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ABSTRACT

The Effects of Physical Restructuring on the Socioeconomic Status of Neighborhoods: Selective Migration and Upgrading

In the last few decades, urban restructuring programs have been implemented in many Western European cities with the main goal of combating a variety of socioeconomic problems in deprived neighborhoods. The main instrument of restructuring has been housing diversification and tenure mixing. The demolition of low-quality (social) housing and the construction of owner-occupied or private-rented dwellings was expected to change the population composition of deprived neighbourhoods through the in-migration of middle and high income households. Many studies have been critical with regard to the success of such policies in actually upgrading neighborhoods. Using data from the 31 largest Dutch cities for the 1999 to 2013 period, this study contributes to the literature by investigating the effects of large-scale demolition and new construction on neighborhood income developments on a low spatial scale. We use propensity score matching to isolate the direct effects of policy by comparing restructured neighborhoods to a set of control neighborhoods with low demolition rates, but with similar socioeconomic characteristics. The results indicate that large-scale demolition leads to socioeconomic upgrading of deprived neighborhoods through the in-migration of middle and high income households. We find no evidence of spillover effects to nearby neighborhoods, suggesting that physical restructuring only has very local effects.

JEL Classification: O18, P25, R23

Keywords: urban restructuring, neighborhood change, selective migration, demolition

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Introduction

Many Western European governments have a long tradition of urban restructuring programs to regenerate deprived neighborhoods. In the Netherlands, many post-war neighborhoods, in particular, have experienced rapid processes of decline, evidenced by a combination of housing deterioration and socioeconomic problems such as high crime rates, high unemployment rates, and concentrations of poverty. In response, the Dutch government implemented urban restructuring programs that mainly focused on housing diversification in deprived areas that were dominated by social rented housing. Through the demolition of low-quality social housing and the construction of more expensive owner-occupied or private-rented dwellings, policy-makers aimed to create a socioeconomic mix of residents in these deprived neighborhoods. The in-migration of middle-class households in these neighborhoods was thought to lead to a process of socioeconomic upgrading (Kleinhans, 2004; VROM, 1997). The socioeconomic upgrading of these previously deprived neighborhoods was thought to have positive spill-over effects on nearby neighborhoods, by improving the housing market position, reputation, and attractiveness of the larger geographical area (cf. Deng, 2011; Ellen and Voicu, 2006).

Many studies have since been critical about the effectiveness of urban restructuring policies in actually achieving neighborhood change (e.g. Lawless, 2011; Permentier et al., 2013; Tunstall, 2016; Wilson, 2013). It has been argued that although urban restructuring has led to a physical upgrading of neighborhoods and a diversified population composition as a result of selective migration, it has failed to lead to significant changes in the socioeconomic status of neighborhoods (cf. Bailey and Livingston, 2008; Jivraj, 2008; Permentier et al., 2013; Tunstall, 2016; Wilson, 2013). One possible explanation for the lack of neighborhood change is that, in some cases, the original residents moved back into the restructured neighborhood (Kleinhans and Van Ham, 2013). Another explanation is that the size and scope of restructuring differed between neighborhoods. In many cases, only parts of neighborhoods were targeted for restructuring which meant that the rest of the neighborhood remained largely unchanged (cf. Dol and Kleinhans, 2012). Both explanations imply that the extent of in-migration of higher income groups has been too limited to stimulate neighborhood upgrading. In addition, many studies analyzing the effects of physical restructuring have focused on relatively large administrative areas, which means that the effects have to be large to change the trajectory of the entire neighborhood. A fourth explanation for the lack of neighborhood change is often overlooked in the current literature; research has shown that neighborhoods are rather slothful, which means that significant changes take time to have effect (Meen et al., 2013; Tunstall, 2016; Zwiers et al., 2016a; Zwiers et al., 2016b). Prior studies on urban restructuring have been limited by a relatively short-time perspective, ranging from one to six years (e.g. Lawless, 2011; Permentier et al., 2013; Wittebrood and van Dijk, 2007), while it is possible that the effects of physical restructuring will only be visible over a much longer period of time.

The present study therefore analyzes to what extent large-scale demolition and new construction leads to neighborhood upgrading and to what extent this physical restructuring of deprived neighborhoods has stimulated processes of selective migration on a low spatial scale over a 14-year period. Our contribution to the literature is fourfold: (1) we analyze neighborhood change on a relatively low spatial scale, i.e. 500 by 500 meter grids, which allows us to better capture the effects of very localized demolition and new construction; (2) our long-term perspective provides insight in the effects of selective migration over and beyond the course of the restructuring programs and the extent to which restructured neighborhoods have been successful in maintaining and attracting middle and higher income groups over time; (3) we use propensity score matching to compare neighborhoods that experienced physical restructuring to neighborhoods with similar socioeconomic characteristics that did not, allowing us to better capture the causal effect of physical restructuring on neighborhood change; (4) we analyze to what extent physical restructuring has had positive spillover effects on nearby neighborhoods.

Physical restructuring and selective migration

Neighborhoods are very dynamic in their population composition as a result of residential mobility and demographic events, however, neighborhood status tends to be relatively stable over time (Tunstall, 2016; Zwiers et al., 2016a; Zwiers et al., 2016b). This can be explained by the fact the housing stock tends to remain unchanged after initial construction (e.g. Meen et al., 2013; Nygaard and Meen, 2013; Zwiers et al., 2016a). Next to less frequent cases of gentrification or decline, this spatial lock-in implies that processes of residential mobility often do not lead to neighborhood change, as households with similar socioeconomic characteristics move in and out of these neighborhoods, thereby maintaining the status quo over longer periods of time (Meen et al., 2013; Zwiers et al., 2016a). Physical restructuring has however the potential to induce neighborhood change by fundamentally changing the housing stock and stimulating selective migration (Meen et al., 2013).

Over the past few decades, many Western European governments have indeed used physical restructuring as a tool to combat processes of decline in deprived neighborhoods. Although urban restructuring often consisted of both people-based and place-based programs, most restructuring policies were strongly focused on the housing stock and aimed to create a social mix in deprived neighborhoods through housing diversification (Kleinhans, 2004). Housing diversification was achieved through the demolition, upgrading or sales of low-quality social rented or council housing and the construction of new upmarket owner-occupied or private-rented housing in order to attract a more affluent, middle-class population. The inflow of higher income groups as a result of these tenure changes was expected to lead to the socioeconomic upgrading of these deprived neighborhoods (Kleinhans, 2004; VROM, 1997).

However, studies evaluating area-based urban policies have been critical about the effectiveness of restructuring in generating processes of neighborhood upgrading through selective migration (e.g. Lawless, 2011; Permentier et al., 2013; Tunstall, 2016; Wilson, 2013). While some studies have found small positive effects in terms of selective migration as a result of restructuring (Bailey and Livingston, 2008; Jivraj, 2008; Permentier et al., 2013; Wittebrood and Van Dijk, 2007), others have found that selective migration can lead to increasing concentrations of poverty in restructured neighborhoods (cf. Andersson and Brama, 2004; Jivraj, 2008) or elsewhere (Andersson, 2006; Andersson et al., 2010; Posthumus et al., 2013).

In the current literature, it is thus unclear to what extent physical restructuring affects selective migration and how this contributes to positive neighborhood change. Researchers have argued that the effectiveness of physical restructuring in generating neighborhood change depends on the size and scope of these policies (Jivraj, 2008; Nygaard and Meen, 2013; Tunstall, 2016). Major demolition and new construction is necessary to change the trajectory of a neighborhood (Bolt et al., 2008; Nygaard and Meen, 2013; Tunstall, 2016). In many cases, only parts of neighborhoods were targeted for restructuring, which means that the rest of the neighborhood remained unchanged (cf. Dol and Kleinhans, 2012). This could lead to a (temporary) in-flow of higher income groups in the newly constructed part of the neighborhood, however, this might not be enough to stimulate the upgrading of the entire neighborhood. At the same time, many residents from demolished dwellings have moved within the restructured neighborhood, thereby impeding neighborhood change (Kleinhans and Varady, 2011; Kleinhans and Van Ham, 2013; Posthumus et al., 2013). When a large proportion of the low-income residents moves within the restructured neighborhood, a greater share of middle and higher income groups moving into the restructured neighborhood is needed to generate neighborhood change. Moreover, the effects of physical restructuring might only be visible over a longer period of time as neighborhood change takes long to take effect (Tunstall, 2016; Zwiers et al., 2016a). The effectiveness of restructuring depends on the ability of restructured neighborhoods to maintain and attract middle and higher income groups over time. As renovated or newly constructed dwellings age over time, continuous investments are necessary to maintain a certain housing quality (Weber et al., 2006). If unsuccessful, positive effects might be visible at first, however over time, new processes of decline might become apparent leading to the out-migration of middle- and high-income households (Musterd and Ostendorf, 2005).

The question remains to what extent physical restructuring has effects outside those areas which were directly targeted for demolition and new construction. First of all, several researchers have been concerned with processes of displacement. As the share of affordable housing is reduced in restructured neighborhoods this forces low-income households to find affordable housing elsewhere (Atkinson, 2002; Posthumus et al., 2013). This process of displacement might lead to increasing concentrations of poverty in other deprived neighborhoods (Bolt and Van Kempen, 2010; Posthumus et al., 2013). Second of all, US studies have found evidence for positive spillover effects of physical restructuring. Changes to the housing stock in deprived neighborhoods might improve the reputation and attractiveness of the entire area, leading to positive spillover effects on house prices in nearby neighborhoods (Deng, 2011; Ellen and Voicu, 2006).

The present study explores three hypotheses. First, it can be assumed that neighborhoods that have experienced large-scale demolition and new construction, resulting in a substantially different housing stock, have seen more positive change in the average neighborhood income over time than control neighborhoods with similar socioeconomic characteristics that have experienced little physical restructuring. Second, we expect that this process of neighborhood upgrading in restructured neighborhoods can be explained by the gradual out-migration of low-income households and the in-migration of middle- and high-income households. Third, it could be hypothesized that neighboring areas experience positive spillover effects as a result of the upgrading of restructured neighborhoods. Improvements to the housing stock are likely to improve an area's reputation and lead to rising house prices. We thus might also expect an increased inflow of higher income households in neighborhoods surrounding restructured neighborhoods.

Data and methods

This study used longitudinal register data from the System of social Statistical Datasets (SSD) from Statistics Netherlands. We have data on the full Dutch population from 1999 to 2013. Neighborhoods are operationalized using 500 by 500 meter grids. These grids consist of approximately 500 residents on average. To analyze neighborhood change over time, we focused on the yearly average household income adjusted for inflation in a neighborhood. To ensure the comparability of household incomes across different household types, an equivalence factor was used. We have divided household income by the square root of household size. Conceptually, this means that a four-person household has twice the needs of a single-person household (OECD, 2013).

We focus on neighborhoods that have experienced substantial restructuring, as we know that major restructuring is necessary to generate neighborhood change (Bolt et al., 2008; Nygaard and Meen, 2013; Tunstall, 2016). We specifically focus on the total number of demolished dwellings as demolition has been the main tool of urban restructuring in the Netherlands (Kleinhans, 2004). Our measure of demolition includes demolition, renovation and new construction. We have selected neighborhoods that have experienced more than one standard deviation above the average total number of mutated dwellings between 1999 to 2013. This has resulted in a total of 393 neighborhoods. To test for spillover effects, we have used queen criteria to identify adjacent neighborhoods, selecting all neighborhoods that share a boundary with the restructured neighborhoods. We have identified a total of 921 adjacent neighborhoods. Propensity score matching was used to identify control neighborhoods. Propensity score matching is used to create matched sets of treated and untreated subjects with similar propensity scores (Rosenbaum and Rubin, 1983). The propensity score is the probability of treatment conditional on a number of observed baseline characteristics (Austin, 2011). This study used the average equivalized household income in 1999, the share of unemployed individuals in 1999, the number of households in 1999 and the share of rented dwellings in 1999 as baseline covariates. Unemployment was defined as receiving unemployment or social assistance for a full year or longer. As we are unable to distinguish between social rented housing and private rented housing in the data, the share of rented dwellings included both, although the majority of rented housing in the Netherlands is social housing (Statistics Netherlands, 2014).

Control neighborhoods were constrained to have experienced below average physical mutations between 1999 to 2013, with the main goal of isolating the effects of physical restructuring on neighborhood change. We have used nearest neighbor matching with replacement, which means that restructured neighborhoods were matched with control neighborhoods with the closest propensity score (Rosenbaum and Rubin, 1985). Matching with replacement implies that each control neighborhood can be used as a match more than once, which is particularly useful for the present study as there are only a limited number of neighborhoods that could function as a suitable control group (Wittebrood and Van Dijk, 2007). We have identified 142 control neighborhoods. For comparability, these neighborhoods were selected from the 31 largest cities within the Netherlands. Control neighborhoods were not allowed to neighbor restructured neighborhoods. Neighborhoods with fewer than 10 residents have been excluded from the analyses.

To reduce selection bias it is important that the covariates are balanced between the treated and untreated subjects. We found no significant mean differences between the control neighborhoods and the restructured neighborhoods in the average household income in 1999, the share of unemployed individuals in 1999 and the share of rented dwellings in 1999 (results not shown). There was a significant mean difference in the number of households in 1999. Inspecting the distribution of the explanatory variables with quintiles of the propensity scores proved that the baseline covariates were balanced between the restructured and control neighborhoods (cf. Austin, 2009). The only exception here is the number of households in 1999, where we find a discrepancy in the number of households between the restructured and control neighborhoods, especially in the fourth and fifth propensity score quintile. However, excluding this variable from the propensity score model leads to severe imbalances in the other covariates (results not shown). We therefore keep the number of households in 1999 as a baseline covariate in the propensity model.

The number of households in 1999 was associated with both our neighborhood groups and our outcome variable. As mentioned above, the number of households in 1999 was imbalanced between groups. The number of households measures the density in a neighborhood, but can also be understood as a measure of the potential for change: higher density is generally associated with less change over time. As such, this confounding variable distorted the relationship between our neighborhood groups and the change in the average neighborhood income. The inclusion of the number of households as a control variable substantially changed the regression coefficients as the differences between neighborhood groups became larger and statistically significant (results not shown). We have therefore examined the distribution at different levels of the number of households in 1999. We have created five strata based on quintiles of the number of households in 1999, which are presented in Table 1.

Table 1. Descriptive statistics of the five strata based on quintiles of the number of households in 1999

	Stratum 1	**Stratum 2**	**Stratum 3**	**Stratum 4**	**Stratum 5**
% Restructured neighborhoods	0.25	0.76	8.14	18.32	72.52
% Control neighborhoods	8.45	9.15	11.27	24.65	46.48
% Adjacent neighborhoods	6.19	13.36	17.59	26.28	36.59
% All other neighborhoods	25.92	23.69	22.08	18.50	9.80
Average number of households 1999	23.84 (10.38)	113.69 (44.95)	327.49 (75.98)	614.32 (96.91)	1308.76 (565.12)
Average change in equivalized neighborhood income (corrected for inflation)	3503.82 (8621.51)	2862.44 (5693.33)	1588.94 (3092.66)	888.88 (2362.96)	917.36 (2564.42)
N	**1083**	**1065**	**1073**	**1072**	**1071**

Note: Standard deviations in parentheses.

The majority of restructured neighborhoods fall into the fifth stratum (72.52%), while the share of control neighborhoods (46.48%) and adjacent neighborhoods (36.59%) is much lower. The share of all other neighborhoods that fall into the fifth stratum is disproportionally lower; 9.80%. In addition, the change in the average neighborhood income also differs between strata, which illustrates the confounding effect of the number of households on the relationship between the neighborhood groups and change in the average neighborhood income. As a result, the relationship between the neighborhood groups and change in the average neighborhood income is distorted. We therefore conducted a stratified analysis of five OLS regression models with robust standard errors to explain changes in the average neighborhood income over time. There was some multicollinearity between the neighborhood groups in models for the first and second strata because of the small group size of the restructured neighborhoods and the control neighborhoods. For these models, these two groups have therefore been combined into one group. The residuals showed some deviations from normality. There was however no clear indication of heteroscedasticity and the results from the regression with OLS standard errors did not differ substantially from the results from the regression with robust standard errors. However, the OLS standard errors of the most important predictors were larger than the robust standard errors in the fourth and fifth strata, which suggests that the OLS standard errors were biased upward. As such, we decided to report the results from the OLS regression with robust standard errors.

To analyze patterns of selective migration, we focus on the net migration rates of different income groups. Based on the national household income distribution, we have created three income categories: low-income groups (the lowest 40%), middle-income groups (the middle 30%), and high-income groups (the top 30%) (see also Hochstenbach and Van Gent, 2015). In this study, migration is defined as the move out of a grid into a different grid (so moves within grids are ignored). We compare the population composition at the beginning of each year (January lst) to the population composition at the beginning of the following year. This implies that multiple moves within a year are ignored. Net migration rates are compared between restructured neighborhoods, adjacent neighborhoods, control neighborhoods, and the rest of the neighborhoods in the 31 largest Dutch cities.

Results

Table 2 presents the descriptive statistics of the restructured neighborhoods, the adjacent neighborhoods, the control neighborhoods, and the rest of the Netherlands.

Table 2. Descriptive statistics of the different neighborhood groups, 1999-2013.

	All other neighborhoods	**Restructured neighborhoods**	**Adjacent neighborhoods**	**Control neighborhoods**
Average neighborhood household income 1999	33586.79 (10635.23)	22210.04 (3218.76)	26643.43 (6995.28)	22513.82 (5986.92)
Average neighborhood household income (equivalized) 1999	22535.27 (6693.20)	16735.07 (2498.67)	19456.64 (4322.46)	16396.21 (4215.16)
Average % unemployed 1999	5.90 (6.25)	16.05 (6.68)	10.65 (7.82)	16.55 (17.55)
Average % rented dwellings 1999	41.60 (27.19)[d]	80.55 (15.96)	64.86 (24.94)[a]	79.16 (19.15)
Average number of households 1999	325.83 (356.73)	1312.72 (808.77)	715.81 (561.74)	774.75 (502.19)
Average neighborhood household income 2013	51059.92 (18429.70)	35125.92 (7655.25)	40067.19 (14123.84)	34129.84 (17060.72)
Average neighborhood household income (equivalized) 2013	34486.66 (11068.17)	26127.70 (5657.34)	29282.52 (9154.23)	25350.69 (13173.47)
Average neighborhood household income (equivalized), adjusted for inflation 2013	24742.40 (7910.57)	18319.01 (3799.37)	20672.64 (6365.70)	17209.25 (5702.81)
Average % unemployed 2013	4.42 (4.53)	9.82 (4.95)	7.77 (5.61)	10.68 (6.60)
Average % rented dwellings 2013	40.12 (23.13)[e]	67.93 (14.39)	59.51 (21.27)[b]	69.27 (19.05)[c]
Average number of households 2013	355.99 (377.18)	1293.67 (825.01)	780.30 (594.96)	801.38 (522.61)
Average demolished dwellings 1999-2013	7.01 (16.59)	291.91 (190.28)	25.69 (33.41)	5.51 (7.80)
Average difference in neighborhood equivalized household income 1999-2013 (adjusted for inflation)	2207.13 (5593.12)	1583.94 (2576.90)	1216.00 (3972.30)	813.04 (5219.22)
N	**3908**	**393**	**921**	**142**

Note: Standard deviations in parentheses. Grids with less than 10 households have been excluded from the analyses.
[a] N = 918 [b] N = 920 [c] N = 140 [d] N = 3802 [e] N = 3869

The average equivalized neighborhood household income in the restructured neighborhoods was 16,735 euros in 1999. The average equivalized neighborhood household income was higher in the adjacent neighborhoods, 19,456 euros, and slightly lower in the control neighborhoods, 16,541 euros. The average equivalized neighborhood household income was much higher in the rest of the Netherlands, 22,535. The average share of unemployed individuals was 16.05% in the restructured neighborhoods, compared to 10.65% in adjacent neighborhoods and 16.11% in the control neighborhoods. These shares are far above the average share of unemployed individuals in the rest of the rest of the country; 5.90%. These descriptive figures indicate that neighborhoods that have experience large-scale demolition and new construction were among the most disadvantaged neighborhoods of the country. The average share of rented dwellings in 1999 was 80.55% in the restructured neighborhoods, which was similar to the average share of rented dwellings in the control neighborhoods, 79.16%. The average share of rented dwellings in the rest of the country was almost half of that in the restructured neighborhoods: 41.60%. The average share of rented dwellings in the adjacent neighborhoods was 64.86%. The restructured neighborhoods were highly populated areas: the average number of households in 1999 was 1,312.72, compared to 774.75 in the control neighborhoods, 715.81 in the adjacent neighborhoods, and 325.83 in the rest of the country.

In 2013, the average equivalized neighborhood household income adjusted for inflation increased to 18,319 euros in the restructured neighborhoods. This means that, after adjusting for differences in household size and inflation, the average neighborhood income has increased with 1,583 euros. This increase is more than twice that of the increase in the control neighborhoods: the 2013 average neighborhood household income increased to 17,209, reflecting an average increase of 813 euros. The average neighborhood household income in the adjacent neighborhoods increased with 1,216 euros to 20,672. All other neighborhoods in the Netherlands experienced an average increase of 2,207 euros leading to an average neighborhood household income of 24,742. The average share of unemployed individuals dropped in all areas. The average unemployment rate declined to 9.82% in the restructured neighborhoods, compared to 10.68% in the control neighborhoods, 7.77% in the adjacent neighborhoods, and 4.42% in the rest of the country. The average number of households remained relatively stable in all grids: in 2013, the average number of households was 1293.67 in the restructured neighborhoods, 801.38 in the control neighborhoods, 780.30 in the adjacent neighborhoods, and 355.99 in the rest of the Netherlands.

The average number of demolished dwellings between 1999 and 2013 was 291.91 in the restructured neighborhoods and the average share of rented dwellings decreased to 67.93% in 2013, reflecting an average reduction of almost 15%. The average number of demolished dwellings in the control neighborhoods was much lower: 5.51. However, the average share of rented dwellings also decreased substantially in these neighborhoods: from 79.16% to 69.27%. The average number of demolished dwellings was 25.69 in adjacent neighborhoods and the average share of rented dwellings decreased to 25.69%. The average number of demolished dwellings was 7.01 in the rest of the Netherlands, and these neighborhoods have also experienced a small decrease in the average share of rented dwellings: from 41.60% in 1999 to 40.12% in 2013. While the decrease in the share of rented dwellings in the restructured neighborhoods can most likely be ascribed to physical restructuring, the decrease in the share of rented dwellings in the other neighborhoods can be the result of other factors. As the Dutch policy of urban restructuring went hand-in-hand with the liberalization of the housing market, homeownership was increasingly stimulated and many rented dwellings were sold off to owner occupiers (Uitermark and Bosker, 2013).

Table 3 presents the results from the stratified OLS regression on neighborhood income change. The results from the first stratum show no significant results between the restructured and control neighborhoods (reference group) and the adjacent neighborhoods ($b = 3907.07$, $p > 0.001$), and all other neighborhoods in the Netherlands ($b = 6032.55$, $p > 0.001$). This suggest that in low density areas, the change in the average neighborhood income is similar in all neighborhoods. The average equivalized neighborhood income in 1999 was included as a baseline covariate to control for floor and ceiling effects. A high average equivalized neighborhood income in 1999 has a negative effect on the change in the average neighborhood income ($b = -0.43$, $p < 0.001$). This might be explained by the fact that higher income neighborhoods are generally characterized by neighborhood stability over time (Solari, 2012).

Table 3. Results from the stratified OLS regression with robust standard errors

	Stratum 1		Stratum 2		Stratum 3		Stratum 4		Stratum 5	
	b (se)	*β*	*b (se)*	*β*	*b (se)*	*β*	*b (se)*	*β*	*b (se)*	*β*
Control neighborhoods					-2590.85 (1053.63)*	-0.10	-1214.85 (383.89)**	-0.09	-1638.85 (240.75)***	-0.15
Adjacent neighborhoods	3907.07 (3193.45)	0.10	-1759.35 (2556.43)	-0.10	-2411.53 (793.64)**	-0.28	-1119.59 (355.03)**	-0.20	-1229.42 (174.19)***	-0.22
All other neighborhoods (ref = restructured neighborhoods)	6032.55 (3093.50)	0.17	-1375.38 (2486.43)	-0.08	-2258.26 (756.14)**	-0.29	-1111.11 (326.96)**	-0.22	-1185.24 (213.54)***	-0.22
Neighborhood disposable income 1999	-0.43 (0.10)***	-0.43	-0.03 (0.04)	-0.04	0.04 (0.03)	0.07	0.11 (0.03)**	0.18	0.29 (0.04)***	0.41
Amsterdam	-711.84 (1139.48)	-0.02	-203.65 (701.98)	-0.01	-299.94 (777.82)	-0.02	-28.75 (576.60)	-0.00	672.93 (225.21)**	0.10
Rotterdam	2759.61 (12.98.73)*	0.07	1214.44 (744.35)	0.05	817.20 (453.62)	0.06	489.20 (282.88)	0.06	142.18 (181.08)	0.02
The Hague	3015.68 (1757.95)	0.06	4285.43 (2005.00)*	0.15	1408.00 (1033.45)	0.08	667.38 (631.79)	0.05	-303.35 (257.67)	-0.04
Utrecht	1305.19 (1176.87)	0.03	827.68 (1659.34)	0.02	-155.89 (525.51)	-0.01	-1330.55 (818.45)	-0.09	110.13 (310.89)	0.01
Constant	-2221.75 (3071.77)		4075.42 (2488.94)		3719.06 (744.61)***		2005.91 (324.90)***		2502.83 (232.46)***	
Adjusted R2	0.18		0.02		0.02		0.05		0.17	
N	**1083**		**1065**		**1073**		**1072**		**1071**	

Note: Standard errors in parentheses.
* $p < .05$. ** $p < .01$. *** $p < .001$.

The average neighborhood income in 1999 is the strongest predictor of neighborhood change ($\beta = -0.43$), which illustrates a strong degree of path dependency (Zwiers et al., 2016a). To test if the changes in the average neighborhood income are not just driven by housing market dynamics in the four largest cities, dummy variables have been included. Compared to the rest the Netherlands, we find no significant differences in the neighborhood income in low-density neighborhoods in Amsterdam ($b = -711.84$, $p > 0.001$), The Hague ($b = 3015.68$, $p > 0.001$), and Utrecht ($b = 1305.19$, $p > 0.001$). Low-density neighborhoods in Rotterdam seem to have experienced a significantly higher increase in the neighborhood income than the rest of the Netherlands (2759.61, $p < 0.05$).

The results for the second stratum show no significant differences between restructured and control neighborhoods and adjacent neighborhoods ($b = -1759.35$ $p > 0.001$) and all other neighborhoods ($b = -1375.38$, $p > 0.001$). For these neighborhoods, the average neighborhood income in 1999 is not an important predictor ($b = -0.03$, $p > 0.001$, $\beta = -0.04$). There are no significant differences between Amsterdam ($b = -203.65$, $p > 0.001$), Rotterdam ($b = 1214.44$, $p > 0.001$), Utrecht ($b = 827.68$, $p > 0.001$) and the rest of the country. Neighborhoods in the Hague show as significantly higher increase in the average neighborhood income ($b = 4285.43$, $p < 0.05$).

We find significant differences in the change in the neighborhood income between the neighborhood groups in the third, fourth and fifth stratum. In all three strata, the restructured neighborhoods show a significantly higher change in the average neighborhood income between 1999 and 2013. In the fifth stratum, the control neighborhoods show a significantly lower change in the average neighborhood income compared to the restructured neighborhoods ($b = -1638.85$, $p < 0.001$). Both the adjacent neighborhoods and all other neighborhoods also show a significantly lower change in the average neighborhood income compared to the restructured grids, ($b = -1229.42$, $p < 0.001$) and ($b = -1185.24$, $p < 0.001$), respectively. This finding implies that in higher density areas, the restructured grids have seen the most change in the average neighborhood income.

In high density neighborhoods, the average neighborhood income in 1999 has a positive effect on neighborhood income change ($b = 0.11$, $p < 0.01$) and ($b = 0.29$, $p < 0.001$) in the fourth and fifth stratum, respectively. The average neighborhood income in 1999 is the strongest predictor of neighborhood change in the fifth stratum ($\beta = 0.41$). While the average neighborhood income in 1999 has a negative effect on neighborhood change in the first stratum, it has a positive effect in the fourth and fifth stratum. A higher neighborhood income in 1999 is associated with less neighborhood change in low-density areas, while it seems to lead to more neighborhood change in high-density areas. A possible explanation is that higher income neighborhoods show more stability in low-density areas. In high-density areas, higher income neighborhoods might experience processes of gentrification over time, making them more attractive, leading to increases in the average neighborhood income. Similarly, we find that Amsterdam experiences significantly more change compared to all other neighborhoods in the fifth stratum ($b = 672.93$, $p < 0.01$). As many inner-city neighborhoods in Amsterdam have become increasingly popular over time, Amsterdam has experienced processes of gentrification resulting in strong rises in house prices and neighborhood income (Hochstenbach and Van Gent, 2015).

Most of the change in the average neighborhood income seems to occur at the top and bottom ends of the density distribution. Although we do not find significant differences between our neighborhood groups in the first stratum, we see that 18% of the variation in the change in the average neighborhood income is explained by this model. Low-density neighborhoods have seen the highest increase in the neighborhood income; on average 3503 euros (see table 1). The model for the fifth stratum explains 17% of the variation in the change in the average neighborhood income. High-density neighborhoods have seen an average increase of 917 euros in the neighborhood income (see table 1). Of these neighborhoods, the restructured neighborhoods have experienced the strongest increases in neighborhood income.

To understand the drivers of these socioeconomic changes in the four neighborhood groups, we analyzed the net migration rates of different income groups. Figure 1 illustrates the net migration rates of low-income households.

Figure 1. Net migration rates of low-income households

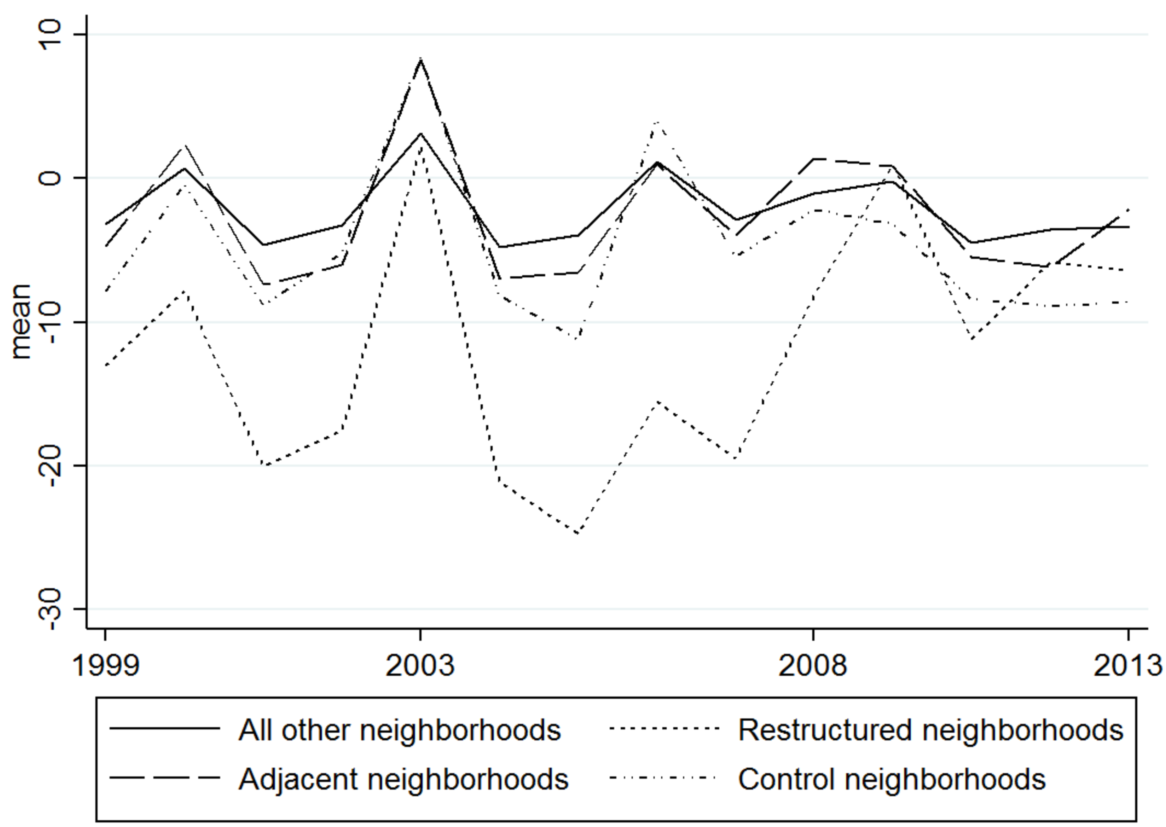


Figure 1 shows that the mobility of low-income households in and out of restructured neighborhoods is more dynamic than in the adjacent neighborhoods, control neighborhoods and all other neighborhoods. This finding is in line with previous research that has shown that low-income households tend to be more mobile than other income households (Clark and Morrison, 2012) and that low-income neighborhoods generally have high turnover rates (Kearns and Parkes, 2003; Clark and Morrison 2012). We see that restructured neighborhoods have experienced a large outflow of low-income households over the course of urban restructuring programs. The outflow of low-income households has somewhat diminished in recent years as large-scale demolition and new construction has come to an end - though there are still more low-income households moving out than in. The mobility rates of low-income households in the three other neighborhood groups are similar and appear to be relatively stable.

Figure 2 and 3 show the net migration rates for middle and high income groups. The figures show that the restructured neighborhoods have experienced an increasing in-flow of middle and high income groups over time. The net migration rates for middle-income groups show a slight decline in the control neighborhoods. In general, the net migration rates for middle and higher income groups has remained relatively stable in the control neighborhoods, the adjacent neighborhoods, and all other neighborhoods in the Netherlands. The increasing in-flow of middle and higher income households in the restructured neighborhoods suggests that the large-scale demolition and new construction in these neighborhoods have indeed stimulated the selective in-flow of middle and higher income groups.

Figure 2. Net migration rates of middle-income households

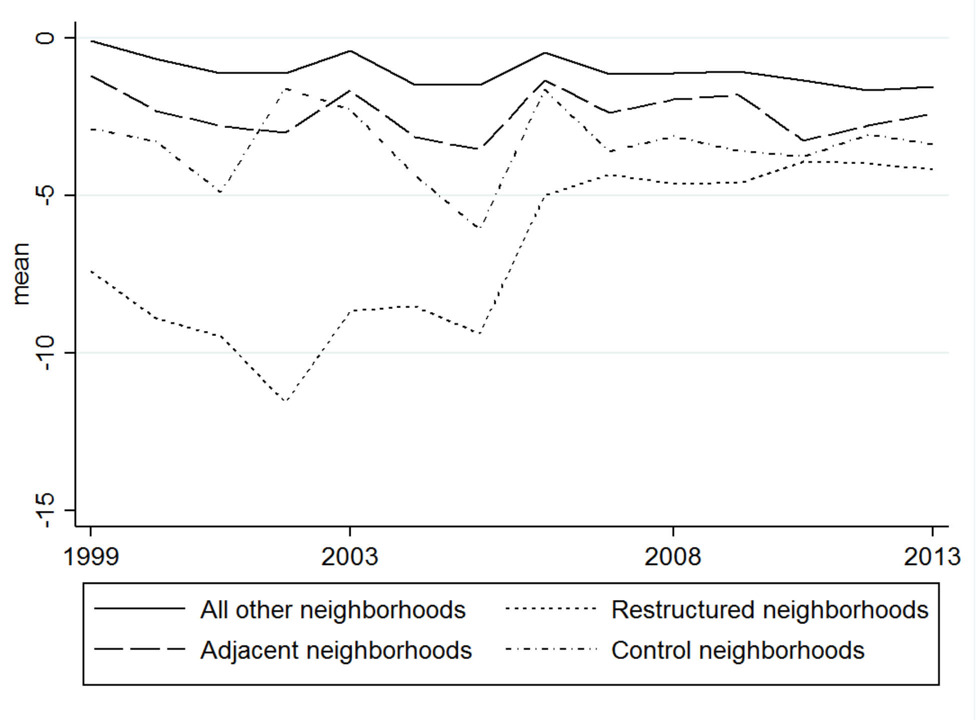
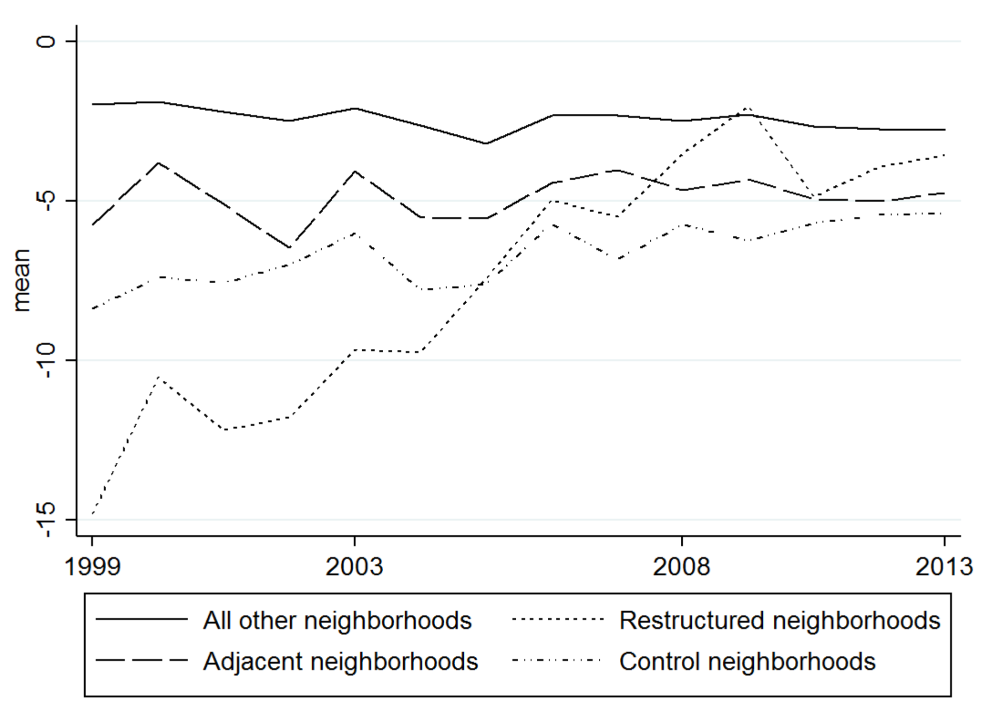


Figure 3. Net migration rates of high-income households



Discussion and conclusion

This paper has analyzed the effects of large-scale demolition and new construction on neighborhood income change over time and has studied the role of selective migration. Our findings provide several contributions to the literature. First of all, we find that restructured neighborhoods have experienced the largest increase in the average neighborhood income. Focusing on a low spatial scale, we find that large-scale demolition and new construction has strong positive effects on the neighborhood income developments of deprived neighborhoods. Second of all, we find that selective migration is an important driver of neighborhood change. The in-migration of middle and higher income groups seems to be the driving force behind the upgrading of restructured neighborhoods. It is often argued that the demolition of low-cost rental housing and the construction of owner-occupied and private-rented dwellings leads to the displacement of low-income households (e.g Boterman and Van Gent, 2013) leading to new processes of neighborhood decline elsewhere (e.g. Posthumus et al., 2013). We indeed see negative migration rates of low-income households during restructuring, however, we do not see an increase in the migration rates of low-income households to other neighborhoods. In other words, large-scale demolition does not seem to lead to new concentrations of low-income households in other deprived neighborhoods (see also Kleinhans and Varady, 2011). As such, large-scale demolition seems to be effective in breaking up concentrations of poverty by creating a larger geographical spread of low-income households (Bolt and Van Kempen, 2010). Third of all, we did not find any spillover effects of restructuring to nearby neighborhoods. Although it is often assumed that improvements to the housing stock lead to a better reputation of the entire area (VROM, 1997), and that increased house prices have spatial spillover effects on nearby dwellings and neighborhoods (Ellen and Voicu, 2006; Deng, 2011), we find no evidence of such direct spillover effects in terms of the average neighborhood income. The restructured neighborhoods have experienced a significantly higher increase in the average neighborhood income than the adjacent neighborhoods and we do not find an increase in the share of higher income groups in the adjacent neighborhoods. However, this is not to say that the adjacent neighborhoods have not profited from the developments in the restructured neighborhoods in more indirect ways. The change in the average neighborhood income in the adjacent neighborhoods might have been much lower if the change in neighborhood income was lower in the restructured neighborhoods. In other words, the adjacent neighborhoods might have experienced much less positive change if the restructured neighborhoods did not experience restructuring at all.

All in all, our findings show that large-scale demolition and new construction has a positive effect on neighborhood change on a low spatial scale. As neighborhoods are generally relatively stable over time, large-scale demolition seems an effective way to fundamentally change the built environment and population composition in a neighborhood within a relatively short period of time. The change in the average neighborhood income in restructured neighborhoods is significantly higher than in any of the other neighborhoods, which shows that physical restructuring functions as a shock that induces neighborhood change through selective migration (Meen et al., 2013). We find that most neighborhood change occurs at the top and bottom ends of the density distribution: low-density areas can quickly experience change because small changes in the population composition can have strong effects on neighborhood status. In high-density areas, large changes in the population composition are necessary to have an effect on neighborhood status and physical restructuring has played an important role in generating these changes. We find a strong degree of path-dependency in neighborhood change: in low-density areas, a high neighborhood income in 1999 is associated with less change over time. We argue that high income neighborhoods in low-density areas are generally characterized by more stability. High homeownership rates together with a high satisfaction with the neighborhood might lead to lower residential mobility in these areas, thereby leading to less change and more stability over time. Contrarily, in high-density areas, a high neighborhood income in 1999 is associated with more change over time. As high income neighborhoods in high-density inner-city areas are becoming increasingly popular, these neighborhoods may experience processes of gentrification over time (Hochstenbach and Van Gent, 2015). This does not necessarily imply that there is a change in the population composition only as a result of selective migration of high-income households. It is also possible that the population in-situ experiences socioeconomic upgrading (cf. Teernstra, 2014). High-density inner-city areas are often characterized by a large young, highly educated population that will experience substantial income gains over time, which will contribute to increases in the average neighborhood income, even when residential mobility is low (Hochstenbach and Van Gent, 2015).

The findings from the present study shed new light on the effectiveness of urban policies. Many studies have been unable to isolate an effect of urban policies on neighborhood change, which can be explained by the relatively short-time span, the focus on large administrative units, the difficulty in measuring ‘urban policies’, and finding a suitable control group. The present study has therefore focused on physical restructuring on the level of 500 by 500 meter grids over a 14 year time period. The use of a measure of demolition and new construction as the main indicator of physical restructuring allowed us to identify a reliable control group. This approach allowed us to identify the positive effect of urban restructuring on neighborhood income developments through the in-migration of higher income households. However, the effects of demolition and construction are localized to the restructuring neighborhoods and do not extend to other nearby neighborhoods. Although the average neighborhood household income is still below the average income in the rest of the Dutch grids, these restructured grids are catching up, despite a lower starting position. Future research should analyze to what extent restructured neighborhoods will be able to maintain their improvements and continue along this trend. The present study has focused on the effects of urban restructuring on the neighborhood level, whether urban restructuring has positive effects on individual outcomes is still subjected to debate.

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