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Tipping points in Dutch big city neighbourhoods

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Abstract
Micro-level studies using individual and household data have shown that residential location choices are influenced by neighbourhood ethnic composition. Using three conurbation samples in the Netherlands – Amsterdam metropolitan area, Rotterdam-The Hague metropolitan area and the country's largest conurbation, the 'Randstad' urban agglomeration – this paper analyses the evolution of neighbourhood ethnic composition as a social interaction outcome of disaggregated household behaviour. The potential 'tipping point' in neighbourhood ethnic composition, beyond which 'white flight' (or the departure of native or advantaged households) occurs, is tested. The share in neighbourhood population of native Dutch and Western minority did not exhibit the hypothesised 'tipping' behaviour in its growth rate with respect to initial share of non-Western minority. This paper argues that the large social housing sector, centralised tax regime, and strong regulatory role of the state in housing and urban planning, are the main explanatory factors for the relative constancy in Dutch neighbourhood ethnic composition.

Keywords
ethnic segregation, neighbourhood, regression discontinuity, tipping point, urban renewal

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Introduction

Recent studies (Chetty et al., 2015; Kling et al., 2005; Ludwig et al., 2013) based on the large-scale Moving to Opportunity (MTO) housing experiment in the USA have further vitalised the case of 'neighbourhood effects', the independent effect of living in specific neighbourhoods on individual (household) outcomes such as education attainment and household poverty. Chetty et al. (2015), for example, have found that children who have moved to lower-poverty neighbourhoods when they were young (below age 13) have, on average, higher levels of income, are more likely to be college educated and are less likely to be single parents as adults. The broader non-MTO literature has also strongly suggested the presence of neighbourhood effects (among others, Overman, 2002, for Australia; Gijsberts and Dagevos, 2007, for the Netherlands), but within the constraints of this paper, I refer to the reviews by Jencks and Mayer (1990), Sampson et al.

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(2002) and Durlauf (2004). What is noteworthy in these studies is that they collectively concur with the idea that some neighbours are and *should be* more desirable than others. As a complement to these studies, which would most likely galvanise public intervention in encouraging selective neighbourhood mobility, this paper examines how neighbourhood composition changes over time. More specifically, given inter-neighbourhood mobility, do neighbourhoods 'tip' towards becoming highly segregated neighbourhoods? By focusing on Dutch metropolitan areas with a large proportion of non-native households, the paper also highlights an additional important factor, that is: residential segregation, when it concerns a minority group of migrant background, is still an indicator of the lack of social-spatial mobility (Kesteloot and Cortie, 1998; Musterd, 2005; Sager, 2012) and/or social assimilation (Alba et al., 1999; Massey, 1981).

Schelling (1971: 181) characterises the neighbourhood 'tipping point' as the point where 'a recognisable new minority enters a neighbourhood in sufficient numbers to cause the earlier residents to begin evacuating'. The related literature defines this phenomenon as 'white flight' (first mentioned in Grodzins, 1958; see also Boustan, 2010; Coleman et al., 1975). Despite its origin in North American racial segregation literature, 'white flight' research is picking up in Western Europe with its rising migrant population (Bråmå, 2006; Mocetti and Porello, 2010; Rathelot and Safi, 2014).

Empirically, the Schelling 'all-minority' neighbourhood is rarely observed even in the USA and less so in the Netherlands with its lower levels of socioeconomic and spatial inequalities (Musterd, 2005). To begin with, the native population is not homogeneous and not all consider minority neighbours to be a disamenity (Ong and De Witte, 2013). Next, neighbourhood ethnic composition is but one of many factors that determines residential location choice. Besides other neighbourhood attributes, one needs to account for the neighbourhood supply of dwelling types because housing is a heterogeneous good that is made up of many attributes such as central heating and the number of rooms (c.f. Bajari and Kahn, 2005; Ong and De Witte, 2013). The mediating role of governmental and private-sector agencies in neighbourhood composition could be positive, e.g. by local interventions promoting and sustaining ethnically mixed neighbourhoods (Galster, 1990a; Saltman, 1991) or negative, e.g. 'redlining' in mortgage markets (Aalbers, 2005). This multidimensionality to neighbourhood valuation and supply-side factors are what could cultivate semi-stable 'integrated' neighbourhoods when share of minority is below the tipping point (see also Card et al., 2008a).

Complementing the existing studies (among others, Galster, 1990b; Goering, 1978; Schwab and Marsh, 1980), Card and colleagues' tested the 'tipping point' hypothesis for various metropolitan areas using the American census tract data from 1970 to 2000 and regression discontinuity method (Card et al., 2008b). The contribution of this paper applying Card et al.'s framework to a country such as the Netherlands is threefold. First, unlike the segregation discourse in the USA – a country with a long history of immigration intertwined with slavery – ethnic segregation in Western Europe revolves around a native majority group and a voluntary immigrant group received in the last few decades. The majority of the 'non-Western' immigrants in the Netherlands comprise decolonisation migrants, low-skilled 'guest-workers' and family migrants. The 'non-Western' definition precludes ethnic groups deemed to be well assimilated, thus underscoring the socioeconomic dimension in the Dutch ethnic segregation discourse. Since then, the 'non-Western' minority population in the Netherlands has increased by a factor of 12 from 162,320 in

1972 to almost 2 million in 2013 (Centraal Bureau voor de Statistiek (CBS), 2014). A considerable number compared with the national population of only 16.8 million and with most of the 'non-Western' group concentrated in the four largest cities.

Micro-level studies in the Netherlands using individual and household data have shown that residential location choices are affected by neighbourhood ethnic composition (Bolt et al., 2008; Feijten and van Ham, 2009; Ong and De Witte, 2013; van der Laan Bouma-Doff, 2007; van Ham and Feijten, 2008; Zorlu and Latten, 2009; Zorlu and Mulder, 2008). In the Dutch context, 'white flight' generally refers to the spatial residential mobility of native Dutch and Western-origin households who have, on average, relatively more resources than non-Western minority households in the housing market (Musterd and De Vos, 2007; Musterd and Deurloo, 2002). This corresponds to the negative relationship between non-Western minority neighbourhood composition and housing price with the distaste for non-Western minority neighbours also exhibited by some of the non-Western minority homeowners (Ong and De Witte, 2013). Bolt et al. (2008) found native Dutch households to be more likely, compared with non-Western minority households, to move out of 'concentrated' neighbourhoods with at least 40% non-Western minority. There is also evidence of 'white avoidance' (Ellen, 2000) with native Dutch households being less likely, compared with Turkish and Moroccan households, to move from a 'non-concentrated' to a 'concentrated' non-Western neighbourhood (Bolt et al., 2008). While the occurrence of 'white flight' and 'white avoidance' has been heavily implied in the abovementioned Dutch studies, none (to my best knowledge) has focused on finding potential critical thresholds in ethnic minority composition beyond which neighbourhoods will tip. This paper aims to fill this scholarly gap.

As a second contribution, this paper offers an interesting comparison between a West European investigation and the North American findings prevalent in the neighbourhood segregation literature. The centralised tax regime, large social housing sector and pervasive regulatory role of the government in the Netherlands are expected to moderate neighbourhood segregation outcomes. As a densely populated country, the state is mandated to heavily regulate housing and land markets with subsidies (e.g. for the construction of social housing until the 1990s and rent for the low-income), zoning and land use plan, and legislation such as the Housing Act (Dieleman et al., 1999). Strong central governance and redistribution offer a levelling effect across neighbourhoods and municipalities to reduce 'Tiebout-type' of neighbourhood sorting (Tiebout, 1956). Inevitably, Vermeulen and Rouwendal (2007) find housing supply in the Netherlands to be inelastic to prices.

Third, during the study's observation period, neighbourhood ethnic and socioeconomic composition has been tempered by urban restructuring policies with explicit aims for selective out-migration from neighbourhoods and 'social mixing'. 'Social mixing' here refers to the desegregation of social groups stratified based on socioeconomic and demographic characteristics in the targeted spatial set. It was the main message in policy documents such as 'The Differentiated City' and the 'Report on Urban Renewal' and the centrally coordinated policies such as the 'Big City Policies' in the 1990s and the more recent 'Priority Neighbourhoods' policy (Ministerie van VROM (Volkshuisvesting Ruimtelijke Ordening en Milieubeheer), 1996, 1997, 2007b; Tweede Kamer, 1990; VROM-raad, 2001). The earlier policies were more structural, e.g. through the sale of social rented dwellings, demolition and replacement, upgrading and joining with other units (Kruythoff, 2003). The later 'Vogelaar' or

'Priority Neighbourhoods' policy from 2007 was more social-oriented with large investments made in other key areas such as schooling (Ministerie van VROM, 2007b; Permentier et al., 2013).

This paper examines neighbourhood dynamics in three main conurbations in the Netherlands: (1) the Amsterdam metropolitan region, (2) the Rotterdam-The Hague metropolitan region, and (3) the 'Randstad' urban agglomeration, the country's largest which overlaps to a large extent with the first two metropolitan areas (see Figure 1).

Methodology and data

To determine the existence of tipping behaviour in neighbourhood ethnic composition in the Netherlands, I apply the estimation methodology proposed by Card et al. (2006, 2008b) to Dutch neighbourhood panel data from 1998 to 2008 (CBS, 2010, 2013a; see Appendix for further elaboration of the data set). For brevity, I refer to the abovementioned papers for detailed explanation on the estimation methodology and its underlying theoretical framework.

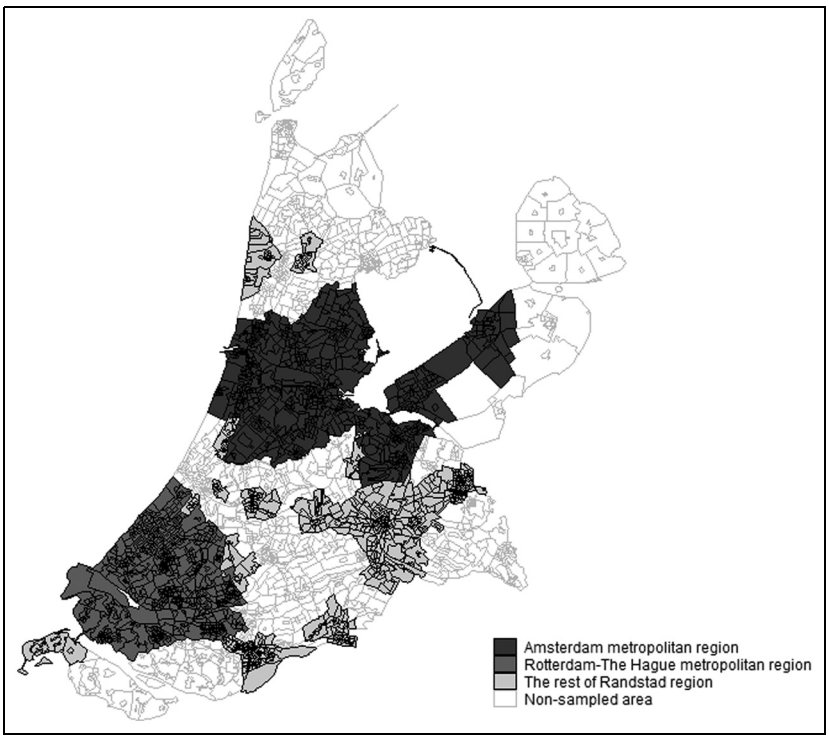

Figure 1. Map of the three conurbation samples across neighbourhoods in the Netherlands, 2009. 'The rest of Randstad region' represent Randstad neighbourhoods that are not included in the Amsterdam metropolitan region or the Rotterdam-The Hague metropolitan region. 'Non-sampled area' comprise neighbourhoods in the four provinces of Flevoland, Noord-Holland, Utrecht, Zuid-Holland that are not part of the three conurbation samples. 'Neighbourhood' here refers to the administrative definition '*buurt*' while the remainder of the paper denotes the four-digit postcode area.
Source: Classification of conurbation samples using neighbourhood data from CBS (2010).

Methodology

The Card et al. (2006, 2008b) method is divided into two steps. First, it locates the potential tipping points in the data using a data-intensive search procedure. Then the potential tipping point candidate is tested using the regression discontinuity method, i.e. to see if there was a sufficient 'break' in the evolution of the dependent variable (decadal change in share of native Dutch and Western minority households) to consider the candidate point (share of non-Western minority in neighbourhood in 1998) as a genuine tipping point. An important innovation introduced by Card et al. in order to use standard hypothesis testing involves splitting the city-specific sample(s) into two independent subsamples – two-third of the observations are used for the data-intensive tipping point search procedure, while the remaining one-third are used for statistical testing of the hypothesis of discontinuity. While Card et al. explored two distinct methods in their search for candidate tipping points, the more robust 'fixed point' approach is used for the relatively small Dutch city samples.

Finding potential tipping points. The 'fixed point' method first assumes the existence of a tipping point. It is designated as the unstable equilibrium point in neighbourhood 'minority' share where its 'native' population's growth rate equals that of the city mean. Here, the city-specific growth rate that is averaged across all its neighbourhoods over the observation period serves as a reference point. For neighbourhoods with initial minority population below the tipping point value, its native population should have grown more than the city average during the observation period. Equally, for neighbourhoods with initial minority share beyond the tipping point, a relative decrease in native population is expected. Being an unstable equilibrium, the latter is hypothesised to tend towards minority-only population over time as the native population continues to leave the neighbourhood.

There can be more than one candidate tipping point and tipping point(s) are derived from the intersection(s) between some growth function of neighbourhood native and Western minority population and the city's mean growth rate (see Figure 2).

The smoothed growth function of native Dutch and Western minority share with respect to non-Western share is fitted using a global polynomial model following Card et al. (2006, 2008b). Given that global polynomial models are susceptible to outliers, the sample for each city is limited to neighbourhoods with not more than 50% non-Western minority residents in 1999. The '50%' threshold is set based on visual inspection and it trims between 3.5% and 8.7% of the data in the three samples. The deviation between neighbourhood i's growth rate in native Dutch and Western minority share (relative to initial neighbourhood composition), $\Delta Y_i = (Y_{i,2008} - Y_{i,1998})/N_{i,1998}$ from its city j-specific mean growth rate, $\overline{\Delta Y_j}$ is fitted as a fourth-order polynomial of the neighbourhood share of non-Western minority in the base year, $x_{i,1998}$ with the stochastic error term, ε_i:

$$\Delta Y_i - \overline{\Delta Y_j} = \sum_{p=0}^{4} \lambda_p x_{i,1998}{}^p + \varepsilon_i \qquad (1)$$

The regression coefficients are then used to calculate the roots of the polynomial equation and the root with the most negative slope is considered a 'tipping point' candidate. Following Card et al. (2008b), the procedure is refined by fitting a fourth-order polynomial using a smaller sample within ten percentage points from the previously identified root.

Testing candidate tipping points. Subsequently and using the second subsample of

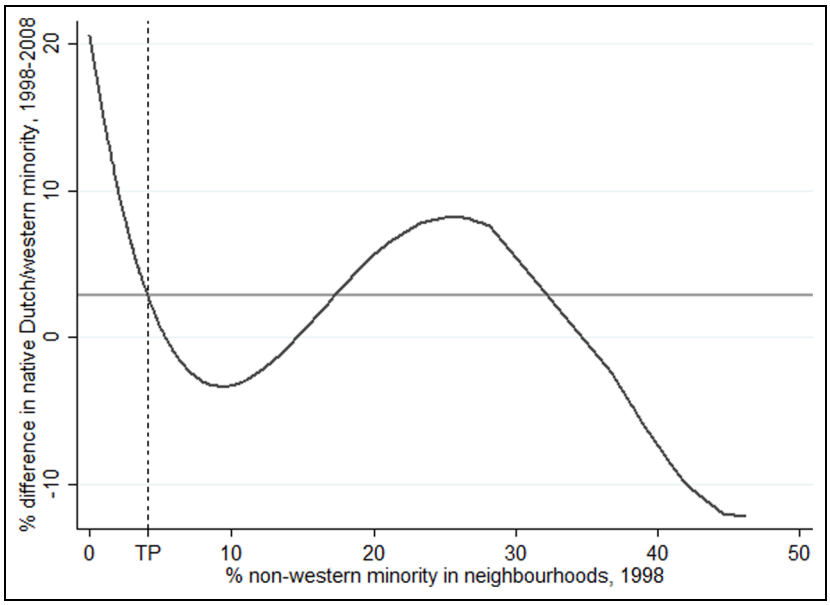

Figure 2. 'Fixed point' method.
Note: Horizontal line represents the city-specific mean growth rate. 'TP' is tipping point.

neighbourhoods not selected for the tipping point search procedure, I test for the potential discontinuity effect of non-Western minority share as deviated from its tipping point, $(x_i - x_{tip})$ on the growth rate in native Dutch and Western minority share, ΔY_i. The following regression discontinuity specification is used:

$$\Delta Y_i = \sum_{p=0}^{4} \alpha_p (x_{i,1998} - x_{tip})^p + d1[x_{i,1998} > 0] + \boldsymbol{\beta} \boldsymbol{Z}_{i,1998} + \epsilon_i \quad (2)$$

where $d1[x_i > 0]$ is an indicator variable taking the value one if the percentage of non-Western inhabitants is larger than the 'tipping point' share, x_{tip}, and zero otherwise, while $\boldsymbol{Z}_{i,1998}$ represents the vector of neighbourhood covariates for the base year, and ϵ_i the random error term. Neighbourhood control variables pertaining to base year 1998/1999 include average housing price, residential density, share of households with children, share of elderly people above the age of 65, share of individuals reporting welfare benefit as their main source of income in 1998 (as a proportion to number of inhabitants aged 15 to 64) and percentage of rental housing from the housing stock (as of 2003 since earlier data is not available[1]). Residential density is measured from high to low based on the density of addresses. The results of the regression discontinuity models are reported in the following section.

Data

Owing to the relatively small spatial and population size of Dutch cities[2] and the data-intensive methods proposed by Card et al., the study focuses on the 'Randstad' or the largest urban agglomeration in the Netherlands which comprises the four largest cities (Amsterdam, Rotterdam, The Hague and Utrecht) and their interconnected urban hinterlands (for other

Table 1. Descriptive statistics of regional and neighbourhood characteristics in 2009.

	The Netherlands	Randstad	Amsterdam Metropolitan	Rotterdam-The Hague
Land size (km^2)	33,681.0	2702.9	1604.3	992.9
Number of residents ('000)	16,500.0	5197.8	2267.3	2196.5
Number of households ('000)	7317.8	2464.6	1079.4	1034.9
Neighbourhood attributes				
Land size (km^2)	8.7	3.7	4.8	3.4
Number of residents	4282.2	7199.1	6788.3	7471.2
Number of households	1900.2	3413.5	3231.7	3520.1
Native Dutch (%)	86.8	73.4	75.4	70.0
Western (%)	7.4	10.5	10.6	10.8
Non-Western (%)	5.8	16.1	14.0	19.2
Turkish (%)	1.6	3.2	2.5	3.8
Moroccan (%)	1.4	3.3	2.9	3.0
Surinamese (%)	1.4	3.9	3.7	5.0
Antillean/Aruban (%)	0.6	1.4	1.0	1.9
Other non-Western (%)	3.3	5.6	5.4	6.4
Single household (%)	28.1	37.9	36.3	38.0
Household with children (%)	39.2	33.7	34.5	33.4
Average household size	2.4	2.2	2.2	2.2
Average income ('000)	29.6	32.5	33.7	32.2
Welfare benefit recipients (%)	18.7	20.9	20.5	21.2
HH below social minimum (%)	6.8	8.5	8.0	9.4
Owner-occupied dwellings (%)	68.8	53.3	55.4	51.8
Rental dwellings (%)	30.3	45.3	43.2	47.0
Average dwelling price ('000)	282.7	279.7	313.5	247.3
Residential density	4.0	2.5	2.9	2.2
Total neighbourhoods[a]	3941	745	346	305

Notes: 'Randstad' is the largest urban agglomeration in the Netherlands and consists of the four largest cities (Amsterdam, Rotterdam, The Hague, Utrecht) and their interconnected urban hinterlands. 'HH' refers to households and average income is per income-earner. 'Ethnicity' variables refer to country of birth or, for second-generation migrants, the mother's country of birth that is considered primarily to that of the father's. 'Residential density' is measured from very high (1) to very low (5). '% Welfare recipients' measures the share of inhabitants aged 15 to 64 who reported receiving pension, unemployment, disability or other welfare benefit as their main source of income in 1998.
[a]Maximum number of four-digit postcode neighbourhoods which does not exclude neighbourhoods with missing values on the covariates.
Source: CBS (2013a).

definitions of the Randstad, see Hendriks, 2006). In addition, smaller sample analyses were conducted for two metropolitan regions: the Amsterdam metropolitan area and the Rotterdam-The Hague metropolitan area. In 2009, approximately 2.3 million inhabitants live in the Amsterdam metropolitan area spread across 1604 km^2 of land while a similar number – 2.2 million – live in the smaller Rotterdam-The Hague metropolitan area of 993 km^2 (see Table 1). The Randstad area also overlaps, but not entirely, the two metropolitan regions with its 2702 km^2 of land mass and 5.2 million inhabitants, almost one-third of the national population.

Relevant neighbourhood data from Statistics Netherlands (CBS) are only available from 1998, unlike the three-decade-span American census data used by Card et al.

(2008b). Noticeable change in neighbourhood attributes such as ethnic composition would rely on the mobility of many disaggregated households and, thus, is expected to be gradual. Despite the disaggregated annual Dutch neighbourhood data, only the data from years 1998 and 2008 are utilised to compute *decadal net growth rate* in neighbourhood share of native Dutch and Western minority – the main dependent variable. Using decadal neighbourhood ethnic turnover as opposed to a pure 'white flight' measure is advantageous as it incorporates 'white avoidance', i.e. 'white' households avoiding neighbourhoods with 'non-white' proportions beyond the critical threshold when relocating (Ellen, 2000).

As neighbourhood units, I use the Dutch four-digit postcode area that is comparable with the census tract in the USA. The average number of inhabitants per four-digit postcode neighbourhood is 4282 at the country level and 7199 at the big city level in 2009 (see Table 1). The size of a four-digit postcode area in the Randstad is about 3.7 km^2 (1.4 square miles). Similar information is available at a smaller spatial aggregation-level, i.e. the more homogenous and functionally demarcated '*buurt*', but the four-digit-postcode neighbourhood is more stable over time and appropriate for our study. As a result, ethnic composition change is observed for more than 98% of the four-digit postcode neighbourhoods between 1998 and 2008. Following Card et al. (2008b), sparse neighbourhoods with fewer than 50 inhabitants were excluded[3] in the later analysis along with neighbourhoods with population growth rates that are greater than 1000% or native Dutch population growth rates that are greater than 500% during this period.[4]

The Dutch statistical data categorise one as of 'foreign' background if at least one parent is born abroad. A second-generation person of 'foreign' background is born in the Netherlands while someone who is born abroad to parents who were both born in the Netherlands is not considered of 'foreign' background.[5] Here, 'non-Western' refers to origins from Turkey, Africa, Latin America and Asia, with the notable exceptions of Indonesia and Japan. Inhabitants with origins from the latter two are considered 'Western' because of their perceived higher socioeconomic position in Dutch society (c.f. Alders, 2001) – implying that the 'non-Western' categorisation contains a socioeconomic dimension. By this definition and historical events (such as the 'guest worker' schemes from the 1960s and 1970s), non-Western migrants have typically assumed a lower than average socioeconomic status when they first entered the country. Subsequent social mobility and assimilation of the group have been hampered by the steady inflow of low-educated and non-Dutch-speaking family migrants via the family formation and reunification channels (Bonjour, 2008; Hooghiemstra, 2003; Tweede Kamer, 2004). The sizeable conflation of socioeconomic assimilation and ethnicity leads this study to primarily group the 'Western' minority with the native Dutch as part of the dependent variable (although this assumption is later relaxed to check for the robustness of the results).

From Table 1, it is evident that neighbourhoods in the conurbations have a much higher percentage of Western and non-Western minority residents compared with the rest of the country. This is despite the underestimation of average postcode neighbourhood share of non-Western minority provided in Table 1 as its corresponding information is not provided in the administrative neighbourhood data for neighbourhoods with fewer than ten non-Western minority residents (CBS, 2013b).[6] Comparatively, these neighbourhoods are, on average, also wealthier, more expensive and densely populated, and have

proportionally lower owner-occupancy and more single-person households.

Empirical findings

The tipping point search procedure has found potential tipping point candidates for the three multi-municipality conurbations: 2.90% of non-Western minority for the Amsterdam metropolitan area, 9.75% for the Rotterdam-The Hague metropolitan area, and 6.22% for the Randstad region. The candidate tipping point for the Amsterdam metropolitan region is considerably smaller than the other two samples – most likely due to the proportionally fewer non-Western minorities in the suburban areas (see Table 1). Preliminary graphical analyses by means of Figures 3, 4 and 5 suggest that 'tipping' behaviour of growth in native Dutch and Western minority share between 1998 and 2008 was not observed for all three samples, i.e. the relationship between the two variables appears to be fairly continuous without an obvious 'break'. Using two-thirds of each conurbation sample, the smoothed function (using local polynomial fit) of growth rate in native Dutch and Western minority neighbourhood share during that period is plotted separately, before and after the tipping point, against share of non-Western minority in 1998. The tipping point value derived from the search procedure is represented by the vertical line while crosses denote the observation points and the shaded area the 95% confidence interval.

This result was confirmed by the regression discontinuity tests of the tipping points

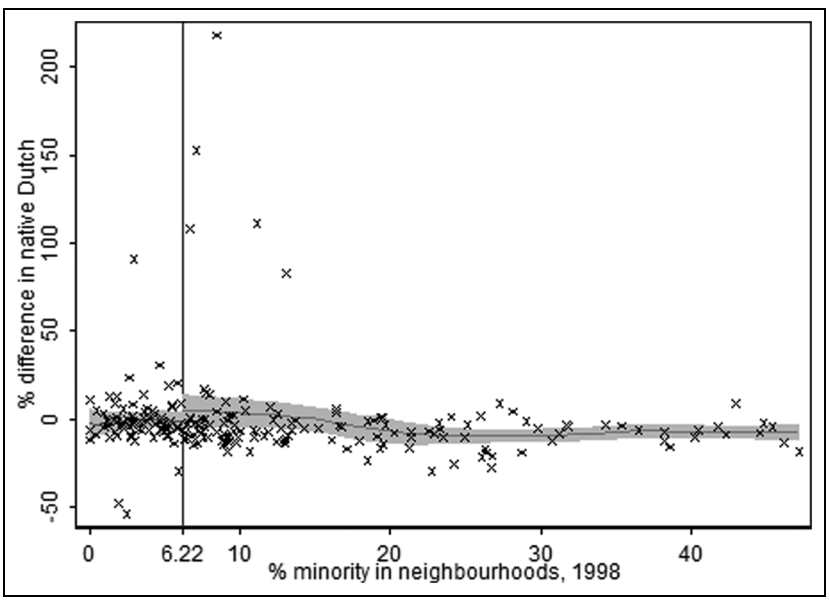

Figure 3. Growth in native Dutch/Western minority share on non-Western minority share in Amsterdam, 1998–2008. The local polynomial fit of growth rate in native Dutch and Western minority neighbourhood share between 1998 and 2008 is plotted before and after the tipping point against share in non-Western minority in 1998 using two-thirds of each sample. Local polynomial estimate uses Epanechnikov kernel and rule-of-thumb bandwidth. Crosses denote the observation points, shaded area the 95 confidence interval, while the vertical line shows the tipping point derived from the two-stage polynomial search procedure.
Source: CBS (2010), own calculations.

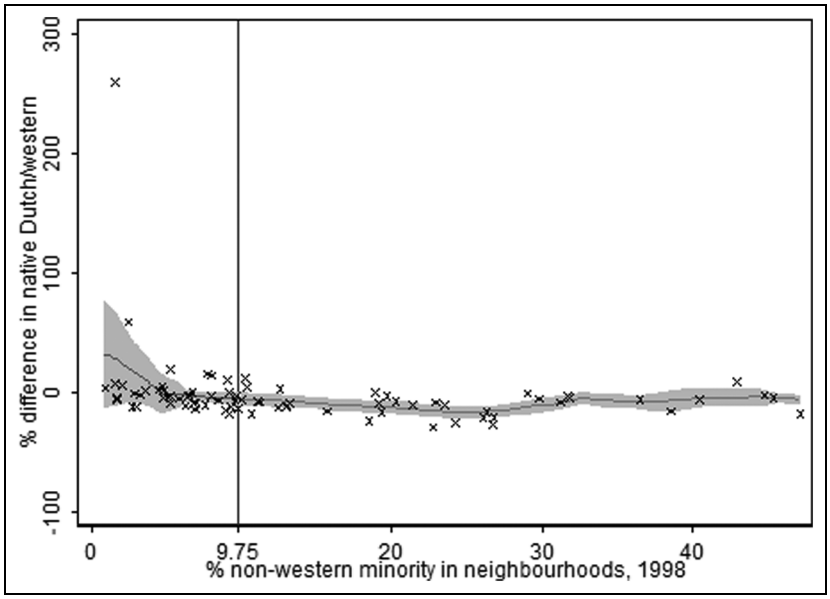

Figure 4. Growth in native Dutch/Western minority share on non-Western minority share in Rotterdam-The Hague, 1998–2008. The local polynomial fit of growth rate in native Dutch and Western minority neighbourhood share between 1998 and 2008 is plotted before and after the tipping point against share in non-Western minority in 1998 using two-thirds of each sample. Local polynomial estimate uses Epanechnikov kernel and rule-of-thumb bandwidth. Crosses denote the observation points, shaded area the 95 confidence interval, while the vertical line shows the tipping point derived from the two-stage polynomial search procedure.
Source: CBS (2010), own calculations.

for the respective conurbation samples in Table 2. The coefficients of the tipping point indicator variable exhibited contradicting effect signs depending on the sample and covariates and remained or became statistically insignificant.[7] For example, 'tipping' was observed in the baseline model for the Rotterdam-The Hague metropolitan area, i.e. the average negative growth rate difference in native Dutch and Western minority share before and after the tipping point is 9.35 percentage points. However, the discontinuity indicator variable loses its statistical significance once the fourth-order polynomial terms of non-Western share and neighbourhood controls are included. While the smaller Amsterdam and Rotterdam-The Hague metropolitan samples could potentially suffer from low statistical power owing to their small sample sizes, the non-significant result was consistent with the larger Randstad sample which consists of 47 municipalities, including the municipalities of Amsterdam, Rotterdam and The Hague. Standard errors were allowed to cluster at the municipality level for all samples. Statistically significant polynomial terms of non-Western share for the Amsterdam and Randstad samples (not reported in Table 2) and the linear term for the Rotterdam-The Hague sample are indicative of the variable's explanatory power despite the lack of 'tipping point' effect.

Besides neighbourhood ethnic composition, socioeconomic and demographic covariates seem to be useful correlates for native

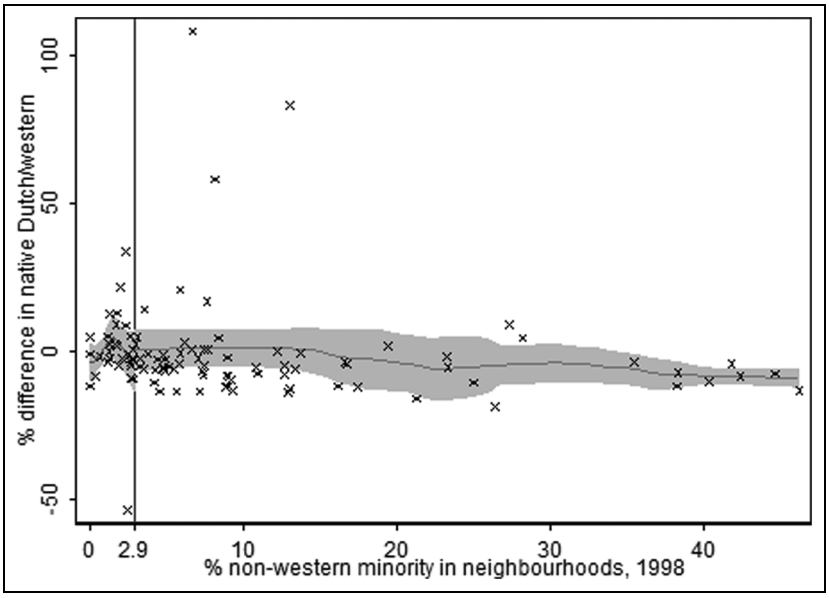

Figure 5. Growth in native Dutch/Western minority share on non-Western minority share in Randstad, 1998–2008. The local polynomial fit of growth rate in native Dutch and Western minority neighbourhood share between 1998 and 2008 is plotted before and after the tipping point against share in non-Western minority in 1998 using two-thirds of each sample. Local polynomial estimate uses Epanechnikov kernel and rule-of-thumb bandwidth. Crosses denote the observation points, shaded area the 95 confidence interval, while the vertical line shows the tipping point derived from the two-stage polynomial search procedure.
Source: CBS (2010), own calculations.

Dutch and Western minority growth rate. In particular, the proportion of households with children has a clear negative correlation, all things equal. The neighbourhood's native Dutch and Western minority population experiences a mean negative growth of 0.59, 0.41 and 0.72 percentage points for every increase in the proportion of households with children in Amsterdam metropolitan, Rotterdam-The Hague metropolitan, and the Randstad, respectively. Residential density as scaled from high to low hints at the suburbanisation preference of native Dutch and Western minority households in the Randstad and Amsterdam metropolitan samples. And they seem to prefer fewer renter neighbours since one percentage increase in rental housing is associated with a decrease of one-quarter to one-half a percentage point in native Dutch and Western minority growth in Amsterdam metropolitan and the Randstad region. Interestingly, this group in the Randstad region also appears disinclined to stay in neighbourhoods with more elderly inhabitants, i.e. every percentage point increase in share of elderly is correlated with a 0.61 percentage point decrease in native Dutch and Western minority growth rate. Given the fact that the model does not account for the endogeneity and potential omitted variable bias with regards to the control variables, the relationship between these variables and the dependent variable is assumed to be non-causal.

Table 2. Regression discontinuity results for change in native Dutch/Western share at tipping point, 1998–2008.

	Amsterdam Metropolitan			Rotterdam-The Hague			Randstad Metropolitan		
Beyond tipping point	2.08	4.00	−2.55	−9.35**	1.42	12.04	6.32	8.01	7.65
	(4.63)	(4.47)	(5.75)	(4.41)	(5.79)	(7.42)	(5.64)	(6.60)	(8.46)
% Non-Western minus TP	−0.26**	0.08	2.46	−0.29	0.34	−1.81**	−0.48**	−0.07	0.31
	(0.10)	(0.30)	(1.50)	(0.35)	(0.55)	(0.71)	(0.19)	(0.14)	(1.08)
% Rental housing		−0.28*	−0.26*		−0.04	0.07		−0.46*	−0.48*
		(0.14)	(0.15)		(0.12)	(0.17)		(0.25)	(0.25)
Average house price (‘000)		−0.07	−0.07		−0.12	−0.07		−0.05	−0.06
		(0.04)	(0.04)		(0.15)	(0.10)		(0.04)	(0.05)
Residential density		4.09	4.52*		13.30	8.63		5.16**	5.67**
		(2.48)	(2.57)		(11.64)	(7.54)		(2.29)	(2.61)
% Welfare recipients		−0.35	−0.48		−1.27	−1.10		−0.19	−0.16
		(0.50)	(0.51)		(1.50)	(1.34)		(0.23)	(0.24)
% Households with children		−0.58**	−0.59**		−0.40*	−0.41*		−0.67**	−0.72**
		(0.24)	(0.25)		(0.21)	(0.22)		(0.26)	(0.28)
% Elderly (> 65 years)		−0.47	−0.37		0.31	0.01		−0.62***	−0.61***
		(0.29)	(0.28)		(0.89)	(0.64)		(0.22)	(0.22)
Quartic in % non-Western minus TP	No	No	Yes	No	No	Yes	No	No	Yes
Number of neighbourhoods	102	83	83	80	75	75	213	188	188
Adjusted R^2	0.001	0.048	0.020	0.033	0.080	0.062	0.019	0.149	0.152

Notes: Two-tailed significance: *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. ‘TP’ refers to ‘tipping point’. All neighbourhood covariates pertain to base year 1998/1999 except share of rental housing stock measured in 2003. The standard errors in parentheses are clustered at the municipality level. ‘Residential density’ is measured from very high (1) to very low (5). ‘% Welfare recipients’ measures the share of inhabitants aged 15 to 64 who reported receiving pension, unemployment, disability or other welfare benefit as their main source of income in 1998.

Source: CBS (2010, 2013a).

Why neighbourhoods in Dutch big cities did not tip between 1998 and 2008

A lack of 'tipping point' behaviour in neighbourhood turnover hints at the effectiveness of the related social and area-based policies that are already in place. In the following section, I outline several key hypotheses that could shed light on the lack of 'tipping' behaviour in native Dutch and Western growth rate between 1998 and 2008 with respect to initial non-Western share.

Data: Observation period and neighbourhood definition

Since the relevant neighbourhood administrative data is only available from 1998, it is likely that this study has missed out on most of the 'tipping' phenomena in big city neighbourhoods. For instance, native Dutch households may have selectively left the at-risk of 'tipping' neighbourhoods in the big cities as part of the mass suburbanisation of native Dutch households since the 1960s (Bontje and Latten, 2005; Dieleman and Wallet, 2003). Although this study encompasses the suburban neighbourhoods within the metropolitan regions, it is likely that the spatial 'dichotomisation' has already occurred prior to 1998 – akin to Farley et al.'s (1978) 'chocolate city, vanilla suburbs' analogy. Excluding the outliers, growth rate in native Dutch and Western minority with respect to initial non-Western share hovers close to 0% as seen in Figures 3, 4 and 5. For this to happen within the tight housing market (low vacancy rate of 2.2% in 2007, see Ministerie van VROM, 2007a), one would imagine the out-migration of households from a neighbourhood to roughly correspond with the in-migration of households of similar ethnic group. Indeed, non-Western minority households have been found to buck the suburbanisation trend or re-concentrate into specific suburban neighbourhoods (Burgers and van der Lugt, 2006; Zorlu, 2009). This selective residential mobility could be due to, among others, differential financial resources, racial discrimination in the housing market (Aalbers, 2005; Saltman, 1979) and ethnic differences in preference for housing and neighbourhood attributes such as neighbourhood ethnic composition (see Ong and De Witte, 2013 on heterogeneous preferences among homeowners in the Netherlands). Besides 'white avoidance', 'minority avoidance' could be at play here.

Another possible issue relates to the definition of 'neighbourhood' or the areal unit of interest. The four-digit postcode neighbourhood used in this study could be too large, spatially and population-wise, or functionally incoherent compared with the smaller *buurt* neighbourhood definition. The departure of native Dutch households from 'non-Western minority' concentration neighbourhoods has been recorded at the smaller six-position postcode neighbourhood or block-level in Amsterdam (Musterd and Deurloo 2002; Musterd and De Vos, 2007). The sensitivity of spatial-based measures and analysis to the definition of areal units such as a neighbourhood is known as the 'modifiable areal unit problem' (c.f. Fotheringham and Wong, 1991). Spatial segregation studies have found different levels of segregation depending on which areal unit is used, e.g. the smaller *îlots* (Verdugo, 2011) or the larger *communes* (Rathelot and Safi, 2013) in France. Moreover, residential mobility decision depends on the individual household's subjective perception of what constitutes the neighbourhood and thus, the perceived level of neighbourhood ethnic segregation (Guo and Bhat, 2007).

Table 3. Regression discontinuity results for change in native Dutch share at tipping point, 1998–2008.

	Amsterdam Metropolitan			Rotterdam-The Hague			Randstad Metropolitan		
Beyond tipping point	3.54	4.85	−0.40	8.24	−0.80	−8.72	2.50	3.13	4.18
	(4.70)	(4.49)	(4.19)	(15.40)	(8.86)	(8.82)	(6.43)	(7.76)	(10.02)
% Minority minus TP	−0.25***	0.06	0.82	−0.88	−0.03	0.43	−0.34*	−0.18	−0.17
	(0.09)	(0.19)	(0.53)	(0.88)	(0.21)	(0.88)	(0.18)	(0.16)	(0.57)
% Rental housing		−0.25*	−0.24*		0.05	0.15		−0.34	−0.31
		(0.13)	(0.12)		(0.10)	(0.14)		(0.23)	(0.23)
Average house price ('000)		−0.07	−0.06		−0.08	0.06		−0.03	0.01
		(0.04)	(0.04)		(0.15)	(0.07)		(0.05)	(0.05)
Residential density		4.11*	4.09*		11.43	0.60		3.75	4.01*
		(2.34)	(2.30)		(9.63)	(4.66)		(2.35)	(2.04)
% Welfare recipients		−0.33	−0.35		−0.86	−0.59		−0.09	−0.16
		(0.34)	(0.39)		(1.04)	(0.59)		(0.19)	(0.20)
% Households with kids		−0.48**	−0.63*		−0.38**	−0.28		−0.54**	−0.64**
		(0.21)	(0.33)		(0.17)	(0.23)		(0.23)	(0.25)
% Elderly (> 65 years)		−0.38	−0.60*		−0.05	−0.24		−0.68**	−0.72**
		(0.27)	(0.34)		(0.47)	(0.26)		(0.28)	(0.30)
Quartic in % minority minus TP	No	No	Yes	No	No	Yes	No	No	Yes
Number of neighbourhoods	102	83	83	80	75	75	213	188	188
Adjusted R^2	0.005	0.057	0.030	0.058	0.084	0.107	0.014	0.135	0.134

Notes: Two-tailed significance: *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. 'Minority' and 'TP' refer to 'Western and non-Western minority' and 'tipping point', respectively. All neighbourhood covariates pertain to base year 1998/1999 except share of rental housing stock measured in 2003. The standard errors in parentheses are clustered at the municipality level. 'Residential density' is measured from very high (1) to very low (5). '% Welfare recipients' measures the share of inhabitants aged 15 to 64 who reported receiving pension, unemployment, disability, or other welfare benefit as their main source of income in 1998.
Source: CBS (2010, 2013a).

Methodology: Minority definition and statistical power

For the main analysis, the dichotomous 'native Dutch and Western' versus 'non-Western' social grouping was used. While valid and justifiable, it is contentious because the Western minority group could also be inserted as a right-hand side explanatory variable instead, either as a separate covariate or combined with the non-Western group to form a general 'minority' category (see also 'minority definition' in Card et al., 2008b). As a form of robustness check, the analysis was re-run with growth rate in native Dutch share as the dependent variable and 'minority' share as the main variable of interest, see Table 3. The tipping point candidates remain statistically insignificant as the results reproduce similar conclusions derived from Table 2 using the initial dichotomous categorisation.

Compared with the large North American city samples of Card et al. (2008b), this study could potentially suffer from low statistical power because of the Dutch metropolitan regions' small sample sizes and the use of Card et al.'s data-intensive, 'tipping point' search methodology. If there is indeed a 'tipping point' effect, the low statistical power is translated into a higher probability for making a 'false negative' or 'Type II' error, i.e. failing to reject the null hypothesis of no 'tipping point' effect when it is indeed false. Even so, I argue that the lack of statistically significant result for the larger Randstad agglomeration sample to be indicative of the true relationship between the growth in neighbourhood share of native Dutch and Western share with respect to its share of non-Western minority.

Government policies

Current literature on 'tipping point' in neighbourhood ethnic composition is limited by the North American scope. The Netherlands differs substantially in several ways, three main factors relevant to this study are summarised here: (1) a large social housing sector, (2) centralised tax and redistributive regime, and (3) the strong regulatory role of the state in housing and urban planning.

Table 4. Housing tenure type by ethnicity, 2006.

	Native Dutch	Non-Western	Western
Owner-occupied	59.26	22.61	42.86
Social rental	30.56	66.23	42.93
Private rental	8.21	9.16	12.29
Other	1.97	2.00	1.92

Source: Housing Survey (Ministerie van VROM, 2006), own calculation with household weights.

Unlike North American cities, only slightly more than half of the large Dutch city housing stock comprises of owner-occupied dwellings (see Table 1). There is also an unusually large social housing sector occupying up to 37% of the total national stock or 75% of rented dwellings in 2007 (Ministerie van VROM, 2007a). This was the result of decades-long state subsidised housing construction by housing associations which was later stemmed in the mid-1990s. Quite uniquely, the Dutch social housing sector supports socially integrated neighbourhoods as it is socially differentiated and less stigmatised (e.g. as compared with council housing in the UK). This reality however is not static with the growing owner-occupancy sector at the expense of social housing stock. The latter is heading towards 'residualisation', i.e. catering only to low-income or socially disadvantaged households (van Kempen and Priemus, 2002). Migrant households of non-Western origin are especially likely to be social housing tenants – 66% in 2006 compared with 31% for native Dutch households and 43% for Western minority households nationwide (see Table 4).

Table 5. Overview of post-war urban policies in the Netherlands.

Policy name	Main goal	Period	Orientation	Slogan
Creating CBDs	Stronger urban economy	To 1970	Efficiency	New jobs
Urban renewal	Improving urban housing	1970–1980	Social justice	New housing for neighbourhood
City renewal	Stronger urban economy	1980–1990	Efficiency	Stop urban degradation
Multiple-problem	Help disadvantaged neighbourhoods	1985–1990	Social justice	Stop cumulating problems
Social renewal	More social cohesion	1990–1994	Social justice	Higher participation
Big City Policy I	Mixed neighbourhoods	1994–1998	Social justice	Immigration of high incomes
Big City Policy II	Stable neighbourhoods	1998–2004	Social justice	Prevent leaving neighbourhood
Big City Policy III	Stronger neighbourhoods	2004–2009	Efficiency	Powerful cities
Big Cities Policy +	Integrated neighbourhoods	From 2007	Social justice	Prevent parallel societies

Notes: 'CBDs' refers to 'central business districts' created within cities. 'Big Cities Policy + ' includes recent policies such as the 'Vogelaar' or 'Priority Neighbourhoods' policy.
Source: Musterd and Ostendorf (2008).

Centralised tax regime and redistribution reduce the influence of neighbourhood amenities and the Tiebout sorting prevalent in the USA (e.g. Bayer et al., 2004). The budget of local municipalities that are responsible for urban planning is largely drawn from general tax revenues and not local taxation (Van Der Burg and Dieleman, 2004). Under the 'Big City Policy', the Amsterdam and Utrecht municipalities received approximately €1.8 billion and €428 million (respectively, €2456 and €1642 per capita) from the national government between 1999 and 2003 (Aalbers et al., 2004). Moreover, local amenities such as schools are almost universally funded by central government coffers (Ladd and Fiske, 2009). Redistribution also involves social transfers with low-income, single-household occupants of both social and private rental dwellings eligible for government rental subsidy as long as the rent is below the specified threshold (Rijksoverheid, 2014).

One could argue that urban renewal programmes are justifiable in the context of a densely populated country with scarce land for new construction (also noted in Kruythoff, 2003). Furthermore, the public role in urban planning is necessary with the unusually large social rented housing sector administered by local housing associations (for examples, see Aalbers et al., 2004). 'Social mixing' continues to be featured prominently in urban planning policies (Ministerie van VROM, 1996, 1997, 2007b; Tweede Kamer, 1990; VROM-raad, 2001). Altogether these policies are extensive, costly and reflect the shift within the Dutch policy tradition of using spatial measures exemplified in Table 5 (Musterd and Ostendorf, 2008).

All the factors mentioned above basically reduce the leverage of market mechanisms in the Dutch housing market (Vermeulen and Rouwendal, 2007) that would have otherwise resulted in high levels of neighbourhood segregation observed in the USA and elsewhere (among others, see Massey and Denton, 1993; Musterd, 2005; Wilson, 1987).

Conclusion

The main aim of this paper was to test the potential 'tipping point' dynamic in neighbourhood ethnic composition that has been documented in North American studies (e.g. Card et al., 2008b). For comparability, the same methodology by Card et al. (2006, 2008b) was applied to three Dutch conurbations – the Amsterdam metropolitan area, the Rotterdam-The Hague metropolitan area, and the Randstad region – using administrative neighbourhood data from 1998 to 2008. I fail to find 'tipping point' behaviour in decadal growth of native Dutch and Western minority neighbourhood share with respect to initial share of non-Western residents, despite their negative statistical association. While some native Dutch and Western minority households did flee or avoid neighbourhoods with non-Western minority share beyond a certain threshold, this effect on neighbourhood segregation was limited. These at-risk neighbourhoods did not 'tip' towards hyper-segregated ethnic enclaves during the observation period.

If 'social mixing' remains the main objective in urban planning, the lack of 'tipping point' dynamic in neighbourhood ethnic change offers some limited support to the policy practices in the Netherlands. Several factors that have most likely reduced the potency of market mechanisms responsible for self-segregation in the Netherlands have been offered in this paper. First, the unusually large social housing sector supports socially integrated neighbourhoods as it is socially differentiated and not marginalised to the low socioeconomic group. Second, taxation is mostly centralised and heavily redistributed across municipalities while local amenities such as schools are almost universally funded by the central government. Third, the housing stock diversification and urban renewal programmes may have stemmed or even reversed the 'tipping' tendency of at-risk neighbourhoods.

From a policy perspective, spatial planners could monitor the development of critical thresholds in neighbourhood composition trends so that these thresholds (should they exist) can be incorporated in designing of preventive rather than curative neighbourhood policies (Galster et al., 2000). A dynamic outlook improves on the current use of static indicators used to select 'problem' neighbourhoods in the Netherlands – also pointed out by Van Gent and colleagues (2009) in their critique of the 'Priority Neighbourhoods' urban restructuring programme. More also appears to be gained by combining housing policy with socio-spatial assimilation policy, e.g. by reducing barriers to ethnic minority owner-occupied housing. Since the study does not rule out the possibility of neighbourhoods having 'tipped' prior to the observation period, further research with a longer historical data could provide more robust results. Additionally, future research could account for the likelihood of multiple tipping points within a metropolitan area (see for instance, Galster, 1990b; Goering, 1978) which may have resulted in this paper's non-significant results for *one* tipping point per metropolitan area. Last but not least, the use of this or a similar methodological approach on other, especially West European, metropolitan areas, should lead to further substantive contributions to the present tipping point literature dominated by North American studies.

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Notes

1. The exclusion of some of the variables reported in Table 1 is either due to the lack of pre-2004 data (e.g. neighbourhood composition by ethnicities such as Turkish and Moroccan) or multicollinearity issues with those included in the final analysis (e.g. between average household size and percentage of households with children in neighbourhood).
2. For example, there are only 69 and 59 four-digit-postcode neighbourhoods within the Amsterdam and The Hague municipalities, respectively, while Card et al. (2008b) excluded cities with fewer than 100 census tracts.
3. For the Randstad, Amsterdam, and Rotterdam-The Hague conurbations, the number of sparse neighbourhoods (fewer than 50 inhabitants) excluded were 23, 13 and 7, respectively.
4. Card et al. (2008b) excluded census tracts with growth rates larger than five standard deviations of the metropolitan statistical area average and/or have experienced growth of native 'white' population that is more than 500% of the base population. In my data set, 22 neighbourhoods experienced either total population growth rate of above 1000% or native Dutch population growth rate of above 500%.
5. The use of 'country of origin' as a defining characteristic in administrative data along with its academic derivatives is not without critique (for a critical review, see Phillips, 2007).
6. Native Dutch share in Table 1 is overestimated as it is calculated based on the neighbourhood Western and non-Western minority composition.
7. The discontinuity or 'tipping point' variable has been inspected for potential multicollinearity problems, e.g. with non-Western minority share and its polynomial terms.

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Appendix

Data

The neighbourhood data used in this paper comprise of two neighbourhood data sets from Statistics Netherlands: the 'Population and Household Data by Four-Digit Postcode' and the 'Neighbourhood Key Figures, 1995–2012' (Centraal Bureau voor de Statistiek (CBS), 2010, 2013a). The latter data set defines neighbourhood by the administrative definition (*buurt*), which is collapsed into the larger spatial aggregation four-digit postcode neighbourhood used in this study. The *buurt* neighbourhood is not a complete subset of the four-digit postcode area (an average of three per postcode neighbourhood) so the most common four-digit postcode is used. Residential density is originally based on the number of addresses per km^2 measured at the *buurt*-level on a five-point scale: 1 = at least 2500 addresses, 2 = 1500 to 2500 addresses, 3 = 1000 to 1500 addresses, 4 = 500 to 1000 addresses, and 5 = less than 500 addresses. Neighbourhood data are also available for years 1995 and 1997 but the 'non-Western' minority category is limited to those of Turkish, Moroccan, Surinamese, Dutch Antillean and Aruban descent. Indicator variables were created in addition to the data sets to define the three conurbation areas (see Milieuhulp, 2014; Metropoolregio Amsterdam, 2012; Metropoolregio Rotterdam Den Haag, 2013 for a list of municipalities included in the conurbation samples of the Randstad, Amsterdam, and Rotterdam-The Hague metropolitan regions, respectively).