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DISCUSSION PAPER SERIES

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ABSTRACT

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The socio-economic mosaic of urban neighbourhoods changes under the influence of three distinctive distributional processes: reordering of the socio-economic position of urban neighbourhoods; changing levels of inequality between neighbourhoods; and an overall growth or decline in income levels which affects all neighbourhoods of an urban area. With the common practices in analysing neighbourhood change, the roles of these underlying processes are unclear. This paper builds on a decomposition method to analyse the roles of the three components of change in four largest Dutch city-regions. The results points to substantial variations in components of change in the four city-regions.

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Introduction

The socio-economic hierarchy of urban neighbourhoods changes over time and this affects the socio-spatial organisation of cities. There are several typical processes of change which can be observed. In many contemporary cities patterns of change involve the reversal of urban and suburban fortunes. Intensive gentrification among city-core neighbourhoods has made them richer and unaffordable, whereas suburban neighbourhoods that served as alternative destinations for lower-income groups experienced socio-economic decline (e.g. Bailey & Minton, 2017; Cooke & Marchant, 2006; Hochstenbach & Musterd, 2018; Hulchanski, 2010). Another typical process of change is the increase in economic inequality and segregation within urban areas (e.g. Tammaru, Marcińczak, Van Ham, & Musterd, 2015) and the increasing polarization among neighbourhoods (Chen, Myles, & Picot, 2012; Hulchanski, 2010). Also, increasing disparities between cities due to their divergent success in the transition to a post-industrial economic base (Moretti, 2012) change the fortunes of entire urban areas, which affects their neighbourhood hierarchies. These processes of change represent three distinctive distributional changes which interact in transforming the urban socio-spatial structure. First, the *reordering* of the socio-economic position of urban neighbourhoods. Second, the changing levels of *inequality* between neighbourhoods. And third, an overall *growth or decline* in income levels within an urban area, which affects all of its neighbourhoods.

Contemporary debates on urban change lack a systematic, comparative perspective as to which processes of change are more important. City-relative measures of neighbourhood socio-economic status, which are commonly used in neighbourhood change research, overlook the role of *growth* and confound the processes of *reordering* and *inequality* (Modai-Snir & van Ham, 2018b). Using absolute measures of total change, on the other hand, is not useful in comparing change processes across cities, unless the underlying components of change can be distinguished from each other. Recently, a decomposition method from income mobility research (Van Kerm 2004) has been introduced in the context of neighbourhood change; the method can be used to decompose neighbourhood change into the three contributing processes and analyse their relative importance (Modai-Snir & van Ham, 2018b). It has been successfully applied in analysing neighbourhood change components across 22 metropolitan areas in the US, (Modai-Snir & van Ham, 2018b) and in analysing the roles of change components in intensifying an existent divide in the metropolitan area of Tel-Aviv, Israel (Modai-Snir & van Ham, 2018a).

This paper aims at deepening insights of the drivers of socio-spatial change across four large city-regions in the Netherlands, by using the decomposition method of neighbourhood change components. The Dutch context is of interest because of its distinctive welfare regime and its regulated housing market; these stand in sharp contrast with the US and Israel contexts where the decomposition method has previously been used. In the Netherlands, the political agenda and the debates on urban inequalities reflect a strong engagement with societal challenges posed by increasing inequalities. This paper seeks to answer the following questions: How do the three distinctive processes underlying neighbourhood change, *inequality*, *reordering* and *growth,* vary across the four city regions given their differing contexts? And how do they interact in transforming urban socio-spatial structures in each case?

The four largest Dutch city-regions – Amsterdam, Rotterdam, The Hague and Utrecht – vary in their historical circumstances, economic standing, ethnic compositions and housing opportunities. Amsterdam, the capital and the most populous city, is one of the top financial centres of Europe, and is characterised by an overheated housing market and pervasive

gentrification (Hochstenbach and van Gent 2015). Rotterdam is the second largest city in The Netherlands and hosts the largest port in Europe. Its economy is centred on logistics and lags behind the other cities. The Hague has a dominant role as a host of public institutions, and it acts as the seat of the Dutch government and many central international organizations. The Hague exhibits a strong historical socioeconomic spatial divide (Meijers, Hoogerbrugge, Louw, Priemus, & Spaans, 2014). Finally, Utrecht is a large educational centre and serves as a transportation hub.

Neighbourhood Socioeconomic Change and its Components

There are several processes which generate change in the socio-economic position of urban neighbourhoods. The population composition of neighbourhoods can change as a result of selective residential mobility of people, and because of *in situ* change of residents (e.g Ellen & O'Regan, 2011; Hochstenbach & van Gent, 2015). But there are underlying distributional changes that explain how and why neighbourhoods change from a system point of view. A recent paper (Modai-Snir & van Ham, 2018b) identified three such changes that represent substantive socio-spatial change processes, and applied a method from the field of income mobility (Van Kerm, 2004) that splits their contributions to the total observed change among neighbourhoods in: 1) the reordering of neighbourhoods within a given distribution of neighbourhoods, 2) the changing level of inequality among neighbourhoods, and 3) the overall growth or decline of neighbourhood income across the entire distribution of neighbourhoods in the urban area. The following section introduces each distributional change and relates them to theoretical perspectives on neighbourhood change.

During most of the 20th century, the socioeconomic change of neighbourhoods received attention essentially as a phenomenon related to within-urban processes. The most acknowledged drivers of neighbourhood decline and increase were the aging of the housing stock, reinvestment in declining areas and infrastructure development, processes which shift the locations of income classes within cities. The depictions of 'invasion and succession' by Chicago school researchers (Park, 1952) and the 'filtering' of housing from high- to low-income classes (Muth, 1973; Rosenthal, 2008) reflect the idea of a continuous exchange of relative positions among neighbourhoods of an urban area. Socioeconomic change which is associated with positional exchanges among neighbourhoods can be identified as the *reordering* component. Neighbourhood reordering follows characteristic spatial patterns as cycles of decline and reinvestment stick to the chronological development of cities outwards from the core (Brueckner & Rosenthal, 2009). The decline of inner-city neighbourhoods during the 20th century and their subsequent revival can be seen as part of a cyclic reordering process. Central-city revival has also been attributed to cities' comparative advantage in the knowledge economy and the increasing demand for high-end amenities (Glaeser & Gottlieb, 2006).

On top of change due to reordering within cities' hierarchies, substantial socioeconomic change can also be related to transformations of those hierarchies due to broad-scale economic, social and political developments. Among those, the increase in inequality within urban areas is at the forefront of the urban change discourse (e.g. Florida, 2017; Tammaru et al., 2015). Increasing individual-level inequality in urban areas drives neighbourhood socioeconomic change throughout the urban hierarchy because the distribution of neighbourhood average incomes adjusts itself to the distribution of individual incomes. When the share of high incomes increase relative to the share of low incomes, average incomes in rich neighbourhoods increase while those of poor ones stagnate or decrease (Chen et al.,

2012). Another typical change in the distribution of neighbourhoods is the increasing proportions of rich and poor neighbourhoods on the expense of middle income ones. Both processes are referred to as polarisation[1]. Neighbourhoods socioeconomic conditions change in the course of the adjustment of the neighbourhood distribution. For example, the expansion of the urban high-income class will generate demand for high-end neighbourhoods, and their number will increase at the expense of middle- and low-income neighbourhoods through processes of gentrification. The *inequality* component refers to neighbourhood socioeconomic change that is related to the changing distribution of neighbourhood incomes.

The third component of neighbourhood change is also related to macroeconomic processes and is attributed to the overall growth or decline in incomes in an urban area. Economic growth or decline of a city can reflect national or global economic trends, labour restructuring, and trends in the selective mobility of people across cities. Neighbourhoods are swept along by their respective city's fortunes and so some of the change they experience may be attributed to a uniform pattern of *growth or decline* across all neighbourhoods of a metropolitan area.

Using the Van Kerm (2004) method that decomposes total neighbourhood change into its contributing components, an analysis of data from the US revealed striking variation across metropolitan areas in the roles of the three components (Modai-Snir & van Ham, 2018b). Another study that focused on the Tel-Aviv metropolitan area in Israel, showed that effects of reordering and increasing inequality can be clearly distinguished from each other, and that they exacerbate an existent socioeconomic divide in different ways (Modai-Snir & van Ham, 2018a).

The Complex Interactions among Neighbourhood Change Components

The total change observed among neighbourhoods of a single urban area reflects the combined effects of change components which emerge concurrently and interact in complex ways. Existent research does not reveal this complexity. For example, a recent study classified neighbourhoods in Amsterdam and the Hague as either 'reordering' or 'polarizing' by referring to the change in neighbourhoods' shares in city incomes over a period, relative to their initial shares (Bailey, van Gent, & Musterd, 2017). Neighbourhoods were classified as 'reordering' if the total change they experienced countered their initially low or high position in the neighbourhood hierarchy, or as polarizing if the change reinforced their position. But in fact, neighbourhoods can be reordering and polarizing at the same time. A poor neighbourhood can improve its relative position in the neighbourhood hierarchy but simultaneously experience a downgrade in absolute conditions if the income distribution is widening, and the income shares of low-income people (and neighbourhoods) decline. An affluent neighbourhood can move down in the neighbourhood hierarchy but increase in absolute terms because the income shares of the upper class increased. These examples emphasize that not only 'reordering' and 'polarizing' are different processes that can occur simultaneously, but that they can affect neighbourhoods in opposite directions.

Modai-Snir and van Ham (2018b) demonstrated these opposite effects empirically and explained the theoretical rational. The dynamics of reordering reflect mean reversion such that

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[1] Inequality and polarisation are interrelated but should be distinguished from each other. Polarisation is a specific type of change in the income distribution where observations increasingly concentrate at the tails of the distribution. This is the type of change occurring in neighbourhood income distributions of contemporary cities (e.g. Hulchanski, 2010).

low-income neighbourhoods are likely to increase, and high-income neighbourhoods are likely to decrease. The effect of inequality makes low-income neighbourhoods decrease and high-income neighbourhoods increase. Gentrification processes serve as a typical example of complex interactions between these change components. A gentrifying neighbourhood will typically increase its relative position in the urban hierarchy because it draws high-income people from other places in the city. As long as a considerable proportion of the neighbourhood's housing stock is still occupied by low-income households, increasing inequality may generate decreases in absolute average incomes and attenuate the appearance of gentrification processes as reflected in neighbourhood average incomes. As the high-income group becomes the majority in the gentrified neighbourhood, the effect of inequality on that neighbourhood's status can become positive. The stage of gentrification determines, therefore, the effect of the inequality factor on the socioeconomic transition.

The relationship between the *growth* and *inequality*[2] components should also be discussed. These components reflect different spatial levels of income sorting and therefore a trade-off between them is expected to some extent: The inequality factor relates to inequality within the urban area and the growth factor relates to the overall growth in incomes of an entire urban area, which is related to increasing inequality between urban areas. If overall inequality is increasingly absorbed at one spatial level that would be at the expense of inequality at another spatial level; and so, a negative relationship between the growth and inequality components is likely. This relationship was demonstrated in the analysis of neighbourhood change components across US metropolitan areas during the period 1980-2010 (Modai-Snir & van Ham, 2018b). Contemporary urban processes can further explain this relationship. The 'third wave of gentrification' continues to play an important role in accommodating an expanding urban high-income class with its link to large-scale capital, large developers and the promotion by urban and housing policies (Hackworth & Smith, 2001). This massive reinvestment which started in city centres is gradually spreading outwards. In the most attractive cities the overheating housing market spreads gentrification processes to almost the entire urban area; this spreading out exacerbates the housing affordability crisis and pushes low-income groups further towards metropolitan edges and beyond. Neighbourhood change in 'superstar' cities involve, therefore, an important growth component and a less substantial inequality component (Modai-Snir & van Ham, 2018b).

The restructuring of the economy impacts different cities in different ways, and so cities are expected to vary with respect to the importance of change components. The national context, particularly the welfare regime, has an important role in mitigating inequalities and their spatial expressions. Within a given national context, different cities show different change dynamics. For example, the more a city is embedded in the global economy the more it is likely to experience income growth (Moretti, 2012), and present sharp spatial divides (Musterd, Marcińczak, van Ham, & Tammaru, 2016). Other city contextual factors such as city size, deindustrialization and proportion of visible minorities explain the variation in the dynamics of individual-level income distributions across urban areas (Bolton & Breau, 2012), and so they should be related to variations in distributional change among neighbourhoods. Historical divides tend to be persistent and divided cities are likely to change in a way that replicate this divide (Modai-Snir & van Ham, 2018b). To examine and compare dynamics of

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[2] The negative relationship between the 'inequality' and 'growth' neighbourhood change components should not be confused with the ongoing inequality-growth debate in the macroeconomic literature. The latter focuses on the effect of individual-level inequality on economic growth.

urban socio-spatial change across cities with differing contexts, the three components of change should be considered separately.

The Dutch Context

The macroeconomic context, the welfare regime, housing policies and the regulatory environment all play an important role in socio-spatial processes. In this section the Dutch context is discussed in relation to the factors which affect neighbourhood change processes.

Income inequality in the Netherlands is low in an international perspective, and increases in inequality during the last decade have been modest (OECD, 2015). However, stable overall inequality in the Netherlands masks increasing inequalities on the basis of spatial divisions due to spatial distribution dynamics; income inequality is on the rise in the largest Dutch cities (Groot & de Groot, 2013; PBL, 2016). Distributional dynamics also reflect a process of polarisation in urban areas which was the most extreme in Amsterdam during the years 2006-2012 (PBL, 2016). A socioeconomic divide is most apparent in The Hague, where a geological border shaped a historical divide between high- and low-income zones (Meijers et al., 2014), a divide which seems to be intensifying (Bailey et al., 2017). Urban inequalities in the Netherlands follow, therefore, worldwide trends despite the notion of a relatively egalitarian society.

Other global urban trends also replicate in Dutch cities. The locations of urban classes across cities are changing. Gentrification of inner cities (e.g. Hochstenbach & van Gent, 2015), increasing unaffordability of city centres, and consistent displacement of lower-income households (e.g. Hochstenbach and Musterd 2017) are issues at the front of the discourses on urban problems and inequalities. The hierarchy between the cities manifests in socioeconomic differences across them. The capital city Amsterdam, for example, increasingly attracts people, and has been leading increases in prices on the housing market. The overheated housing market is both a symptom and stimulus of extensive gentrification processes.

The Dutch welfare regime is assumed to moderate inequality levels induced by globalization but is also expected to mediate the translation of inequalities into the spatial dimension. This has to do with housing policies that aim at reducing spatial disparities, extensive provision of social housing and the regulated rental housing market (van der Wusten & Musterd, 1998). There is an on-going debate about the effects of the restructuring Dutch welfare state on urban areas. The restructuring involved lower subsidies and benefits and less involvement in the housing market; the liberalizing of the national housing system since the 1990's is manifested in the rising promotion of homeownership and a partial withdrawal of the state from the provision of social housing (van Gent, 2013). Concerns about the changing housing system involve, for example, the potential marginalization of the public housing sector (Musterd, 2014) and intensifying divisions between inner-city and outer post-war neighbourhoods due to spatial patterns of tenure conversions (Boterman & van Gent, 2014). Urban restructuring schemes have also been blamed for encouraging gentrification (Uitermark, Duyvendak, & Kleinhans, 2007) and for the displacement of low-income groups (Bolt, van Kempen, & Van Weesep, 2009; Posthumus, Bolt, & van Kempen, 2012).

Despite the processes described above, the Dutch housing market is highly regulated and social housing provision is still substantial. Among the four cities this paper is focused on, Amsterdam and Rotterdam have higher proportions of social-housing units (45.8% and 46.8%

respectively) compared to The Hague and Utrecht (33.3% and 33.9% respectively)[3]. These still large proportions ensure that low-income households are less likely to be priced out of cities. By preventing displacement, the housing system can make the inequality component of change appear stronger compared to more liberalized housing markets.

Data and Methods

The data for this study were obtained from the Social Statistical Data-base (SSD), a unique longitudinal individual-level dataset available from Statistics Netherlands (CBS). This database covers the entire population of the Netherlands. It contains data from a range of government registers and includes demographic and socioeconomic population characteristics. As we focus on neighbourhoods, we aggregated individual-level data by spatial units that represent neighbourhoods: We used CBS neighbourhood delineations (*Buurten*) which adhere to generally recognized physical boundaries and represent relatively homogeneous areas. By using neighbourhood boundaries as defined in 2014 we derived consistent spatial units. The average population of a *Buurt* is around 2000-2500 people, but there is a large variation in population sizes (Standard deviations by city range between around 2000 to 3000).

Disposable income data is only available for the whole population from 2010 and after. Up to 2009 such data is available only for a sample which would yield too few observations in many neighbourhoods. We therefore used pre-tax incomes including all benefits, which are available for the years 1999-2014. Average neighbourhood income was computed by summing up income over all individuals and dividing by the number of residents aged 18 and up (a cut-off which represents potential inclusion in the workforce). This way we account for the effect of unemployment on neighbourhood socioeconomic status. Although people aged 18-24 are often not fully active in the labour market, we included them in the computation because the effect of such group on neighbourhoods is of relevance. Retired individuals are also included because pensions differ according to past income status, reflecting unequal resources. All incomes are expressed in 2014 values.

Research Areas
In contrast with previous studies on the Dutch context which focused on cities within municipal boundaries, we focus on city-regions (cities and surrounding urban, suburban and rural areas). This geographic focus is likely to expose socio-spatial dynamics that are related to the interplay of scales.

The metropolitan regions of Amsterdam (Stadsregio Amsterdam), Rotterdam (Stadsregio Rotterdam), The Hague (Stadsgewest Haaglanden) and Utrecht (Bestuur Regio Utrecht) consist of 36, 15, 9 and 9 municipalities respectively. After excluding neighbourhoods with less than 50 income observations, the number of neighbourhoods analysed in the Amsterdam, Rotterdam, The Hague, and Utrecht city-regions sum up to 772, 451, 352, and 267 neighbourhoods, respectively.

Method
This paper uses a method that was presented by Van Kerm (2004) in the context of income mobility, which has been recently applied in the context of neighbourhood change (Modai-Snir & van Ham, 2018b). The method quantifies the contributions of three factors to the total

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[3] Data extracted from the online databank of Statistics Netherlands https://opendata.cbs.nl/statline

change in neighbourhood absolute incomes: (a) the *reordering* of neighbourhoods within a given distribution of neighbourhood average incomes (b) the increasing *inequality* among neighbourhoods and (c) the overall *growth* or decline of incomes among all neighbourhoods in the metropolitan area.

Income change is measured by relating to two different income observations, at different time points, t and t+1, for each spatial unit (neighbourhoods within each urban area). Total socioeconomic change within the single urban area can be summarized by relating two vectors of neighbourhood average incomes: at time t and the other at time t+1. Observed neighbourhood average incomes are in absolute terms to account for the *growth* component.

The method is based on the construction of hypothetical neighbourhood income vectors, each reflecting how the array of neighbourhood incomes would look like at time t+1, if only one component of change (a, b or c as listed above) had an effect. The first hypothetical vector demonstrates the isolated effect of *reordering*; it reflects how the array of neighbourhood incomes would look like if they followed the same exchange of relative positions observed in the data, net of the influences of factors b and c. It is constructed by ordering the observed vector of initial neighbourhood average incomes according to the rank orders of the vector of final incomes. The second hypothetical vector demonstrates the effect of *increasing inequality* among neighbourhoods; it reflects how the array of neighbourhood average incomes would look like if they were only influenced by the increasing inequality, but not by overall income growth (or decline) nor by reordering. It is constructed by applying the Lorenz curve of the observed vector of final incomes (at time t+1) to the observed vector of initial incomes. The third hypothetical vector only incorporates the effect of the *growth* or decline in incomes. It is constructed by inflating the vector of initial incomes by the ratio between the means of neighbourhood average incomes at time t+1 and t (see more detailed explanations of the original method in Van Kerm, 2004).

The amount of change associated with the transition between the initial vector and each hypothetical vector is computed using a mobility measure that was proposed by Fields & Ok (1999):

$$C(x, y) = \sum_{i=1}^{n} |\log y_i - \log x_i|$$

where y_i and x_i refer to the incomes of neighbourhood *i* at a time *t+1* and time *t*, respectively. In computing the measure using the hypothetical vector related to components *a, b or c* instead of the observed incomes at time t+1 we derive the total changes in the urban system that can be attributed to each component. Because the measure aggregates individual units' contributions, sub-group contributions might as well be aggregated to indicate the role of each component in relation to different neighbourhood groups (in that case the measure is used without the absolute-value notation). Finally, the Shapley decomposition procedure (Shorrocks, 2013) which averages the contributions given different sequences of elimination, is further used to derive components that add up to the total amount of change, as explained by Van Kerm (2004). Van Kerm used a nested decomposition which decomposes total change into 'exchange' and 'structural' factors, and then decomposes the structural components into components related to inequality and growth. In this paper we rather treat the three factors as non-hierarchical.

Results

The cities included in this study have gone through typical processes of socio-spatial change, but at the same time they followed distinctive trajectories due to their differing historical, social and economic contexts. The summary statistics in Table 1 show some of these commonalities and divergences. In 1999, the starting point of this study, neighbourhoods in the metropolitan areas of Amsterdam and Utrecht had higher mean incomes than those in Rotterdam and The Hague. In the next 15 years, neighbourhoods in those metropolitan areas further diverged from those of Rotterdam and The Hague, as indicated by metropolitan averages of growth in neighbourhood mean incomes. The standard deviations of neighbourhood average incomes were higher in Amsterdam and The Hague than in the other two cities, implying higher inequality among neighbourhoods in these urban areas. This inequality intensified substantially in these cities during the period 1999-2014.

Focusing on how these processes operated at two different spatial levels reveals a common pattern. In all cities, neighbourhood mean incomes at the starting point of this study were lower in city-neighbourhoods, compared to the average over all neighbourhoods of each respective metropolitan area. However, the growth in average incomes was substantially higher among city neighbourhoods. In Amsterdam, Rotterdam and The Hague, Standard deviations of cities' neighbourhood income distributions increased much more than those of the respective metropolitan areas. City neighbourhoods have become wealthier and more unequal than their suburban counterparts.

[INSERT TABLE 1 HERE]

The descriptive statistics reveal that all three processes of neighbourhood change took place in the four Dutch cities. The following analysis will examine the relative importance of each component and examine how they interacted in transforming the socio-spatial structures of the four city-regions.

The roles of three change components
The roles of the *reordering*, *growth* and *inequality* components in generating urban socio-spatial change are varied. The common pattern among all is the dominance of the *reordering* factor which ranges between 73% in Amsterdam and 88% in Rotterdam (Table 2). Amsterdam displays the weakest relative effect size of reordering, compared to the other examined cities, with both growth and inequality appearing as important components. This conforms to the classical image of world cities which are associated with increasing affluence and increasing internal inequalities and polarisation. The importance of components does not fully conform, however, to change components among leading metropolitan areas in the US; those rather display an important growth factor coupled with a less important inequality factor (Modai-Snir & van Ham, 2018b). Given the relatively small size of Amsterdam, the importance of the inequality component relative to American 'superstar' cities is even more conspicuous. The role of the growth component has been the most important among the neighbourhoods of Utrecht, where it accounted for 17% of neighbourhood change, coupled with the lowest contribution of the inequality component among the four cities (4%). In Rotterdam too, the contribution of the inequality component was modest. The role of increasing inequality in neighbourhood change was the highest (20%) in The Hague, the city which is associated with the most pronounced levels of segregation and a historical divide.

[INSERT TABLE 2 HERE]

To understand how varying component contributions affected neighbourhood socioeconomic hierarchies of each city-region we computed average component contributions for neighbourhood income quintiles. Factor contributions are directional, in the sense that increases and decreases are differentiated. Figure 1 demonstrates how the *growth* component accounts for a 'base-line' increase across each city's neighbourhood hierarchy. Neighbourhoods in Amsterdam and Utrecht, regardless of their relative position in the urban hierarchy, improved their conditions more than those in Rotterdam and The Hague due to a shift of the whole distribution of neighbourhood incomes. Change related to the *inequality* component is tied to the neighbourhood income distribution at the starting point of the study. When the level of inequality among neighbourhoods increases, low-income neighbourhoods decrease, and high-income neighbourhoods increase in average incomes. This effect is prominent in Amsterdam and The Hague, where the inequality component was most important. The effect on middle-income neighbourhoods is also remarkable. The change in the urban income distributions in Amsterdam and The Hague was such that neighbourhoods pertaining to quintiles 1-4 in 1999 experienced progressive decreases associated with that component and only neighbourhoods of the top quintile experienced increases.

In The Hague, low-income neighbourhoods (quintiles 1-2) were subject to the most important inequality-related drop in incomes. The pattern of low- and middle-income neighbourhoods sharing an inequality-related decrease follows also in Rotterdam where the effect was modest. In Utrecht the effect of inequality was negligent across all socioeconomic positions. The contributions associated with the *reordering* component follow an opposite pattern of change (compared to change associated with the *inequality* component) with increases, on average, among low-income neighbourhoods and decreases among high-income ones. In Utrecht the effect is the largest across the entire hierarchy. The counteracting pattern of the inequality factor may have led, in some cases, to a situation where an increase in relative positions did not yield a substantial increase in neighbourhood average incomes (in absolute terms). It is important, however, to note that while the starting income position completely determines the change associated with the inequality factor, it only explains up to 10% of the change related to the reordering component in each city (variance components derived using ANOVA type 3 sum of squares).

[INSERT FIGURE 1 HERE]

The spatial patterning of exchange- and inequality-driven change
In examining the spatial patterns of components' contributions we are primarily interested in how income disparities between inner-city and outlying neighbourhoods developed, and due to which contributing components. The *growth* component represents an even spread of income change throughout each metropolitan area it has no effect on the within-city socio-spatial organization; the maps show therefore the *reordering* and *inequality* components.

The maps of change related to the reordering component (Figure 2) reveal that in all city-regions almost the entire inner-city is upgrading relative to the outlying area. This picture emerges as more extreme than it would be if standard measures of neighbourhood change were used, because they would include the counteracting effect of the inequality component. For example, Hochstenbach, Musterd and Teernstra (2015) identified 26 city neighbourhoods in Amsterdam as gentrifying. By not splitting the inequality-related change, and by focusing only on city neighbourhoods detached from the surrounding context it is impossible to see

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that actually almost all city neighbourhoods increased in socioeconomic status (using a cut-off that roughly corresponds to the half standard deviation cut-off used in their study). According to the 'reordering' component, the actual number of city neighbourhoods that increased relative to the entire metropolitan area is 57. The extent of gentrification described by Hochstenbach et al. (2015) is thus underestimated, because the counteracting effect of inequality on income change was not separated. A striking finding relates to the effect of inequality on Amsterdam metro's neighbourhoods (Figure 3). The map shows an extremely spread effect, with many neighbourhoods losing income and very few gaining. This pattern conforms to contemporary dynamics of income distributions, with increasing income shares at the top of the income distribution and decreases along its middle and low ranges.

The map of the reordering component in The Hague reveals a picture which deepens the understanding of the city's socio-spatial processes. Results from a previous study have shown an increasing socioeconomic divide along the Northeast-Southwest axis (Bailey et al., 2017). The 'reordering' map shows that only a cluster of neighbourhoods south to the centre has declined in relative positions (figure 2). The southeast is actually showing increases in positions relative to the entire metropolitan area. Change associated with the inequality factor is spatially distributed similarly to the findings of the previous study (Figure 3). In contrast with Amsterdam, where the inequality effect is spread across the entire city-region, in The Hague it is more contained around city boundaries. Together, these results suggest that The Hague city-neighbourhoods are gradually upgrading and that the pattern of intra-city disparities is gradually giving way to a city/suburbs pattern. The inequality factor which is related to past circumstances reflects the remaining of the within-city cleavage. The spatial pattern of change related to increasing inequality masks the urban process at work.

[INSERT FIGURE 2 HERE]

The spatial pattern of reordering in Rotterdam shows widespread downgrading in suburban areas adjacent to municipality borders. Within the city, reordering follows a north-south divide; neighbourhoods in the north upgrade in relative positions while those in the south rather stagnate or decrease. The pattern of inequality-related change follows the same pattern but is not substantial in magnitude. In Utrecht, a radial pattern of reordering is evident with decreases concentrated from both sides of city boundaries.

[INSERT FIGURE 3 HERE]

Discussion

The aim of this paper was to get more insight in neighbourhood socioeconomic change by using a decomposition method which splits the total observed change into three contributing components: the reordering of neighbourhoods within a given distribution of neighbourhoods in an urban area, the increasing inequality among them, and the growth of incomes across the entire urban hierarchy of neighbourhoods.

This approach, which originates from income mobility research, has been recently applied to studying neighbourhood change (Modai-Snir & van Ham, 2018b). As it was previously used to analyse neighbourhood change processes across 22 metropolitan areas in the US, the first thing to reflect on, is how Dutch neighbourhoods change in comparison with their American counterparts. The US data revealed striking variation in the relative roles of change

components. The roles of the 'growth' and 'inequality' components together accounted for 22% and up to 74% of total change, while in Dutch cities they accounted together for only 12%-27% of total change. As those components are related to increasing inequalities at varying scales, it is straightforward to see how the different settings influence processes of change. Although in Dutch cities those components seem modest, they cannot be neglected. Twenty-seven percent of the total change among Amsterdam's neighbourhoods is due to changes in the distribution of neighbourhood incomes. Also in The Hague and Utrecht these components exemplify the effect of broad-scale societal change on neighbourhoods and urban areas. The relatively large role of the inequality component in Amsterdam and The Hague should be viewed in light of housing policies. Dutch policies are likely to prevent displacement beyond city boundaries and so the within-city inequality component seems to be relatively important; in American superstar cities the 'inequality' component is less dominant, which points to a higher spatial scale at which increasing inequality is absorbed in more liberal housing systems.

The analysis highlights the importance of overall growth in neighbourhood change processes; this effect only appears when observing absolute incomes (which is rarely the practice in neighbourhood change research). In the Dutch context, the figures emphasise how the diverging competitiveness of the Randstad north and south wings has been significant in diverging neighbourhoods' fortunes. In targeting policies at deprived neighbourhoods, it is important to consider not only neighbourhoods' relative standings in their respective urban area but prioritize action amongst the country-wide neighbourhood hierarchy.

The setting of each city can be used to interpret the different importance of change components. Amsterdam is the most globally connected city and it is surprising to see that neighbourhoods in Utrecht were more affected by an overall growth in incomes. The negligent role of increasing inequality in Utrecht can be attributed to the lower proportion of social housing which eliminates an important buffer of gentrification, lower proportions of migrant populations and highest proportions of people with tertiary education. In other words, the population of Utrecht is more homogeneous. The extreme role of inequality in The Hague highlights the role of existent urban divides in changing neighbourhoods during economic restructuring. Reordering processes reflect the changing attractiveness of neighbourhoods in the city and relate to contemporary processes. The inequality component is a reminiscent of spatial disparities in the previous urban cycle. The inequality effect masks the real extent of change and gentrification; this paper shows that in Amsterdam and the Hague gentrification processes are even more widespread than reported in previous papers that did not decompose change (Bailey et al., 2017; Hochstenbach et al., 2015). In Rotterdam, with its logistics-centred economic base the modest role of overall income growth is not unexpected. This may also explain the modest role of inequality in neighbourhood change; increasing income inequality is a feature associated with competitiveness in the global knowledge economy. Despite these differences, all four city-regions share a common spatial pattern of an 'inside-out' reversal; inner city neighbourhoods increased mainly because of the increase in relative positions compared to suburban neighbourhoods; increasing inequality did not play a significant role in this emergent division. This analysis demonstrates the need to decompose change components to fully understand socio-spatial dynamics. Also, it indicates the need to focus on larger geographical areas in the analysis of socio-spatial change, and not only on the space confined by municipal boundaries.

Finally, it should be noted that conclusions are drawn with respect to the data used in this study, of pre-taxed income including benefits. The analysis does not reflect the effect of an

important equalizing mechanism of the Dutch welfare state and may overstate the actual role of increasing inequality in neighbourhood change as reflected by net incomes.

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		Amsterdam		Rotterdam		The Hague		Utrecht	
		metro	city	metro	city	metro	city	metro	city
N neighbourhoods		772	93	453	78	352	104	389	97
Neighbourhood average income 1999	mean	24,909	22,951	23,007	19,685	23,778	22,086	24,547	22,164
	(SD)	(7,209)	(5,983)	(6,286)	(5,229)	(7,560)	(7,144)	(5,981)	(6,613)
Neighbourhood average income 2014	mean	26,133	25,415	23,476	21,769	24,293	24,270	25,903	24,233
	(SD)	(9,452)	(8,684)	(7,053)	(6,761)	(9,936)	(10,789)	(6,677)	(7,386)
% change in average income	mean	5.0	10.6	3.3	12.4	2.3	9.4	7.8	13.2
	(SD)	(22.0)	(20.3)	(22.1)	(30.3)	(24.0)	(29.2)	(26.4)	(30.2)

Table 1 Descriptive Statistics

	Reordering	growth	Polarisation
Amsterdam	73%	11%	16%
Rotterdam	88%	5%	7%
The Hague	77%	3%	20%
Utrecht	79%	17%	4%

Table 2 Relative contributions of neighbourhood change components in each city
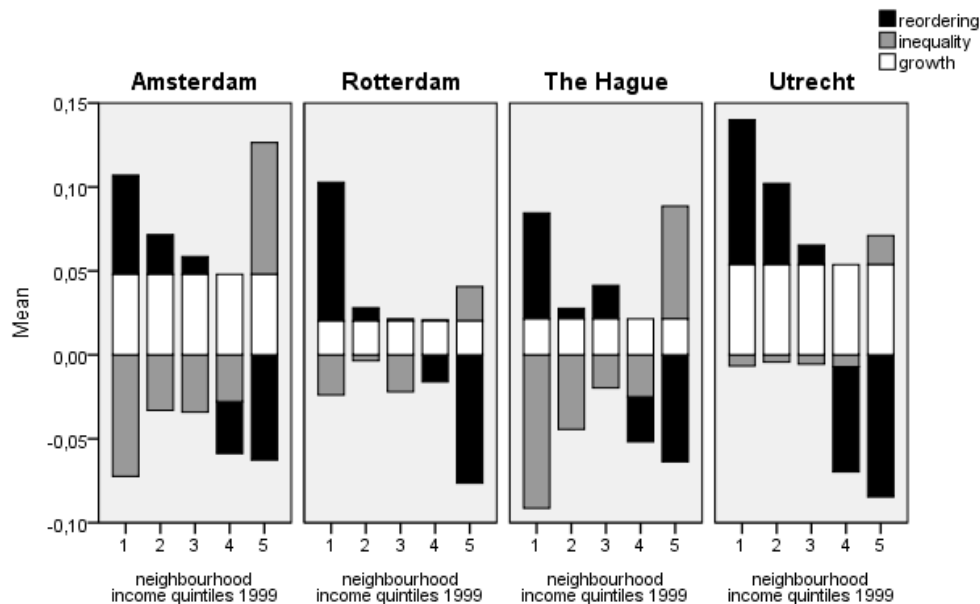

Figure 1 Component contributions across neighbourhood income quintiles of each city
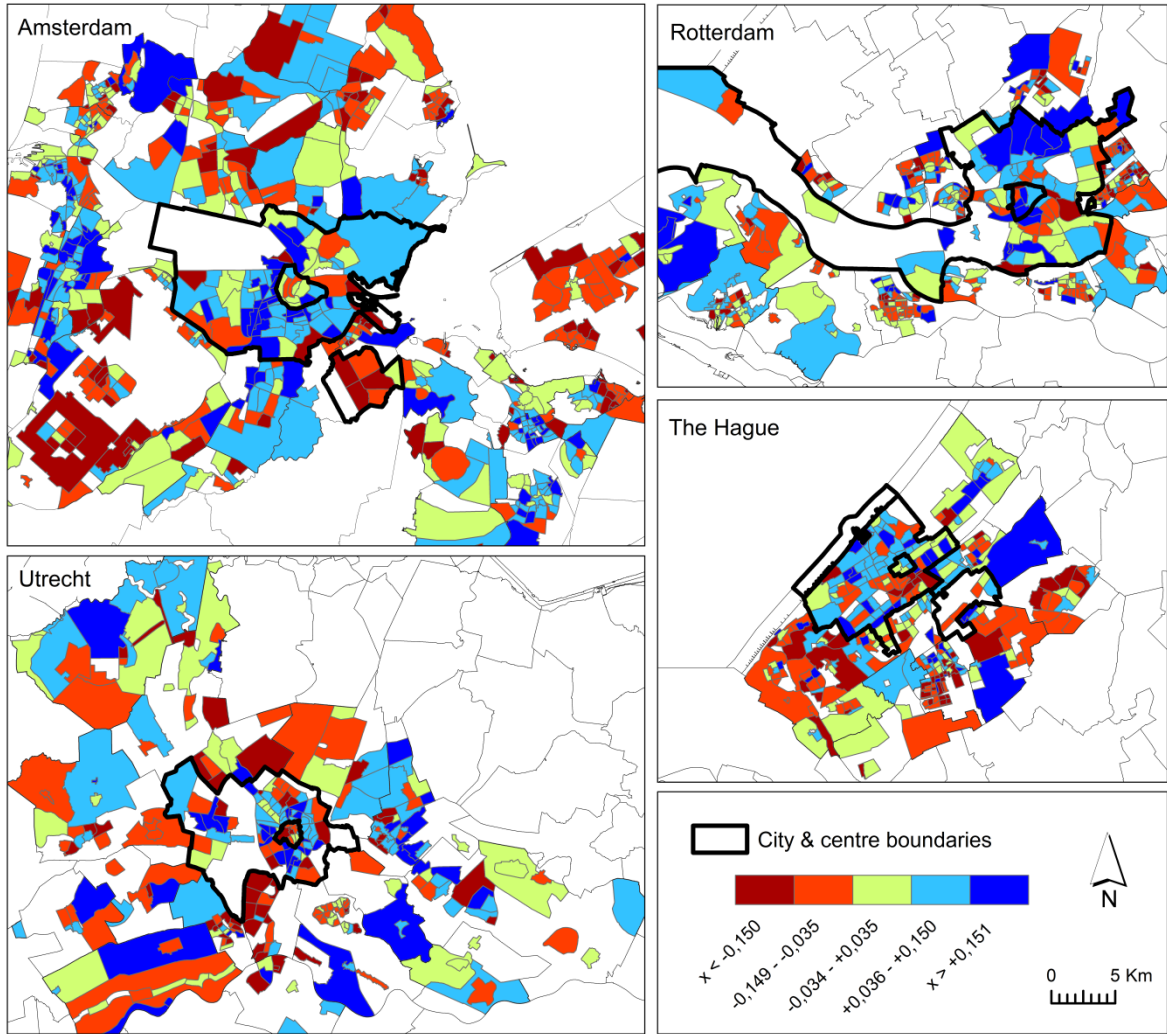
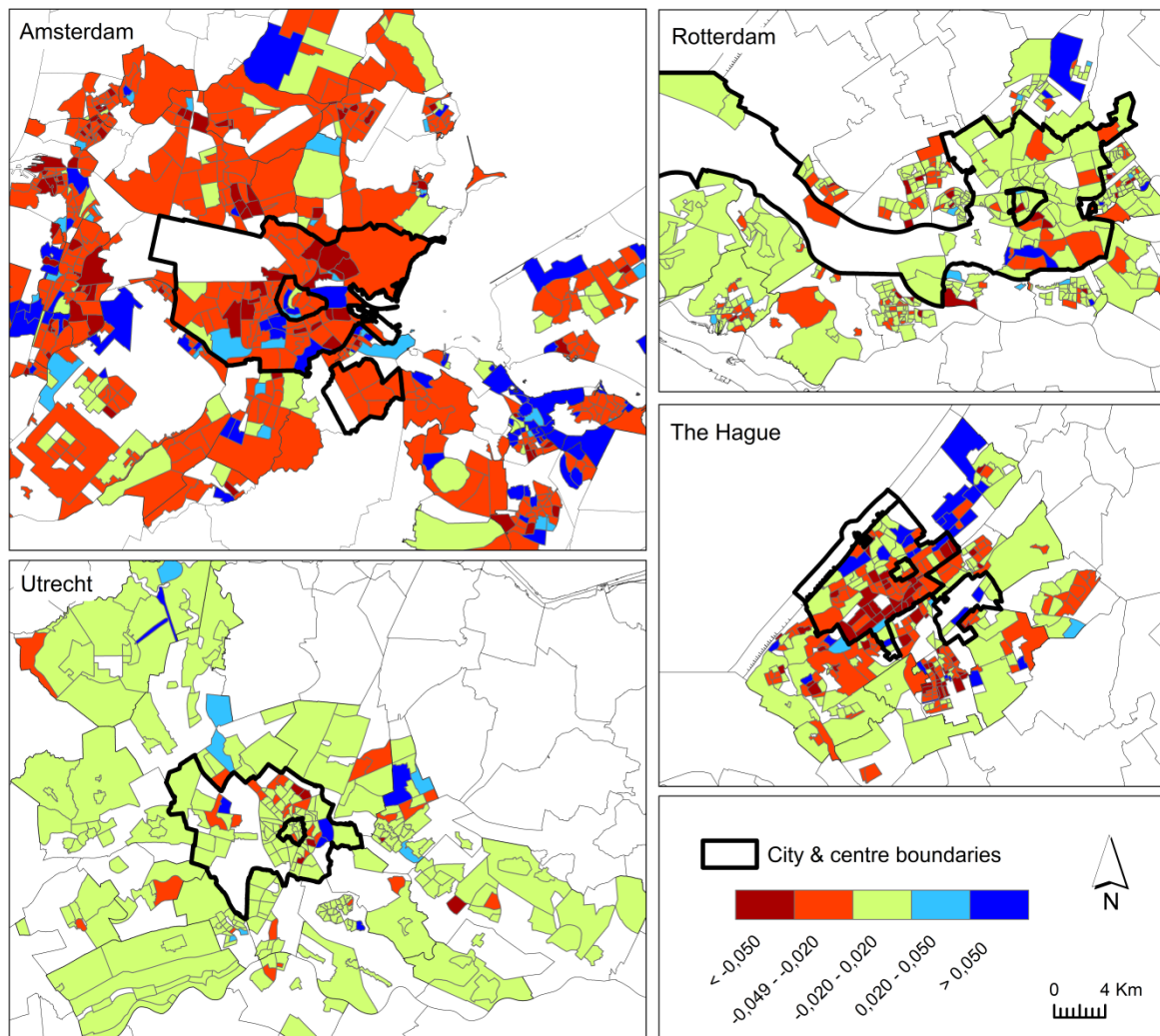**Figure 2 Neighbourhood change due to the 'reordering' component**

Figure 3 Neighbourhood change due to the 'inequality' component