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Publication date
2018

Document Version
Final published version

Published in
Conference papers of the European Network for Housing Research (ENHR 2018)

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Abstract

Contextual poverty is a multiscale phenomenon which affects socioeconomic outcomes of people as well as individual decisions to move in or out of the neighbourhood. Large-scale poverty reflects regional economic structures. Meso-scale concentrations of poverty within cities are related to city-specific social, economic and housing characteristics. Exposure to poverty at small spatial scales influences individuals through social mechanisms such as role models or social networks. Particularly these smaller scales are often neglected, largely due to the lack of data. Register data for the full population of the Netherlands, geocoded to 500m by 500m grid cells, makes it possible to consider a wide range of scales. However, altering scale yields different empirical results, as stated within the modifiable areal unit problem (MAUP). Our measure of contextual poverty, therefore, embraces a range of spatial scales of contexts and compares different places within and between cities, revealing different spatial patterns of multiscale poverty.

Keywords: poverty, spatial scale, exposure, distance profile, inequality

1. Introduction

Poverty in the residential context can affect socioeconomic outcomes of people, as follows from a large body of the neighbourhood effects literature (Van Ham, Manley, Bailey, Simpson, & Maclennan, 2012). Furthermore, spatial concentration of low-income people can influence individual decisions to move in or out of the neighbourhood (Bolt & Van Kempen, 2003; Sampson, Morenoff, & Gannon-Rowley, 2002; Van Ham & Clark, 2009). Poverty concentrates at various spatial scales. Single spatial scales capture some and miss other spatial extents of contextual poverty. Scale is this view is one aspect of the modifiable areal unit problem (MAUP; Manley, 2014; Manley, Flowerdew, & Steel, 2006; Openshaw, 1984), which suggests that measuring contextual characteristics is affected by the size and exact boundaries of the spatial units.

The reasons to examine different spatial scales of contextual poverty are related to both causes and consequences of poverty: Different processes lead to concentration of poverty at different spatial scales, and different mechanisms of contextual effects arise from different spatial scales (Galster, 2012). Moreover, multiple scales jointly form the so-called spatial opportunity structure which varies across space (Galster & Sharkey, 2017). However, considering a larger number of scales simultaneously and comparing different places across cities represents big challenges in terms of data availability and method selection.

This study investigates poverty in Dutch cities at multiple spatial scales, from small neighbourhoods, a range of surrounding areas, up to the city/regional level. We used data for the full population of the

Netherlands, geocoded to 500m by 500m grid cells, and created areas centred on individual locations, the so-called bespoke neighbourhoods (introduced by Buck, 2001; Johnston et al., 2000; MacAllister et al., 2001), at a range of spatial scales. These scales, based on Euclidean distance, constitute for each location its distance profile of exposure to poverty. The study shows what levels of poverty people are exposed to in their place of residence and which spatial scales of residential context are relevant to better understand exposure to poverty in different cities in the Netherlands. Considering a large number of scales, the study demonstrates how poverty changes over distance from home in different places – different cities and different parts of the same city.

2. Contextual poverty and spatial scale

Poverty can be conceptualised and measured in many ways, but the most common and straightforward concept is monetary poverty, whose indicator is 'at-risk-of-poverty rate', i.e. the percentage of individuals with an equivalent net disposable household income below the poverty threshold (Goedemé & Rottiers, 2011). Most research in Europe set the threshold of poverty at a certain percentage of the national median income. Largely on the suggestion of ILO and OECD, low income is usually defined as being below two thirds of the median income (Fritzell & Ritakallio, 2010; Goedemé & Rottiers, 2011; ILO, 2013; vom Berge et al., 2014), but lower thresholds such as 50% of the median are also used (Bäckman, 2008; Marlier, 2007).

Large-scale concentrations of poverty reflect regional economic structures and labour markets. Income inequality at large scales, between countries and regions, has received a lot of attention in the economic and geographic literatures (Wilkinson & Pickett, 2006).

Meso-scale concentrations of poverty within cities are related to city-specific social, economic and housing characteristics. For example, many Dutch and Swedish cities contain large urban districts with predominantly social housing (Bolt, Phillips, & Van Kempen, 2010). These urban districts attract more low-income residents, while the better-off ones are more prone to leave (Bolt, Van Kempen, & Van Weesep, 2009).

Exposure to poverty at small spatial scales influences people through social mechanisms such as role models or social networks (Galster, 2012). These mechanisms can, for example, impact on an individual's job search behaviour, and they often serve as a theoretical starting point of empirical studies examining neighbourhood effects on individual socio-economic status (Van der Klaauw & Van Ours, 2003). However, many studies do not operationalise neighbourhoods at small spatial scales, largely due to the lack of data.

3. Data and methods

We used register data for the full population of the Netherlands, geocoded on 500m by 500m grid cells (Sociaal Statistisch Bestand – SSB, see Bakker, 2002; Houbiers, 2004), for the year 2011. Starting from each grid cell, we created bespoke areas at twenty one spatial scales, which form a distance profile (for a more detailed descritpion of this method, see Petrović, van Ham, & Manley, 2018). The lowest scale is 500m×500m cell itself, from which other bespoke areas spread in twenty concentric circles. Radii of bespoke areas range from 500m up to 10km, with 500m increments. At all these spatial scales, we measured poverty using the share of low-income households as defined by the Statistics Netherlands (CBS, 2014). For each grid cell, we calculated the share of low-income households starting from 0.25km^2 of a single cell up to 314km^2 of the cell's wider surroundings (the largest circle).

We investigated three distinct Dutch cities, namely Amsterdam, Utrecht, and Groningen. Amsterdam is the biggest city in The Netherlands, with 810.000 people living in the area of 165km^2. Utrecht has the fourth largest population in the country (330.00) and the area of 95km^2. These two cities are both part of Randstad, the biggest conurbation in The Netherlands. The third city, Groningen, with the seventh largest population (200.000 people) and the area of 80 km^2, is spatially relatively isolated from other cities.

To compare poverty in different places at different spatial scales, we used Theil's index (Theil, 1967). This hierarchical measure of entropy here compares inequality in the share of low-income households at various spatial scales in different places both between and within cities. We first measured the inequality for each spatial scale to get insight into different spatial extents of poverty, and to demonstrate the effect of scale as an aspect of the modifiable areal unit problem (MAUP; Openshaw, 1984). Theil's index is calculated as follows:

$$T = \sum_{i=1}^{n} s_i \log(n s_i)$$

$$s_i = y_i / \sum_{i=1}^{n} y_i$$

n = number of grid cells

y_i = share of low-income households for cell i measured at specific scale

Theil's measure of inequality is further decomposed in between and within inequality as follows:

$$T = \underbrace{\sum_{g=1}^{\omega} s_g \ln(n/n_g s_g)}_{T_B} + \underbrace{\sum_{g=1}^{\omega} s_g \sum_{i \in g} s_{i,g} \ln(n_g s_{i,g})}_{T_W}$$

$$s_g = \sum_{i \in g} y_{i,g} / \sum_{i}^{n} y_i$$

$$s_{i,g} = y_{i,g} / \sum_{i=1}^{n_g} y_{i,g}$$

n_g = number of grid cells in city g

y_i = share of low-income households in cell i

T_B = Between-city component of inequality

T_W = Within-city component of inequality

In addition, we applied Theil's index to measure scalar variability of distance profiles, which encompass the share of low-income households at all twenty one scales, and thereby to measure the inequality between distance profiles both within one city and between cities. This builds on the use of Shannon's entropy for measuring scalar variability in potential exposure to non-Western ethnic minorities in Petrović et al. (2018).

4. Results

Figure 1 shows the share of low-income households measured at the smallest available scale (neighbourhoods of 500m by 500m). In Amsterdam, low-income neighbourhoods are scattered over the city, whereas in Groningen low-income neighbourhoods are slightly more concentrated in the city centre. The concentration of low-income neighbourhoods is more obvious in the eastern part of Utrecht, as opposed to the more affluent western part of the city.

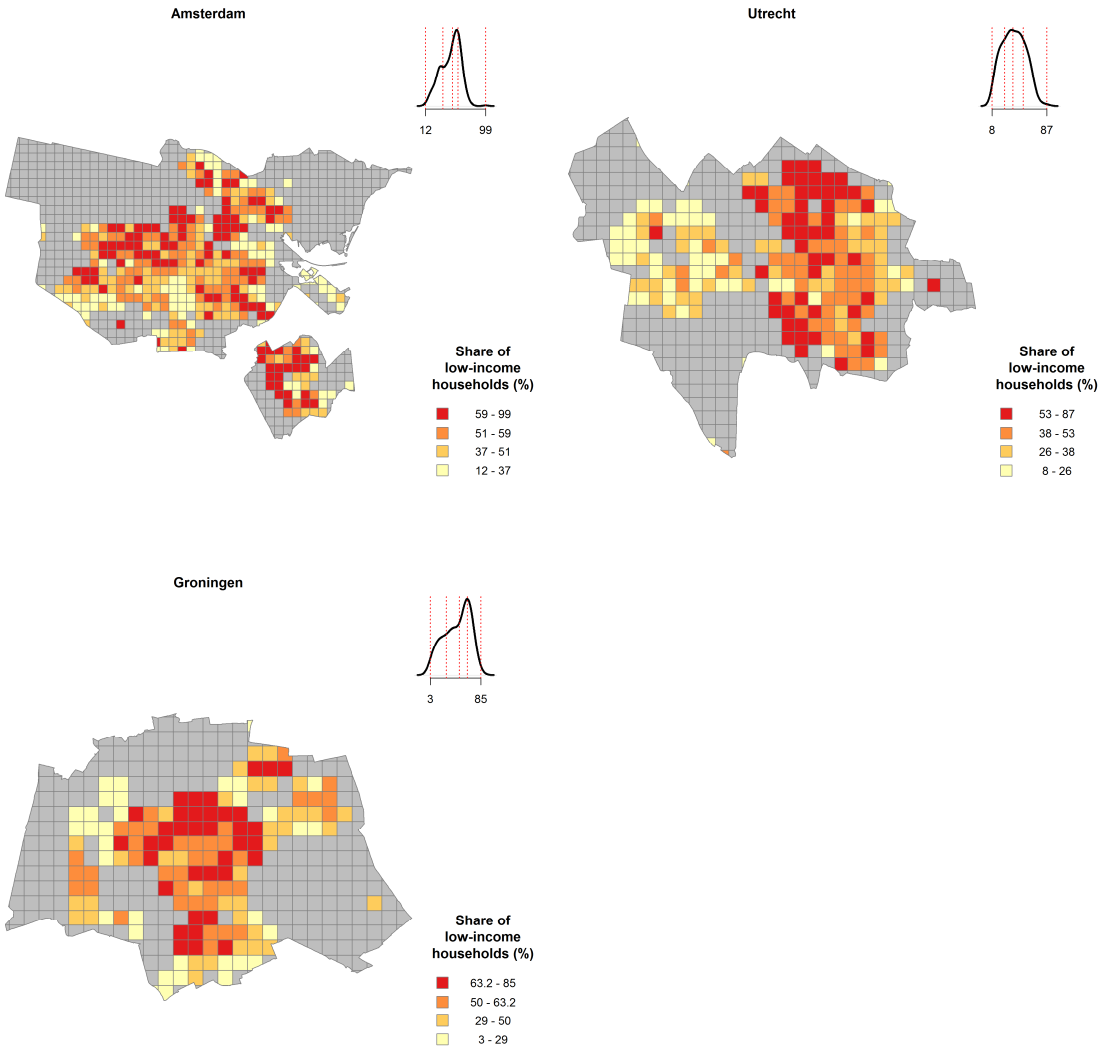

Figure 1: Share of low-income households in 500m by 500m grid cells in Amsterdam, Utrecht, and Groningen, in 2011

Boxplots in Figure 2 show the share of low-income households at twenty one spatial scales. In Amsterdam, median is constant across scales and the interquartile range is quite small at almost all scales, which suggests a fairly even spread of poor and affluent neighbourhoods. Fluctuations of the median in Utrecht and Groningen, as well the wider interquartile ranges at meso scales, particularly in Utrecht, suggest that these cities have different spatial patterns of poverty. Overall, Utrecht has lower level of poverty (around 40% of low-income households at the scale of 10km) than Amsterdam and Groningen (around 50%).

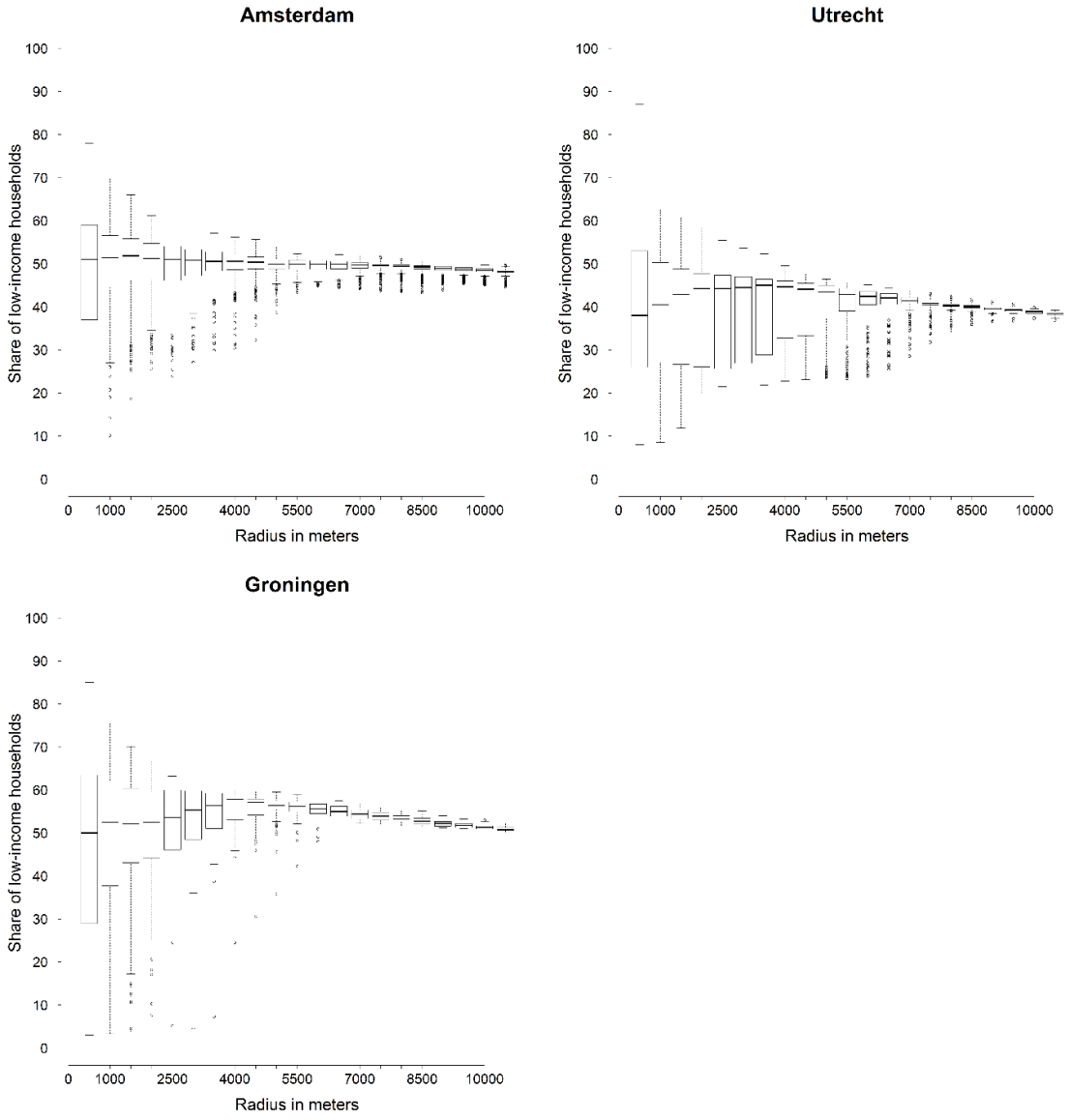

Figure 2: Share of low-income households at twenty one spatial scales in Amsterdam, Utrecht, and Groningen

Figure 3 shows Theil's index of inequality in the share of low-income hoeseholds between and within the three cities, calculated separtely for each of the twenty one spatial scales. At smaller scales, up to 1,5km, there are big differences within cities, because each cities has avariety of neighbourhoods, from the poorer to more affluent ones. From 6,5km inequality is mostly due to differences between cities. Even bigger bewteen-city inequality can be expected when the entire country is taken into account. Polarisation index is not relevant for large scales, due to very small differences in values for bespoke areas with a 10km radius.

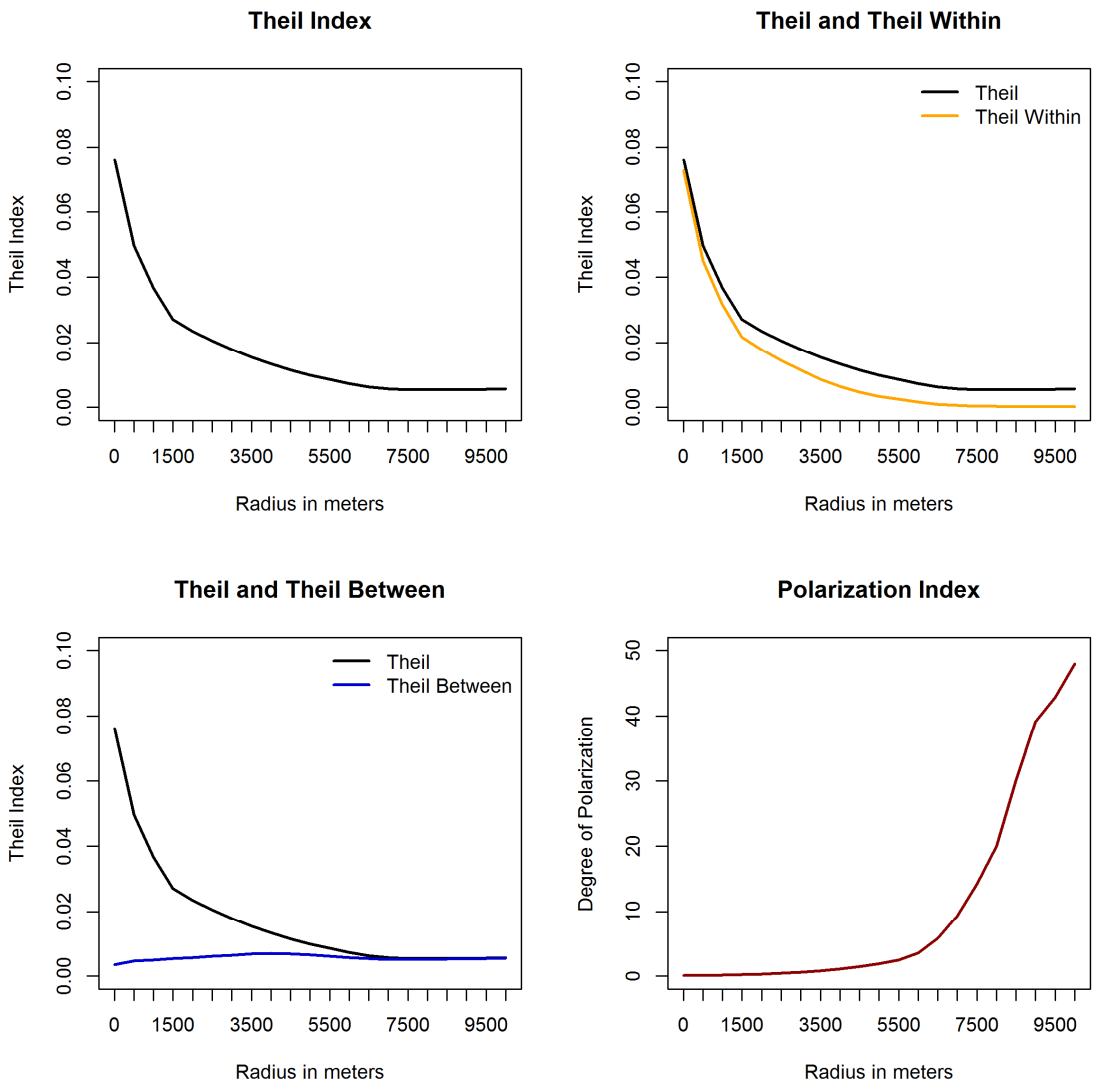

Figure 3: Theil's index of inequality considering all three cities

Figure 4 shows inequlaity for each city separately, so that the between component of Theil's index summarises in one index the information that was suggested from the boxplots. The peak around 4,5km in Groningen indicates the distance (bespoke area radius) at which poverty concentrates. In Amsterdam, the index is bigger at small scales, which indicates the big variery of small neighbourhoods in terms of household income, but more iquality between different parts of the city at larger scales. Lower level of poverty in Utrecht is also visible in the lower level of Theil's index.

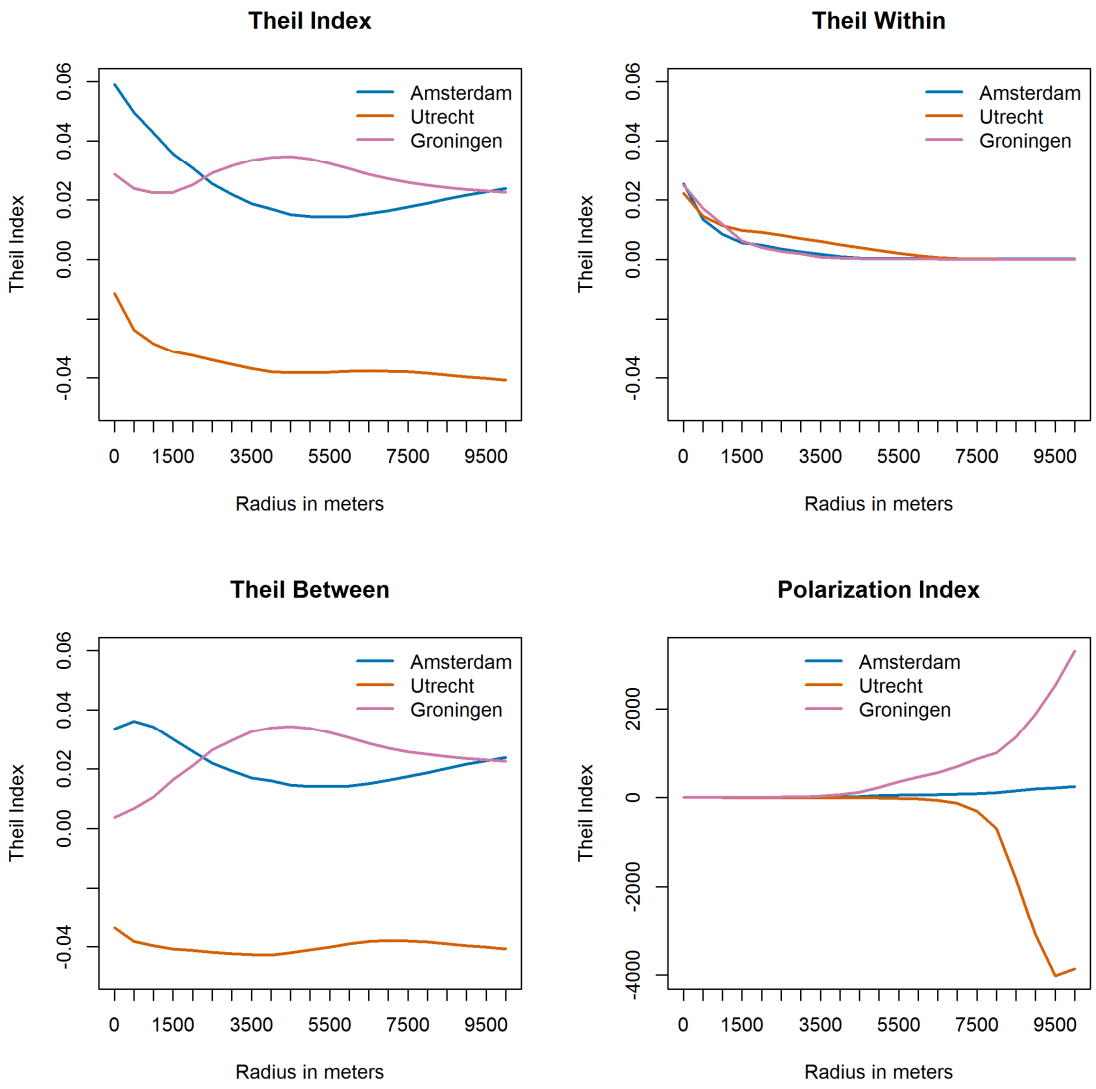

Figure 4: Theil's index of inequality by city (Amsterdam, Utrecht, and Groningen)

Finally, Figure 5 show the results of the second application of Theil's index – for masuring scalar variability and studying spatial patterns of poverty at multiple spatial scales simousltanously. The information gained from the previous results regarding the scattered and concentrated poverty in specific cities now come together. What appeared to be scattered poverty across the city Amsterdam when we considered only one spatial scale, should be complemented by other spatial scales. Some of the poor neighbourhood are surrounded by other poor neighbourhoods at a wider range of spatial scales, forming distnct pockets of multiscale contextual poverty. Other neighbourhoods, although having high shares of low-income houshold, are surrounded by different levels of poverty, and therefore, represent different spatial contexts.

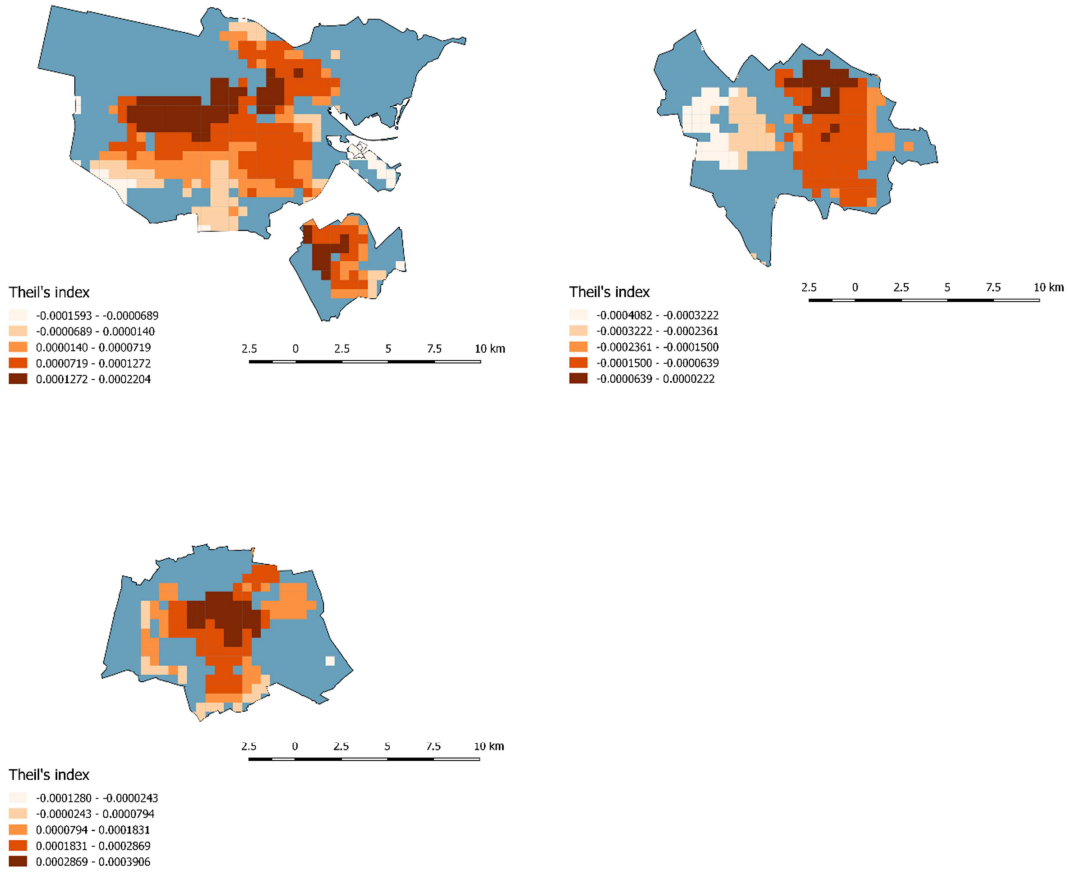

Figure 5: Theil's index for multiple scales (Amsterdam, Utrecht, and Groningen)

The multiscale application of Theil's index in Figure 5 also shows more clearly spatial patterns of poverty in Utrecht and Groningen. Utrecht is clearly divided in the poorer eastern part and the more affluent western part of the city. Therefore, being more affluent than Amsterdam and Groningen does not apply to the entire city of Utrecht, but to one spatially very distinct part of the city. Groningen has another very specific spatial pattern of poverty, namely the core-periphery distinction, where the city centre is poorer, persistently at multiple scales, than the rest of the city.

5. Conclusions

In this study, we constructed distance profiles of exposure to poverty, which consist of a range of spatial scales, and we measured inequality in exposure to poverty for each spatial scale separately as well as scalar variability across distance profiles. Differences in Theil's index for specific spatial scales showed the effect of scale as an important aspect of measuring contextual poverty in different places. Furthermore, the results provide insight for the neighbourhood effects research as to which spatial scales should be taken into account when studying how living in low-income areas affects individual outcomes of people in different places.

The application of Theil's index in measuring scalar variability of distance profiles showed that various scales jointly define distinct areas of exposure to poverty, which differ within and between cities. Thereby, each city has a specific spatial pattern of poverty. Various spatial patterns of contextual poverty are also informative for the neighbourhood effects literature, which suggests that living in concentrated poverty affects chances and outcomes of individuals.

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