristics (service temperature, color), objective characteristics (style category, gluten free, packaging). The variable *brew_dum* was used in the model to represent the fixed effects for each brewery, while the variable *BreweryAwardCum* is the key variable of interest, included to assess the impact of breweries' reputation on beer prices while controlling other factors listed before.

In this estimation, the omitted variables, used as reference, are:

- For style_dum: style_dum6 = IPA
- For glutenfree_dum: glutenfree_dum1 = no
- For packaging_dum: packaging_dum2 = 33 cl bottle
- For Tservice_dum: Tservice_dum2 = 4-6 ° C
- For color_dum: color_dum4 = dark
- For brew_dum: brew_dum13= Birrificio Nadir
- For year_dum: year_dum1 = 2021
- For fermentation_dum: fermentation_dum1 = Bottom Fermentation

The estimation results for the model described above are presented in *Table 5-14*

R-squared	= 0.9599
Root MSE	= .07907

(Std. Err. adjusted for 14 clusters in Brewery)

log_pnotax	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BreweryAwardCum	.0086467	.0038538	2.24	0.043	.0003211	.0169724
ABV	.0406461	.008916	4.56	0.001	.0213843	.0599079
packaging_dum2	-.0997847	.0915095	-1.09	0.295	-.297479	.0979096
packaging_dum3	.872123	.0464303	18.78	0.000	.7718165	.9724295
packaging_dum4	.8627925	.0399017	21.62	0.000	.7765901	.9489949
color_dum1	-.055827	.0384243	-1.45	0.170	-.1388376	.0271835
color_dum2	-.0475752	.0365318	-1.30	0.215	-.1264974	.031347
color_dum3	-.0382271	.038552	-0.99	0.340	-.1215136	.0450593
style_dum1	-.0606278	.0190368	-3.18	0.007	-.1017544	-.0195012
style_dum2	-.0752577	.0204107	-3.69	0.003	-.1193524	-.031163
style_dum3	-.0379125	.0278306	-1.36	0.196	-.0980368	.0222118
style_dum4	-.0383674	.0234476	-1.64	0.126	-.0890228	.012288
style_dum5	-.0685403	.0288638	-2.37	0.034	-.1308968	-.0061837
style_dum7	-.0516536	.0489723	-1.05	0.311	-.1574517	.0541446
style_dum8	-.0680473	.0501424	-1.36	0.198	-.1763733	.0402788
style_dum9	-.1143209	.0954002	-1.20	0.252	-.3204204	.0917787
style_dum10	-.0618429	.0542537	-1.14	0.275	-.1790509	.0553651
style_dum11	-.0423944	.0554296	-0.76	0.458	-.1621427	.0773539
brew_dum1	-.1134022	.0344616	-3.29	0.006	-.1878519	-.0389525
brew_dum2	-.6663431	.2510728	-2.65	0.020	-1.208753	-.1239334
brew_dum3	-.1121923	.1194781	-0.94	0.365	-.370309	.1459244
brew_dum4	-.215601	.0263489	-8.18	0.000	-.2725244	-.1586776
brew_dum5	-.1520797	.0281297	-5.41	0.000	-.2128502	-.0913092
brew_dum6	-.2032149	.1243159	-1.63	0.126	-.4717831	.0653533
brew_dum7	-.0295806	.0347725	-0.85	0.410	-.1047021	.0455409
brew_dum8	-.2053401	.1517488	-1.35	0.199	-.5331734	.1224933
brew_dum9	-.3251128	.057521	-5.65	0.000	-.4493793	-.2008463
brew_dum10	-.4186949	.0499652	-8.38	0.000	-.5266381	-.3107517
brew_dum11	-.1224547	.0577557	-2.12	0.054	-.2472284	.002319
brew_dum12	-.0040517	.0427393	-0.09	0.926	-.0963843	.0882809
brew_dum14	-.2515345	.0262969	-9.57	0.000	-.3083454	-.1947236
fermentation_dum2	-.0068085	.0510353	-0.13	0.896	-.1170636	.1034466
fermentation_dum3	.0447118	.0468264	0.95	0.357	-.0564504	.1458741
glutenfree_dum2	.0349219	.0200645	1.74	0.105	-.0084248	.0782686
Tservice_dum1	-.0181026	.0460983	-0.39	0.701	-.1176918	.0814867
Tservice_dum3	-.013999	.0230678	-0.61	0.554	-.063834	.035836
Tservice_dum4	-.0112265	.0459637	-0.24	0.811	-.1105251	.0880721
_cons	.7881826	.0699785	11.26	0.000	.6370033	.9393619

Table 5-14- Regression model n.1 on Beer Price

Analysing the effect of the individual variables on beer prices, it can be observed that:

- BreweryAwardCum has a positive and significant effect at 5% on price. Specifically, a one-unit increase in the number of awards for a brewery is associated with a beer price increase, on average, of 0.86%.
- The ABV (Alcohol by Volume), with a coefficient of 0.0406 and a p-value of 0.001, is also positive and significant at 1%. Specifically, a one percentage point increase in the alcohol content of beer is associated with a price increase of 4.06%
- Regarding the beer format, as we might have expected, both the 37.5 cl bottled format (*packaging_dum3*) and the 75 cl bottled format (*packaging_dum4*) have a positive and highly significant (p-value < 0.001) impact on price, compared to the omitted category (*packaging_dum3*=33 cl bottled).
  In this case, we cannot approximate the percentage increase using the regression coefficient, as the latter is very different from zero. Using the specific formula to calculate the percentage change, we see that the price of 37.5 cl beers is 139% higher than that of 33 cl bottled beers. For the 75 cl format, the increase is 135%, which makes sense, considering that the capacity is more than double respect to the 33 cl format. For the 37.5 cl bottle, the considerable price difference compared to the omitted category can be explained by the fact that this is a special format, less common on the market, and often linked to special packaging, which helps to justify the much higher price. The 33 cl can, on the other hand, has a negative but not significant coefficient.
- The color of the beer does not have a significant impact on the price, in fact whether the beer is light, amber or dark, does not seem to make a big difference in terms of market value
- Certain style types have a very significant impact on price: Amber Ale type beers (*style_dum1*) are priced about 6% lower than the omitted category (*style_dum6*=IPA), American Ale (style_dum2) and European Ale (style_dum5) are priced about 7.5% and 6.8% lower than IPA beers, respectively.
- The fermentation method and serving temperature do not have a significant impact on price. The gluten-free characteristic also does not have a particularly significant effect (p-value=0.105); however, the positive coefficient (0.035) suggests that gluten-free beers generally have slightly higher prices than regular beers.
- As for the individual breweries (*brew_dum*), some of them have significantly lower prices than the reference variable (*brew_dum13*= Brewery Nadir). These breweries are Argo, Baladin, Canediguerra, Carrù, Della Granda, Flea and Vetra

For all classes of dummy variables, a joint significance test (*testparm*) has been performed. It is a joint test to see if the dummies among the same class are equal to 0, justifying their presence in the regression.

Variabile Dummy	F-Statistic	p-value
Style (style_dum)	5.67	0.0024
Brewery (brew_dum)	$1.4x10^7$	0.0000
Color (color_dum)	1.34	0.3046
Packaging (packaging_dum)	3242.77	0.0000
Fermenation (fermentation_dum)	2.86	0.0937
Gluten-Free (glutenfree_dum)	3.03	0.1000
Service Temperature (Tservice_dum)	0.13	0.9385

Significance tests showed that the variables of serving temperature and color were not statistically significant, suggesting that they had no significant impact on the model. For this reason and for the purpose of completeness, the same regression model used previously was constructed but without these dummies.

The second regression model that was constructed is as follows:

$$log_{pnotax} = f\left(\begin{array}{c} BreweryAwardCum, ABV, packaging\_dum, style\_dum, \\ fermentation\_dum, brew\_dum, glutenfree\_dum, \end{array}\right)$$

From the results obtained from the model, described in *Table 5-15*, it can be seen that they are in line with those of the previous model, even after removing the non-significant dummies.

				R-squared	=	0.9595
				Root MSE	=	.07886

(Std. Err. adjusted for 14 clusters in Brewery)

log_pnotax	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BreweryAwardCum	.0086309	.003841	2.25	0.043	.000333	.0169288
ABV	.0370907	.0082229	4.51	0.001	.0193262	.0548552
packaging_dum2	-.0975241	.0911784	-1.07	0.304	-.2945031	.0994549
packaging_dum3	.8758899	.0225319	38.87	0.000	.8272126	.9245672
packaging_dum4	.8613899	.0394341	21.84	0.000	.7761977	.9465821
style_dum1	-.0622207	.0159885	-3.89	0.002	-.0967618	-.0276795
style_dum2	-.0720638	.0181381	-3.97	0.002	-.1112487	-.0328789
style_dum3	-.0354314	.0248992	-1.42	0.178	-.0892227	.01836
style_dum4	-.0249515	.0192156	-1.30	0.217	-.0664642	.0165611
style_dum5	-.0628224	.0306202	-2.05	0.061	-.1289734	.0033286
style_dum7	-.0526601	.0528213	-1.00	0.337	-.1667735	.0614533
style_dum8	-.0226641	.0531497	-0.43	0.677	-.1374871	.092159
style_dum9	-.0994712	.0872608	-1.14	0.275	-.2879866	.0890442
style_dum10	-.0610225	.0345038	-1.77	0.100	-.1355633	.0135184
style_dum11	-.0529659	.0471305	-1.12	0.281	-.1547852	.0488534
brew_dum1	-.1057696	.0351937	-3.01	0.010	-.1818009	-.0297384
brew_dum2	-.6589271	.2641321	-2.49	0.027	-1.22955	-.0883044
brew_dum3	-.1152285	.1153714	-1.00	0.336	-.3644732	.1340161
brew_dum4	-.2105783	.0252626	-8.34	0.000	-.2651549	-.1560017
brew_dum5	-.1536771	.020314	-7.57	0.000	-.1975629	-.1097913
brew_dum6	-.1950933	.1170281	-1.67	0.119	-.4479172	.0577305
brew_dum7	-.0367803	.0251234	-1.46	0.167	-.0910562	.0174957
brew_dum8	-.2013398	.1525525	-1.32	0.210	-.5309096	.1282299
brew_dum9	-.3084103	.0444446	-6.94	0.000	-.404427	-.2123935
brew_dum10	-.4223155	.0475307	-8.89	0.000	-.5249994	-.3196316
brew_dum11	-.1166794	.052121	-2.24	0.043	-.22928	-.0040787
brew_dum12	.0016095	.0405709	0.04	0.969	-.0860386	.0892575
brew_dum14	-.2465191	.0218128	-11.30	0.000	-.2936428	-.1993954
fermentation_dum2	-.000256	.0472029	-0.01	0.996	-.1022317	.1017196
fermentation_dum3	.0496209	.0457081	1.09	0.297	-.0491254	.1483672
glutenfree_dum2	.0351312	.0180136	1.95	0.073	-.0037849	.0740472
_cons	.7434939	.0699233	10.63	0.000	.5924338	.8945539

Table 5-15- Regression model n.2 on Beer Price without non-significant dummies

Analyzing the construction of the two previous models and, in particular, the variable *BreweryAwardCum*, whose impact on beer prices is to be assessed, it can be observed that this variable shows a trend over time. In other words, it is not subject to random fluctuations, but follows an upward trend, as the awards accumulated by a brewery cannot decrease. Similarly, the dependent variable (*log_pnotax*), is also influenced by a time trend, as it tends to increase over time, except in exceptional situations, due to inflation.

Consequently, in order to prevent these common trends from distorting the estimation of *BreweryAwardCu*m's effect on price, it is essential to control for time effects. For this reason, a new regression model was created from the first one, including temporal dummies in the

model *(year_dum*), to capture aggregate variations over time and better isolate the specific impact of the variable of interest. By doing so, a model better suited to the objective of our analysis was obtained.

The equation of the newly constructed regression model is as follows and the results obtained are those listed in *Table 5-16*.

$$log_{pnotax} = f\left(\begin{array}{c} BreweryAwardCum, ABV, packaging\_dum, color\_dum, style\_dum, \\ fermentation\_dum, brew\_dum, glutenfree\_dum, Tservice\_dum, year\_dum \end{array}\right)$$

log_pnotax	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BreweryAwardCum	-.0037049	.0011146	-3.32	0.005	-.0061129	-.0012969
ABV	.0404491	.0089829	4.50	0.001	.0210428	.0598554
packaging_dum2	-.1003624	.0921181	-1.09	0.296	-.2993715	.0986467
packaging_dum3	.8716002	.0474649	18.36	0.000	.7690585	.974142
packaging_dum4	.8630622	.0401144	21.52	0.000	.7764004	.949724
color_dum1	-.0564101	.0384126	-1.47	0.166	-.1393955	.0265752
color_dum2	-.0480607	.0368005	-1.31	0.214	-.1275634	.0314421
color_dum3	-.0388957	.0386068	-1.01	0.332	-.1223006	.0445092
style_dum1	-.0609728	.0193784	-3.15	0.008	-.1028374	-.0191082
style_dum2	-.0750381	.0203876	-3.68	0.003	-.1190828	-.0309934
style_dum3	-.0378734	.0279404	-1.36	0.198	-.098235	.0224882
style_dum4	-.039271	.0238978	-1.64	0.124	-.090899	.012357
style_dum5	-.069249	.0291403	-2.38	0.034	-.1322029	-.0062951
style_dum7	-.0508029	.0499201	-1.02	0.327	-.1586488	.057043
style_dum8	-.0672248	.050536	-1.33	0.206	-.1764011	.0419515
style_dum9	-.1150135	.0964654	-1.19	0.254	-.3234144	.0933874
style_dum10	-.060922	.0549764	-1.11	0.288	-.1796913	.0578474
style_dum11	-.0417175	.0557722	-0.75	0.468	-.162206	.078771
brew_dum1	.0076798	.0317262	0.24	0.813	-.0608605	.0762201
brew_dum2	.1905797	.093741	2.03	0.063	-.0119355	.3930949
brew_dum3	-.023912	.1075037	-0.22	0.827	-.2561596	.2083356
brew_dum4	-.1573197	.0239516	-6.57	0.000	-.209064	-.1055754
brew_dum5	-.1393817	.0278213	-5.01	0.000	-.1994859	-.0792775
brew_dum6	.0205876	.1146873	0.18	0.860	-.2271791	.2683544
brew_dum7	-.0506995	.029282	-1.73	0.107	-.1139595	.0125604
brew_dum8	.1320099	.1174901	1.12	0.282	-.121812	.3858318
brew_dum9	-.217055	.0510542	-4.25	0.001	-.327351	-.106759
brew_dum10	-.2513375	.0357093	-7.04	0.000	-.3284827	-.1741923
brew_dum11	.0320605	.0332791	0.96	0.353	-.0398346	.1039556
brew_dum12	.1218572	.0253084	4.81	0.000	.0671816	.1765327
brew_dum14	-.1838089	.0275072	-6.68	0.000	-.2432345	-.1243833
fermentation_dum2	-.0020377	.0497489	-0.04	0.968	-.1095137	.1054382
fermentation_dum3	.0435942	.0470185	0.93	0.371	-.0579831	.1451715
glutenfree_dum2	.0349486	.0201352	1.74	0.106	-.008551	.0784481
Tservice_dum1	-.0179873	.046481	-0.39	0.705	-.1184034	.0824287
Tservice_dum3	-.0144099	.0231697	-0.62	0.545	-.0644649	.0356451
Tservice_dum4	-.0093029	.0467718	-0.20	0.845	-.1103472	.0917414
year_dum2	.0525382	.0109965	4.78	0.000	.0287818	.0762947
year_dum3	.0903422	.0170135	5.31	0.000	.0535868	.1270977
year_dum4	.1087637	.0153306	7.09	0.000	.075644	.1418833
_cons	.7591113	.0765441	9.92	0.000	.5937479	.9244748

Table 5-16- Regression model n.3 on Beer Price with temporal dummies

The analysis of the results reveals a completely unexpected outcome, in contrast to the initial hypothesis and the result of the two previous models. Previously, in fact, in line with the initial hypothesis, it was observed that the number of awards received by a brewery (as indicators of reputation) has a positive effect on beer prices.
However, the results of the following model show a totally opposite effect of awards on price, being negative and significant. From the coefficient (-0.0037) and the p-value (0.005) of the variable *BreweryAwardCum*, it can be seen that a one-unit increase in the number of awards for a brewery is associated with a decrease in beer price, on average, of 0.37%, which is significant at 5%.

Analyzing the variables (*year_dum*), it can be seen that they are all significant at 1% and positive with respect to the omitted variable (*year_dum1*=2021). Specifically, in 2022 prices increased by 5.2% compared to 2021, in 2023 they increased by 9%, and in 2024 they increased by 10.8%, again compared to 2021. This increase can be reasonably attributed to inflation, which registered significant levels especially in the period between 2021 and 2023 and then stabilized in 2024 and is thus in line with the percentages observed in the model. Combining the information from the *year_dum* and the B*reweryAwardCum* variable, we can say that the analyzed companies, all things being equal, increase prices but slightly less than the average inflation in each year.

Going on with the analysis of the results of the model, for the variables ABV, packaging type, fermentation type, service temperature, gluten free, beer style and color, the same considerations can be made as for the previous models in that their effect on price has not changed apart from a slight variation in the coefficients.

Regarding the *brew_dum* variables, now that *year_dums* have been introduced, the results obtained are different from the previous models.
Baladin brewery (*brew_dum2*) sells its beers at an average price 19% higher than that of Nadir (*brew_dum13*), which is the reference category in the model. Similarly, Mastino brewery (*brew_dum12*) adopts a 12% higher average price policy than the Nadir. On the other hand, the Canediguerra, Carrù, Della Granda, Flea and Vetra breweries, as in the previous models, appear to apply lower average prices than Nadir. Specifically, Canediguerra (-16%), Carrù (-14%), Della Granda (-21%), Flea (-25%) and Vetra (-18%).

As for the previous models, for all classes of dummy variables a joint significance test (*testparm*) has been performed.

Variabile Dummy	F-Statistic	p-value
Style (style_dum)	5.70	0.0023
Brewery (brew_dum)	60317	0.0000
Color (color_dum)	1.32	0.3097
Packaging (packaging_dum)	3340.46	0.0000
Fermenation (fermentation_dum)	2.40	0.1295
Gluten-Free (glutenfree_dum)	3.01	0.1000
Service Temperature (Tservice_dum)	0.13	0.9385
Year (year_dum)	23.29	0.0000

Based on the results, a new model was created without the non-significant variables (color, serving temperature, type of fermentation). The results of this new model are listed in *Table 5-17* and were used as a check on what was found in the previous model. The results are in line with those of the old model, and only for the *style_dum* variable, a new style category proves to be significant, namely Lagers & Pilsners (*style_dum7*). In particular, Lagers & Pilsners beers are about 9.2% cheaper than IPAs

Then, for the sake of completeness, a further model was constructed, using a trend instead of time dummies (*year_dum*). The results confirmed what had been estimated earlier, in particular the *trend* variable verified an average price growth over the years of 3.6%, which aligns perfectly with the inflation rates obtained previously with the year dummies.

$$log_{pnotax} = f\left(\begin{array}{c} BreweryAwardCum, ABV, packaging\_dum, style\_dum, \\ brew\_dum, glutenfree\_dum, year\_dum \end{array}\right)$$

R-squared	= 0.9637
Root MSE	= .07471

(Std. Err. adjusted for 14 clusters in Brewery)

log_pnotax	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BreweryAwardCum	-.0039411	.0011651	-3.38	0.005	-.0064582	-.001424
ABV	.0359245	.0074189	4.84	0.000	.0198971	.051952
packaging_dum2	-.0987661	.0925464	-1.07	0.305	-.2987005	.1011682
packaging_dum3	.8921662	.0232438	38.38	0.000	.8419511	.9423813
packaging_dum4	.8600481	.0387583	22.19	0.000	.7763159	.9437803
style_dum1	-.0665459	.0176794	-3.76	0.002	-.1047399	-.0283518
style_dum2	-.0730443	.0191194	-3.82	0.002	-.1143493	-.0317393
style_dum3	-.0369817	.0248024	-1.49	0.160	-.0905639	.0166005
style_dum4	-.0301224	.0160336	-1.88	0.083	-.0647609	.0045161
style_dum5	-.0921196	.0191281	-4.82	0.000	-.1334433	-.050796
style_dum7	-.099004	.0323869	-3.06	0.009	-.1689717	-.0290364
style_dum8	-.0167829	.0517347	-0.32	0.751	-.1285489	.0949831
style_dum9	-.122119	.1019536	-1.20	0.252	-.3423763	.0981382
style_dum10	-.0625459	.0354689	-1.76	0.101	-.1391717	.0140799
style_dum11	-.0527197	.0455192	-1.16	0.268	-.1510579	.0456185
brew_dum1	.012969	.021692	0.60	0.560	-.0338938	.0598317
brew_dum2	.2159654	.089713	2.41	0.032	.0221522	.4097785
brew_dum3	-.0477622	.1043582	-0.46	0.655	-.2732145	.17769
brew_dum4	-.1509677	.0165571	-9.12	0.000	-.186737	-.1151983
brew_dum5	-.1380901	.0206551	-6.69	0.000	-.1827128	-.0934674
brew_dum6	.0278397	.1065382	0.26	0.798	-.202322	.2580014
brew_dum7	-.0521634	.0152952	-3.41	0.005	-.0852066	-.0191201
brew_dum8	.1311408	.1154874	1.14	0.277	-.1183545	.3806361
brew_dum9	-.1975569	.0404065	-4.89	0.000	-.2848498	-.1102641
brew_dum10	-.24592	.022584	-10.89	0.000	-.2947098	-.1971301
brew_dum11	.0400683	.0260126	1.54	0.147	-.0161285	.0962651
brew_dum12	.1241916	.0224515	5.53	0.000	.0756881	.172695
brew_dum14	-.1786106	.0184672	-9.67	0.000	-.2185066	-.1387145
glutenfree_dum2	.0330197	.0184949	1.79	0.098	-.0069361	.0729754
year_dum2	.0523299	.0109586	4.78	0.000	.0286553	.0760044
year_dum3	.0909496	.0169558	5.36	0.000	.054319	.1275803
year_dum4	.109877	.0157293	6.99	0.000	.0758959	.1438581
_cons	.7697904	.0511628	15.05	0.000	.6592598	.880321

Table 5-17- Regression model n.4 on Price with temporal dummies and without non-significant dummies

5.3.2 Regression models on breweries revenue

Given the unexpected results from the models including time dummies, which indicate that brewery awards not only fail to positively influence beer prices but even show a slightly negative and statistically significant effect, further investigation was considered necessary.
For this purpose, Lorenzo Dabove (Kuaska), one of the greatest experts on craft beer in Italy, who had already contributed to the research through the interview discussed in the previous chapter and had provided the price lists used for the construction of the dataset, was again consulted.

During the discussion, the econometric results were discussed, and a possible explanation was identified. According to Kuaska, the reason why the awards won by each brewery do not lead to an increase in the price of beer lies in the structure of the craft beer market itself. In this sector, says Kuaska, awards are not a lever to increase the unit price of the product, but a way to increase the visibility of the brewery. The achievement of awards by a brewery, in fact, Kuaska argues, attracts local media attention, encourages interviews and helps to broaden brand awareness. This process, however, does not directly result in an increase in the price of beer, but rather in an expansion of the customer base. Consequently, breweries that gain recognition over time do not aim to increase the average price of their products, but to increase their customer base and thus sell a larger volume of beer.

The observations provided by Kuaska, therefore, allow us to explain the slightly negative effect of awards on the price of beers, as companies tend to lower their prices in order to be able to increase the quantity sold. The effect of the awards, in fact, according to Kuaska would be found not on prices, but on the quantity produced by each brewery in the dataset.

This interpretation suggested the idea to build a new econometric model, aimed at verifying the impact of awards not on the price of beer, but on the annual quantity sold or produced, by the analyzed breweries.

However, as data on the annual quantity of each brewery was not available, as they were too difficult to obtain, it was decided to use revenue instead of quantity. The analysis therefore focused on revenue trends, examining both the average annual growth rate and the effect of the awards received by the breweries on revenue dynamics over time.

For this new objective of the analysis, a brewery fixed effects model was developed with a different approach than the previous one. Whereas the initial analysis was conducted at the level of the individual beer, using beer price as the dependent variable, the focus here shifts to revenue, which has a granularity at the level of the brewery and not of the individual beer. For this reason, we cannot include the variables used previously, which are specific to individual beer such as style, fermentation method, and color, among others.

The regression model constructed is as follows and the results are shown in *Table 5-17*.

$$log_{fatturato} = f\left(\begin{matrix} BreweryAwardCum, \\ brew\_dum, year\_dum \end{matrix}\right)$$

Again, for the same considerations as in the case of the price regression models, *year dummies* were included in the model in order to adequately capture time effects, as the *BreweryAwardCum* variable follows a time trend.

In this estimation, the omitted variables, used as reference, are:

- For brew_dum: brew_dum13= Birrificio Nadir
- For year_dum: year_dum1 = 2021

The variables *brew_dum6* (Birrificio dei Castelli), *brew_dum7* (Birrificio del Golfo), *brew_dum11* (Birrificio Maltus Faber), on the other hand, are not present in the analysis because, as already mentioned in the description of the dataset, the revenues of these breweries were not available. In addition to these, the variable *year_dum4* (year 2024) is also not present in the analysis, as it was not possible to obtain the turnover for 2024 for any of the breweries, as the balance sheets had not yet been filed at the time of the research.

R-squared = 0.9973
Root MSE = .08837

(Std. Err. adjusted for 11 clusters in Brewery)

log_f	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BreweryAwardCum	.0127834	.0181549	0.70	0.497	-.0276682	.053235
brew_dum1	.8371431	.1754971	4.77	0.001	.4461112	1.228175
brew_dum2	3.572886	1.240583	2.88	0.016	.8086948	6.337077
brew_dum3	.768821	.1270841	6.05	0.000	.4856599	1.051982
brew_dum4	2.555634	.096826	26.39	0.000	2.339893	2.771376
brew_dum5	1.375223	.0181549	75.75	0.000	1.334771	1.415674
brew_dum8	2.169644	.4417686	4.91	0.001	1.185322	3.153966
brew_dum9	2.670469	.1512906	17.65	0.000	2.333372	3.007566
brew_dum10	3.983685	.2299617	17.32	0.000	3.471298	4.496072
brew_dum12	1.804927	.1694455	10.65	0.000	1.427379	2.182476
brew_dum14	1.986447	.0907744	21.88	0.000	1.784189	2.188705
year_dum2	.1577032	.0384372	4.10	0.002	.0720596	.2433467
year_dum3	.1083605	.1163233	0.93	0.374	-.1508239	.3675448
_cons	11.41668	.0234956	485.91	0.000	11.36433	11.46903

Table 5-18- Regression model on breweries revenue

Analysing the results obtained from the econometric model shown in *Table 5-18*, the following considerations can be made:

- With regard to the variable of greatest interest, i.e. *BreweryAwardCum*, it can be seen that the awards obtained by each brewery have a positive impact on turnover of approximately 1.3%, but this effect is not significant (p-value = 0.497)
- An analysis of the *brew_dum* variables indicates that all the breweries included in the model exhibit, on average, higher revenues compared to the omitted reference category (*brew_dum13* = Nadir Brewery). Moreover, these differences are statistically significant, as evidenced by the corresponding p-values. As all coefficients are very different from zero, the percentage increases were calculated with the classical formula and the approximation to the coefficient itself was not used.
  In particular, Birrificio Argo (+130%), Birrificio Baladin (+3451%), Birrificio Ca' del Brado (+113%), Birrificio Canediguerra (+1180%), Birrificio Carrù (+293%), Birrificio dell'Eremo (+767%), Birrificio della Granda (+1343%), Birrificio Flea (5251), Birrificio Mastino (+504%) and Birrificio Vetra (+624%).
- The time dummies analysis shows that the coefficients are significantly higher than those obtained in the price regression model. In particular, the coefficients of *year_dum2* (2022) and *year_dum3* (2023) assume values of 0.157 and 0.108, respectively, indicating an average increase of 15.7% and 10.8% in revenues compared to 2021.
  Unlike previous price models, in which the average increase was 3.6 %, consistent with the inflationary trend over the period, in this case the average increase of 13.25 % is significantly higher than the inflation rate recorded over the same time interval. This suggests that the increase in revenues cannot be explained solely by inflation but it is the result of broader and more complex factors beyond our control.
  This result is due to the fact that the sample analyzed consists exclusively of breweries of a certain quality, all of which are characterized by recognition and have significant growth in revenues over this time frame. So, the time dummies in this particular case represent the average growth not of the entire industry, but of these particular companies examined, making it particularly complex to isolate the effect of awards on turnover. To isolate the effect of awards on revenues, it would therefore be necessary to have a group of breweries without awards, so that a direct comparison can be made between award-winning and non-award-winning breweries and see the different impact of awards on their market revenues.

Nevertheless, we can say that awards have a positive, although limited, effect on the sales growth of the companies analyzed. As Kuaska suggested, awards do not have an effect on the price of beers but rather boost sales and production. Therefore, breweries tend to lower their prices slightly in order to achieve this increase. This would explain the negative coefficient of awards in the price regression model, indicating that their impact is more on sales volumes than on price increases.

In order to ensure an even more complete view and to be able to compare the price and revenues regression even better, the fourth price model with time dummies and without the highly non-significant variables was built again considering only breweries and years for which revenues were also available.

The results obtained are as follows:

				R-squared	=	0.9453
				Root MSE	=	.08295

(Std. Err. adjusted for 11 clusters in Brewery)

log_pnotax	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
BreweryAwardCum	-.0070385	.0024827	-2.84	0.018	-.0125703	-.0015068
ABV	.0467868	.0086631	5.40	0.000	.0274842	.0660894
packaging_dum2	-.0937837	.0878656	-1.07	0.311	-.2895605	.1019931
packaging_dum3	.9184395	.0002888	3180.52	0.000	.9177961	.9190829
packaging_dum4	.8666101	.0773122	11.21	0.000	.6943478	1.038872
style_dum1	-.0719282	.0226688	-3.17	0.010	-.1224375	-.0214189
style_dum2	-.0833714	.0233255	-3.57	0.005	-.1353439	-.0313989
style_dum3	-.0289852	.0350025	-0.83	0.427	-.1069756	.0490052
style_dum4	-.0213062	.0139498	-1.53	0.158	-.0523883	.0097758
style_dum5	-.0919651	.0220721	-4.17	0.002	-.1411449	-.0427853
style_dum7	-.0919956	.0298456	-3.08	0.012	-.1584957	-.0254954
style_dum8	-.0555726	.0521703	-1.07	0.312	-.1718153	.0606701
style_dum9	-.1277792	.1042467	-1.23	0.248	-.3600554	.1044969
style_dum10	-.0771736	.0444012	-1.74	0.113	-.1761056	.0217584
style_dum11	-.103453	.0258236	-4.01	0.002	-.1609915	-.0459145
brew_dum1	.0363691	.0405829	0.90	0.391	-.0540552	.1267933
brew_dum2	.4060049	.1825765	2.22	0.050	-.0008009	.8128108
brew_dum3	-.0666682	.100935	-0.66	0.524	-.2915653	.1582289
brew_dum4	-.1538406	.0256813	-5.99	0.000	-.2110622	-.0966191
brew_dum5	-.1443664	.0242161	-5.96	0.000	-.1983233	-.0904095
brew_dum8	.1968984	.1452795	1.36	0.205	-.1268044	.5206013
brew_dum9	-.1881093	.0462	-4.07	0.002	-.2910495	-.0851692
brew_dum10	-.2291701	.0428636	-5.35	0.000	-.3246763	-.1336639
brew_dum12	.1360288	.034753	3.91	0.003	.0585943	.2134633
brew_dum14	-.1860465	.0293382	-6.34	0.000	-.2514161	-.1206769
glutenfree_dum2	.0405653	.0266686	1.52	0.159	-.0188562	.0999867
year_dum2	.0619734	.0103298	6.00	0.000	.0389571	.0849897
year_dum3	.1165018	.0194511	5.99	0.000	.0731621	.1598415
_cons	.7172445	.0539258	13.30	0.000	.5970902	.8373987

Table 5-19-Regression Model on beer price with the same observation of the Revenue one

Analyzing the results, the same considerations can be made as before, as the effect of awards on prices is again negative and significant. This finding supports our interpretation that awards exert a positive, albeit limited, effect on turnover. The increase in sales and production associated with awards suggests that breweries may respond by slightly reducing prices in order to stimulate demand and achieve higher volumes.

Specifically, the ABV again has a positive coefficient (0.047) and is significant at 1%. This means that an increase of one percentage point in the alcohol content of the beer is associated with a price increase of approximately 4.7%.

With regard to the beer format, both the 37.5 cl bottle format (*packaging_dum3*) and the 75 cl bottle size (*packaging_dum4*) also have a positive and highly significant (*p-value* < 0.001) impact on price, compared to the omitted category (*packaging_dum3*=33 cl bottle format). The price of 37.5 cl beers is 150% higher than that of 33 cl bottled beers, while for 75 cl beers, the increase is 138%. The 33 cl can format, on the other hand, has a negative but not significant coefficient.

The style types, which were significant in model No. 4, continue to be significant on price. In particular, beers of the Amber Ale type (*style_dum1*) are priced about 7.2% lower than the omitted category (*style_dum6*=IPA), those of the American Ale type *(style_dum2*) , European Ale (*style_dum5*) and Lagers & Pilsners (*style_dum7*), are priced about 8.3%, 9.2% and 9.2% lower respectively. Also significant in this new model are beers of the Strong Belgian Ale type (*style_dum11*), which are about 10% cheaper than IPAs.

With regard to the brew_dum variable, the breweries that were significant in model no. 4 continue to be so. Baladin brewery and Mastino sell their beers at an average price that is 40% and 13.6% higher than that of Nadir (*brew_dum13*), respectively. The Canediguerra, Carrù, Della Granda, Flea and Vetra breweries apply lower average prices than Nadir brewery. Specifically, Canediguerra (-15%), Carrù (-14%), Della Granda (-19%), Flea (-23%) and Vetra (-19%).

The gluten-free variable that used to be significant at 10% is now no longer significant, but we can still say that gluten-free beers are generally priced about 4% higher than normal beers.

6 CONCLUSIONS

Over the last few years, beer has become increasingly central in the consumption of the Italian population, which has traditionally been more attracted to wine. This has happened thanks to an industry that has invested in innovation, research and development, but also in the dissemination of beer culture.

Until 2019, the Italian beer market had a long series of successes with historic increases in production, consumption and exports, establishing itself as a key player in both the beverage industry and the national economy. Unfortunately, this long series of successes had to suffer a setback in 2020 with the advent of the Covid-19 pandemic. National beer production, in fact, decreased by 8.4%, from 17,288 thousand hectoliters produced in 2019 to 15,829, after volumes had increased by around 35% in the previous 10 years.

After the end of the pandemic, the sector experienced a remarkable recovery, reaching record numbers in 2022, with 18,352 thousand hectoliters produced. The year 2023, on the other hand, can be defined as a contradictory year of settling and planning, marked by price increases along the entire axis of the production chain. Beer production in 2023 reached 17.4 million hectoliters, down by 5.02% compared to the previous year, but looking at consumption, it can be seen that, compared to ten years ago (2013), it grew by 20.9%, a clear sign of how beer has become an increasingly rooted element in Italian gastronomic culture. In terms of value, sales increased from EUR 3.8 billion in 2021 to EUR 4.4 billion in 2023, with a CAGR of around 7.61%, mainly driven by the increase in market prices due to inflation. However, as regards individual beer consumption, Italy, with 36.1 liters, ranks only 23rd in Europe, where the top positions are occupied by the Czech Republic (128 liters), Austria (99 liters) and Germany (88 liters).

Currently, the beer market in Italy is characterized by an almost oligopolistic structure, with a few large companies holding most of the market shares. There are five major companies: Heineken Italia Spa, Birra Peroni Srl, Anheuser-Busch InBev Spa, Carlsberg Italia Spa and Birra Castello Spa, followed by Hausbrandt Trieste 1892 Spa and Birra Lucana Srl. Calculating the market concentration index (CR5), it is 69.2%, confirming that the sector is highly concentrated in the hands of a few large multinational companies. This implies that competitive dynamics are limited and that smaller companies, such as craft breweries, may find it difficult to access large-scale distribution channels or to compete in terms of price and production volumes.

However, despite this strong concentration, the Italian beer market is distinguished by its dynamism and attractiveness, characterized by the continuous birth, growth and closure of new craft breweries. This phenomenon is favored by the limited incidence of economies of scale and high product differentiation, elements that allow craft brewers to find their own niche within the market. In addition, the increasing sophistication of the Italian consumer,

who is more and more oriented towards refined and distinctive tastes, has favored the development of the craft beer movement with beers with unique characteristics, thus contributing to the diversification of supply.

The first craft brewer entered the market in 1988, and the spread of craft breweries was initially rather slow, but there was an exponential increase after 2000. Over the past ten years, microbreweries have seen a percentage increase of 70.43% (from 443 units in 2014 to 755 in 2023), brew pubs have similarly increased by a share of 71% (from 142 to 243 pubs). With a total of 998 units, Italy is the fourth country in Europe for the number of active craft breweries in 2023, preceded only by France, England and Switzerland, which have 2300, 1779 and 1170 active breweries respectively.

In order to understand what are the key factors that determine the success or not of a craft brewery over the others and what is the relationship of the craft sector with the traditional brewing industry, semi-structured qualitative interviews were conducted with 3 experts of the Italian craft sector: Lorenzo Dabove (aka Kuaska), Andrea Camaschella and Eugenio Signoroni.

The interviews revealed that there are two key factors that determine the success of one craft brewery over another: passion and entrepreneurship. According to Kuaska, if there is only passion, as in most cases, and entrepreneurship is missing, a brewery is condemned to fail. Entrepreneurship in the case of craft breweries includes the ability to manage a distribution, marketing and business strategy. Examples such as Baladin brewery, with a revenue of over EUR 8 million or Flea brewery, with a turnover of over EUR 7 million, show that a correct balance between passion for the product and business management can generate significant economic results.

A recurring theme, highlighted by all three interviewees, is the difficult relationship of the craft world with that of mass production. The industry, in fact, has reacted to the growth of craft beers by introducing “crafty” lines, i.e. products that imitate the aesthetics and language of craftsmanship while remaining industrial, thus generating confusion in the average consumer, who is uneducated in distinguishing “craft” from “crafty”. Added to this are the difficulties of craft breweries in accessing the main distribution channels, often presided over by large companies thanks to aggressive commercial policies.

According to Camaschella and Signoroni, an error of the Italian craft sector has been in its communication with the consumer. In fact, the craft movement has always used a closed and self-referential, sometimes elitist language, addressing almost exclusively a niche of enthusiasts, without elaborating a narrative capable of speaking also to a broader public. This lack of openness has contributed to slowing down the growth of the sector, limiting the penetration of the product in everyday consumer contexts.

According to the interviewees, the future perspective of the craft sector should not be to compete on a large scale with the industry, but to focus on strong territorial roots, excelling in quality and local identity. In fact, a model based on well-managed regional breweries,

capable of enhancing their context, is according to experts the most sustainable way to consolidate the sector.

In the last part of the thesis, an econometric analysis was carried out on STATA through the construction of hedonic regression models, with the aim of giving a quantitative view to the qualitative one provided previously. In particular, the objective of the econometric models constructed is to estimate the factors influencing the price of Italian craft beer, with a particular focus on the impact over time of the awards obtained by each brewery, both on the price of individual beers and on revenues.

The initial construction of the dataset was carried out using four official price lists provided by Lorenzo da Bove and belonging to the supplier Timossi. From these price lists, it was possible to obtain the prices, taxes and excise duties, the format and the names of the producing breweries, of the craft beers distributed by Timossi, for the years 2021 to 2024. This data was integrated with time-invariant information regarding the intrinsic characteristics of each beer (alcohol content, degree of bitterness, style, serving temperature, etc.), and characteristics relating to the individual brewery, such as size of cellar, size of brewhouse and production region. In addition, time variant variables were also added for each brewery, such as annual turnover and cumulative number of awards won (reputation indicator).

Information on the individual beers was obtained by consulting the Italian Beer Guides and the websites of each brewery. Revenues, on the other hand, were obtained by consulting the balance sheets of the companies on Telemaco, an online service of Infocamere that allows access to official data and documents of companies registered in the Italian Companies Register.

From the econometric price models, it can be observed the key role of some variables in significantly influencing the price of craft beer. In particular, the alcohol content index (ABV) has a positive and significant impact on the price, increasing it by about 4.7%. The bottle format has a significant influence, with 37.5 cl and 75 cl bottled beers being 150% and 138% more expensive respectively than the 33 cl bottled format, while the 33 cl can shows no significant effect.

Some beer styles are significant: Amber Ale (-7.2%), American Ale (-8.3%), European Ale (-9.2%) and Lagers & Pilsners (-9.2%) are less expensive than IPAs, as well as Strong Belgian Ale (-10%). In contrast, serving temperature, color and type of fermentation do not influence the price. Regarding the individual breweries, Baladin sells its beers at an average price 40% higher than that of Nadir, which represents the reference category, and Mastino brewery also adopts a 13% higher average price policy. On the other hand, the Canediguerra, Carrù, Della Granda, Flea and Vetra breweries apply lower average prices than Nadir. Specifically, Canediguerra (-15%), Carrù (-14%), Della Granda (-19%), Flea (-23%) and Vetra (-19%).

With regard to awards, a surprising result emerged. Contrary to our hypothesis, in fact, the awards obtained by each brewery would seem not to have a positive and significant influence on the price of beers, but rather a negative impact.

Given these results, Kuaska was consulted again, who argues that awards do not act as a lever to increase the unit price of beer, but rather promote the notoriety of the brewery, stimulating an increase in production and sales. Therefore, companies would tend to lower prices in order to increase the quantity sold, thus explaining the slightly negative and significant coefficient observed on prices.

This interpretation led to the development of a new econometric model to assess the impact of awards not on price, but on the annual quantity of beer produced or sold. However, given the absence of direct data on quantity, annual revenue was used as the dependent variable.

The results of the model show that awards have a slightly positive (+1.3%), but not significant effect on revenues. Furthermore, the temporal dummies show extremely high regression coefficients, describing an average annual increase in revenue of around 12.5%, which cannot be attributed exclusively to inflation, as was the case in the price model, but reflects broader dynamics. This result is due to the fact that the sample used for the analysis is composed exclusively of top-quality breweries, all of which are characterized by awards and significant growth in turnover over the time period examined. Consequently, the time dummies capture the average growth of these specific companies which, as can be seen from the coefficients, are high performers, making it difficult to isolate the effect of awards on revenues. Therefore, in order to isolate this effect, it would be necessary to have a group of breweries without awards, so that a direct comparison can be made between award-winning and non-award-winning breweries and to see the different impact of awards on their turnover.

An interesting idea for future developments of the thesis could therefore be to enrich the dataset created for the present work with non-awarded breweries and build the hedonic regression models again, then compare the new results with those obtained in this thesis.

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