1. Introduction

The European brewery map has changed fundamentally over the last thirty years. The constant acquisition and concentration of traditional industrial brewery production has occurred (Cabras & Higgins, 2016; Hasman et al., 2021; Materna et al., 2019), while there has also been a boom of microbreweries as a socio-cultural response from consumers and local producers to global standardisation in production and taste (Schnell, 2013; Schnell & Reese, 2003; Swinnen, 2017; Wojtyra, 2020). Apart from a sharp increase in the number of breweries, their spatial distribution changed fundamentally as they began to appear even in regions where they were almost historically non-existent (e.g. Garavaglia, 2018). However, the way this ‘microbrewing wave’ has spread across Europe has not yet been systematically mapped. The first goal of this paper is to fill this gap, compiling a database of all breweries in Europe from 1990 to 2020, including their exact geographical location. The second goal of the paper is then to indicate various factors that may explain the spatio-temporal attributes of this wave.

Looking at history, brewing in Europe was largely spatially concentrated in areas with suitable climatic conditions for hops production, namely in the belt from southern England through Benelux, southern Germany and Czechia to Austria and Slovenia (Barth et al., 2020; Kopp, 2014; cf. Kubeš, 2021). While there were tens of thousands of breweries in these areas in the nineteenth century (e.g. around 19,000 in Germany in 1880, or 16,798 in the United Kingdom, in 1881; Pattninson, 2017), beer was brewed only marginally in the rest of Europe. Technological and legislative changes during the industrial revolution allowed the concentration of production in a limited number of larger breweries, which then merged into a few transnational corporations (TNCs) due to globalisation (Harvey, 2010; Hasman et al., 2021). The four largest TNCs currently account for 50-60% of global beer production (Howard, 2014; Madsen, 2020).

Although beer gradually reached all European countries in a small number of large breweries, the concentration of brewing to its traditional areas was still evident in 1990 (Wojtyra, 2020). However, a high density of breweries persisted in only one region in Europe – Bavaria (Maier et al., 2020). There were several reasons for this. Maier et al. (2020) mention the strong connection of breweries with the local community and the specialisation or niche occupation of Bavarian breweries (e.g. high-quality beers, local beers). The second reason is the great emphasis on quality which has been evident since the nineteenth century (Meussdoerffer, 2011) and stems from the strong local anchoring of Bavarian breweries. These have always been very small companies that were part of local guilds and later local powerful industrial associations favoured by state regulations through progressive taxation for example (Carroll et al., 1993). Finally, Bavaria was only marginally affected by the two world wars (unlike Rhineland and Belgium, see Carroll et al., 1993) and did not become part of the Eastern Bloc (unlike Czechoslovakia, where controlled concentration of brewing and
the closure of hundreds of smaller breweries occurred, see Kratochvíle, 2005).

With the exception of Bavaria, however, a unified global market has emerged, offering only slightly different beers in terms of quality and taste, most often lager (Garavaglia & Swinnen, 2017). The products were distributed from a few large breweries within the countries, breaking the bonds between the place of production and consumption. Such bonds were historically essential for beer. Therefore, it lost its characteristic features of a local product related to local identity (Materna et al., 2019). This caused growing opposition to the unified unrooted supply of TNCs and a renewed interest in local beers (Garavaglia & Swinnen, 2017; Wojtyra 2020) and diverse beer offer (Pokrivčák et al., 2019). Beside this socio-cultural reasoning, the emergence of new microbreweries was also supported by the changes directly related to globalisation – better availability of information, raw materials, capital, and technologies necessary for brewery construction and subsequent beer production (Garavaglia & Swinnen, 2017). As a result, the first new microbreweries emerged in the United States in the form of ‘homebrewing’ (Garavaglia & Swinnen, 2018) and the United Kingdom in the form of consumer support for the declining small independent brewing sector in the 1970s (Cabras & Bamforth, 2016; Elzinga et al., 2015; Reid & Gatrell, 2017). The breweries’ establishment accelerated in the 1990s when the wave also spread to other countries, particularly in continental Europe (Wojtyra 2020).

The spread of the brewing wave through Europe can be explained by spatial diffusion theory (Hägerstrand, 1967), which distinguishes the spread of innovations (here microbreweries) by neighbourhood effect (contagious diffusion to neighbouring regions) and hierarchical diffusion (through core areas, especially capital regions). In the second case, we can also understand the core regions as the traditional brewing regions, where interest in microbreweries appears first and from which this wave spreads elsewhere. It thus depends on the beer market’s stage of development in a given country, which we can express using the product life-cycle theory (Hána et al., 2020).

The product life-cycle relates the stage of the production volume development of a certain product with characteristics of the product, producing companies and the whole industry operation (Dicken, 2015; Hána et al., 2020; Vernon, 1966). After the launch of the new product on the market, the first stage (growth) follows, when its production grows, introducing economies of scale. As the product becomes popular, in the second stage (maturity) the market becomes saturated and gradually dominated by successful manufacturers, from which large TNCs can emerge through acquisitions. In the third stage (decline), price reduction, standardisation of mass production, and changes in consumer preferences in favour of the innovative product occur. It is in this third phase when customers become tired of standardised production and look for new special forms of the product or completely new products. Such an opportunity is offered by a socio-cultural turn to local production and locally rooted products – neolocalism (see Schnell, 2013; Schnell & Reese, 2003; Taylor & DiPietro, 2020). Using the beer life-cycle concept defined by Hána et al. (2020), we have made two assumptions. First, beer is a specific commodity whose trading takes place within relatively closed national markets which allows us to independently assess the position of individual countries in the product’s life-cycle. Second, beers from craft breweries represent an innovative separate product whose life-cycle should increasingly compete with the life-cycle of beers from industrial breweries (which still maintain a dominant market share). Therefore, we assume that microbreweries will first emerge in countries that are in the decline stage of the industrial breweries’ beer life-cycle which is most in favour of new consumption possibilities.

2. Materials and methods

2.1. Mapping of European breweries

The primary source about the number and location of European breweries is the website www.ratebeer.com. It is the world’s most famous website associating a community of people who record visited breweries and rate tasted beers. The website was established in 2000, and in 2021 it has over 7,600 active users (with more than 100 ratings added). The indisputable advantage of the database is therefore its robustness and the fact that the records contain brewery addresses and years of establishment or closure.

However, the way records were entered into Ratebeer is also related to some potential issues. Although each user must register and be approved by site administrators before entering records, options for correctness control of the data entered are limited. A large number of obviously incorrect entries are quickly identified and corrected by administrators or the community, but partial errors can remain unnoticed for a long time. Furthermore, if breweries were established or closed before the establishment of Ratebeer (2000), the dates of establishment or closure have to be considered with caution. As a result, there should be hundreds of breweries that ceased to exist between 1990 and 2000, and the data for this period will therefore be underestimated. Importantly, this should distort the absolute number of breweries, but not their spatial distribution.
We checked the reliability of the Ratebeer database by comparing it with the data from the Brewers of Europe reports and various regularly updated national beer websites (Table 1). As Ratebeer includes records about ‘gypsy breweries’ (approximately 15% of records), it exceeds sources from websites from countries where gypsy breweries are omitted (e.g., Poland, Spain, Germany). Conversely, in cases of countries where the base of Ratebeer users is underdeveloped, there are fewer records on Ratebeer (see, for example, France and particularly Russia). The low correspondence between Ratebeer and other sources in Russian and too few breweries reported in Turkey have forced us to exclude these two countries from the analyses.

Despite these limitations, we believe that the robustness of the Ratebeer database, the control system of records, and its solid and reasonable compliance with other sources allows us to use it for mapping the microbrewing wave across Europe. The issue of missing records about breweries operating before the year of Ratebeer’s establishment is largely diminished by the fact that the vast majority of European microbreweries were established after this year (Pattinson, 2017). Moreover, there is no reason to expect that Ratebeer contains any systematic error. Even in countries with a lower correspondence, there are deviations in both directions – they can be either underestimated, perhaps due to a smaller national Ratebeer community, or overestimated due to the lower quality of local beer websites. To conclude, although the Ratebeer database may contain inaccuracies on a detail level, we believe it is suitable for the general mapping of Europe. To maintain international comparability (although partially limited by varying degrees of user activity across countries), we decided against compiling it with other sources and use them only to occasionally fill in missing data on a brewery’s location or year of establishment/closure.

We utilised the data from Ratebeer for the construction of the main database containing information on the number of breweries per million inhabitants in European regions. We chose NUTS 2 regions (or the most comparable administrative units in countries where NUTS classification is not implemented) as the most suitable units in terms of size and comparability. We calculated the data for each year from the period 1990–2020 and they correspond to the first of January. This database served as the main source for all map outputs and calculations and can be downloaded as Supplementary data.

### 2.2. Other methods

We measured the process of spatial diffusion of breweries by several indices. We used the Gini coefficient of concentration weighted by the regional population size to measure changes in the overall degree of breweries’ spatial concentration:

$$G = \frac{1}{2Y} \sum_{i=1}^{k} \sum_{j=1}^{k} \left( \frac{n_i}{n} |y_i - y_j| \right),$$

where $Y$ is the weighted average of the number of breweries per million inhabitants, $y_i$ and $y_j$ corresponding numbers in regions $i$ and $j$, $n_i$ and $n_j$ the population in regions $i$ and $j$, $n$ the total population, and $k$ the number of regions (Novotný et al., 2014).

We measured the relevance of hierarchical diffusion by (1) the share of breweries located in regions of capital cities and (2) the share of breweries in countries belonging to individual stages of the beer life-cycle. We categorised the countries into three stages by a hierarchical cluster analysis using eight variables that define the national beer market (Hasman et al., 2021; Hána et al., 2020) and then compared to each other in terms of the spread of the microbrewing wave. All variables refer to 2008, which is the earliest year with most data available (for descriptive statistics and data sources see Table 2). We measured countries’ similarity by the Squared Euclidean distance and then grouped countries by the Ward’s method.

To evaluate the neighbour diffusion, we calculated the time series of Moran’s I, one of the most widely used indicators of spatial autocorrelation (Cliff & Ord, 1973). Its values range between $-1$ and 1. Positive values denote the clustering of regions with a relatively high occurrence of breweries, while negative values correspond to an improbable situation in which regions with a high number of breweries are adjacent to regions with a low number. Finally, values near zero imply the absence of a spatial pattern in the breweries’ distribution across regions. Moran’s I is computed as

| Table 1. Comparison of the number of breweries listed in the Ratebeer databases and other sources. |
|-------------------------------------------------------------|
| Country | Ratebeer | Brewers of Europe | Local website | Local website – source |
|---------|----------|--------------------|---------------|-----------------------|
| Czechia | 530      | 488                | 507           | https://pividky.cz/    |
| Germany | 2014     | 1539               | 1548          | https://brauer-bund.de/|
| France  | 1026     | 1600               | 1584          | http://yves.bou.pagesperso-orange.fr/brasseries/brasseries_francaises.htm |
| Italy   | 1253     | 874                | 1739          | https://www.microrinifici.org/ |
| UK      | 2395     | 2030               | 1745          | http://www.quaffale.org.uk/ |
| Poland  | 412      | 318                | 262           | https://informatorpwny.wordpress.com/category/mapy-piwnie/ |
| Austria | 337      | 298                | 317           | https://bierland-oesterreich.at/ |
| Spain   | 943      | 538                | 517           | https://cerveceros.org/documentation |
| Russia  | 448      |                    | 1311          | http://f.beerum.ru/viewtopic.php?f=8&t=3945 |
| Turkey  | 14       | 12                 |               |                       |

Main sources: https://www.ratebeer.com/, https://brewersofeurope.org/
follows (Netrdová & Nosek, 2009):

\[
I = k \sum_{i=1}^{k} \sum_{j=1}^{k} w_{ij} (y_i - \bar{y})(y_j - \bar{y}) \sum_{i=1}^{k} \sum_{j=1}^{k} w_{ij} \sum_{i=1}^{k} (y_i - \bar{y})^2 ,
\]

where \( \bar{y} \) denotes the mean number of breweries per million inhabitants across Europe and \( w_{ij} \) corresponds to the weighting matrix, which defines neighbouring localities. Considering the nature of the analysed area, which also includes isolated island regions, and findings of other research (Chocholatá & Furková, 2018; Furková, 2020), we opted for the 8-nearest neighbours scheme. We excluded from the analysis geographically too remote units (Azores, Canary Islands, Crete, Cyprus, Iceland, Jan Mayen and Svalbard, Madeira) which do not have any proximate neighbours. Finally, we identified continuous clusters of regions with a relatively high (or low) number of breweries by the local equivalent of the ‘global’ Moran’s I, Local Indicators of Spatial Association (LISA; Anselin, 1995).

### 3. Results

Based on the beer life-cycle stage (Hána et al., 2020), we divided European countries by cluster analysis into three categories (Figure 1). Table 3 shows the mean values for the beer market characteristics by these categories. Countries in the growth stage have

| Table 2. Characteristics of countries’ beer markets – descriptive statistics. |
|-------------------|------------------|------------------|---|
| Yearly beer consumption per capita [litres] | Mean  | Std. Deviation |
| Share of consumption in restaurants | 64.8  | 23.3 |
| Share of imported beer on consumption | 31.3  | 18.0 |
| Share of lager beers on consumption (2016) | 20.7  | 19.9 |
| Share of TNC on production | 91.6  | 8.3 |
| Concentration of production | 65.1  | 19.9 |
| Number of beer pints affordable per average income (2013) | 745.5 | 391.6 |

Note: unless stated otherwise, all variables refer to 2008. Concentration of production is defined as the share of the three largest brands on the national market.
low beer consumption and affordability with a small share of beer being consumed in restaurants. These countries are at the beginning of beer consumption culture, therefore a high proportion of beer is imported here, and TNCs’ share of production remains relatively low. Higher beer consumption and affordability characterise the maturity stage. TNCs completely dominate in this stage, which manifests in their large market share, high concentration of production, and a very high share of lager as a standardised beer style (Garavaglia & Swinnen, 2017). States in the decline stage have the highest overall beer affordability and consumption in restaurants. The onset of innovative small producers as a socio-cultural reaction on standardised mass production apparently relates to the decline in the TNCs share, lower production concentration, and a more varied beer offer, evidenced by a substantial decline in lager consumption.

Figure 2 shows the breweries’ distribution by the country’s position in the beer life-cycle. Until the mid-2000s, the vast majority of both existing and new breweries concentrated in countries that were in the decline stage by 2008. Conversely, the number of breweries in the countries in the growth stage remained negligible until around 2005 when this group caught up with the countries in the maturity stage. The main microbrewing wave also started in the countries categorised into the decline stage two years in advance (in 2010). Interestingly, the development of countries in the maturity and growth stages is mutually very similar after 2005. Thus, the brewery boom here does not seem to be a consequence of the development of local markets (related to life-cycles, see Hána et al., 2020), but a spatial diffusion from other countries.

Figure 3 presents the changes in the spatial concentration of breweries. In the beginning, breweries were strongly concentrated in a limited number of regions (Main map 1) with a Gini coefficient of 0.75, while the spatial clustering level was moderate (Moran’s I 0.32). LISA maps (Main map 2) reveal a cluster of high values around Bavaria, while low values cluster together in the regions of southern Europe and Ukraine. Due to the large concentration in Bavaria, a relatively small proportion of breweries (6.3%) were located in the regions of capital cities (compared to a 15% share of the total population). During the 1990s, new breweries emerged relatively evenly across all countries in the decline stage, reducing the relative share of Bavaria. This lowered the degree of spatial concentration, but the values of Moran’s I or the share of capitals did not change until the turn of the century when a new cluster of high values appeared in the British Isles. A major turning point came after 2012 when the microbrewing wave entered the countries in the maturity and growth stages.

Table 3. Mean characteristics of countries’ beer markets by life-cycle stage.

|                                | Growth | Maturity | Decline |
|--------------------------------|--------|----------|---------|
| Yearly beer consumption per capita [litres] | 55.8   | 68.0     | 87.7    |
| Share of consumption in restaurants     | 22.8   | 30.7     | 40.8    |
| Share of imported beer on consumption (2016) | 29.6   | 13.3     | 13.9    |
| Share of lager beers on consumption     | 91.9   | 95.1     | 80.0    |
| Number of beer pints affordable per average income (2013) | 575.2  | 675.8    | 1294.9  |
| Concentration of production            | 68.9   | 79.0     | 59.8    |
| Share of TNC on production             | 55.3   | 73.1     | 58.2    |
Eastern France to Spain, via Czechia to Slovakia, and via Austria and Slovenia to Croatia; secondly from Belgium via the Netherlands, Denmark, and Scandinavia to the Baltics; and finally from England to the rest of the United Kingdom and Ireland. Southwestern, Southern, and Northern Europe have thus gradually ceased to be the areas with a low density of breweries, and this status now belongs exclusively to Eastern European regions. Hierarchical diffusion also applies, as the share of the regions of the capital city in the total number of breweries has almost doubled within a few years.

4. Discussion

This paper presents how the microbrewing wave has spread across Europe and attempts to explain it in a multidimensional economic and socio-cultural way. For the first time, this phenomenon is shown and mapped in detail in a context that transcends national borders. This development had two main phases (Main map 1). Firstly, microbreweries as new innovative products were established almost exclusively in the countries belonging to the late life-cycle stage of beer from industrial breweries. The consumers of such countries have turned from the standardised mass production of large breweries and have looked for such specialties that have clear local roots. Therefore, they also became pioneers in the arrival of a new brewing wave. After the speed of the microbrewery boom accelerated massively around 2012, the microbreweries spread to other regions as a socio-cultural fashion wave proven by traditional beer countries, so the position of the countries in the beer life-cycle no longer plays a role. Conversely, there was a tendency to spread to neighbouring regions from the traditional brewing regions as well as hierarchically to the regions of capital cities both in countries in growth and mature stages of industrial beer production.

The research utilised the new database based on brewery data and locations from the Ratebeer website. It is necessary to consider the limitations of these data which, however, should not affect general spatial patterns. We thus believe that our paper and maps provide a unique look at the fundamental changes that beer geography in Europe has undergone over the past thirty years which will be interesting to follow in the future as well.

Software

We used ArcGis 10.8.1 to create Main maps 1 and 2. We calculated cluster analysis in SPSS Statistics 25 and obtained values of Gini coefficients through EasyStat 1.0 (Novotný et al., 2014). Finally, we computed Moran’s I and LISA in GeoDa 1.12.1.131 (Anselin et al., 2006).

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Data availability statement

Data can be downloaded as Supplementary data.

Disclosure statement

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