



Original article

# How industrial transformation shapes suburbanisation in the XXI century: insights from the Wrocław urban agglomeration in Poland

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## ABSTRACT

This article aims to examine the relationship between industrial transformation and suburbanisation processes in an urban agglomeration in Central and Eastern Europe (CEE), using the case of the Wrocław agglomeration (south-western Poland) in the 21st century. This relationship is analysed in the context of economic, demographic, and spatial changes occurring within the area under study. The analysis demonstrates that the observed shifts in the spatial distribution of industrial activity reinforce the dynamics of suburbanisation in the urban agglomeration. Conversely, changes in the use of industrial land and the accompanying demographic transformations (primarily within the core of the agglomeration) tend to mitigate the intensity of suburbanisation. These findings may have significant implications for spatial policy-making in CEE cities and contribute to their more sustainable development.

**KEY WORDS:** suburbanisation, industrial transformation, relationship, post-socialist city, Wrocław

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## 1. Introduction

Suburbanisation is a global socio-economic phenomenon observed in both developing and highly developed countries, particularly within urban agglomerations. Although this process is defined, studied, and interpreted in various ways, its occurrence generally signals the presence of a multi-dimensional process of considerable complexity. It encompasses social, economic, environmental, and subsequently functional and spatial transformations at the interface between large cities and their suburban zones (KRYCZKA ET AL., 2025). Research indicates that suburbanisation is not a new phenomenon; depending on the world region, it may have influenced the urban environment for a significant period. Importantly, it is characterised by regional specificity, scale, and

dynamics shaped by local conditions (PHELPS & WU, 2011). In Poland, this phenomenon has also been widely studied in other urban contexts, for example in Krakow, where significant contributions have been made by ZBOROWSKI & WIĘCŁAW (1999), GAŁKA & WARYCH-JURAS (2011), and KUREK ET AL. (2014), emphasising the regional diversity and dynamics of the suburbanisation processes.

Industrial transformation is likewise a global process, typically accompanying broader socio-economic shifts occurring within individual countries. It is especially pronounced in regions undergoing profound systemic and economic reforms, often associated with the transition from centrally planned (communist) economies to market-oriented (capitalist) ones, and from industry-based economies to those oriented towards services (HAMILTON ET AL.,

2005). In recent years, industrial transformation has increasingly taken the form of deglomeration and deconcentration, functional and environmental changes, adaptation to the principles of sustainable development, and the ongoing Industry 4.0 revolution (see [BAJGAR ET AL., 2023](#); [RYVAK, 2024](#)). As with suburbanisation, industrial transformation contributes to significant changes in the socio-economic structures of a region and substantially impacts its functional and spatial configuration (see [HLAVÁČEK ET AL., 2019](#); [SZMYTKIE, 2020](#); [BREZDEŃ & SZMYTKIE, 2021](#)). This process, too, is shaped by national and regional factors and, in terms of its scale, dynamics, and impact, is adapted to the specific conditions of each region (see [BOGUSZ, 2024](#)).

Central and Eastern Europe (CEE) is a region that, since 1989, has experienced an intense phase of socio-economic transformation related to the shift from a centrally planned (communist) economy to a market-oriented (capitalist) one ([WINCKLER, 1992](#)). The removal of total state control over economic and spatial processes in these countries significantly accelerated the intensity of socio-economic processes, resulting in numerous and large-scale functional and spatial transformations. Among the processes that have strongly influenced CEE countries, numerous studies have identified suburbanisation as one of the most impactful in shaping the transformation of these post-socialist societies (see [KUBEŠ, 2015](#); [SZMYTKIE, 2021](#)). At the same time, industrial transformation in CEE has also been frequently identified as a key element of change – primarily in economic terms – linked to the continuing shift toward a service-based economy of national economies, that is, the transition from industrial to service-oriented development models (see [POTRATZ & WIDMAIER, 1996](#)).

Despite growing scholarly interest in both suburbanisation and industrial transformation, research addressing the interrelations between these two processes remains limited – particularly within the context of post-socialist CEE countries. Existing studies have generally treated them as separate and independent phenomena. However, empirical data from cities such as Wrocław (Poland), Brno, and Ostrava (Czech Republic) suggest that industrial transformation and suburbanisation may interact, either reinforcing or counteracting one another, leading to complex socio-economic restructuring of urban areas ([HLAVÁČEK ET AL., 2019](#); [SIKORSKI & SZMYTKIE, 2021](#)).

The aim of this article is to determine the extent and nature of the relationship between industrial transformation and suburbanisation processes, based on selected empirical data illustrating these

dynamics within the Wrocław urban agglomeration (Poland). Existing literature – especially in the context of CEE countries, including Poland – has primarily focused on describing the scale, dynamics, and effects of each process separately, recent studies have begun to explore their interrelations more systematically (e.g., [LORENS, 2005](#); [KUREK ET AL., 2014](#); [KUREK ET AL., 2020](#); [SPÓRNA, 2018](#)). However, there is a noticeable gap in studies that seek to address, in a synthetic and integrated manner, whether and to what extent these two phenomena are interconnected.

This article is partly based on the author's earlier work, which focused on deconcentration of industrial areas and activities in the Wrocław agglomeration ([SIKORSKI & KRYCZKA, 2023](#)), the demographic and spatial changes in selected industrial and post-industrial areas of Wrocław ([SIKORSKI & SMĘTKIEWICZ, 2024](#)), the functional transformation of industrial buildings ([SIKORSKI & KRYCZKA, 2025](#)), comparative research on industrial land-use change in Brno and Wrocław ([KUNC ET AL., 2023](#)), and the economic suburbanisation of the region ([SIKORSKI & SZMYTKIE, 2021](#)). Some of the data and methodological approaches used in this article were previously published in the above-mentioned works. In this study, they are reinterpreted and integrated into a broader analytical framework. However, unlike these earlier contributions, this analysis combines all of the above-mentioned research perspectives and explores the mutual relationships between industrial transformation and suburbanisation within the studied region.

## 2. Theoretical background

Understanding the interplay between industrial transformation and suburbanisation requires situating both processes within broader theoretical frameworks of urban change in post-socialist contexts. Suburbanisation, while often treated as a demographic or morphological phenomenon, has increasingly been conceptualised as part of wider processes of economic and spatial restructuring ([SÝKORA & OUŘEDNÍČEK, 2007](#); [HIRT & STANILOV, 2007](#)). In Central and Eastern Europe (CEE), suburbanisation reflects not only market liberalisation, but also the fragmentation of urban governance and shifts in land-use regimes after 1989.

Industrial transformation in CEE, on the other hand, has been examined through models of deindustrialisation, tertiarisation, and reindustrialisation linked to globalization, foreign direct investment, and institutional transition ([HAMILTON](#)

ET AL., 2005; POTRATZ & WIDMAIER, 1996). Some scholars propose lifecycle models of industrial land (OSWALT & RIENIETS, 2006), including phases of expansion, decline, abandonment, and reuse. In the post-socialist context, this trajectory is often nonlinear and closely intertwined with the dynamics of metropolitan development (KISS, 2002; SIKORSKI & KRYCZKA, 2023).

The intersection of these two processes – suburbanisation and industrial transformation – has received less systematic attention. Emerging studies suggest that industrial decentralisation may act as a catalyst for economic suburbanisation, while functional reuse of inner-city industrial areas may slow the outflow of population and businesses (FRANTÁL ET AL., 2015). Therefore, analysing these dynamics together enables a more nuanced understanding of post-socialist urban evolution, where demographic, economic, and spatial factors intersect.

### 3. Materials and methods

#### 3.1. Study area

Wrocław and its suburban zone are located in Central and Eastern Europe, in the south-western part of Poland, within the central-eastern area of the Lower Silesian Voivodeship (see Fig. 1). In numerous scholarly studies, the Wrocław urban agglomeration is defined as comprising the core city of Wrocław and nine surrounding municipalities that constitute its suburban zone (see SIKORSKI & SZMYTKIE, 2021; KUZARA & SZMYTKIE, 2024). The total population of the agglomeration amounts to 757 187, of which as many as 583 385 reside within the city of Wrocław itself (PESEL, 2020). The total area of the agglomeration covers 1 391.8 km<sup>2</sup>, including 292.8 km<sup>2</sup> occupied by the city of Wrocław.

In recent decades, the Wrocław agglomeration area has experienced intensive economic development, encompassing both the central city and the surrounding suburban municipalities. The most dynamic growth has been observed in the municipalities of Czernica, Długołęka, and Kobierzyce. Their economies are primarily based on knowledge-intensive services, including information technology, business consulting, education, and healthcare, with increasing specialization in e-commerce and engineering services. In recent years, economic development has become particularly concentrated in municipalities bordering Wrocław, indicating strong functional linkages with the agglomeration core, while simultaneously

revealing a growing degree of economic autonomy. Suburban areas are transforming into independent growth poles, which necessitates the adaptation of spatial planning policies to their evolving role within the agglomeration structure (SIKORSKI & SZMYTKIE, 2021; KUNC ET AL., 2023).

The process of suburbanisation in the Wrocław agglomeration began to intensify following the socio-economic transformation that commenced in 1989. This suburbanisation predominantly took the form of residential suburbanisation, characterised by the outward migration of population and housing functions from the central city to its suburban zone (GAŁKA & WARYCH-JURAS, 2011; SZMYTKIE, 2020). In recent years, intra-urban suburbanisation has also become increasingly evident, involving the movement of population and residential functions from the city centre to its peripheral districts (SZMYTKIE, 2021). Similar processes accompanied the industrial transformation in the study area. A key driver of industrial change was the political and economic transformation of the country, which fundamentally altered the principles of spatial planning and the commercialisation of urban space. As a result of market-driven processes, a significant portion of industrial activities was relocated to the suburban areas of the Wrocław agglomeration. Simultaneously, former industrial sites in the urban core were repurposed for other, typically more extensive, functions – mainly service-oriented (see SIKORSKI, 2019; KUNC ET AL., 2023; SIKORSKI & KRYCZKA, 2023, 2025).

The Wrocław agglomeration serves as a representative example of post-socialist urban and suburban transformation in Central and Eastern Europe (CEE) after 1989 (KUNC ET AL., 2023). Like other major cities in the region, during the era of centrally planned economies it functioned as a key industrial centre (SLENCZEK, 1996). However, following the systemic and economic transformation initiated in 1989, the agglomeration gradually shifted toward a service-based development model. Consequently, industry – previously a cornerstone of the urban economy – began to lose its dominant role and faced the need to redefine its place and function within the economy and urban space (SIKORSKI 2019). The economic transformation triggered the emergence of suburbanisation processes in the region (SZMYTKIE, 2021). The socio-economic transformations observed in Wrocław and its suburban hinterland display similarities to the changes experienced in other CEE cities (e.g. ONDOŠ & KOREC, 2008; KUNC & TONEV, 2022; SZCZYRBA ET AL., 2022).

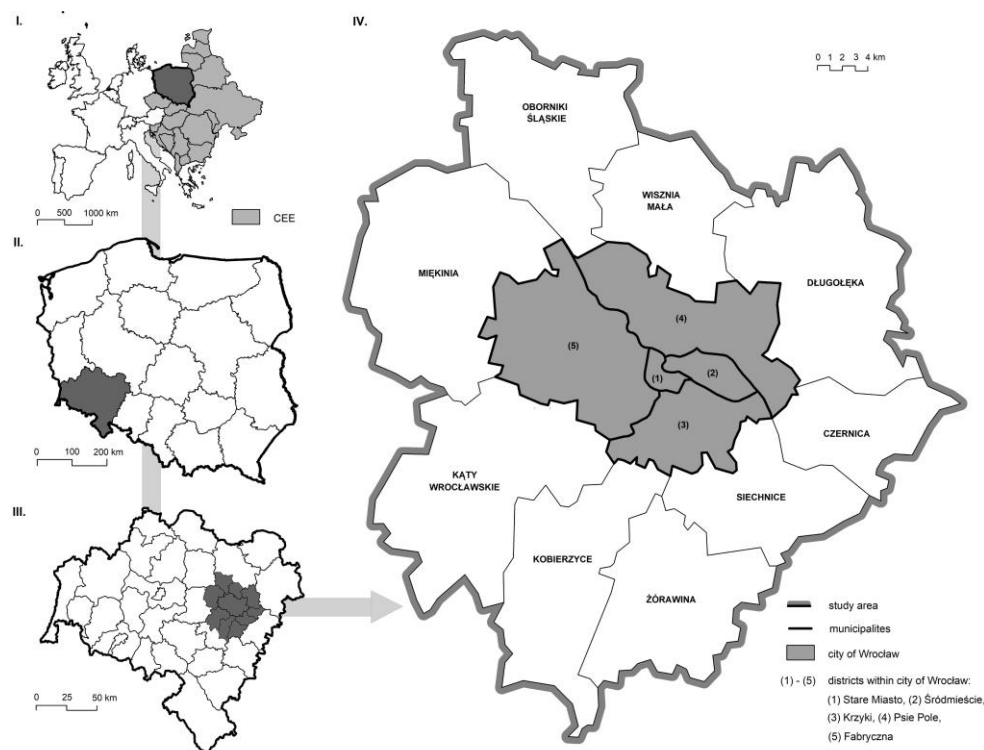


Fig. 1. Study area (IV) in the context of Europe (I), Poland (II), and the Lower Silesian Voivodeship (III) (Source: own study based on (Sikorski, Kryczka, 2023))

### 3.2. Data and research design

The study of the relationship between suburbanisation and industrial transformation in CEE urban agglomerations is hindered by limited access to high-quality data (ILNICKI & JANC, 2024). To address this, the study employs unique datasets (acquired by purchase or request) and an original research procedure developed by the author.

The analysis focused on two main objectives: (I) identifying spatial changes in industrial activity in the Wrocław agglomeration, and (II) gathering address-level statistical data on business entities, population, and housing.

For (I), topographic maps (1:10,000 scale) from geoportal.gov.pl and MAPSTER (<http://igrek.amzp.pl/>; an online platform that provides access to digitized historical topographic maps of Poland, covering various editions from the 19th century to the present) were georeferenced and analysed in GIS to detect industrial land use changes (LU ET AL., 2004). Identified sites were assigned street-level addresses. To a large extent, the identification of industrial areas was based on previous research of a similar nature conducted by SIKORSKI & KRYCZKA (2023), who applied a method involving the analysis of cartographic sources from the period 1980s–2020s.

For (II), three types of data were collected:

1. Business migration (REGON DATABASE, 2008–2024) – including company address, sector, ownership, and employment structure.
2. Population data (PESEL, 2000–2020) – with information on number, age, and gender of residents by address.
3. Housing stock (PESEL, 2000–2020) – number and location of residential units.

A common spatial denominator – the address – enabled integration and longitudinal analysis. Additionally, the distance from each address to the Wrocław city centre (market square) was calculated and mapped (Figures 3–5).

While valuable, both REGON and PESEL datasets have limitations. REGON reflects company headquarters rather than operational sites and includes inactive entities, while PESEL data may under-represent actual residency due to outdated declarations (see RACZYK, 2009; CELIŃSKA-JANOWICZ, 2016; KUZARA & SZMYTKIE, 2024). Despite these issues, they remain the only comprehensive sources for socio-economic analysis at this scale. Furthermore, these datasets enable the prediction of demographic and economic trends, thereby enhancing their analytical utility despite the aforementioned limitations.

## 4. Results

### 4.1. The economic aspect of suburbanisation

In 2024, the Wrocław agglomeration hosted a total of 175 340 business entities, of which 10 275 were industrial enterprises, accounting for 5.9% of all registered entities. The vast majority of these businesses were located in the core of the agglomeration – that is, in the city of Wrocław – where 139 524 entities had their registered office, representing 79.6% of all entities in the studied area. Similarly, most of the region’s industrial enterprises (7 821, or 76.1% of the total) were located in Wrocław (Table 1).

Between 2008 and 2024, the number of business entities in the Wrocław agglomeration increased by 57 144, of which 40,137 (or 70.2%) were established in the urban core – Wrocław. During the same period, 1 536 new industrial entities were registered, representing 2.7% of all newly established businesses. Interestingly, unlike the general trend, new industrial entities were predominantly located in the suburban zone, which accounted for 67.6% of all new industrial businesses in the agglomeration.

In the same period, 33 725 business entities changed their registered addresses within the Wrocław agglomeration. Most of these migrations occurred within the city of Wrocław itself, with 29 629 entities (or 87.9% of all migrations). A total of 1 789 industrial entities relocated during this time,

accounting for 5.3% of all business migrations. Similar to the overall trend, most industrial migrations took place within Wrocław, representing 81.9% of all industrial relocations in the agglomeration.

The contribution of business migration to the overall growth of business entities in the Wrocław agglomeration was substantial, accounting for 59.0% of the increase. Migrating entities represented 73.8% of the newly established businesses in Wrocław, compared to 24.1% in the suburban zone. In the case of industrial entities, migrations accounted for 116.5% of the net growth – indicating that in Wrocław, industrial migration contributed to a 294.4% increase, while in the suburban zone, it accounted for 31.1% of industrial growth.

As previously mentioned, the migration of business entities, including industrial enterprises, occurred primarily within the core of the studied agglomeration. However, in the context of Wrocław versus the suburban zone, the dominant migration direction was outward – from the city to the suburban zone. A total of 4 096 entities (12.1% of all migrations) relocated from Wrocław to the suburban zone, including 323 industrial enterprises (1.0%). In contrast, only 1 158 entities (3.4% of all migrations) moved in the opposite direction – from the suburban zone to Wrocław – including just 75 industrial enterprises (0.2%), which is approximately four times fewer on average (Fig. 2).

Table 1. Characteristics of growth, migration, and their mutual relationships for all business entities and industrial entities in the Wrocław agglomeration, 2008-2024 (Source: author’s own study based on REGON data)

| Municipality               | Business entities |          |     | Growth    |          |      | Migrations |          |      | Migrations/<br>growth [%] |          |
|----------------------------|-------------------|----------|-----|-----------|----------|------|------------|----------|------|---------------------------|----------|
|                            | 2024              |          |     | 2008-2024 |          |      |            |          |      |                           |          |
|                            | Total             | Industry | [%] | Total     | Industry | [%]  | Total      | Industry | [%]  | Total                     | Industry |
| Czernica                   | 3 324             | 237      | 7.1 | +2 019    | +123     | 6.1  | 463        | 44       | 9.5  | 22.9                      | 35.8     |
| Długołęka                  | 7 130             | 484      | 6.8 | +3 766    | +248     | 6.6  | 895        | 71       | 7.9  | 23.8                      | 28.6     |
| Kąty Wrocławskie           | 4 771             | 255      | 5.3 | +2 053    | +96      | 4.7  | 475        | 29       | 6.1  | 23.1                      | 30.2     |
| Kobierzyce                 | 5 154             | 316      | 6.1 | +2 900    | +172     | 5.9  | 606        | 37       | 6.1  | 20.9                      | 21.5     |
| Miękinia                   | 2 955             | 265      | 9.0 | +1 327    | +111     | 8.4  | 333        | 37       | 11.1 | 25.1                      | 33.3     |
| Oborniki Śląskie           | 3 442             | 246      | 7.1 | +703      | -2       | -0.3 | 192        | 18       | 9.4  | 27.3                      | -        |
| Siechnice                  | 4 538             | 327      | 7.2 | +2 468    | +151     | 6.1  | 590        | 35       | 5.9  | 23.9                      | 23.2     |
| Wisznia Mała               | 2 125             | 157      | 7.4 | +724      | +47      | 6.5  | 246        | 21       | 8.5  | 34.0                      | 44.7     |
| Żórawina                   | 2 376             | 167      | 7.0 | +1 046    | +92      | 8.8  | 294        | 31       | 10.5 | 28.1                      | 33.7     |
| No data                    | 1                 | -        | -   | +1        | -        | -    | -          | -        | -    | -                         | -        |
| Suburban zone              | 35 816            | 2 454    | 6.9 | +17 007   | +1 038   | 6.1  | 4 096      | 323      | 7.9  | 24.1                      | 31.1     |
| City of Wrocław            | 139 524           | 7 821    | 5.6 | +40 137   | +498     | 1.2  | 29 635     | 1 466    | 4.9  | 73.8                      | 294.4    |
| Total in the agglomeration | 175 340           | 10 275   | 5.9 | +57 144   | +1 536   | 2.7  | 33 731     | 1 789    | 5.3  | 59.0                      | 116.5    |

Between 2008 and 2024, mainly service companies migrated from Wrocław to the suburban area (3 668 entities; 90.0%). In particular, these were companies engaged in professional, scientific, and technical activities (804 entities; 19.6% of migration), wholesale and retail trade (733; 17.9%), construction (391; 9.5%), information and communication (382; 9.2%), and health care and social assistance (351; 8.6%). Among industrial entities, these were mainly entities classified as manufacturing (304; 7.4%).

Regarding the spatial distribution and concentration of business and industrial entities as a function of distance from the agglomeration centre

(Wrocław's market square), minimal changes were observed during the study period and not exceeding several percentage points. Over half of the business entities (61.4% in 2008; 60.5% in 2016; 59.4% in 2024) and industrial entities (62.8% in 2008; 60.2% in 2016; 58.7% in 2024) were concentrated within the 2,000-6,000 metre buffer zone from the agglomeration centre. Within the average distance to municipal boundaries ( $\bar{x}$  = 9 656.5 m), approximately 80% or more of all entities were aggregated: 83.4% (2008), 81.8% (2016), and 80.4% (2024) for business entities, and 81.5% (2008), 78.7% (2016), and 76.9% (2024) for industrial entities (Fig. 3).

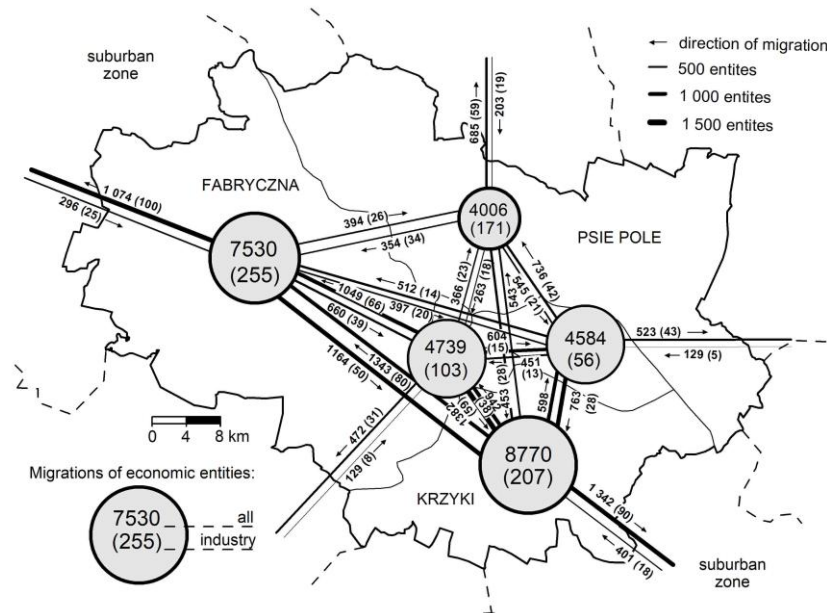


Fig. 2. Migration of business and industrial entities in the Wrocław agglomeration in 2008-2024 (Source: author's own study based on REGON data)

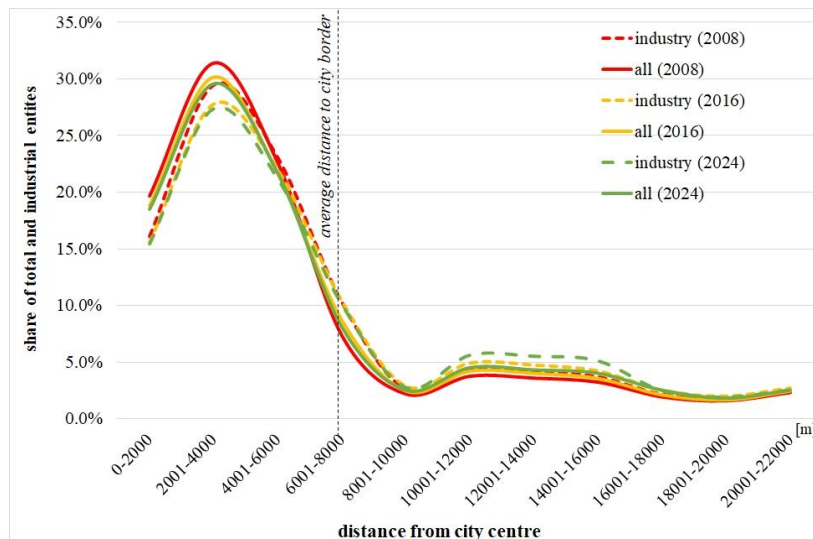


Fig. 3. Change in the spatial distribution of total and industrial business entities in the Wrocław agglomeration in 2008–2024 (Source: author's own study based on REGON data)

#### 4.2. The demographic aspect of suburbanisation

According to the PESEL database, the total population of the Wrocław agglomeration in 2020 was 757 187 inhabitants. Of these, 583 385 individuals (77.0%) resided in the agglomeration's core (Wrocław city), while 173 802 (23.0%) inhabited its suburban zone. Within post-industrial areas, 10 933 residents were recorded across the agglomeration in 2020, with 10 247 (93.7%) located in Wrocław and 509 (6.3%) in its suburban periphery. Collectively, 1.4% of the agglomeration's total population resided on post-industrial lands (Table 2).

Between 2000 and 2020, the Wrocław agglomeration experienced a net population increase of 45 383 inhabitants (+6.4%). This growth was driven by a suburban zone gain of 65 986 residents (+61.2%), offset by a decline of 20 603 inhabitants (-3.4%) in Wrocław city. During this period, post-industrial areas saw a total increase of 7 582 residents, predominantly concentrated in Wrocław (7,586 new inhabitants; +285.1%), contrasted with a marginal decline of 4 residents in suburban post-industrial zones. Population growth on post-industrial lands accounted for 16.7% of the agglomeration's total demographic increase from 2000 to 2020.

Analysis of spatial distribution changes in the share of the population residing in industrial areas as a function of distance from the agglomeration centre (Wrocław's market square) between 2000 and 2020 reveals pronounced centrality-oriented clustering. Over 80% of residents in such areas were concentrated within 8,000 metres of the agglomeration core (68.4% in 2000; 76.2% in 2010; 81.2% in 2020). A notable increase in population density (approximately 15%) was also observed in the buffer zone at the city-suburban boundary interface (Fig. 4).

#### 4.3. The building traffic (residential) aspect of suburbanisation

In 2020, the Wrocław agglomeration comprised 290 422 residential units, with 237 135 (81.7%) located in the urban core (Wrocław city) and 52 287 (18.3%) in its suburban periphery. Post-industrial areas hosted 4 963 residential units across the agglomeration, including 4 799 (96.7%) within Wrocław and only 164 (3.3%) in suburban zones. Collectively, post-industrial lands accounted for 1.7% of the agglomeration's total housing stock (Table 3).

Table 2. Characteristics of the population and its growth in the Wrocław agglomeration and its post-industrial areas in 2000–2020 (Source: author's own study based on PESEL data)

| Municipality                  | Population |                  |     | Growth    |                  |       | Growth/<br>population [%] |                  |
|-------------------------------|------------|------------------|-----|-----------|------------------|-------|---------------------------|------------------|
|                               | 2020       |                  |     | 2000-2020 |                  |       |                           |                  |
|                               | Total      | Industry<br>area | [%] | Total     | Industry<br>area | [%]   | Total                     | Industry<br>area |
| Czernica                      | 16 293     | 15               | 0.1 | +8 946    | +8               | 0.1   | 54.9                      | 53.3             |
| Długołęka                     | 33 067     | 40               | 0.1 | +15 573   | +18              | 0.1   | 47.1                      | 45.0             |
| Kąty Wrocławskie              | 24 263     | 15               | 0.1 | +7 441    | -24              | -0.3  | 30.7                      | -160.0           |
| Kobierzyce                    | 20 583     | 151              | 0.7 | +8 934    | -17              | -0.2  | 43.4                      | -11.3            |
| Miękinia                      | 16 771     | 36               | 0.2 | +5 977    | +15              | 0.3   | 35.6                      | 41.7             |
| Oborniki Śląskie              | 19 432     | 35               | 0.2 | +2 642    | +17              | 0.6   | 13.6                      | 48.6             |
| Siechnice                     | 22 678     | 193              | 0.9 | +10 549   | -12              | -0.1  | 46.5                      | -6.2             |
| Wisznia Mała                  | 9 954      | 21               | 0.2 | +2 893    | +4               | 0.1   | 29.1                      | 19.0             |
| Żórawina                      | 10 761     | 3                | 0.0 | +3 031    | -3               | -0.1  | 28.2                      | -100.0           |
| Suburban zone                 | 173 802    | 509              | 0.3 | +65 986   | -4               | 0.0   | 38.0                      | -0.8             |
| City of Wrocław               | 583 385    | 10 247           | 1.8 | - 20 603  | +7 586           | -36.8 | -3.5                      | 74.0             |
| Total in the<br>agglomeration | 757 187    | 10 933           | 1.4 | +45 383   | +7 582           | 16.7  | 6.0                       | 69.3             |

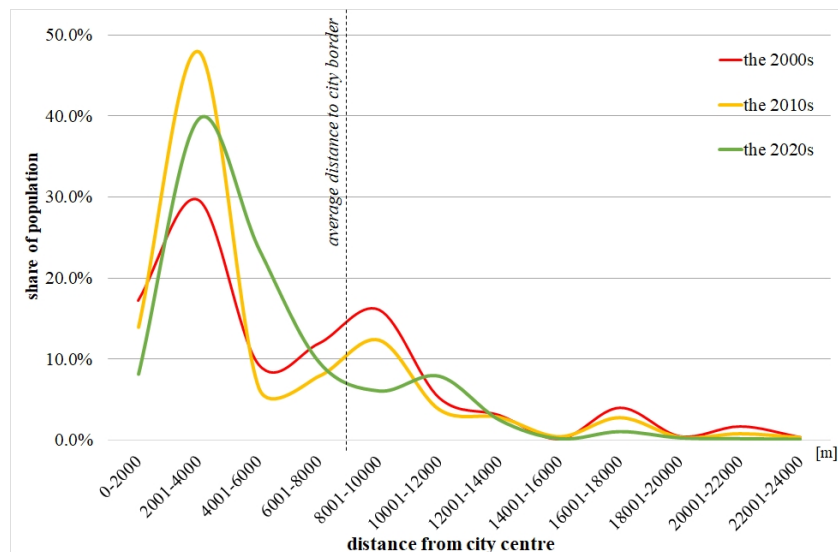


Fig. 4. Change in the spatial distribution of the population living in post-industrial areas of the Wrocław agglomeration in 2000–2020 (Source: author’s own study based on PESEL data)

Between 2000 and 2020, the agglomeration experienced a net gain of 23 978 residential units. This growth was driven by a suburban increase of 29 493 units, contrasting with a decline of 5 515 units in Wrocław city. During this period, post-industrial areas contributed 3 811 new residential units, predominantly concentrated in Wrocław (3 788 units), with a marginal suburban addition of 23 units. Housing growth on post-industrial lands accounted for 15.9% of the agglomeration’s total residential expansion from 2000 to 2020.

Between 2000 and 2020, the agglomeration saw an 8.3% overall increase in residential units, primarily due to a 55.3% surge in suburban zones, offset by a 2.3% decline in the urban core. Post-industrial areas

played a significant role in the core’s housing dynamics, contributing 78.9% of all new residential units in recent years.

Mirroring population distribution patterns, residential units on post-industrial lands exhibited pronounced spatial clustering near the agglomeration’s urban core (proximity to Wrocław’s city centre). Within an 8 000 metre radius of the agglomeration centre (Wrocław’s market square), high-density zones accounted for 72.9% (2000), 81.3% (2010), and 83.6% (2020) of such units. Additionally, the buffer zone at the urban-suburban interface showed incremental growth, aggregating approximately 15% of post-industrial residential units across the study area (Fig. 5).

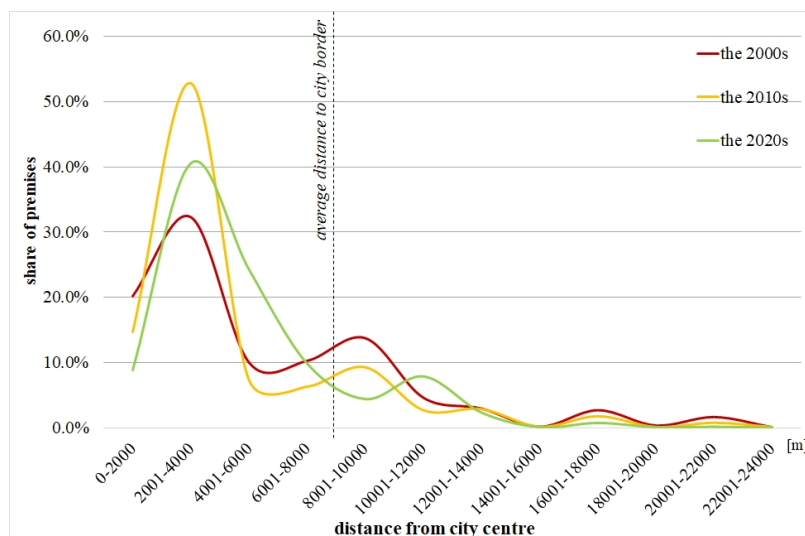


Fig. 5. Changes in the spatial distribution of residential units in post-industrial areas of the Wrocław agglomeration in 2000–2020 (Source: author’s own study based on PESEL data)

Table 3. Characteristics of residential units and their growth in the Wrocław agglomeration and its post-industrial areas in 2000–2020 (Source: author's own study based on PESEL data)

| Municipality               | Residential units |               |     | Growth    |               |       | Growth/<br>Residential units [%] |               |
|----------------------------|-------------------|---------------|-----|-----------|---------------|-------|----------------------------------|---------------|
|                            | 2020              |               |     | 2000-2020 |               |       |                                  |               |
|                            | total             | industry area | [%] | total     | industry area | [%]   | total                            | industry area |
| Czernica                   | 5 057             | 4             | 0.1 | 2 037     | 1             | 0.0   | 40.3                             | 25.0          |
| Długołęka                  | 9 771             | 18            | 0.2 | 4 293     | 10            | 0.2   | 43.9                             | 55.6          |
| Kąty Wrocławskie           | 7 862             | 9             | 0.1 | 4 855     | -6            | -0.1  | 61.8                             | -66.7         |
| Kobierzyce                 | 6 343             | 48            | 0.8 | 2 975     | 8             | 0.3   | 46.9                             | 16.7          |
| Miękinia                   | 5 009             | 10            | 0.2 | 2 923     | 6             | 0.2   | 58.4                             | 60.0          |
| Oborniki Śląskie           | 5 864             | 10            | 0.2 | 5 050     | 4             | 0.1   | 86.1                             | 40.0          |
| Siechnice                  | 7 481             | 56            | 0.7 | 3 508     | -2            | -0.1  | 46.9                             | -3.6          |
| Wisznia Mała               | 2 761             | 7             | 0.3 | 1 786     | 2             | 0.1   | 64.7                             | 28.6          |
| Żórawina                   | 3 139             | 2             | 0.1 | 2 066     | 0             | 0.0   | 65.8                             | 0.0           |
| suburban zone              | 53 287            | 164           | 0.3 | 29 493    | 23            | 0.1   | 55.3                             | 14.0          |
| city of Wrocław            | 237 135           | 4 799         | 2.0 | -5 515    | 3 788         | -68.7 | -2.3                             | 78.9          |
| total in the agglomeration | 290 422           | 4 963         | 1.7 | 23 978    | 3 811         | 15.9  | 8.3                              | 76.8          |

## 5. Discussion

As previously noted, suburbanisation constitutes a multifaceted phenomenon with diverse definitions and interpretations. Most commonly, it is described in the context of population migration from urban cores to peripheral zones (KUBEŠ, 2013). In the Wrocław agglomeration, a significant population outflow from the urban core (Wrocław city) to its suburban periphery was observed between 2000 and 2020, with a net loss of 20 603 residents (-3.4%) in the city and a gain of 65 986 (+61.2%) in suburban areas. Notably, the industrial transformation of the agglomeration triggered functional repurposing of former industrial sites, enabling residential development that partially offset population decline. During this period, post-industrial areas in Wrocław absorbed 7 586 new residents (+285.1%), totalling 10 247 inhabitants by 2020. These data indicate that without residential repurposing of post-industrial lands, the city's population loss to suburban zones would have been 26.9% higher (28 189 residents instead of 20 603).

Suburbanisation patterns are similarly reflected in the structural dynamics of residential units. Between 2000 and 2020, Wrocław's urban core lost 5 151 residential units, while suburban zones gained 29 493. Post-industrial redevelopment contributed 3 811 new units, 3 788 of which were

concentrated within the city. By 2020, post-industrial areas hosted 4 963 residential units (4 799 in Wrocław). Without this transformation, the urban core's residential decline would have been 40.7% more severe (9 303 units instead of 5 151).

The data presented above may indicate the presence of a phenomenon referred to as "inner suburbanisation" within the Wrocław agglomeration – a process previously identified by SZMYTKIE (2021). This form of suburbanisation encompasses not only the outward migration of population and residential development to suburban municipalities, but also the internal redistribution of inhabitants and capital towards underutilised or repurposed areas located within the administrative boundaries of the city. In this context, "internal suburbanisation" typically refers to intensive residential development as well as economic processes occurring in peripheral areas of the city that lie within its administrative boundaries, often on agricultural land (greenfields). It is not limited to filling gaps in development – it involves transforming sparsely urbanized areas into suburban-style housing estates. This process is mainly driven by internal migration (from the centre to the periphery), although migrants may also come from outside the city. Similar dynamics have been observed in other Polish agglomeration regions, most notably in the Katowice conurbation (SPÓRNA & KRZYSZTOFIK, 2020), and known in other

post-socialist cities as well (see LORENS, 2005; ZBOROWSKI & WIĘCŁAW, 1999).

In turn, spatial visualizations of population and residential unit concentration changes in post-industrial areas (Fig. 4 and 5) reveal a gradual deconcentration trend over time, albeit confined primarily within Wrocław's administrative boundaries. These findings indicate that functional transformations of industrial lands in the urban core may contribute to mitigating suburbanisation pressures.

The economic dimension of suburbanisation – understood as the relocation of business entities from urban cores to peripheries – presents interpretive challenges. REGON registry data (2008-2024) identified 4 096 business entities (including 323 industrial firms) migrating from Wrocław to its suburbs, accounting for 7.9% of total suburban business growth and 31.1% of industrial sector expansion. Notably, 85.4% of these relocations involved sole proprietorships (SIKORSKI & SZMYTKIE, 2021), suggesting a correlation between residential and business suburbanisation.

Industrial land-use changes further contextualize these trends. Between 1980 and 2020, Wrocław's urban core experienced a 35.8% reduction in industrial land area (1,366.2 ha to 877.8 ha), while suburban zones saw a 489.8% increase (143.8 ha to 848.0 ha) (SIKORSKI & KRYCZKA, 2023). While these shifts align with suburbanisation patterns, caution is warranted due to potential confounding factors such as deliberate deglomeration policies (cf. XIN, 2019).

Comparative insights from other CEE metropolitan areas reinforce the findings observed in Wrocław. In Brno (Czech Republic), industrial decentralisation toward the southern suburban zone has occurred in parallel with the redevelopment of former manufacturing sites within the urban core (FRANTÁL ET AL., 2015). Similarly, in Ostrava, deindustrialisation following the decline of heavy industry has led to significant shrinkage in central districts (SLACH ET AL., 2019). Although Wrocław did not experience such a pronounced decline in its central districts, the process of deindustrialisation followed a similar trajectory, particularly in terms of the functional transformation of former industrial sites.

In Budapest, industrial decentralisation has contributed to the relocation of manufacturing activities to peripheral areas, while former inner-city industrial zones have been increasingly redeveloped for commercial and service functions (KISS, 2002). Compared to Wrocław, these cities show similar patterns of industrial land reuse mitigating population

loss in core areas, although the scale and pace vary depending on national policy frameworks, real estate pressures, and institutional capacities.

A key distinction in the Wrocław case is the relatively high proportion of micro-enterprises driving suburbanisation. While in Brno and Budapest medium-sized and larger firms played a more visible role, in Wrocław the suburban expansion is more fragmented, driven by small-scale entrepreneurs. This suggests that the Wrocław region reflects a more bottom-up, household-level dynamic of economic suburbanisation, shaped by a combination of deregulated land markets and low entry barriers for business activity.

These comparisons highlight the importance of local institutional settings and policy responses in shaping the outcomes of industrial restructuring. They also confirm that while suburbanisation and industrial transformation are region-wide phenomena, their interactions remain spatially differentiated and path-dependent.

Among the 4,096 firms that moved from Wrocław to the suburbs between 2008 and 2024, 94.9% were micro-enterprises (up to 9 employees). Similar patterns were seen among industrial firms. Only three larger businesses (including one industrial) relocated during this period. This suggests that business migration had limited impact on the agglomeration's overall economy. However, since micro-enterprises make up 96.7% of firms in Poland and generate 28.2% of GDP (GUS, 2024), their relocation may act as a development stimulus for suburban areas, fostering local growth through business cooperation.

## 6. Conclusions

The conducted analyses demonstrate that certain aspects of industrial transformation in the Wrocław agglomeration are closely linked to suburbanisation processes, with the potential to both amplify and mitigate their dynamics. However, a fundamental challenge in identifying these inter-connections lies in the limitations of statistical data (accessibility and quality) that could empirically substantiate such relationships.

The research revealed that spatial shifts in economic activity, including industrial operations, exhibit trends analogous to suburbanisation, thereby reinforcing its scale. Conversely, functional transformations enabling residential and demographic development on post-industrial lands – primarily concentrated in the agglomeration's core –

contribute to reducing the intensity and pace of suburbanisation within the study area.

A key conclusion is that industrial transformation in the Wrocław agglomeration likely stems from multiple overlapping processes, with suburbanisation representing only one component. Quantitatively assessing the strength of these interconnections remains challenging, as their interplay is likely contingent on local, regional, national, and even global contextual factors.

Nevertheless, these findings hold significant implications for urban and spatial policymaking in Central and Eastern European (CEE) cities. They illustrate that industrial transformation can, on one hand, unlock land reserves for new functional uses, thereby mitigating suburbanisation pressures. On the other hand, many aspects of industrial restructuring – such as deglomeration and decentralization – share characteristics with suburbanisation, and their coexistence may exacerbate the process.

Depending on spatial policy priorities, strategic approaches to industrial transformation could either attenuate or intensify suburbanisation's impacts on CEE urban agglomerations. This is particularly critical in addressing suburbanisation's adverse effects, including risks of uncontrolled urban sprawl (cf. DAWID ET AL., 2023).

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## Materials and data

- Baza danych obiektów topograficznych (BDOT10k) (Database of topographic objects). Available at: <https://www.geoportal.gov.pl/pl/dane/baza-danych-obiektow-topograficznych-bdot10k/> (accessed: 2 June 2025).
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