A childless urban renaissance? Age-selective patterns of population change in North American and German Metropolitan areas

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ABSTRACT
Since the 1980s and 1990s, many metropolitan areas in North America and Europe have registered population growth within the urban core, driven primarily by younger, better-educated and higher-income people—a phenomenon often referred to as ‘urban renaissance’ or ‘re-urbanization’. To date, the research on this topic has primarily focused on the socio-spatial implications, especially with the type and intensity of displacement pressures affecting low-income households. Demographic manifestations of this have rarely been explicitly targeted by empirical studies. This paper addresses the change of intra-regional age structures in metro areas that have witnessed a demographic revival of their core areas. It hypothesizes that an increasing segregation by age is a universal pattern of urban demographic change in advanced Western countries. With data for six German and US metro areas over a period of 20 years (1990–2010), strong evidence for this proposition was found: in all regions, the urban core became ‘younger’ over time, whereas the ageing of the population was more dynamic in suburban areas. However, the analysis also revealed transatlantic differences: whereas a kind of ‘childless’ urban renaissance can be posited for the American cities, families in Germany were at least partially involved in the process of densification of inner-city areas. The analysis provides evidence for a general trend towards re-urbanization and age segregation in regions of both countries. At the same time, re-urbanization is assessed as a strongly context-dependent development with distinctly varying socio-spatial characteristics.

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INTRODUCTION
‘Do cities need kids?’—in the February 2015 issue of Governing Magazine, Alan Greenblatt used this provocative title for his article on gentrification in Seattle, Washington. According to him, Seattle is ‘not necessarily a place that is welcoming to families’ (Greenblatt, 2015, p. 1). The population of downtown Seattle has grown significantly in recent years, and families have indeed taken

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part in this trend, but they tend not to remain for very long as their first child grows up. The main
reason for this is the drastic shortage of affordable dwellings that meet the demands of low- or
middle-income families. The age-selective migration out of cities such as Seattle manifests itself
in a perceivable spatial separation of various age groups across the urban region. ‘The result is that
Americans, already used to segregation by income and race, are seeing another type of geographic
separation, with people living apart according to their stages of life’ (Greenblatt, 2015, p. 1).

In some ways, Seattle seems to be everywhere. Since the 1980s and 1990s, many cities in
advanced capitalist societies have registered population growth within their urban core, driven
primarily by younger, better-educated and higher-income people (Birch, 2005; Bromley, Tallon
& Roberts, 2007; Florida, 2013; Haase et al., 2010; Juday, 2015; Moos, 2015; Van Criekingen,
2010). These contemporary forms of demographic and socio-spatial transformation, which are
often referred to as ‘urban renaissance’ or ‘re-urbanization’ or ‘urban resurgence’ – in the following
we only use the term ‘re-urbanization’ – have been both welcomed and critically reflected by urban
scholars. They stand in sharp contrast to patterns of suburbanization and the related emptying
of urban cores, especially during the 1970s. However, in the affected cities, this process is often
accompanied by fierce political controversies surrounding the displacement of lower-income
households and the responsibilities for policy-makers at both state and local levels.

As early as the beginning of the 1980s – initially in North America, then in Europe – the first
hints emerged that the deep economic and demographic crises in large cities might only be an
intermediary phase within a more comprehensive post-Fordist restructuring. Following years of
decline, a rise in populations of many core and inner cities has been documented, accompanied by
dynamic socio-spatial changes (Bourne, 1992; Cheshire, 1995; Frey, 1988; Smith, 1979). While in
the 1980s, re-urbanization was a strongly selective phenomenon that could only be observed in
relatively few, economically dynamic metropolises and – within these – only in a relatively small
number of neighbourhoods, numerous contemporary studies have shown that renewed (and,
in some cases, sustained) population growth could be generated during the 1990s and 2000s in
a wide range of cities in both North America and Europe (Birch, 2005; Herfert & Osterhage,
2012; Juday, 2015; Kabisch, Haase, & Haase, 2012a; Rae, 2013; Turok & Mykhnenko, 2008).

To date, the research on this topic has primarily focused on the socio-spatial implications,
especially with the type and intensity of displacement pressures affecting low-income households
(for an overview, see Atkinson, 2004; see also Beauregard, 1990; Lees, Slater, & Wyly, 2008; Ley,
1996). Demographic manifestations of this have also been targeted by empirical studies, but to a
lesser extent. The relatively few studies referring to this suggest that convergent trends in North
America and Europe are taking place, especially with a view of the demographic composition
of the in-migrating population of central urban areas (Buzar, Hall, & Ogden, 2007a; Growe &
Münter, 2010; Haase et al., 2010; Holm, 2012; Hyra, 2015; Juday, 2015; Nathan & Urwin, 2005).
In a recent study on population change in inner-city districts in Montreal, Toronto and Vancouver,
Moos (2015) introduced the term ‘youthification’, based on the observation of strong growth in
the share of young adults during the last two decades. Youthification, according to Moos, is less of
an economically mediated, class-based process than gentrification, and is instead driven more by
demographics and lifestyles. In European studies, similar trends of a forced invasion of younger
individuals in the centres of large urban regions have been observed (Bromley, Tallon, & Roberts,
2007; Chatterton, 1999; Simons & Weiden, 2016).

The demographic change of inner-city areas could be seen as an integral part of an increasing
age-based segregation at metropolitan and regional levels. The rejuvenation (or ‘young-ing’ accord-
ing to the Brookings Institution, 2010, p. 83) in inner-city areas stands in contrast to the trends
of ageing (‘greying’) in suburbia (Bundesministerium für Verkehr, Bau und Stadtentwicklung
(BMVBS), 2013; Nelson, 2013). The historical significance of this development becomes especially
clear when recalling the results of older research on age-related segregation. Until the 1980s,
these studies came to the conclusion in both European and North American urban regions that
age-based segregation is driven by the centrifugal migration of younger individuals (Cowgill, 1978; Lagory, Ward, & Juravich, 1980; Schütz, 1982; Smith & Hiltner, 1975). Therefore, one must consider the reversal of demographic structures with concentrations of younger people in central locations, which is now being discussed in many North American and European urban regions – at least since the end of the Second World War – as a new and comparatively young phenomenon. However, few studies have empirically explored the effects of re-urbanization and gentrification on particular age groups and the changes in the age structure of affected areas (Henig, 1981; Singelakis, 1990).

In sum, it can be observed that similar demographic trends in urban core areas are being observed in North America and Europe, which are referred to here as re-urbanization and are manifested, among others, in the form of population growth and a concentration of younger people in inner-city areas. However, it is unclear whether or to which degree common causation patterns can be assumed. For the present paper, we assume hypothetically that inner-city areas have become more important to younger individuals as a place to live due to macro-scale economic and social changes. At the same time, it can be assumed that – in the face of significant demographic, institutional or socio-structural differences between both continents – patterns of re-urbanization manifest themselves in a locally and regionally deviant, context-dependent way. Against this backdrop, it is the objective of this study to review the hypothesis of convergent processes in age-selective population change patterns in the core areas of urban regions using the example of German and American metropolitan areas over a period of 20 years (1990–2010). We consider processes of an age-based ‘segregation’ as the increased spatial separation of people of different age groups across the metropolitan area. As shown above, the most relevant group referring to re-urbanization seems to be the 18–29-year-olds. Therefore, we focused on the 18–24-year-olds as potential education migrants and on 25–29-year-olds as young professionals. A third relevant age group is comprised of 0–17-year-olds, since the evaluation of the changes in this population can lead to conclusions on the residential location choices of families. We are especially interested in the core–periphery structure in this regard. Thus, the primary intention of this study is not to address population change patterns at the neighbourhood level.

Based on the literature, we assume three forms of transatlantic convergence regarding the intra-regional patterns of population change:

- growing population numbers in inner-city areas;
- growing numbers and shares of young adults (aged from 18 to 29 years) within the entire population of these areas; and
- a temporally increasing overrepresentation of younger individuals in inner urban areas and corresponding increases in age-related segregation at the urban–regional level.

We understand our research strategy as ‘differentiating’ according to which comparative research attempts to identify differences regarding the characteristics of a phenomenon that can be observed across different spaces (Pickvance, 2005). Therefore, our aim is to analyze variations in the character or intensity of the study object by systematically exploring differences between the cases. Following the ‘most-different-systems’ design of comparative research, we have selected from a group of regions in which the studied phenomenon can be encountered and that simultaneously display heterogeneity in significant, independent variables. German and American regions, therefore, appear to be suitable for such a comparison, since re-urbanization is evident as a transatlantic pattern, but stark differences have been put forward in significant contextual conditions such as demographic development, housing markets, the setting of the urban structures and the urban planning framework.

The paper is structured as follows. The next section first discusses the possible causes of re-urbanization and developments in age segregation before the paper substantiates the selection of case studies and explains the data concept. This is followed by the presentation of the empirical
findings from a total of six urban regions in both countries. The last section then discusses the transatlantic convergence of the observed development patterns.

**FACTORS BEHIND RE-URBANIZATION AND DEVELOPMENTS IN AGE-BASED SEGREGATION**

For the purposes of this paper, we define re-urbanization as population growth in urban cores that follows a prolonged phase of population decline and is typically (but not necessarily) accompanied by economic, social and physical change. As mentioned in the introduction, the scientific debate surrounding the phenomena of socio-spatial change in inner-city areas – primarily centred upon gentrification – has existed since the 1970s. In view of new empirical findings, however, more than a few voices have questioned whether the understanding of gentrification that underlies most studies – defined as an invasion of middle-class households in previously ‘lower-status’ inner-city residential neighbourhoods – satisfies the multidimensionality and diversity of recent developments (e.g., Buzar et al., 2007a). We share this scepticism and tie this to a number of factors.

First, re-urbanization – in contrast to gentrification – does not just address social change in the impacted neighbourhoods, but rather a process of demographic growth that encompasses a broader social spectrum of contributing households (Buzar et al., 2007a, 2007b; Chatterton, 1999; Deas & Hincks, 2014; Fishman, 2005; Haase et al., 2010; Karsten, 2003; Lilius, 2014; Rérat, 2011; Van Criekingen, 2010).

Second, re-urbanization cannot be understood as a spatially limited process that is confined to a comparatively small number of inner-city neighbourhoods and can only be observed in large metropolises with a dynamic service sector and an existing built stock from the pre-war period. Numerous empirical studies have pointed to a large number of cities in which inner-city population growth occurred following an often-prolonged period of population decline (Buzar et al., 2007b; Herfert & Osterhage, 2012; Kabisch & Haase, 2010; Turok & Mykhnenko, 2008). Astonishingly, these cities also include cases that do not align well with ‘typical’ expectations on gentrification processes (a high built density and built stocks from the pre-war period), such as Los Angeles (Mulherin & Howell, 2012) or Atlanta and Houston (Sohmer & Lang, 2001).

Third, we see re-urbanization as being conceptually more open to novel architectural and physical manifestations of inner-city population development than what is permitted by the classical understanding of gentrification. In addition to the upgrading of established inner-city neighbourhoods, re-urbanization is increasingly taking on the form of new residential development on land that had not yet been used for residential purposes (cf. the debate on ‘residentialization’ in Buzar et al., 2007a). This is accompanied by partially novel built typologies (cf. the debate on ‘Vancouverism’ in Kataoka, 2009; or ‘condofication’ in Lehrer & Wieditz, 2009). In the affected urban areas, this often manifests itself as increasing population density, which stands in certain contrast to traditional forms of gentrification that are usually accompanied by a decline in densities in older neighbourhoods (Moos, 2015). We do not deny that the processes of inner-city densification described here might (and in many cases also do!) go alongside social gentrification and the displacement of poorer households into neighbouring areas, but wish not to be confined to this issue. However, gentrification – at least in its traditional understanding – might be too narrow to capture the variegated nature of demographic processes and the related change of built-up structure in cities and urban regions (Buzar et al., 2007b).

While the evidence for re-urbanization is largely undisputed, its causal background is a topic of contention. Re-urbanization is usually understood as a complex restructuring process in metropolitan areas which is driven by macro-scale economic and social changes. In this way, possible driving forces behind this development include changes in the economy and job market in post-Fordist societies, demographic change, changes in lifestyle and consumer behaviour or public- and private-sector investments in the revitalization of inner-city housing estates. However,
empirical evidence, justified expectations and normative impetus often enter into a relationship that is not easy to disentangle.

In view of the processes of age-based segregation that are central to this study, it is reasonable first to search for explanations for re-urbanization in residential migration patterns that differ according to life cycle and life course (Clark & Dielemann, 1996; Estiri, Krause, & Heris, 2015). Numerous studies considered residential mobility as an expression of the changing demographic and economic characteristics of a household from establishment to dissolution (Clark & Huang, 2003; Clark & Onaka, 1983). In this vein, decisions to relocate are adaptive reactions to a household’s changing needs and opportunities in various phases of life. Empirical studies have been able to demonstrate close statistical correlations between phase transitions and migration rates, residential forms as well as locational decision-making processes (Clark, 2012; Clark & Huang, 2003; Estiri et al., 2015), and age is still considered to be an appropriate proxy for various household phases and phase transitions (Clark, 2012; Estiri et al., 2015). In this way, age groups display marked differences in their migration frequency, consumption of living space and choice of location (Benetsky, Burd, & Rapino, 2015; Clark, 2012; Gatzweiler & Schlömer, 2008).

Life-cycle concepts offer a plausible means of explaining the irregular distribution of age groups in urban areas. In this way, the migration of students into larger cities in which a higher concentration of educational facilities exists as well as younger individuals’ greater appreciation of the cultural and consumptive services that larger cities offer provide possible explanations for the overrepresentation of ‘twentysomethings’ in inner-city areas. Following this line of argument, the size of particular cohorts has a substantial influence on the dynamics and direction of intraregional population movements (Myers & Pitkin, 2009).

However, life-cycle concepts have not been able to provide insight into the background of increasing overrepresentation over time. If this is the case – and that is the central assumption of this study – structural and behavioural effects must play a role that is attributable either to individual shifts in preference or to structural developments in the property (real estate) markets such as changes in price or supply. Previous studies on this issue can be classified into two (strongly simplified) groups (Hamnett, 1991). On the one hand are approaches that primarily explain re-urbanization by means of supply factors. These studies see essential causes in the valorization and capital exploitation interests of municipal land and real estate market actors. The driver of re-urbanization in this case is the expansion of the real estate supply for a particular spectrum of consumers, which can at least partially be attributed to an active public policy of improving inner-city areas (Colomb, 2007; Lees, 2008). On the other hand are studies that regard the phenomenon as an expression of the quantitative increase in the significance of particular social groups as well as a change in locational preferences. A correspondingly influential approach emphasizes the consumptive preferences of particular socio-demographic groups and their specific locational needs (Florida, 2002; Glaeser & Gottlieb, 2006; Storper & Manville, 2006). Rising wages, a differentiation of lifestyles and the expansion of knowledge-intensive service jobs have created a more strongly represented group of consumers for urban living (Hamnett, 1991). Metropolises – following this line of argument – can fulfil this demand with a broad range of consumption and cultural amenities as well as a tolerant and creative atmosphere (Florida, 2013; Lilius, 2014). According to this argument, especially (but not only) highly qualified professionals would prefer to live in urban locations with a high centrality and low costs to access urban infrastructural and cultural amenities.

Other sociodemographic explanations make references to the differentiation of household and lifestyle types related to the second demographic transition. Here, a special emphasis is placed on the erosion of the traditional family and the increase in significance of smaller household types (Buzar et al., 2007b; Kabisch, Steinführer, & Haase, 2012b; Ogden & Hall, 2000). It is assumed that particular demographic groups that are gaining in quantitative significance, such as childless households, empty-nesters or single-parent households, tend to prefer central living (Florida,
The increasing absolute size of these groups is, according to this view, partially responsible for the population dynamics in urban cores and inner cities.

In sum, it is important to note that the new appeal of inner-city areas to a broad spectrum of households – but in particular to younger individuals – is a common characteristic of both American and European urban-development trajectories. However, the explanation for these developments is blurred by a confusing array of approaches that make use of structural and behavioural theory and selectively target economic, sociodemographic, cultural or political factors. The present study cannot claim to provide a thorough clarification of this. With its analysis of developments in the age structures of urban regions in the United States and Germany, however, it aims to evaluate their convergence, which will allow for preliminary conclusions on the relevance of universal as well as context- and path-dependent explanatory frameworks.

**SELECTION OF THE CASE-STUDY REGIONS**

The present study stretches across three German and three American regions: Frankfurt/Main, Munich and Stuttgart as well as Boston, Massachusetts, Philadelphia, Pennsylvania, and Portland, Oregon. This selection was guided by comparability principles with regards to the fundamental research dimensions as well as principles of heterogeneity. In all cases, the study focused on large metropolitan areas within a relatively closely defined range of population size as well as spaces in which the phenomenon of re-urbanization – albeit in different ways – could be found. As mentioned in the introduction, the selection of regions according to the most-different-systems design should simultaneously represent a bandwidth of specific contextual conditions (see Table 1 for details).

All selected US and German regions have recently experienced population growth (Table 2) in the urban core and developments in the downtown areas were striking in all cases (Birch, 2005). Philadelphia, Boston and Portland registered an increase of population between 10,000 and 16,000 people in their inner cities between 1990 and 2010. In the three German cities, the demographic revival of central areas began later, but with a not-less-impressive intensity. Munich realized a population increase of about 12,000 people in its inner city in just a decade (2000–10); Stuttgart’s downtown saw a growth of 14,000 dwellers between 2005 and 2015 (Brombach et al., 2018) and Frankfurt’s inner-city boroughs are expected to grow by up to 20% until 2040 (Dobroschke & Gebhardt, 2015).

At the same time, the regions strongly differ in terms of relevant contextual conditions. Boston, Philadelphia and Portland differ in their economic trajectories (a relatively robust, high-performing Boston and Portland economy versus a still-recovering Philadelphia region), built structures and urban form (Boston and Philadelphia with a dense urban core and a large stock of pre-war multi-family housing versus a much less-dense urban core in the Portland metro area), as well as the land-use governance and growth-management regimes (Portland with its restrictive regional growth-management approach versus rather laisser-faire regimes of growth control in the Boston and Philadelphia regions; e.g., Pendall, Puentes, & Martin, 2006). Frankfurt, Munich and Stuttgart demonstrate stark contrasts in their economic trajectories and (regional) planning approaches. Whereas Frankfurt and Munich stand out for their dynamic service sector industries, Stuttgart’s economy is still characterized by a strong manufacturing sector. Stuttgart is also well known for its restrictive regional planning regime. In contrast, the metropolitan area of Munich belongs to those German regions that do not have established effective regional approaches of controlling urban growth (Greiving, Dappen, Schlegelmilch, & Selk, 2012).

Therefore, the selection was guided by the question of why particular phenomena – of re-urbanization and age segregation – emerged in all regions under consideration despite differential framework conditions, and how these phenomena developed in the respective areas.
Table 1. Key indicators for study regions (50-km ring zone).

|                               | Boston, MA | Philadelphia, PA | Portland, OR | Frankfurt | Munich | Stuttgart |
|-------------------------------|------------|------------------|--------------|-----------|--------|-----------|
| Number of intra-regional statistical units | 842        | 1358             | 411          | 348       | 274    | 468       |
| (census tracts, communities, urban districts) |            |                  |              |           |        |           |
| Land area of 50-km ring zone (km²) | 5926       | 7607             | 7680         | 7523      | 7502   | 7769      |
| Population, 2010 (millions)    | 4.16       | 5.43             | 2.17         | 4.26      | 3.16   | 4.16      |
| Population of the metro area, 2010 (millions)a | 4.55       | 5.97             | 2.23         | 4.18      | 3.07   | 2.19c     |
| Gross domestic product (GDP) per capita in the largest city, 2010 (US$, millions)b | 80,446     | 58,040           | 63,246       | 56,431    | 60,970 | 52,426    |
| Core cities > 150,000 inhabitants | Boston     | Philadelphia     | Portland, Vancouver (WA) | Frankfurt, Mainz, Wiesbaden | Munich | Stuttgart |
| Urban density (inhabitants/hectare urbanized area)d | 16          | 17               | 13           | 48        | 43     | 49        |
| Spatial structure             | Monocentric | Monocentric      | Monocentric/bipolar | Polycentric | Monocentric | Polycentric |
| Growth management at regional scales e | Weak        | Weak             | Strong        | Polycentric | Weak   | Strong    |

aData are from the US Census Bureau and Bundesamt für Bauwesen und Raumordnung (BBR).

bData are from the Organisation for Economic Co-operation and Development (OECD) metropolitan area database.

cExcluding the neighbouring city-region of Sindelfingen.

dUrbanized area was measured with the percentage of impervious surfaces (data are from the National Land Cover Database (US) and European Soil Sealing V2 (DE)).

eAuthors’ own assignment based on Dawkins and Nelson (2003), Nelson et al. (2004) and Pendall et al. (2006).
Table 2. Population change and change in urban density in US and German metro areas, 1990–2000 and 2000–10.

| Region | 0–5 km | 5–10 km | 10–20 km | 20–30 km | 30–40 km | 40–50 km | % Inhabitants/km² | % Inhabitants/km² | % Inhabitants/km² | % Inhabitants/km² | % Inhabitants/km² | % Inhabitants/km² |
|--------|--------|---------|----------|----------|----------|----------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Boston | 1990–2000 | 6.2 | 349.4 | 2.0 | 78.4 | 3.6 | 34.9 | 7.7 | 34.1 | 7.0 | 26.5 | 12.2 | 37.5 | 5.8 | 37.2 |
|        | 2000–10 | 7.6 | 453.1 | 2.4 | 96.5 | 2.3 | 22.9 | 3.1 | 14.8 | 3.4 | 13.9 | 4.4 | 15.2 | 3.4 | 22.9 |
| Philadelphia | 1990–2000 | -5.9 | -421.4 | -5.5 | -204.1 | 0.1 | 1.5 | 6.5 | 42.0 | 12.1 | 43.4 | 9.4 | 24.2 | 3.0 | 20.1 |
|        | 2000–10 | 3.1 | 209.7 | -2.4 | -84.6 | 1.4 | 21.1 | 4.9 | 33.9 | 7.5 | 29.9 | 6.8 | 19.1 | 3.5 | 24.0 |
| Portland | 1990–2000 | 7.0 | 91.5 | 11.8 | 121.7 | 42.7 | 189.0 | 36.1 | 38.4 | 22.1 | 11.2 | 15.9 | 2.0 | 26.7 | 51.5 |
|        | 2000–10 | 10.0 | 139.6 | 9.0 | 103.9 | 19.1 | 121.0 | 21.0 | 30.4 | 14.8 | 9.1 | 12.9 | 1.9 | 15.6 | 38.2 |
| Frankfurt | 1990–2000 | -0.8 | -20.5 | 5.1 | 60.4 | 5.9 | 36.5 | 8.7 | 32.8 | 9.4 | 25.8 | 9.2 | 19.9 | 5.7 | 30.0 |
|        | 2000–10 | 4.1 | 97.6 | 3.7 | 46.8 | 2.3 | 15.1 | 2.0 | 8.3 | -0.5 | -1.6 | -1.0 | -2.4 | 2.2 | 12.2 |
| Munich | 1990–2000 | 8.8 | 641.2 | -3.1 | -67.9 | 12.3 | 56.6 | 14.9 | 24.1 | 15.4 | 22.6 | 12.9 | 18.5 | 8.2 | 29.5 |
|        | 2000–10 | 10.1 | 800.3 | 11.6 | 243.6 | 7.0 | 36.0 | 7.8 | 14.5 | 6.9 | 11.7 | 5.7 | 9.1 | 8.7 | 33.5 |
| Stuttgart | 1990–2000 | -2.6 | -99.7 | 4.3 | 75.6 | 5.0 | 43.4 | 8.0 | 38.4 | 9.2 | 27.4 | 9.2 | 24.9 | 6.5 | 32.0 |
|        | 2000–10 | 2.8 | 105.7 | 5.8 | 106.9 | 2.4 | 22.1 | 2.6 | 13.6 | 0.9 | 2.9 | 0.7 | 2.1 | 2.3 | 12.1 |

Note: Highest values are shown in bold.
SPATIAL REFERENCE, DATA AND METHODS

The empirical analyses discussed in the following were carried out using a ring-zone model, which delineated and internally differentiated the studied regions using rings with a defined radius. Ring-zone models are an established method for analyzing spatial structures and developments; they are especially appropriate for showing core–edge relationships and developmental gradients within urban areas (Estiri et al., 2015; Juday, 2015; Siedentop, Kausch, Einig, Gössel, & Tellkamp, 2003). In our case, the outer ring zone (representing the outer boundary) has a radius of 50 kilometres around a defined regional centre (the city hall of the dominant core city) and the internal structure is defined by ring-zones with a width of 5 km in the inner regional areas and 10 km in the outer areas. The six rings created based on census tracts or municipal boundaries (0–5, 5–10, 10–20, 20–30, 30–40, 40–50) were then aggregated into three spaces of analysis: The ‘core area’ formed the innermost ring zone, with a maximal distance of 5 km from the regional centre. An ‘inner suburban zone’ was comprised of statistical spatial units at a distance of between 5 and 20 km, while the ‘outer suburban zone’ represented spatial units at a distance of at least 20 km.

Thus, equivalent analytical regions were created that were largely circular in form and had approximately the same dimensions. The incorporated area has a good spatial overlap with the outer boundaries of the urban administrative regions (metropolitan statistical areas in the United States; Stadtregionen in Germany). Thus, large parts the of commuter belts are covered by the 50-km radius. In the following sections, the accordingly defined analytical regions are uniformly referred to as ‘metropolitan areas’.

The zonal statistics were supplemented by the calculation of location quotients (LQs) and segregation measures at the level of disaggregated spatial units (census tracts, municipalities and districts). The LQ relates the share of a demographic group (here, age group) within a territorial unit to the share of the same group across the entire region (Estiri et al., 2015). Values > 1.0 indicate a statistical overrepresentation, while those < 1.0 indicate an underrepresentation of the respective group. By using the following formula, the index of segregation measures the spatial (in)equality of an age group (AG) within a metropolitan area. The calculation is based on the share of an age group in relation to the share of all other age groups (NotAG) in a tract (i).

The result – half the sum of all tracts – spreads from 0 to 1, where ‘0’ means a spatial equality of the age group and ‘1’ a complete spatial inequality:

\[
\frac{1}{2} \sum_{i=1}^{N} \left| \frac{AG_i}{AG_{metro}} - \frac{NotAG_i}{NotAG_{metro}} \right|
\]

For the study regions in the United States, data from the company GeoLytics were used covering the results from the census in the years 1990, 2000 and 2010. The data are available in a homogenized form for the territorial boundaries from 2000, which means that the census data from 1990 and 2010 are projected onto the territorial boundaries from 2000. The German data originate from the respective statistical offices of the federal states and represent the results of annual updates on the basis of censuses from 1987. In order to detect intra-city developments in German core cities, the statistical offices of the core cities also provided data at the district level for the respective cities. Like the municipal statistics published by the state offices, this data source is based on annual updates of the census. However, due to different updating methods, population figures published by the state and the municipal offices show slight differences. Nevertheless, there is no alternative to using municipal data sources when small-scaled demographics in larger cities should be analytically addressed.

Note that a comparison of the demographic developments in German and American metro regions is constrained by the limited availability of equivalent data. For instance, data on household structures and household income are not available at disaggregated levels in Germany. On the
other hand, migration data, by which the residential mobility of particular demographic or age groups can be studied according to source and target location, are not available for the United States. We are fully aware of the analytical constraints imposed by using age group instead of household data.

**EMPIRICAL FINDINGS OF THE CASE STUDIES**

Unsurprisingly, a comparison of population developments in American and German metro areas during the 1990s and 2000s reveals marked differences that express the divergent demographic growth pressure in both countries. The calculated ring-zone statistics for the six selected metro areas show that the highest growth rates in the American regions during both decades were overwhelmingly found in the outer suburban zone, which suggests sustained suburbanization (Table 2). In Germany, the focal points of growth during the 1990s were also located a certain distance from the centre. During the 2000s, however, the highest growth rates were achieved within the inner areas of the regions. A process of suburbanization that stretched far into rural areas was therefore supplanted by an intraregional concentration.

When considering the core zones of the study areas, it becomes apparent that population gains could be registered throughout the 2000s (during the 1990s, this was not yet the case in all German regions). In all regions, a significant trend towards re-urbanization in the inner regional areas appears evident. This becomes even clearer when the changes in population within the ring zones are normalized according to land area (change in population/km² of land area). With the exception of Stuttgart, the core zones accounted for the strongest growth in population density over the past decade. Altogether, these figures show that processes of re-urbanization could be encountered in all the regions under consideration.

How did these demographic processes affect the spatial distribution of various age groups? In the analysis of relative population development according to age, it should be kept in mind that calculated rates of change can be attributed not only to migration to and from the spatial units under consideration, but also to transitions between age groups as well as birth and death rates. In this regard, the data reflect demographic structural effects – the ‘through-migration’ of quantitatively differentially represented age cohorts – as well as behavioural patterns that manifest themselves in decisions to move. For this reason, it appears more sensible to consider changes in the shares of particular age groups amongst the entire regional population (as a percentage) instead of percentage changes alone.

When considering the age-related composition of the population in selected areas within the three German and three American regions, similar basic patterns can be encountered. Table 3 compares certain demographic indicators for the 5-km ring zone (core area) and the entire analytic region (50-km radius). It highlights how the population structure in core areas markedly differs from the regional average. Within the 5-km ring zone in all regions, the share of 0–17-year-olds is below average, while the shares of 18–24- as well as 25–29-year-olds are above average. At the same time, our figures show that age segregation in the American regions is clearly more marked than in the German cases. This is especially highlighted by the LQs (Figure 1), which are clearly more strongly differentiated for the three age groups in the American regions under consideration than for the German areas (shown here using the deviation from the value 1.0).

Table 3 further clarifies that age segregation became more pronounced on both sides of the Atlantic between 1990 and 2010. The changes in the shares of the age groups under consideration often deviate strongly from the regional trend, which strengthened the over- or underrepresentation of younger people. In the core areas of all American regions, the shares of residents younger than 18 years dropped, while the shares of 18–24- and 25–29-year-olds grew (one exception for the 18–24-year-olds is Portland); correspondingly, the LQs either shrank (0–17-year-olds) or grew (18–24- and 25–29-year-olds). In the three German regions, the trends in the 18–24- and
### Table 3. Change in demographic patterns in the core area (5-km ring zone) related to the 50-km region, 1990, 2010 and change between 1990 and 2010.

|                | 5-km ring zone | 50-km ring zone | 5-km ring zone | 50-km ring zone |
|----------------|----------------|-----------------|----------------|-----------------|
|                | 1990 | 2010 | 1990–2010 | 1990 | 2010 | 1990–2010 | 1990 | 2010 | 1990–2010 |
| **Boston**     |      |      |          |      |      |          |      |      |          |
| Share of age 0–17 (%) | 16.3 | 13.5 | –2.8    | 21.6 | 21.6 | 0.0      | 14.1 | 14.4 | 0.3     |
| Share of age 18–24 (%) | 19.6 | 21.4 | 1.8     | 12.0 | 10.5 | –1.5    | 9.7  | 8.3  | –1.4    |
| Share of age 25–29 (%) | 13.9 | 14.6 | 0.7     | 9.9  | 7.4  | –2.5    | 10.4 | 9.0  | –1.4    |
| Share of age 30–49 (%) | 29.0 | 28.4 | –0.6    | 30.6 | 28.2 | –2.4    | 30.9 | 33.6 | 2.7     |
| Share of age 50–64 (%) | 10.6 | 13.0 | 2.4     | 13.1 | 19.2 | 6.1     | 17.9 | 17.6 | –0.3    |
| Share of age 65–74 (%) | 6.2  | 4.9  | –1.3    | 7.2  | 6.6  | –0.6    |      |      |          |
| Share of age > 74 (%)* | 4.6  | 4.1  | –0.5    | 5.6  | 6.4  | 0.8     | 17.0 | 17.2 | 0.2     |
| Old age dependency ratio | 0.22 | 0.17 | –0.05   | 0.19 | 0.20 | 0.01    | 0.25 | 0.25 | 0.00    |
| Young age dependency |      |      |          |      |      |          |      |      |          |
| **Philadelphia** |      |      |          |      |      |          |      |      |          |
| Share of age 0–17 (%) | 22.8 | 17.6 | –5.2    | 24.2 | 23.1 | –1.1    | 11.9 | 12.3 | 0.4     |
| Share of age 18–24 (%) | 14.0 | 18.5 | 4.5     | 10.3 | 10.1 | –0.2    | 10.2 | 8.4  | –1.8    |
| Share of age 25–29 (%) | 10.3 | 11.9 | 1.6     | 8.5  | 6.9  | –1.6    | 11.3 | 10.6 | 0.7     |
| Share of age 30–49 (%) | 26.1 | 25.9 | –0.2    | 29.4 | 26.9 | –2.5    | 32.4 | 35.9 | 3.5     |
| Share of age 50–64 (%) | 12.5 | 15.1 | 2.6     | 13.9 | 19.5 | 5.6     | 17.9 | 16.6 | –1.3    |
| Share of age 65–74 (%) | 8.2  | 5.7  | –2.5    | 8.2  | 6.8  | –1.4    |      |      |          |
| Share of age > 74 (%)* | 6.2  | 5.3  | –0.9    | 5.6  | 6.7  | 1.1     | 16.5 | 16.2 | –0.3    |
| Old age dependency ratio | 0.23 | 0.15 | –0.08   | 0.22 | 0.21 | –0.01   | 0.23 | 0.23 | 0.00    |
| Young age dependency |      |      |          |      |      |          |      |      |          |
| **Portland**    |      |      |          |      |      |          |      |      |          |
| Share of age 0–17 (%) | 18.6 | 14.4 | –4.2    | 25.7 | 23.8 | –1.9    | 14.4 | 13.5 | –0.9    |
| Share of age 18–24 (%) | 11.1 | 10.4 | –0.7    | 9.0  | 8.7  | –0.3    | 11.3 | 8.3  | –3.0    |
| Share of age 25–29 (%) | 9.9  | 12.7 | 2.8     | 8.2  | 7.6  | –0.6    | 10.7 | 9.2  | –1.5    |
| Share of age 30–49 (%) | 34.9 | 32.7 | –2.2    | 33.1 | 29.4 | –3.7    | 29.6 | 34.2 | 4.6     |
| Share of age 50–64 (%) | 11.0 | 19.1 | 8.1     | 11.9 | 19.3 | 7.4     | 18.3 | 17.0 | –1.3    |
| Share of age 65–74 (%) | 7.5  | 6.0  | –1.5    | 6.9  | 6.1  | –0.8    | 7.5  | 9.8  | 2.3     |
| Share of age > 74 (%) | 7.0  | 4.7  | –2.3    | 5.2  | 5.1  | –0.1    | 8.4  | 7.9  | –0.5    |
| Old age dependency ratio | 0.22 | 0.14 | –0.08   | 0.19 | 0.17 | –0.02   | 0.23 | 0.26 | 0.03    |
| Young age dependency |      |      |          |      |      |          |      |      |          |

Note: It is not possible to differentiate between the age groups 65–74 and > 74 years in the German region; therefore, this value indicates the age group > 64 years in the German region.
Figure 1. Location quotients (LQs) for different age groups for 1990 and 2010 in core areas (0–5 km).

Note: It is not possible to differentiate between the age groups 65–74 and > 74 years in these regions.
the 25–29-year-olds point in a similar direction: the shares of the age groups did not completely rise over time, but even sank in some cases. In all relevant cases, however, this occurred to a lesser extent than the trend across the entire region. For this reason, the LQs rose altogether (with the exception for the 18–24-year-olds in Stuttgart). On the other hand, for the 0–17-year-olds, the German regions display a divergent trend compared with the American regions. Here, growth (Frankfurt and Munich) or smaller proportional losses than in the entire region (Stuttgart) could be found. Correspondingly, the changes in LQ in the relevant age group are positive.

The empirical analysis conducted here initially shows similar developments in the six case study regions. The core areas experienced significant rejuvenation during the 1990s and 2000s, which can primarily be attributed to gains in migration. Therefore, re-urbanization does not just take place as residential densification in the regional centres, but is also a process of increasing age segregation. In both the American and the German contexts, young adults at an age of higher education (18–24-year-olds) and career starters (25–29-year-olds) are participating demographic groups. At the same time, our findings indicate divergent trends for families with children. While families in the German regions appear to play a role in the population growth of the inner regional areas, a strong negative trend can be discerned for the American regions. This overall picture is further underlined by a strong fall of the young age-dependency rate in the core zones of the American cities, whereas the respective German values remained quite stable during the 1990s and 2000s.

While the period between 1990 and 2010 has been considered until now, a perspective differentiated according to decade offers further insights (Table 4). Here, dynamic age segregation can be observed over time. The rates of change of 18–24- as well as 25–29-year-olds were consistently higher during the 2000s than during the 1990s; the only exception to this is Portland (25–29-year-olds). On the other hand, the negative trends in the number of under 18-year-olds in the American regions amplified over time; in Germany, however, partially positive growth rates (as mentioned above) are observable. Our figures also indicate that the developments in age structure in the core areas display a contrasting trend to the demographic development at regional and national levels.

The spatial characteristics of the demographic trajectories of the six studied regions and their core zones that have been indicated until this point can be displayed in greater detail by means of the LQ and the index of segregation for each age group (Table 5). Our data show a high increase between 1990 and 2010 for the 25–29-years-olds in all cases and also for the 18–24-years-olds, with the exception of Portland. In contrast, the values for all other age groups stagnated or dropped (the only exception was Munich, 30–49-year-olds). Furthermore, either the 18–24- or the 25–29-years-olds represented the highest value in 2010 in all cases (again, with the exception of Munich). Thus, the calculated values underline the above presented findings that there is a growing tendency of segregation of these younger persons within the metro areas. It can also be shown that the values for the US metros are usually higher than those for their German counterparts. However, this is also caused by the different numbers and spatial sizes of the intra-regional statistical units in the selected US and German regions (Dangschat, 2014) (Table 1).

In sum, considerable age segregation processes could be found in the case study regions of both countries during the 1990s and 2000s, and these manifested themselves as rejuvenation in inner regional areas and as ageing in peripheral areas. While re-urbanization in Germany was in part driven by families with children, in American regions, childless households tended to be the protagonists of central city living.

**DISCUSSION**

Our empirical findings show that a residential renaissance of the urban core could be posited for all six regions and processes of re-urbanization became even more dynamic over time. All regions experienced population growth during the 2000s and the decade’s growth rates outperformed the
Table 4. Relative change (%) of selected age groups (years), 1990s and 2000s.

| Region    | Age 0–17 |          |          | Age 18–24 |          |          | Age 25–29 |          |          |
|-----------|----------|----------|----------|-----------|----------|----------|-----------|----------|----------|
|           | Core     | Region   | Nation   | Core      | Region   | Nation   | Core      | Region   | Nation   |
| Boston    | 1990–2000| 3.1      | 13.6     | 13.2      | 3.8      | –18.6    | 1.3       | 0.5      | –21.3    | –9.6     |
|           | 2000–10  | –7.9     | –3.6     | 2.4       | 20.5     | 17.2     | 12.6      | 20.1     | 3.6      | 9.7      |
| Philadelphia | 1990–2000| –7.2     | 7.1      | 13.2      | 0.0      | –10.9    | 1.3       | –19.1    | –23.3    | –9.6     |
|           | 2000–10  | –19.2    | –4.9     | 2.4       | 28.2     | 17.9     | 12.6      | 39.0     | 11.4     | –9.7     |
| Portland  | 1990–2000| –2.9     | 25.8     | 13.2      | 3.5      | 28.8     | 1.3       | 29.5     | 20.0     | –9.6     |
|           | 2000–10  | –5.9     | 8.0      | 2.4       | 6.1      | 9.8      | 12.6      | 16.6     | 13.3     | 9.7      |
| Frankfurt | 1990–2000| 1.0      | 9.6      | 1.0       | –22.9    | –21.9    | –21.1     | –22.3    | –25.8    | –29.6    |
|           | 2000–10  | 3.9      | –4.7     | –13.9     | 14.2     | 6.9      | 3.1       | 15.0     | –0.3     | 0.4      |
| Munich    | 1990–2000| 12.4     | 13.3     | 1.0       | –16.9    | –21.7    | –21.1     | –12.5    | –23.1    | –29.6    |
|           | 2000–10  | 10.5     | 3.6      | –13.9     | 20.0     | 15.4     | 3.1       | 28.7     | 11.0     | 0.4      |
| Stuttgart | 1990–2000| –2.8     | 10.4     | 1.0       | –26.2    | –23.3    | –21.1     | –20.1    | –26.6    | –29.6    |
|           | 2000–10  | –3.2     | –9.2     | –13.9     | 0.4      | 8.2      | 3.1       | 8.6      | –2.8     | 0.4      |
1990–2000 values in all cases. However, re-urbanization in both countries is taking place under strongly contrasting demographic development contexts. Moreover, the geography of re-urbanization reveals striking differences. In the American regions, this appeared as a location-selective process according to which relatively few census tracts displayed very high relative growth rates, which hints at a resettlement of vacant areas or areas that had previously not been used for residential purposes (‘residentialization’). Here, a picture emerges of finely differentiated, intensely disparate development patterns that encompass growth and shrinkage trends within a sometimes close spatial proximity (see also Landis, 2016). In Germany, these developments are spatially more diffuse; here, growth is more evenly distributed across the region’s central areas and the growth rates are comparatively lower.

Regarding age-structure development, however, we could observe rather similar trends. In both countries, demographic rejuvenation within the regional cores could be ascertained and this could only be explained to a very limited degree by cohort effects. We have shown that the rates of change in the age groups of 18–29-year-olds strongly deviate from the trends in the entire region and in part even stand in contrast to national-level demographic developments. In other words: the rejuvenation of inner regional areas was much more apparent than could have been expected based on the cohort size of the relevant age groups under the assumption of constant migratory trends.

Therefore, it can be concluded that structural and behavioural effects must play a role in driving re-urbanization. Plausible explanations hint at the increase in the rates of students within an age cohort as well as at a culturally contingent shift in preferences in favour of urban living. The partially strong construction activity of small apartments in inner-city areas – at least in the US context – might also explain this, since this process has often created the prerequisites for a larger-scale growth of youngsters in the first place.

Our analysis revealed a relevant difference between German and American regions. A kind of ‘childless urban renaissance’ can be posited for the American cities, for which we showed that the representation of children and youth below 18 years of age has continued to decline in the regional core areas (see also Johnson, Winkler, & Rogers, 2013). In contrast, families in Germany were at least partially involved in the process of densification of the cores; this is confirmed by Buzar et al. (2007a) who found evidence that the ‘European style’ of re-urbanization is also driven by families. One possible reason for this lies in the deviant developments of the regional real estate markets in the American and German regions considered here, which offer families with children options for ‘family-friendly’ living to varying degrees. Individual studies hint at inner-city construction activity, which is rather oriented towards childless households (Moos, 2015), while residential construction activity in German metropolises – and especially in the ownership segment – is often

### Table 5. Index of segregation for selected age groups (years), 1990 and 2010.

|        | Age 0–17 | Age 18–24 | Age 25–29 | Age 30–49 | Age 50–64 | Age > 64 |
|--------|----------|-----------|-----------|-----------|-----------|----------|
| Boston | 1990     | 0.14      | 0.19      | 0.16      | 0.08      | 0.12     | 0.17     |
|        | 2010     | 0.14      | 0.28      | 0.25      | 0.07      | 0.11     | 0.15     |
| Philadelphia | 1990 | 0.12      | 0.15      | 0.15      | 0.09      | 0.12     | 0.21     |
|        | 2010     | 0.12      | 0.20      | 0.18      | 0.07      | 0.10     | 0.18     |
| Portland | 1990    | 0.12      | 0.14      | 0.14      | 0.08      | 0.11     | 0.19     |
|        | 2010     | 0.12      | 0.14      | 0.18      | 0.08      | 0.11     | 0.16     |
| Frankfurt | 1990   | 0.07      | 0.03      | 0.06      | 0.04      | 0.04     | 0.10     |
|        | 2010     | 0.05      | 0.06      | 0.12      | 0.04      | 0.04     | 0.07     |
| Munich | 1990     | 0.11      | 0.05      | 0.08      | 0.04      | 0.06     | 0.10     |
|        | 2010     | 0.08      | 0.07      | 0.15      | 0.05      | 0.04     | 0.09     |
| Stuttgart | 1990  | 0.07      | 0.03      | 0.05      | 0.04      | 0.04     | 0.09     |
|        | 2010     | 0.05      | 0.05      | 0.09      | 0.03      | 0.03     | 0.06     |

Note: Highest values are shown in bold.
targeted at families (Frank, 2016). It seems the process of rental gentrification in German inner cities was less prohibitive to families than processes of new-build gentrification in US cities. Next to this, stronger preferences in favour of family living in less dense urban environments and the poor reputation of public schools in American cities might also play a role.

In summary, significant trends towards age segregation in the regions under consideration could be found during the 1990s and 2000s. These developments manifested themselves in inner regional areas as demographic rejuvenation and in peripheral areas as ageing. Under the current framework conditions, a number of factors suggest that age-based segregation in the spatial-structural form will persist in the coming years and will not be a temporary cyclical phenomenon (cf. Moos, 2015, who points to the high residential turnover of central areas in Canadian cities). Relevant ubiquitous factors are, amongst others, the constantly rising rate of students and the increasing cultural attraction of urban life to young adults (Juday, 2015; Moos, 2015). In the German context, Simons and Weiden (2016) speculated on the so-called ‘swarm behaviour’ of young adults. Based on theories of collective behaviour (such as tipping models), they believe that younger people take their migration decisions dependent on the decisions made by relevant peers. The migratory tendency of this particular demographic group towards larger cities could, therefore, have a self-reinforcing effect because the felt lack of peers in close proximity creates an incentive to move.

At the same time, we assess re-urbanization as a strongly context-dependent development with distinctly varying socio-spatial characteristics and manifestations in the urban form. We interpret our findings as evidence for universal economic and social changes that have led to an increase in the significance of dense residential areas with a high degree of centrality and above-average accessibility. At the same time, locally and regionally specific contextual conditions lead to a broad variety of socio-spatial changes and structural developments. Here, the mechanics of the land and real estate markets as well as urban and regional planning appear especially relevant to us. Factors such as the amount of infill and redevelopment capacities, the existence or restrictiveness of regional growth-management policies as well as the effectiveness of socially inclusive local housing policies make an impact on the intensity of inner-city population growth and its demographic and social composition.

In conclusion, it should be admitted that re-urbanization and the relative changes in the economic, socio-spatial and structural image of cities and regions is still only partly understood. Therefore, we see the need for more detailed empirical research – and especially for international comparative research – as correspondingly high. Comparisons of urban phenomena allow researchers to test the validity of theories across regional and national boundaries, and they sharpen our view of generalizable and special, context-dependent aspects of urban development (Bourne, 2008). Furthermore, more research on the social effects of the rising presence of youngsters (mostly as one-person households) in inner-city neighbourhoods is necessary. We know little about the change of service provision in affected areas or the wider consequences of an eroding social interaction of different age groups in daily life (cf. the discussion of the ‘childless city’ by Modarres & Kotkin, 2013). Last, but not least, a normative question remains: should city governments do more on promoting family housing in central urban neighbourhoods; and, if yes, what are effective and realistic measures (cf. Lilius, 2014)? In the German context, a revival of social housing programmes is under discussion, just to give one example. Beyond issues of real estate market failures and lack of affordable housing, also questions of family-oriented urban design and service provision (schools, public parks or playgrounds) remain crucial.

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