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Compact and polycentric urban forms as intertwined concepts: Learning from the impacts of Covid–19 retail restrictions on spatial (in)equalities in Brno (Czech Republic)

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Abstract

Urban structure conceptualisation using compact and polycentric city narratives is often performed separately. However, although both are based on different spatial grammars, they are inextricably linked. The spatially equitable distribution and accessibility of urban functions are often seen as their main contributions. This paper uses the unprecedented circumstances of the COVID-19 pandemic to further analyse the relationship between the two narratives, using the radical transformation of a retail network in a post-socialist city (Brno, Czech Republic) as an example. Based on an in-depth analysis of government measures aimed at preventing the spread of the coronavirus and their coverage in the media, operational changes among all stores in the city are quantified. A comparative spatial analysis then shows that, in addition to economic inequalities, spatial injustice was exacerbated by the position of the central government, with varying degrees of intensity depending on the type of urban structure. It is argued that the resilience potential of polycentric and compact structures is very low, especially in the absence of retail planning and reflection upon spatiality in ensuring social equity.

Keywords: compact city, polycentricity, spatial justice, retail, COVID-19

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1. Introduction

New socioeconomic processes associated with globalisation and rising consumption have been altering traditional urban forms related to industry and production over the last few decades (Hall & Pain, 2006; Sassen, 2000). The spatial organisation of society has evolved into multifaceted worldwide networks which interconnect different economic actors, both physically and virtually (Kloosterman & Lambregts, 2001). The space of places, that is, the space of rather enclosed everyday social and spatial routines (travel to work, shops, home), is now embedded into the more dominant space of flows—flows of people, goods, capital, technology, information and innovation (Castells, 1996).

When considering the material transformations of heavily urbanised areas, sprawling urban landscapes are the main visible outcome (Artmann et al., 2019; NuiSSL & Rink, 2005). Compact and polycentric city narratives emphasising the equitable spatial redistribution of basic services, in particular, have become the political and planning response to this sprawl (Bailey & Turok, 2001; Dempsey, 2010). However, the operationalisation of policy goals into planning tools and actual urban development has its limits. One problem is the lack of understanding of how polycentric and compact structures affect the functional space of the city and how they relate to the social sphere in residents' everyday lives.

The research objective of this paper is to highlight the limitations of the polycentric and compact city concepts as imaginations of sustainable spatial development. We use the transformation of the retail network in the post-socialist city of Brno (Czech Republic) as it exhibits features of both a compact and a polycentric city. The transformation of the retail network is both long- and short-term. The long-term transformation comes as a result of socialist directive planning that post-socialist liberalisation tendencies and internationalisation have modified. The short-term changes have been caused by imposed socioeconomic restrictions in reaction to the COVID-19 pandemic that has become, in many ways, unprecedented. The rapid onset of the pandemic disrupted spatial patterns of behaviour and (temporarily) severed existing (extra-) urban ties. We believe that such a unique situation serves as a distinct spatial laboratory revealing the pros and cons of both planning concepts which may otherwise be suppressed or untapped. The research thus asks: What impact has this sudden restriction of retail amenities had on the spatiotemporal structure of the city and the accessibility of retail? What are the implications for understanding compact and polycentric urban forms?

Using textual analysis of government regulations together with their coverage in the media, unique time series data of the retail network development in Brno and a model application of restrictive

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measures (applied in the Czech Republic) on the operation of individual stores, the paper compares retail accessibility and spatial patterns in two cases:

1. Retail regulation based on the government COVID-19 measures, and
2. Hypothetical regulation based on the government COVID-19 measures without economic discrimination.

Hence, the spatial analysis reveals differences in the accessibility of retail between a situation of real store closures (retrospectively designated as discriminatory) and a hypothetical situation in which a number of retail units would remain open (assuming the application of an economically non-discriminatory framework). The results are interpreted with consideration for spatial justice and equity principles, the intended outcomes of polycentric and compact urban structures. At the same time, the importance of spatial policies that must be addressed in the face of economic or legislative decisions is highlighted. From this point of view, we assert, that rather than attempting a straightforward comparison of the two spatial planning concepts, this article offers a perspective on the specific post-socialist urban context and draws on the unprecedented consequences of the COVID-19 pandemic upon the functioning of urban retail.

2. Compact and polycentric structures: Towards spatially just urban settings?

Urban sprawl – often characterised as leapfrog or scattered development, commercial strip development, or large expanses of low-density or single-use development (Ewing, 1997) – has several negative economic (e.g. Carruthers & Ulfarsson, 2003), social (e.g. Nguyen, 2010), physiological (e.g. Ewing et al., 2003) and ecological (e.g. Johnson, 2001) consequences which have been deeply analysed. The opposite of sprawl is often referred to as a compact urban form. Dempsey (2010) highlights the main characteristics of compact cities and argues that the compact city has a relatively high residential density, mixed land uses, an efficient public transport system and predispositions that encourage walking and cycling. It supports low energy consumption, reduces pollution, enhances social interactions and safety and represents an urban form with less intense car mobility. Hence, the promotion of compact urban development, abandoned space reuse, vacant inner lot development and urban densification, have been identified as the primary strategies to manage the manifold consequences of urban sprawl.

Despite the difficulties in turning the theoretical spatial imagination of the compact city into practice (Burton, 2002), some evidence about the benefits of compact urban forms (compared to the disadvantages of sprawl) has been provided. These include shorter travel-to-work distances (Boussauw et al., 2012), the higher vulnerability of sprawling metropolitan regions to climate change (Stone et al., 2010) and evidence from the effective implementation of anti-sprawl policies in Portland, Oregon and Randstad, Holland (Dieleman and Wegener, 2004).

Acceptance of the ‘compact’ narrative in planning policies was made possible by the assumption of greater social equality that a compact city provides. The idea of social justice in the sense of a fair distribution of resources has permeated spatial policies and visions of compact cities (Ancell & Thompson-Fawcett, 2008; Zhu & Guo, 2022). Compactness has many characteristics, and each may have a different impact on social equality. For example, Burton (2000) claims that compact forms may offer benefits such as improved public transport use, reduced social segregation and better access to facilities. While this spatial extension of the traditional Rawlsian theory of justice adds space as a fundamental aspect affecting the lives of the most disadvantaged, only the consideration of cultural, temporal and structural processes brings deeper insight into urban spatial inequalities (Soja, 2010).

Compact city proponents usually base their arguments on the abundant negative consequences related to uncoordinated and sprawling urban forms. Yet there are high numbers of urban dwellers and companies leaving dense core cities for the outer urban rim in search of better living, environmental or business conditions (Couch & Karecha, 2006). The concentration of human activity in large metropolitan regions is accompanied by deconcentrating processes taking place on the intra-metropolitan level. Residential and commercial suburbanisation represent, in some urban regions, dominant redistributive processes (Lang, Blakely & Gough, 2005; Stanilov & Sýkora, 2014), which seriously impact how core cities function.

Scholars are now discussing spatial planning visions that would mitigate overcrowding, inaccessibility and low environmental quality in order to make cities healthier, greener and more liveable, for example, via proactive measures focused on attracting investment and people into other (less populated) regions and cities—in line with the territorial cohesion discourse (Medeiros & Rauhut, 2020). In contrast to traditional central place and hierarchical urban system models (Berry, 1964; Christaller, 1933), the polycentric narrative has helped to explain the increasing complexity of urban systems which become less hierarchically structured and integrated into broader urban networks. Unlike monocentric (concentric/radial) cities, often seen as a spatial arrangement producing negative environmental and economic externalities (traffic, overpopulation, congested infrastructure), polycentric development is understood as a concept offering positive externalities and economies of scale typical for large agglomerations while mitigating agglomeration diseconomies and urban sprawl that occur in monocentric urban forms (Bailey & Turok, 2001).

As a highly scale-dependent concept, polycentricity takes a different shape and structure at the intra-urban level (Malý, 2019). The polycentric (multinucleated) city is defined by the existence of sub-centres, understood as a natural concentration of jobs, population, services and other activities (Giuliano, 1991). These are perceived as a counterweight to the urban core. Networked sub-centres (secondary centres) are a prerequisite for shortening commuting distances, lowering costs and, indirectly, mitigating traffic load or excessive mobility (Kang-Rae & Banister, 2007; McMillen, 2001).

Some of the features of a compact and polycentric city are incorporated in the concept of the “15-minute city” (15mC), which has been gaining the attention of urban scholars in recent years. This acronym hides principles that originate in the philosophy of chrono-urbanism that forms the grounds of time-oriented policies and planning. The premise of the 15mC is that the time spent travelling is inversely proportional to the quality of life. Thus, this concept aims to construct and re-develop cities with primary focus on accessibility to housing, entertainment, schools, work, healthcare, and commerce. The purpose of 15mC is to bring activities closer to people instead of transporting people to them. The time limit is equivalent to the walking and cycling accessibility of urban functions (Moreno et al., 2021; Marino et al., 2023).

The emphasis on localism is reflected in several aspects. Mixed (multifunctional) development is supposed to ensure intensive contacts between the inhabitants of the individual neighbourhoods and to reduce dependence on the car. As Zhang et al. (2021) noted, 15mC objectives can also be consistent with the principles of polycentric development. Proponents of the concept also argue that the increasing digitalisation of the world (Fourth Industrial Revolution) is leading to a decreasing need for individual commuting. For example, (long) daily commuting can be replaced by online work (Allam et al., 2022). The popularity of 15mC has been boosted in recent years by the COVID-19 pandemic. Although the 15mC concept originally followed the need for sustainability

and climate change responsibility, the pandemic revealed other related contexts, especially the socio-spatial ones. For example, it was crucial to ensure the availability of basic human needs (food, water, material goods), especially for socially vulnerable groups.

However, the applicability of the 15mC concept has its limitations. It is challenging to implement it in already very fragmented cities (North America, Southeast Asia). On the contrary, it is easier to enforce the imagination in more compact European cities. The 15-minute limit is also problematic regarding universality of its principles (walking speed, cycling speed), i.e. it does not consider people with disabilities (Khavarian-Garmsir et al., 2023).

Although polycentric and compact narratives are based on different theoretical foundations and spatial grammar, both are supposed to combat the negative externalities of urban sprawl and land fragmentation by providing a fair redistribution of urban functions and thus ensuring spatially just cities (after all, 15mC can be considered a specific, although probably unintended attempt of their integration). Yet, there is still a lack of knowledge about how these concepts interlink despite their common planning features, spatial (urban) dimensions and socially egalitarian goals. This paper seeks to describe this relationship through the lens of sudden and intense changes to spatiotemporal patterns in the retail network.

3. Overlapping urban forms in Central and Eastern European post-socialist cities: Example of the retail network

The urban forms of post-socialist cities in Central and Eastern European (CEE) countries are shaped mainly by historical medieval structures, relics of (proto-)industrial buildings, socialist estate housing construction and industrialisation, and post-socialist suburban single-family housing projects and commercial deconcentration to the outskirts (Szelenyi, 1996). Although the pre-modern urban development period was similar to Western Europe, socialist directive planning resulted in the emergence of specific urban structures and links with the original, largely organic urban growth. The result is, therefore, a more or less compact core structure transitioning into densely populated housing estates (Hirt, 2013). The strength of the transport links between these typologically different urban forms is then influenced by a number of factors, such as the efficiency of public transport, the existence of physical barriers (industrial sites, brownfields) and the centrality of the sub-locations and the degree of mobility generated (Seidenglanz et al., 2016).

In this respect, a specific feature of many post-socialist CEE cities is the very dense public transport network inherited from the socialist era (Pucher & Buehler, 2005), alongside which individual car transport began to make significant progress in the period of post-socialist transformation. Thus, paradoxically, the current enormous potential in the use of public transport in some post-socialist cities may not be fulfilled purely because of the sudden widespread availability of the car, which, given the suppression of individualism in the socialist period, is now all the more used and understood as a status symbol, a manifestation of freedom and independence (Pojani et al., 2018). Factors of economic efficiency, speed or flexibility of individual transport modes may then play a secondary role.

The layering of urban structures and socio-spatial habits have implications for the functioning of the city as a whole. To understand the relationship between urban form and urban everyday life, it is necessary to identify the basic functional elements of the city. Beyond jobs, it is retail that defines the spatial patterns of human activity, and that clearly illustrates the benefits and drawbacks of specific urban forms and their linkages

(Fernandes & Chamusca, 2014). In post-socialist cities, the retail sector, as a significant feature of urban centrality, has recently undergone a dynamic transformation that results not only in various shopping behaviours and consumer preferences but also in overlapping urban schemes and spatio-functional patterns in the retail environment (Kunc & Křižan, 2018).

Due to a lack of investment in internal trade (unlike in advanced market economies), the socialist central-command economy was unable to provide sufficient retail services. In Czechoslovakia, for illustration, underinvestment in the retail sector has resulted in only about half the level of service standards compared to Western European countries (Drtnina & Krásný, 1989 cited in Kunc & Novotná, 2022). The spatial standardisation of the services and trade supply was based on a central settlement system, the result of which was an overloaded retail network in centres (monocentric model), illogical shop and shopping centre construction in rural settlements, and housing estates with high population density suffering from insufficient retail facilities (Szczyrba, 2005). Although some neighbourhoods struggled with commercial underdevelopment, the shops concentrated within the compact city were an important socio-spatial hub in the everyday lives of local residents.

The privatisation and commercialisation of the retail network after 1989 brought changes to the spatial urban structure. While the initial atomisation stage showed signs of decentralisation among retail structures and an increase in the number of retail outlets, the subsequent internationalisation stage increased the concentration of retail floor area and brought about an expansion of new retail formats (e.g. hypermarkets, discount stores) often located on the peripheral but in rather accessible (by car) locations within metropolitan areas (Garb & Dybicz, 2006). Although the retail supply continues to grow and, especially in large cities, expand their regional importance in terms of daily shopping trips (Maryáš et al., 2014), the spatial concentration of new retail forms is reflected in the polycentric nature of retail, where many shopping centres are dependent on customers commuting by car and looking for a fun shopping experience (Spilková, 2012). However, the distribution of shopping malls may not be spatially balanced. As a study in Hungary shows (Sikos, 2022), the location of large-scale retail formats is not so much a result of spatial planning as it is a consequence of the spatial polarisation of purchasing power, with many larger cities in poorer regions (often border regions) not having a shopping mall within their districts.

This concentration phase is slowly ending as the retail sector in the CEE market reaches stabilisation (Coe & Hess, 2005). New localisation strategies for stores with smaller space requirements are emerging. These stores are located in central city districts and are able to compete with international large-format stores on city outskirts through specialisation, product quality or specific opening hours. This is leading to distinct time-space retail configurations (chronotopes) that produce and shape specific urban rhythms (Muliček & Osman, 2018). Moreover, there is a differentiation in the portfolio and services of individual retailers, which is reflected both in how the socioeconomic profile of customers is structured and, in their ability, to reach the products. Not only smaller stores but also retail chains place emphasis on the provision of organic and local products (hyperlocal retail), incorporate hybrid sales concepts enabling convenient and quick shopping (omnichannel), offer in-store staging (testing the products in the store) or tailor-made services (Kunc & Křižan, 2022).

The significant share of e-commerce and penetration of smart technologies (increasingly utilising artificial intelligence) in retail at the moment (Priporas et al., 2017), together with local entrepreneurial strategies competing with large retail chains, are having an impact on the spatiotemporal organisation of the retail network in CEE cities. The uneven distribution of specific

store formats is reflected in varying degrees of accessibility to different socioeconomic groups. However, the legacy of relatively well-equipped compact urban structures ensures the availability of basic fast-moving consumer goods even in declining inner-city neighbourhoods. This is particularly evident when compared to the largely sprawled urban environments of car-oriented urban societies in Canada or the United States (Hamidi & Ewing, 2014). The advantages of this compact retail structure—accessible by foot, bicycle, or public transportation—combined with large stores in the suburban fringe, creating a polycentric configuration of shopping malls, is that they generate a stable retail network with relatively fair accessibility across the urban population. However, the resilience of this network to external factors is questionable, as the case study below will show.

4. Methods and data

The empirical analysis consists of two main steps. The first uses a review and textual analysis of Czech government regulations issued during the COVID-19 pandemic from early 2020 to April 2022 and a media analysis (online newspapers, social networks) focused on critiques and interpretations of specific restrictions and their discussion among relevant actors. Given the inconsistency in the formal structure of the publication of government measures and the frequent changes in the content of individual regulations, the issues highlighted in the media provide some guidance for the analysis. For instance, it was not uncommon for government regulations to be interpreted differently by the Minister of Health, the Director of the Institute of Health Information and Statistics of the Czech Republic and the Prime Minister. Hence, in addition to the main official government communication channels publishing the binding rules, newspapers with predominantly national coverage were analysed in order to clarify some ambiguously drafted regulations. The aim of this part of the analysis is to identify the main principles related to the opening of shops that were part of the government measures, and then to select those with the greatest potential spatiotemporal impact on the functioning of urban society. The focus was on finding the spatiotemporal context and the impact of the often universally enforced rules. The first phase of the analysis resulted in the identification of a time period (from 22 October to 2 December 2020) that was economically discriminatory towards shop operators. In the next empirical step, the same period is examined from a spatial justice perspective, that is, how the government regulations affected consumers in terms of the spatial accessibility of retail.

The aim of the second step is to assess the extent to which retail accessibility was affected by anti-COVID-19 measures. The quantitative spatial analysis works with data on the distribution of population and retail within the city borders of Brno (with the exception of a shopping centre and adjacent commercial zone located south of the city, but functionally integrated into the urban space). Retail data comes from Brno Retail Research (Data Brno, 2021a) and provides information about location, size of sales area (m^2) and the products offered by stores in the city. Population data shows the distribution of permanent residents as of 2021 (Data Brno, 2021b). The spatial analytical units are the morphogenetic zones of the city (Data Brno, 2021a) and a grid cell network uses a grid side length of 250×250 m.

The morphogenetic zones represent aggregated types of urban environment that reflect different material and urban socioeconomic development. The diversity of each zone is also the precondition for the differentiated development of the retail network, with different retail formats and assortments exhibiting specific locational strategies due to different space requirements or types of customers (Data Brno, 2021a). There are six morphogenetic zones (Fig. 1):

1. The urban core (an area of protected historic urban fabric),
2. The inner city (compact urban structures of the nineteenth and early-twentieth century adjacent the urban core),
3. The wider inner city (here, the compact urban structure is less distinct and includes a mix of apartment and family houses),
4. Villa neighbourhoods (residential single-family homes predominantly of higher socioeconomic status),
5. Prefabricated housing estates (large-scale monofunctional modernist housing estates built since the 1960s and complemented by new housing developments), and
6. The suburban zone, (a peri-urban area where original villages are mixed with new residential and commercial construction).

In order to examine the impact of the anti-COVID-19 measures, two layers of retail data were created. The first shows shops open based on government regulations. The second shows the same stores and also those stores whose closure was deemed economically discriminatory and illegal by court action. While the former depicts the actual situation at an examined period under the ordered restrictions, the latter is hypothetical and serves as a baseline against which the spatial effects of the applied measures are examined. In other words, the analysis compares the accessibility of shops whose opening was allowed under the anti-COVID-19 measures (a regulated retail layer, hereafter referred to as the RR layer) and those that should have been open had the discriminatory measures not been in force (a hypothetical retail layer, hereafter referred to as the HR layer).

The comparative analysis has two parts. The first examines how accessibility to the nearest store has changed as a result of applied regulations at the morphogenetic zone level. Using network analysis (GIS calculations), the walking time distance was measured by setting the average speed at 5 km per hour. The outcome is

- a. A comparison of the number of shops and their sales area between the RR and HR layers,
- b. A comparison of average time accessibility between the RR and HR layers, and
- c. The variation in the proportion of residents with good walking accessibility to the nearest shop (within 300 m) between the RR and HR layers.

Walking accessibility serves here as a proxy for compact city principles, as it points to the quality of amenity provision expressed through low mobility demands (short distances).

The second part of the analysis calculates the locational potential (LP) for residents at grid cell scale. For the centroid of each cell with 10 or more residents, the walking time distance to all stores (OD matrix) is derived using network analysis (GIS calculation). LP is an index that represents the difficulty of reaching all stores, where the importance of a store is determined by its sales area. LP is calculated as follows:

$$LP = \sum_{i=1}^n (S_i/T_i).$$

In this formula, n is the number of spatial units (grid cells), the S_i value is the sales area of a store (i) and T_i is the time distance from a given grid cell to a store (i). LP provides an opportunity to assess the overall accessibility of retail, with special emphasis on central retail spaces. The sales area serves here as a simple measure of centrality in terms of the significance of a particular store for its customers (the larger the sales area, the more potential customers). Hence, LP illustrates the accessibility of central retail spaces. Comparison of the two situations suggests a variation in the degree of polycentric retail arrangement for each residential

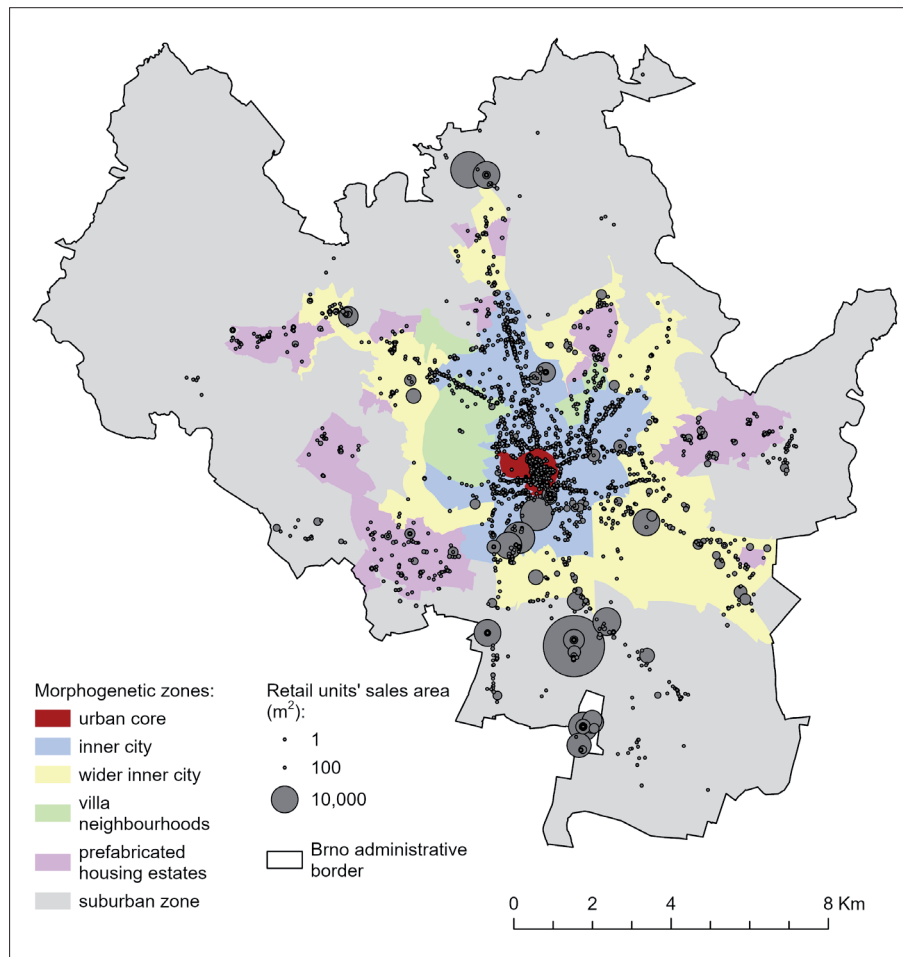


Fig. 1: Retail units and morphogenetic zones in Brno
Source: authors' processing based on Data Brno (2021a)

locality under study (since there are several central retail spaces in Brno). Comparison of the LP values for RR and HR layers is achieved by standardising the values using the z-score method. The difference between standardised LP values for RR and HR layers then shows the relative change in the LP of a given site (grid cell) compared to other sites.

5. Results

5.1 Covid-19 pandemic shopping rules and their implications for changes in the spatiotemporal organisation of Czech society

The COVID-19 pandemic has had an extraordinary impact on the daily behaviour of the population, not only in terms of personal (physical) discipline (voluntary isolation, home office prioritisation) but also in terms of bureaucratic and health measures (British Academy, 2021). CEE countries have not faced a similarly massive spread of respiratory diseases in recent decades. Thus, in terms of impact, parallels can perhaps only be sought with natural disasters, although in many aspects it is a completely unprecedented situation (Krisp & Špatenková, 2010).

During the 2020–2022 period, the Czech government applied restrictive measures that had significant impact on the functioning of retail facilities as well as those of education, sports, services and so on (Government of the Czech Republic, 2022).¹ These regulations were applied centrally-directive in cooperation with

regional public health authorities and, therefore, (almost) absent non-specialist (health) public discussion with other affected actors (municipal government, local politicians). Corrections to the applied rules were achieved mainly through media coverage or public response on social networks. However, individuals (employees of security agencies, etc.) or institutions were required to 'supervise' compliance with restrictive rules, albeit without new (expanded) powers to enforce them (Government of the Czech Republic, 2020a). The content and strictness of the rules, especially in the first weeks of the pandemic, were variable and very chaotic. An example is the complete closure of the Litovel and Uničov regions, in which the first outbreaks occurred. These regions (municipalities) were immediately and hermetically sealed at 3 a.m. at the behest of an emergency committee. Thus, for example, the Litovel Municipal Police could not operate in the town as the officers lived outside the municipality, and there were no respirators ready for them. The total number of confirmed people infected on the day of the closure was 25 (Olomouc Regional Public Health Authority, 2020; Tauberová, 2020). In the later stages of the pandemic, such a hermetic closure was no longer applied.

Another controversial measure having a spatial impact was that of 1 March 2021 when it was not possible to travel outside home district for three weeks except in special cases (commuting, family care, need for medical care, dealings with a public agency, arranging for pet care, attending a funeral or travelling for an

¹ The applied medical-bureaucratic measures and individual approach to the COVID-19 pandemic were not the same all the time. In the first months of 2020 and 2021 particularly, there was significant tightening of rules and restrictions on personal freedoms compared to other parts of the year. The analyses thus relate to the situation relative to the contingency measures at a particular time.

exam). This closure was also applied to retail as part of an effort to reduce the spread of the coronavirus. However, almost immediately after the application of the rules, a local exemption was given to the inhabitants of the Plzeň-City district – a large part of the district is occupied by the city of Plzeň with approximately 175,000 inhabitants. They were allowed to shop at the Globus shopping centre, located just outside the district boundary. The arguments for this exemption were the need to buy food and the popularity of the shopping centre (MV ČR, 2021). An even more significant exception was the merging of the Brno-město (covering the whole city of Brno) and Brno-venkov (hinterland) districts. The merger was argued to be natural, that is, that the city and its hinterland are so interconnected they could not be separated. From a retail perspective, it should be noted at this point that just outside the southern boundary of Brno is a retail park which includes a large amount of Brno's retail space. Similarly, more than 40 other municipalities from the rest of the country with intensive cross-district relations applied for an analogous exception, mainly for shopping opportunities. Most were not approved (Vlčková, 2021). According to the spokesperson for the Ministry of the Interior, 'Such requests are not granted as the government measures adopted are aimed at minimising population movements across district boundaries' (Vlčková, 2021). As a result, large shopping centres were favoured over smaller outlets as regards limited cross-district-border mobility.

The restrictive rules were gradually made more systematic. The intention of the government was to create a predictable plan for anti-epidemic measures. The final product of this effort was PES (an acronym for 'anti-epidemic system' in Czech), which was preceded by several other forms of public health protection systems. Following the logic of this system, decisions were subsequently made to close down individual facilities (stores, playgrounds etc.) and define other operational options for them (PES MZ ČR, 2020). However, the universality of the regulation soon ran into its limits. The rules (protection levels) were often not applied strictly on the day an epidemic level was exceeded but were dependent on the outlook of models, which were saturated by epidemiological data. The rules were identical across the country, that is, the same rules were applied to shopping malls (mainly located in large cities or in their hinterlands) as well as the smallest of shops regardless of location.

For the purpose of this article, it is not necessary to describe the entire list of restrictions here. Moreover, the rules were weakened or tightened according to the epidemiological situation, and at the same time, there were exceptions. Nevertheless, the main principles dictating the opening of facilities are summarised in the three points listed below.

Restriction of sales hours – an obligation and, later, recommendation to prioritise times for vulnerable groups

The health risks associated with COVID-19 led relatively early to an effort to protect vulnerable groups of citizens (people aged 65 and over, people with disabilities and illnesses). The government, therefore, defined prominent times (time prioritisation) during which only groups of vulnerable people were permitted to enter food stores, drugstores, pharmacies and so on. Other groups were not allowed to shop, and compliance with the rules was required by security guards and facility staff. However, from an interview with the chairman of the Council of Senior Citizens in the Czech Republic, this demand did not come from seniors but was implemented by the government itself (Spěváčková, 2020). In the first phase, a two-hour 10–12 p.m. interval was selected. However, this time was subsequently changed to a 7–9 a.m. interval (as the priority time). After a few days, another update was made, moving the prominent time interval to 8–10 a.m. The chaotic application of the regulation was a consequence of the conflicting priorities and, especially, the government's lack of

knowledge about the spatiotemporal behaviour and habits of the population—and not just its vulnerable groups (Government of the Czech Republic, 2020c; Kučerová, 2020).

The first 10–12 p.m. adjusted time interval was met with criticism, especially from pensioners, in part because seniors are used to shopping as soon as shops open, as claimed by the Czech Confederation of Commerce and Tourism (Novinky.cz, 2020). There was thus a mix of seniors shopping with the majority of society outside the exclusive times. At the same time, the Deputy Minister of Health and later Minister of Health Roman Prymula commented that seniors were dissatisfied with the shopping hours because they would miss discount promotions (iRozhlas, 2020b). For these reasons, the interval was shifted to an earlier time position. Seniors were the first customers to enter disinfected stores as soon as they opened; thus. The risk to this most vulnerable group was reduced to a minimum. However, this time conflicted significantly with the needs of productive society to purchase food before the start of their work shifts. Moreover, employees working 12-hour shifts may have been unable to shop at all due to the overall limited sales hours. The third change finally established the 8–10 a.m. time interval as it was also problematic that some shops were not open at 7 a.m., and, therefore, the seniors' exclusive time was reduced. This final prominent time was applied to shops with a sales area of more than 500 m². For all other operators, the general rule was that a person from the health risk group (seniors, disabled people) had to be served first; thus, they did not have to wait in line with other people for their turn in the small shops.

Visitor limitation by sales area (number of m² per person)

This rule was applied mainly on the basis of the initial knowledge of the spread of the coronavirus and should have led to the adherence of spacing between persons. The ratio of the number of customers did not change very often. At first, it was necessary to keep 15 m² per person, and later 10 m² was enough. Limiting the number of persons as regards the sales area should not automatically have led to the closure of small shops (with an area of less than 10 m²) – only one person should then have been allowed to enter, with other customers forced to wait in line. However, from the government's perspective, small shops had to remain closed as their opening would lead to a 30% increase in the mobility of the population – as the health minister Jan Blatný said in a TV interview (Bohuslavová, 2020). Thus, although smaller shops would be able to ensure spacing between persons, increased population mobility would contribute to a more rapid spread of the virus. This led to an unwillingness to allow the sale of certain products (toys, stationery, etc.) typically associated with these smaller units.

Restrictions on the sale of the product range

Only an assortment of basic and necessary products (food, medication, glasses, telecommunication devices, feed, etc.) were allowed. A similar logic of necessity was applied to services. For the most part, services that included personal contact between customer and service provider were prohibited.

The product range was the subject of many discussions and disputes. For example, the application of the strictest rules in the winter and spring of 2021 prevented the purchase of clothes and shoes (including for children) but allowed the sale of weapons and ammunition (iRozhlas, 2020a). The lack of justification for these steps was uncompromisingly criticised by the public. However, from the point of view of the retail network, disputes over the range of products between individual retailers are important. As was mentioned before, operators of large retail chains (Tesco, Globus, etc.) were favoured over small retailers in several periods. These retailers could also sell goods that could not be sold in other specialised (smaller) shops. This preference was the result of food

being sold as the predominant product, especially in supermarket- and hypermarket-type shops. ‘Predominant’ is the key word here because the sale of food as a product was never restricted. Large format shops thus stayed open with the possibility of selling clothes, sporting equipment or toys as ‘complementary’ goods. This logic implies a necessary change in the spatial behaviour of customers. They were forced to leave their usual purchasing habits and instead use the few open shopping centres (with the exception of e-commerce), where they could buy ‘complementary’ products (Government of the Czech Republic, 2020b). This situation was formally applied in practice between 22 October and 2 December 2020.

Sixty-three senators opposed this practice via a lawsuit brought to the Constitutional Court (Belšán & Niebauer, 2020). They characterised the rules as discriminatory and illegal. Although the rules were realigned before the court’s decision, the court did annul at least some of the government measures still in use. In arguing against the favouritism of certain stores, the Constitutional Court argued that ‘by its nature, it is evident, for example, that the essence of retail sales lies precisely in the fact that people visit shops close to their homes (or jobs) and therefore do not have to travel far and use public transport’ (Constitutional Court, 2021, 18). This argumentation was then accompanied by the government’s dissenting opinion, which, on the contrary, sees a change in purchasing patterns as normal and possible: ‘Retail includes not only sales, e.g. in counter and self-service stores, but also supermarkets, hypermarkets, department stores, outlets, etc., where it is not true that people do not travel longer distances from their home or work to visit them. Incidentally, retail includes highly specialised stores, for which it cannot be ruled out (on the contrary, it can be assumed) that customers will travel longer distances to make purchases, as they simply do not have such a specialised store close to their home’ (Constitutional Court, 2021, 27). As a result, the rules were equalised, and the sale of these complementary goods was also banned in large format stores. Unsellable goods were taped over. However, this ban was limited to specific shelves, and the sales area was not reduced. Hence, the number of customers (related to the previous visitor limitation by the sales area rule) who could enter the shop remained the same despite the limited amount of goods being sold.

Notwithstanding the subsequent adjustment of the restrictions and the court decisions, the end of October to the beginning of December 2020 was characterised by the effects of these COVID-19-related measures (see Tab. 1 for a simplified overview). Not only were these discriminatory from an economic point of view for shop operators (supply) but they also impacted the spatiotemporal organisation of the retail network and consumer patterns (demand). This is the subject of the subsequent quantitative analysis of retail network transformation which uses the city of Brno as a case study.

5.2 Covid-19-related retail changes with consideration for compact and polycentric structures: The case of Brno city

Brno is the second largest city in the Czech Republic with almost 400,000 inhabitants. On a national scale, it figures as a centre of justice, education and research. At the regional level, it

is a natural centre of economic activity, attracting commuters from its wider hinterland. During the post-socialist period, the heavily industrialised urban environment saw not only its physical space transformed but also its economic structure. These changes include a strengthening of the service sector, particularly in advanced producer services and IT. The most significant changes in Brno’s retail network are also linked to the post-socialist transformation. In the period before 1989, retail units and a substantial amount of retail space were notably concentrated in the city’s historic core, partly due to the earlier formation of the city (a distinct and compact medieval town core). Regarding spatial distribution, the urban core was also prioritised in the socialist period (retail centrality), but conversely, the peripheral areas struggled with a lack of amenities. The retail network hierarchy followed the Christallerian logic considerably – local shops interspaced with higher level retail units up to the town centre.

For this reason, the historical core was relatively well saturated. Even for new retail developments, spaces adjacent to the historic core were still preferred. The onset of the market economy after 1989 allowed for the emergence of specialised shops via ribbon development away from the city centre while simultaneously saturating the local market with previously unavailable goods (product saturation). A significant element was the addition of local shops into housing estates in order to meet daily consumption needs. However, the city’s spatial formation was most influenced by the emergence of shopping malls, typically on the Brno’s periphery. The advent of large format stores, especially after the turn of the millennium, changed the ratio of retail space in favour of the peripheries (Fig. 1). The consequence has been a significant change in consumer commuting and shopping rhythms and an overall change in shopping behaviour (Muliček & Osman, 2018).

As a result of the government regulations, the sales area of shops in Brno was reduced (Tab. 2). The highest relative decrease was in the compact urban structure (morphogenetic zones 1 and 2). The closure of these shops also had an impact on the highest relative increase in walking distance to the nearest shop. However, the significant density of shops in the central part of the city meant that the vast majority of residents still had a shop with basic daily necessities within walking distance. In this respect, the situation was worse in the dispersed development of the wider inner city and villa neighbourhoods (morphogenetic zones 3 and 4). The different initial conditions imposed by the spatial configuration of retail and population resulted in variable susceptibility to the applied government regulations. While the compact urban structure was most affected in terms of the decrease in retail sales area per inhabitant, the dispersed urban form was disadvantaged by a deterioration in time accessibility to retail.

The enormous impact on the urban core is evident when both layers are compared to each other relatively (Fig. 2). If the average retail sales area (m²) per resident is relativised to a value corresponding to 1 (for each of the layers separately), then the historic core was most affected by the government regulations. The urban core had approximately twice as little retail space available as it could have had. In all other zones, the relative value remained about the same.

Typology of restrictive measures		
Spatial	Temporal	Purpose-driven
<ul style="list-style-type: none"> closure of persons in the home district visitor limitation by sales area closure of small shops and services home office prioritisation 	<ul style="list-style-type: none"> restriction of sales hours privileged service and shopping time for health risk groups 	<ul style="list-style-type: none"> closure of shops and services according to the type of service or assortment closure of playgrounds, schools, and other institutions

Tab. 1: Summary of the COVID-19-related restrictive measures applied at the end of 2020 in the Czech Republic
Source: authors’ elaboration

Morphogenetic zone	Population	Average retail sales area (m ²) per resident			Weighted (residents) average time (min) to reach the nearest store			Share of residents (%) living within 300 m of the nearest shop		
		HR	RR	Change (%)	HR	RR	Change (%)	HR	RR	Diff.
1	4,640	10.1	4.0	-60.4	0.2	0.4	+61.8	100.0	100.0	0.0
2	108,530	1.2	0.8	-33.3	1.4	1.6	+14.1	94.3	92.2	-2.1
3	67,240	0.6	0.5	-16.7	2.7	3.1	+11.4	76.6	70.7	-5.8
4	21,585	0.3	0.3	0.0	3.7	3.9	+6.2	58.3	53.4	-4.9
5	126,496	0.4	0.3	-25.0	2.8	2.9	+5.3	73.6	69.9	-3.7
6	46,657	1.7	1.2	-29.4	5.1	5.6	+9.1	46.8	42.1	-4.7
SUM	375,148	0.9	0.6	-33.3	2.7	2.9	+8.8	76.3	72.5	-3.8

Tab. 2: Retail-related characteristics via comparison of HR and RR layers
Source: authors' calculations based on Data Brno (2021a, 2021b)

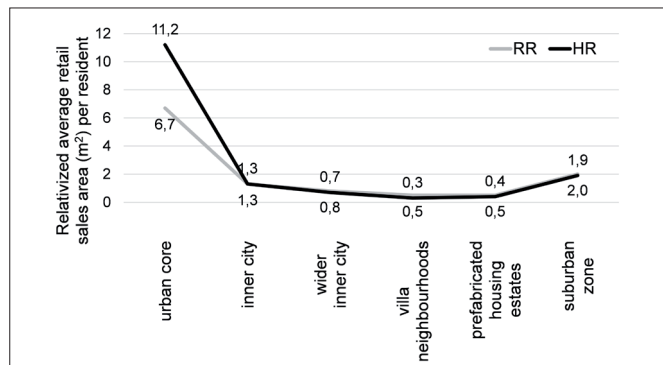


Fig. 2: Relativised average retail sales area (m²) per resident for both the HR and RR layers
Source: authors' calculations based on Data Brno (2021a)

Closer insight into the Brno area is provided by a grid analysis. Comparing the standardised LP values between HR and RR layers allows for an assessment of the spatial differentiation of the impact of COVID-19-related regulations on retail accessibility, particularly with respect to central retail spaces. While the decline in absolute LP values due to the imposed government rules is observed across all locations (grid cells), the standardisation offers a closer look at the variation in potential store accessibility. Across the inhabited area of Brno, we can see parts with a significant relative deterioration in store reachability, but also, on the contrary, parts where the regulations' impact was not as strong (see Fig. 3 illustrating the range from the minor to the major worsening of LP2).

The city centre experienced the greatest loss of LP when compared to other locations. There was a significant reduction of smaller shops within a comfortable distance, disrupting the compactness of central urban structures. A noticeable decline in LP is also observed in the southern and south-eastern sectors of the city, where the closure of some larger stores within shopping centres and large-scale retail formats in the vicinity of major traffic intersections had a negative impact. The function of secondary retail centres in Brno's peripheral areas (especially in the southern part of the city in the cadastres of the former rural settlements) were significantly weakened. The polycentric character of urban retail was thus disturbed by the government sales regulations, affecting detrimentally areas located outside the compact core and near suburban retail centres in particular.

Local incidences of deteriorated LP are visible on shopping streets radially emerging from the urban core. The decrease in the density of shops in the urban parterre (building's commercial

ground floor) had the effect of weakening the commercial function of these streets. They are important both in terms of compactness (mixture with housing in urban-block structures) and as secondary centres for the urban districts in the wider city centre. Locations in the immediate proximity of some retail parks and shopping malls (Slatina- Řípská, Nový Lískovec-Kampus) but in more compact urban structures were also significantly affected by closure, but this was not as important for the value of LP in the wider area, where retail demand had been saturated by other shops due to the more highly built-up densities.

Contrariwise, a relatively minimal or negligible decline in LP was recorded in the areas of some prefabricated housing estates (the city districts located on the edge of the city's administrative boundaries), where the already insufficient amenities could not be further affected by the closure of a few shops. Thus, relatively speaking, these places were not as fundamentally affected by the government rules. The same applies to some areas of older compact (family) housing in the wider city.

To summarise, the negative impact of regulations in Brno was most pronounced primarily in the historic core. However, on a local scale, there was a similar negative impact of regulations when comparing the HR and RR layers of other historic village cores that later became part of Brno (e.g. the historic core of Královo Pole or Líšeň – the solitary dark grid cells with 'significant' or 'maximal' values in the areas of red 'moderate' values). These have, in principle, the same compact urban structure, although their influence on the surroundings was minimal due to the lower significance of these locations as central places. In contrast, in the purely residential areas east of the historic core, also with a compact structure, the effect was very weak. Locally, almost no specialised shops are concentrated here.

6. Discussion

The analysis pointed to the specific position of the historic compact centre. The historic core, however, was not disadvantaged *a priori* in terms of its position in the city but in terms of the health and bureaucratic rules applied, which, due to their specifications, most affected compact structures. This is, to some extent, a distortion of the (contemporary) compact city narrative ideal, where compact forms are seen as the solution to a number of present-day urban problems (Dempsey, 2010). The effect of discriminatory rules is then even more obvious if these compact structures are part of a polycentric city system. In this respect, the south-eastern area of the city was the most affected, suffering from the partial closure of the adjacent commercial zone; the weakening of the historic core, which is the next most accessible

² The standardised values are transformed into a more readable form by assigning the number 100 to the average values (z-score = 0). A standard deviation value of 1 is then given the number 20. The resulting standardised LP take values greater or less than 100. The difference between these values (= HR – RR) is interpreted as the impact of the COVID-19 measure on the worsening of LP and quantified as follows: minimum = -10.0 or less, negligible = -2.0 to -9.0, moderate = -1.9 to 1.9, significant = 2.0 to 9.9 and maximum = 10.0 or more.

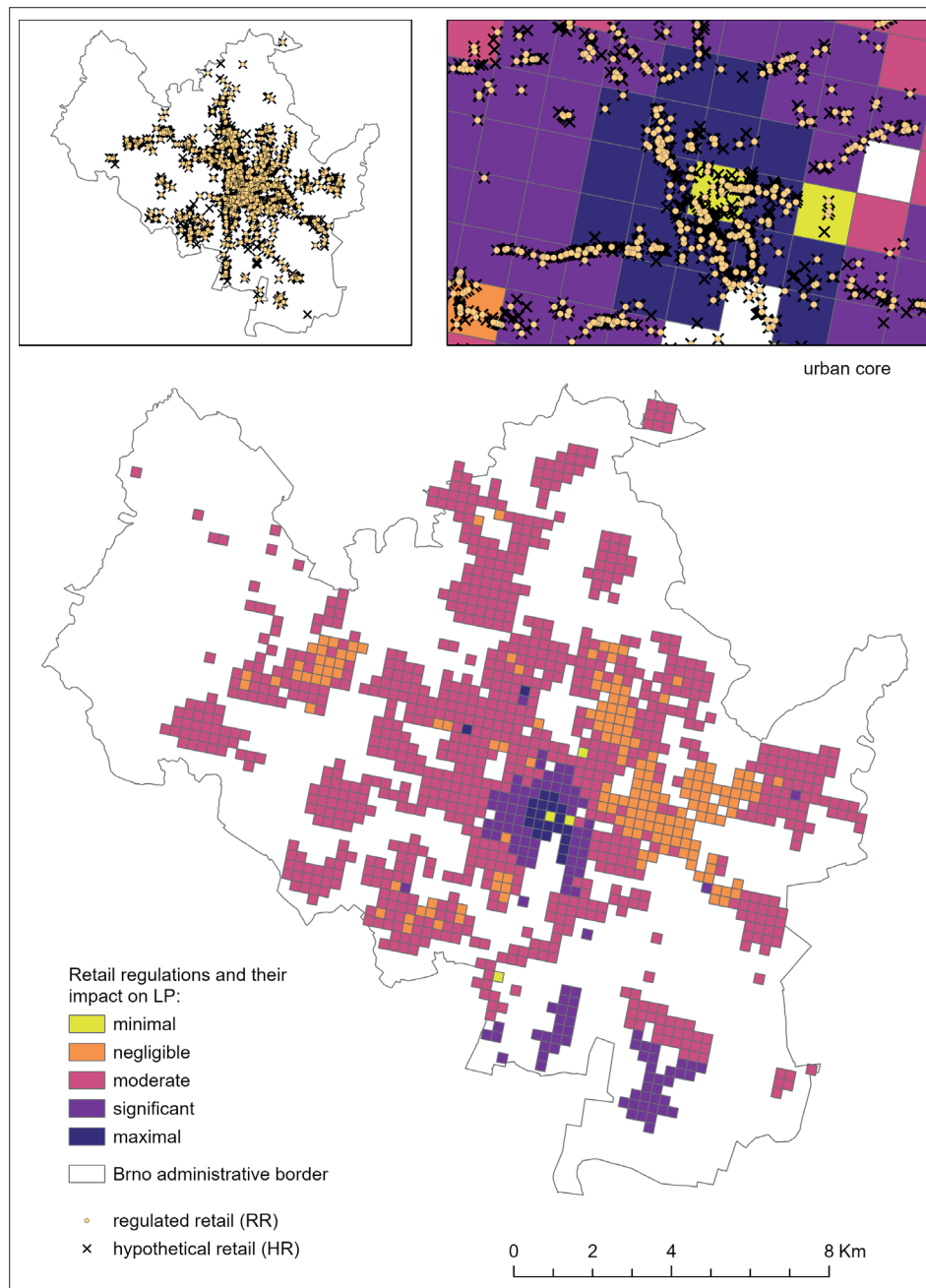


Fig. 3: The relative LP change based on the retail COVID-19-related regulations; minimal = minor worsening of LP, maximal = major worsening of LP

Source: authors' calculations and processing based on Data Brno (2021a)

centre for this area; and being surrounded by physical barriers (motorways) affecting functional connectivity with the territories beyond. The compact structure of the historic core, with its high retail density, thus also plays the role of a central location for more distant areas. In contrast, such a significant impact of COVID-19-related regulations on the whole area did not manifest in the areas of the wider compact centre, because their surroundings were sufficiently saturated by another secondary centre.

While a compact structure does not necessarily guarantee sufficient amenities, proximity to a central area may not be an advantage in the absence of alternative opportunities. Shop specialisation (product range) and the size of the sales area are factors that differentiate the urban retail structure. Although compactness may increase social equality in conjunctural periods through increased access to facilities (Burton, 2000), the vulnerability of urban forms has a direct impact on the spatial distribution of commercial amenities and changes in socio-

spatial inequity. In times of crisis (Kluge, 2022), this case study thus indicates that the urban structure, whether in a polycentric configuration or a compact city, shows a low degree of resilience. One of the key factors is the unpreparedness of crisis management and legislation in the context of retail planning, whose spatial distribution is primarily based on market mechanisms in the deregulated neoliberal economic environment (Fernandes & Chamusca, 2014).

As can be seen, various parts of the city were affected differently by the rules set during the period under examination. However, in this form of inequity, recall that it is also the customer's discriminatory position, which has arisen, in particular, from the unequal conditions of retail sales opportunities. In terms of spatial (in)justice at the city level, there has been no analysis or reflection upon the situation from the position of the public authorities. The affected areas, in which ideally (hypothetically) shops should have been open, have not been offered any

compensation for the restricted conditions. Unjust urban geographies (Soja, 2010) were exacerbated from a position of power without awareness of the interconnections with the social injustice produced.

Efforts to level the playing field were spurred on by parts of the political spectrum and also by lobbyists and traders, a result of the unfair privilege of sale (privilege of profit), as noted above. The subsequent legislative remedy for this unequal situation thus led to the righting of an economic injustice, whereby all traders were prevented from selling altogether, or, on the contrary, all traders, regardless of the parameters of their stores, could sell a particular type of product. Thus, economic factors, but not spatial ones, were decisive for institutionalised justice. Compensation programmes worked precisely on the logic of lost profits; that is, discrimination was recognised only in terms of disrupted retail business models. The situation is all the more paradoxical because most restrictive or even discriminatory measures were based on spatial constraints.

Given the deepened spatial injustice, economic inequity (increased transport costs, both in passenger transport and logistics) and time inequity (increased travel time) may have been partly passed on to customers. This effect can be understood all the more urgently as the mobility of, especially vulnerable groups with reduced motility (disabled, elderly, etc.), was affected by the restrictions during the COVID-19 pandemic. This observation reveals the fundamental interconnection between social and spatial structures as determinants of geographical space, conceptualised by Soja's socio-spatial dialectic (2010). However, it is necessary to remember that this is not only a material space, but also a virtual ICT-generated space (Priporas et al., 2017), where a significant part of retail transactions takes place, but with a considerable social differentiation of users. Thus, the accessibility of online shopping varies across different population groups (age, gender, education, etc.) and trying to improve it is one of the challenges of retail accessibility planning.

7. Conclusion

Using the unprecedented impacts of the COVID-19 pandemic on social and spatial urban relations, the study demonstrated that the interrelationship between the two narratives of the compact and polycentric city can be conceptualised through the measure of accessibility and locational potential of residential areas relative to retail supply. The result of the analyses showed how complicated urban space can be when restrictive rules are directly applied to the established spatial configuration of a city, here represented by the retail network. Brno, a post-socialist city, shows signs of higher retail density in compact structures while also offering a polycentric pattern of large-scale retail formats. Measuring its absolute sales area and accessibility values revealed that the historic core was substantially harmed by discriminatory regulations. In addition, relative deterioration in local accessibility was also observed for peripheral sites linked to secondary commercial centres. The form of a compact city thus fails in the case of a unique territorial concentration of functions that has no alternative in terms of accessibility and specialisation of services in the city area. At the same time, it is possible to point out the limit of the polycentric pattern of large-scale stores, where the absence of complementary functions (typical of a compact city) in a close proximity can pose a major problem in the physical accessibility of everyday goods in the event of the closure of a commercial centre.

Spatial inequities in the ability to use the services of retailers have been reinforced (albeit unconsciously) by the activities of central government, to varying degrees in different types of urban structure. In the absence of systematic retail planning at the urban (metropolitan) level, the established advantages of traditional compact urban structures complemented by

a polycentric arrangement of commercial functions are no longer valid. As a result of the changing specialisation and location of retail units, the urban structure itself is only one of the multiple factors to be considered when trying to improve the resilience of certain urban locations to unexpected crises. Here, there is also an opportunity for further research by projecting the socioeconomic or demographic status of the population in the localities concerned. Although it is clear that all customers may not always shop according to the same spatial and temporal strategies, the analysis has shown the existence of unreflected spatial discrimination, the spatial differentiation of which is derived from the spatial configuration of the retail network, the urban structure and the accessibility of central retail locations.

It is also clear that the rules set by the Czech government (as a central ruling authority) had to be primarily general and could not reflect the individual situation of each city. Our study showed that some inequalities could have been handled at the level of local decisions. However, necessary competencies were not devolved to local authorities. In light of the COVID-19 pandemic, a shift of competencies is something to be considered in the future. Nonetheless, the key prerequisite for reducing inequalities is a better knowledge of spatiotemporal logic of the territories concerned. This is a major challenge for urban policies that do promote evidence-based decision-making, but this capability is limited to medium- and long-term planning horizons and, as has been shown, not to short-term measures based on sudden crises.

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