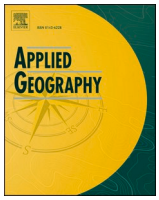
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Urban inequalities in the 21st century economy

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ABSTRACT

In the last decade or so, inequality studies have assumed renewed prominence across the social sciences. In this introduction to a special issue of *Applied Geography*, we set out to articulate the importance of urban spatial context in broader present-day inequality debates. We argue that the information-based economy is emphatically urban-based and that it has forged new spatial inequalities in and between cities and among urban populations. Income gaps have widened, inter-city disparities have grown, suburbs have been re-sorted into a wide array on the basis of class and race or ethnicity, and many central cities have assumed a renewed importance within metropolitan areas. We argue that attention to urban spatial dimensions at various scales is critical to understanding current inequality trends, from intra-urban to regional and global scales. Contributions to this special issue from North America, Europe, South America, and China suggest that deepening urban inequalities are pervasive across the globe.

1. Introduction

Inequality has long been an important theme in the social sciences, and it has acquired renewed prominence in the last couple of decades. This is expressed, for example, in the recent establishment of special research centers such as UCLA's Institute on Inequality and Democracy, LSE's International Inequality Institute, Stanford's Center on Poverty and Inequality, and the University of Amsterdam Centre for Inequality Studies. It is also apparent, of course, in the literature. The work by Thomas Piketty (2014), particularly, drew much attention and it was emblematic of a wider trend across the academy (e.g., Stiglitz, 2012) and in public debates and popular media (e.g., The Economist, 2019).

The debates have focused mostly on national trends and, insofar they have international reach, pertain to aggregate national data sources. In such studies, inequality trends are often related to issues of economic globalization, international migration, and neoliberal government policies. Many studies rely exclusively on income data even though it is widely acknowledged that inequality is a multifaceted phenomenon with economic, social, environmental, and political dimensions. Variations across class, race, ethnicity, age, gender, or citizenship status are also often considered at the national level.

At the same time, urban studies scholars and geographers have long attended to questions of inequality (e.g., Harvey, 1973) and have done so at a finer spatial scale, as expressed in studies of residential segregation and neighborhood development (see Galster & Sharkey, 2017; Hamnett, 2019). In some respects, this tradition goes back as far as the urban ecology approach of the Chicago School. There appears, however, a significant disconnect with the more general social science literature and much of that is probably due to different scales of analysis and the attention (or lack thereof) to the role of space in the creation or maintenance of inequality.

In this article, we set out to articulate the importance of the urban context in broader present-day inequality debates. In part, this is simply a reflection of rapid and ongoing urbanization worldwide, where social questions are increasingly urban questions (Brenner & Schmid, 2014; Wang, He, Liu, Zhuang, & Hong, 2012). It is also, we argue, related to the worldwide emergence of new modes of production in the last few decades (digital, information-based, consumer oriented) that signal an unprecedented urbanization of the world economy, what Scott (2017) refers to as the "third wave". Finally, we argue that this new, largely urban-based, economy is accompanied by new and deepening inequalities across multiple dimensions. Our argumentation is based on a broad overview of the literature, in part from a comparative perspective (Nijman, 2015a), and with special attention to the other articles in this special journal issue. Our main point is that, if we want to understand overall inequality trends in the 21st century and the policies needed to

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confront them, it is imperative to consider their urban contexts.

The rest of this paper is structured as follows. In section 2, we provide an outline of the goals and organization of this special issue and we give a brief overview of the included articles. Section 3 sets out a concise theoretical argument that focuses on the urban impacts of the new 21st century post-industrial economy and on the new inequalities that are inherent to this economy and that play out at different scales. Section 4 provides a concise discussion on inter-urban and regional dynamics of inequality and in section 5-7 the focus shifts to a more elaborate discussion of intra-urban inequalities. The paper ends with section 8, a series of conclusions and final remarks.

2. Objectives and organization of this special issue

The collection of papers in this special issue resulted from similarly themed sessions at two conferences in 2019: the Comparative Urbanism conference of the newly founded Urban Studies Institute at Georgia State University in March 2019, and the Annual Meeting of the American Association of Geographers in April. Additional papers were solicited through a call from *Applied Geography*. The goal was to bring together a set of papers on present-day urban inequalities with different (global) geographic foci, at various scales, and with attention to different inequality dimensions.

This special issue is intended to broaden the understanding of the spatial and temporal aspects of urbanization – including their patterns, processes, and intertwinement with equitable and sustainable development. On the basis of theoretically guided empirical research, it examines spatial and temporal dimensions of socio-economic inequality, analyzes the significance of the urban context of inequalities, and provides insights for urban planners and administrators to balance efficiency, equity, and environment. Its point of departure comprises the following broad research questions:

- What are the trends and nature of inequality in the city/cities in question? What are the temporal and spatial dynamics?
- What is the explanation for these inequality trends and, specifically, how do they relate to (a) urbanization trends, (b) shifting modes of production and changing urban political economies, and (c) local/national urban policies?
- How do economic inequalities interact with disparaties in terms of race, gender, age, ethnicity, and migration-status?
- How is urban inequality manifested in residential segregation, spatial mismatch, housing inequality, digital divide, environmental injustice, and in general spatial inequality?
- What are the theoretical and policy implications of the research?

Among the geographic foci of the resulting set of nine papers are cities in the United States, China, Europe, and South America; they combine analyses of inequalities at regional/inter-urban and intra-urban scales; and they cover a range of inequality dimensions including questions of residential segregation, commuting, food access, health, housing disparities, job access, economic vitality, and demography. The current issue stands apart from previous collections on inequality in terms of its global comparative approach, attention to variation in scale, and its focus on the role of the new urban economy. All the papers included in this special issue were reviewed following the standard review protocol and quality standards of *Applied Geography*.

3. Theorizing inequality in the new urban economy

While social disparities are always culturally and historically mediated and as such vary from one time or place to the next, contemporary inequalities can also be argued to be fundamentally conditioned by prevailing modes of production and associated labor relations – and these tend to operate at much wider, even global, scales. Proper understanding of current *urban* inequalities requires a fundamental understanding of such recent shifts in the nature of production and of the spatial ramifications of these shifts, particularly at the urban scale. As we argue below, the new economy has propelled urban inequalities in three ways: (1) greater bifurcation of the workforce and deepening income inequalities; (2) increasing inter-urban inequalities (growth vs. shrinkage); and (3) revival of central cities and urban centers that have become increasingly exclusionary, along with increased 'sorting' and inequalities between different suburban areas.

It is widely agreed that the rise and (relative) decline of manufacturing were highly significant to processes of urbanization. There is no need here for a general review but it is worth noting that the manufacturing era generally witnessed urban growth and expansion of the (lower) middle classes. The later decline of manufacturing in North America and Europe since the 1960s was directly related to the ensuing urban crisis, one aspect of which involved the shrinking of the working middle classes. For the purpose of this paper, we are particularly interested in what happened since the 1980s and in more recent years.

The share of the U.S. workforce in manufacturing dropped steadily, from 24% in 1960 to 8% in 2016, and it never returned to previous levels. The recovery of urban growth since around 1990 was in essence based on the emergence of a new economy; a new mode of production that was, even more than during the industrial age, emphatically situated in urban areas. Instead of manufactured goods, the new economy revolves around information products and was propelled by the digital revolution. It involves mainly finance and professional and business services (accounting, insurance, advertising, consulting, marketing), cultural industries (Sassen, 2012; Scott, 2017), and, in some urban areas, high-tech industries (e.g., Silicon Valley, The Texas Corridor, the NC Research Triangle, etc.).

New corporate and job growth was accompanied with population increases, an expanding tax base, increased infrastructure spending, construction, etc. A look at the biggest companies based in New York is illustrative. According to Fortune.com, in 2019 the ten biggest (publicly traded) companies in terms of revenues headquartered in New York were Verizon, J.P. Morgan Chase, Citigroup, MetLife, Pfizer, AIG, New York Life Insurance, Morgan Stanley, Goldman Sachs, and TIAA. Half of them are in finance, three in insurance, and the other two in information technology and pharmacology. Even in cities where more traditional companies dominate (such as manufacturing and foods, as in Chicago or Pittsburgh), most jobs in these companies in the city are filled with what Robert Reich (1991) calls 'symbolic analysts', highly educated and highly paid white collar workers.

The urban revival under the new economy has been very uneven: for every New York, there are dozens of smaller cities struggling to latch on to the information economy; for every Silicon Valley, there are dozens of urban regions lacking hi-tech industrial development. For some of the cities that did not follow the example of New York, deindustrialization had lasting and deeply erosive effects; the transition to an urban information economy, high-tech production and especially consumption never quite arrived and the return to growth never happened. In 2017, one in ten U.S. cities had shrinking populations and the experience is not unique to the United States. For example, one-third of Germany's cities are losing population; the same is happening in varying degrees across Europe and, notably, also in Japan and South Korea. In some countries, the problem is compounded by low birth rates and slow or even negative overall population growth.

Within cities, the ramifications for inequality have been just as significant. While cities such as New York and others revived against the backdrop of this dynamic new economy, the benefits did not accrue equally across the urban population. In fact, the new economy has only deepened the inequality that crystallized during the period of deindustrialization and urban decline. Professional workers in the new economy tend to be highly educated, highly skilled, and highly paid. The service workers in that same economy, from retail personnel to clerical staff to hospitality workers, tend to be low-skilled and low-paid. Accordingly, the new urban economy is characterized by a bi-modal income

distribution, a bifurcated workforce, and a polarized social structure (e.g., Sassen, 2012). To keep with the example of New York: in 2016, the top 1% of income earners took 40% of all income while the bottom half had to make do with 6% (NYIBO, 2017). Nationally, in terms of wealth (of greater significance than income to the truly advantaged), in 2014 the top 0.1% of the U.S. population had more than doubled its wealth since 1980 and controlled as much as the bottom 90% (Saez & Zucman., 2014).

This trend of increasing inequality is perhaps most extreme in the U.S. but it appears evident in cities around the world where the new economy has emerged, including Europe, China, and India (various papers, this volume; Nijman, 2006; 2015b). The Chinese case, in particular, demands some discussion for our purpose. Chinese cities today are the scene of a conjunction of manufacturing, deindustrialization, and the new economy all at once. One could say that successive developments that shaped U.S. cities over three or four decades, are compressed in time and space across Chinese cities today (Nijman, 2019).

China has already experienced some deindustrialization and there will be more to come – but deindustrialization will not be as massive or disruptive as in the U.S. Presently, manufacturing constitutes about 20% of all employment and has been steady over the last decade or so (Levinson, 2017). Productivity continues on an upward trajectory: the increase in value added through manufacturing from 2008 to 2015 was 80% (adjusted for inflation), compared to only 2% for the U.S. (Levinson, 2017). Nonetheless, China is (and has been) subject to selective deindustrialization – particularly so in the older industries of the country's Northeast but also, more recently, in major cities such as Shanghai or Beijing.

Events in Beijing in recent years underscore this selective deindustrialization and economic transition. The authorities have been demolishing large dense residential areas in Beijing that were populated by rural migrants without *hukou* (household registration system). While the government cited reasons such as safety hazards and recent deadly fires in several neighborhoods, observers pointed to a declining need for low-skilled employment in the major cities and an aggressive government policy to make room for more highly educated workers in the new economy (Buckley, 2017).

Hence, notwithstanding the relative overall stability of manufacturing, it is clear that China's economy is in transition and that the new economy has been growing in importance. According to a recent OECD report, between 2006 and 2016, the contribution of manufacturing to GDP decreased steadily from 48 to 40% and dropped below the contribution of services for the first time in 2012 (OECD, 2017). To be sure, the urban information economy and its high-tech accompaniments are already there. The economy in the last two decades has been diversifying, and investments in IT and high-tech sectors are substantial and growing. The total valuation of China's 'unicorns' (startup companies valued at $1 billion or more) in 2016 was roughly on a par with that of the U.S., a powerful indicator of the presence of a mature and dynamic new economy (McKinsey, 2017).

The rapid emergence of the new urban economy, where incomes tend to be higher, often much higher, than in manufacturing or low-skilled services, has contributed to growing inequality and this will likely increase further in the years to come (particularly in a generational sense, with higher incomes among young professionals). It is a different inequality, however, from that which characterized U.S. cities in recent decades: if in the U.S. the middle class dwindled due to deindustrialization, in China it did not. Rather, the growing inequality in Chinese cities is related to the introduction of a new class of (very) high income earners in the new economy.

In many cities around the world, the shift towards an information-based mode of production has in recent years been accompanied by two interrelated trends that have contributed to a revival of central cities and, especially in the U.S., a re-sorting of suburbia. First, the logic of agglomeration in the new urban economy has shifted to an emphasis on knowledge transfers and networking in a high density and high circulation environment – the city as "the office," especially for growing numbers of self-employed and freelancers (Carlino, 2015; Kloosterman, 2020; Scott, 2017). The new economy places a premium on networking, both virtually and in real space, and on the importance of a 'feel' for what is trending, especially in the cognitive-cultural sectors. Notions of the 'gig economy' and the 'sharing/platform economy' have rapidly found a way into popular discourses but their significance is not entirely clear; in terms of the actual (relative) numbers of workers, types of workers, incomes, and vulnerabilities (Graham, Hjorth, & Ledonvirta, 2017; Davidson & Infranca, 2016; Shambaugh, Nunn, & Bauer, 2018). We do know that these segments of the new economy are disproportionately located in cities.

The second trend pertains to the rise of cities as sites of *consumption* (Jayne, 2005). The sharp decline in manufacturing employment and, eventually, its replacement with new employment in high tech and/or information activities, resulted in growing inequality and the formation of a class of high income earners who either work and live in the city or who work further out but choose to *live* in the city for its amenities. This means that cities and city centers have become preeminent sites of consumption, consumer services, and amenities. As Glaeser, Kolko, and Saiz (2000) observed at the turn of the century: "the future of cities depends on the ability … to provide attractive places for increasingly rich workers."

The combined effect of these trends has been what Ehrenhalt (2012) termed "the great inversion": The movement of corporate activity, retail, restaurants, entertainment, people, back into the city, drawn to 'urban chic' and amenities. These new urbanites are relatively young, tend to be highly educated, have relatively high incomes, and, at least in the U.S., are predominantly White. The idea of inversion rests, of course, on the prior history of suburbanization (and White flight) and urban decay that was especially characteristic of US cities. It does not mean that suburbs have been growing any less quickly (Kolko, 2017), but it does imply central-city revival and renewed growth.

In the U.S., especially, the "return" to the city tends to exclude minorities (and lower income earners) and, as such, is causing a racial (and political) makeover of central cities. At the same time, certain suburbs witness the departure of young and highly educated people to the central city. Those suburbs may at the same time witness an influx of foreign migrants or the very people who are being displaced from the center. Gentrification has been prominent feature of central city revival. Many older inhabitants have had to find more affordable housing in the suburbs and, as a result, suburbia has become increasingly sorted on the basis of socio-economic status and race (Nijman, 2020; Nijman & Clery, 2015). Central cities have now also become places of consumption for lower income classes living away from (or having been displaced from) the central city. To them, 'going to the city' is not about going to work, but about leisure and consumption.

In sum, the new economy, for all its vigor, growth and contributions to aggregate prosperity, has forged new spatial inequalities in and between cities and among urban populations. The income gap has widened, inter-city disparities have grown, suburbs have been re-sorted into a wide array on the basis of class and race, and perhaps most striking of all, for many working in the new economy, aspirations of urban living have supplanted the old dream of a home in suburbia. The ULI (2016, p. 31), addressing an audience mainly of developers and realtors, refers to the "willingness" of metropolitan populations, whether in central cities or suburbs, "to pay a premium for more urban living," adding that it has "become somewhat of a luxury good that many households will not be able to afford."

4. Inter-urban inequalities in regional and global context

Scholars have heatedly debated the trends of spatial inequality, especially regional inequality, and sources or mechanisms for decades, even centuries (Wei, 2015, 2017). Convergence and divergence are two

mainstream schools of thought concerning income and spatial inequality. The convergence school holds that regional inequality arises during the early stages of development, and declines as the economy matures, largely determined by free mobility of capital and labor. On the other hand, the divergence school argues that regional inequality tends to be maintained and even intensified; agglomeration and capital accumulation tend to reinforce spatial inequality and uneven development.

Barro and Salaimartin (1992) emphasizes beta-convergence (i.e., poorer regions tend to grow faster than richer regions), and club convergence among regions with similar development conditions. These studies have revitalized the research on regional inequality, but have also drawn criticism (Martin & Sunley, 1998; Wei & Ye, 2009).

Notions of agglomeration, cumulative causation, and increasing returns to scale have also increasingly drawn the attention of scholars who tend to be concerned with the negative effects of globalization, including the rise of spatial inequality (Ezcurra & Rodríguez-Pose, 2013; Wei, 2015). The recent global financial crisis has further intensified the debates on income inequality, especially the trend of polarization and the decline of intergenerational mobility (Beyer & Stemmer, 2016; Ewing, Hamidi, Grace, & Wei, 2016; Ezcurra & Rodríguez-Pose, 2013). Geographers have paid special attention to the spatiality of inequality, employing concepts of scale, space, place, network, location, and mobility (Wei, 2015).

The urban economy is the most dynamic component of cities, and analyzing economic inequality is important to understanding urban inequality and addressing urban problems. Economic inequality is an essential component of urban inequality. Geographers are keen to provide a multi-perspective view of geographical phenomena. Scale is essential to the understanding of the spatiality of inequality (Wei, 2000, 2015). Inequality among cities, or interurban inequality, has long been studied and is closely linked to the study of urban systems. For example, the study of city size distribution can be considered as a study of uneven population distribution across cities (Iyer, 2003). Interurban inequality also contributes greatly to regional inequality, since the concentration of resources in and the attractiveness of major cities are important sources of factor mobility and regional inequality (Black, Natali, & Skinner, 2006; Zhong & Wei, 2017).

Intra-urban economic inequality has drawn particular attention in studies of North American cities. Intra-urban inequality is fundamental to multidimensional urban inequality and often strengthens the degree of other dimensions of urban inequality. Many dimensions of urban inequality, such as spatial mismatch, residential segregation, and food deserts, are closely interwined.

Urban inequality is embedded in the broad socio-economic context, especially the process of globalization and technological change. Globalization has directly changed the pattern of urban inequality, and the concept of global cities is based on the intensification of intraurban inequality in global command and control centers arising from globalization (Friedmann, 1986; Sassen, 1991). Indeed, external forces have long been argued as critical forces of spatial polarization and urban inequality in developing countries (Kasarda & Crenshaw, 1991). Neoliberalism raises concerns about growing inequality; Shi and Dorling (2020), for example, uncover diverse patterns of inequality resulting from neoliberalism in Beijing and London, and call for considering local conditions (for example, speed of change) in global urban studies.

Foreign direct investment (FDI) tends to prefer cities with well developed infrastructure, covenient access to political power, substantial integration with the global economy, and advanced social-economic conditions, which result in an increase of urban primacy and spatial polarization (Huang & Wei, 2011). FDI also agglomerates within cities, leading to urban spatial polarization and segregation (Grant & Nijman, 2004, pp. 45–66; Huang & Wei, 2014; Wu, 1999). Closely related to FDI is foreign trade, which also has greatly influenced urban inequality. Trade liberalization tends to worsen the core-periphery gap, and more trade-oriented countries tend to exhibit more regional inequality (Rodríguez-Pose, 2012). Zhu, Yu, and He (2020) further discover that export upgrading mainly benefits urban areas, and the concentration of exports in urban areas tends to lead to more severe urban-rural inequality.

Technology is a major agent of globalization and has been regarded as a main source of urban growth in both developed and developing countries (Liefner & Wei, 2013; Malecki, 1997). However, the development and the increasing importance of technology may contribute to urban inequality as well. Digital inequality has arisen as a huge concern as rapid technological change further centralizes talents, capital and innovation, and leaves many places behind. Interregional knowledge spillovers only happen when the technological gap is not too wide (Nocco, 2005), hence technological advances may lead to greater regional inequality and polarization. Technology also results in other dimensions of urban inequality, such as residential segregation, which should be carefully addressed by urban planners and policy makers (Florida & Mellander, 2020).

5. Intra-urban dynamics of inequality: housing

Income inequality has been increasingly exacebrated by inequality in wealth, especially the appreciation of property values (Goodman, 1988). Skyrocketing housing prices and the problem of housing affordability have become challenging issues globally. Housing is an essential need for urban residents, and the housing market is intertwined with urban inequality in multiple ways. In the housing market, buyers have different preferences. Preferences, and even discrimination, of different groups combined with differences in income, education, age, and race result in residential segregation (Clark, 2009; Ihlanfeldt & Scafidi, 2002), Such differentials are also reflected in the existence of housing submarkets (Wu, Wei, & Li, 2019). The segregation of housing markets and the problem of housing affordability have been regarded as drivers of urban inequality (Baker, Bentley, Lester, & Beer, 2016; Wei & Ewing, 2018).

Orthodox studies of housing price inequality are mainly based on a hedonic model, considering the effects of housing attributes, location, and, in later studies, neighborhood effects. Location often refers to access to important geographical features and services, such as transportation facilities, CBDs, and shopping centers. Nevertheless, such models are often simplified, and recent studies have attempted to expand the determinants by including urban amenities and spatial structure (Li, Wei, & Wu, 2019a). Housing prices are also often cyclical, and the recent global financial crisis was largely caused by the housing crisis. Li and Wei (2020) study the resilience of housing prices in relation to the financial crisis and find that while the influence of amenities is important, neighborhood conditions also contribute greatly to the fluctuation of housing prices.

More expensie houses usually have a desirable living environment and better accessibility to superior urban amenities, while “negative amenities”, which are related to potential adverse effects on people including safety and health hazards (Li, Wei, Yu, & Tian, 2016), usually decrease housing prices (Bin & Landry, 2013). Consequently, as richer people are able to buy “better houses” and poorer people cannot, the housing market results in an evolutionary inequality and residential segregation. Most neighborhood-beneficial amenities increase local housing prices, resulting in the concentration and segregation of housing affordability (Li et al., 2016). Lack of affordable housing has resulted in homeless people and slums, a terrible form of urban living (Shinn & Gillespie, 1994). Inequality in the housing market and residential segregation may limit the posssiblity of upward mobility (Ewing et al., 2016). Housing inequality has also risen in Chinese cities, and service amenities, especially education and subways, have become even more important factors affecting housing prices than in cities in the developed countries (Li, Wei, Wu, 2019; Yuan, Wu, Wei, & Wang, 2018).

As an alternative way to live in cities, the rental housing market is particularly important to migrant workers and low-income families.

Given the profit-driven nature of real estate developers, cheap rental houses are often lacking in the market. Rental housing is also related to urban inequality. Discrimination may exist, as the dwelling owners may select renters (Ahmed & Hammarstedt, 2008). Similar to the housing market, the accessibility to various resources also plays a vital role in rental prices, which results in an uneven spatial pattern of rents (Li, Wei, Wu, & Tian, 2019b). More importantly, renters may not receive the same rights as homeowners. For example, renters in China may not have access to public schools and public housing because of the *hukou* system (Li, Wei, Yu, Tian, 2019). Rents in large cities tend to be high compared to income, especially in job-concentrated downtown areas, which may result in a new form of housing poverty (Sato, 2006). Li and Wei (2020) explore the patterns of rent stress in China and identify several critical determinants including policy, economic conditions, urban hierarchy, as well as north-south and rustbelt-sunbelt divisions (Liu et al., 2020).

Affordable housing programs also are critically linked to urban poverty and inequality. Many affordable housing programs have "failed" to some degree (Albright, Derickson, & Massey, 2013; Nguyen, Basolo, & Tiwari, 2013; Zou, 2014). These programs tend to cover the people who are more vulnerable (Huang, 2012). However, in the U.S., illegal immigrants are suffering more from housing affordability problems (McConnell, 2013), but the lack of legal status may prevent them from getting housing assistance (McCarty & Siskin, 2004). There are similar situations in China, as many policies are only available to registered residents (local urban *hukou* holders), and government policies provide registered residents better accessibility, or lower barriers to get the benefits than migrants (Huang, 2012). Furthermore, these programs may not be welcomed by nearby communities because of "not in my back yard" (NIMBY) effects (Nguyen et al., 2013). Combined with the fact that people relying on affordable housing usually have lower income and mobility, these people may get stuck in areas with less development, which can finally constrain their upward mobility (Verdugo, 2016).

6. Intra-urban dynamics of inequality: residential segregation

Residential segregation has long been a subject of inquiry by urban geographers and sociologists (Fossett & Waren, 2005; Massey & Denton, 1988), and its related demographic dynamics may complicate patterns of neighborhood change and segregation (Wyly, 1999). Residential segregation is linked to multiple dimensions of inequality including inadequate education, poor health, and lack of jobs (Li, Campbell, & Fernandez, 2013; Wei, Xiao, Simon, Liu, & Ni, 2018; Williams & Collins, 2001). Segregation is a significant societal concern and is central to the study of urban inequality in cities in the United States, and increasingly in Europe and developing countries as well. Musterd, Marcinczak, van Ham, and Tammaru (2017) reported an alarming increase in socioeconomic segregation between poor and rich in European capital cities.

Residential segregation is in a significant concern in urban inequality (Massey & Denton, 1988). The spatial concentration of deprivation results in lower social position and social mobility since the residents do not have stable or productive social networking to gain access to resources (Bolt, van Kempen, & van Ham, 2008). These disadvantages further lead to serious social problems such as dropping out of school, limited job accessibility, and social exclusion (Massey, Condran, & Denton, 1987).

The study of residential segregation can be traced back to the 1920s. Using the terms from biology such as invasion, succession, and dominance, the Chicago school described the dynamics of residental flows and neighborhood composition using terms borrowed from ecology (Denton & Massey, 1988). In this view, with the "invasion" of blacks, whites will move out to avoid unhappiness or conflict, and their houses will be mostly occupied by blacks.

Two perspectives dominate the interpretation of residential segregation. The racial preference perspective holds that discrimination persists within different groups, and people are sensitive to local population-composition changes, and when they feel the mixture has exceeded their tolerance, they will move out (Bolt et al., 2008). The other perspective highlights exclusion; immigrants lack the means to buy a house in a neighborhood with high socioeconomic status, and face institutional barriers erected by mortgage providers, real estate agencies, and local and national institutions (Bolt et al., 2008).

Residential segregation may increase or decrease, and it is driven by different processes in different cities (Beiley, van Gent, & Mustered, 2017). Several types of residential segregation have been identified. The most studied one is racial residential segregation. Many studies of racial residential segregation, especially in the U.S., are focused on the segregation of African Americans, which is still at a high level and is a comprehensive result of economic factors and preferences (Clark, 1986). Other studies also find that racial residential segregation varies among different ethnic backgrounds. For example, Mexican immigrants in the U.S. generally fit the trend described by the spatial assimilation model (Brown, 2007). Chinese immigrants, however, are more likely to fit the cultural preference model, although some of them are not pursuing residential assimilation, as Chinese immigrants still prefer to live among other Chinese (Yu & Myers, 2007).

Income segregation is also an important topic, and has been increasing over time as well (Galster & Sharkey, 2017). The economic condition of a household is naturally linked to housing choices and neighborhood assets because people need to pay more for amenities (Li et al., 2016, 2019). Income segregation results in severe problems when local governments highly depend on taxes to provide social welfare, public goods, and infrastructure (Ross, Houle, Dunn, & Aye, 2004). The rich may "self-segregate" thanks to their enhanced residential mobility (Reardon & Bischoff, 2011; Watson, 2009). Scholars have also begun to relate income segregation to other dimensions of urban inequality, such as spatial mismatch. For example, Haddad (2020) uncovers the positive and intensifying relationship between income segregation and commuting time, which significantly affects urban poor. In addition, Florida and Mellander (2020) find that economic segregation impacts local innovation and economic performance, which may intensify regional inequality.

Partly because of income segregation, skill segregation is another type of residential segregation. Economic development requires complementarity among high- and low-skillworkers. The polarization of wages in labor markets between high- and low-skilled labor may result in skill-based residential segregation. Such segregation has negative effects on skill-based or knowledge-based urban growth. Except for the typical results of residential segregation such as limited access to job information and networks and low upward mobility, the isolation of low-skilled workers also decreases the productivity of high-skilled workers because they also have low accessibility to the services they demand (Li et al., 2013).

Residential segregation is also highly sensitive to local demographical changes (Cloutier, 1984), and migration. Wessel, Turner, and Nordvik (2018) identified the importance of migration and immigration in spatial integration and segregation. Focusing on foreign-born immigrants, Bagchi-Sen, Rogerson, Seymour, and Franklin (2020) highlight their role in averting population loss in the U.S., and discover that major cities are usually the destinations of foreign-born; the authors provide insights concerning a number of urban issues including new forms of segregation, immigrant inequality, shrinking cities, and love-hate relationships between residents and migrants.

7. Multidimensional urban inequalities

Besides economic, housing and residential inequalities, urban inequality is multi-dimensional and highly complex. It is all aspects of the cities, such as education inequality, transportation inequity, spatial mismatch, environmental injustice, the digital divide, food deserts, and unequal access to government services. Different dimensions of urban inequality are intertwined and interactive and related to geographical

factors, including urban space, scale, zoning, environment, and accessibility to various urban facilities. For example, education inequality is partly the consequence of residential segregation and housing affordability, as well-off people are able to pay more for better education resources (Wei et al., 2018).

Concentrating on accessibility of job opportunities, "spatial mismatch" has become a major concern in the metropolitan areas in the United States (Chapple, 2006). Two kinds of spatial mismatch are highlighted by researchers. The first one studies spatial variation and commuting behavior in the labor market and housing market, and the second one studies the impacts of spatial mismatch on people in terms of demographic and socioeconomic conditions (Horner, 2004; Kim, Sang, Chun, & Lee, 2012). In Western countries, scholars are mainly attracted to racial or socioeconomic spatial mismatch (Mclafferty & Preston, 1992; Ross, 1998). Although residential segregation is still one of the most important causes of spatial mismatch, it is not as pervasive as in the past. Nevertheless, the spatial mismatch level seems have not to have decreased in step with the decline of residential segregation, which suggests residential segregation is not the only cause of spatial mismatch.

Urban sprawl and job decentralization have been regarded as the most important processes resulting in spatial mismatch, as these processes have changed the location choices of people's housing as well as job opportunities (Brueckner, 2000; Glaeser & Kahn, 2001, p. 8117; Wei & Ewing, 2018). As population sprawls, people who cannot afford new suburban homes are remain in the old community. As employment sprawls, especially the service and manufacturing jobs which are suitable to poor and under-educated people, poor people who are trapped in urban centers and highly rely on public transportation facilities no longer have access to these jobs (Ding & Bingham, 2000; Glaeser & Kahn, 2001, p. 8117). Job decentralization also affects people's commuting time. In monocentric cities, decentralization can partly solve the traffic problem because people in the suburbs may have better accessibility to their jobs locally (Giuliano & Small, 1993; Gordon, Kumar, & Richardson, 1989). However, in a polycentric city, the complexity of urban spaces and unevenly distributed houses and job opportunities have significant negative effects on commuting time (Giuliano & Small, 1993), although others disagree (Veneri, 2010). Job opportunities and spatial mismatch in the context of polycentric development need further investigation.

Related to urban environment and health, environmental injustice/inequality has been an important concern of urban equity (McCartney, Collins, & Mackenzie, 2013; Stewart, Bacon, & Burke, 2014). Evidence shows a higher asthma rate among low income and minority groups because of location of transportation facilities such as highways and rail stations (Garcia et al., 2013; Rosenbaum, 2016). Scholars have revealed that vehicles and other small sources of air pollution may contribute more than large pollutive facilities to health problems in poor neighborhoods. Busy roads produce both air pollution and noise, and the inverse-distance based relationship between busy roads and negative impacts on health has been uncovered (Stewart et al., 2014). Moreover, urban green space has been recognized as another important factor in environmental inequality and social justice (Whitehead, 2009; Wolch, Byrne, & Newell, 2014). Green spaces attract people to do more physical activities, and reduce local pollution (Wei et al., 2018; Wolch et al., 2014). Poor people usually have less access to urban green spaces for two reasons. First, they are trapped in urban centers, which are crowded and there is not enough available area for urban green spaces. Second, the region they live in may lack resources, and local government may not be able to maintain urban green spaces.

Scholars are also concerned with the accessibility to healthy food. Suitable accessibility to health food stores is related to better eating habits and results in better health conditions. The concept of "food desert" is used to describe areas lacking access to healthy food, which is usually related to uneven distribution of healthy food stores. However, as most studies are concentrated on the U.S., research is insufficient in other areas, which may have different patterns and mechanisms than the U.S. For instance, Garcia, Garcia-Sierra, and Domene (2020) analyze food access in Barcelona, and find relative equal accessibilities to food stores in the city; however, the accessibility to organic food is linked to better socioeconomic conditions, and broadly, the restructuring of the retail sector (Zhang & Wei, 2017).

In summary, urban inequality is multi-dimensional and these dimensions are closely related. It is still worthwhile to have a comprehensive view of urban inequality. For example, Musterd, Hochstenback, & Boterman (2020) highlight the importance of considering different dimensions such as wealth and income, the structural changes of urban population composition, and diverse changing trends in analyzing socio-economic inequality, which lead to a better understanding of various socio-economic inequality patterns.

8. Conclusion

Research on the urban spatial dimensions of inequality highlights dimensions of inequality dynamics that are missed in debates relying on nationally aggregated data. We have argued that present-day inequality trends derive in important ways from the emergence of the new information-based economy in the last few decades. More than ever before, cities are the sites of production in this new economy and it is within cities, and between cities, where present-day inequalities are most conspicuous. Inequalities are often created, conditioned, and recreated, in urban space.

The contributions to this special issue explore the spatiality and dimensions of urban inequality in multiple perspectives. Inequality trends pertain to economic/income inequality, housing quality and affordability, residential segregation, and public health. The studies in this issue are based on a rich and diverse collection of source materials from North America, Europe, South America and China, advancing our understanding of the particularities and generalities of urban inequality. Together, the papers in this issue suggest that urban inequalities have been on the rise across the globe.

This collection of papers also raises important questions, and it is clear that there are still many research gaps to fill. First, the new economy is neither monolithic nor static. The rapid development of digital technologies implies that the working of the urban economy and the new division of labor is a moving target. For example, the uneven economic landscape of U.S. cities has been changing with technological progress and the rise of the network/platform economy. How these forces contribute to urban inequality and how to address arising urban problems remain challenging questions. More generally, theories of urban economic/income inequality in the context of rapid technological change are under-developed and are insufficient to examine emerging patterns of urban inequality (Huang & Wei, 2019). In particular, more research is needed on the significance of the growing segment of self-employed workers and the emergence of the gig economy. This category of workers is spread across different education levels and income classes but they probably share similar vulnerabilities at times of recession.

Similarly, and partly related to highly dynamic labor markets, housing markets are far from stable. More research is needed on housing in terms of spatiotemporal dynamics and inequality, including shifts from owner-occupied to rental housing. Conventional measures of housing inequality are especially problematic in international comparisons. For instance, substantial price ranges may indicate more choices of housing at a variety of prices or it can reflect considerable spatial segregation. In China, especially, underlying mechanisms of housing markets and affordability remain poorly understood. For example, the significance of subway stations for housing prices in China has a close relationship with the over-concentration of jobs and the poor housing affordability in urban centers (Li et al., 2019b). We need more comprehensive studies of housing markets, inequality, affordability, and change.

Third, residential segregation is an urban phenomenon consisting of different dimensions including race, income, and skill, and studies have confirmed that the different dimensions are interrelated (Reardon & Bischoff, 2011) – but these interrelationships vary considerably across the world. Despite years of research on residential segregation, different dimensions are seldom analyzed in an integrated framework. The mechanisms underlying residential segregation are highly complex; whereas geographers often pay attention to local factors of change, external and structural forces are often overlooked.

Fourth, conceptualizations and measurements of income inequality have become increasingly arbitrary (e.g., The Economist, 2019). This is partly a matter of defining high versus low incomes. In urban contexts, processes of segregation and gentrification tend to involve not the highest incomes (certainly not the infamous "1 percent") but rather middle and upper-middle incomes and lower incomes, with the former as gentrifiers and the latter as displaced (also see Schlichtman & Patch, 2014). Moreover, for a substantial share of urban households, it is wealth and not just income that has become an increasingly important indicator of economic status, i.e., wealth expressed in home equity and retirement funds. Accordingly, the distinction between home-owners versus renters is increasingly significant, in cities around the world.

Lastly, the literature confirms the existence of inter-relationships between different dimensions or forms of urban inequality (Anderson et al., 2003; Krivo & Kaufman, 2004; Raudenbush & Kasim, 1998). The coronavirus pandemic was only underway for a couple of months at the time of writing (early March 2020) but it already pointed to the highly disparate vulnerabilities of different population groups, demographics, and occupational categories (e.g., Holpuch, 2020). In the new urban economy, homeless people, workers in the low-paid service sector, janitorial staff, hotel and restaurant workers, public transit workers, and those who cannot work from home, have compensated sick days or basic health insurance are among the most economically disadvantaged *and* most exposed to public health risks. Similar vulnerability differentials can be observed in regards to urban environmental threats and hazards, from hurricanes in Miami to air pollution in Delhi and urban heat waves in Tokyo.

Our understanding of such inter-relationships is limited. The notion of urban 'syndemics' (Singer, Bulled, Ostrach, & Mendenhall, 2017) can be used to indicate the spatial convergence of an array of conditions that define well-being and inequality: problems of, for example, unemployment, low incomes, poor health, low education, and lack of access to amenities, food, and urban services, often are concentrated in space but it is hard to identify the key drivers of such processes. Emergent approaches in data analytics and urban policy analytics rely on potentially rich data sources to study the multiple dimensions of urban inequality, and the development of data science and GIS can provide powerful tools to increase our understanding. In the meantime, any progress in our understanding of the nature of present-day inequalities requires close attention to their urban spatial dynamics, across the globe.

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Appendix A. Supplementary data

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