Suburbanization Processes in Sofia: Demographic, Socio-Economic and Spatial Transformation of the Agglomeration Area

Szuburbanizációs folyamatok Szófiában: demográfiai, szocio-ökonómiai és térbeli átalakulás az agglomeráció térségében

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ABSTRACT: The paper studies the agglomeration area of Bulgaria's capital, Sofia. The territorial scope of the metropolitan agglomeration encompasses 7 (LAU 1) municipalities including Sofia, Bozhurishte, Elin Pelin, Gorna Malina, Kostinbrod, Slivnitsa and Svoge, and comprises 146 (LAU 2) individual settlements. The total area of Sofia agglomeration covers almost 3,550 km² (3.2% of national territory), while it had 1,359,270 inhabitants (almost 21% of national population) according to the last population census (7 September 2021). During the whole period between 2001 and 2021, Sofia agglomeration has grown in population by more than 95,000 people (7.6%). Bozhurishte, Kostinbrod and Elin Pelin,

along with Sofia municipality itself, are the municipalities with the best demographic indicators within the agglomeration area. According to the typology of Webb, type 6 agglomeration settlements (migratory and natural decrease, natural > migratory) are predominant during the first subperiod (2001-2011), while type 8 (migratory increase compensates for natural decrease) has become the leading type in the second subperiod (2011-2021). Despite the increasing number of type 8 settlements, however, the population decline of Sofia city alone (19,361 people) exceeds more than twice the combined population growth of all type 8 settlements (8,929 people), and as a result – the total population number of the agglomeration declined during the second subperiod.

In 2021, the GDP in Sofia agglomeration represented 43% of the national economy, while the GDP per capita in Sofia (BGN 38,891) was more than double the national average. A significant number of the industrial sites are located in the neighbouring municipalities that fall within the agglomeration, with leading economic activities in manufacturing, transport and logistics. The distribution of FDI, however, is uneven: some 97% of them concentrated in Sofia municipality alone. Sofia agglomeration is distinguished by a relatively stable and balanced labour market, characterized by high economic activity and low unemployment rate compared to other agglomerations in the country.

Together with the demographic processes, the increasing soil sealing is another evidence of the spatial expansion of suburbanization. The largest share of new soil sealing was observed in Sofia municipality itself (approximately 370 ha), followed by Elin Pelin (105 ha), Bozhurishte (46 ha) and Kostinbrod (32 ha). Based on the intensity of new constructions and population change, the so-called zone of active influence of the agglomeration core has been outlined. The zone is made up of settlements meeting two conditions: they have a high intensity of new constructions and they are type 8 or type 7 according to the typology of Webb in the period between 2011 and 2021.

During the considered period, the northern, eastern, southern and western peripheries of the agglomeration area developed each in its own specific way, with different new construction intensity, morphological structure and inter-settlement spaces. Suburbanization processes observed in Sofia are generally comparable to those of other post-socialist European capitals in terms of historical legacies, demographic transformation, spatial dynamics, and land use shifts.

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ABSZTRAKT: A tanulmány Bulgária fővárosának, Szófiának az agglomerációját, annak kiterjedését,
népességdinamikáját, szuburbanizációs folyamatait, az új beépítéseket, valamint az agglomerációt
alkotó települések közötti különbségeket vizsgálja. A települések népességdinamikájának elemzésére (a
2001-2021 közötti időszakot két szakaszra bontva) John W. Webb tipológiáját alkalmazza. A beépített
területek és a vízzáró felszínek változásait műholdfelvételek és a Copernicus adatbázisban elérhető
vízzárósági rétegek felhasználásával kutatja, különböző intenzitású új beépített területeket határoz
meg. A települések gazdasági profilját és munkaerőpiaci helyzetét a GDP ágazati szerkezete, a
foglalkoztatási és a munkanélküliségi ráta, a közvetlen külföldi tőkebefektetések és egyéb paraméterek
alapján elemzi. Az agglomeráció központja – Szófia városa – morfológiai szerkezetét is vizsgálja. A
demográfiai és gazdasági folyamatok, valamint az új építkezések intenzitása alapján körülhatárolja a
főváros körüli aktív befolyási övezetet, amely egyrészt az intenzív új beépítés területe, másrészt az
utóbbi években jelentős bevándorlási többletet felmutató településeket foglalja magába. Ez a zóna
képezi az agglomeráció lényegét, ahol a szuburbanizáció és a gazdasági tevékenységek a
legintenzívebbek.

Introduction

Suburbanization is a complex phenomenon with diverse effects in the post-socialist countries such as Bulgaria. It offers opportunities for improved living conditions, a stronger sense of community and a slower pace of life, but it is also related to negative consequences including urban sprawl, environmental impacts and social inequalities. In the recent decades, new problems arose from the growing demographic importance of the capital cities and the controversial interaction between urban growth, urban sprawl and suburbanization.

The up-to-date literature survey indicates that suburbanization processes in Central and Eastern Europe share some common features and also have specific characteristics across the different countries (e.g. Kinossian 2022; Schmidt, Fina, Siedentop 2015; Taubenböck et al. 2019; Wolff, Haase, Haase 2018). It is now well established from a variety of studies that temporal and spatial transformation of urban cores and agglomeration areas of post-socialist cities are the subjects of research and typology based on predominantly demographic statistics, changes in housing stock and the urban fabric, and more recently – with the rapid development of GIS and remote sensing technologies – land usage and land cover (e.g. Cocheci, Petrisor 2023; Hardi 2022; Hirt 2013; Kubeš, Nováček 2019; Siedentop, Fina 2012).

Comparing Bulgaria to other post-socialist countries, the scale of suburbanization varies depending on the specific context of each country. However, a few general patterns emerge:

– *Central European countries:* Slovakia, Czechia and Hungary have experienced relatively moderate levels of suburbanization, with a more balanced distribution of the population between urban and suburban areas. The transformation of Bratislava agglomeration is in sync with the most

common trends typical for all post-socialist European capitals: affluent population prefers the inner ring of the urban area, in contrast to lower income and lower educational level residents who settle down in more remote areas. Changes in the urban fabric are due to positive migration balance and expanding built-up areas: a transformation of mainly arable lands into urban, where new quarters have different spatial/morphological structures (Šveda, Madajová, Podolák 2016). Comprehensive scientific research has been done regarding Budapest agglomeration and its post-socialist (sub)urban development (e.g. Földi, Kovács 2014; Harangozó et al. 2019; Kovács et al. 2019; Lennert et al. 2020). They considered the role of geographic location, historical background, demographic and socio-economic features, changes in land use and soil imperviousness, etc. The development of Prague agglomeration can be described by intensive suburbanization and migration impact, as well as a gradual revitalization completed by significant new residential, commercial, and warehouse constructions (Ouředníček et al. 2018; Ouředníček, Temelová 2009).

– *Baltic countries:* Estonia, Latvia and Lithuania have witnessed more rapid suburbanization, particularly around their capital cities during the post-socialist transition. As Krišjāne and Berzins (2012) pointed out, suburbanization processes in Riga agglomeration are socially divisive and those with high or lower-class social status are more likely to move to suburbs. Tammaru et al. (2009) stated that suburbanization reshapes Tallinn agglomeration in many directions: intensive new building constructions (mainly multifamily houses), changes in agglomeration structure and an increase in the number of daily commuters occur. Current suburbanization processes in Lithuania led to a low level of spatial and social segregation in Vilnius city and a division of the capital agglomeration between rich (northern) and poorer (southern) neighbourhoods (Valatka, Burneika, Ubarevičiené 2018).

– *Southeastern European countries:* Suburbanization in Serbia, Romania and Bulgaria has been more chaotic mainly due to the lack of long-term and targeted urban and regional policies, the significant outflow of population from the urban centers to the surrounding suburban areas, underdeveloped public infrastructure in the new residential areas, the expansion of retail and warehouse buildings, the constant soil sealing along the main transport axes crossing the capital agglomerations, etc. (Dinic-Brankovic et al. 2016; Dumitrache et al. 2016; Săgeată et al. 2023 ; Slaev et al. 2018).

According to the World Urbanization Prospects report by the United Nations (2019), 25.3% of the Bulgarians live in suburban areas, compared to an average of 22.2% in the post-socialist countries. The country's economic development and higher disposable incomes in the recent years have made it possible for more people to buy homes in suburban areas. Another factor is the rising costs of housing in the urban agglomerations, making it difficult for many people to afford

to live in the city centre. As a result, suburban neighbourhoods have become more attractive, as they tend to be more affordable in terms of real estate prices. Finally, the transportation infrastructure has improved significantly in recent years, making it easier for people to commute from suburban areas to the city centre.

The current suburbanization processes in Bulgaria, particularly around the capital city of Sofia, have been rarely studied. Existing research focuses on the intensity of suburbanization and the "core-periphery" problem (Ganev 1990; Yankov 2015), social and spatial restructuring, and diversity of suburbs (Daskalova, Slaev 2015; Garcia-Ayllon 2018; Hirt 2006, 2007; Hirt, Kovachev 2006), interactions between sustainable urban development, urban sprawl and urban growth (Slaev, Nedović-Budić 2016), and the role of urban planning in urban sprawl and suburbanization (Slaev et al. 2018; Slaev, Kovachev 2014; Slaev, Nikiforov 2013; Stanilov, Hirt 2014). This study explores the contemporary suburbanization processes by analysing the population dynamics, the socio-economic and the spatial transformations in the agglomeration area of Sofia. By using a range of indicators reflecting the comprehensive and complex nature of the agglomeration, an attempt to delineate the so-called zone of active influence of the capital city has been made. This is the area where the most intensive functional and spatial interactions between the different elements of the agglomeration system are observed.

Materials and methods

The methodology of *defining the agglomeration area* and determining its exact geographical scope remains debatable. According to Ganev (1990), the Sofia agglomeration includes nine municipalities: Sofia, Bozhurishte, Elin Pelin, Gorna Malina, Kostinbrod, Pernik, Radomir, Slivnitsa and Svoge. In the process of developing the "Methodology for determining territories with specific spatial characteristics" as part of the National Spatial Development Concept of Bulgaria – 2013–2025 (NSDC 2012), the Sofia agglomeration was defined by seven municipalities: Sofia, Bozhurishte, Elin Pelin, Gorna Malina, Kostinbrod, Slivnitsa and Svoge. In the same document, a metropolitan agglomeration covering twelve municipalities (Sofia, Bozhurishte, Dragoman, Elin Pelin, Gorna Malina, Ihtiman, Kostenets, Kostinbrod, Pernik, Radomir, Slivnitsa and Svoge) was adopted. In the documents above, mainly demographic indicators were used for defining the boundaries of the metropolitan agglomeration. In this study, various indicators classified into three groups (demographic, socio-economic and spatial characteristics) have been used for the objective delineation of the Sofia agglomeration. To achieve this goal, the area of the metropolitan agglomeration has been limited to *7 (LAU 1) municipalities* (Sofia, Bozhurishte, Elin Pelin, Gorna Malina, Kostinbrod, Slivnitsa and Svoge) *comprising 146 (LAU 2) individual settlements,* where the most intensive suburbanization

processes are observed (Figure 1). Thus, the area of Sofia agglomeration covers almost 3,550 km² (3.2% of national territory), while it had 1,359,270 inhabitants (almost 21% of national population) according to the last population census (7 September 2021).

Figure 1.: Location and municipalities of Sofia agglomeration
A szófiai agglomeráció elhelyezkedése és települései
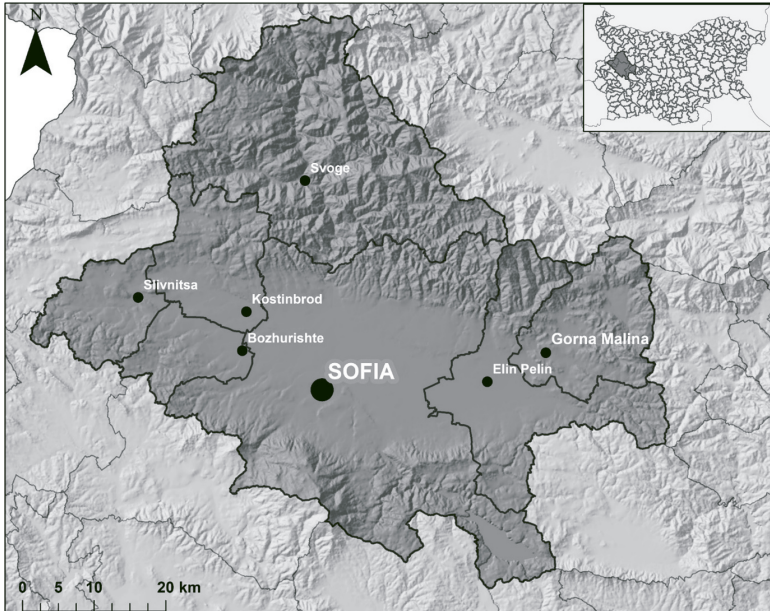
Source: authors' compilation

In this study, the definitions of agglomeration nucleus/core and agglomeration area, as formulated in the National Spatial Development Concept (NSDC 2012) have been adopted:

- The agglomeration nucleus is a core city incorporating neighbouring settlements and their adjacent land plots, forming an integrated continuous spatial system.
- The agglomeration area is the territory of a group of municipalities (LAU 1), where intensive functional links exist between the core city and the surrounding settlements.

The population dynamics of Sofia and its agglomeration in the periods between 2001–2011 and 2011–2021 have been analyzed using the types of population change introduced by John W. Webb (Webb 1963). His typology is based on the structure of population change (share of natural and migratory increase/decrease in the structure of population dynamics). According to this typology, there are 4 types of population increase and 4 types of population decrease (Table 1).

The census data of National Statistical Institute (NSI) have been used for the analysis, where the share of net migration rate in population change (M) has been calculated as follows:

$$M = A-N$$

where A is the absolute change of the population number for a given period, and N is the natural increase/decrease for the same period. The relative change of the population number and the shares of natural and migratory increase/decrease respectively, have been calculated for the periods between the population censuses (2001–2011 and 2011–2021).

Analysis of *economic profile, labour market and housing stock* is based on the data of National Statistical Institute, Employment Agency and Institute for Market Economics from the years 2022 and 2023, as well as on municipal development plans. The following indicators have been analysed: Gross Domestic Product (GDP), Gross Value Added (GVA), number of micro- and small enterprises, Foreign Direct Investments (FDI), labour force aged 15-64, as well as employment and unemployment rate of the population aged 15-64 years. A comparative spatial analysis and combinations of analytical indicators characterizing the economic environment have been applied in order to describe the sectoral profile as well as the state of labour market and real estate market of the municipalities within the agglomeration.

Geospatial database and decoding of satellite images (Google Earth) have been used for the analysis of *land cover* types and their change, in order to delineate the spatial transformation of urban areas. Currently, the most suitable database for the European regions is created and coordinated by the European Commission under the Copernicus program. More precisely, this database contains layers with information on the imperviousness of the territories (Hardi 2022). These layers

Table 1.: Types of population change according to Webb
A népességváltozás típusai Webb szerint

	Types of population increase
1	Migratory and natural increase, migratory > natural
2	Migratory and natural increase, natural > migratory
3	Natural increase > migratory decrease
8	Migratory increase > natural decrease
	Types of population decrease
4	Migratory decrease > natural increase
5	Migratory and natural decrease, migratory > natural
6	Migratory and natural decrease, natural > migratory
7	Natural decrease > migratory increase

Source: authors' compilation based on Webb (1963)

have high resolution, which allows to identify objects with artificial pavement and buildings with a small area, and also recognizes green areas within the urban space, so they are not included in the calculation of artificial surfaces. Dynamics of built-up areas can be tracked, as the geospatial database is available for four years (2006, 2009, 2012, 2015) and includes two types of layers called „Imperviousness Density (IMD)" and „Imperviousness Change" (IMC).

Results

Population dynamics of agglomeration core and other municipalities

The analysis shows that during the period between 2001 and 2021, the population of Sofia agglomeration has grown by more than 95,000 people (7.6%). Some 96% of that growth is due to Sofia city itself, despite its population decline during the second subperiod (2011–2021). On the other hand, Sofia municipality including the city itself and 37 other settlements (3 small towns and 34 villages) has grown by over 103,000 people between 2001 and 2021, although it also shows a population decline in the second subperiod (2011–2021). Bozhurishte is the only municipality in the agglomeration area which registered a constant population growth in both subperiods, and reached the highest relative increase (18.5%) in the number of inhabitants (Figure 2). Bozhurishte municipality is located to the northwest and close to the city of Sofia, along the major transport axis Istanbul – Sofia – Belgrade – Central Europe.

During the second subperiod (2011–2021), Elin Pelin is the other municipality with population growth (1.2%). It can be considered as the southeastern counterpart of Bozhurishte in terms of geographical location and overall development. Unlike Bozhurishte, however, Elin Pelin municipality has lost some population compared to 2001, although that loss is relatively small (4%). Last but not least, Kostinbrod is the third municipality in the agglomeration with stable demographic and economic development due to its proximity to the core city. It recorded the smallest population decline (1%) over the 2001–2021 period, while – unlike Elin Pelin – Kostinbrod registered insignificant (0.9% and 0.1%) population decline in both subperiods. Consequently, Bozhurishte, Elin Pelin and Kostinbrod along with Sofia municipality itself, are *the municipalities with the best demographic indicators* in the agglomeration area.

The situation in the other three municipalities of Sofia agglomeration (Gorna Malina, Slivnitsa and Svoge) is quite different. Population decline in these three municipalities is more pronounced, exceeding 23% in the case of Svoge, which is located in Stara Planina Mountain. On the other hand, Gorna Malina is entirely rural, as even its municipal center is a village. Geographical location, proximity to the agglomeration core and – in the case of Svoge – physical characteristics of the

terrain all play a crucial role in the demographic and economic development of these municipalities. Slivnitsa municipality is crossed by the major transport axis Istanbul – Sofia – Belgrade – Central Europe, but unlike Bozhurishte and Kostinbrod, it is in a larger distance to the northwest from the agglomeration core. Gorna Malina, on the other hand, is crossed by a transport axis (road and railway) of secondary importance (Sofia – Burgas), and along with being a rural municipality, it is also mountainous to a certain extent.

Figure 2.: Population dynamics of Sofia agglomeration and its municipalities (change in percentage of the population number for 2001–2011, 2011–2021, and 2001–2021)
A szófiai agglomeráció és önkormányzatainak népességi dinamikája (a népességszám százalékos változása 2001–2011, 2011–2021, 2001–2021)
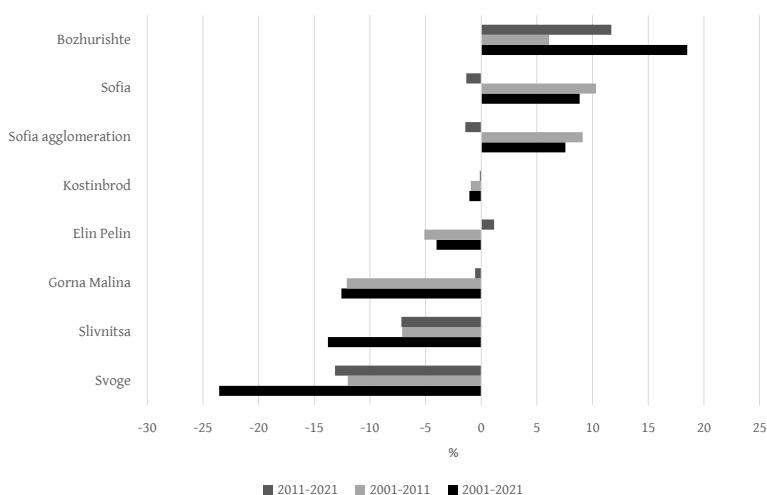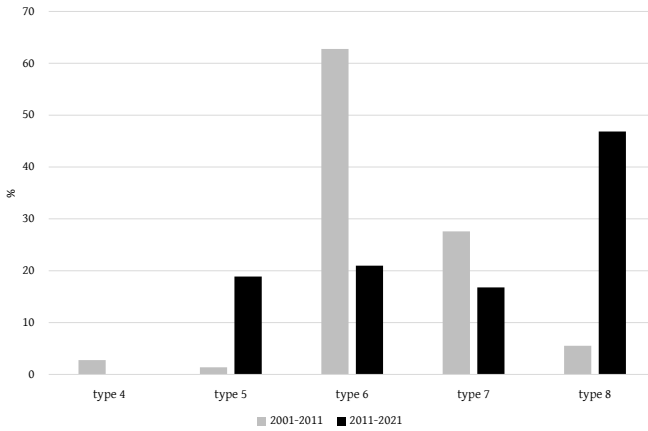

Source: authors' compilation based on NSI data

Types of population change according to Webb

During the first subperiod (2001–2011) type 6 followed by type 7 are the predominant categories of agglomeration settlements based on the typology of John W. Webb. It means population decline as a whole (Figure 3): although many settlements had positive net migration rate during the first subperiod, it was not enough for a population growth, apart from just a few settlements of type 8 (Figure 4). In the second subperiod (2011–2021) a completely different situation can be observed: type 8 has become the leading one in the agglomeration, mostly due to the transformation of settlements in type 7, whereas the number of type 6 settlements has dropped significantly. As it can be seen from Figure 5, the vast majority of type 8 settlements are located in Sofia basin, in the immediate vicinity of the city. However, in this second subperiod, the population decline of Sofia city

alone (19,361 people) exceeded more than twice the summarized population growth of all type 8 settlements (8,929 people), and as a result, the overall population of the agglomeration declined by 19,734 people.

Figure 3.: Distribution of settlements in Sofia agglomeration based on the typology of Webb
A települések eloszlása a szófiai agglomeráció településein Webb tipológiája alapján
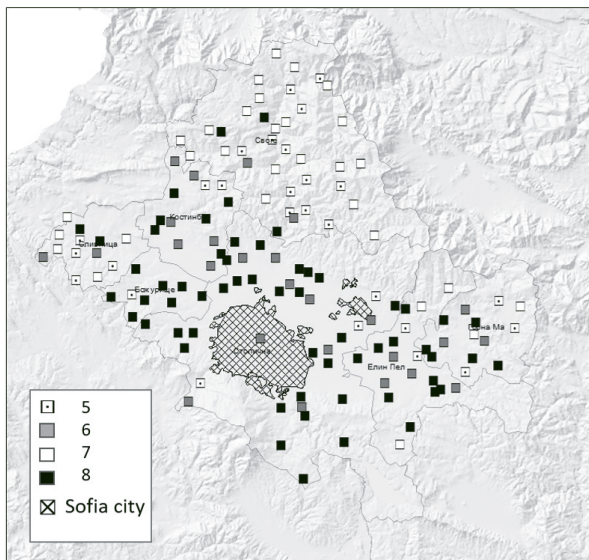

Source: authors' compilation based on NSI data

Figure 4.: Settlements of Sofia agglomeration based on the typology of Webb (2001–2011)
A szófiai agglomeráció települései Webb tipológiája alapján (2001–2011)
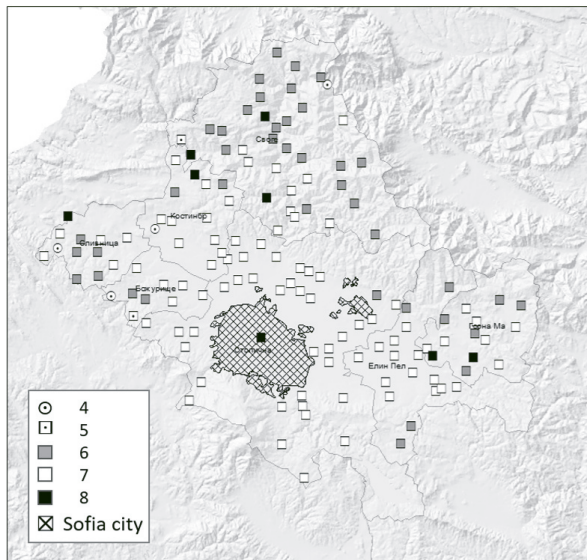
Source: authors' compilation based on NSI data

Figure 5.: Settlements of Sofia agglomeration based on the typology of Webb (2011-2021)

A szófiai agglomeráció települései Webb tipológiája alapján (2011–2021)

Source: authors' compilation based on NSI data

Economic characteristics, labour market and housing stock

City of Sofia has a strong influence on the economic development of the municipalities in the agglomeration. Daily labour migrations contribute to the formation of secondary nuclei around the city. For example, approximately 49% of persons employed in Svoge municipality commute daily to the city of Sofia. In the municipalities of Bozhurishte and Kostinbrod are the shares 47% and 40% respectively (Institute for Market Economics 2023b). These processes have a strong impact on the economic development and labour markets of the municipalities forming the agglomeration, where numerous industrial enterprises and logistics centres are located. Regardless of the deepening of these processes, the economic growth of the agglomeration is mainly due to the core, city of Sofia itself. The established new industrial zones of Bozhurishte and Elin Pelin exert the strongest influence: in Bozhurishte a scientific and development centre was built by "Industrial Zones" National Company (Bozhurishte Municipality 2014; Elin Pelin Municipality 2021). Elin Pelin can be distinguished by its favourable transport and geographical position (Hemus and Trakia highways pass through its territory), which makes the municipality an important logistics centre (Program for Sofia 2021).

GDP of Sofia agglomeration represented 43% of the national economy in 2021, while the GDP per capita in Sofia (BGN 38,891) was more than double the national average (BGN 17,299). Sofia municipality itself has the largest share in the Gross

Value Added (GVA) created in Sofia agglomeration (92.5%), whereas the shares of the other municipalities are insignificant (Institute for Market Economics 2023a). The agglomeration as a whole provides about 18% of the industry GVA and 51.5% of the service sector GVA within the economy of Bulgaria (Sofia municipality alone has a share of 51% in the gross value added of the service sector). Services are dominated by trade, transport and telecommunications, administrative and professional activities, as well as by the rapidly growing IT sector. A significant number of industrial sites are located in the neighbouring municipalities within the agglomeration. They are characterized by a diversified economy with leading activities in manufacturing, transport and logistics. A large number of micro- and small enterprises operate on their territories.

The agglomeration can be distinguished also by the highest investment activity, while enterprises report significant export revenues. Foreign direct investments (FDI) reached EUR 14.7 billion (52.1% of those nationwide as of 2021). The distribution of FDI, however, is uneven, with some 97% of them concentrated in Sofia municipality alone. Although the other municipalities in the agglomeration benefit from that indirectly, their own FDIs are significantly smaller (Institute for Market Economics 2023a). FDI in Sofia municipality is mainly in trade, transport and tourism, whereas industry and logistics play the key roles in the surrounding municipalities. About 30% of all enterprises in the country are concentrated in Sofia agglomeration, which is especially valid (over 39%) for the large enterprises. Despite the strong influence of the core city Sofia on the development of the agglomeration, in the last 5 years there has been an "export" of industrial production to the other municipalities falling within the scope of the agglomeration, which results in their own socio-economic development.

Sofia agglomeration has a relatively stable and balanced *labour market,* characterized by high economic activity and low unemployment rate compared to the other agglomerations in the country. As of 2022, 22.5% of the Bulgarian labour force (aged 15-64) was concentrated in Sofia agglomeration (NSI 2023). The economic activity of the population in Sofia is above the national average (65.4% as opposed to 56.62%). The distribution of economically active persons in the municipalities of Sofia agglomeration largely follows the population. The labour force in the agglomeration, as in the country as a whole, is decreasing in number, but its relative share in the national labour force is increasing: the reported decline in the labour force of the Sofia agglomeration (1.5%) is much lower than the national average (4.5%).

The *employment rate* of population aged 15-64 years in Sofia is 76.4%, while the total number of persons employed reached high levels as a result of migration of young and qualified personnel to the capital city. The structure of employment by economic activities shows that manufacturing has the leading positions in the municipalities of Bozhurishte, Kostinbrod and Slivnitsa, whereas employment in the service sector prevails in Sofia municipality. Significant differences in

employment levels between Sofia and the rest of the agglomeration are observed. Sofia agglomeration can be characterized by a low *unemployment rate:* in 2022, it was just 3%, the lowest being in Sofia municipality itself. The municipality of Svoge, on the other hand, exhibits the highest unemployment rate (Figure 6).

Figure 6.: Unemployment rate in Bulgaria and the municipalities of Sofia agglomeration (2022, %)
Munkanélküliségi ráta Bulgáriában és a szófiai agglomeráció településein (2022, %)
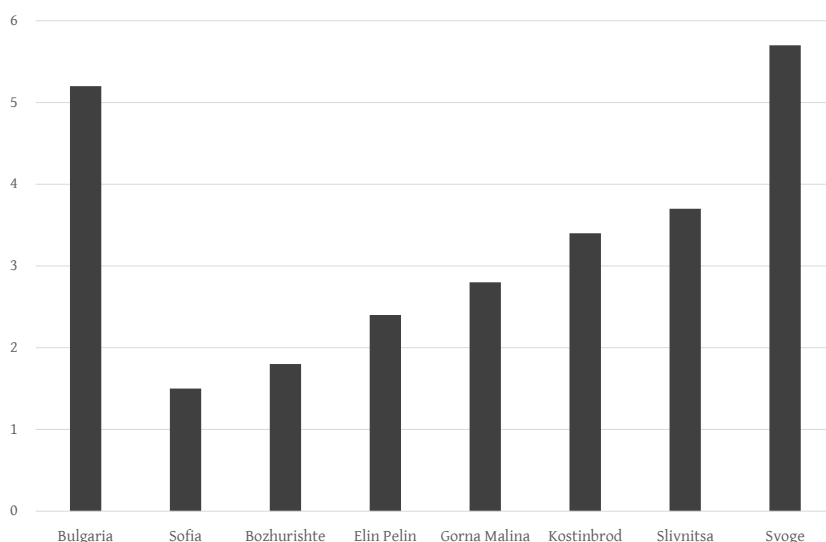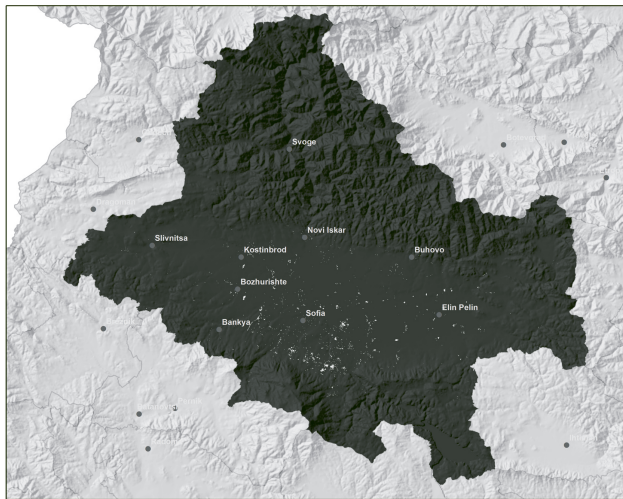

Source: authors' compilation based on Employment Agency data (2023)

Better economic situation and higher wages determine the lower share of people living below the poverty line in Sofia agglomeration (11.3% compared to 22.1% national average). The *real estate market* continues to develop: during the 2011-2022 period, the number of dwellings in the Sofia agglomeration increased dramatically – between 20% and 25% in the city of Sofia – along with an increase in their relative share of all dwellings in the country (NSI 2023). There has been a growth in demand for residential properties in other municipalities of the agglomeration as well. The prices of residential properties in the agglomeration have been increasing significantly, as a result of the ongoing suburbanization processes, intensified during the coronavirus pandemic. Over the past two years, the average residential property prices have increased by approximately 25%. Despite the significant growth in the number of the newly built homes in Sofia, according to some real estate experts, around one third of the dwellings in the city are uninhabited (Bulgarian National Radio 2022). As a result, a paradox has been observed: the number of dwellings is growing, whereas the number of residents is declining.

Spatial dynamics of agglomeration core and other municipalities

In tracking the spatial aspects of suburbanization, changes in the soil sealing since the beginning of the twenty-first century have been examined. Developments within the *regulated urban boundaries* (RUB) of the city of Sofia and within the agglomeration area outside the RUB including the six other municipalities as well have been investigated (Figure 7).

Figure 7.: New soil sealing in the agglomeration area of Sofia (2006–2015)
*Új talajlefedettség Szófai agglomerációs övezetében (2006–2015)*

Source: authors' compilation

Together with the demographic processes, the increasing soil sealing is another evidence for the spatial expansion of suburbanization: between 2006 and 2015 the sealed areas increased by 405 ha (3.1%) in the core, within the RUB of Sofia city, as opposed to 579 ha (4.6%) in the agglomeration area outside the core. The largest share of new soil sealing was observed in Sofia municipality itself (approximately 370 ha), followed by Elin Pelin (105 ha), Bozhurishte (46 ha) and Kostinbrod (32 ha). The municipalities of Svoge, Slivnitsa and Gorna Malina stand out with the smallest areas of new soil sealing (ranging between 6.4 and 14.5 ha) in the same period.

New constructions are the most intense in and around the settlements experiencing the highest gravitational force of Sofia, located closest to the city (nearly two-thirds of the new constructions affected the settlements within Sofia municipality). However, dynamics has been changing during the discussed period: more than half of the new constructions occurred in the years between 2009 and 2012, right after the global financial crisis of 2008-2009. Based on the intensity of new constructions and population change, the so-called *zone of active influence* of
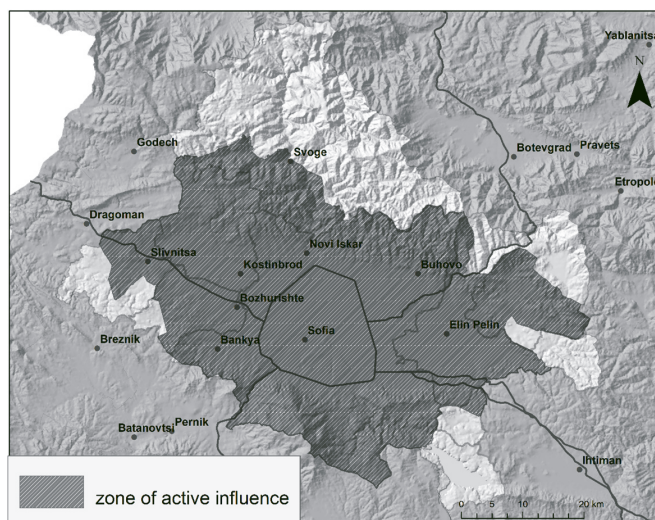
Figure 8.: Intensity of new constructions in Sofia agglomeration (2006–2015)
Az új beépítések intenzitása Szófia agglomerációjában (2006–2015)
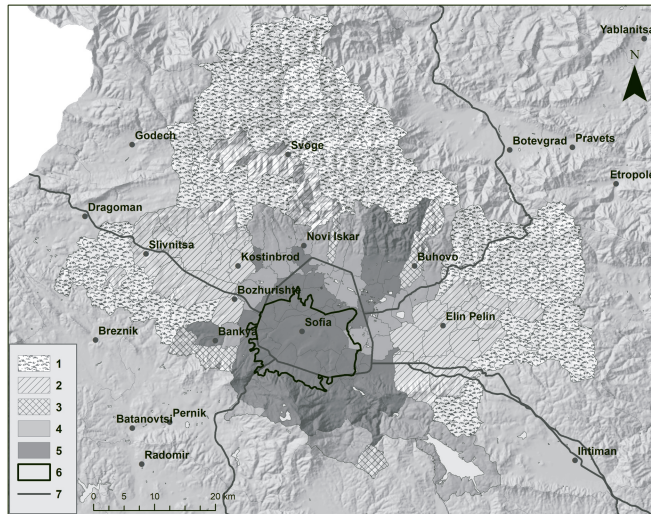
Source: authors' compilation
Legend: 1. Low (outside Sofia municipality); 2. High (outside Sofia municipality);
3. Low (within Sofia municipality); 4. Medium (within Sofia municipality); 5. High
(within Sofia municipality); 6. RUB of Sofia city; 7. Main transport axes.

Figure 9.: Zone of active influence (ZAI) of the agglomeration core
*Az agglomerációs mag aktív befolyási övezete*

Source: authors' compilation

the agglomeration core can be outlined (Figure 9). The zone is made up of settlements meeting two conditions: they have a high intensity of new constructions (Figure 8) and they are type 8 or type 7 according to the typology of Webb in the period between 2011 and 2021 (Figure 5).

The *zone of active influence* (ZAI) of Sofia is outlined based on demographic, socio-economic and spatial processes that have been observed since the beginning of the twenty-first century. Against the background of the deepening demographic crisis, the settlements that are included in the ZAI exhibit migratory influx, which is formed both by new residents moving out of the capital city, as well as from other parts of the country. In some of these settlements (Webb type 8), the positive net migration rate compensates for the negative natural increase and as a result, their population grows. In other settlements in the ZAI (Webb type 7) the migratory influx still cannot compensate entirely for the natural decrease, but some of them are expected to transform into Webb type 8 in the near future. In the conditions of an unfavourable socio-economic situation in recent decades, the settlements in the ZAI attracted investments and created jobs, which led to the immigration of qualified labour force. The working-age population also benefits from the proximity and the improved transport accessibility of the capital city in recent years, given that most employed people nowadays own a car – in many cases more than one – per household. The expansion of industrial zones is associated precisely to the attracted investments in area-consuming activities, in and around most of

Figure 10.: Urban morphology of the city of Sofia
Szófia város morfológiája
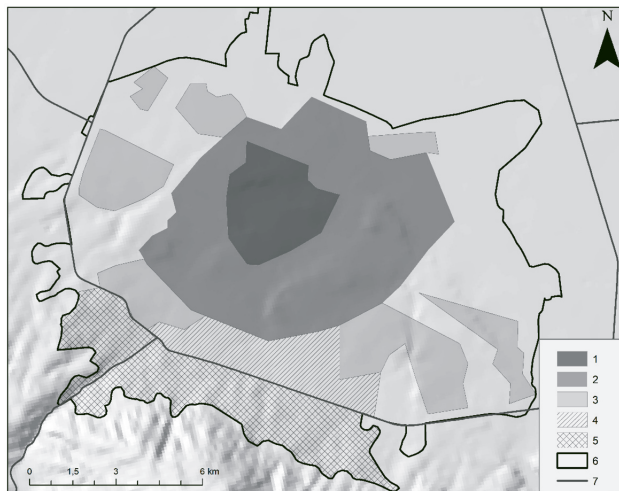
Source: authors' compilation based on Program for Sofia (2021)
Legend: 1. Central city; 2. Inner city; 3. Periphery belt; 4. Large panel housing complexes; 5. Vitosha foothills neighbourhoods; 6. RUB of Sofia (as of 2009); 7. Main roads.

the settlements in the ZAI. The spatial expansion of soil sealing is also related to the increase in new residential constructions, which is particularly typical for the southern and western periphery of the ZAI.

In terms of *urban morphology,* the city of Sofia is typical for most cities from the former Eastern Bloc. Four concentric zones can be clearly identified. The central city (CC) is the area with the largest accumulation of administrative, representative, cultural, etc. functions. Areas around the CC constitute the inner city, which is, broadly speaking, the belt between the CC and the former railway ring. Most parts of the inner city were built in the period between the two World Wars. The periphery of the compact city includes both the large *panel housing complexes* and the so-called *new neighbourhoods.* The panel complexes mainly were built between the 1960s and 1980s, with the majority of the housing stock concentrated in several clusters on the outskirts of the compact city. The largest clusters of panel housing complexes are Lyulin and Mladost, each with over 100,000 inhabitants (Program for Sofia 2021).

The *southern periphery* of the city represents the greatest interest in the present study. This is where the *new neighbourhoods* are located. Their construction dates back to the beginning of the twenty-first century. They are characterized by spontaneous constructions in a short period of time, following a rapid acquisition of new land for residential constructions on former agricultural lands, former villages and villa areas within the RUB of Sofia. These newly developed areas are distinguished in many cases by luxurious housing units, chaotic structure of development, with no compliance with the Territorial Planning Act. These areas urgently need the development of the hitherto missing social and technical infrastructure so as to ensure quality environment and transport accessibility. The new neighbourhoods (Krastova Vada, Malinova Dolina, Manastirski Livadi, etc.) gradually take over the foothills of Vitosha Mountain, reaching the very borders of Vitosha Nature Park (Figure 11).

Figure 11.: New residential complexes in the southern periphery of Sofia (left: 2003; right: 2023)
Új lakónegyedek Szófia déli perifériáján (balra: 2003; jobbra: 2023)

Source: Google Earth

During the considered period, the northern, eastern, southern and western peripheries of the agglomeration area developed each in its own specific way with different new construction intensity, morphological structure and inter-settlement spaces. The *western parts* stand out as areas of the second-highest new construction intensity, following the southern periphery. The western periphery includes settlements within Sofia municipality and in the municipalities of Bozhurishte, Kostinbrod and Slivnitsa. In contrast to the eastern peripheries, here the changes in land development are largely due to residential constructions. A distinctive feature is the gradual merging of the capital city on the one hand, and the nearby small towns of Bozhurishte and Kostinbrod on the other, forming a continuous built-up area with no clearly defined boundaries between the municipalities. Densification of new constructions and merging of settlements have been observed in the case of the town of Bozhurishte and the nearby village of Gurmazovo through residential and industrial areas, which emphasizes the development of Bozhurishte as a satellite industrial town with an optimal spatial and functional structure (Bozhurishte Municipality 2021). Due to functional land cover changes, the western suburban periphery is perceived as a "new potential" for unloading the capital from traditional, area-intensive production. The natural resources of that area create conditions for livestock breeding, processing of agricultural raw materials, production of construction materials, etc. During the considered period, the Bozhurishte Industrial Zone (BIZ) has been developed. Unlike the eastern periphery, the western periphery exhibits a development of some high-tech industries, as well as food industry, logistics and trade, machinery and equipment, etc.

The *eastern suburban area* covers the settlements east of the city of Sofia, within Sofia municipality itself, as well as the municipalities of Elin Pelin and Gorna Malina. Both Hemus and Trakia highways pass through that territory, which makes it suitable for business development in the field of logistics, warehousing and production. In contrast to the western parts of the agglomeration, here the changes in the functional purpose of the newly developed areas are mainly related to the construction of new warehouses and production facilities. In many cases, the newly developed areas are not attached to the old industrial areas, but are at a distance from the urbanized part of the settlements, which is in contradiction with the adopted norms for the organization of the territory. In this way, continuous industrial spaces are formed between the individual settlements. Outsourcing of production and storage capacities is dictated by the need to offload certain functions requiring large spaces. The companies that benefit from the vacant land are mostly in low-tech industries, which in some cases cause environmental pollution, as well as a number of services which require larger spaces. Compared to the western peripheries of the agglomeration area, gated residential complexes in the eastern part of the agglomeration area are very rare. Only a slight increase of residential complexes is observed, most often, through increasing the density of constructions within the RUB of the settlements.

The *most remote eastern municipality* – Gorna Malina – exhibits no significant changes in terms of new constructions and soil sealing. The few developments are related to sports and entertainment facilities, which are extremely favourable for weekend and short-term tourism. Moving away from the main national and international roads, the intensity of spatial dynamics decreases and gradually subsides. These processes are typical for the settlements located in the mountainous terrain surrounding the Sofia plain, which remain on the periphery of the capital's gravitational influence. Similar to the eastern periphery, the villages located in Stara Planina Mountain (the Balkan Range) stand out with minor or no new constructions.

The *northern periphery* of Sofia and its surroundings are characterized by industrial and warehouse areas, which represent the industrial heritage of the socialist past. Gradually, certain parts of these areas are being restructured to performing new functions in the service sector. In the villages to the north of the agglomeration core, industrial areas built in the past are being renovated and expanded by new production and warehouse bases. In general, the northern periphery exhibits the worst environmental conditions. This is one of the main reasons for the significant difference in the quality of living environment observed between the northern and southern periphery of the city. In the last two decades, in the villages located in the northern and north-eastern parts of the agglomeration, no significant expansion of residential areas has been observed, apart from some constructions of new buildings within the settlements' RUBs.

The *northernmost part* of the agglomeration area falls within the municipality of Svoge, which is located entirely in Stara Planina Mountain. The mountainous topography and the Iskar River gorge determine the development and planning of the territory. The Iskar River gorge, however, allows a duplication of a second-class national road and a double railway, which provide relatively quick access to the capital city with journey times ranging from 35 minutes to one hour respectively. The settlements that fall under the direct influence of the city of Sofia are those located precisely along the railway line and include the most dynamically developing villages in the municipality, with some other villages along the road to Buchin Prohod mountain pass and the town of Kostinbrod. During the socialist period, the area developed as a preferred location for second homes and villa zones for the residents of Sofia, since that particular part of the mountain is not declared a natural park, and therefore, no building restrictions exist. This is unlike the southern periphery of the agglomeration, which reaches the foothills of Vitosha Mountain Nature Park. In this regard, the municipality of Svoge can be characterized by a significant housing stock, which is not permanently inhabited.

Discussion and conclusion

The results of the population dynamics analysis show that the positive net migration rate is the key factor for the population increase observed in the settlements surrounding the capital city. The number of daily commuters is gradually increasing due to better job opportunities and higher salaries: Sofia agglomeration is draining the population of other regions within the country. The settlements in the agglomeration are located predominantly within a 15-30 km distance from the urban centre and in that aspect show similarities with other post-socialist capitals such as Prague, Warsaw, Bratislava and Tallinn (Kubeš, Nováček 2019). In the last few years, Sofia agglomeration witnessed a rapid increase in new residential constructions offering citizens dwellings in a broad price range. With current high inflation, economic crisis, and the collapse of the real estate markets in some European countries, the long-existing tradition in Bulgaria for individuals to obtain and live in their own homes is severely jeopardized.

The city of Sofia has a leading and determining role both nationwide and in its agglomeration. Sofia municipality has a strong influence on the development of the other six municipalities in the agglomeration, where many production facilities and logistics centres are located determining their economic development. As a result, the labour market in the agglomeration is in a relatively stable condition with low unemployment and high employment rates. Commercial suburbanization in Sofia agglomeration is taking place in several well-delineated quarters of Sofia city itself (e.g. Mladost and Druzhba), as well as in the western and eastern periphery of the agglomeration (municipalities of Bozhurishte and Elin Pelin). The transport infrastructure supports the enlargement of commerce and warehouse constructions, thus leading to expansion of sealed territories. Similar suburbanization trends are observed in other capitals in Central and Eastern Europe, such as Bucharest (Săgeată et al. 2023).

Suburbanization processes observed in Sofia are generally comparable to those of other post-socialist European capitals in terms of historical legacies, demographic transformation, spatial dynamics and land use shifts. However, as Siedentop and Fina (2012) stated, changes in land cover and built-up areas in the European urban agglomerations cannot be explained only by demographic and economic features. There are substantial differences in the spatial patterns of urban growth and suburbanization across the countries. Peculiarities of the political and institutional framework (e.g. frequent changes in normative documents, new constructions in the absence of an up-to-date master plan of the capital cities), state and regulations of the real estate market (imbalanced supply and demand of dwellings, low mortgage rates, etc.), and the investment activity play a substantial role in the evolution of the capitals' (sub)urban models of post-socialist countries such as Bulgaria and Romania (Wolff, Haase, Haase 2018). While

these similarities provide a general framework for understanding suburbanization in post-socialist capitals like Sofia, it's important to recognize that each city has its own unique historical, cultural, and geographical context that shapes the specific dynamics of suburbanization.

In recent years, therefore, the territory of Sofia municipality has been insufficient for the ever-increasing and diverse functions that the city performs. The municipalities gravitating towards the capital city have their own socio-economic and ecological profiles, but all of them are largely tied to the development and needs of the core city, acquiring an ever greater potential for cooperation and development. The settlements in the agglomeration area already take over some functions from the capital city in terms of production, habitation, infrastructure, and recreation. The inherited land purpose from the past, as well as the ongoing growth of the southern neighbourhoods of Sofia, predetermine the existing imbalance between the northern and southern peripheries, and to a much lesser extent between the western and eastern peripheries. Between the latter areas, especially in the last decade, there are some deepening differences: while in the eastern periphery, the newly performed functions mainly are related to storage and production facilities, in the western periphery these functions are also accompanied by the expansion of residential areas. An expansion of the urbanized area is observed primarily along the main transport infrastructure. Although the gravitational pull of the surrounding settlements is weak, they have the spatial potential to protect the capital city from an even greater population increase. In this regard, it is necessary to build and develop a road network and transport to ensure quick and convenient access to the surrounding settlements, and to create alternative employment in order to overcome the excessive monocentrism of the capital region by retaining the population in the surrounding smaller settlements. In addition, public transport should be more efficient to reduce the dependence on the use of private transport. In this way, strong internal functional connections will be formed between the settlements within the agglomeration area, and the administrative boundaries will only be conditional. As a result, the observed processes of spatial and social segregation, as well as the obvious south-north disparities in the urban development of the Sofia agglomeration might be mitigated successfully with specific policies and strategic documents (Program for Sofia 2021).

Acknowledgement

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