Demographic trends in urban structures: Comparison of development in the broader centres of the cities of Brno (CZ) and Vienna (AT) in the 21st century

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Abstract. Czech Republic is facing housing insecurity and cities are challenged by a shortage of housing supply. The issue of housing affordability can be demonstrated on the cities of Brno and Vienna, which are connected by a close geographical position and a similar urban development in the 19th century. After 1918 (the disintegration of the Austro-Hungarian Empire), the Austrian capital Vienna has focused on a continual support of social housing. The development of housing in the Czechoslovak city of Brno was changing and influenced by the period of socialism. Since the beginning of the 21st century, the housing development in Brno and Vienna has been therefore, after a politically different period, comparable again. Vienna has a similar historical development to Brno, and in the long term, it represents an adequate comparative study due to a successful social housing policy. In this paper, we mobilize a comparative study of broader city centres. The development of housing is monitored in the parameters of demographic trends. The paper reviews comparable demographic data obtained from databases of the office for national statistics of Austria and the Czech Republic: population development and population ageing expressed as a percentage of the population aged 65+ to the population aged 0-14. The study demonstrates the importance of these two indicators of demographic changes, which can reflect the attractiveness of housing for different groups of residents. The results show that in both cities, there is a population decline in historical city cores. While in the vicinity of the historical core of Vienna, there is moderate population growth, a similarly uniform trend cannot be observed in Brno.

1 Introduction

Over the past couple of decades, housing affordability has become one of the most critical challenges in cities and the Czech Republic is no exception. Many Czech households are struggling to access affordable housing, especially in cities.[1] Development and management of housing can be reflected in the structure of the population and its demographic trends. Recent studies focused on Europe [2] foreign cities [3], or Czech regions

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Several types of urban structures, sets of buildings with repetitive spatial, functional and operational arrangements [5], are used for housing in European cities. These are mainly the growing structures of historical cores, urban blocks from the 19th century, apartment buildings from the 20th and 21st centuries of various spatial forms, neighbourhoods made up of family houses, or high-rise prefabricated panel housing estates from the period of socialism in the second half of the 20th century [5]. The problems and benefits of different urban planning concepts are discussed in many studies at the scale of entire cities [6],[7]. Central parts of European cities can be characterized by similar forms of residential urban structure, especially if the cities have undergone comparable historical and urban development. An example can be the Austrian capital Vienna (approx. 1.92 million inhabitants in 2021), and the Czech city of Brno (approx. 400,000 inhabitants in 2021) are close to each other by geographical distance (approx. 120 km), partially shared historical past within the Austria-Hungary Empire, and a similar urban development due to industrialization in the 19th century. Among other things, rapid urban development in the mentioned period resulted in the demolition of the city wall defensive systems, which enabled the connection of the historic city core with the surroundings and the subsequent construction of numerous residential blocks in the localities around the original historic city [8]. Blocks of apartment buildings created in this way still represent an important form of housing in the current broader centres of the cities of Vienna and Brno. After the disintegration of the Austro-Hungarian Empire in 1918, the two cities developed separately within the successor states - Austria and Czechoslovakia. The number of Viennese residents stagnated or even declined after the collapse of the monarchy, due to the proportions of Vienna as the capital of a much bigger state. In defiance of that, Vienna became known for its social-democratic policy with a long tradition and well-established social housing system [9], which still positively affects the quality of life in the city. In the second half of the 20th century, deindustrialization and subsequent suburbanisation took place in Vienna, which did not manifest itself in Brno until the 1990s [10].

Brno began to develop rapidly with the advent of socialism. In the socialist period, housing construction in Brno was concentrated within the framework of the planned economy in the intensive construction of housing estates on the outskirts of the city, while the maintenance of apartments in the inner city was neglected. Quantitative needs outweighed qualitative requirements. After the period of socialism (1989), various significant changes took place. Šykora, Kamenický and Hauptmann [11] describe commercialization of the historic core, suburbanization, and social differentiation of prefabricated housing estates as the main processes in Brno in the 1990s. Hatz [12] makes the assertion that, suburbanization demonstrated itself in the decline of socially strong groups of the population in the inner city and their movement to the outskirts, which contributed to the restructuring of the inner city. The processes of gentrification and reurbanization work against population decline, which selectively improve selected parts of the inner city, as claimed by Kubeš and Kovács [13] and Musil et al. [14]. These processes concern both the city of Brno and Vienna, but each in a different period.

Not until the end of the 20th century in the conditions of the independent Czech Republic (established in 1993) the housing policy in Brno become more stable. The development of housing in Brno and Vienna, after a long and politically different period, is therefore well comparable again in the 21st century. Albeit the city of Vienna is assumed to be more developed in some aspects. Vienna has a similar historical development to Brno, but in the long term, thanks to a specific and successful social housing policy, it represents an adequate comparative study. Current analytical comparative studies follow up data for entire cities, we believe that a comparative method at the level of city districts has not yet been applied. This
paper mobilizes a comparative study of broader city centres and at the same time asks the question, of whether living in the vicinity of the city centres could currently represent an alternative to living on the outskirts of cities.

The attractiveness of a specific urban structure, especially the historic core or the surrounding structure of apartment buildings, is indicated by the demographic parameters of the territory. But the demographic parameters are resulting reflection of many other factors that were not thoroughly discussed and represent certain limitations in the article. For instance, safety, transport accessibility, the level of civic facilities or the selling prices and rents of apartments.

The aim of the study is to examine demographic trends in the broader centres from the period 2001 to 2021, especially demographic trends at the level of smaller residential structures and small urban districts or cadastral territories. Within the framework of these criteria, this paper attempts to identify similarities and differences over the last two decades, when both cities were developed in comparable socio-economic circumstances.

2 Methods, data, and analysed areas

2.1 Methodology and data

The paper presents mutually comparable, internationally standardized data from the databases of Austria and the Czech Republic. Specifically, it examines the development of the number of inhabitants and the population ageing expressed as a percentage of the population aged 65+ to the population aged 0-14 (the age index [15]). Monitored data reflect the situation in the years 2001 (or 2002 in Vienna), 2011 and 2021. In order to clearly understand the development trends and their spatial relations, obtained data were converted into graphs and maps.

The resulting integrals of the demographic data can indicate the attractiveness or a decrease in the attractiveness of the given territory, if the changes are not caused by some large-scale external factors, for example, the redevelopment of the housing stock. The age structure of the population is also analyzed and the positive structure is considered to be balanced as Kopáčik et al. [16] highlighted in their previous research. For instance, the demographic parameters of the locality may indicate that the number of permanent residents in the area is decreasing, or that children are not represented here. These two important indicators of demographic development may reflect the lower availability of housing for specific groups of the population, for instance, families with children.

In Vienna and Brno, demographic trends are analysed in the population of persons with a habitual residence. The data were obtained from public databases of the National Statistical System of Austria (NSSA) and the Czech Statistical Office (CSO).

The CSO draws from the census of people, houses and apartments, conducted in 2001, 2011 and 2021. The NSSA draws from the population register. In Vienna, the trend of demographic development is analyzed between the years 2002, 2011 and 2021. The analysis begins with the year 2002, after the changes in the administrative system of municipalities and districts. This change redefines and unifies the methodology for obtaining data in the whole Austria, accordingly a person staying at a given address for more than 90 days is considered a person with a habitual residence [17].

2.2 Analysed Areas

The areas of interest are defined by the administrative boundaries of city districts in broader centres of Vienna and Brno.
In Vienna are included districts adjacent to the historic city core (Fig. 1), the original historic city (Innere Stadt) which is also included. The surveyed districts are as follows: Innere Stadt, Landstrasse, Wieden, Margarten, Mariahilf, Neubau, Josefstadt, Alsergrund and Leopoldstadt. The district Leopoldstadt is included only marginally, as it is not a typical urban structure of the vicinity of the city centre and includes a number of other functional areas, especially urban recreation and greenery. Innere Stadt has the character of a historical city core or the original fortified historic city. The other districts are typical districts of residential city blocks.

In Brno, the city district Brno-střed is divided into cadastral territories in the vicinity of the historic city core for better comparability with Vienna. The following cadastral territories are analyzed (Fig. 2): Brno-město – the city's own historic core –, Staré Brno, Štýřice, Pisárky, Stránice, Veveri, Černá Pole, Zábrdovice and Trnitá. Some territories are only partially located in the Brno-střed district, however, for the purposes of our analysis are used only data representing a part of the cadastral territory located in the city district Brno-střed. More specifically parts of the cadastral territories Zábrdovice, Pisárky, Trnitá and Černá Pole. The territory of the Brno-město had grown from the historical structure of the original city, the cadastral areas of Staré Brno, Veveri, Černá Pole, Zábrdovice and Trnitá are dominantly represented by residential buildings, and the more distant localities of Pisárky, Stránice and Štýřice are numerously represented by family houses that can serve as an additional example of the urban structure. Individual localities thus have mutually different urban and social characteristics.

It is important to note that the social structure of the cadastral area Zábrdovice (partly Trnitá) is significantly different, where a significant part of the community has consisted of socially disadvantaged residents for decades (according to data from the CSO, the lower tens percent of residents). For instance, this inevitably poses a question concerning the stability of residential living here and thus also the stability of society. The rental housing of this locality is either represented by municipal apartments with regulated rent (83.3 CZK/m² [18]) or apartments in private ownership, where roughly twice that amount of the rent (advertised on real estate servers) can be additionally financed from the State Investment Support Fund. The knowledge of the calculated rent prices is limited, municipal apartments and private apartments are difficult to compare because, in the case of municipal apartments, the cost includes the rent of the floor area and in the case of private apartments, the cost includes the rent of the floor area and usually also energy costs.
Moreover, a comparison of housing prices for sale of a two-room reference apartment in good technical condition with an area of 50 m² is in the analyzed area at slightly different levels: in the cadastral territory of Zábrdovice (street Bratislavská) the sales price is 89,000 CZK/m², in the cadastral territory Veveří (street Veverčí) 109,000 CZK/m², and in the cadastral territory of Brno-město – the historical city core – (Náměstí Svobody) 115,000 CZK/m² [19].

Additive to the context, data for other city districts outside of the broader centres of Vienna and Brno were also analyzed. The data was processed in the same structure as in the case of individual localities of the main interest.

3 Results and discussion

3.1 Analysis of Vienna

Statistical data from the databases of NSSA has been converted into the following graphs and maps. (Fig. 3-6)
Fig. 4. Age index in individual districts in the broader centre of Vienna in 2002, 2011 and 2021 [17] (compiled by authors)

Fig. 5. Percentage change in the number of inhabitants in individual districts in Vienna between 2002 and 2021 [17] (Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap, and the GIS User Community; compiled by authors)
Fig. 6. Age index in percentages in individual districts in Vienna in 2021 [17] (Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap, and the GIS User Community; compiled by authors)

The only district in Vienna where the population is continuously decreasing (and this locality is ageing significantly at the same time) is the historic core of the Innere Stadt. In all other districts in the central part of Vienna, the population is increasing slightly but steadily. According to the source data, the small increase in the number of inhabitants is mainly due to the increase in the working-age population [17].

In all districts of the central part of Vienna, there is a predominance of residents aged 65+ over children aged 0-14 in 2021. The trend of the development of the age index is increasing somewhere, while it is rather stable elsewhere (Landstrasse, Wieden, Brigittenau, Leopoldstadt). The most significant predominance of residents aged 65+ over children aged 0-14 occurs in the historic core (age index: 256%).

Worth mentioning that completely different trends compared to the broader city centre can be observed in the northeastern and southern parts of Vienna (Florisdorf, Donaustadt, Favoriten, Simmering), where according to the source data [17], there is a significant increase of residents in different age groups, especially children (the age index is low here for this reason).

The population of Vienna as a whole is continuously growing. Between the years 2002 and 2021, the number of inhabitants increased by approx. 350,000 to approx. 1.92 million. In Vienna, the age index increased until 2011, after which the trend reversed (currently 114%).

3.2 Analysis of Brno

Statistical data from the databases of CSO has been converted into the following graphs and maps. (Fig. 7-10)
Fig. 7. Number of inhabitants in individual cadastral territories in the broader centre of Brno in 2001, 2011 and 2021 [15] (compiled by authors)

Fig. 8. Age index in individual cadastral territories in the broader centre of Brno in 2001, 2011 and 2021 [15] (compiled by authors)

Fig. 9. Percentage change in the number of inhabitants in individual cadastral territories in Brno between 2001 and 2021 [15] (Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap, and the GIS User Community, compiled by authors)
In the historic city core of Brno, as well as in Vienna, the population is decreasing. In the broader centre, in the vicinity of the historical core of Brno, a uniform trend of development cannot be observed as in Vienna, where the population is generally slightly increasing, especially the working-age population. Locations close to the historical core in Brno are different from each other in terms of the character of the urban structure. For instance, the cadastral territories Staré Brno, Zábrdovice, and Trnitá are undergoing construction and redevelopment, and thus also face changes in social composition. The cadastral territory of the historic core and Veveří are mainly made of apartment buildings inhabited by the majority population. A similar dwelling urban structure is placed in localities Zábrdovice and Trnitá, however, the structure of the socially weaker population prevails here. In more distant locations, there are cadastral territories made up of family houses (Štýřice, Pisárky, Stránice). These localities can serve rather as supplementary examples of urban structure.

The cadastral territory of Staré Brno recorded a significant increase in the population, especially in the working-age (a total of +35.4% between 2001 and 2021), specifically a sub-location – the so-called basic settlement unit – Pekařská. According to source data [15], between 2011 and 2021 there was an increase of almost 5,000 inhabitants in this locality and a larger number of new apartments were built here. In the cadastral territory of Staré Brno, the age index decreased at the same time. The same phenomenon, albeit to a lesser extent, occurred between 2011 and 2021 in the locality Veveří, where almost no new apartments were built. However, the locality of Veveří still shows a decrease in the number of inhabitants (-7.4%) compared to 2001.

Fig. 10. Age index in percentages in individual cadastral territories in Brno in 2021 [15] (Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap, and the GIS User Community; compiled by authors)
In the part of the cadastral territory Zábrdovice (also Trnitá), since 2001 the number of inhabitants has grown and was subsequently stabilized in 2011. At the same time, in the mentioned part of Zábrdovice, there is a very significant and stable numerical superiority of children over seniors. The age index in 2021 was only 48% here.

According to source data, the reduction of the age index between 2011 and 2021 is a consequence of the reduction in the number of residents aged 65+, not an increase in the number of children, in most of Brno’s localities in the broader centre [15]. The situation is different in the cadastral territory of Zábrdovice or part of Trnitá.

It is worth mentioning the fact that, as well as in Vienna, the increase in the number of inhabitants and at the same time a low age index are shown by urban districts (often with new housing construction) on the outskirts of the city (e.g. Medlánky and Žebětín; age index: 77 and 67%).

The population of Brno has been steadily growing for the past 20 years. Between the years 2002 and 2021, the number of inhabitants increased by approx. 22,300 to approx. 398,510 [15]. In both cities Brno and Vienna, the age index increased until 2011, after which the trend reversed. However, the age index in 2021 in Brno (114%) was still higher than in Vienna (130%).

4 Discussion

It is important to note that the analysis works with statistical data, which are usually based on the number of inhabitants with a habitual residence. However, around a hundred thousand people who are permanently registered elsewhere partially live in both cities. For instance, students, commuters, foreigners without permanent residence including refugees, etc. These people tend to reside in the inner cities rather than in the suburbs. A number of them live at least partially in the city, therefore, the real situation may be slightly different. This phenomenon is also indicated by the results of an investigation based on the movement of mobile phones [20].

The results of the study indicate some changes in the expected trends, therefore, the following discussion rather indicates certain trends and principles that should be further verified. In Vienna, there is a significant decrease in the number of inhabitants, especially in the historic core. A similar development is undergoing also in some parts of the inner city of Brno. Paradoxically, it is not a former working-class district, but rather a former bourgeois district of the city. To some extent, this development can be related to the reduction of the average number of household members in large apartments. In terms of ageing, the inhabitants in the historic centre of Vienna are significantly the oldest from the selected areas, while in the case of Brno, the historic core shows rather average characteristics.

It can thus be conceivably presupposed that Vienna has already gone through the stage of development in which Brno is today. Long after 1989, the housing market was still regulated and it was disadvantageous for residents to change their place of residence according to their social situation in Brno. As a consequence, housing still does not fully correspond to the social structure of the population. Another phenomenon that would also have to be taken into account is migration. Foreign immigrants including refugees and illegal residents in Austria head mainly to Vienna [21], while in the case of the Czech Republic, their main destination is Prague. Moreover, the critical immigration flow of Ukrainians has not yet been reflected in the statistical data.

5 Conclusion

In both cities, a similar demographic trend can be observed in the last two decades. The research shows, that number of residents of the historic cores is decreasing. The issue
apparently rests on the priority to support commercial functions instead of housing functions in this locality, which is supposed to be attractive only from the point of view of users and visitors of the inner city.

Demographic trends of districts close to the historic core are different in the analyzed cities. While in Vienna a steady increase in the number of inhabitants can be observed in all monitored territories, in the case of Brno a similarly uniform trend cannot be observed. This trend is caused mainly due to the mutual differences of localities in terms of the character of the urban structure (often undergoing construction or renewal), the social composition of the population, and thus attractivity to the specific social groups in Brno.

In connection with the observed results is inevitably posed the question, whether housing in the broader centre can represent an alternative to housing on the outskirts of the city. The results indicate, that this can be the case for people of working age. As the results showed, the localities lie mainly in the vicinities of the historic cores. For instance, all Viennese localities around the historic core and localities Staré Brno and Vídeví in Brno. In the case of Brno, an important factor is a stable or increased supply of quality apartments in a safe location (while the support of housing is currently weakened by the absence of a new zoning plan). In the mentioned locations in Brno, privately owned rental housing is in many cases offered for prices, which are driven up and have become to be a problem of availability. This is primarily due to a lack of municipal housing support and the ability to compete with privately owned rental housing.

In the case of Brno, it is interesting to note, that the mentioned marginalized group of society tend to use rented housing in a traditional community, which can be found, for example, in Zábředovice or Trnitá. All age groups of the population, including children, find housing here.

Living in the vicinity of the city centre especially appeals to younger and more educated people. That is also the reason for rebuilding or modernizing individual houses, blocks or streets, while new buildings are usually multi-purpose and combine not only housing but also services and offices. The trend of densification in cities is more advantageous than the continuous monofunctional suburbanization from a territorial and infrastructural point of view (including energy).

An important role in the population growth in Vienna (in all parts except the historic core) can be the tradition of its social housing policy and the resulting good image of the city that attracts residents. The authors point out that in other cities (for instance Berlin) social housing is used as an emergency response to fluctuations in the housing market, while in Vienna it is a long-term conceptual policy. Here can be also seen the difference between Brno and Vienna. One of the factors is housing support from the city, which can be the subject of further, more detailed research. For instance, different forms of apartment ownership can be discussed, including municipal ownership.

The issue of the attractiveness of housing is currently strongly influenced by the dynamic development of the real estate market. In turn, the structure of the urban population is significantly affected by migrants and war refugees, especially from Ukraine. Only the stabilization of the social and economic situation on the Czech and Austrian sides will make it possible to implement a further analysis of the development over time, which will certainly be very desirable.

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