To tip or not to tip, is that the question?

Tipping points, evidence from the Netherlands

Master thesis

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Tempus Fugit

I dedicate this Master thesis to Paul Lobensteijn.

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Abstract

The social interaction model that was introduced by Card, Mas and Rothstein in 2008 assumes that neighbourhoods can be racially mixed and stable up to the point where the share of immigrants reaches a critical value, known as the tipping point. Once the share of immigrants reaches and exceeds this tipping point, the natives will exit the neighbourhood.

Based on the fact that the Netherlands has received large groups of immigrants over time and that they usually settle down in neighbourhoods where there are already other immigrants residing, this research tries to answer the following question: *Can we identify tipping points in the six largest cities in the Netherlands and have they changed over time?* This done for the periods 1998-2003, 2004-2012 and 1998-2012. The data was collected from the website of Statistics Netherlands and was gathered at the zip code level.

By using the structural break method we find four tipping points for the period 1998-2003, ranging from 10,65% to 26,01%. For the period 2004-2012 five tipping points we found, ranging from 21,18% to 48,08%. The same exercise yields two tipping points for the period 1998-2012, 16,45% and 17,11%. When we compare the results for the period 1998 - 2003 with those of the period 2004 - 2012 we see that the tipping points in the second period are almost twice as high.

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Chapter 1: Introduction

What makes a neighbourhood an attractive neighbourhood? In other words, why do people want to live in neighbourhood A and not in neighbourhood B?

Leidelmeijer, Marlet, Woerkens van, and Schullenberg, (2011) argue that there are several factors that determine whether or not people find a neighbourhood attractive. For example how safe do people feel themselves in a neighbourhood? What is the quality of the available stock of houses, how big are these houses, are there only rental houses and how old are they? What is the quality of the neighbourhood itself in terms of degeneration and nuisance?

Apart from these factors, there is also a different mechanism that influences the attractiveness of a neighbourhood. This mechanism is the perception of attractiveness based on the ethnic composition of that neighbourhood. This thesis seeks to understand whether social interactions between residents, based on ethnicity can explain the evolution of neighbourhoods specifically why certain neighbourhoods "tip" and go from being integrated to segregated once the share of immigrants in that neighbourhood passes a certain threshold, known as the tipping point.

Schelling (1971) was one of the first researchers who developed a social interaction model to describe ethnic segregation as a result of the increased concentration of immigrants in a neighbourhood. He argues that the ethnic composition of a neighbourhood might change when the demand for housing of the natives decreases when the share of immigrants in that neighbourhood rises. In his model the natives will start to exit the neighbourhood when the share of immigrants exceeds a personal tolerance threshold, also known as the tipping point. This exiting of the natives is also known as tipping behaviour. Based on the increased inflow of immigrants into the Netherlands over the past decades, we have reason to believe that within the framework of the model that is used in this research this has created an exogenous shock and has increased the share and concentration of immigrants in the Netherlands. This in turn could eventually result in tipping behaviour of the natives. This research will test for the presence of tipping points in the six largest cities in the Netherlands for the period 1998-2012.

The residential choices of immigrants in a host country have been investigated by different researchers. For example Edin, Fredriksson and Åslund (2003) find evidence that immigrants tend to move to neighbourhoods where there is already a higher share of immigrants residing,

thus contributing to an even higher concentration of immigrants in that neighbourhood. Åslund (2005) shows that immigrants who moved to Sweden have a tendency to move to neighbourhoods where: a) there is already a large group of immigrants living that was born in the same country as the immigrant and b) areas that already host a large overall share of immigrants in general. Neighbourhoods that already have a large share of immigrants today can expect a large inflow of immigrants over time, resulting in an even higher share of immigrants in the future. It is also very likely that the future immigrants will largely have the same country of birth as the immigrants that are already present. Bartel (1989) finds that new immigrants who moved to the United States in 1980 are clustered in geographical areas. Roughly 75% of them are living in the top 25 Standard Metropolitan Statistical Areas (SMSAs). In contrast, this number for the native population is roughly 50%. The concentration of immigrants in particular neighbourhoods may lead to tipping.

The aim of this research is to try to answer the central question: *Can we identify tipping points in the six largest cities in the Netherlands and have they changed over time?* In order to do this we will try to identify tipping behaviour of the natives in the six largest cities in the Netherlands during different periods. These periods are 1998-2003, 2004-2014 and 1998-2012. The reason why these different periods are chosen is because: a) if we take different periods, we can see if there has been a change over time and b) the debate surrounding immigration intensified starting roughly at the beginning of 2000, the period when Pim Fortuyn was at the height of his political success. He was one of the most prominent advocates of a more restrictive immigration policy. Later on the murder on Theo van Gogh on 2 November 2004 also sparked controversy and added to a more intense debate about a more restricted immigration policy in the Netherlands.

Tipping points have been identified in other countries, for example in Sweden and the United States, but not yet in the Netherlands. Therefore this research aims to contribute by identifying these tipping points in the Netherlands.

We use the methodology of Card, Mas and Rothstein (2008) to detect tipping points in the six largest cities in the Netherlands for the periods 1998-2003, 2004-2012 and 1998-2012. The data that was used was collected from the website of Statistics Netherlands and was gathered at the zip code level. For the period 1998-2003 we find four tipping points, ranging from 10,65% to 26,01%. For the period 2004-2012 five tipping points were found, ranging

from 21,18% to 48,08%. And for 1998-2012 we only find two tipping points, 16,45% and 17,11%.

When a neighbourhood tips it is likely that it eventually becomes segregated. Research shows that the concentration of immigrants in neighbourhoods does not always yield positive results. For example Massey (1990) argues that in the 1970s racial segregation played a crucial role in the enlargement of the social underclass in American cities. He shows that there is a strong link between an increase in poverty and the increase in residential segregation. Cutler and Glaeser (1997) examine the effects that spatial segregation might have on outcomes for blacks in terms of school performance, level of unemployment and single parent families. They find that blacks who live in more segregated neighbourhoods perform worse in these terms than the blacks that live in neighbourhoods that are less segregated. Cutler, Glaeser and Vigdor (2008) have a more balanced view and show that immigrant groups with a low education level suffer negative consequences from living in an immigrant enclave, while it might be beneficial for immigrant groups with a higher education level.

Tipping points can be useful for policymakers. Many[1] of them prefer neighbourhoods that are racially mixed. They argue that living conditions in a mixed neighbourhood are better and that these neighbourhoods are economically stronger compared to an all-immigrant neighbourhood. In order to keep a neighbourhood racially mixed and to prevent it from tipping, policymakers need to know what makes a neighbourhood attractive, this way keeping the natives in, while at the same time keeping the share of immigrants below the identified tipping point and thus preventing the neighbourhood from tipping. Doff (2010) shows in her research that in 2003 the city of Rotterdam introduced a policy that aimed towards dispersing immigrants across the city. In the seventies Rotterdam already had tried to achieve a more even distribution of immigrants in the city. The plans were not implemented because they were labelled as discriminating towards immigrants. During a later period the discussion was renewed and topics such as ethnic concentration and multi-ethnic neighbourhoods were put back on the policy agenda. This led to a new policy in Rotterdam that stimulated the de-concentration of ethnic memories and aimed at spreading them more evenly across the city.

[1] One of the biggest advocates of mixed neighbourhoods in the Netherlands is the Socialist Party (SP). On their website: http://www.sp.nl/wonen/ they write that they strive to create mixed neighbourhoods in terms of age, income and ethnic background. Also the Dutch Labour Party (PvdA) and especially their department for young members argues that when immigrants live in a segregated neighbourhood for a long time and when this is involuntarily this might not have positive effects on these immigrants. Therefore they favour mixed neighbourhoods. See for example: http://www.js.nl/politiek/standpunten/standpunt/t/woonsegregatie.

The rest of this research is organised as follows. Chapter 2 gives an overview of the most relevant literature for this research. Chapter 3 discusses the theoretical framework that is used. Chapter 4 will give an overview of the data that was collected for this research. Chapter 5 explains the empirical model that was used to identify the tipping points. Chapter 6 gives an overview of the results. Chapter 7 will discuss what the implications of these results can be for policymakers. Chapter 8 contains the conclusion and recommendations for future research.

Chapter 2: Literature review

This chapter contains a literature review and discusses several articles that have been written in the past, dealing with social interaction models, also known as models about tipping behaviour. This chapter does not aim to be an exhaustive overview of all the material about tipping behaviour that has been written earlier but it will include articles from authors that are seen as the most prominent in this field and whose material has also been used for this particular research. By doing so it gives the reader an idea of where the subject of this research can be placed the discussion about tipping behaviour.

Theoretical models of tipping

In his 1969 article Schelling tries to find an explanation for the segregation that could be the result of choices that are discriminatory and are made by individuals. Based on these ideas, Schelling later publishes his 1971 article that has become one of the building blocks to explain tipping behaviour and racial segregation on a neighbourhood level within the field of economics. Schelling (1971) uses tolerance schedules between whites and blacks to explain the racial composition in a neighbourhood. He argues that the racial composition of a neighbourhood might change when the willingness of the whites to tolerate a black neighbour decreases when the share of blacks in that neighbourhood rises. The whites will start to exit the neighbourhood when the share of blacks exceeds a personal tolerance threshold, also known as the tipping point. The model assumes that as soon as there is a change in the share of blacks, the neighbourhood will shift to an either all-white or an all-black neighbourhood, resulting in total racial segregation. The main argument of Schelling's model is that only a weak preference of whites to live next to other whites can have a dramatic effect on the racial composition in a neighbourhood once the share of blacks changes and the neighbourhood can end up in a situation of total segregation. The tipping process in his article works as follows: Suppose there is a small increase in the share of blacks around the tipping point in a neighbourhood. This increase causes the most racist white person to leave the neighbourhood because he/she feels uncomfortable with this higher share of blacks in the neighbourhood. This exit of the most racist white person decreases the share of whites. This in turn then makes the second-most racist white person feel uncomfortable, resulting in exiting the neighbourhood, reducing the share of whites even further. This in turn makes the third-most racist white person feel uncomfortable, also resulting in an exit, reducing the share of whites

in the neighbourhood even more. This chain reaction keeps on going, leading to the point where eventually even the most tolerant white person feels uncomfortable and leaves. The neighbourhood ends up being totally racially segregated with a share of 100% blacks. If we look back then we see that the chain reaction was set in motion all because there was an initial increase in the share of blacks in the neighbourhood that only bothered the most racist white person. Schellings model assumes that the whites who depart the first when the share of blacks increases are whites with the lowest racial tolerance towards blacks.

Clark (1991) indicates that based on several recent surveys about residential preferences to have either a white person or a black person as a neighbour, it seems that there is a slightly different relationship between whites and blacks in a neighbourhood when compared to Schellings model. According to Clark individuals prefer to live and socialize with other individuals who have a similar income level, share similar interests and belong to a similar social class. According to Clark these elements are the driving force behind the observed segregation on a neighbourhood level. In Schellings tolerance schedule it was predominantly the racial element that was the driving force behind the segregation pattern in a neighbourhood.

Empirics of tipping

Card, Mas and Rothstein (2008A and B) are also widely recognized for their contribution to the debate about tipping points and tipping behaviour. The model Card et al. use follows from the insights of Schelling (1971). Schelling used tolerance schedules to explain the racial composition in a neighbourhood. Card et al. have created a variation of this model. The shape of the demand function of the whites is influenced by two effects, the standard demand effect and the taste for diversity effect. This second effect indicates that whites are willing to pay a premium for housing, when they are living in a racially mixed neighbourhood. This taste for diversity effect is positive as long as the share of blacks is below the critical share (= tipping point). Once this critical share of blacks is passed, the whites are no longer willing to pay a premium for housing to live in a racially mixed neighbourhood, because according to them the share of blacks has become too high. The model assumes that the willingness to pay of the group of whites for housing in a neighbourhood depends on the share of blacks that is also living in this neighbourhood. The authors also assume that the location of the tipping point is depending on the level of tolerance of whites towards blacks. The more tolerant the whites are, the higher the tipping point will be. The central question Card et al. (2008B) try to answer is whether or not whites will show tipping behaviour once the inflow of blacks into the

neighbourhood exceeds the tipping point. In order to identify tipping points the authors use two different methods. These methods are the structural break method and the fixed point method. In the structural break method tipping points are identified by searching for a structural break in the relationship between on the one hand the share of blacks in a neighbourhood in a specific base year and on the other hand the change in the share of whites in that same neighbourhood over a period of ten years that starts from this base year. In the fixed point method the tipping point is the share of blacks where the growth rate of whites equals the average growth rate of the neighbourhood. In their article both methods identify tipping points that are fairly similar. In this research the break point method is used to identify the tipping points in the six largest cities in the Netherlands. The method itself will be explained in more detail later. The data that Card et al. (2008B) use are Census tracts from 1970 to 2000 for cities in the United States. Census tracts are geographical areas that include roughly 4000 people and represent neighbourhoods that are demographically homogenous. They also divided the total period into smaller sections, ranging from 1970 to 1980, 1980 to 1990 and 1990 to 2000. In their article the authors identify tipping points for individual cities in the United States for the investigated periods. These tipping points range from 6,25% to 25%. The evidence that is found in the article gives strong reason to believe that there is tipping behaviour of the whites that is caused by the increased share of the blacks in a neighbourhood. The authors show that Census tracts beyond the identified tipping points experience a substantial outflow of whites. Therefore they conclude that segregation between whites and blacks is (at least in part) driven by the preferences of whites to live in a neighbourhood with a maximum share of blacks.

In another article Card, Mas and Rothstein (2008A) the authors investigate if neighbourhoods that are racially mixed can be stable in the long run and do not shift towards an either all-white or all-black neighbourhood in case there is an external shock in the share of blacks. The data that is used is the same data that they used in their 2008B article, Census tracts from 1970 to 2000 for cities in the United States. The method the authors use in the 2008A article is the fixed point method. Card et al. (2008A) conclude that based on their research that as long as racially mixed neighbourhoods maintain a share of blacks that is below the tipping point these neighbourhoods remain racially mixed and stable over time. Neighbourhoods that have a share of blacks that reaches and exceeds the tipping point will eventually turn into an all-black neighbourhood.

Easterly (2009) argues in his article that Schellings model has undergone very little empirical testing on a universal and neighbourhood level. One of the exceptions to this is the article of Card, Mas and Rothstein (2008B). The data used by Easterly is the same data that Card et al. (2008B) use in their article, which is Census tract data for the United States for the period 1970 till 2000. Both Easterly and Card et al. (2008B) use the same methods to estimate tipping points. Easterly (2009) aims to test Schellings theory of tipping on a neighbourhood and universal level. This universal level should be interpreted as a national level for the United States for the period 1970 till 2000. This level includes 202 individual metropolitan areas that make up the total sample of Census tract data that is used for his research. Easterly first tests for the whole period of 1970 till 2000 and then decade. Besides testing Schellings tipping theory on a neighbourhood and universal level, Easterly (2009) tries to discover whether the high degree of segregation that we can see in American neighbourhoods for the period 1970-2000 is caused by the tipping behaviour of whites or if other factors also influence this tipping process. Easterly (2009) indicates that in the work of Card et al. (2008B), the authors find tipping points on a neighbourhood level. However Easterly (2009) does not find evidence that supports Schellings model on a universal level, because he is not able to identify tipping points that apply on such a level. Easterly emphasizes that there could also be other factors that influence the observed segregation but that they are not included in the model of Schelling. After testing, he finds that population density in a neighbourhood is a factor that has the most predictive power, when it comes to explaining changes in the share of whites in that same neighbourhood. Easterly concludes that caution is needed when applying the tipping point theory and to assume that it sufficiently explains observed segregation. Other factors might also influence the segregation process at the same time, but that they are not included (yet) in the empirical model.

According to Dorn (2008) one of the major limitations of Schellings (1971) tolerance schedule is that it does not consider the influence of homeownership and expectations regarding future tipping. According to Dorn homeowners face a financial incentive to sell their house before the neighbourhood reaches its tipping point, to avoid a financial loss when their houses depreciate in value. People who rent a house do not face such a financial risk and therefore are less sensitive to an increase in the share of blacks. Dorn argues that neighbourhoods with a high share of white homeowners are more likely to tip at a lower tipping point in comparison to a neighbourhood with a high share of whites who rent a house. He analyzes the relationship between the rate of homeownership in a neighbourhood and tipping in that same neighbourhood, by building on the work of Card et al (2008B). The

model Dorn uses to identify the tipping points is the structural break method and the data he uses is the Census tract data for the period 1970 till 2000, which is the same data Card et al. (2008B) used in their article. Dorn shows that when a neighbourhood tips, the neighbourhoods with a higher rate of white homeownership show a larger decrease of the white population and a drop in the housing prices in comparison with neighbourhoods with a lower share of white homeownership. Additionally, in case of tipping, the average education and income levels in the neighbourhood drop. Dorn argues that this is true because homeowners, on average have a higher income and education level in comparison with renters who are poorer and have on average a lower education level. The homeowners do not leave the neighbourhood earlier because they have a lower level of tolerance towards blacks, but they do this to avoid a financial loss due to the deprecation in value of their homes. The research of Dorn (2008) shows that tipping is not strictly driven by racial motives but other factors such as homeownership also (might) play a role in the tipping process.

In their article Deurloo and Mustard (1998) recognize the fact that ghetto formation, or the fear of this process, is a recurring item on the agenda of policymakers. Many of them believe that the increased number of immigrants into the European cities will eventually result in an extreme racial segregation and these cities will turn into ghettos, as has happened in cities in the United States with respect to the black population. They investigate if there has been ghetto formation in Amsterdam among different immigrant groups. They do this on the basis of micro-level spatial data that is available for the period 1994-1996. They conclude that in Amsterdam there are no ghetto like developments among the different immigration groups, such as can be observed in the United States. Only a fairly small share of all the immigrants is living in a concentrated area. There are no major differences in concentration levels among the different ethnic groups.

The paper that is most relevant for my research is the article of Andersson, Hammarstedt and Neuman (2012). The authors try to identify specific tipping points in the twelve largest municipalities in Sweden for the period 1990 till 2007. The data that was used to identify these specific tipping points were SAMS-areas, or as they are also known: Small Area Market Statistics. Every SAMS-area consists roughly of 1000 people. The final dataset of the authors contained 3053 individual SAMS-areas. They use the terms natives and immigrants instead of whites and blacks. The authors explore how the preferences of the native population in these different municipalities have contributed to the racial segregation in Sweden. They compare different periods in order to see if there has been a change in the tipping points over time. These periods are 1990-2000 and 2000-2007. The model that they use to identify the specific

tipping points is the structural break method, introduced and developed earlier by Card et al. (2008A and B). This method is also used in this research to identify the tipping points in the six largest cities in the Netherlands. Andersson et al. (2012) find evidence that in the majority of the twelve largest municipalities in Sweden the native population shows tipping behaviour. These tipping points range from 2% to 39,5%.

Chapter 3: Theoretical model

This research uses the theoretical model that was developed by Card et al. (2008B) to identify the tipping behaviour among the natives (including Western immigrants) in the six largest cities in the Netherlands. This same model was also used by Andersson et al. (2012) to identify the tipping behaviour among the natives in the twelve largest Swedish municipalities.

Assumptions

The model starts out with a neighbourhood; in this neighbourhood there is a stock of houses that is assumed to be homogenous. For these homogenous houses there are two types of potential buyers. These types of buyers are the natives and immigrants.[2]

The demand for a house or as it is specified in the model, the willingness to pay for a house is indicated by *b natives*, which is the demand function of the natives and *b immigrants*, which is the demand function of the immigrants. The willingness to pay of the natives depends on the share of immigrants living in this area. This share of immigrants is indicated by *m*. The share of natives living in the same area is indicated by *1-m*. The model assumes that at a relatively low share of immigrants, the willingness to pay of the natives, increases as *m* also increases. This happens up to a certain point where the level of *m* reaches a critical share. Beyond this critical share of *m*, the willingness to pay of the natives decreases. This process is also shown in figure 1. In other words, as long as the share of immigrants is low enough, the natives are willing to pay a premium to live in a mixed neighbourhood. However when the number of immigrants passes the critical share, the natives become reluctant to accept immigrants as their neighbours and their willingness to pay decreases.

When we look at the demand curve of the immigrants we see that it is a straight and downward sloping line. This indicates that it is a regular demand curve and that there is a standard demand effect. The marginal willingness to pay for housing of every extra immigrant is decreasing if we move from the left to the right along the demand curve of the immigrants. The model assumes that the willingness to pay of the immigrants is negatively related to the share of immigrants.

[2] In the research that is conducted for the Netherlands the group of natives consist of natives *and* Western immigrants. The group of immigrants consists of non-Western immigrants. The Data chapter discusses these sub-groups in more detail.

When we look at the demand curve of the natives we see that it is not a straight line but a parabolic curve. As we can see the first part of this parabolic demand curve of the natives is upward sloping. This indicates that the marginal willingness to pay for housing increases, if we move from the left to the right along the demand curve of the natives. If we move from the left to the right in figure 1, this means that the share of immigrants (*m*) increases, while at the same time the share of natives (*1-m*) decreases. As indicated earlier, the demand curve of the natives is not a straight line but a parabolic curve. If there would only be the standard demand effect at work, than the demand curve of the natives would be an upward sloping line. This is however, not the case as we can see in figure 1. The model assumes that besides the standard demand effect there is also another effect at work. These two types of effects together shape the demand function of the natives. As we can see in figure 1, once the level of immigrants passes a critical share (= the tipping point), the demand curve of the natives starts to slope downward. What could cause this effect?

Besides the standard demand effect, there is also the taste for diversity effect at work within the demand curve of the natives. This taste for diversity effect indicates that natives are willing to pay a premium for housing, when they are living in a mixed neighbourhood. This taste for diversity effect is positive as long as the share of immigrants is below the critical share (= tipping point). Once this critical share of immigrants is passed, the natives are no longer willing to pay a premium for housing to live in a mixed neighbourhood. Beyond the critical share of immigrants, the natives no longer see it as an advantage to live in a mixed neighbourhood because; according to the natives the share of immigrants has become too high.

Beyond the critical share of immigrants the taste for diversity effect becomes negative and is stronger than the standard demand effect, thus resulting in a downward sloping demand curve of the natives beyond the critical share of immigrants. In case the taste for diversity effect would not have any influence on the demand for housing of the natives, their demand curve would be a straight line. The demand curve of the natives would be an upward sloping line, from left to right. In case there would be an external shock and the number of immigrants would increase, the demand curve of the immigrants would shift upwards, along the demand curve of the natives. All the possible equilibriums would be stable.

Possible equilibriums

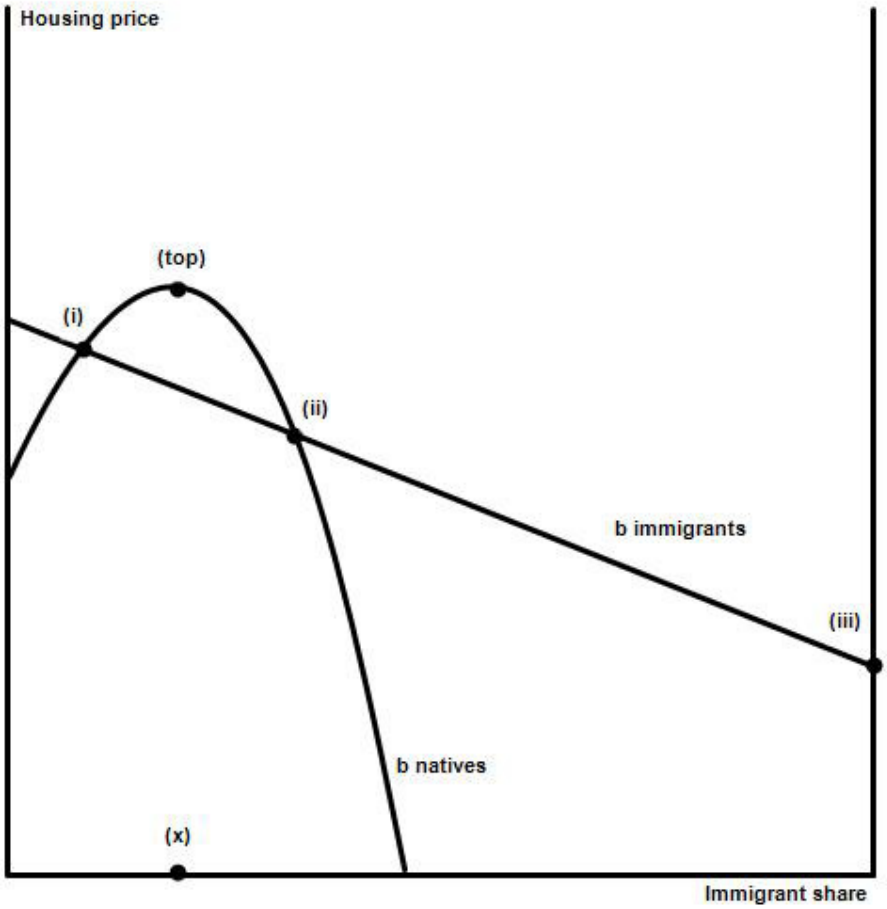
As is shown in figure 1, there are three possible equilibriums. Two of these equilibriums are mixed, consisting of a mix of natives and immigrants and one equilibrium is an all-immigrant

equilibrium. Two of these equilibriums are stable and one is an unstable equilibrium. A neighbourhood will be mixed as long as the natives' willingness to pay for housing increases as the share of immigrants also increases. For example when we look at point (i), this is a mixed and stable equilibrium. When we are left of point (i) the immigrants outbid the natives because their willingness to pay is higher than that of the natives. Because of this more and more immigrants are moving into the neighbourhood, the immigrant share increases and we move to the right. However if we look to the right of point (i), we see that the natives outbid the immigrants because their willingness to pay is higher than that of the immigrants. In this case more and more natives are moving into the neighbourhood, the immigrant share decreases and we move to the left, returning in point (i). Thus point (i) is a mixed and stable equilibrium. The above is true above as long as the natives' willingness to pay for housing increases as the share of immigrants also increases. Beyond a certain share of immigrants we see that the demand curve of the natives starts to slope downwards. We can see this happening in figure 1 to the right of the point (top) on the demand curve of the natives. To the right of this point the demand curve of the natives starts to slope downwards, indicating that when the share of immigrants increases, the demand for housing of the natives decreases.

For example when we look at point (ii), we can see that in this point the natives' willingness to pay is decreasing, thus resulting in an unstable, mixed equilibrium. If for some reason the neighbourhood is pushed out of point (ii) it will move either to point (i) or point (iii).

For example if the share of immigrants increases beyond that of point (ii), the immigrants will continue to outbid the natives because their willingness to pay is higher than that of the natives. In this case the share of immigrants increases, while are the same time the share of natives decreases. Finally we end up in point (iii), which is a stable, all-immigrants equilibrium. When we move to the left of point (ii), the share of immigrants decreases, the natives will outbid the immigrants because their willingness to pay is higher, the share of immigrants decreases more and we return again to point (i), which is a stable and mixed equilibrium.

Figure 1

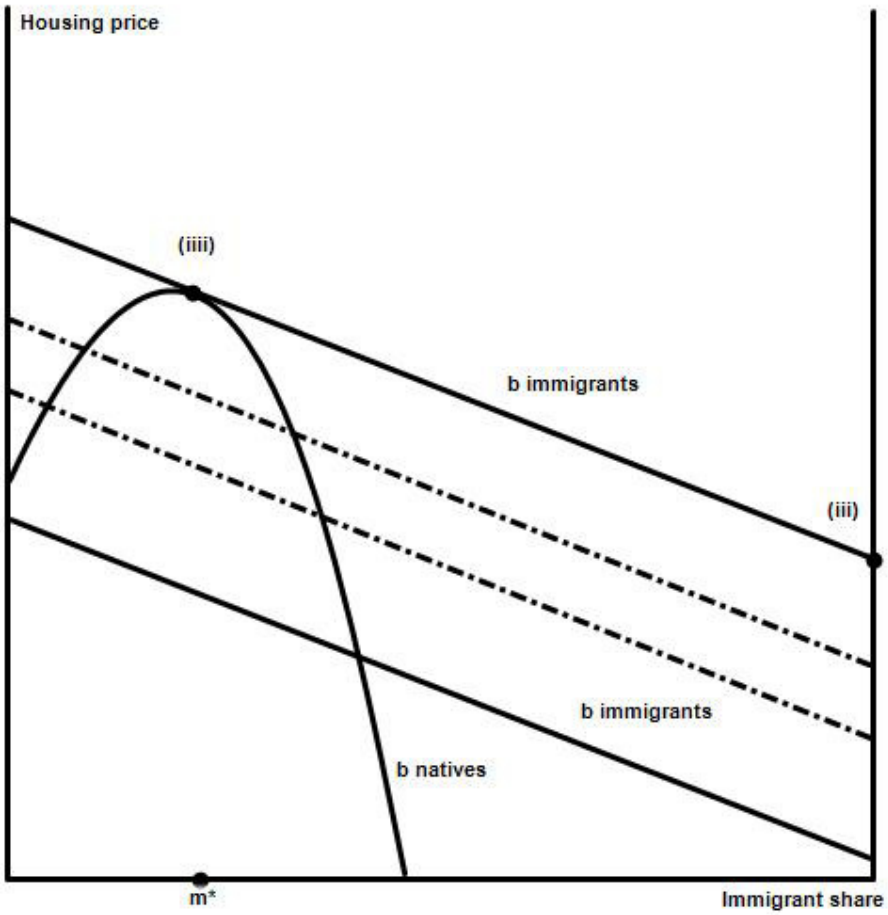


Exogenous shocks

What happens is for some reason there is an exogenous shock and the inflow of immigrants into the neighbourhood increases? When we take a look at figure 2 we can see what happens. We start out with an all-native neighbourhood, at one time this neighbourhood experiences an exogenous shock and the inflow of immigrants increases. This increased inflow of immigrants will shift the demand curve of the immigrants upwards. As long as the natives' willingness to pay for housing increases, while at the same time the share of immigrants also increases the neighbourhood will be a mixed and stable equilibrium. The highest share of immigrants that will generate a mixed and stable neighbourhood is up to the share of immigrants where the demand curves of the natives and immigrants touch each other. As we can see in figure 2, this is at point (iiii), with an immigrant share of m^*. If the demand for housing of the immigrants

increases even more, we see that the share of immigrants continues to grow and that it passes the critical point of m^* and that the neighbourhood will experience tipping behaviour of the natives. Beyond this point, the immigrants will continue to outbid the natives because their willingness to pay is higher than that of the natives, while at the same time the share of immigrants increases and we eventually reach the all-immigrant and stable equilibrium point (iii).

Figure 2



Chapter 4: Description of the data

In this section the data that was collected for this research will be discussed. Issues that will be addressed are for example: where did the data come from, why do we expect tipping behaviour in the Netherlands, in what different periods is the data divided, in what sub-groups can the total population be divided, what restrictions are imposed on the data and what are the consequences of these restrictions?

In this research the tipping behaviour of the native population in the six largest cities in the Netherlands is studied. These cities are: Amsterdam, Rotterdam, Den Haag, Utrecht, Tilburg and Eindhoven.

The data that is used to study the tipping behaviour of the native population in relation to the number of non-Western immigrants as a share of the total population is data that is collected from the website of Statistics Netherlands (CBS). The data that is studied ranges from 1 January 1998 until 1 January 2012. Statistics Netherlands confirmed that no other data outside these years was available, in digital or paper form.

The total period that is studied is divided into three different periods:

- 1 January 1998 - 1 January 2003
- 1 January 2004 - 1 January 2012
- 1 January 1998 – 1 January 2012

The reason for this particular choice of periods comes down to the fact that around the year 2003, the debate in the Netherlands surrounding the issue of immigration of non-Western immigrants intensified. For example when we look at Penninx (2006) and Brug, van der, Fennema, Heerden, van, Lange, de (2009) we see that it was during this period Pim Fortuyn, one of the most prominent advocates of a more restricted immigration regime for non-Western immigrants, especially the ones coming from Muslim countries, was at the height of his political success. On May 6 2002, Fortuyn was murdered. Only one week after his assassination, his political party claimed one of the biggest successes in political history in the Netherlands. On 2 November 2004, Theo van Gogh was murdered by a Dutch-Moroccan Muslim. Van Gogh was a film director and mainly known for his critical views on the role of women in a Muslim society. His assassination intensified the debate surrounding immigration of non-Western immigrants even further. Therefore this study tries to find out if there are different tipping points before and after 2003.

Why do we expect tipping behaviour in the Netherlands?

Based on the increased inflow of immigrants into the Netherlands over the past decades, we have reason to believe that within the framework of the model that is used in this research this has created an exogenous shock and has increased the share of immigrants in the Netherlands. This could eventually result in tipping behaviour of the natives.

Jennissen (2001) gives a clear overview of the history of immigration into the Netherlands during the last decades. In the post Second World War era, the Netherlands faced a large inflow of labour migrants. They mainly originated from Southern Europe, Morocco and Turkey. These labour migrants were attracted to the Netherlands because of the shortages that started to exist on the Dutch labour market caused by the economic growth during the post-war era. This wave of labour migration was ended by the recession that started in 1973. After this wave of labour migration the Netherlands faced another type of immigration wave. It consisted mainly of family migration that consisted of family reunification and family formation. The labour migrants from Morocco and Turkey were the driving force behind the family migration. This wave lasted roughly from 1976 till 2005. During the Eighties the Netherlands were confronted with mainly asylum seekers and illegal immigrants that formed the majority of the group of immigrants. As a direct result of the decolonization process, in the Fifties and Sixties immigrants were coming in from the former Dutch East Indies. During the period of 1974 till 1980 there was also in increased inflow of immigrants coming from Surinam when this country became independent on 25 November 1975. As a more recent turn of events, after the European enlargement in 2004, the Netherlands were facing yet another wave of labour migrants. The majority of them came from Poland. After 2007 they were joined by labour migrants coming from Bulgaria and Romania.

Definition of sub-groups

The total population that is studied is divided into two different sub-groups. These sub-groups are the natives and the non-Western immigrants. The sub-group of natives includes both the group of natives plus the group of Western immigrants. The definitions below of a native, a Western immigrant and a non-Western immigrant are based on the definitions Statistics Netherlands (www.cbs.nl) has formulated regarding these different sub-groups.

A person is identified as a native resident if he/she was born in the Netherlands and if his/her parents were also born in the Netherlands. A person is identified as a Western immigrant if at least one of the parents of this person was born in Europe (excluding Turkey), North America, Oceania, Indonesia, or Japan. Based on their social economical and social

cultural position, immigrants from Indonesia and Japan are regarded as Western immigrants. In this case it mainly concerns people who are born in the former Dutch colony "Nederlands-Indië" and employees of Japanese companies and their families.

The reason why Western immigrants are included in the sub-group of natives is that in other studies, conducting similar research, the native residents are also grouped together with the Western immigrants. For example when we look at the research of Andersson et al. (2012), we see that they also group the natives and Western immigrants together. The reason why they do this is because they want to observe the tipping behaviour of the natives in response to the arrival of non-Western immigrants into the neighbourhood. Therefore when in this thesis is referred to the group of natives, this includes both the native population *and* the Western immigrants.

A person is identified as a non-Western immigrant if at least one parent was born in Africa, Latin-America, Asia (excluding Indonesia and Japan) or Turkey.

Restrictions

The data was collected at the zip code level and we start with a sample size of 4747 individual observations. The number of individual zip codes in the cities is 325. The zip code level is the smallest or finest geographical level at which Statistics Netherlands collects data.

If we would like to identity tipping points within the six largest cities in the Netherlands, the collected data must be as homogenous as possible so that a sensible comparison can be made. If we allow the data to be heterogeneous, it would be possible that we would find multiple tipping points within the same city. This is not what we are looking for. The aim of this research is to identify a single tipping point per city, per period. Therefore we strive to obtain a level of homogeneity for the data that is as high as possible. In order to increase this homogeneity within the total sample, a number of restrictions are imposed.

The first restriction is that only the zip codes that a represented in every year will be included. Every zip code that is not present in every year (ranging from 1998 until 2012) will be excluded. This means that for example a zip code that was present from 2002 until 2012 will be excluded because it can not be compared to a zip code that is present during the whole period, ranging from 1998 until 2012.[3] Once this restriction is imposed, the sample size drops from 4747 to 4545. The number of individual zip codes in the cities drops from 325 to 303.

[3] One of the reasons why certain zip codes are not present in every year could be that the cities within this research have grown over time, thus including zip codes in a later year that did not exist in earlier years. Another reason could be that certain zip codes were grouped together in a certain year, thus existing in one year and no longer existing (as an individual zip code) in the next year.

Table 4.1 Summary of the zip codes below gives information about the different zip codes, including the ones that were removed. As we can see the number of zip codes that were removed is 202. When we compare the zip codes that were removed with the ones that were kept, we see that the values for several indicators vary between the two groups of zip codes. For example when we look at the indicator "Average total population per zip code" we see that the value (4752) for this indicator is much lower for the zip codes that were removed, compared to the value (8009) of the zip codes that were kept. If we compare the other values in the table we see that the values for the zip codes that were removed are all lower compared to the values of the zip codes that were kept. One of the reasons for these lower values could be that the quality of the sample that is removed is not as good as the quality of the sample that is kept. When we study the sample that is removed, we see that there are many missing values. For example there are 4 missing values for the factor "total population". For the "native population" there are 16 missing values, for the "immigrant population" there are 5 missing values, for the "Western immigrants" there are 11 missing values and for the "non-Western immigrants" there are 35 missing values. These missing values most likely reduce the average for every individual indicator. When we look at the years that are missing of the series of zip codes that were removed we see that the years that are missing the most are the years at the beginning of every series. For example out of the 21 zip code series that were removed, 8 of them only have data starting from 2002. These series thus are missing the years 1998, 1999, 2000 and 2001.

Table 4.1 Summary of the zip codes

	Total number of zip codes	Zip codes, frequency equals 15	Zip codes, frequency does not equal 15
Sample size	4747	4545	202
Average total population per zip code	7870	8009	4752
Average number of natives per zip code	4695	4749	3474
Average number of immigrants per zip code	3176	3260	1278
Average number of Western immigrants per zip code	933	955	436
Average number of non-Western immigrants per zip code	2242	2304	843
Average % of non-Western immigrants	23,83	24,23	14,92

Another restriction that is imposed on the data is the use of box plots. They were made for every individual city, for every individual period. Box plots are a statistical tool that correct for outliers. By doing this, the sample size per city drops, while improving the quality of the output of the regression analysis. The way a box plot works is as follows. First the different quartiles in the total sample are identified. The next step is to subtract the 1st quartile (Q1) of the 3rd quartile (Q3). This gives the width of the box plot, this is also known as the Inter Quartile Range, or IQR. IQR= Q3-Q1. The width of the box or IQR is a measure of how big the spread of the values in the sample are. It is assumed that the values in the sample are clustered around a certain central value. This central value is the median of the sample. The larger the IQR, the larger the spread of the values around the median is. An outlier is identified as a value in the sample that lays more than one and a half times the width of the box from either end of the box. This means that if a value in the sample is smaller than Q1-1,5 x IQR or bigger than Q3 + 1,5 x IQR it is classified as an outlier, because it is too far away from the central value in the sample.[4] Table 4.2 Box plots, summary of the results, below indicates what the consequences are by applying box plots and how many values were removed.

[4] http://www.purplemath.com/modules/boxwhisk3.htm

Table 4.2 Box plots, summary of the results

		Sample size before correction of outliers	Sample size after correction of outliers
Amsterdam	1998-2003	76 (plus 1 missing value)	61
	2004-2012	77	64
	1998-2012	76 (plus 1 missing value)	65
Den Haag	1998-2003	54	53
	2004-2012	54	52
	1998-2012	54	49
Eindhoven	1998-2003	31	28
	2004-2012	31	24
	1998-2012	31	28
Rotterdam	1998-2003	73	63
	2004-2012	72 (plus 1 missing value)	66
	1998-2012	73	65
Tilburg	1998-2003	27	23
	2004-2012	27	23
	1998-2012	27	21
Utrecht	1998-2003	41	33
	2004-2012	41	34
	1998-2012	41	32

Data trends

Table 4.3 Summary of statistics for the different periods, below gives an overview of specific indicators for the data that was collected for the period 1998-2012. As we can see the average share of non-Western immigrants as a % of the total population rose in the period 1998-2003 from almost 20% to almost 25% in the period 2004-2012. If we look at the growth figures we can see that the total population in the six cities that were studied grew with 6,37%

in the period 1998-2012 , with 2,11% in the period 1998-2003 and 3,93% in the period 2004-2012. If we look at the growth rate of the native population for these same periods, one can observe a different trend. In this case the native population did not grow, but showed a reverse trend over time. For the period of 1998-2003 there was a decrease of the native population of 3,60%. For the period of 2004-2012 the native population grew with only 1% but this was not enough to offset the decrease that took place in the earlier period, resulting in an overall decrease of the native population for the period 1998-2012 with 3,15%.

When we take these figures into account and we see on the one hand an increase of the total population in the periods and we see that the native population decreased (or only showed a minor growth of 1%) the growth of the total population is most likely caused by a growth of the non-Western immigrant population. When we look at the figures we can see that the group of non-Western immigrants has grown in all the periods. This group grew with almost 20% in the period 1998-2003 and with over 10% in the period 2004-2012. In the period 1998-2012 the growth for this group was more than 35%, adding to the growth of the total population.

If we look at table 4.3 Summary of statistics for the different periods we can also observe another trend. In this table the zip codes are grouped together according to different levels of % of non-Western immigrants as a % of the total population. For example when we look at the zip codes where 0% to 5% of the total population is of non-Western origin we can see that in 1998 16,50% of the total number of zip codes had a share of 0% to 5% of non-Western immigrants. In 2003 this figure had dropped to 11,88%. In 2004 this figure had dropped even further to 10,56% and in 2012 this figure was even lower at 6,93%. This means that the number of neighbourhoods with a 0% to 5% share of non-Western immigrants as a % of the total population has dropped with 57,48% over the period 1998-2012. If we do the same for the zip codes where 5% to 20% of the total population is of non-Western origin we get the following results: 1998 = 46,20%, 2003 = 41,58%, 2004 = 40,92% and 2012 = 38,94%. This means a reduction over the period 1998-2012 of 15,71%. However when we continue this exercise for the zip codes where 20% to 50% of the total population is of non-Western origin we get the following results: 1998 = 29,04%, 2003 = 34,98%, 2004 = 36,63% and 2012 = 37,62%. In this case there is an increase over the period 1998-2012 of 29,55% of zip codes where 20% to 50% of the total population in of non-Western origin.

A similar trend can be observed when we look at zip codes where 50% to 100% of the total population is of non-Western origin. Here the results are: 1998 = 8,25%, 2003 = 11,55%, 2004 = 11,88% and 2012 = 16,50%. In this case there is an increase over the period 1998-2012 of 100%.

Conclusion data trends

When we look at these figures for 1998 till 2012 we can see that on the one hand zip codes with low(er) shares of non-Western immigrants (0% to 5% and 5% to 20%) have decreased in number while on the other hand zip codes with high(er) shares (20% to 50% and 50% to 100%) of non-Western immigrants have increased in number during the same period. This could indicate that the zip codes have become more densely populated with non-Western immigrants while at the same time the number of zip codes with a high(er) share of natives has been reduced during the same period.

If we take a closer look at the growth rates of the total population, the natives and the non-Western immigrants we can see that for the zip codes with a low(er) share of non-Western immigrants (0% to 5% and 5% to 20%) as a % of the total population, the growth rates are all negative for the different periods (1998 - 2003, 2004 - 2012 and 1998 - 2012). However if we do the same for the zip codes with a high(er) share of non-Western immigrants (20% to 50% and 50% to 100%) as a % of the total population we see the opposite. In these cases the total population, the natives and the non-Western immigrants all show a positive growth rate for all the different periods. The only exception is when we look at zip codes where 20% to 50% of the total population is of non-Western origin. In this case we see for the period 2004 - 2012 a very small negative growth rate for the non-Western immigrants of -0,11%. This trend reinforces the earlier identified trend where we saw a decrease in the number of zip codes with a low(er) % of non-Western immigrants, while on the other side the number of zip codes with a high(er) share of non-Western immigrants increased. It seems that not only the number of zip codes with a high(er) % of non-Western immigrants is growing but also the % of non-Western immigrants actually living in these zip codes with a high(er) % of non-Western immigrants seems to be increasing at the same time.

Table 4.3 Summary of statistics for the different periods, part 1

	1998-2003	2004-2012	1998-2012
average % of non-Western immigrants in year = t-1 as a % of the total population	19,65%	24,49%	19,65%
Growth of the total population in %, from year = t-1 to year = t	2,11%	3,93%	6,37%
Growth of the native (=natives plus Western immigrants) population in %, from year = t-1 to year = t	-3,60%	1,00%	-3,15%
Growth of the non-Western immigrant population in % from year = t-1 to year = t	19,77%	11,02%	35,84%
Zip codes where 0%-5% of the total population is of non-Western origin in base year (= t-1)			
% of zip codes of the total sample in the base year (=t-1), (absolute number)	16,50% (50)	10,56% (32)	16,50% (50)
% of zip codes of the total sample in the last year (=t), (absolute number)	11,88% (36)	6,93% (21)	6,93% (21)
Growth of the total population in %, from year = t-1 to year = t	-42,22%	-40,31%	-65,74%
Growth of the native (=natives plus Western immigrants) population in %, from year = t-1 to year = t	-42,14%	-40,24%	-65,68%
Growth of the non-Western immigrant population in % from year = t-1 to year = t	-44,38%	-43,43%	-68,15%
Zip codes where 5%-20% of the total population is of non-Western origin in base year (= t-1)			
% of zip codes of the total sample in the base year (=t-1), (absolute number)	46,20% (140)	40,92% (124)	46,20% (140)
% of zip codes of the total sample in the last year (=t), (absolute number)	41,58% (126)	38,94% (118)	38,94% (118)
Growth of the total population in %, from year = t-1 to year = t	-14,08%	-7,02%	-22,37%
Growth of the native (=natives plus Western immigrants) population in %, from year = t-1 to year = t	-14,44%	-7,50%	-23,13%
Growth of the non-Western immigrant population in % from year = t-1 to year = t	-11,33%	-3,41%	-16,45%

Table 4.3 Summary of statistics for the different periods, part 2

Zip codes where 20%-50% of the total population is of non-Western origin in base year (= t-1)			
% of zip codes of the total sample in the base year (=t-1), (absolute number)	29,04% (88)	36,63% (111)	29,04% (88)
% of zip codes of the total sample in the last year (=t), (absolute number)	34,98% (106)	37,62% (114)	37,62% (114)
Growth of the total population in %, from year = t-1 to year = t	20,37%	4,30%	27,33%
Growth of the native (=natives plus Western immigrants) population in %, from year = t-1 to year = t	18,96%	6,50%	28,35%
Growth of the non-Western immigrant population in % from year = t-1 to year = t	23,25%	-0,11%	25,21%
Zip codes where 50%-100% of the total population is of non-Western origin in base year (= t-1)			
% of zip codes of the total sample in the base year (=t-1), (absolute number)	8,25% (25)	11,88% (36)	8,25% (25)
% of zip codes of the total sample in the last year (=t), (absolute number)	11,55% (35)	16,50% (50)	16,50% (50)
Growth of the total population in %, from year = t-1 to year = t	35,92%	38,31%	97,50%
Growth of the native (=natives plus Western immigrants) population in %, from year = t-1 to year = t	30,83%	48,71%	104,82%
Growth of the non-Western immigrant population in % from year = t-1 to year = t	38,83%	32,68%	93,26%
Legend			
t-1 = base year of every period, for example for the period 1998-2003, the base year = 1998			
t-1 for period 2004-2012, is 2004			
t-1 for period 1998-2012, is 1998			
t=1 is the last year for every period, for example for the period 1998-2003, t=1 is 2003			
t=1 for period is 2004-2012, is 2012			
t=1 for period 1998-2012, is 2012			

Chapter 5: Empirical model

The method that is used to identify the tipping points in the six individual cities for the three different periods is the same method that is also used by Andersson et al. (2012) and Card et al. (2008B). The theoretical model that was constructed earlier predicts that the number of natives (including Western immigrants) will decrease discontinuously once the number of non-Western immigrants as a percentage of the total population exceeds a critical level. This critical level is the tipping point we are trying to identify.

Explanation of the model

In the model that we use to identify the tipping point per city per period, the growth of the native population (including Western immigrants) is a function of the number of non-Western immigrants as a percentage of the total population. We look at three different periods. These periods are: 1 January 1998 - 1 January 2003, 1 January 2004 – 1 January 2012 and 1 January 1998 – 1 January 2012. Every period has a base year, this is equal to *t-1*. For example the base year for the period 1998-2003 is 1998. When the year is simply specified as t , this means the last year of every period. For example t for the period 1998-2003 is 2003. The model looks at values at the zip code level, per individual city. The zip code level is the smallest geographical level at which Statistics Netherlands collects data. The individual zip codes are indicated by i .

The candidate tipping point is assumed to be somewhere between 0% and 50% of non-Western immigrants as a percentage of the total population. This range of 0% to 50% is chosen based on the fact that other articles conducting similar research identifying tipping points also employ a range of 0% to 50%. See for example Card et al. (2008B). In this article the authors assume that the tipping point is located somewhere between 0% and 50% and therefore they select a value for the candidate tipping point in this particular interval.

In order to find the tipping point we estimate the following regression function for every individual zip code, in every time period. The regression is run separately by city and therefore looks like:

$$dn_{i,t} = \alpha_{i,t} + d_{i,t}\,[m_{i,t-1} > m^{*}_{i,t-1}] + \varepsilon_{i,t} \qquad (1).$$

In the research that is conducted here, the candidate tipping point is denoted by $m^{*}_{i,t-1}$.

$dn_{i,t}$, is the growth rate of the native population for zip code = *i,* for year = *t*. In this case when year = *t*, this is the last year of every specific period.
This growth is calculated by solving the following equation for every individual zip code, for every individual period:

$$dn_{i,t} = (N_{i,t} - N_{i,t-1}) / P_{i,t-1} \qquad (2).$$

$N_{i,t}$ is the number of native residents (including Western immigrants) for zip code = *i* ,for year = *t.*
$N_{i,t-1}$ is the number of native residents (including Western immigrants) for zip code = *i* ,for year = *t-1.* In this case year = t-1, this is the base year of every specific period.
$P_{i,t-1}$ is the total population for zip code = *i* , for year = *t-1.*

$m_{i,t-1}$ is the number of non-Western immigrants as a percentage of the total population for zip code = *i* , for year = *t-1.*
$m_{i,t-1}$ is calculated by solving the following equation for every individual zip code, for every individual period:

$$m_{i,c,t-1} = M_{i,c,t-1} / P_{i,c,t-1} \qquad (3).$$

$M_{i,t-1}$ is the number of non-Western immigrants for zip code = *i* , for year = *t-1.*
$P_{i,t-1}$ is the total population for zip code = *i* , for year = *t-1.*

$d_{i,t}$ is a dummy variable. This dummy variable equals 1 if $m_{i,t-1}$ is larger than $m^{*}_{i,t-1}$ (this is the candidate tipping point) and this dummy variable equals 0 in all the other cases.
$\alpha_{i,t}$ is a constant term and $\varepsilon_{i,t}$ is a random term.

The tipping point is identified at the value for $m^{*}_{i,t-1}$ that yields the highest value for R^2 when the regression analysis is run based on equation (1). This particular value for $m^{*}_{i,t-1}$ represents the number of non-Western immigrants as a percentage of the total population at which this particular period, reaches the tipping point. This tipping point is specified as the point where the growth of the native population (including Western immigrants) changes discontinuously as a result of the number of non-Western immigrants as a percentage of the total population.

Chapter 6: Results

In this section we will discuss the results that were obtained after running the regression analysis for the different cities and different periods in order to identify the tipping points for the six largest cities in the Netherlands. These findings will also be compared to the results that were obtained for the United States and Sweden

Summary of the tipping points

Table 6.1 Summary of the tipping points below, gives an overview of the results that were obtained by running the regression analysis in order to find the tipping points for the different cities during the different periods. Only the statistically significant tipping points were included when the values for this table were calculated. All the tipping points that were not statistically significant were excluded. This means for example when the mean tipping point for every period was calculated, this was done by taking the average of the tipping points during that period that were statistically significant. The statistically insignificant tipping points were excluded from this calculation. In order to see which tipping points were statistically significant, a check was made both the 5% significance level and at the 10% significance level. The result was that the tipping point for the city of Rotterdam in the period 2004 - 2012 was not statistically significant at the 5% level but was statistically significant at the 10% level. All the other tipping points that were statistically significant at the 10% level were also statistically significant at the 5% level. In order to include the highest number of tipping points that are statistically significant, the 10% significance level was chosen. When in this research the significance level is discussed, we are referring to the significance level of the regression coefficient. This significance level indicates whether or not the regression coefficient is significant or not. This significance level is connected to the F-value of the regression model.

For the period 1998 - 2003 we were able to identify four statistically significant tipping points for six of the cities. The lowest statistically significant tipping point for this period was located in Den Haag and was 10,65%. The highest statistically significant tipping point for this period was located in Amsterdam and was 26,01%. The mean statistically significant tipping point for this period was 17,56%. If we look at the period 2004 - 2012 we see that for five of the six cities statistically significant tipping points are identified. In this case the lowest statistically significant tipping point is located in Eindhoven at 21,18% and the highest

statistically significant tipping point was located in Rotterdam at 48,08%. The mean statistically significant tipping point for this period was 33,36%. For the whole period of 1998 - 2012 we can only find two statistically significant tipping points. These points are located in Tilburg at 16,45%, which is also the lowest point. The other statistically significant tipping point is located in Utrecht at 17,11%. The mean statistically significant tipping point for this period was 16,78 %.

When we compare the results for the period 1998 - 2003 with those of the period 2004 - 2012 we see that the mean statistically significant tipping point is almost twice as high in the later period and that the spread between the minimum and maximum statistically significant tipping point also has increased in the second period. The period 1998 - 2012 only yields two statistically significant tipping points. The spread between these two points is fairly minimal and the mean statistically significant tipping point for this period is almost comparable to the one of the period 1998 - 2003. A difference between the minimum and the maximum statistically significant tipping point indicates that the native population (including Western immigrants) has a preference towards non-Western immigrants that varies from city to city. In the second period of 2004 - 2012 the spread between the minimum and the maximum tipping point became even larger, indicating that the attitude of the native population (including Western immigrants) towards non-Western immigrants varied even more from city to city during this period. In addition to this, the majority of the cities in the period 2004 - 2012 had higher statistically significant tipping points than in 1998 - 2003.

Within the boundaries of this model, it seems that the attitude of the native population (including Western immigrants) towards non-Western immigrants has changed over time and that they have become more tolerant in the period 2004 - 2012 towards non Western-immigrants.

Table 6.1 Summary of the tipping points

	1998-2003	2004-2012	1998-2012
Mean tipping point for all the cities combined	17,56	33,36	16,78
Minimum tipping point for all the cities combined	10,65	21,18	16,45
Maximum tippingpoint for all the cities combined	26,01	48,08	17,11
Total number of cities	6	6	6
Number of cities with a statistically significant tipping point at a significance level of 5%	4	5	2
Number of individual zip codes	303	303	303

Graphical display of the tipping points

In the appendix Specific tipping points, per city for 1998-2003, 2004-2012 and 1998-2012 the specific tipping points for every individual city for every different period are graphically displayed. In order to understand what we are looking at, a description of the graphs is given here. On the vertical (or Y-)axis the dependent variable is displayed. In this case this is the growth of the native population (including the Western-immigrants). The way this growth is calculated is explained in the chapter "Empirical model". On the horizontal (or X-)axis the independent variable is displayed. In this case it is the number of non-Western immigrants as a percentage of the total population for year = t-1. The way this percentage is calculated is explained in the chapter "Empirical model".

If we take a look at the graph itself we can see many individual circles, each circle represents an individual zip code. The X-coefficient of every circle is the dependent variable ($dn_{i,t}$) and the Y-coefficient is the independent variable ($m_{i,t-1}$). In the graph the solid lines show the linear trend of the dependent variable (native population growth) and this is a function of independent variable (number of non-Western immigrants as a percentage of the total population).

A distinction is made between the trend before the tipping point and after the tipping point. The method of fit that was used in SPSS was the LOESS-option. LOESS stands for: Locally Estimated Scatterplot Smoothing. The LOESS-option was chosen because, as a smoothing

function it tries to visually capture the relationship between the dependent and independent variable, while at the same time it reduces the influence caused by outliers and it makes minimal assumptions about the relationship between these variables. [5] The % of points to fit was set at 75% and for the kernel the option "Triweight" was selected. The option "Triweight" was selected because in this particular kernel gives higher weights to data that is close to the current point, while on the other hand it gives little weight to extreme cases.[6]
The reason why these setting in SPSS were chosen is because they produced trend lines that are smooth and give a clear image of the trend, without making the trend lines too smooth and running the risk of loosing too much information. Other settings in SPSS were also tried but the LOESS-option, in combination with the 75% points to fit, with a Triweight kernel, produced the best fit to graphically display the tipping points.

The dashed horizontal line represents the mean of Y (growth rate of the native population). The vertical line indicates the number of non-Western immigrants as a percentage of the total population where we observe the tipping behaviour of the native population. This is the tipping point.

Graphs combined with data trends

The graphs in the appendix Specific tipping points, per city for 1998-2003, 2004-2012 and 1998-2012 graphically depict how the growth of the native population (including Western immigrants) is related to the number of non-Western immigrants as a percentage of the total population. When we look back at table 4.3 Summary of statistics for different periods in the "Data" chapter we saw that during the three different periods of 1998-2003, 2004-2012 and 1998-2012 the zip codes with a low(er) percentage (0%-5% and 5%-20%) of non-Western immigrants, the growth of the native population (including Western immigrants) was negative. However when we look at the same periods we can see that in the zip codes with a high(er) percentage (20%-50% and 50%-100%) of non-Western immigrants the growth of the native population (including Western immigrants) was positive. Therefore, if we look at the graphs for the different periods of the individual cities we would expect to see an upward trend of the growth rate of the native population (including Western immigrants) starting from a 20%-level (and higher) of non-Western immigrants. This is true for most of the cities and especially visible when we look at the graphs for the period 2004-2012.

[5] http://n-steps.tetratech-ffx.com/PDF&otherFiles/stat_anal_tools/LOESS_final.pdf

[6] http://publib.boulder.ibm.com/infocenter/spssstat/v20r0m0/index.jsp?topic=%2Fcom.ibm.spss.statistics.help%2Fgpl_function_smooth_loess.htm

Information per tipping point

If we look at Table 6.2 Information per tipping point, we see the statistical information per tipping point. All the tipping points that are statistically significant at the 10% significance level are marked in the table. For example when we look at Amsterdam for the period 1998-2003 we see the "Dependent" (value: -9,26) and the independent (value: 26,01), these two values form the coordinates of the tipping point. The tipping point was identified because at this specific point, the R^2-value was at it is highest level (value: 0,09). The significance level is the significance level of the regression coefficient (value: 0,019). The F-value is the F-value at the tipping point itself.

In order to say how large the actual change in growth of the native population (including Western immigrants) at the tipping point is, we take a look at the regression coefficient. This value indicates how much the dependent variable changes when there is a change of the dependent variable of 1 unit. For example in this particular case an increase of 1%-point in the number of non-Western immigrants as a percentage of the total population will result in a -0,043% change of the growth of the native population (including Western immigrants).

As we can see in the table the value of the regression coefficient ranges from -0,673 to 0,182 for all the tipping points (in this case this also includes the tipping points that are not statistically significant). When we only take into consideration the tipping points that are statistically significant then the value of the regression coefficient ranges from -0,673 to 0,154 which is an even smaller spread in the regression coefficients. This indicates that the change of the dependent variable is fairly small if the independent variable changes with 1.

Table 6.2 Information per tipping point

	1998-2003	2004-2012	1998-2012
Amsterdam			
Dependent	-9,26	8,83	1
Independent (=tipping point)	**26,01**	**30,38**	**35,44**
R-square	0,09	0,009	0,019
Significance level	0,019	0,444	0,277
F-value	5,85	0,59	1,2
regression coefficient	-0,043	-0,022	-0,058
Rotterdam			
Dependent	-2,12	-4,36	-15,36
Independent (=tipping point)	**8,21**	**48,08**	**12,4**
R-square	0,021	0,049	0,011
Sig. level	0,262	0,076	0,398
F-value	1,28	3,89	0,73
regression coefficient	-0,033	0,052	-0,046
Den Haag			
Dependent	-7,22	4,43	-2,79
Independent (=tipping point)	**10,65**	**44,98**	**29,85**
R-square	0,092	0,126	0,031
Sig. Level	0,028	0,01	0,223
F-value	5,14	7,18	1,53
regression coeffcient	-0,073	0,07	0,051
Utrecht			
Dependent	-9,83	6,43	-21,16
Independent (=tipping point)	**17,11**	**27,44**	**17,11**
R-square	0,265	0,134	0,152
Sig. Level	0,002	0,033	0,028
F-value	11,15	4,97	5,36
regresion coefficient	-0,146	-0,133	-0,263
Tilburg			
Dependent	-9,7	-8,43	-8,58
Independent (=tipping point)	**16,45**	**25,12**	**16,45**
R-square	0,252	0,173	0,5
Sig. Level	0,015	0,049	0
F-value	7,07	4,38	19,03
regression coefficient	-0,328	-0,178	-0,673
Eindhoven			
Dependent	-5,22	1,61	3,69
Independent (=tipping point)	**18,08**	**21,18**	**15,46**
R-square	0,057	0,197	0,035
Sig. Level	0,22	0,03	0,34
F-value	1,58	5,4	0,95
regression coefficient	-0,095	0,154	0,182

International perspective

The Netherlands has a reputation of being a tolerant society. But is this also the case? In order to say something about how tolerant the Netherlands are towards immigrants in an international perspective, the statistically significant tipping points that were obtained in this research for the six largest cities in the Netherlands will be compared to tipping points in other countries that were identified in other research. Tipping points are a measure of the level of tolerance in a society. The higher these tipping points are, the more tolerant the natives are towards immigrants in that society.

The Dutch tipping points will be compared to tipping points that were identified in the United States, taken from Card et al. (2008 A and B) and tipping points for Sweden taken from Andersson et al. (2012). The comparison that is made is rather crude because: a) in the different countries, the tipping points are identified for different periods and b) the geographical areas that were used to calculate the tipping points also vary from country to country. Therefore this comparison only serves as an indication how the tipping points in the different countries compare to each other. The table below gives an overview of the tipping points that were obtained in the Netherlands.

Table 6.3 Tipping points in the Netherlands, taken from this research

Own research			
City	**Tipping point per period in %**		
	1998-2003	2004-2012	1998-2012
Amsterdam	26,01	/	/
Rotterdam	/	48,08	/
Den Haag	10,65	44,98	/
Utrecht	17,11	27,44	17,11
Tilburg	16,45	25,12	16,45
Eindhoven	/	21,18	/

As we can see the minimum tipping point is 10,65% and the maximum tipping point is 48,05%. The average tipping point is 24,6%. When we perform the same exercise for the United States we get the following results.

Table 6.4 Tipping points, taken from Card et al. (2008 A & B)

Card et al. (2008 A & B)	
City	**Tipping point in %**
Chicago (1970-1980)*	5
Los Angeles (1970-1980)	15
Long Beach (1970-1980)	15
Indianapolis (1970-1980)	12,5
Portland (1970-1980)	6,25
Vancouver (1970-1980)	6,25
Middlesex (1980-1990)	16,25
Somerset (1980-1990)	16,25
Hunterdon (1980-1990)	16,25
San Antonio (1980-1990)	25
Pittsburg (1980-1990)	8,75
Nashville (1990-2000)	15
Toledo (1990-2000)	17,5

* = Taken from Card (2008A)

The minimum tipping point here is 5% and the maximum tipping point is 25%. The average tipping point is 13,46%.

When we look at Sweden we can get the following tipping points.

Table 6.5 Tipping points, taken from Andersson et al. (2012)

Andersson et al. (2012)		
City	**Tipping point per period in %**	
	1990-2000	2000-2007
Stockholm	3,5	7,0
Göteborg	16,0	16,0
Malmö	14,0	39,5
Uppsala	2,0	4,0
Linköping	6,5	6,0
Västerås	5,0	9,5
Örebro	8-13,5	3,0
Norrköping	7,0	5,5
Helsingborg	6,0	7,5
Jönköping	5,5	6,0
Umeå	4,0	3,5
Lund	20-25	6,5

The minimum tipping point here is 3,5%, while the maximum tipping point is 39,5%. The average tipping point for Sweden is 7,65%.

When we compare the results from the three countries we see the following:

Table 6.6 Overview tipping points the Netherlands, the United States and Sweden

	Minimum tipping point	**Maximum tipping point**	**Average tipping point**
Country			
The Netherlands	10,65	48,05	24,6
The United States	5	25	13,46
Sweden	3,5	39,5	7,65

We see that the minimum tipping point in the Netherlands is roughly twice as high compared to the same number in the United States and roughly three times as high as that number in Sweden. When we look at the maximum tipping point we see that the value for the Netherlands is almost twice as high as that number in the United States and that this only slightly higher when compared to Sweden. When the average tipping point is taken into consideration we see that the value of the Netherlands is almost twice as high in comparison to that number in the United States and roughly three times as high as that number in Sweden.

Chapter 7: Possible policy implications of tipping

Many policymakers prefer neighbourhoods that are racially mixed. They are argue that living conditions in a mixed neighbourhood are better, these neighbourhoods are economically stronger and that crime rates in such neighbourhoods are lower, compared to an all-immigrant neighbourhood.

Possible policy implications

Leidelmeijer et al. (2011), Massey (1990) and Cutler and Glaeser (1997) showed that the concentration of immigrants in neighbourhoods does not always yield positive results, for example in terms of poverty development, school performance, unemployment rates, single parent families and overall living conditions in a neighbourhood.

This research shows that there are tipping points in the six largest cities in the Netherlands. Therefore it is not a matter if tipping will occur, but when tipping it will occur. Given this knowledge we can ask ourselves the question what options are available to policymakers to influence the tipping behaviour of natives in a neighbourhood and to prevent a neighbourhood from tipping. One way to do this is to find out what makes a neighbourhood attractive and pleasant to live in, thus influencing the tipping behaviour of natives and keep them from exiting the neighbourhood.

The article of Leidelmeijer et al. (2011) shows that the attractiveness of a neighbourhood is rated in terms of how safe people feel in a neighbourhood, what is the quality of the houses that are available, are there only rental houses in a neighbourhood or are there also houses owned by homeowners, how old are the houses, what is the quality and reputation of schools in the neighbourhood and what is the quality of the neighbourhood itself in terms of degeneration and nuisance? Kauko (2006) finds in his research that factors such as the accessibility of a neighbourhood and the functionality and spaciousness of the available housing in a neighbourhood determine whether or not people find a neighbourhood attractive or not.

By influencing the factors that make a neighbourhood attractive, policymakers can try to influence the tipping behaviour of the native population in a neighbourhood. For example they can make sure that there are enough houses in a neighbourhood that meet the quality requirements of the natives, or that people feel safe in a neighbourhood by making sure there is enough lighting in public spaces. These are just two examples of possible actions

policymakers can take to try to influence the tipping behaviour of the natives, but naturally there are many more alternatives policymakers can choose to make a neighbourhood more attractive and thus try to influence the tipping behaviour of the natives in that particular neighbourhood.

Possible adverse effects

Andersson and Bråmå (2004) describe the policy the Swedish government has implemented since the 1990s to solve problems in what they call distressed neighbourhoods. These are neighbourhoods with an immigrant share of 50% or more. This policy aims to prevent ghetto formation, racial segregation and to make such neighbourhoods economically and socially stronger. The authors show that this type of policy may not have the desired effects, because it is not always clear what the exact aim of this policy is. Is it to make the individuals who are living in such neighbourhoods better off or is the aim to target the social and economic problems of the neighbourhood as a whole? When the policy is successful in helping the individuals to find a job and improve their education level, this might not be beneficial for the neighbourhood as a whole. Since it is usually those people who have become better off who move out of the distressed neighbourhood. According to the research of Andersson and Bråmå (2004) the people who move out are usually replaced by people who are more likely to be dependent on social benefits and are without a job. This development does not help the overall position of the neighbourhood and continues the distressed nature on a neighbourhood level. According to them, these simultaneous developments have been overlooked by researchers over time.

Galster (2007) argues in his paper that policymakers often use housing policies to mix neighbourhoods in terms of income levels and ethnicity. By doing so, they hope to create neighbourhoods that are racially mixed and socially and economically stronger. Such policies only work when the aim is to improve the overall wellbeing of the individuals in absolute terms, for example in terms of education level, employment rate and income level.

Chapter 8: Conclusion and recommendations for future research

The social interaction model of Card et al. (2008 A and B) assumes that neighbourhoods remain racially mixed and stable up to a critical share of immigrants, also known as the tipping point. Once a neighbourhood reaches and exceeds this tipping point, the native population will show tipping behaviour and starts to leave the neighbourhood. This tipping process continues until the neighbourhood is totally segregated and there are only immigrants living in the neighbourhood.

Over the past few decades the Netherlands has received large groups of immigrants. According to literature these groups often settle down in neighbourhoods where there are already other groups of immigrants, often with the same ethnic background. Based on the increased inflow of immigrants in the Netherlands over the past decades, we have reason to believe that within the framework of the model that is used in this research, this has created an exogenous shock and has increased the share of immigrants in the Netherlands. In order to see whether or not this inflow of immigrants has resulted in tipping behaviour of the native population, the following central question was formulated: *Can we identify tipping points in the six largest cities in the Netherlands and have they changed over time?* This is done for the periods 1998-2003, 2004-2012 and 1998-2012. The data was collected at the zip code level and obtained from the website of Statistics Netherlands.

By using the structural break method four tipping points for the period 1998-2003 were found, ranging from 10,65% to 26,01%. For the period 2004-2012 we found five tipping points, ranging from 21,18% to 48,08%. The same exercise yields two tipping points for the period 1998-2012, 16,45% and 17,11%. The values of the regression coefficients of the identified tipping points range from -0,673 to 0,154. Therefore we can say that there are tipping points but the actual change in growth of the native population that we can observe at these tipping points is rather small.

When we compare the results for the period 1998 - 2003 with those of the period 2004 - 2012 we see that the tipping points are almost twice as high in the second period. Therefore we can say within the boundaries of this model, over time the attitude of the native population towards immigrants has changed and that they have become more tolerant towards immigrants in the period 2004 - 2012.

Recommendations for future research

The research that has been conducted here does not assume to be perfect and complete. It is only intended to serve as a starting point and provide input for future research in the Netherlands while identifying tipping points. Based on the experience gained during this research and with the help of the literature that was studied, several recommendations for future research were formulated. These recommendations are listed below.

Differences among different immigrant groups?

Bayer, McMillan and Rueben (2004) find that during their analysis of the racial segregation patterns in the San Francisco Bay Area, the model that they used was able to explain different amounts of the racial segregation pattern for different ethnic groups. For example their model was able to explain a higher amount of racial segregation for Asians and even more so for Hispanics than for whites and blacks. Therefore it could be interesting if future research would divide the group of Western immigrants into smaller and more ethnically specific groups to see what influence this might have on the tipping behaviour of the group of natives in a neighbourhood.

Composition of the natives who leave

The objective of Dahlberg, Fredriksson and Jofre-Monseny (2012) is to provide a more complete and in depth view of the tipping behaviour in Sweden, while using individual register data for the period 1987 – 1989. The model that they use is the same one that was also used by Card et al. (2008B). Dahlberg et al. (2012) find that there are several questions that Card et al. (2008B) do not answer in their research. For example: What kind of people move out of a neighbourhood, once it tips? or, Children that perform well at school, do they move out of neighbourhoods that tip? One of the findings of the authors is that the natives who move out the first are mainly wealthy (those people with an income in top 3 income deciles) individuals. This is also in line with the findings of Dorn (2008), who showed that it were predominantly the home owners who leave a neighbourhood first, to avoid a financial loss when the neighbourhood tips. Another group of natives that moves out early once the neighbourhood tips is the group of parents with children who do well at school. The authors find evidence for the fact that the grades of the native students in a neighbourhood that has tipped are lower. This suggests that native families with children, who do well at school, leave the neighbourhood once it starts tipping. These findings suggest that tipping might increase income segregation and segregation in the performance at school of the native children

between the group of natives that moves out once a neighbourhood starts tipping and the natives that stay behind in that same neighbourhood.

When we look at the articles of Dorn (2008) and Dahlberg et al. (2012), we see that these authors not only try to identify tipping points but also look at the composition of the group of natives that leave. In the research to identify the tipping points in the six largest cities in the Netherlands, the composition of the natives who leave, once a neighbourhood experiences tipping is left untouched. Based in the arguments of Dorn (2008) and Dahlberg et al. (2012), in future research it could be interesting to look at the characteristics of the natives that leave, once a neighbourhood experiences tipping.

The causes of tipping: native flight or native avoidance?

The aim of this research was to identify the tipping points in the six largest cities in the Netherlands. Once they were identified, the research came to an end. In the article of Andersson et al. (2012), the researchers take an additional step after the tipping points in the twelve largest municipalities in Sweden were identified. By using the regression discontinuity method they investigated what the driving forces were behind the drop in the share of natives, once a neighbourhood had tipped. According to them the drop of the native population beyond the tipping point had different causes in the different periods. In the 1990s the driving forces behind the drop were both the increased out-migration of natives (also known as native flight) and reduced in-migration of natives (also know as native avoidance). However in the 2000s the main driving force behind the drop seemed to be the increased out-migration. The decreased in-migration did not play a major in this period[7].

As a recommendation for future research in the Netherlands, it could be interesting to see what the driving forces are behind the identified tipping points that were identified in this research. At this point only the overall results are known, and not to what extend native flight and native avoidance played a role.

[7] For the period 1990-2000 Bråmå (2006) also investigated what the driving forces were behind the drop in the share of natives beyond the tipping point. The author shows that the increased concentration of immigrants is mainly driven by native avoidance and not so much by native flight. This result is different compared to the findings of Andersson et al. (2012), where for the same period the main driving forces were both the native flight and native avoidance. Bråmå (2006) indicates that from the research it is not clear what the actual causes and motives of the natives are for them to display native avoidance.

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http://www.sp.nl/wonen/

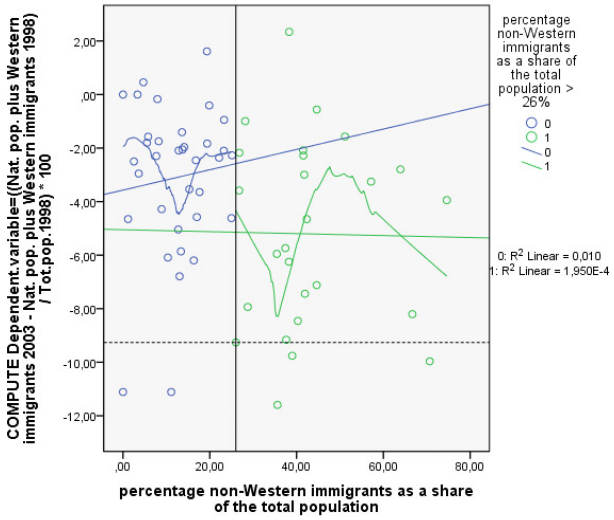
http://www.js.nl/politiek/standpunten/standpunt/t/woonsegregatie

Raw data:

The raw data for this thesis was collected from the website of Statistics Netherlands: (www.statline.cbs.nl).

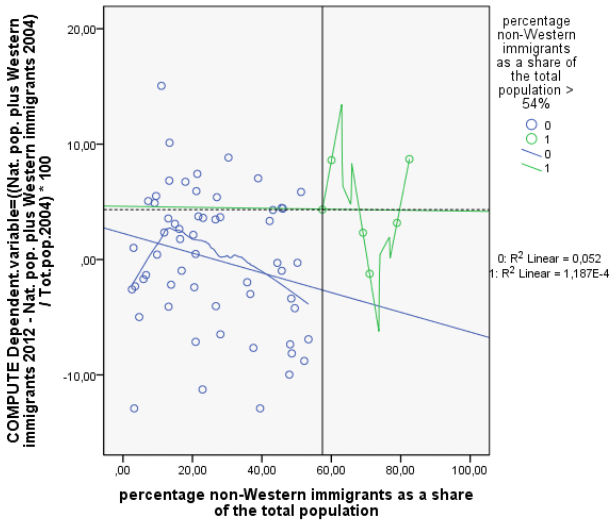
Appendix: Specific tipping points, per city for 1998-2003, 2004-2012 and 1998-2012

1998-2003 Amsterdam



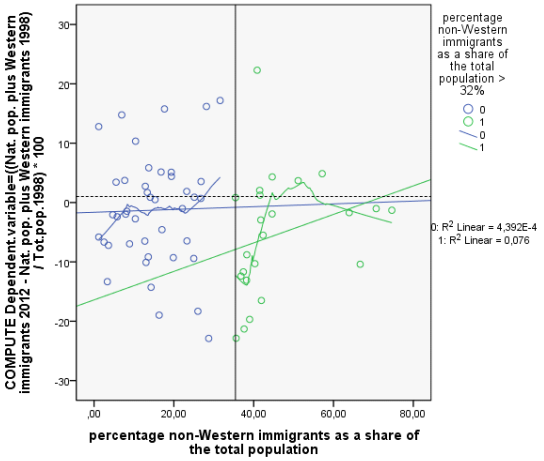
Dependent	-9,26
Tipping point	26,01
Highest R-square	0,09
Sig. Level	0,019

2004-2012 Amsterdam



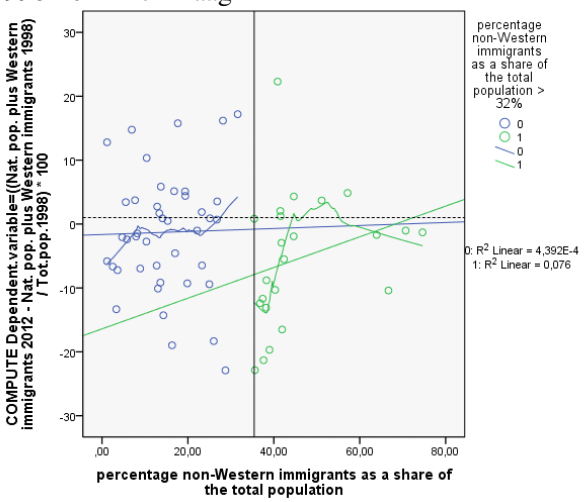
Dependent	4,32
Tipping point	57,43
Highest R-square	0,044
Sig. Level	0,096

1998-2012 Amsterdam



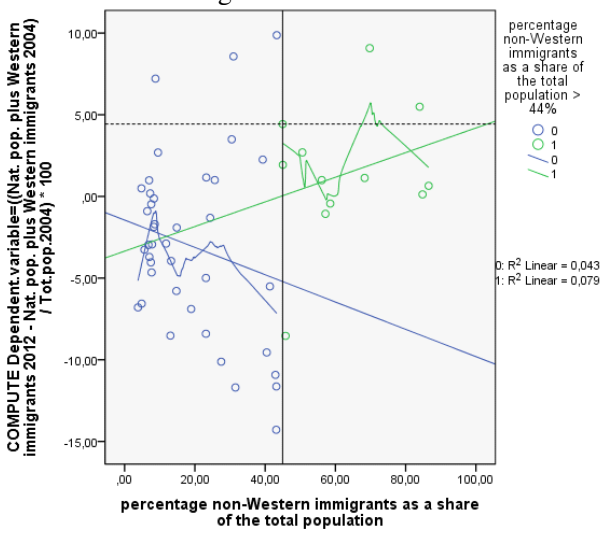
Dependent	1
Tipping point	35,44
Highest R-square	0,019
Sig. Level	0,277

1998-2012 Den Haag



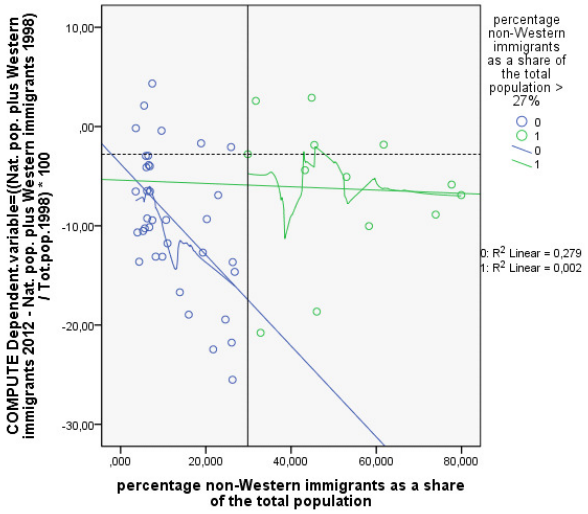
Dependent	1
Tipping point	35,44
Highest R-square	0,019
Sig. Level	0,277

2004-2012 Den Haag



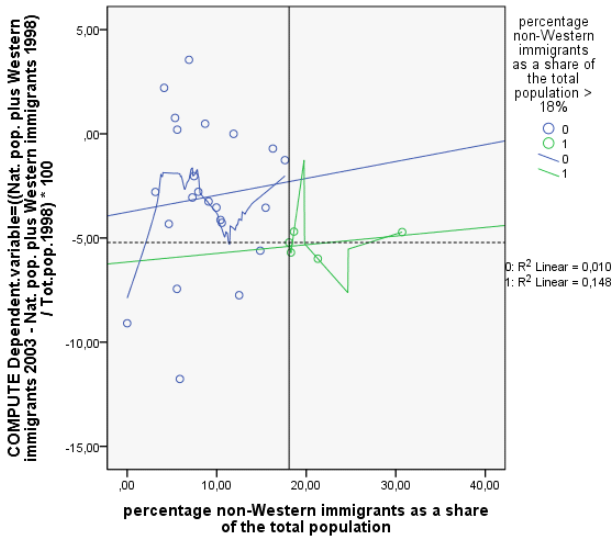
Dependent	4,43
Tipping point	44,98
Highest R-square	0,126
Sig. Level	0,010

1998-2012 Den Haag



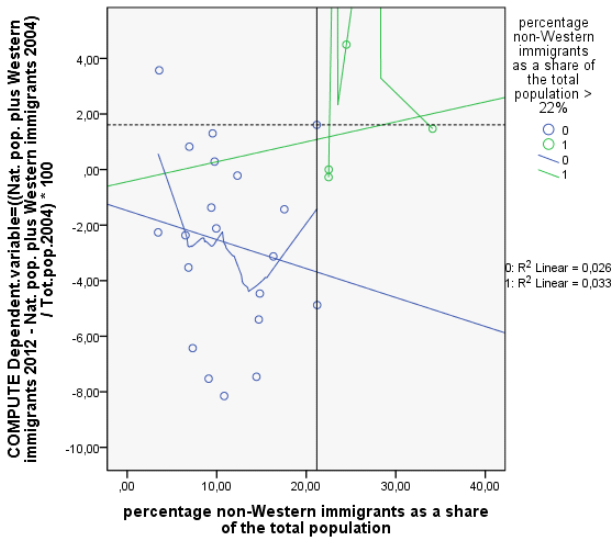
Dependent	-2,79
Tipping point	29,85
Highest R-square	0,031
Sig. Level	0,223

1998-2003 Eindhoven



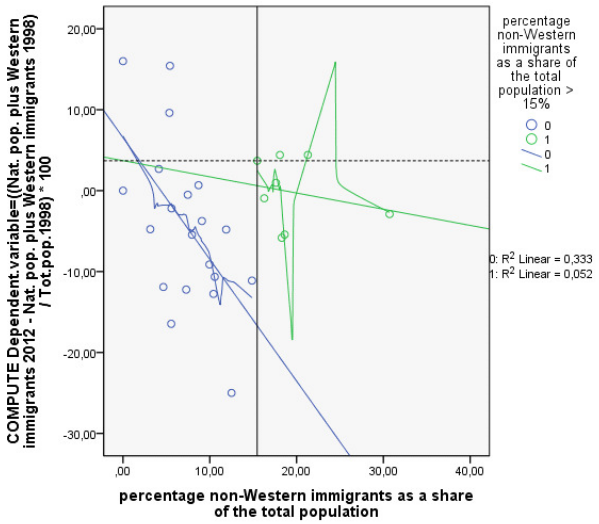
Dependent	-5,22
Tipping point	18,08
Highest R-square	0,057
Sig. Level	0,220

2004-2012 Eindhoven



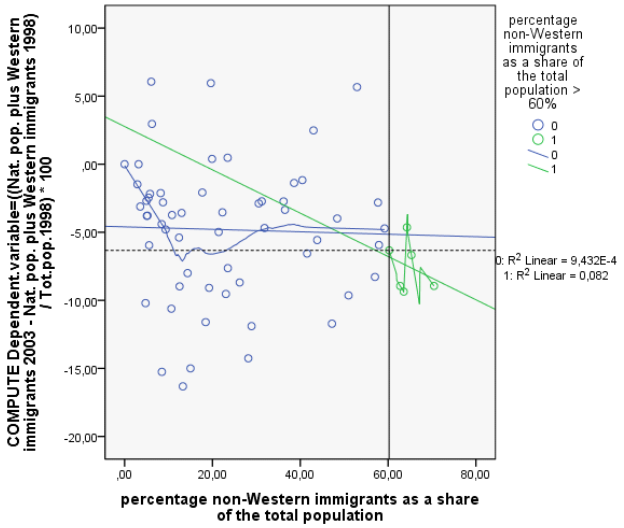
Dependent	1,610
Tipping point	21,18
Highest R-square	0,197
Sig. Level	0,030

1998-2012 Eindhoven



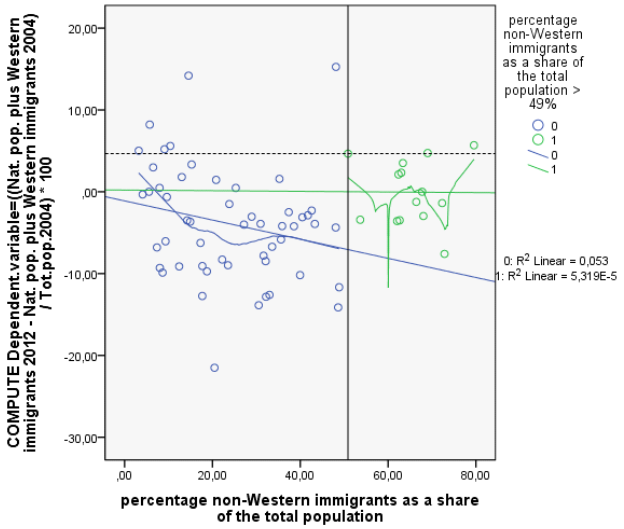
Dependent	3,690
Tipping point	15,46
Highest R-square	0,035
Sig. Level	0,340

1998-2003 Rotterdam



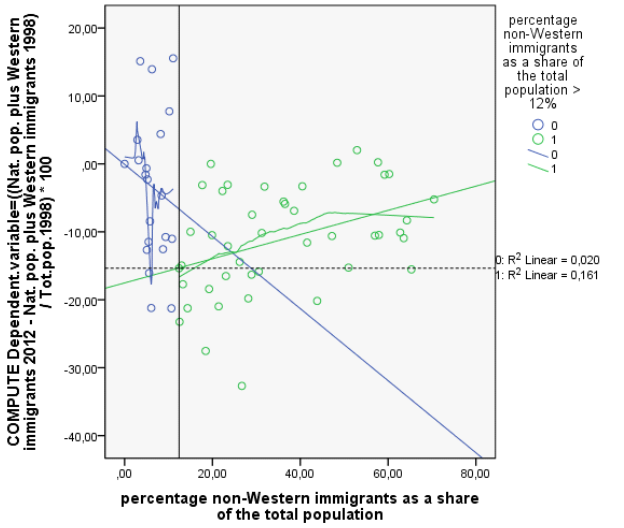
Dependent	-6,33
Tipping point	60,24
Highest R-square	0,027
Sig. Level	0,202

2004-2012 Rotterdam



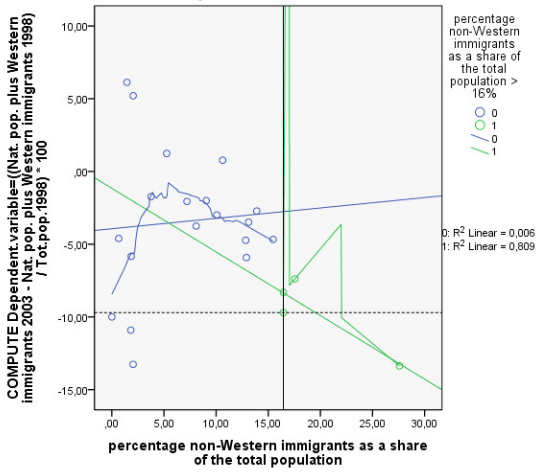
Dependent	4,660
Tipping point	50,87
Highest R-square	0,057
Sig. Level	0,053

1998-2012 Rotterdam



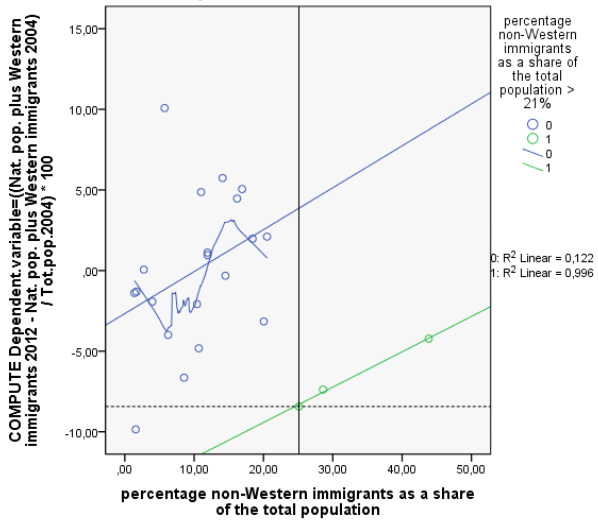
Dependent	-15,36
Tipping point	12,40
Highest R-square	0,011
Sig. Level	0,398

1998-2003 Tilburg



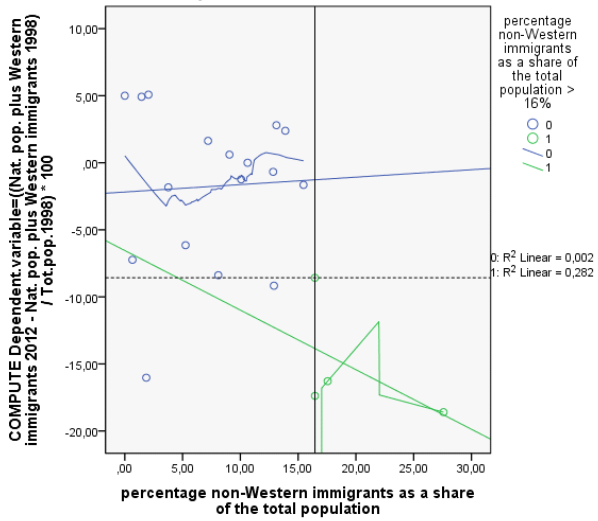
Dependent	-9,70
Tipping point	16,45
Highest R-square	0,252
Sig. Level	0,015

2004-2012 Tilburg



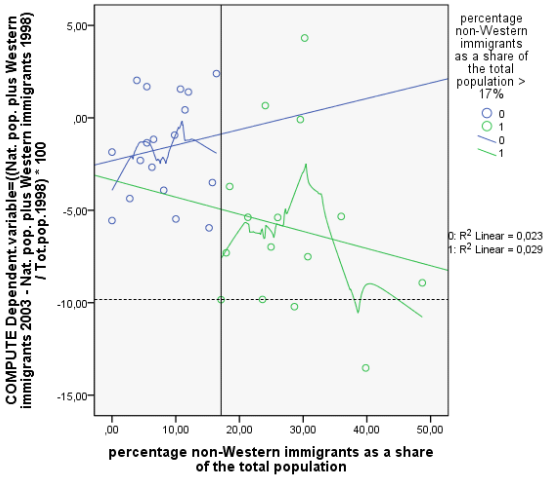
Dependent	-8,43
Tipping point	25,12
Highest R-square	0,173
Sig. Level	0,049

1998-2012 Tilburg



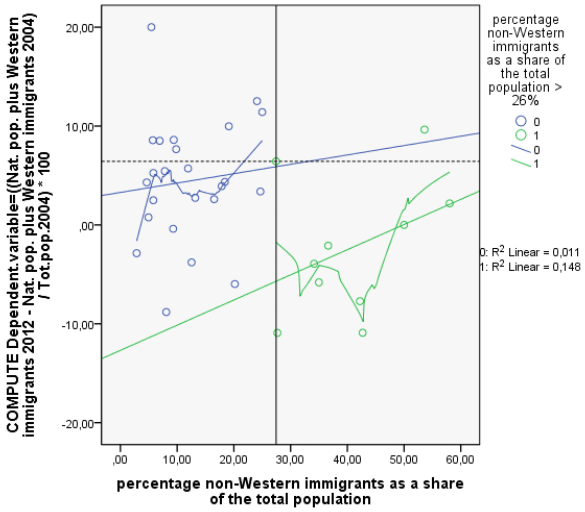
Dependent	-8,58
Tipping point	16,45
Highest R-square	0,500
Sig. Level	0

1998-2003 Utrecht



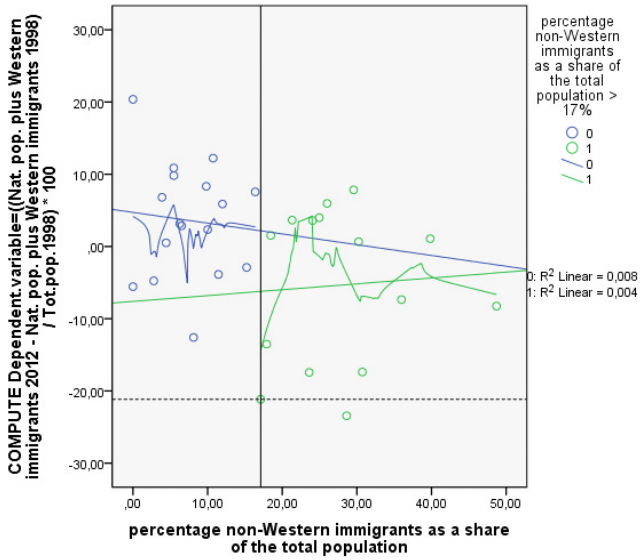
Dependent	-9,83
Tipping point	17,11
Highest R-square	0,265
Sig. Level	0,002

2004-2012 Utrecht



Dependent	6,430
Tipping point	27,44
Highest R-square	0,134
Sig. Level	0,033

1998-2012 Utrecht



Dependent	-21,16
Tipping point	17,11
Highest R-square	0,152
Sig. Level	0,028