Driver Factors, Wildcards and Spatial External Effects of Urban Sprawl in Poland (2016–2022)

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Abstract. The recent years were rich in new and unexpected social and political factors for Poland, such as the COVID-19 lockdown in 2020–2021 and the refugee crisis in 2021–2022. These 'wildcards' will definitely have serious consequences for people and cities, directly and through the impact of so-called externalities. The paper identifies trends in the geographical development of urban areas in Poland during the last five years (2016–2021), particularly in terms of residential suburbanization and urban sprawl. The study aims to explore the driver factors that determine the spatial scale of suburbanization and reveal 'wildcards' that may indirectly affect this process but are hard to be quantified and embedded into spatial analysis. Both wildcards and externalities of suburbanization seem to be underexplored, and this paper's goal is to bring progress on this pass. The spatial analysis applying location quotients (LQ) metrics creates the possibility for comparisons of locations with intensified urbanization for different time moments, thus fulfilling a function similar to the standardization of features considering time and space perspectives. The results makes the evidence to progressive suburbanization around the main Polish cities during the years 2016–2021, revealing, at the same time, distinguishing features of spatial development for the period associated with social and political stresses (2021).

Keywords: Urban sprawl · Residential suburbanization · Driver factors · Wildcards · Poland

1 Introduction

In 2020, the Polish construction industry showed more than just impressive growth, especially against the past twelve years, starting from the 2007–2008 Global Financial Crisis (Fig. 1). Furthermore, 2020 became the first year in which the communist era's indicators were exceeded in terms of construction. It's even more interesting because nowadays, a population decline is observed in Poland, while in the communist era, the high demand for new housing was conditioned, to a large extent, by the post-war (WWII) baby-boomer generation that started entering the labor market [1].

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This communication paper aims to reveal trends in the geographical development of the urban areas in Poland over the last five years (2016–2021), particularly in terms of suburban sprawl, identify the driver factors that directly determine the spatial extent of suburbanization and look for other phenomena that may indirectly affect the urban sprawl but are hard to be quantified and imbedded into spatial analysis such as COVID-19 lockdown and the war in Ukraine in 2022.

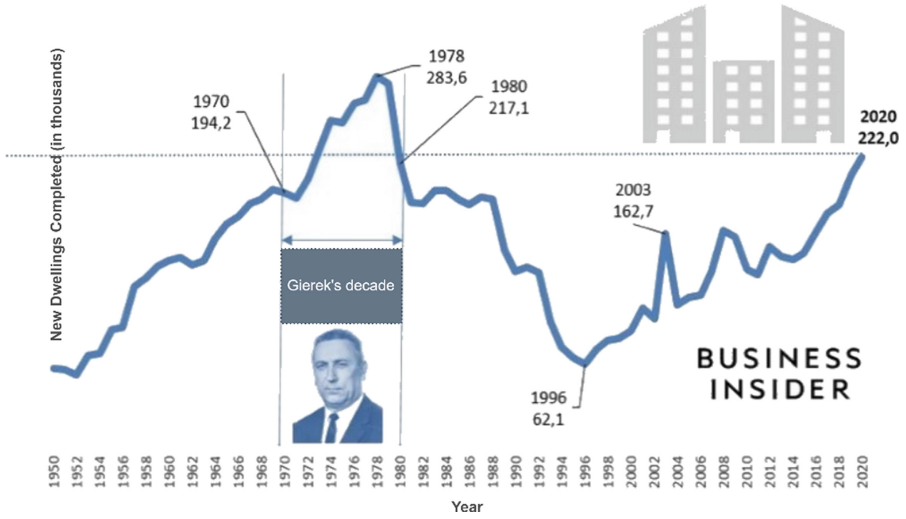

Fig. 1. Housing constructed in Poland, year-on-year [1]. Translated from Polish.

The continuous global trend of urbanization as well as both internal and external (international) migration are apparent factors that empower the development of cities and urban functional areas around them. At the same time, in some cases, the geographical location may imply specific conditions for city development, too.

Among the main dimensions of urban expansion are suburban sprawl [2] and inner-city processes such as gentrification and re-urbanization. At the same time, the recent years have been bringing a disruption impact, with the COVID-19 outbreak (since 2020) and the war in Ukraine (since February 2022). These 'wildcards' will definitely affect - directly and indirectly - all people, especially those living in urban areas, and cities as they are.

Within the COVID-19 lockdown periods (2020/2021), substantially more people were looking for houses outside of the cities (Fig. 2) to relocate from the downtowns.

Another enormous wildcard that may affect the housing market and geographical development was the unanticipated war outbreak in (neighboring to Poland) Ukraine in 2022.

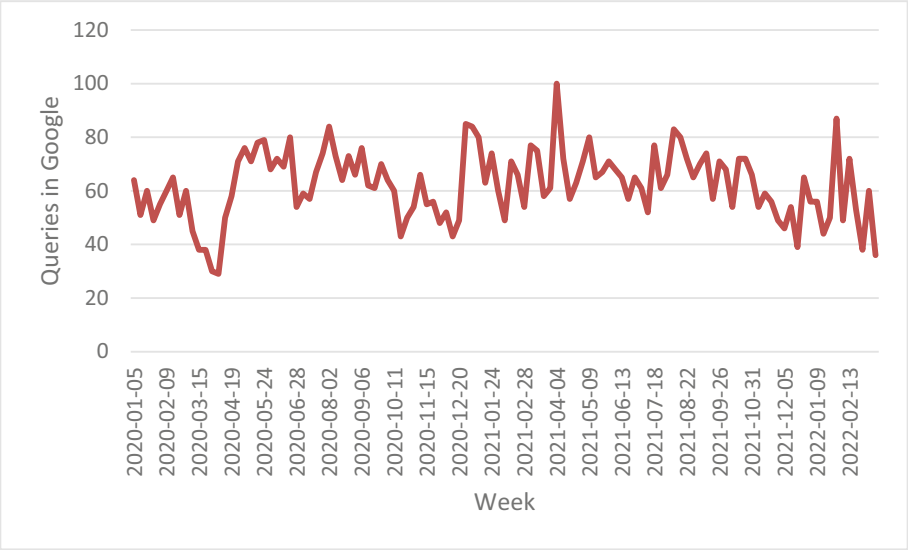

Fig. 2. Google trends data, Poland: 'House to buy'; queries per week: 01.01.2020–20.03.2022

According to the Polish Central Statistical Office data, at the end of February 2020, the last month before the COVID-19 outbreak, there were 1.39 million Ukrainian citizens in Poland inhabiting cities. Later, some of them returned to Ukraine, but at the end of 2021, the Centre of Migration Research of the University of Warsaw estimated this population in about 1 million [3]. The situation has radically changed with the beginning of war outbreak in break in Ukraine on Feb. 24th, 2022, and the colossal (additional) influx of refugees from Ukraine – mainly women, children, and the elderly (Fig. 3).

Not all of the refugees are planning to stay in Poland. Some of them are going farther, but some, especially men who earlier worked in Poland, intend to return or have already returned to Ukraine to fight. Relocation and accommodation of the refugees are temporary for the moment. But, the housing rental market reacted immediately. Rental prices skyrocketed contrary to the pandemic and the lockdown a year ago when there was a bear market. During the two years of the COVID-19 pandemic (2020–2021), apartment rentals ceased to be a profitable business. Remote learning for students, closed borders for foreigners, working from home, uncertainty about one's finances - all these have caused renters to leave the previously thriving market.

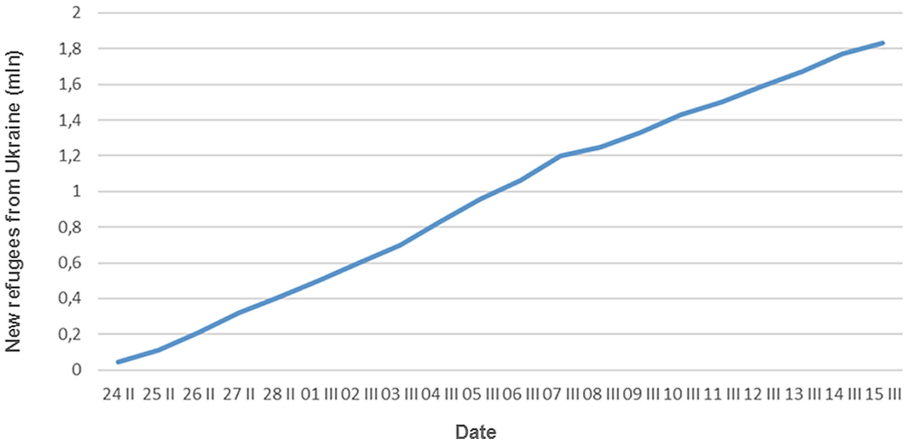

Fig. 3. The influx of refugees from Ukraine since 24 February 2022 in Poland (millions) [4].

Those above-mentioned inter alia factors seem significant for the further development of urbanization in Poland at the moment. However, it would be worth examining the suburban sprawl during the last five years, aimed to check if the global trends sustained in Poland before, during the pandemic period, and nowadays in completely different international and national circumstances.

However, the central hypothesis of the recent study concern confirmation of stability and persistence of global trends concerning suburban sprawl observed since 2016 in Poland despite different impacts of stimulants, de stimulants, and nominates factors taken into account or suspected to affect the observed phenomenon.

2 Factors of Suburban Sprawl, Wildcards, and Externalities

2.1 Urban Sprawl, Suburbanization

Suburbanization refers to population migration to suburbs, resulting in the rapid development of peripheral areas of cities and urban sprawl. While both of the above-mentioned terms are commonly used interchangeably, urban sprawl is generally associated with a spontaneous and uncontrolled dimension of suburbanization and its numerous negative impacts, i.e. poor accessibility, lack of functional open spaces, and huge environmental costs. "A variety of definitions for sprawl have been put forth that describe sprawl as a specific form of urban development with low-density, dispersed, auto-dependent, and environmentally and socially impacting characteristics" [5, p. 160].

The last decade offered a wide range of simple and synthetic indicators, attempting to capture urban sprawl [6–8]. Notwithstanding hot discussions, almost all these multiple indicators are fundamentally-based on land uptake and population variables; wherein there is a strong tendency to consider population density within built-up areas rather than within the whole territory of a unit [2].

Although urban sprawl refers to the urbanization of suburbs, quantification of urban sprawl requires a comparison of relevant indicators for both urban areas (that are losing their functions) and urbanizing peripheral areas (that are gaining new inhabitants) in a time perspective, i.e. estimated at least at the beginning and the end of the analyzed period.

Urban sprawl is conditioned by people's individual decisions about where to live and work for a better quality of life. It can be accelerated by numerous socioeconomic and demographic factors, including the price of land and apartments, transportation availability, rising living standards, and inner-city problems (Fig. 4).

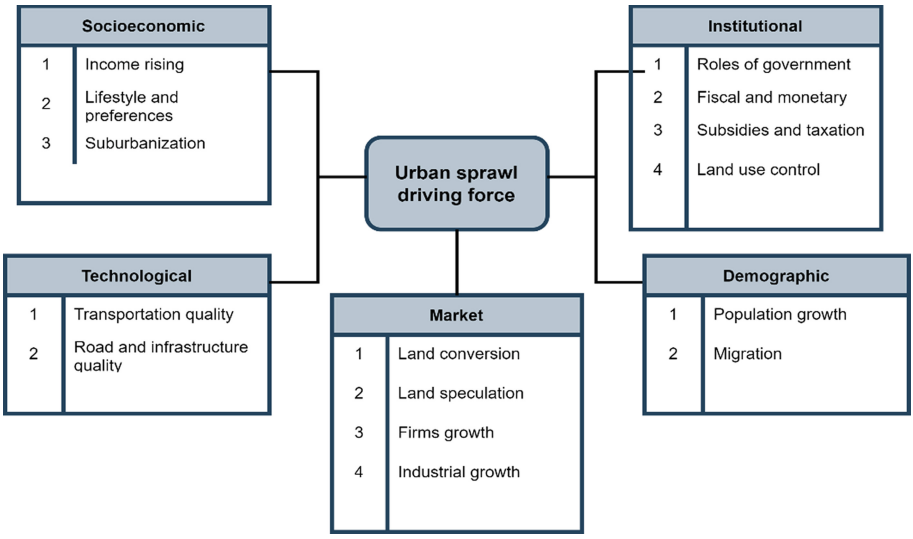

Fig. 4. Urban sprawl driving force [9].

The recent evidence established that in 1990–2014, urbanization in general and urban sprawl specifically are increasingly decoupled from demographic dynamics (such as population growth) and are likely the result of households relocation from city centers to peripheries [10]. It is worth noting that some comprehensive predictive models consider the ethnic composition of the population as a factor of suburbanization [11]. In the American context, it is assumed that increases in the percentage of ethnic minority populations within cities led to a growth in urban sprawl [12]. In a European context, the opposite impact on ethnic minority populations was observed [13].

Evaluation of the existing definitions for urban sprawl reveals that most of them involve three spatial aspects: the expansion of the urban space, the increase of dispersion of the build-up area, and low-density development in suburbia with a high land take per person [14, 15].

Residential suburbanization may be related not only to permanent housing. While seasonal population shifts to "second homes" in some cities have been registered [16], the hypothetical wildcards of suburbanization stay unexplored [17].

2.2 Wildcards (Black Swans)

The 'wildcards' or, according to Taleb [18], 'Black Swans' represent those unexpected (astonishing and shocking) events that are generally considered unlikely but the occurrence of which could fundamentally affect the condition of people (societies). The triplet characteristics summarizing wildcards are rarity outlier, extreme impact, and retrospective (though not prospective) predictability of the event [18].

Two such wildcards are happening during the last years, overlapping in time: the global COVID-19 pandemic since the beginning of 2020 and the outbreak of war in Ukraine in February 2022. Both will have a giant impact on different aspects of European societies and the EU economy, especially in neighborhood countries of Ukraine.

Taking a look at retrospection of the last two years of the course of a COVID-19 in Poland [19, 20], it is hard to say if the global pandemic is near its end. On the other hand, it is hard to assume if the war in Ukraine will last for a longer time (similar to the 2014 invasion of Russia on Crimea, Donetsk, and Lugansk in Ukraine) or there is a solution coming shortly.

These two 'wildcards' will certainly have at least a significant impact on Polish society and economy through external effects.

2.3 External Effects and Spatial Externalities

Externalities are common for all human activities and, of course, also for economic processes. They are usually defined as side effects of actions (in either production or consumption) that affect other people not directly related to that activity. Externalities affect people independently of their will, but their impact can be positive or negative. Externalities are associated with either additional benefits or social costs not included in the calculation of economic activity. It is widely believed that externalities arise from the relationship between the economy and the environment.

Negative externalities are seen in terms of environmental pollution, location of landfills, vandalism, social pathologies, and crime. Positive spillovers in the economy are associated with economies of scale in services, the benefits of agglomeration - location and urbanization, and, more recently, the benefits of globalization. In economics, they are treated as unexpectedly occurring gains from spillover effects [21].

"Broadly defined, spillovers, or other economic neighborhood effects, refer to unanticipated changes in the well-being of the population, i.e., the actions of individuals or third parties, and sometimes events that indirectly affect other people's standard of living. The costs or rewards of externality effects are not included in the direct account of economic activity" [22, p. 167]. Marshall [23] defined spillover effects as market externalities of economic activity, Pigou [24] - as differences between social and private costs and benefits. A more detailed and slightly different definition of externalities was formulated by Mishan [25], who viewed them as expected (anticipated) or unanticipated spillover effects of third-party activities that directly or indirectly affect changes in people's living standards.

Externalities are viewed, through the lens of the growth pole theory, as differences in the action of centripetal and centripetal forces, concentration and dispersion, or attraction and repulsion [26], explaining the spatial order and spatial patterns of urbanization [27–29]. The classification of externalities includes the distinction between financial and technological, sectoral and urbanization, positive and negative, and productivity (labor) or development (regional) effects. In spite of the classification, a detailed description of externalities is most often done through a case-by-case analysis [30].

Spatial Externalities. Tracing the suburban sprawl is one aspect of land-use change research, which is the consideration of spatial externalities [31]. Spatial externalities are defined similarly as unexpected and indirect effects of human actions that cause a decrease (additional cost) or an increase in value (additional gain) for others [25]. Thereby, the pandemic outbreak and the war-related refugee crisis may influence the residential preferences of the population in many ways and result, inter alia, in a considerable population shift and, consequently, involve changes in residential density. The externalities of land-use change are generally revealed by their intensity (rate) and spatial extent. A distinction can be made between both negative and positive spatial effects. It's believed that the higher the level of externalities at a given land-use class (e.g. built-up areas), the higher the probability of land-use change at a given location [32].

3 Data and Methodology of Research

The index chosen as the independent variable, representing suburban sprawl up to 2021, was new Dwellings Completed per 10,000 of population (per 10K) within counties in Poland from 2016 to 2021 per year due to the need to acquire the relative recent spatial and statistical data. It's proposed that geographical location and volume of new investments in given years show the spatial extent of the frontline of urban growth, particularly suburban sprawl. official data were acquired from Statistics Poland (CSO) [33].

Both absolute values of Dwellings completed per 10K and their location quotients (LQ) by counties were detected. The defining reference value for estimating particular LQ in counties was the average LQ for the whole of Poland for a particular year.

Location quotient (LQ_i), or regional index, for a spatial unit (region) is the ratio of the value of an indicator of a specific economic or social activity S_i in spatial unit i (region i) to the value of that indicator A in a higher spatial unit (country, Eq. 1) [34]:

$$LQ_i = \frac{S_i}{A} \tag{1}$$

Thus, location quotient (LQ) may be used to quantify how actively the construction industry performs (per capita) in a particular region as compared to the national level.

LQ also creates the possibility of comparisons for different time moments, thus fulfilling a function similar to the standardization of features. $LQ < 1$ indicates a 'shortage' of residential construction in the county compared to the national value. $LQ > 1$ reveal 'overrepresentation' i.e. spatial concentration of residential construction [4].

The study is based on the lastly acquired and recently available data. A deeper insight into the changes in the spatial, social, and economic structure of functional urban areas will be needed when new datasets are released, e.g. detailed data of the functional urban areas in Poland (as well as for other EU countries) and Global Human Settlement Layer data (that currently concern only the year 2018). The just-completed national population census (2021) detailed data results are expected to reveal since Spring 2022, but they will also be outdated due to new factors modifying the economic and market situation.

4 Results. Urban Sprawl in Poland in Light of Dwellings Completed Per 10K Population

The general trend of building industry in Poland was continuous growth of dwellings completed per 10K since 2016. The number of dwellings completed per 10K differed depending on size of county and geographical location, but consequently grew over the past years (Fig. 5).

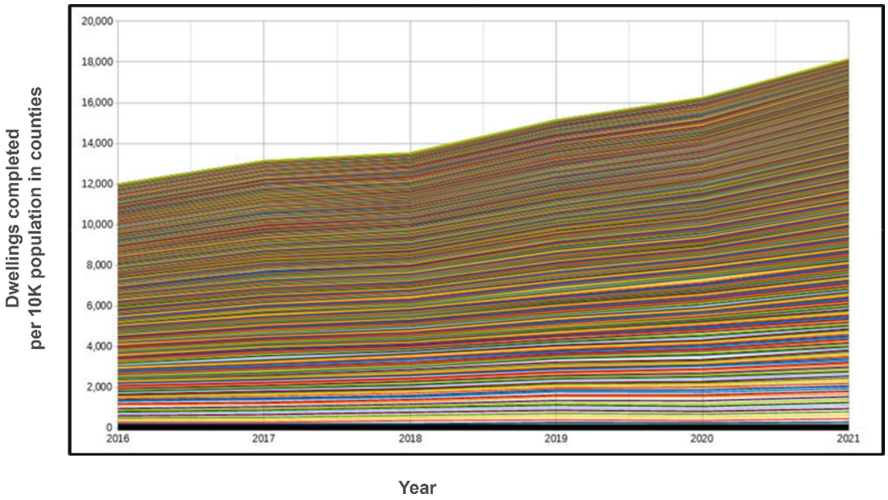

Fig. 5. Stacked, cumulative number of new dwellings completed per 10K population by counties by year in Poland (2016–2021). Counties identified by four-digit statistical number (TERYT).

The spatial diversity of absolute values of dwellings completed per 10K population by counties in starting year of study (2016) is not worth showing. It is better to present LQs because they reveal specific 'bagels' – counties surrounding the main cities in Poland (Fig. 6).

During the observed years before the COVID-19 outbreak (2016–2019), only some minor details of the spatial diversity of the studied phenomenon were changed. Both the absolute values and LQs were similar (Fig. 7).

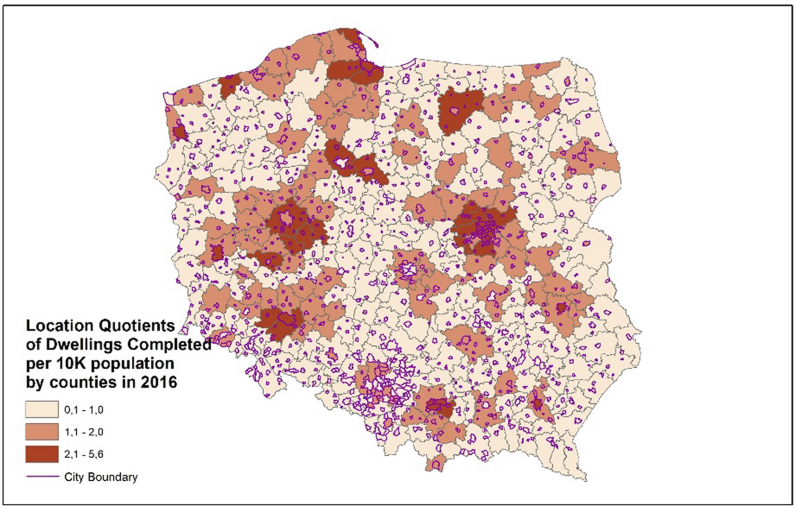

Fig. 6. Location Quotients of new Dwellings completed per 10K population by counties in Poland (2016).

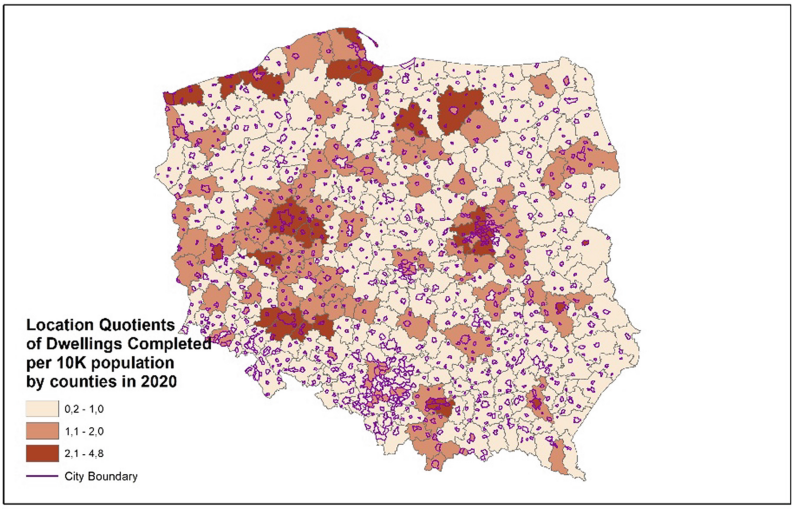

Fig. 7. Location quotients of new dwellings completed per 10K population by counties in Poland (2020).

It seems that after the first year of the COVID-19 pandemic outbreak in Poland, some *'bagels'* have tightened (Fig. 8). However, the Western parts of Poland stayed

unchanged. The Eastern part (along the EU border) clearly diminished the spatial extent of new residential constructions. The span of dwellings completed per 10K also dropped and was closer to the national average.

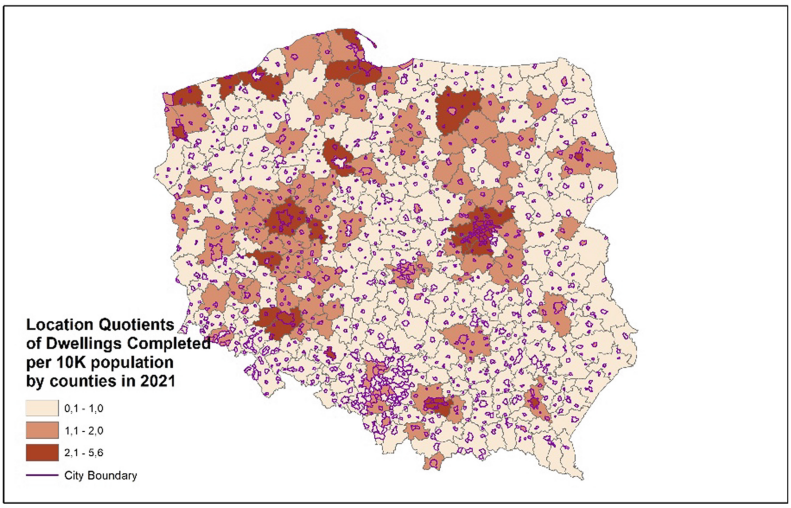

Fig. 8. Location quotients of new dwellings completed per 10K population by counties in Poland (2021).

In 2021, the situation of urban sprawl in Poland changed. It should be mentioned that from August the clashes concerning the 'push and pull' of illegal immigrants tension took place to December in a North East Poland along the Belarusian state border. The special zone along the EU – Belarus border has been announced as closed for visitors.

From 24 February 2022, external conditions changed drastically. Poland has been the target of the massive influx of Ukrainian refugees fleeing the war. The first wave was probably mostly the families of Ukrainian citizens who previously worked in Poland and had a place to shelter themselves. After a few weeks, there were others who fled from Eastern Ukraine. No one knows how many people will yet escape Ukraine, targeting or transiting Poland.

These two above-mentioned external effects will create opposite processes. Continuation of global COVID-19 pandemic waves (e.g. new SARS-COV2 strains in the coming autumn and winter seasons) make another threat to the economic development in Poland, while the massive influx of Ukrainian people could be a stimulus, especially if they decide to settle in Poland for a longer time.

5 Discussion and Conclusions

The paper identifies trends in the geographical development of urban areas in Poland during the last five years (2016–2021), particularly in terms of residential suburbanization and urban sprawl. It's proposed that geographical location and volume of new housing investments in given years show the spatial extent of the frontline of urban sprawl, particularly residential suburbanization. The location quotients (LQ) of new dwellings were used to quantify how actively the construction industry performed in counties in 2016, 2020 and 2021 as compared to the national average.

The results testify to progressive suburbanization around the main Polish cities during the years 2016–2021, revealing, at the same time, distinguishing features of spatial development for the period associated with social and political stresses (2021).

Despite the tendency for a strong development of residential construction in Poland, it is hard to scope out if intensive urbanization processes, especially suburban sprawl, will keep the previous pattern of spatial development and further demonstrate inadequate critical spatial infrastructure investments outside of the cities' boundaries in a longer time perspective.

New releases of (more recent, detailed, and accurate) data can make possible a more comprehensive study which seems to be a natural objective of future research from a long-time perspective. Another opportunity for the possible developments involves replication of estimations of Location quotients of new Dwellings by applying other types of study units, e.g. using data at the municipality level and/or considering the Functional Urban Area classification.

The impact of combinations of different factors shapes synergetic (potentiating) effects and feedback specific to distinct geographic areas. For instance, urbanization in Ukraine is estimated at 69.6% as of the end of 2021 against 60% in Poland as of the end of 2020 [35]. Most refugees from Ukraine seem to be the people from Ukrainian cities. The urban areas were their milieu, and they are migrating to the largest cities of Poland looking for, at least, temporarily or targeting accommodation similar to Ukrainian. It means that Polish cities will note the super high pressure.

The cumulative impact of factors influencing the spatial development of cities is not a simple sum of them but acts in a compound way, but the synergy of the influence of a different number of factors in various geographical areas may not be the same. Then one can expect different ways and different spatial extent of urban sprawl in Polish cities.

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