An anatomy of gentrification processes: variegating causes of neighbourhood change

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Abstract. Several theoretical debates in gentrification literature deal with the role and importance of migration, in situ social mobility, and demographic change in urban social change. These debates focus primarily on structural processes. However, we have comparatively little insight into how and to what degree different mechanisms actually underpin upgrading in urban neighbourhoods. This paper uses Dutch register data to show how residential mobility, social mobility, and demographic change each contribute to gentrification in Amsterdam and Rotterdam. First, our findings show that residential mobility remains key to understanding the growth of higher-income residents in gentrifying neighbourhoods. At the same time, social mobility and demographic change— notably ageing—are most important in explaining dwindling numbers of lower-income residents. Second, large differences exist across neighbourhoods. By mapping three ideal-typical drivers of gentrification, we show how the migration-based 'displacement model' occurs predominantly in upgrading neighbourhoods with a high status. Conversely, in low-status upgrading neighbourhoods social mobility is more important in explaining gentrification. These different forms of upgrading occur simultaneously in both cities and should be integrated to advance our understanding of gentrification as a process that is both widespread and occurs in different, ever-changing forms across neighbourhoods.

Keywords: gentrification, social mobility, residential mobility, urban demography, class, residential displacement, neighbourhood upgrading

1 Introduction

Recent debates on urban gentrification have revolved around the question on what is structurally causing the middle-class transformation of North American and European cities. Notwithstanding the literature on neoliberal urbanism and the political economy of capitalism (notably N Smith, 2002), two related debates have dominated conceptualisations of the gentrification process: the displacement versus replacement debate (eg, Butler and Hamnett, 2009, Freeman, 2005; Slater, 2009), and class versus demography debate (eg, Buzar et al, 2007; Davidson and Lees, 2010; Van Criekingen, 2010). To put it simply, disputes revolve around the question of which structural cause is predominant: class politics resulting in displacement, or population shifts related to demography and economic restructuring. As a result, urban and neighbourhood change has been analysed and appraised in light of either position. Yet, strangely, even though positions on structural causation have become highly developed, we have comparatively little insight into the material causes of neighbourhood change:[1] how and to what degree

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[1] The distinction between material and structural processes is based on Aristotelian causality (Abbott, 2004, pages 95–97).

do different processes actually underpin upgrading in urban neighbourhoods, and do they vary for different types of cities. [2]

To explain neighbourhood social change, gentrification studies typically focus on migration and the characteristics of both in-movers and out-movers. Classic definitions refer to the arrival of more affluent middle-class and to lower-income, lower-class residents increasingly moving out (eg, Atkinson, 2000; Newman and Wyly, 2006; Slater, 2006). Yet, residential mobility is insufficient to explain neighbourhood change, and changing migration trends are one of multiple processes causing neighbourhood upgrading. A few studies have stressed the importance of in situ social mobility processes in explaining processes of neighbourhood upgrading and downgrading (eg, Clay, 1979; Teernstra, 2014; Van Criekingen and Decroly, 2003). Likewise, in explaining social change at the urban level, several authors have pointed to demographic shifts in Western European cities (see Buzar et al, 2007), particularly in cities that are performing well economically. Notable shifts include the increased influx of young people, the willingness of middle-class residents to remain in the city after family formation, and the ageing of the traditional working class (see Boterman et al, 2010; Butler and Hamnett, 2009; Rérat, 2012). As life-course processes are unevenly distributed within the city (Musterd et al, 2015a), demographic trends will likely contribute to neighbourhood change and do so unevenly across the city.

These three mechanisms—residential mobility,[3] social mobility, and changing demographics—have become associated with theoretical positions on gentrification, and in some cases become central to the structural debates. This paper sets out to disentangle these processes in an empirical fashion. Our key research goal is to explore the degree to which different forms or models of gentrification can simultaneously take place within single urban contexts. Furthermore, we investigate whether we can discern a spatial logic as to where these models occur within a city. Further insight into material causes may shed new light on current structural readings of gentrification and ongoing theoretical debates. The main research questions are:

(1) To what extent do causal mechanisms related to residential mobility, in situ social mobility, and demographic processes individually contribute to changes in the social composition of upgrading neighbourhoods in Amsterdam and Rotterdam over time (2004–11)?

(2) How are these processes spatially distributed among different neighbourhoods and neighbourhood types in Amsterdam and Rotterdam?

This paper looks at the two biggest cities in the Netherlands: Amsterdam and Rotterdam. The comparative approach serves to account for, and understand, the role of housing-market context in gentrification and upgrading processes (cf Kadi and Ronald, 2014). While both cities have comparable tenure structures and are subject to the same welfare state context, they differ in terms of economic profile. Amsterdam is characterised by a larger share of middle-class households and, consequently, higher levels of housing demand and more cases of gentrification since the early 1980s (Van Gent, 2013). To be clear, Rotterdam certainly has sites of gentrification (eg, Doucet et al, 2011; Karsten, 2007), but the change in erstwhile low-status neighbourhoods has been more visible and pervasive in Amsterdam's central city. We expect that the urban context will impinge upon the prevalence of causal mechanisms of gentrification and their spatial distributions. As gentrification has matured more in Amsterdam, we expect a bigger impact from migration and to see clearer patterns along the outward-expanding frontier.

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[2] We are aware that the terms 'upgrading' and 'downgrading' may be value laden. In our argument, we use these just to describe income gains or losses at the neighbourhood level.

[3] We use the term 'residential mobility' to denote the mechanism as a whole, and 'migration' to describe migration patterns of individuals or (income) groups.

The remainder of the paper is structured as follows. In section 2 on the theoretical framework we will further discuss and investigate the role of residential mobility, in situ processes' and demographic change in facilitating or mitigating gentrification processes. On the basis of this theoretical discussion, we develop three ideal-typical models of upgrading. Then, in section 3 we will further elaborate upon our case selection (Amsterdam and Rotterdam) and our data and methods in section 4. Subsequently, the empirical section 5 will focus on three aspects of neighbourhood gentrification: general causes—or mechanisms— of change, testing the ideal-typical models, and investigating the spatial dimensions related to different models of upgrading. Key findings are summarised in section 6. Lastly, in the conclusion we will reflect on the theoretical implications of our findings.

2 Theoretical framework
In this theoretical discussion we present an overview of the causal mechanisms that can produce—or provide a counterweight to—a change in the residential composition of gentrifying neighbourhoods: migration patterns, in situ income upgrading, and demographic processes. Furthermore, we link these mechanisms to associated theoretical debates—often linked to discussions about the effects of gentrification.

First, throughout the literature, it is argued that distinctive patterns of migration play an essential role in shaping—and defining—processes of gentrification. As a higher-income, better-off population increasingly moves into an area, lower-income residents are slowly replaced or displaced (eg, Atkinson, 2000; Newman and Wyly, 2006; Slater, 2006). The gentrification stage model links neighbourhood upgrading to successive waves of in-movers (Clay, 1979; Kerstein, 1990). Initially, newcomers with a relatively low income may be able to enter the neighbourhood as early 'pioneering' gentrifiers. As they continue to move into the neighbourhood and the upgrading progresses, these early gentrifiers pave the way for successive waves of higher-status in-movers, leading to more mature gentrification and further income upgrading (Kerstein, 1990).

As gentrification matures, it has often been found that the out-migration of lower-income residents is the result of displacement practices (Lyons, 1996; Newman and Wyly, 2006; Slater, 2006). Marcuse (1986) distinguishes between direct and indirect forms of displacement. Exclusionary displacement, an indirect form, does not reflect the out-migration of lower-income residents, but rather the inability of low-income residents to move into gentrified neighbourhood as a result of changing housing-market conditions: for example, higher rents or a reduction in the number of affordable rental dwellings (Boterman and Van Gent, 2014; Millard-Ball, 2002). Some studies have problematised the direct relationship between gentrification and displacement by highlighting that neighbourhood change does not always lead to low-income residents moving out, or have shown that moving away may be beneficial. Ellen and O'Regan (2011), for instance, found that low-income homeowners are more likely to move out of upgrading areas, suggesting that these households capitalised on increased property values (see also Freeman, 2005; Hamnett, 2003; McKinnish et al, 2010).

Second, next to migration, in situ upgrading processes can also contribute to changes in socioeconomic composition. While residential mobility processes can reproduce or further strengthen already existing segregation patterns, some recent studies stress that in situ mobility can simultaneously ameliorate these tendencies (Bailey, 2012; Jivraj, 2013). Still, comparatively little is known about the precise role and importance of in situ mobility in processes of neighbourhood upgrading and downgrading. Upward social mobility of residents can allow gentrification to progress, even when for a prolonged period in-migrating residents are relatively low-income (McKinnish et al, 2010). Teernstra (2014) shows that, in Dutch cities, the in-movers into both upgrading and downgrading neighbourhoods possess incomes

below the neighbourhood average, but subsequently experience comparatively steep income increases. In a study of Athens Maloutas (2004) demonstrates that in situ social mobility does not occur to the same extent in all neighbourhood types. Particularly in working-class neighbourhoods with relatively low levels of residential turnover, in situ mobility comes to the fore as an important driver of neighbourhood composition change.

Previous work also demonstrates that not all residents experience these in situ income gains to the same extent. Instead, young highly educated people will, in particular, show substantial income gains in the period following in-migration. Rose (1984) stresses the role of the 'marginal gentrifier': often low-income, precariously employed, and seeking an affordable place to live. They generally move to (relatively) low-status neighbourhoods, which function as entry points to the city's housing and labour markets (see Robson et al, 2008). Here, successive waves of marginal gentrifiers may follow each other, maintaining a form of marginal gentrification that does not necessarily progress to a more mature status (see Van Criekingen and Decroly, 2003).

Third, neighbourhood change may also result from demographic shifts. Without referring to demography specifically, several authors have noted changing urban populations with constantly increasing numbers of middle-class and upper-class workers, mostly professionals, and a decreasing blue-collar working-class population (eg, Hamnett, 2003; Préteceille, 2007). While these studies emphasise residential mobility and social mobility as main drivers, there also seems to be a notion of a demographic shift whereby an ageing working-class population is being replaced by a younger middle-class group (Buzar et al, 2007). As such, social economic change at the local level is also the result of a 'demographic conveyor' (Bailey, 2012). Indeed, some studies have shown that growing numbers of young people move to the city to study or following graduation; often these young people stay and become the gentrifying middle class (Rérat, 2012; Smith and Holt, 2007).

This life-course perspective on gentrifiers can also be applied to nongentrifiers in some neighbourhoods: change may result from higher death rates among an older working-class population than among a relatively young middle class. Musterd (2014), for instance, found that, as access to housing has become increasingly difficult in Amsterdam, the population in social-rental housing has begun to age. Another Amsterdam study shows that neighbourhood outcomes of young newly formed households are substantially influenced by parental wealth. Inner-city gentrifying neighbourhoods are predominantly accessed by children of wealthier parents (Hochstenbach and Boterman, 2014). These findings suggest that affordable (social-rental) dwellings in Amsterdam's inner centre are relatively inaccessible to lower-class young people as they are often occupied by an ageing group with few moving options.

The demographic replacement of the working-class population contradicts notions of change according to classic neighbourhood life-cycle theory. This theory states that as housing age more affluent households move away and are replaced by lower-income young households, leading to decline or downgrading ['filtering' (Temkin and Rohe, 1996)]. This view does not hold in cases of gentrification, yet ageing of different cohorts of residents may be an important driver of neighbourhood change, in terms of both upgrading and downgrading (Wiesel, 2012). In general, when gentrification takes place is important: while recently gentrifying areas may display a demographic outflow of low income households, long standing gentrifying areas will also see ageing gentrifiers from the baby boomer generation (Bonvalet and Ogg, 2007).

2.1 Synthesis: dominant debates on gentrification

The three causal mechanisms of neighbourhood population change outlined above also inform current theoretical debates on gentrification. One key debate concerns the question of whether population change is mainly due to displacement practices or, alternatively, results

from gradual replacement processes related to demographic changes. The first stresses the necessity to focus on various forms of displacement and the related influx of affluent households (Slater, 2006; 2009). The latter acknowledges the importance of a changing 'urban class map' in cities due to wider economic changes which have led to an overall growth of middle-class professionals—and a decline in working classes from the industrial era (Butler and Hamnett, 2009, page 219).

A second related debate is concerned with the question of whether or not primarily demographic patterns drive reurbanisation (eg, Buzar et al, 2007) as more young people move to the city and prolong their transitory life-stage before settling down. Other studies highlight, besides the demographic dimensions, underlying structural class differences between the long-term working-class residents and the new, young population settling in gentrifying areas (Davidson and Lees, 2010; Van Criekingen, 2010). This is, inter alia, expressed in the latter group's upward social mobility, despite their initial low income.

3 Case studies: housing market and urban context

This paper adopts a comparative approach by investigating Amsterdam and Rotterdam, two cities with different social-demographic and economic profiles. Global connectedness and economic restructuring have led to labour-market changes in both cities. Yet, Amsterdam's economy is strongly service-oriented and more globally connected, while Rotterdam's economic profile remains characterised by a legacy of deindustrialisation (Burgers and Musterd, 2002). Consequently, the average income level is higher in Amsterdam. As such, Amsterdam and Rotterdam can be considered representative examples of cities that have been relatively more and less successful, respectively, in making the transition to a postindustrial economic structure.

In terms of housing market, there are a few important similarities and differences. The tenure structure is roughly similar, with a dominant social-rental sector. Also, in both cities the size of the social-rental sector is gradually decreasing, facilitating gentrification (Boterman and Van Gent, 2014). Yet, in general, Dutch tenants' rights are well protected. Normal rent increases can only be carried out incrementally, meaning that direct forms of displacement tend to be limited (Musterd, 2014; Van Gent, 2013).

The cities are rather different in terms of housing-market demand and accessibility. High levels of demand and population growth have pushed up real-estate values substantially in Amsterdam since the late 1990s, particularly in centrally located neighbourhoods (Teernstra and Van Gent, 2012). In Rotterdam, real-estate values are comparatively lower and show lower growth (CBS, 2013). Furthermore, Amsterdam's large historic centre appeals to the aesthetic preferences of the urban middle class (Bridge, 2001). In Rotterdam the city centre is dominated by postwar offices and housing with prewar residential areas scattered around it. Most poor neighbourhoods are located south of the New Meuse river.

Differences in demand are also expressed in local urban policies. Gentrification is actively pursued by both municipalities to enhance the 'liveability' of low-status neighbourhoods. Yet, while the Rotterdam municipality focuses on attracting and retaining middle-income and higher-income households (Doucet et al, 2011), gentrification in Amsterdam is promoted as a means to adapt the housing market to already-existing demand (Van Gent, 2013).

These factors have an impact on the historical trajectories of gentrification in both cities. Gentrification began in central Amsterdam in the 1970s and has since spread outwards to most prewar neighbourhoods (Van Gent, 2013). In Rotterdam downgrading was, for a longer period, the dominant process in inner-city neighbourhoods, while the high-status neighbourhoods were more peripherally located in the north. In the late 1980s, marginal forms of gentrification in inner-city neighbourhoods began to appear (Meulenbelt, 1994).

More recent studies of Rotterdam have focused on gentrification through urban redevelopment schemes (Doucet et al, 2011; Uitermark et al, 2007).

These cases were selected because the differences in housing and economic context may impact the prevalence of different gentrification processes, underlying mechanisms, and their spatial patterning. Lower housing demand in Rotterdam may result in lower levels of displacement. Notwithstanding newly built sites, gentrification may be caused by a more gradual demographic shift related to deindustrialisation: the blue-collar working class being replaced by the white-collar middle class. Conversely, Amsterdam has been subject to inner-city change for a longer period and attracts more middle-class workers and students. Migration from outside the city and in situ social mobility may therefore play a more important role than demographic shifts.

4 Data and methods
This paper draws on individual-level, longitudinal register data from the Social Statistics Database of Statistics Netherlands to investigate residential mobility, socioeconomic grading, and demographic shifts for the period 2004–11. This period covers sufficient years to chart the effects and importance of these mechanisms.

The dataset includes data on income, household composition, age, and neighbourhood of residence for all individuals who were registered in Dutch municipalities. Our research population consists of all individuals, aged 25–64 years, who lived in Amsterdam or Rotterdam in 2004 and/or 2011. By looking at individuals (rather than households), we are able to track them over time. We focus on the working-age population because we use income as a measure of social class. While income is an important dimension of social stratification, it should be noted that it is not the only one. Unfortunately, we are unable to include political resources, social networks, and education for a substantial population. The focus on income means that pensioners are excluded because their income does not necessarily reflect social economic status. For similar reasons, we have excluded the age group of 18–24 year-olds from the analyses. They are often higher education students and may receive parental support (Hochstenbach and Boterman, 2014). Our dataset does include the young adult cohort in 2004 who remained in or moved into the city. For 2011 they are part of the 25–64 year-old group included, where we assume income levels reflect their social economic status and influence their housing trajectories. Furthermore, self-employed individuals and other members of a household where the main earner is self-employed have been excluded from the analyses, as their registered income is relatively unreliable.[4] Their exclusion constitutes a caveat in our study. The self-employed include successful professionals, entrepreneurs, and shopkeepers, but also low-income service and construction workers living in precarious conditions (Dekker and Kösters, 2011).

This paper measures aggregate upgrading processes and composition changes at the level of statistical neighbourhoods. These neighbourhoods are stable over time and are predominantly delineated by natural boundaries or major roads. To ensure reliable results, we have excluded small neighbourhoods (fewer than 400 individuals)[5] and neighbourhoods with considerable population change due to renewal or construction. The latter were excluded because we are interested in processes taking place in relatively stable built environments.

[4] Their income is highly volatile, in part because many self-employed individuals report (year-to-year) varying incomes to maximise tax returns. In both years, roughly 17% of the 25–64 age group is excluded following this selection criterion.

[5] Excluded areas are rural, business, or industrial with scattered housing, or newly built neighbourhoods. Because of limited moves and changes, small neighbourhoods would result in skewed visualisations and counts in the GIS analyses. We have kept our neighbourhood selection constant for all analyses to enable comparison of figures and tables.

Following these selection criteria—and the exclusion of individuals with missing income data for any one year or living in an institutional household—our dataset consists of a core population of 313 863 (in 2004; 70% of the total number 25–64 year olds in the entire municipality for that year) and 322 234 (2011: 69%) in Amsterdam, and 253 683 (2004: 78%) and 253 481 (2011: 75%) in Rotterdam. The included percentage is higher for 2004, which is the result of excluding neighbourhoods constructed, or substantially expanded, after 2004. For the same reason, the percentage is lower for Amsterdam.

Before analysing migratory, grading, and demographic patterns, we first assessed the initial status of the different neighbourhoods and whether they subsequently showed patterns of upgrading or downgrading. The initial status—high or low—is based on a division between above-average and below-average median income levels in 2004 respectively related to the city average. Similarly, neighbourhoods with an increase in the median income (corrected for inflation) during the period 2004–11 are defined as upgrading. It should be noted that this period also includes the economic crisis of 2008. Preliminary analyses reveal that this slowed income growth in both cities (results not presented). Regardless, multiple neighbourhoods show real income upgrading for the entire period, also after correcting for inflation. Both cities improved their position relative to the rest of the country in recent years in terms of income [but also real-estate values (see CBS, 2013)], although more so in Amsterdam.

After defining our neighbourhood categories, we have used gross-household-income percentiles to group individuals into three income categories: low incomes (the lowest 40%), middle incomes (the middle 30%), and high incomes (the top 30%) for multiple years.[6] As mentioned, income is but one dimension of class. For the sake of interpretation, 'high income' roughly corresponds with upper and upper middle classes, 'middle income' with lower middle classes, and 'low income' with lower classes.

The percentile groups are based on nationwide data. Referencing national income enables a cross-case comparison of Amsterdam and Rotterdam, as well as an assessment of the change in their relative composition over time.[7] These income groups will serve to shed light on the three mechanisms from our theoretical section and on their (net) effect on (changes in) population composition. We also look at the 'share' of the population involved in each mechanism, which can be seen as the relative importance of each mechanism. Colloquially, this share represents the percentage of residents that migrates, experiences social mobility, ages out of/into the core population, or remains stable over time. Figure 1 presents a schematic overview of the causal mechanisms contributing to—or mitigating— neighbourhood composition change. We look at demographic trends through ageing patterns: that is, individuals turning 25 years old and entering the population group, or individuals reaching 65 and, hence, exiting the population group. Deaths are also included in this latter category. In some cases individuals experience a combination of these mechanisms (eg, they migrate and experience social grading). In all these cases, they are grouped within the residential mobility mechanism.

Figure 1 shows all possible processes of composition change, with horizontal lines depicting residential mobility flows and vertical lines representing demographic (ageing) processes. The gentrification literature makes various assumptions with regard to salient mechanisms. In other words, some mechanisms are seen as more important in explaining neighbourhood upgrading than others. On the basis of the literature, we distil three ideal-typical models through which

[6] The delineation of these categories is based on preliminary bivariate correlations between (the level of) neighbourhood grading and the increasing/decreasing presence of individual income decile groups.
[7] An alternative approach is to base income groups on city averages. Major disadvantages are that income groups are no longer comparable between cities and that rising income levels in both cities will shift decile boundaries between 2004 and 2011, leading to mathematically induced downward social mobility.
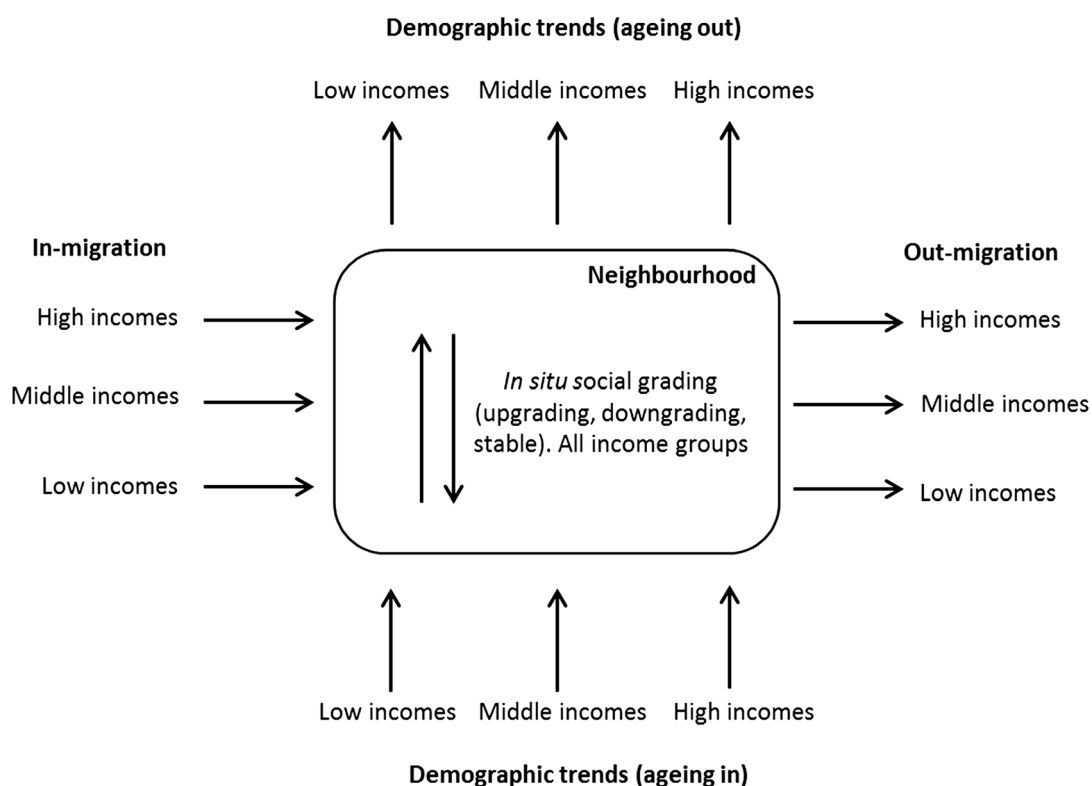
Figure 1. Schematic overview of possible neighbourhood composition change through residential mobility, social mobility, and ageing.

neighbourhood upgrading can occur (figure 2). We define a displacement model, an ageing model, and an in situ social mobility model on the basis of a set of criteria related to the individual mechanisms. For each model, we require both the net effect and the 'share' of each involved mechanism (schematically represented by arrows in figure 2) to exceed average municipal levels. Additionally, the net effect of the mechanisms also needs to reflect upgrading: that is, a net loss of low-income categories or gain of middle-income and high-income individuals. We determine the following three models on the basis of a set of rules:

(1) Displacement model:[8]
  ● Above-average (negative) net effect of migration and an above-average share of migration among low-income residents, and;
  ● Above-average (positive) net effect of migration and an above-average share of migration among middle-income or high-income residents.

(2) In situ social mobility model:
  ● Above-average (negative) net effect and share of social low-income residents who experience in situ upward social mobility (and move to the middle-income or high-income category) while staying in the same neighbourhood.

(3) Ageing model:
  ● Above-average (negative) net effect and share of ageing (out) of low-income residents.

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[8]Although we cannot make definitive claims regarding the occurrence of displacement, the likelihood of any form of particularly direct displacement taking place is greatest for this model of upgrading. For the sake of simplicity, we therefore refer to this model as the displacement model. This does not imply that displacement cannot occur in the other models. Indirect (exclusionary) displacement is to be expected in all three models.
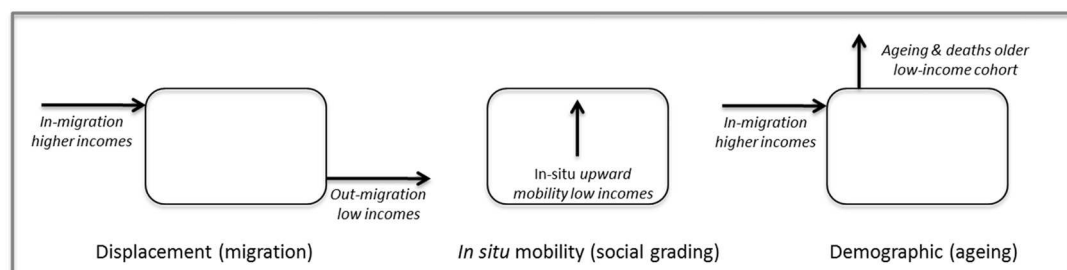
Figure 2. Schematic representation of the salient models that can produce neighbourhood (population) upgrading/gentrification.

We investigate whether these three ideal-typical processes occur in both cities, and to what degree they contribute to social change. Several models can apply in single neighbourhoods, which would imply a volatile neighbourhood population or the existence of different smaller neighbourhoods within a statistical unit. Using GIS, we map the occurrence of these various processes in Amsterdam and Rotterdam. By defining to what extent these different ideal-typical models occur and in which type of neighbourhood, and by mapping these different models, we aim to uncover whether and to what degree multiple causes take place in different city types, and whether there is a spatial logic to these processes.

5 Analyses and results
5.1 Population changes in upgrading and downgrading neighbourhoods
Figure 3 shows the spatial distribution of the four defined neighbourhood categories for both cities. Amsterdam shows a concentrical pattern in which high-status upgrading neighbourhoods are located predominantly in the central city and the southern boroughs. Low-status upgrading neighbourhoods are concentrated mainly in the 19th-century belt surrounding the city centre. Downgrading is mostly found in the outer-ring neighbourhoods (cf Teernstra and Van Gent, 2012). In Rotterdam, low-status upgrading neighbourhoods are fewer in numbers and more scattered, mostly located directly to the east and west of the commercial city centre, or in the vicinity of the Kop van Zuid waterfront development [notably Katendrecht, (A in figure 3)]. High-status upgrading neighbourhoods are found primarily in the more suburban north, the city centre itself, and the renewal area of Hoogvliet in the southwest. Downgrading occurs mainly in the largely postwar areas south of the New Meuse river and in prewar former working-class neighbourhoods west and north of the centre, often right next to upgrading areas. When looking at income groups in these four types of neighbourhoods for the 2004–11 period, we find different patterns of change. Table 1 shows overall population composition for both cities' different neighbourhood types as well as both percentage point and absolute percentage changes in the population composition.

The cities show little difference in their compositions and change. They both testify to a decrease in low-income individuals. Also, both urban populations show nearly identical gains in income (figure not shown). Yet, there is one important difference: Amsterdam shows a greater growth in high-income individuals, both in share and in numbers. This is also reflected by the structurally higher average income level in Amsterdam (figure not shown).

These differences in income category change over seven years are not evenly distributed across neighbourhoods. In particular, low-status upgrading neighbourhoods saw overall decreases in the share of low-income residents. This decrease was stronger in Amsterdam neighbourhoods than in Rotterdam (−5.9 and −4.1 percentage points, respectively). The overall loss of low-income individuals meant a comparable increase in share of middle-income and high-income categories in Rotterdam (1.9 and 2.2 percentage points, respectively).
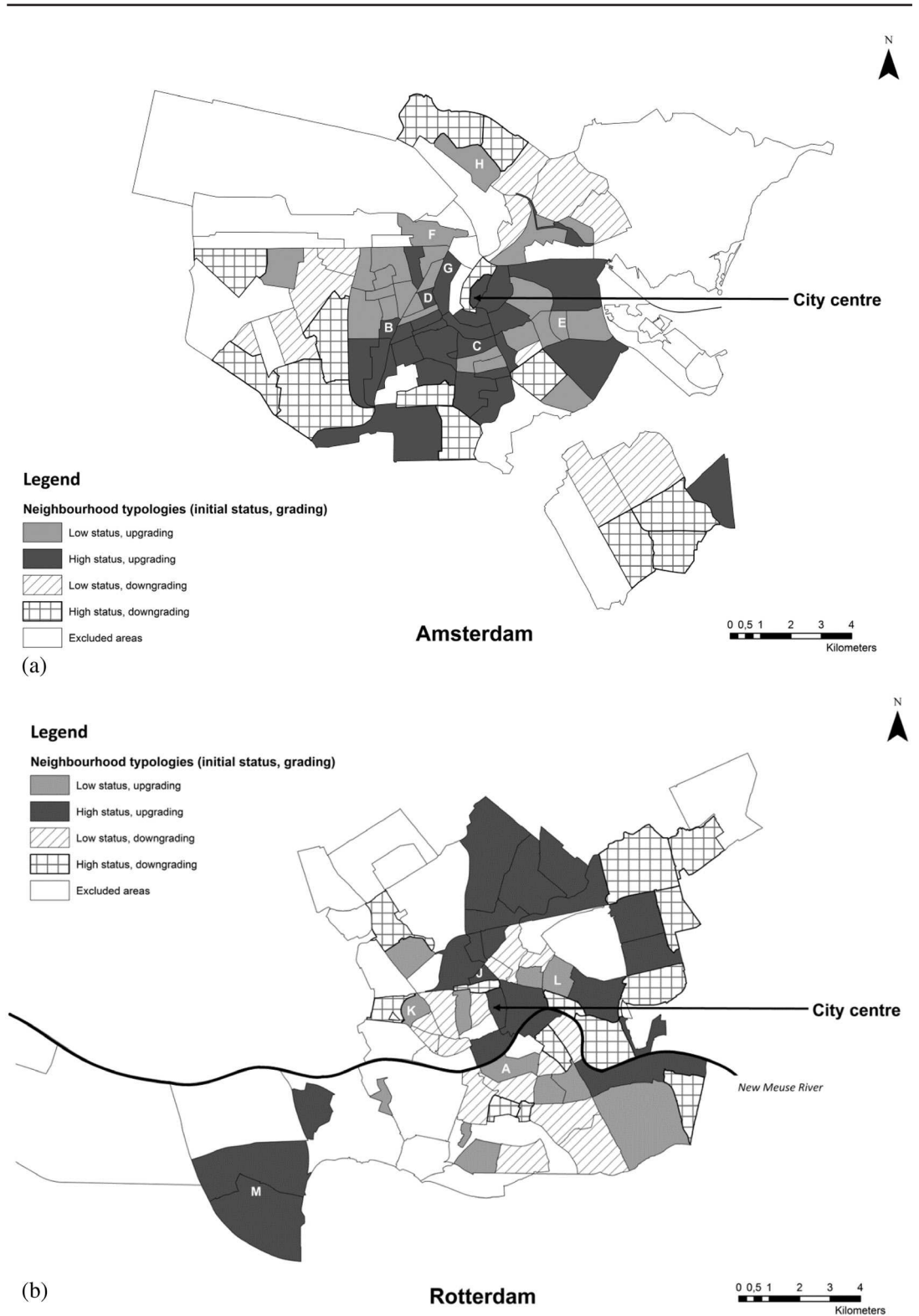
Figure 3. Neighbourhood grading (2004–11) and initial status (2004) in (a) Amsterdam and (b) Rotterdam (source: authors' adaptation of data from the Social Statistics Database).

Table 1. Population composition of the different neighbourhood types in 2004 and 2011 and percentage point and absolute change.

Neighbourhood type	N	2004: income categories (%)			2011: income categories (%)			Percentage change 2004–11			Percentage change 2004–11			Total
		low	middle	high	low	middle	high	low	middle	high	low	middle	high	
Amsterdam														
Low status, upgrading	25	43.0	33.6	23.4	37.1	34.6	28.2	−5.9	1.0	4.9	−10.6	6.6	25.1	3.5
High status, upgrading	29	28.6	28.4	43.0	25.3	27.6	47.2	−3.3	−0.8	4.2	−8.0	1.1	14.1	4.1
Low status, downgrading	11	39.5	33.9	26.6	39.4	35.4	25.3	−0.1	1.4	−1.3	0.6	5.1	−4.1	0.9
High status, downgrading	13	22.3	29.5	48.3	25.3	30.0	44.7	3.1	0.5	−3.6	14.5	2.4	−6.9	0.6
City wide	78	34.6	31.5	33.9	32.1	31.9	36.0	−2.5	0.4	2.1	−4.8	4.1	8.9	2.7
Rotterdam														
Low status, upgrading	12	41.6	34.2	24.2	37.5	36.1	26.4	−4.1	1.9	2.2	−8.4	7.4	11.0	1.7
High status, upgrading	21	23.6	31.9	44.5	21.4	31.5	47.1	−2.2	−0.4	2.6	−7.8	0.2	7.4	1.5
Low status, downgrading	15	44.2	33.1	22.7	43.2	34.1	22.7	−1.0	1.0	0.0	−4.8	0.5	−2.4	−2.5
High status, downgrading	13	23.3	32.0	44.6	26.1	32.9	41.0	2.8	0.9	−3.6	10.9	1.9	−8.9	−0.8
City wide	61	33.3	32.8	33.9	32.0	33.5	34.5	−1.3	0.8	0.6	−4.0	2.2	1.6	−0.1

Amsterdam's low-status upgrading neighbourhoods saw a smaller growth in middle-income (1.0 percentage points) and a substantial growth in high-income individuals (4.9 percentage points). It is notable that the low-status upgrading neighbourhoods in 2011 still host an above-average share of low-income residents compared with both cities. High-status upgrading neighbourhoods show similar trends in both cities, with the share and number of low-income and middle-income residents decreasing in favour of the high-income category. It appears that in these neighbourhoods gentrification matured further and, again, this process was substantially stronger in Amsterdam than in Rotterdam. Overall, it is also notable that in both cities the upgrading neighbourhoods experienced some population growth (final column table 1), while downgrading neighbourhoods saw only a small increase in Amsterdam, and a decrease in Rotterdam.

5.2 Net effects of residential mobility, social mobility, and demographic trends
These trends do not reveal how and to what extent various mechanisms (residential mobility, in situ social mobility, and demographic trends) cause changes in population, either by contributing to one another or by cancelling each other out. Table 2 presents a

Table 2. Net effect (percentile change) of individual mechanisms for individual income categories in different neighbourhood typologies 2004–11 (source: authors' adaptation of data from Social Statistical Database).

| | Amsterdam, 2004–11 | | | | | Rotterdam, 2004–11 | | | | |
| | upgrading | | downgrading | | city wide | upgrading | | downgrading | | city wide |
	low status	high status	low status	high status		low status	high status	low status	high status	
Low incomes										
Net migration	0.7	1.7	3.7	5.8	2.4	1.4	1.5	2.9	5.2	2.7
Net social mobility	−1.0	−0.9	−0.5	0.2	−0.7	−0.7	0.0	−0.9	0.5	−0.3
Net ageing	−4.2	−3.0	−3.0	−2.8	−3.4	−4.2	−3.4	−4.1	−3.1	−3.7
Sum	−4.6	−2.3	0.2	3.2	−1.7	−3.5	−1.8	−2.1	2.5	−1.3
Middle incomes										
Net migration	3.1	2.3	2.5	2.9	2.7	3.8	3.1	0.9	3.3	2.7
Net social mobility (with low)	1.0	0.8	0.8	0.2	0.8	0.8	0.1	1.1	−0.2	0.5
Net social mobility (with high)	−1.0	−0.9	−0.1	0.2	−0.6	−0.6	−0.6	−0.6	0.0	−0.5
Net ageing	−0.9	−1.9	−1.5	−2.5	−1.6	−1.5	−2.6	−1.2	−2.5	−1.9
Sum	2.2	0.3	1.7	0.7	1.3	2.6	0.0	0.2	0.6	0.7
High incomes										
Net migration	4.8	7.0	−0.1	−1.2	3.5	2.3	4.7	−0.7	−1.7	1.3
Net social mobility	1.0	1.0	−0.2	−0.6	0.5	0.5	0.5	0.4	−0.3	0.3
Net ageing	0.2	−1.9	−0.8	−1.6	−0.9	−0.2	−1.9	−0.3	−2.0	−1.1
Sum	5.9	6.1	−1.1	−3.3	3.0	2.7	3.3	−0.5	−4.0	0.5
Sum of total population	3.5	4.1	0.9	0.6	2.7	1.7	1.5	−2.5	−0.8	−0.1

Note: The overall growth or decrease (sum) of each income category differs (slightly) from the percentage point changes presented in table 1. This is because table 2 takes into account overall population growth or decrease in these neighbourhoods.

precise breakdown of how each mechanism has contributed to overall population growth, or decrease, and to shifts in population composition for each neighbourhood type. The net effect of the individual mechanism is calculated for each neighbourhood and for each income category (for the period 2004–11), and is computed as follows: it is the absolute inflow to minus the absolute outflow from the neighbourhood for each mechanism (via in-migration and out-migration, in situ income gains and losses, or ageing in and out). This net balance is subsequently divided by the *total* 2004 neighbourhood population. Thus, the net effect of a mechanism can be read as the percentile change of a single income category relative to the *total* neighbourhood population during the period 2004–11. In table 2 the net effects are aggregated from individual neighbourhoods to the four neighbourhood types. The percentile changes of all mechanisms together add up to the overall population growth or decrease (also presented in the final column of table 1).

To aid interpretation, we will give an example: table 2 gives a net effect of +0.7 for migration of low-income residents living in low-status upgrading neighbourhoods in Amsterdam. This means that more low-income residents moved into than out of these neighbourhoods and that—isolated from other mechanisms and changes in the population size—this would result in a +0.7 percentage point increase in the share of low-income residents living in the neighbourhood. Yet, due to the negative net effects of the other mechanisms—social mobility and ageing—the presence of low-income residents saw a 4.6 percentile decrease. Finally, when taking into account the percentile change of the other income categories (+2.2 for middle incomes and +5.9 for high incomes), we come to an overall population growth of 3.5%. The other figures, for individual mechanisms, income groups, and neighbourhood types, can be interpreted in the same fashion. For all neighbourhood types and in both cities the data show that migration has a positive (net) effect on the number of low-income residents living in the neighbourhood. Hence, residential migration patterns of low-income residents, isolated from all other mechanisms and income groups, do not directly contribute to a decreasing presence of low-income residents in upgrading neighbourhoods. Nevertheless, the positive net effect of low-income migration is substantially greater in downgrading than in upgrading neighbourhoods. This indicates that migration patterns of low-income residents are still distinctively different in upgrading and downgrading neighbourhoods.

The decreasing presence of low-income residents in upgrading neighbourhoods can instead be explained by looking at the two other mechanisms—in situ social mobility and demographic trends. Indeed, particularly in Amsterdam, in situ social mobility contributes to a decrease in the share of low-income residents in low-status and high-status upgrading neighbourhoods. Alternatively, in Rotterdam social mobility only leads to a net decrease of the number of low-income residents in low-status upgrading and low-status downgrading neighbourhoods. Demographic processes, in all neighbourhood types, contribute to the greatest extent to a net decrease in the low-income population. In other words, ageing processes result in a declining low-income working-age population. Furthermore, the (negative) net effect of these demographic patterns is greater in low-status upgrading neighbourhoods than in other neighbourhood types. Nevertheless, since the vast majority of this population remains in the neighbourhood after ageing out of the core population, [9] ageing patterns should be interpreted as a more gradual process resulting in slowly dwindling numbers of low-income residents.

In addition to a net increase in low-income residents, table 2 highlights that migration causes increasing shares of both the middle-income and the high-income population in low-status upgrading neighbourhoods. In Amsterdam, migration accounts for a net percentile

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[9] All residents in the category 'ageing out' have stayed in the neighbourhood, at least in 2011, except those individuals who died.

increase of 3.1 for the middle-income group and of 4.8 for the high-income group in low-status upgrading neighbourhoods. Likewise, in Rotterdam these groups saw a 3.8 and 2.3 percentile increase, respectively. Also, the effects of the other mechanisms—whether positive or negative—are substantially smaller in this neighbourhood type for these income categories. Social mobility leads primarily to an increasing share of high-income residents in these neighbourhoods. The net effects of social mobility on the number of middle-income residents are small in both cities, as the (net) upward mobility of low incomes are cancelled out by a similar net upward mobility of erstwhile middle-income residents.

In sum, our analyses show that residential mobility has a positive net effect on the share of low-income residents in low-status and high-status upgrading neighbourhoods, seemingly providing an initial counterweight to neighbourhood upgrading. Nevertheless, overall, we see a relative decline of low-income residents in both cities, resulting from demographic processes and social mobility. Moreover, residential mobility also plays a substantial role in furthering upgrading processes via substantial net in-migration of middle-income and high-income groups.

5.3 'Share' of residential mobility, in situ social grading, and demographic trends

While individual mechanisms may produce net effects, it is possible that only a relatively small share of the population is actually involved in the mechanisms. To gain a sense of the scale of population dynamics, table 3 presents the 'share' (in percentages) of the residents involved in each individual mechanism. As with the net effects, the share consists of non overlapping, mutually exclusive categories.

Table 3 reveals that migration accounts for a greater share of residents (for all income categories) than in situ social mobility, and ageing and death.[10] In other words, even though the net effects of migration are relatively modest, the mechanism itself accounts for a substantial population overturn. Around 40% of the research population moves neighbourhood at least once in the seven-year period. The moderate net effect and large magnitude imply that residents of the same status replace each other through moving, which essentially dampens any neighbourhood income upgrading or downgrading.

Interestingly, in low-status upgrading neighbourhoods in Amsterdam residential mobility rates among low-income residents are considerably lower than those for other income groups. In Rotterdam the share of migration is slightly higher among low-income residents than for the other categories (for all neighbourhood types). This confirms the notion that higher levels of housing demand in Amsterdam cause lower-income groups to become 'trapped' in their current dwellings and neighbourhoods. Yet, the share of demographic (ageing) processes is greater for the low-income category than for the other income categories, in both cities but, as expected, more so in Rotterdam. Although this share is small compared with migration (around 10%), the above-average out-ageing of the low-income population in particular may shape neighbourhood change.

5.4 Three ideal-typical models and spatial patterns

The previous analyses gave insight into the dynamics involved in producing neighbourhood population change in different types of upgrading neighbourhoods. Focusing on the three previously identified and defined ideal-typical models (see figure 2), it is possible to establish which forms of upgrading are prevalent across each city.

Table 4 shows how often the different models of upgrading can be found in both low-status and high-status upgrading neighbourhoods in Amsterdam and Rotterdam. Although multiple models can be applicable to single neighbourhoods, in the majority of upgrading

[10] This is partly due to our choice to favour migration over other mechanisms. In most cases migration does not coincide with others mechanisms.

Table 3. The share of neighbourhood residents involved in each mechanism of population change for each income category (%) and for each neighbourhood type (2004–11) (source: authors' adaptation of data from the Social Statistics Database).

| | Amsterdam, 2004–11 | | | | | Rotterdam, 2004–11 | | | | |
| | upgrading | | downgrading | | city wide | upgrading | | downgrading | | city wide |
	low status	high status	low status	high status		low status	high status	low status	high status	
Low incomes										
Migration	42.1	46.6	44.7	44.5	44.1	42.5	44.1	43.4	47.0	43.9
Social mobility	11.6	12.2	12.7	14.2	12.3	12.4	14.4	11.6	13.7	12.7
Ageing	9.8	10.5	9.5	10.5	10.0	10.6	12.7	10.4	11.5	11.1
No change[a]	36.4	30.7	33.1	30.7	33.6	34.5	28.8	34.6	27.8	32.3
Sum	100	100	100	100	100	100	100	100	100	67.7
Middle incomes										
Migration	46.6	49.4	43.2	38.4	45.4	40.7	41.8	40.0	40.1	40.7
Social mobility (with low)	11.1	8.6	11.6	8.4	10.1	11.3	7.6	12.2	7.9	9.8
Social mobility (with high)	9.3	11.2	10.4	15.7	11.0	11.2	14.6	11.2	14.9	12.9
Ageing	6.9	7.3	8.5	9.0	7.7	9.0	8.7	8.7	8.9	8.8
No change[a]	26.1	23.4	26.3	28.6	25.8	27.8	27.3	28.0	28.2	27.8
Sum	100	100	100	100	100	100	100	100	100	100
High incomes										
Migration	52.7	54.1	39.8	35.4	47.5	40.5	40.1	37.5	33.1	37.8
Social mobility	15.7	8.8	17.7	12.0	12.5	19.3	11.9	20.8	13.3	15.1
Ageing	5.6	4.9	7.9	5.8	5.7	7.0	5.6	7.2	6.1	6.3
No change[a]	26.0	32.2	34.6	48.8	34.3	33.3	42.5	34.5	47.5	40.8
Sum	100	100	100	100	100	100	100	100	100	100

[a] The category 'no change' represents individuals who did not move to another neighbourhood, remained in the same income category, and were part of the 'core population' (aged 25–64 years) in both 2004 and 2011.

neighbourhoods just one dominant model prevails. The three models occur simultaneously in only one neighbourhood [Westindische Buurt in Amsterdam (B)]. Alternatively, it may be the case that no dominant model can be identified, which indicates that several mechanisms contribute to population change, albeit each one to only a minor extent. This was the case for fifteen upgrading neighbourhoods (14%). The spatial prevalence of the three models in both Amsterdam and Rotterdam is mapped in figure 4. Overall, and key to this paper, the findings reported here suggest there is a clear association between neighbourhood status and dominant model of upgrading in both cities.

Importantly, these data show how the displacement model, in which migration patterns are key to explaining population change, occurs predominantly in upgrading neighbourhoods with an already high status. This association is particularly well highlighted by spatial patterns in Amsterdam [Figure 4(a)]. It shows that the displacement model applies primarily to the affluent southern boroughs, but also to neighbourhoods that have experienced gentrification since the mid-1990s [eg, Oude Pijp (C)]. Similarly, the displacement model also occurs in

Table 4. The absolute number of neighbourhoods in which the different models of upgrading can be found in Amsterdam and Rotterdam (source: authors' adaptation of data from the Social Statistics Database)

	Amsterdam		Rotterdam		Total	
	upgrading		upgrading		upgrading	
	low status	high status	low status	high status	low status	high status
Displacement model	4	16	2	7	6	23
Social mobility model	16	8	8	7	24	15
Ageing model	6	10	4	6	10	16
No dominant process	3	4	1	7	4	11

Note: multiple processes can occur within a single neighbourhood, as can be seen in figure 4.

combination with the ageing and the social mobility model, predominantly in neighbourhoods in the southern and western districts where gentrification has also been occurring for a longer period, and is still ongoing. These neighbourhoods boast a large prewar housing stock and are located in the city centre or the affluent southern boroughs [eg, Da Costabuurt (D)].

The social mobility model, where social upgrading forms an important explanation for decreasing shares of low-income residents, is associated primarily with low-status upgrading neighbourhoods in the Amsterdam context [eg, Indische Buurt (E) in the east and Spaarndammerbuurt (F) in the west]. These neighbourhoods represent current frontiers of gentrification processes in Amsterdam and are subject to a changing population as well as substantial changes in the local housing stock via the privatisation of former social-rental dwellings. The dominance of the social mobility model in these boroughs suggests a relatively large share of upwardly mobile households moving to these neighbourhoods, which may indicate early and more marginal forms of gentrification.

The ageing model can mostly be found in stable, upgrading high-status neighbourhoods— for example, in central neighbourhoods where gentrification has matured and seemingly stabilized [eg, Jordaan (G)]. Low-income groups are even less likely to 'age in' these high-status neighbourhoods, due to restrained accessibility, while older cohorts of low-income residents 'age out'. Alternatively, the ageing model applies to low-status upgrading neighbourhoods located further from the city centre—for example, several garden villages in the north or east [eg, Tuindorp Oostzaan (H)]. These garden villages have only recently begun to show minor tendencies of upgrading, as their ageing populations are slowly changing. Here, liberalisation of the local housing stock enables these processes of upgrading to occur.

In Rotterdam it is more difficult to discern clear spatial patterns of the various models of upgrading. Nevertheless, here too we find the displacement model to be associated primarily with high-status upgrading neighbourhoods. These are, for example, the various high-status upgrading neighbourhoods directly north of the commercial centre [eg, Provenierswijk (J)].

Interestingly, the social mobility model is relatively equally distributed over low-status and high-status upgrading neighbourhoods in Rotterdam (table 4). This model drives upgrading in several (low-status and high-status) neighbourhoods scattered throughout the inner city [eg, Spangen (K), Kralingen-West (L)]. These spatial patterns contrast to the situation in Amsterdam where social mobility contributes primarily to the upgrading of low-status neighbourhoods.
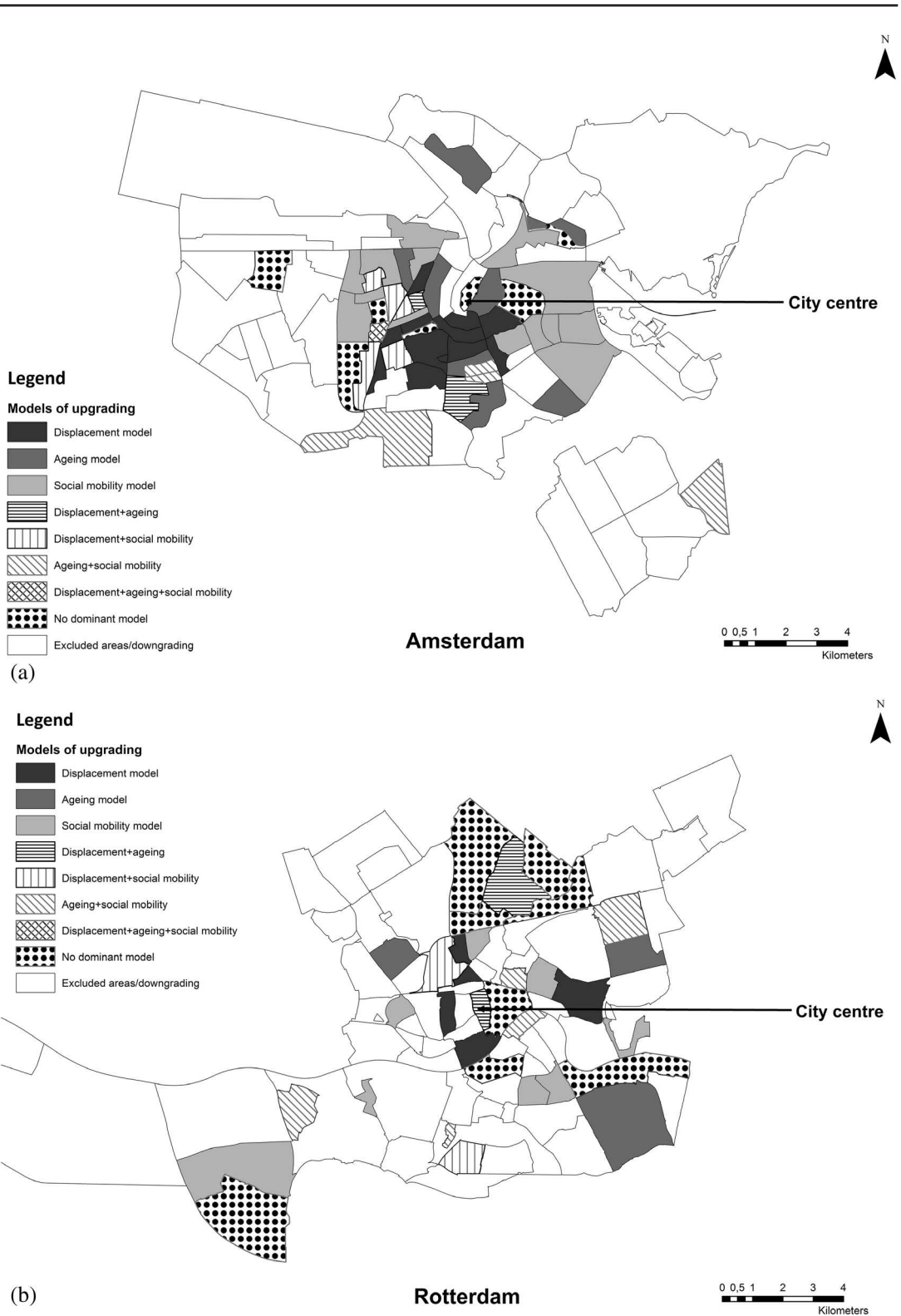
Figure 4. Different (combinations of) upgrading models for each neighbourhood in (a) Amsterdam and (b) Rotterdam (source: authors' adaptation of data from the Social Statistics Database).

Finally, Rotterdam shows comparatively more peripheral neighbourhoods experiencing upgrading. In the affluent, leafy, suburban north most neighbourhoods do not adhere to a specific model of upgrading. This reflects these neighbourhoods' continuous high status and their further increasing affluence. South of the river most neighbourhoods demonstrate downgrading, albeit with a few exceptions. Although it is difficult to identify a causal model of upgrading for these southern neighbourhoods, a closer examination of their characteristics and developments reveals that upgrading is likely due to the conversion of a substantial share of the social-rental stock to owner occupancy during this period.[11] Here, the large-scale renewal of Hoogvliet in the southwest (M) is a case in point (cf Uitermark et al, 2007).

6 Key Findings

In order to contribute to theoretical debates on causes of urban gentrification, this paper has anatomised the material processes involved in producing (different forms of) gentrification at neighbourhood level. Our study highlights how the degree to which material causes (migration, social mobility, ageing, and death) are producing—or alternatively, mitigating—gentrification varies both between different urban contexts and between different neighbourhoods. The influence and effect of these material causes differ between different income categories.

Overall, in upgrading neighbourhoods, we see more low-income residents moving in than moving out. Yet, these areas see a declining share of low-income residents due to social mobility processes and an ageing low-income cohort. Compared with migration, these two gradual shifts have been relatively understudied in analysing gentrification processes. These findings also indicate the importance of selective in-migration of initially low-income, upwardly mobile, residents into these neighbourhoods as well as more general patterns of income improvements over the life course (see discussion on marginal gentrification in the conclusions).

To be clear, residential mobility is by far the most important process in neighbourhood dynamics in terms of magnitude, and directly causes gentrification through the influx of middle-income and high-income residents into specific neighbourhoods. Yet, the modest net effects at the urban scale confirm that residential mobility predominantly reproduces the social economic composition of neighbourhoods, sustaining social segregation (Musterd et al, 2015b; Sampson, 2012).

In addition to dissecting processes, we have charted different forms of gentrification in upgrading neighbourhoods. Our analyses found three ideal-typical models occurring in close proximity to each other in both cities, and doing so beyond the inner city, in a wide range of neighbourhoods across urban space (see Préteceille, 2007; Smith, 2002). While the presented maps may resemble patchwork quilts, we can discern some patterns. The displacement model applies mostly to high-status neighbourhoods, and gentrification in low-status neighbourhoods is characterised mainly by patterns of in situ socioeconomic upgrading. These findings conform to the general trends discussed above and hint at marginal gentrification, where earlier in-migration of upwardly mobile residents delay shifts in the population composition in terms of income (Hochstenbach et al, 2014; Van Criekingen, 2010).

The spatiality of the three models also reflects housing-market differences in both cities. Amsterdam shows clear concentric patterns. The displacement model is confined primarily to the traditionally affluent southern boroughs and adjacent gentrifying neighbourhoods. In the current gentrification frontiers east and west of the centre, change is characterised primarily by in situ social mobility. In Rotterdam, pockets of upgrading are predominantly confined

[11] Housing-tenure register data provided by OBI Rotterdam.

to, either, areas with a relatively large prewar housing stock, or to neighbourhoods where governmental interventions have pushed gentrification through renewal (Uitermark et al, 2007). The association between neighbourhood status and dominant mode of upgrading is less pronounced than in Amsterdam. Here, lower housing costs will likely enable households to better adjust their housing situation to their household situation, while displacement pressures seem comparatively lower in Rotterdam's high-status neighbourhoods.

7 Conclusion

This paper has extended original conceptualisations of gentrification processes to include multiple causes of neighbourhood upgrading. Our analyses show that modes of gentrification vary between neighbourhoods in both cities, and that causation is contingent on both neighbourhood and urban context. These findings inform ongoing and interrelated theoretical debates about gentrification, most notably about the question of whether dwindling numbers of lower-income or working-class residents in gentrifying neighbourhoods are the result of gentrification-induced displacement, or the result of broader, gradual replacement processes (eg, Freeman, 2005; Hamnett, 2003; Slater, 2006; 2009). Furthermore, a second key debate addressed in this paper concerns the need either to focus on the demographic shifts involved in gentrification, or to focus on underlying class dimensions and differences instead (eg, Buzar et al, 2007; Davidson and Lees, 2010; Rérat, 2012; Van Criekingen, 2010). In these core debates the implication is that gentrification, at least when it occurs within a single urban context, can be decisively explained through a single theoretical model of change. In contrast, our findings stress that the different models of upgrading—corresponding to theoretical positions—are varyingly involved in producing gentrification within various neighbourhoods resulting in different forms of gentrification across the city. Therefore, the different models underlying these debates are not contradictory, mutually exclusive, or irrelevant to the study of gentrification. Instead, they should be effectively integrated to advance our understanding of gentrification as an urban phenomenon that stretches far from the inner-city core, that occurs in multiple guises and is liable to change its spots over time. This allows for interpretations of gentrification that simultaneously recognise its widespread nature as well as neighbourhood-level variations in the mechanisms of population composition change, apart from migration.

To advance a more integrated understanding of gentrification, we would like to suggest four avenues for future research. First, this paper uses administrative neighbourhood boundaries to analyse neighbourhood change. These neighbourhoods are comparably large—in many cases exceeding residential perceptions of neighbourhood. As hinted above, some of our neighbourhoods may actually consist of smaller units with each their own dynamic. The ability to take lower levels of scale into account would benefit our type of analysis (see Fotheringham and Wong, 1991; Jivraj, 2013).

Second, while we have emphasised the role of urban context, the national context may also play an important role. The Netherlands presents a highly regulated case with a welfare state legacy which has put a brake on rapid gentrification and direct displacement (Van Gent, 2013). Consequently, neighbourhood upgrading may, to a larger degree, be shaped by more gradual causal processes related to social mobility and ageing. Alternatively, residential mobility may be more dominant in market-oriented contexts.

Third, our study has referred to marginal gentrification and the importance of life course, social mobility, and residential mobility. To understand how these relate to neighbourhood change and displacement, we suggest investigating how individuals move between different neighbourhoods in a series of moves and how these moves link to life-course events and social mobility (see D P Smith, 2002). Such individual-level analyses can provide important insights into the importance of housing and life-course trajectories on neighbourhood change and displacement.

Fourth, our research suggests that different processes take precedence in different stages of neighbourhood development. Direct and indirect forms of displacement become increasingly more likely as gentrification progresses (see Clay, 1979; Kerstein, 1990). As our dataset is limited to a seven-year period, we were unable to examine the temporal dimension in more detail. Yet, as data become available, it becomes possible to investigate changes in material causation over time: for instance, by performing cohort analyses of subsequent waves of in-migrants and out-migrants. This allows for further investigations of the (changing) role of neighbourhoods while they are undergoing gentrification.

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