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Geographical structure of the local segregation of migrants in (sub)urban China

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Abstract Unprecedented urbanisation in China has profoundly reshaped the country’s social-spatial structure. Owing to economic suburbanisation and urban redevelopment processes, migrants coming from rural areas are increasingly concentrated in suburbs rather than city centres. Against this backdrop, this paper focuses on residential segregation between migrants and locals, and on geographical (re)structuring between the city centre and suburb. Theil’s H Index is used to disaggregate the migrant segregation of each municipality into a within-suburb, a within-centre and a between-centre-suburb component. We use Census data for 258 municipalities in 2000 and 2010; we find that migrant segregation increased in this period. We ascribe this to the increasing segregation of migrants in suburban areas, which offsets the increasingly balanced distribution of migrants between the city centre and suburb. Segregation in city centres also increased slightly in this period. Unexpectedly, less economically developed municipalities, defined by their per capita GDP, tend to be more segregated than their more developed counterparts. Less developed municipalities also have a higher level of suburban employment and housing opportunities in the whole municipality, but feature more segregated suburban spaces and a polarised distribution of migrants between the centre and suburb.

Keywords Segregation · Migrant · Less developed cities · Suburb · Urban redevelopment · China

Introduction

International migration has transformed the social-spatial landscape of global cities profoundly (Sassen, 2001). Not only highly paid professionals concentrate in such cities, but also low-skilled migrants flock into these cities. This may lead to polarised social structures and spatial segregation of highly-skilled, high-earning people from the rest. While China lacks large volumes of international migrants, its grand schemes of industrialisation and modernisation invoke massive flows of domestic rural-to-urban migrants into labour-intensive manufacturing and services industries. These migrants are predominantly, though not entirely, low-skilled and low-paid; they are also institutionally deprived of certain education and housing welfare benefits (Fan, 2001). However, they are—like international migrants elsewhere—essential in responding to labour market needs and consequently in (re)shaping the social-spatial structure of cities.
In 2018, 240 million or 17% of the Chinese population were classified as migrants. Residentially, they are marginalised, living in dilapidated neighbourhoods, urban villages and factory dormitories (Li & Gou, 2020; Liu & Wu, 2006). Their conspicuously disadvantaged institutional and socioeconomic status contrasts with local people and enhances segregation along the line of hukou status.

Migration and urbanisation occur in tandem with industrialisation. Although city centres have long been the economic development hotspots, economic restructuring leads to spatial processes of suburbanisation as suburban areas increasingly become spaces for development (Zhou & Ma, 2000). Concomitantly, migrants are relocating from city centres to suburbs, or move directly into the suburbs, attracted by employment opportunities and less expensive housing (Li & Mao, 2019; Liao & Wong, 2015). They may however not only settle down in urbanized areas, but also in less-urbanized areas where industrialization processes provide industrial jobs in what are generally largely rural areas. In this context, it is important to ask how migrants are incorporated and/or segregated residentially, and how the geographical patterns of hukou-status based segregation may evolve. Does migrant segregation at the city scale decrease along with migrants’ increasing presence in the suburbs? Are migrants less segregated within the suburbs than in city centres due to a relatively cheaper and less exclusionary suburban housing market? Or are they concentrated into homogenous neighbourhoods in the suburb, as a consequence of persistent discrimination along the lines of hukou status? As the shifting geographies of residential segregation by hukou status are embedded in suburban development and urban redevelopment processes, what does it tell us about the meaning and nature of these processes? In an attempt to address these questions, this study would provide answers. Answers to these questions also have important societal implications for the establishment of China’s ‘Harmonious Society’ and the ‘New Urbanisation Plan’, both of which aim for the urban incorporation of domestic rural migrants.

Research has shown that neighbourhood-level segregation between migrants and locals in Shanghai was higher in the suburb than in the city centre in both 2000 and 2010 (Gu et al., 2021; Shen & Xiao, 2020). Yet, this might be a specific observation in a single, highly developed city. While most of the relevant research on suburbanisation and migration has overwhelmingly focused on developed, global cities like Beijing and Shanghai (see for example Shen & Xiao, 2020), other cities are under-researched (Robinson, 2006). We argue that, as political and economic ‘actors’, less developed cities are also spaces of exclusion, but that their processes of exclusion and segregation differ; these differentiated processes might result in a differentiated spatial (re)distribution of migrants, and hence varying geographies of migrant segregation.

In this study, we use a large sample of Chinese cities and address two main descriptive inquiries:

How do segregation levels differ between suburbs and city centres and how do they change during 2000-2010?

How do these (changes in) segregation levels differ among cities of varying economic development levels?

We tentatively explain these variations through addressing the following question:

How can we understand the various levels and manifestations of segregation in different spaces - city centres and suburbs - and in cities of different economic development levels?

This paper therefore focuses on understanding the geographies of migrant segregation (between the suburb and city centre), and how they manifest differently in cities with varying economic development levels. Contextualised in a transitional Chinese economy of ongoing industrialisation, suburbanisation and massive rural–urban migration, as well as strong state control over the migration process, this study aims to add to the knowledge of the geography of migrant segregation, which covers predominantly advanced capitalist countries (see for example Musterd, 2020; Farrell, 2016; Fischer, 2008; Lichter et al., 2015a, 2015b). In the following sections, we first review related literature on geographies of residential segregation. This is followed by a data and methods
section and an empirical analysis section. The paper ends with the conclusion and discussion section.

**Theoretical Framework**

In this section, we focus on understanding geographies of residential segregation in both the Western context and Chinese context, with a particular focus on residential geographies concerning the city centre and the suburb, and with special attention to (im) migrants.

**Geographies of residential segregation in the western context**

Research reveals that residential segregation is a multi-scalar process, occurring at different levels including neighbourhood, place, city and region. These levels do not necessarily correspond: the segregation component at one scale might offset and/or enhance that at another scale (Lee et al., 2008; Lichter et al., 2015b). Disentangling this multi-scalar pattern of residential segregation helps to understand where segregation is occurring (Fischer et al., 2004) and to reveal the dynamics and processes at various scales beyond the often used neighbourhood scale. It also helps to understand the causes and consequences of segregation (Reardon et al., 2009). For instance, the causes of segregation at a larger scale (such as segregation between cities) include economic competition and institutional factors like tax policies, while causes of segregation at a smaller scale (such as segregation between neighbourhoods) include residential preferences, housing market, and school catchment policies.

Literature on geographies of residential segregation concerns segregation along various lines (in terms of ethnicity, socioeconomic or institutional status) and at differentiated scales (neighbourhood, place, city and region). The spatial patterns would typically show a differentiation between city centre and suburbs, and a differentiation within these entities and even smaller units (Farrell, 2016). It is argued that segregation based on immigrant status is driven by social networks, affordable housing and low-end job opportunities leading to higher concentration of migrants in the inner-city compared to the suburb. In western contexts, suburbs have long been reserved mainly for middle class households. Moving to the suburb was seen as a manifestation of upward social mobility (Iceland & Nelson, 2008), consistent with the spatial assimilation theory (Clark, 2007). However, along with the suburbanization of job opportunities and increasing house prices in the city centre due to gentrification, immigrants are increasingly suburbanized or they bypass the city centre to settle down directly in specific suburbs. The link between spatial and social assimilation became less established (Lichter et al., 2015a). Instead, when immigrants are being suburbanized, the segregation of immigrants within the suburb is also increasing (Farrell, 2016).

**Geographies of segregation of migrants and local people in China**

Similar to the disadvantaged positions of international immigrants in contexts such as those in the US and Europe, Chinese migrants are institutionally and socioeconomically disadvantaged, due to their specific hukou status. Migrants in China are allowed to migrate, mostly from rural to urban areas and from less economically developed to economically advanced areas, to participate in economic development. Yet, they do not enjoy the same rights in the city as people with a local hukou status. Welfare benefits such as public housing, child education and pension are most often not available to them (Huang, 2012). Most of them are unskilled or lower-educated and work in low-income manufacturing, construction and customer service industries. Their disadvantaged positions do not offer them much choice on the housing market. Consequently, they usually rent informal and precarious housing in urban villages and inner-city dilapidated neighbourhoods, or live in employer-provided dormitories (Liu & Wu, 2006).

Migration in China is closely linked to processes of industrialization and urbanization. Where migrants settle is predominantly influenced by where jobs and affordable housing can be found. The shifting geographies of migrant segregation are therefore also closely related to the reshuffling of the geographies of jobs and dwellings between the suburb and city centre.

During the socialist period, city centres were cast as economic development hotspots; during more recent economic and spatial restructuring processes, the spaces for accumulation and consequently the major destinations for migration have increasingly shifted to the suburbs, including the urban edge and
rural fringe (Hsing, 2010; Liu et al., 2015). Increasing suburban economic development is epitomised by the large number of industrial parks, new towns and suburban central business districts. At the same time, urban redevelopment in the city centre—a universal strategy in Chinese cities, underwritten by globalisation and neoliberalisation and characterised by demolition and rebuilding (He, 2010)—is also ongoing. Large-scale affordable rental housing in marginalised neighbourhoods like urban villages is increasingly being demolished (Wong et al., 2018), while luxury and middle-class housing has been arising in its place. Housing in the city centre became increasingly unaffordable for migrants. In contrast, informality dominates residential space production in the suburbs (Hsing, 2010) and new urban villages in suburbs are emerging.

When migrants increasingly appear in the suburbs which used to be dominated by local people, migrants become more evenly distributed between the city centre and the suburb. This could contribute to a more even between-centre-suburb landscape. However, how the landscapes within the suburb and within the city centre change remains uncertain. Migrants could become more integrated due to less expensive housing markets in the suburbs. However, progressively segmented land use, concentrated residential development of affordable housing and self-segregation in the suburbs could also lead to persistent residential segregation in the suburbs. To what extent migrants are integrated/segregated in the suburbs also depends on the dispersed/concentrated geographical distribution of employment opportunities in the suburbs (Feng & Zhou, 2005). In the city centre, migrants could be increasingly segregated when the exclusionary urban redevelopment process progresses. However, segregation might also decrease along with a decreasing number of migrants in the city centre.

Geographies of migrant segregation and economic development level

The spatial reconfiguration of segregation by hukou status may differ between cities of varying economic development. Economically more advanced cities, those with a higher level of per capita GDP, possess a larger total package of resources, and thus see stronger spill-overs from the city centre to the suburbs. These suburbs thus feature a diverse and varying assemblage of development opportunities, where routine manufacturing, high-end manufacturing and service industries coexist (Han & Qin, 2009). This might enable the suburbs in more developed cities to develop into a mature stage, with a higher level of resemblance to the city centre. In contrast, resources in less developed cities might gravitate strongly towards the city centre. With weak spill-overs from the city centre, these suburbs might be dominated by monotonous and spontaneously scattered manufacturing industries (Deng & Huang, 2004). This may lead to fragmented concentrations of migrants in the few areas where employment opportunities could be found.

Furthermore, more developed cities might have a more professionalisation of the lower class, thus transforming agrarian employment to low-end industrial and service employment (He et al., 2021). This might imply higher degrees of penetration of capitalist production relations into rural areas, and integration of the once ‘segregated’ rural areas into a larger urban social economic landscape (Ghosh & Meer, 2020). Altogether, integration between migrants and local people might become more feasible in more developed cities.

Data and methods

Data

This study uses subdistrict-level census data for 2000 and 2010. In the census, migrants are those who live in a different township/subdistrict from their hukou registration township/subdistrict for at least six months, while local people’s hukou registration corresponds to their place of residence. This definition includes those who live in a different township/subdistrict but still in the same county and/or municipality (administratively defined cities, shi in Chinese, more on this later) of their hukou registration. These inter-subdistrict migrants are predominantly rural to urban migrants, moving from less to more urbanized and industrialized areas (Wu & Li, 2005, p.160). They are thus fundamentally similar to other migrants across counties and/or municipalities, in that they move for better socioeconomic opportunities and help reveal the uneven rural and urban development.
Theoretically, the subdistrict is the lowest administrative level in China. At that level, political actors address exclusion and inclusion through active policy making in the field of demographic, economic and urban planning, and thus shape the spatial concentration and differentiation of migrants across subdistricts. Analysis at the subdistrict level therefore could reveal these spatial logics and the dynamics which would otherwise be concealed. The subdistrict/township could also include both rural and urban dynamics. These differentiated and mixed rural–urban dynamics in subdistricts are characteristic of the actually-existing and uneven processes of (sub)urbanization process in China. Moreover, although subdistricts as the unit for segregation calculation are comparatively bigger than segregation research in the western context (see for instance Lichter et al., 2015a, 2015b), it is not uncommon to use slightly bigger units for segregation either (Musterd, 2005). Actually research has shown that changes in units’ size do not necessarily lead to big changes in the ranks of segregation levels, as socio-spatial inequality tends to be systematic (Musterd, 2005). The subdistricts are also consistently delineated based on major infrastructure or nature barriers; this enables comparison of the segregation patterns across municipalities (He et al., 2021). Practically, neighbourhood-level census data is rarely available for academic use. The subdistrict level is the finest scale at which we could conduct large scale nation-wide analysis (Wu & Li, 2005). Analysis of this sort could be used as a starting point inviting further analysis; previous studies using this scale for segregation studies (He et al., 2021; Monkkonen et al., 2017) proved to be fruitful and showed interesting variations among municipalities at the subdistrict scale.

For the sake of temporal comparison, municipalities that did not exist in either year, due to new designation or annexation, were excluded. Municipalities without sufficient information on the independent variables (e.g., per capita GDP) were also excluded, most of them in the western region of China. Ultimately, 258 prefecture cities for each census year were included. The spatial unit for calculating segregation was the subdistrict; the average population size was 27,204 in 2000 and 34,881 in 2010. So far, the subdistrict is the smallest spatial scale available for segregation investigation in the whole of China.

Segregation measure: H index

In this study, residential segregation is defined in terms of people’s hukou status (migrants and local people). Theil’s H index is used for the measurement of unevenness, based on a diversity entropy index. Its main advantage for this study lies in its capability to disaggregate/decompose total segregation into a nested set of geographical scales (Lichter et al., 2015b). The diversity entropy is defined as:

\[ E = P_i \ln \left( \frac{1}{P_i} \right) + (1 - P_i) \ln \left( \frac{1}{1 - P_i} \right) \] (1)

Here, \( P_i \) is the proportion of migrants in subdistrict \( i \). Its value is 0 if only one hukou group appears in the subdistrict, and 1 if migrants and locals each constitute half of the population. Based on this, the H index for the municipality is:

\[ H = \sum_{sem} T_s \left( \frac{E_m - E_s}{E_m} \right) \] (2)

Here, \( T \) and \( E \) are respectively the total population and the diversity entropy for the subdistricts (\( T_s; E_s \)) and municipality (\( T_m; E_m \)). The H index measures how diverse the subdistricts are compared to the migrant-local composition at the municipal scale, weighted by their relative population size. The H index at the municipal scale is further disaggregated into between-centre-suburb, within-suburb and within-centre components, based on the following formula (see Reardon et al., 2000 for more details).

\[ H = H_{cs} + \frac{T_CE_C}{T_mE_m} H_C + \frac{T_SE_S}{T_mE_m} H_S \] (3)

\( H_{cs}, H_c \) and \( H_s \) are respectively the segregation between the suburb and centre, within the centre and within the suburb. \( T_m \) and \( E_m \) are respectively the total population and the diversity entropy of the municipality. The first item in the right part of the equation is the component of municipal segregation attributed to segregation between the centre and the suburb; this implies the part of municipal segregation that can only be reduced by changing the relative proportion of migrants and local people in the centre and in the suburb. The second and third items imply the portions of segregation, contributed by the segregation within the centre and that within the suburb; they are
H indexes, weighted by their relative population size \( (T_i/T_m; T_j/T_m) \) and their relative diversity entropy \( (E_m/E_i; E_m/E_j) \). Similarly, these are the parts of total segregation that can be reduced through changes in the relative composition of subdistricts within the centre and within the suburb respectively.

Demarcation of city centre and suburbs

In China, the term *municipality* refers to an administratively defined city (*shi*). These municipalities are actually city-regions, encompassing a high-density and highly-urbanised centre and an extensive suburban and rural fringe area (Hsing, 2010, p. 11). To avoid confusion, the administratively defined city is referred to as ‘municipality’; the city centre as ‘centre’, and the suburban and rural fringe area as ‘suburb’. Thus, analytically, there is only one suburb and one city centre in each municipality; the analytically defined suburb includes all the municipal areas excluding the centre. In our definition, the city centre includes spaces which are highly urbanized and industrialized in the municipality. The suburb includes a heterogeneous variety of less urbanized and industrialized counties, and includes rural places as well (Gururani, 2020; Wu & Keil, 2020).

What constitutes the suburb is a theoretically and empirically problematic issue (Cooke & Denton, 2015). Usually the definition is left to the individual scholar to decide (Forsyth, 2012). Existing research defines suburbs with census data using units based on political boundaries. Adjacency to the city centre, or other characteristics of the built-up area like building age and density, play a role in the defining process. Suburbs have also been identified on the basis of multivariate modelling of a set of variables assumed to relate to suburbs (Airgood-Obrycki et al., 2020; Cooke & Denton, 2015; Terbeck, 2020). As suburban development in China is mainly a post-reform phenomenon (Zhou & Ma, 2000), suburb-centre demarcation is not officially incorporated in any census. Furthermore, the modelling approach to distinguish between types of suburbs is beyond the scope of this paper. Instead, we address this issue based on the hierarchical administrative status of district-level units within municipalities. We consider areas that are referred to as ‘district’ (‘qu’) to be the centre, while the suburb includes those areas referred to as ‘counties’ (‘xian’) or ‘county-level cities’ (‘xian ji shi’).

In the Chinese hierarchical administrative system, administrative status is the institutional embodiment of granted state power and available socioeconomic resources. Districts (‘qu’) are under the direct administration of the municipal government and are the centres for urban and economic development; they are generally granted more state power and preferential policies relative to counties (‘xian’) and county-level cities (‘xian ji shi’), through administrative funds, tax retention and land development quotas (Chien, 2013; Ma, 2005). In contrast, counties and county-level cities are administratively subordinate to the municipality. They can be re-categorised as ‘qu’ through administrative restructuring or annexation into the centre; this generally occurs if they become economically developed, or when they are on the frontier of outward urban expansion (Lin, 2009). Thus, we argue that the variations among these politically designed district-level spaces correspond well with and address properly the essential differences in dimensions of urbanism between the centre and suburb, with the ‘qu’ being dominated by non-agricultural employment, as well as being more densely populated and economically developed.

We have to admit that the city centre and suburb identified here include rural areas in both spaces, although more so in the suburbs than in the centres. No county in China is completely urbanized; counties have both rural and urban dynamics (Tsing, 2010, p.14). This may not conform to classic imaginations of suburbs based on the post-war middle-class low-density urban spaces. However, suburbs and suburbanization take variegated spatial forms and processes (Keil, 2017). This type of suburb is ‘actually-existing’ suburb. It aligns with the concept of ‘urban periphery’ used in both the global North and South contexts (see for instance Keil, 2017; Savini, 2014; Savini et al., 2015). Moreover, it makes more sense, theoretically, to include the rural area in the suburbs than to avoid that, in the rapidly developing Chinese context. Myriad processes are shaping the non-centre landscape simultaneously. These include suburbanization, rural industrialization and urbanization of the suburb. This makes it not practical to draw clear-cut boundaries between the rural and the urban and even between the suburb and the city centre. For instance, suburbanization in China mainly manifests as a process regarding land, housing and labour dynamics extending from the urbanized area to the hinterland, which
is predominantly rural. This also indicates that rural and urban are relational to each other rather than categorically reified separate spaces (Brenner & Schmid, 2014). Furthermore, the rural and urban are governed by one unified municipal government, and constitutive of a unified capital accumulation regime. Additionally, it is also not uncommon to incorporate rural areas when defining the suburb. One typical approach based on census data defines suburbs as all areas within a metropolitan area outside the so called ‘primary cities’ (see for instance Anacker, 2013; Anacker et al., 2017). As ‘metropolitans are delineated at the county level, they often include areas on the suburban–rural fringe and rural populations’ (Anacker, 2017, p.822). Related research is widely cited (Frey, 2011; Kneebone & Berube, 2013; Suro et al., 2011).

Indeed, some ‘qu’ might be hardly urbanized while some ‘xian’ are highly urbanized. In response, two complementary approaches were deployed to reduce misclassification. First, counties (xian) and county-level cities (xian ji shi) that were upgraded to districts (qu) during 2000–2010 were still considered part of the suburbs. Based on the land-centred fiscal revenue system, annexation into city centres and the corresponding administrative upgrading of these suburban counties and/or county-level cities are most often motivated by municipal governments’ desire to expand urban spaces for capital accumulation (Lin & Yi, 2011), rather than by an acknowledgement of their ‘phenomenal’ urban development. By using constant boundaries, we also excluded the influence on segregation of changes in the size of centres and suburbs during the given period.

Second, districts might be ‘over-urbanised’ due to early development, or ‘under-urbanised’ if the administrative adjustment lags behind economic development. In these cases, we manually adjusted the centre-suburb delineation, based on available urban planning documents and related literature. For example, Shanghai had eighteen urban districts (qu) in 2000. In alignment with literature on Shanghai (see for example Wu, 2008), we considered only six of the urban districts as constituting the centre, with the other twelve constituting the inner suburbs. After all of these careful adjustments, the mis-categorisation of genuine suburban areas as centre, or vice versa, should be rare.

Dependent and independent variables for the multivariate analysis

To understand municipal migrant segregation and its shifting geography, four segregation models are constructed focusing on employment and housing aspects. The dependent variables are: (1) the municipal migrant segregation level, (2) the share of between-centre-suburb segregation, (3) the share of within-centre segregation and (4) the share of within-suburb segregation. Compared to absolute values, the shares are more sensitive in capturing the ‘shifting’ geographical structure of municipal migrant segregation, as the components add up to one and a decreasing component(s) has to be compensated by an increasing component(s). Considering the bounded nature of the proportional dependent variables and the need to remain consistent across models, we used the Generalised Linear Model (GLM) for all models. The data in 2000 and 2010 were pooled into a municipality-year dataset.

Following similar research on shifting geographical structures of immigrant segregation (for instance Farrell, 2016; Lichter et al., 2015a, 2015b), as also illustrated in the theoretical framework, the main independent variables for explaining migrant segregation levels include migrant characteristics and municipality-level housing and employment characteristics. Four properties of municipality-wide housing and employment, concerning their structure and geographical distribution, are incorporated into all four models (Table 1). The data came from the 2000 and 2010 district-level censuses (rather than subdistrict level). First, as migrants predominantly work in customer service and manufacturing industries, the proportion of low-end service and manufacturing employees at the municipal scale was used as a proxy for migrant employment opportunities.3 The industrialisation trajectory in China in the first decade of the twenty-first century was dominated by the development of labour-intensive manufacturing and service industries to replace agriculture (He et al., 2021). We expected that municipalities with higher proportions of low-end service and manufacturing employment

3 Six occupation categories are reported in the census: unit head, technician, clerk and related workers, low-end service, manufacturing-related and agriculture-related.
would have a stronger industrial base and stronger spillovers from the city centre to the suburb, and thus a more balanced between-centre-suburb social landscape (i.e., a smaller between-centre-suburb segregation share) and a more diversified and even social landscape in the suburb (i.e., a smaller within-suburb segregation share); they might also simultaneously experience a stronger exclusionary urban redevelopment and polarisation process in the city centre (resulting in a larger within-centre segregation share). Furthermore, given that migrants predominantly rent private housing (Wu, 2008), the proportion of renters was included as a proxy for migrant housing opportunities. Although public and private renting could not be differentiated at the municipal level, the scale of private housing has increased significantly and has dominated the rental market since housing commodification reform in the 1990s. The share of public rental in China was 1.5% in 2010, while that of private rental was 10.5%.4

The geographical structure of employment and housing opportunities also influences the spatial distribution of the migrants. We expected that a higher share of employment and housing in the once ignored suburb would decrease the gap between the suburb and centre (i.e., a smaller between-centre-suburb segregation share), while nonetheless segmenting the suburb (i.e., a larger within-suburb segregation share). This is operationalised as the total amount of low-end service and manufacturing employment (and of rental housing) in the suburb, divided by the total amount of low-end service and manufacturing employment (and of rental housing) for the whole municipality. They are referred to in the tables as ‘share of suburb in the

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municipality’ in terms of low-end service and manufacturing employment (and rental housing).

A dummy variable for the two-year observations was controlled for the time-fixed effect in all models. To explore how municipalities of varying economic development levels differ in municipal migrant segregation and its geographical structure, a related categorical variable was also included. The 258 municipalities are divided into four groups based on their per capita GDP, expressing four economic development levels, each with equal numbers of municipalities. The categorisation in 2010 was applied to both years to ensure consistent comparison. The municipal migrant segregation level was included in the three component models to correct for its structural influence on the three segregation components.

We now illustrate the model-specific variables. In the municipal migrant segregation model, we included several additional municipality-wide variables, including per capita Foreign Direct Investment (FDI) as a proxy for the globalisation level, ecological variables including the total population and the share of migrants, and the region where the municipality is located to control for unobserved systematic geographical differences. More globalised municipalities were expected to be more segregated (Sassen, 2001). Larger populations and higher shares of migrants might allow for higher levels of social-spatial differentiation (Farley & Frey, 1994). Regions were divided into eastern coastal, centre inland and western regions. These variables help to control for the implicit and nuanced variations across regions which structure the differences in migrant segregation between the suburb and city centre. They were hence also included in the between-centre-suburb model. Based on similar theoretical logics, the total population and share of migrants in the suburbs (the centre) were included in the within-suburb (within-centre) model. In the within-centre model, the share of self-built houses in the city centre was also included. Self-built houses could be urban villages or villages in the peripheral rural areas of the districts (qu) comprising the city centre here. These self-built houses provide migrants and young professionals with opportunities for cheaper housing and neighbourhood mix in the city centre, which otherwise may be inaccessible to them (Liu et al., 2015). But this type of housing also tends to concentrate and hence separate from other types of houses. Its effect on migrant-local segregation remains to be seen.

Empirical analysis

National migrant segregation pattern

It is important to situate the analysis of municipal migrant segregation and its geographical structure within the national segregation pattern. The national

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5 We used the log-scale of the total population. The correlation coefficient between these two variables is 0.034, showing no significant collinearity.
migrant segregation level measured by H index (Appendix 1) was virtually stable: 0.272 in 2000 and 0.274 in 2010.

Two points stand out from the national migrant segregation disaggregation (Fig. 1). First, between-municipality differentiation was a significant source of national migrant segregation in both years. It had the highest segregation share in 2000, at 25.2%, and was 23.6% in 2010, second only to the within-suburb component. If we disaggregate the total national migrant segregation into a between-municipality component (adding the between-region, between-province and between-municipality components) and a within-municipality component (adding the between-centre-suburb, within-centre and within-suburb components), the between-municipality component covered 47.4% of the total segregation in 2000; it decreased to 45.8% in 2010. The share of the within-municipality component increased from 52.6 to 54.2% in the given period. The high between-municipality component implies a highly uneven distribution of migrants among municipalities. Migrants are drawn disproportionately to coastal and economically developed municipalities, where abundant employment opportunities are found. It also implies that within-municipality segregation is becoming increasingly significant.

Second, segregation in suburban areas was another increasingly significant source of national migrant segregation during 2000–2010. The share of the within-suburb segregation was 22.1% in 2000. This indicates that 22.1% of total national migrant segregation could only be reduced by changing the relative population composition of the subdistricts within suburbs. The within-suburb share grew to 27.8% in 2010, the highest among all components. The share of the within-suburb component was higher than that of the within-centre component; only 12.5% in 2000 and 13.5% in 2010 of the total national migrant segregation were attributed to the within-centre component. Furthermore, while the within-suburb and within-centre components increased during 2000–2010 by 5.7% and 1% respectively, the between-centre-suburb component decreased from 18.0 to 12.8%. The development of suburban areas seems to result in a more balanced distribution of migrants between the city centre and suburb, but nonetheless a more segregated suburb.

Municipal segregation pattern

As shown above, the uneven population distribution within municipalities became an increasingly important source of national migrant segregation in China during 2000–2010. This indicates that the average unevenness within municipalities (between subdistricts) experienced by a randomly selected average Chinese was high and increasing during the given period. Below we calculate migrant segregation within every municipality independently; each municipal migrant segregation is further disaggregated into between-centre-suburb, within-centre and within-suburb components. These three components differ from those of national migrant segregation, in either their numeric values or meanings; they are always calculated in relation to the largest scale that
is being disaggregated, namely the whole country and each municipality; correspondingly, their interpretations only make sense relationally. In addition to the average segregation level between migrants and local people of all municipalities, we also show the average segregation level of the four city groups by economic development levels. This helps to paint an initial picture on how segregation levels by hukou status relate to economic development levels.

The average municipal migrant segregation \( (N=258) \) was 0.162 in 2000 and 0.168 in 2010 (Fig. 2, Left), an increase of 0.006. More developed municipalities seemed to be less segregated (Fig. 2, Left). The difference between the least and most developed municipalities was most obvious. In 2010, the average H index value was 0.184 for the former, but only 0.139 for the latter. The segregation map (Fig. 3) also indicates that municipalities in the eastern coastal areas, which generally tend to be more developed, were less segregated than inland municipalities.

The within-suburb component was the main and increasingly important contributor to municipal migrant segregation during the period 2000–2010; its increase offset the majority of the decline from the between-centre-suburb component, and contributed to the overall increase of municipal migrant segregation (Fig. 2, Right). These findings apply to all municipalities as a whole and to the four separate municipality groups; here we focus on illustrating the former. The within-suburb component contributed to slightly more than half (51.3%) of average municipal migrant segregation in 2010; the share was 43.8% in 2000, also the highest among the three segregation components. It thus increased by 7.5% during 2000–2010. In contrast, the between-centre-suburb component decreased by 9.4% during 2000–2010, and its average contribution proportion was only 21.5% in 2010. This again indicates that suburban development helps to decrease the difference in population composition by hukou status between the suburb and city centre. The city centre also became increasingly segregated in the first decade of the twenty-first century, but in a more gradual and moderate manner. The average share of the within-centre segregation component was 27.1% in 2010 and 25.3% in 2000, with an increase of 1.8%.

The relationships between economic development and the three segregation components also provide some interesting findings. First, the within-suburb component decreased relatively linearly along with economic development. The contrast between the least developed and most developed municipalities was most obvious, with a significantly lower within-suburb component for the latter. Second, the contribution proportion of the within-centre component decreased along with the economic development level, but increased again in the most developed municipalities. The large share of the within-centre
component in the most developed municipalities might be due to strong exclusionary urban redevelopment processes in their centres. Third, the between-centre-suburb component increased when the economic development level increased, but decreased for the most developed municipalities.

Understanding municipal migrant segregation and its geographical structure

To what extent can we understand municipal migrant segregation through employment, housing, demographic and economic indicators? Table 2 shows some outcomes. The baseline model shows that the most developed municipalities have a significantly lower level of segregation compared with the least developed municipalities ($b = -0.042$ in Model 1a). This difference disappears in the full model.

The full model indicates that municipalities with higher proportions of low-end service and manufacturing employment ($b = -0.167$ in Model 1b) are associated with significantly lower municipal migrant segregation levels, as expected. This effect seems to be largely caused, as we will describe in the segregation component models, by a more balanced landscape between the city centre and suburb, despite a more segregated city centre. As expected, higher proportions of rental housing at the municipal level are also related to significantly lower municipal migrant segregation levels ($b = -0.129$ in Model 1b).

Municipalities with higher proportions of low-end service and manufacturing employment in their suburbs tended to have higher municipal migrant segregation levels ($b = 0.048$ in Model 1b). The key to understand this unexpected result lies in the fact that higher proportions of low-end services and manufacturing employment in the suburb generally occur in smaller and less developed municipalities, rather than in larger and more developed municipalities, measured by their per capita GDP (Fig. 4). The less developed municipalities, most often also smaller in terms of population and economic volume, tend to have a small city centre and a simple economic structure and relatedly a simpler suburban development and suburbanization process. However, their suburbs nonetheless tend to be associated with spontaneous and concentrated investments. This leads to concentrations of migrants and higher levels of segregation in these suburbs on the one hand, and to a more uneven and polarising between-centre-suburb landscape due to limited resources in these municipalities on the other.

| Table 2 b-coefficients of multivariate analysis on municipal migrant segregation levels |
|-----------------------------------------------|-------------------------------|
| Variables                                      | Model 1a | Model 1b |
| Year (Ref = 2000)                              | 0.006    | 0.019***|
| Municipality types (Ref = least developed municipalities) |         |         |
| Less developed municipalities                  | -0.008   | 0.002   |
| Developed municipalities                       | -0.009   | 0.010   |
| Most developed municipalities                  | -0.042***| -0.001  |
| Proportion in the whole municipality (%)       |          |         |
| Manufacturing and service-related employment   | -0.167***|         |
| Rental housing                                 | -0.129** |
| Share of suburb in the municipality (%)        |          |         |
| Manufacturing and service-related employment   | 0.048*   |         |
| Rental housing                                 | -0.080***|         |
| Per capita FDI                                 | -0.081   |         |
| Log value of the total population of the municipality | 0.029*** |         |
| Share of migrants in the municipality (%)      |          | 0.130** |
| Region (Ref = eastern costal region)           |          |         |
| Centre region                                  | 0.020*** |
| Western region                                 | 0.005    |         |
| Constant                                       | 0.177*** | -0.243***|
| Observations                                   | 516      | 507     |

The command GLM in STATA was used. The interpretation of the coefficients was as in regular OLS (Ordinary Least Squares) models. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$
Fig. 4 Shares in the suburb per employment category and per municipality group by per capita GDP in 2010 (left) and changes during 2000–2010 (right). Sources Censuses of 2000 and 2010 at the district level

Table 3 Average marginal effects of the multivariate analysis modelling the share of the three segregation components to municipal migrant segregation levels

<table>
<thead>
<tr>
<th>Variables</th>
<th>The share of between-centre-suburb component</th>
<th>The share of within-centre component</th>
<th>The share of within-suburb component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2a</td>
<td>2b</td>
<td>3a</td>
</tr>
<tr>
<td>Year (Ref = 2000)</td>
<td>−0.094***</td>
<td>−0.080***</td>
<td>0.017</td>
</tr>
<tr>
<td>Municipality types (Ref = least developed municipali-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ties)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less developed municipalities</td>
<td>0.091***</td>
<td>0.063**</td>
<td>−0.051*</td>
</tr>
<tr>
<td>Developed municipalities</td>
<td>0.126***</td>
<td>0.091***</td>
<td>−0.078***</td>
</tr>
<tr>
<td>Most developed municipalities</td>
<td>0.060**</td>
<td>0.05</td>
<td>−0.006</td>
</tr>
<tr>
<td>Proportion in the municipality (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing and service-related employment</td>
<td>−0.200*</td>
<td>0.236***</td>
<td></td>
</tr>
<tr>
<td>Rental housing</td>
<td>0.214</td>
<td>0.073</td>
<td></td>
</tr>
<tr>
<td>Share of suburb in the municipality (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing and service-related employment</td>
<td>0.346***</td>
<td>−0.459***</td>
<td></td>
</tr>
<tr>
<td>Rental housing</td>
<td>−0.602***</td>
<td>0.038</td>
<td></td>
</tr>
<tr>
<td>Municipal segregation levels</td>
<td>0.789***</td>
<td>−0.114</td>
<td></td>
</tr>
<tr>
<td>Log value of the total population of the municipality</td>
<td>−0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of migrants in the municipality (%)</td>
<td>−0.028</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log value of the total population of the centre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of migrants in the centre (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of self-built houses in the centre (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log value of the total population of the suburb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of migrants in the suburb (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>516</td>
<td>516</td>
<td>516</td>
</tr>
</tbody>
</table>

To model the proportional dependent variables, the models were first run using “glm, link(logit) family(binomial) vce(robust)” in _stata_; afterwards, the command “margins, dydx” was utilised to obtain the average marginal effects reported in the table. They should be interpreted as the coefficients in regular OLS regression models. ***p < 0.001, **p < 0.01, *p < 0.05
Our component models which we will describe later support these findings.

The results also support the hypothesis that larger populations \( (b = 0.029 \text{ in Model 1b}) \) and higher shares of migrants \( (b = 0.130 \text{ in Model 1b}) \) at the municipal level were both related to higher levels of municipal migrant segregation. Municipalities in the centre region showed significantly higher migrant segregation levels compared to their eastern coastal counterparts \( (b = 0.020 \text{ in Model 1b}; \text{ also see Fig. 3}) \).

The average marginal effects of the three proportional models are reported in Table 3. The results confirm the descriptive analysis that the overall increase in municipal migrant segregation masks the countervailing dynamics in the constituent segregation components during 2000–2010. The share of the between-centre-suburb segregation component significantly decreased \( (b = −0.094 \text{ in Model 2a}) \), while that of the within-suburb segregation component increased \( (b = 0.077 \text{ in Model 4a}) \). The results also support the descriptive relationships between economic development and the shares of the three segregation components. For instance, the between-centre-suburb segregation share of the less developed municipalities was on average higher than the least developed municipalities, by 9.1%; the magnitude of difference increased to 12.6% for the developed municipalities but decreased to 6% for the most developed (Model 2a).

Municipalities with higher proportions of low-end service and manufacturing employment tended to have more balanced between-centre-suburb segregation landscapes \( (b = −0.200 \text{ in Model 2b}) \) and a more segregated centre \( (b = 0.236 \text{ in Model 3b}) \). Municipalities at a more advanced stage tended to have stronger spillovers from the centre to the suburb, but also stronger exclusionary urban redevelopment in the centre. As also stated above, municipalities with higher shares of employment and housing opportunities in the suburb in relation to the whole municipalities, usually those smaller and less developed municipalities, tended to have more polarising segregation landscapes between the suburb and centre \( (b = 0.346 \text{ in Model 2b}) \) and more segregated suburbs \( (b = 0.326 \text{ in Model 4b}) \). A higher share of rental housing in the suburb was also related to a higher within-suburb component proportion \( (b = 0.367 \text{ in Model 4b}) \). The establishment of suburban rental housing seemed to be concomitant with the re-concentration and uneven distribution of rental housing in the suburb. Other control variables also provided some interesting results. Higher shares of self-built housing in the centre were related to higher shares of within-centre segregation \( (b = 0.396 \text{ in Model 3b}) \). Municipalities with higher segregation levels at the municipal scale also tended to have a higher share of the between-centre-suburb segregation component \( (b = 0.789 \text{ in Model 2b}) \), but a small share of the within-suburb segregation component \( (b = −0.577 \text{ in Model 4b}) \).

### Conclusion and discussion

This paper focused on a description, decomposition and understanding of migrant segregation at the municipal scale in China. We used the 2000 and 2010 Census data for 258 municipalities. Theil’s H index was deployed to disaggregate municipal migrant segregation into between-centre-suburb, within-centre and within-suburb components. The within-suburb component was found to be the major and growing source of municipal migrant segregation during 2000–2010. Its increase offset the majority of the decline in the between-centre-suburb segregation component, and contributed to the overall increase in municipal migrant segregation during the given period. The within-centre component of migrant segregation between municipalities also increased, but more moderately. More developed municipalities tended to have a lower level of segregation between migrants and local people; especially, the migrant segregation levels in the most developed municipalities were significantly lower than the least developed municipalities. Multivariate analysis supports the finding that along with the hukous diversification of the suburb once dominated by local people, the segregation between migrants and locals persisted and was increasing in the suburbs. It also shows that less developed municipalities tended to have higher levels of suburban employment and housing opportunities, but feature more segregated suburban spaces and polarised distribution of migrants between the centre and suburb.

This study has taken a structural approach in understanding the shifting geographies of residential segregation by hukou status in China. The geographies of segregation between migrants and locals are redrawn along with processes of urban redevelopment...
and suburban development. As the suburb absorbs increasingly more migrants, residential segregations within the city centre and within the suburb are both becoming more important in explaining segregation at the municipality scale. This concurs with literature showing how processes of urban redevelopment and suburban development contribute to exclusion and segregation (He & Wu, 2007; Wu & Phelps, 2011). This also involves processes of suburbanization of poverty, direct displacement, and indirect exclusion through high housing price in the city centre (Boterman & van Gent, 2014; Hochstenbach & Musterd, 2017). Although the welfare regime is not directly addressed in this study, it is in general weak in moderating the spatial exclusion towards migrants. Domestic migrants in China are mainly incorporated into the production equation as a low-cost labour force that does not burden the state.

By focusing on migrant segregation and its shifting geographies in China, this study speaks to theories of global suburbanism. Scholars have been searching for narratives, vocabularies and discourses to describe the suburbanization process in the Global South (Wu, 2020). Thus far, state-led, post-suburbia (Wu & Phelps, 2011), displacement and dispossession (Wu, 2020) and heterogeneity (Li et al., 2019; Shen & Wu, 2013) have been among them. This research adds ‘exclusion’ and ‘segregation’ to this search. It has done so through incorporating a wide range of municipalities and through empirically verifying that suburbs were and remained the main source of segregation at the municipality scale. This is connected with the fact that suburban development in China is mainly a state-led process to capitalize on land and capital accumulation (Shen & Wu, 2017). The suburban space is framed based on an economy logic rather than equality and integration. Moving to the suburb does not imply upward social mobility or realizing residential aspirations like in the Western context. Rather, it is mostly associated with dispossession, more affordable housing as well as low-end job opportunities in the suburb. Research has shown suburbs in China mostly take a form of ‘post-suburbia’ (Wu & Phelps, 2011) and heterogeneous in its functions, residential landscapes and population groups (Li et al., 2019; Shen & Wu, 2013). This heterogeneity is nonetheless associated with concentration and segregation. Moreover, suburban development in China happened in almost all cities, regardless of their economic development levels (Liu et al., 2012); smaller and less developed cities have even higher suburbanization levels in manufacturing, low-end services jobs and rental housing opportunities as shown in our study. These differentiated dynamics of Chinese versus ‘Western’ suburbia and among Chinese suburbia in different municipalities also support the necessity of a more nuanced understanding of the nature and meaning of the suburbia and suburbanization processes in the Global South (Wu & Keil, 2020).

This study shows that less economically developed municipalities, defined by per capita GDP, tend to be more segregated by hukou status than their more developed counterparts in China. This finding seems to contradict existing studies that state that the larger metropolises, such as New York and London, are more segregated than smaller ones (Sassen, 2001). As shown in the empirical analysis part, our finding is due to the fact that relatively less developed municipalities tend to have a more segregated landscape between the suburb and city centre and a more segregated landscape within the suburb. These patterns and dynamics are connected with the facts that economically less developed municipalities have a comparatively smaller package of resources, a weaker spill-over from the city centre to the suburb, and a concentrated but fragmented development in the suburb. Migrants in economically less developed municipalities thus are comparatively more likely to be residentially concentrated but fragmented, than those in relatively more developed ones. This negative relationship between economic development level and migrant segregation should be understood contextually in an industrializing and urbanizing Chinese context: segregation between migrants and local people within a Chinese municipality involves both rural and urban dynamics, a different political economy of the suburb as shown above, and concerns migrants mainly orienting towards where jobs are. In contrast, advanced capitalist cities are mostly highly urbanized and industrialized. Segregation of immigrants mainly involves an urban context, historically segregated city centres and mature and homogenous suburbs (although becoming increasingly segregated) (Farrell, 2016). In more developed cities, immigrants contrast more sharply with other highly educated and highly skilled people. This implies that the social spatial outcomes depend on the contextualized interactions
between the local and national developmental stage, industrial structure and historical social spatial landscapes (Musterd et al., 2017). This also shows that small and less developed municipalities present different social-spatial dynamics, processes and outcomes than their more developed counterparts. It thus also answers the call for research on smaller and less developed cities (Bell & Jayne, 2009; Peck, 2015).

Our research has social and political implications. As suburbs have increasingly become the main source of segregation at the municipality scale, these suburbs should be taken as the main focus of de-segregation policies. Our study also has some limitations. We should be cautious about interpreting and generalizing the results to other contexts because of the sub-district scale we applied. Studies using finer spatial scales are required to test the assumptions and conclusions we presented here. Our study is an explorative one, and we had to base our findings on the available (census) data. More research is therefore needed before we can reach a higher level of understanding of how suburbanisation processes play out in shaping social stratification, and which dimensions are driving variations in segregation levels between more and less developed cities in China.

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Declarations

Conflict of interest The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Appendix 1

The national segregation level between migrants and local people by H entropy index is calculated as below.

\[ H = H_R + \sum_{p \in P} \frac{T_p E_R}{TE} H_p + \sum_{m \in M} \frac{T_p E_p}{TE} H_M \\
+ \sum_{c \in C} \frac{T_C E_C}{TE} H_{CS} + \sum_{sd \in S} \frac{T_S E_S}{TE} H_{sd} \]

The national segregation level is decomposed into six segregation components, represented by the six items in the equation sequentially. They correspond to the between-region, between-province, between-municipality, between-centre-suburb, within-centre and within-suburb segregation components in Fig. 1. \( H_R \) indicates the H index value between regions in China, \( H_p \) between provinces within each region, \( H_M \) between municipalities within each province, \( H_{CS} \) between the city centre and suburb within each municipality, \( H_{sd} \) between sub-districts within each city centre (when \( sdeC \)) or between sub-districts within each suburb (when \( sdeS \)). Each segregation component comprises an H entropy value weighted by the relative population size and the relative diversities of the immediate scale they are in to the national scale. For instance, each between-province H index value (\( H_p \)) is weighted by the relative population size of the region these provinces are in (\( T_p/TE \)), as well as the relative diversity entropy (\( E_p/TE \)). The national index values add up to represent the between-province segregation component.

References


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