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On the dynamics of segregation

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On the dynamics of segregation

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Abstract: Card et al (2008a) formalize a model of ethnic residential segregation where an ethnically mixed neighborhood is dynamically stable until its minority share reaches a threshold (the tipping point). Once the neighborhood has surpassed the tipping point, it will experience massive white flight. These authors propose methods to identify tipping points and, using population counts at the US Census tract level, find that tipping is a salient feature of neighborhood dynamics. The objective of this paper is to use individual register data from Sweden to provide a more complete and informative description of neighborhood tipping behavior. We find that tipping is explained by both increased out-migration and decreased in-migration of whites, although increased out-migration seems to be more important. Tipping seems to be driven by relatively rich individuals and by individuals with kids, suggesting that tipping behavior may increase segregation of whites in a number of dimensions. School grades of white students are lower in neighborhoods that have tipped, suggesting that families with kids that do well in school leave neighborhoods that are tipping.

Keywords: Tipping, white flight, ethnic segregation, Regression Discontinuity.

JEL Codes: R21, R23, J15

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1. Introduction

High levels of ethnic neighborhood segregation are observed in the United States and elsewhere. For instance, in 1990 the average black in the US lived in a neighborhood where the blacks' share was 56% (Cutler et al, 1999). Ethnic segregation can partly be explained by differences in education, income or language between minority residents and whites (Bayer et al, 2004). Another mechanism at work might be social interactions in housing demand (Shelling, 1971). If the whites' willingness to pay for housing is a decreasing function of the share of minority residents in the neighborhood, ethnically mixed neighborhoods can be dynamically unstable. This implies that, in equilibrium, all inhabitants in a neighborhood will belong to the same ethnic group, causing segregation of ethnicities across neighborhoods.

One way to assess if social interactions in housing demand are driving ethnic neighborhood segregation is to examine the dynamics of segregation. Card et al (2008a) formalize a model of ethnic residential segregation where an ethnically mixed neighborhood is dynamically stable until its minority share reaches a threshold (the tipping point). Once the minority share of the neighborhood surpasses the tipping point, the neighborhood will experience massive white flight. Hence, models of residential segregation based on social interactions in housing demand predict that neighborhood white population growth will show a discontinuity at a given minority share in the neighborhood (the tipping point).

Card et al (2008a) propose methods to identify tipping points and use Regression Discontinuity (RD) techniques to quantify the effect of tipping on white neighborhood growth. These authors estimate city-specific tipping points using population counts at the US Census tract level. The estimated city-specific tipping points (the minority share where the white neighborhood growth shows a discontinuity) range between 5 and 15 percent. More tolerant cities are found to have higher tipping points.

There are a number of aspects of neighborhood tipping behavior that are not covered by Card et al (2008a). Is tipping behavior explained by out-migration decisions (white flight)? Which individuals are leaving those neighborhoods that are tipping? Do kids that do well in school move out of the tipping neighborhoods? All these questions can not be addressed with neighborhood population counts. The objective of this paper is to use individual

register data from Sweden to provide a more complete and informative description of neighborhood tipping behavior.

Sweden is an ethnically mixed society and a good testing ground to analyze neighborhood tipping behavior. Large influxes of political refugees immigrated to Sweden in different waves in the last decades of the twentieth century. In 2000, 11 percent of the population living in Sweden was foreign-born. 60 percent of the foreign-born entered Sweden as political refugees. The Balkan and the Iranian are the largest communities of refugees. The concentration of refugees in the largest municipalities in the country became a concern and, as a result, a policy that aimed to reduce the geographical concentration of refugees was implemented in 1985. This policy assigned the incoming refugees to initial locations and was operative until 1994. At arrival, a refugee was placed in a refugee centre. If the refugee was granted a residence permit, she/he was assigned to an apartment by the Swedish authorities, and therefore, was initially assigned to a neighborhood. The placement of refugees decreased the geographical concentration of refugees in Sweden and shocked the minority share of many neighborhoods. In this paper, we will examine the whites' reactions to these shocks.

We use the IFAU (The Institute for Labor Market Policy Evaluation) database which has been built using several Swedish registers. We know the neighborhood (small area market statistics-SAMS) of residence of all individuals in Sweden aged 16-64. The SAMS areas average 1,000 inhabitants which is 4 times less than the US Census Tracts. Hence, Swedish data are more finely grained at the spatial level. Along with the neighborhood of residence, we also know a comprehensive set of individual characteristics including the country of birth, the educational level, the number and age of kids in the household and the labor income. These rich data enables us to answer questions like: Is tipping behavior explained by out-migration decisions? Which individuals are leaving those neighborhoods that are tipping? Do kids that do well in school move out of the tipping neighborhoods?

Based on the methodology proposed by Card et al (2008a) to identify tipping points, we find city-specific tipping points for 5 Swedish cities (Stockholm, Uppsala, Linköping, Norrköping and Örebro). We then use RD techniques to quantify the effect of tipping on white neighborhood growth. We find that tipping is associated with a 4.3 percent decrease

in the neighborhood white population growth (measured over a two-year period). Tipping seems to be explained by both increased out-migration and decreased in-migration of whites, although increased out-migration seems to be more important. In particular, increased out-migration of whites accounts for 2/3 of the decrease in the white population growth whereas decreased in-migration of whites explains the remaining 1/3. Tipping seems to be driven by relatively rich individuals. The negative effect of tipping on the neighborhood population growth of rich individuals (those in the highest labor income decile) is as high as 10 percent. When a neighborhood tips, the population of individuals with kids decreases more than the population of individuals without kids. Hence, ethnic segregation also seems to generate segregation of whites according to income and family status (having kids or not). Finally, we also explore if tipping has an effect on the school grades of white students. We find some evidence that the school grades of white students in neighborhood that have tipped are lower, suggesting that families with kids that do well in school leave neighborhoods that are tipping.

After this introduction, the rest of the paper is organized as follows. In section 2 we provide a brief introduction to the Swedish immigration experience. In section 3, we identify city-specific tipping points in Sweden. Having found a significant effect of tipping on white neighborhood growth in section 3, we assess the extent to which tipping behavior is explained by white flight in section 4. In section 5, we exploit the micro nature of the data and examine if the white flight is causing increased income segregation or increased segregation in schools. Section 6 concludes.

2. Ethnic minorities in Sweden and the placement policy of refugees

Immigration is an important phenomenon in Sweden. In the last European Decennial Population Census carried out in 2001, 11 percent of the population living in the country was foreign-born. This is a high figure for European Standards. In that same year, the share of foreign-born population in the EU 15 was 8 percent¹. In fact, the share of foreign-born population living in Sweden in 2001 was as high as that in the US, a country that has been labeled as a country of immigrants.

¹ Eurostat. The population figures for Germany are referred to 2009.

In 1985, half of the foreign-born residents in Sweden had a Nordic origin (mostly Finnish). Most of these immigrants came to Sweden for economic reasons. Another 30 percent of the immigrants came to Sweden from non-western countries mostly for political reasons. These political refugees came primarily from Soviet Republics in Central and Eastern Europe (55%), South-America (10%), Turkey (9%) and Iran and Iraq (9%). The remaining 19 percent of the foreign-born had a non-Nordic but western background.

From 1985 until the end of the nineties immigration to Sweden was quantitatively important and mostly driven by political conflicts. In the year 2000, only a quarter of the foreign-born had a Nordic background whereas 60 percent had arrived to Sweden as political refugees, the Balkan (14 percent) and the Iranian (10 percent) being the largest ethnic communities.

By the mid-eighties, the fact that refugees were geographically concentrated in the largest municipalities in the Country (Stockholm, Göteborg and Malmö) had become a concern. In 1985, these three municipalities accumulated 36 percent of the refugees and 16 percent of the population. In order to favor a more equal distribution of refugees across all municipalities, a policy that placed refugees to an initial location was adopted in 1985². In principle, refugees were to be placed in municipalities with good labor and educational prospects. In the end, the placement of refugees was by and large determined by the availability of housing (Edin et al, 2003). In fact, the placement policy was formally abandoned in 1994 due to the difficulties to find housing for the large influx of refugees fleeing the Bosnia-Herzegovina conflict.

The placement policy was run by the Swedish Board of Immigration. At arrival, a refugee was typically placed in a refugee centre waiting for a residence permit. If the refugee was granted a residence permit, the Board of Immigration assigned the refugee to a municipality. In turn, municipal authorities assigned the refugee to an apartment. Hence, in practice the refugee was assigned to a given neighborhood. It is important to clarify that the placement was only made in terms of the initial location of the refugee. After placement, refugees could move provided they could find an apartment somewhere else.

² Edin et al (2003) provide a more detailed description of the placement policy.

The placement policy increased the dispersion of refugees across Swedish municipalities (Edin et al, 2003). In Figure 1 we try to illustrate the extent to which the geographic distribution of the placements did not reproduce the pre-policy geographic distribution of refugees.

[Insert Figure 1]

In Figure 1 we focus on refugees placed in 1986 and 1987, the first two years the placement policy was operative. We sort the 291 municipalities in Sweden on the horizontal axis according to the municipal population share with a non-western background in 1985. The dashed line indicates the accumulated share of the stock of non-westerns in 1985. The solid line represents the accumulated share of placed refugees between 1986 and 1987. Notice that in relation to the location of non-western immigrants in 1985, refugees were placed in municipalities with lower immigrant densities. Hence, the placement policy seems to have increased the dispersion of refugees across Swedish municipalities.

3. Are there tipping points in Sweden?

In this section we try to identify tipping points in Swedish cities. First, we provide a more accurate definition of what a tipping point is. Second, we describe and explain the empirical methodology that we use to identify tipping points. Third, the identified tipping points are reported and discussed. We conclude this section by estimating the effect of tipping on white neighborhood growth.

What is a tipping point?

If the whites' willingness to pay to live in a given neighborhood is a decreasing function of the share of non-white neighbors, ethnically mixed neighborhoods can be dynamically unstable. The segregation model proposed by Schelling (1971) is a two-sided tipping model where the tipping point is an unstable mixed equilibrium (Card et al, 2008b). When the minority share is below the tipping point, the willingness to pay (for housing) of whites is higher than that of non-whites and, therefore, there is an increase in the share of white neighbors. Conversely, when the minority share is above the tipping point, the willingness to pay (for housing) of whites is lower than that of non-whites and, therefore, there is an

increase in the share of non-white neighbors. Two-sided tipping models predict complete segregation and, therefore, mixed neighborhoods must be transitioning towards all-white or all-minority neighborhoods. Examining the population dynamics of US Census tracts, Card et al (2008b) reject the empirical relevance of two-sided tipping models.

Card et al (2008a) propose a more realistic one-sided tipping model. In this model, whites are heterogeneous with respect to their intrinsic preference for a given neighborhood. This implies that mixed neighborhoods can be dynamically stable (at least for relatively low minority shares). However, if whites' willingness to pay (for housing) decrease at higher minority shares, the model will exhibit a tipping point. In this one-sided tipping model, the tipping point is the highest minority share at which a mixed neighborhood can be dynamically stable³. In Figure 2, we illustrate an example of a tipping point in the model developed by Card et al (2008a).

[Insert Figure 2]

Mixed neighborhoods can be dynamically stable at relatively low minority shares. Points *a* and *b* are dynamically stable mixed equilibria for different levels of minority demand for housing. These shifts in the minority demand for housing can be interpreted as influxes of immigrants in the country. Notice that mixed equilibria will be stable as long as they do not surpass the tipping point. Beyond the tipping point, the willingness to pay (for housing) of whites is lower than that of non-whites and, therefore, there is an increase in the share of non-white neighbors. This starts a cumulative process that will end up with the neighborhood being completely non-white.

Identification of tipping points

The one-sided tipping model described above predicts that the share of whites in the neighborhood should fall abruptly once the tipping point has been surpassed. The main difficulty found in testing this empirical prediction is that tipping points are unknown to the researcher. Card et al (2008a) propose methods to identify tipping points, by searching

³ In this model, the tipping point is a bifurcation and not an unstable equilibrium.

the minority share at which the neighborhood white population experiences a discontinuity.

As Card et al (2008a) note, the minority population increased substantially in most US cities in the 1970-2000 period. Some neighborhoods experienced larger shocks than others, implying that some neighborhoods tipped while others did not. As described in section 2, the minority population also increased in Sweden in the last decades of the twentieth century. In this paper we aim at using variation in the minority share of neighborhoods that stemmed from the influx of refugees entering Sweden, coupled with the placement policy that assigned refugees to municipalities (and neighborhoods). In particular, we will model the neighborhood white population growth between 1987 and 1989 as a function of the minority share in the neighborhood in 1987. The placement of refugees' policy was adopted in 1985. By 1987, 30,514 refugees aged 16 to 64 had been placed within the policy. Among these, 30 percent were Iranians, 10 percent were Chileans, 10 percent were born in North-Africa and the Middle East and 7 percent were Polish. Some neighborhoods received more refugees than others, implying that some neighborhoods tipped while others did not.

We will restrict our attention to the 14 municipalities that in 1987 had more than 50 SAMS with more than 400 hundred inhabitants. The names of the municipalities are provided in Table 1, along with summary statistics of the SAMS in each municipality. For each municipality c , we estimate the following regression for candidate values of the tipping point $m_{c87}^* = 1, 2, \dots, 50$.

$$\frac{Whites_{ic89} - Whites_{ic87}}{Population_{ic87}} = a_c + d \cdot 1[m_{ic87} > m_{c87}^*] + p(m_{ic87}) + \varepsilon_{ic} \quad (1)$$

where i denotes neighborhood⁴, a_c is a constant, ε_{ic} is a random shock and m_{ic87} is the minority share in the neighborhood in 1987, $m_{ic87} = \text{Minority}_{ic87} / (\text{Minority}_{ic87} + \text{Whites}_{ic87})$. We consider that foreign-born individuals that have a “non-western” origin belong to an ethnic minority in Sweden. In the *Whites* category we include people born in Sweden and

⁴ In the regressions we exclude SAMS with less than 400 inhabitants.

foreign-born individuals from “western” countries. We provide a complete list of these countries in Annex 1.

Card et al (2008a) show that tipping points differ substantially across cities in the US. Hence, trying to specify a common tipping point for all US cities smoothes away any discontinuities, giving the false impression that there are no tipping points (see Easterly, 2005). Notice that neighborhoods within a city can also be heterogeneous in a number of dimensions including income, educational level and age of the population. This implies that each neighborhood can, in principle, have a different tipping point. Therefore, the possibility to empirically identify a city-specific tipping point hinges crucially on the fact that neighborhoods in the city are sufficiently homogeneous. In order to make neighborhoods within a city more comparable, we include a second order polynomial of the minority share in 1985, denoted by $p(m_{i85})$, which measures immigrant density prior to the shock, i.e. the arrival of placed refugees. The method used here differs from the “Structural break” method proposed by Card et al (2008a) in that we include this second order polynomial of the minority share in 1985. We test the null hypothesis that $a_c = d$ for each candidate tipping point. The tipping point is chosen by finding the smallest p-value of this test.

Results

In the last column of Table 1, we report the identified tipping points as well as the p-value of the test. We find stronger evidence of neighborhood tipping behavior in some municipalities than in others. For Stockholm, Uppsala, Linköping, Norrköping and Örebro, at the selected tipping point, the white neighborhood growth in neighborhoods to the left of the tipping point is higher (at the 90 significance level) than in neighborhoods to the right of the tipping point. In another group of municipalities, Eskilstuna, Borås, Västerås and Gävle, white neighborhood growth is consistent with tipping behavior, although white neighborhood growth to the left of the tipping point is not statistically different (at the 90 significance level) from white neighborhood growth to the right of the tipping point. In Göteborg and Malmö, the second and third largest municipalities in Sweden, we do not find evidence of neighborhood tipping behavior. In these two municipalities, the minority share of the neighborhood does not seem to predict subsequent white neighborhood growth. The results are not particularly enlightening for

Sundsvall, Umeå and Luleå. The identified tipping point in the first two cases is driven by a single neighborhood whereas in Luleå the identified tipping point is zero. Since the aim of this paper is to provide a more complete and informative picture of neighborhood tipping behavior, we will focus on the first group of municipalities (Stockholm, Uppsala, Linköping, Norrköping and Örebro,) where we find stronger evidence of tipping.

The effect of tipping on white neighborhood growth

In Figure 3 we try to represent graphically the effect of tipping on white neighborhood growth in the municipalities where we find tipping points.

[Insert Table 3 here]

The solid lines represent the average white population growth in the 1987-1989 period to the left and to right of the tipping points. The dots represent the average white population growth in the 1987-1989 period of each minority share (rounded to 1 percent) in the municipality, where the white population growth has been appropriately residualized, i.e. $(Whites_{ic89} - Whites_{ic87}) / Population_{ic87} - \hat{p}(m_{ic85})$. Finally, the dashed lines represent a linear trend of the white population growth in the 1987-1989 period as a function of the minority share in 1987.

In order to quantify the effect of tipping on white neighborhood growth and to provide confidence intervals to the estimates, we use Regression Discontinuity techniques following Card et al (2008a). We pool the observations of all cities where we find a significant tipping point and run regressions of the following type:

$$\frac{Whites_{ic89} - Whites_{ic87}}{Population_{ic87}} = d \mathbb{1}[\tilde{m}_{ic87} > 0] + b(\tilde{m}_{ic87}) + \gamma_c + u_{ic} \quad (2)$$

where minority shares are measured relative to the location of the city-specific tipping point, i.e. $\tilde{m}_{ic87} = m_{ic87} - m_{ic87}^t$, where m_{ic87}^t is the city-specific selected tipping point. γ_c is a city-specific fixed effect, $b(\cdot)$ is a low-order polynomial of the minority share in 1987 and u_{ic} is a random term. The results are reported in Table 2.

[Insert Table 2 here]

The specifications in Table 2 differ in the order of the polynomial of the minority share in 1987. The effect of tipping on the neighborhood growth of the white population is negative and statistically significant in all specifications. When including a quartic polynomial of the minority share (column 5), the estimated effect of tipping on white population growth is -4.3 percent. This effect is quantitatively large. In the sample of SAMS used in this exercise, the standard deviation of the white population growth is 0.06. Hence, the effect of tipping amounts to 0.7 standard deviations decrease in the white population growth.

4. White flight or white avoidance?

Changes in the population of whites in a given neighborhood are the result of flows of whites moving in and out. White flight is a term that has been used to describe the outflow of white neighbors in response to an increased minority density in the neighborhood. White avoidance is a term that has been used to describe the reduction in the inflow of whites in minority dense neighborhoods. The Census data used in Card et al (2008a) does not enable them to assess whether tipping is the result of white flight or white avoidance. In order to analyze the extent to which tipping is the result of white flight, we re-define the dependent variable to be the neighborhood share of white residents in 1987 that had moved out by 1989. The results of this exercise are reported in Table 3.

[Insert Table 3 here]

The estimated effect of tipping on the share of white residents that moved out between 1987 and 1989 is negative in all the specifications, although it is decreasing (in absolute value) in the order of the polynomial of the minority share in 1987. When the included polynomial is quartic, the effect of tipping on the probability of moving out is 0.03. This effect is not small. The standard deviation in the neighborhood share of white residents that moved out between 1987 and 1989 is 0.07. Hence, tipping implies a 0.4 standard deviation increase in the probability that a white moves out.

If we abstract from births and deaths in the population, the white population growth in a neighborhood is the probability of whites moving in minus the probability of whites moving out⁵. Hence, the estimates in Tables 2 and 3 imply that the effect of tipping on the probability of whites moving in (white avoidance) is -0.014. Therefore, white flight accounts for 2/3 of the tipping phenomenon, while white avoidance accounts for 1/3 of it⁶.

The results indicate that neighborhood tipping seems to be explained, to a large extent, by white flight. In principle, one would expect whites moving out from tipping neighborhoods to relocate to neighborhoods with lower minority shares. To examine this issue, we focus on whites that moved out of the neighborhood and compute the share that moved to a neighborhood with a lower immigrant density⁷. As expected, in neighborhoods whose minority share in 1987 was beyond the tipping point, a high share of the whites moving out relocated to a neighborhood with a lower minority share (72 percent of the cases). In order to explore this issue further, we provide Regression Discontinuity estimates of the effect of tipping on the probability that those whites that moved out relocated to a neighborhood with a lower minority share. The results are reported in Table 4.

[Insert Table 4 here]

The effect of tipping on the share of individuals for which migration reduced immigrant density in the neighborhood is positive and significant in all the specifications. The estimated effect is reduced as the order of the polynomial of the minority share in 1987 is increased. When the polynomial included is quartic, tipping increases by 23 percentage points the probability that those whites that moved out relocated to a neighborhood with a

⁵

$$\frac{Whites_{89} - Whites_{87}}{Whites_{87}} = \frac{whites\ in_{87-89} + stayers_{87-89}}{Whites_{87}} - \frac{stayers_{87-89} + whites\ out_{87-89}}{Whites_{87}} = \frac{whites\ in_{87-89}}{Whites_{87}} - \frac{whites\ out_{87-89}}{Whites_{87}}$$

⁶ These results contrast with those found by Bråma (2006) that indicate that white avoidance is more relevant than white flight in Sweden. However, these results refer to a specific city and a different time period which are different from the ones analyzed here.

⁷ The minority shares of the origin and destination neighborhoods are computed with 1987 values.

lower minority share. These results suggest that the motivation to move out from the neighborhood is different in neighborhoods that have tipped.

5. Is white flight causing segregation in other dimensions?

In order to provide a more complete picture of the neighborhood tipping phenomenon, we now try to investigate which groups of people in terms of their characteristics are causing the observed discontinuity in the growth of white residents. More specifically, it is of interest to examine if the white flight is causing segregation in other dimensions, for example increased income segregation or segregation in schools. Before proceeding to these analyses, in Table 5 we provide a brief description of the individuals living in the cities where we find tipping points.

[Insert Table 5 here]

We report the average age and income of all individuals in the first column of Table 5. We also report the shares of the individuals that are males, have kids, have kids aged 1 to 7 and have kids aged 8 to 14. We report these figures for the subset of individuals that moved out of the neighborhood between 1987 and 1989 (movers) in the second column. We do the same for those individuals that did not move between 1987 and 1989 (stayers) in the third column. Movers and stayers differ in a number of characteristics. Movers are younger, less likely to have kids and earn less labor income.

Does white flight cause increased income segregation?

In principle, wealthy people can be considered as being more mobile given that they are in a better position to purchase a dwelling in another neighborhood, if they wish to do so. We proxy wealth with labor income and construct white population growth per income deciles in order to assess if it is the wealthier that are moving out of tipping neighborhoods. Given that younger people are more likely to move and have lower income, we use labor income net of age and gender effects. To do so, we first run labor income on gender and age dummies using the following specification:

$$labor\ income_s = a + \gamma_{male} \cdot 1[gender = male] + \sum_{k=25}^{64} \gamma_k \cdot 1[age = k] + u_s \quad (3)$$

We then compute $labor\ income_s - \overline{labor\ income_s}$, where $\overline{labor\ income_s}$ denotes the predicted labor income in specification (3). This regression is run on all the whites in Sweden aged 25 to 64 separately for 1987 and 1989. We count the number of white residents aged 25 to 64 in each (predicted) income decile, neighborhood and year. The dependent variable is defined as the neighborhood growth rate of white residents in the different income deciles. We run one regression for each income decile. All regressions include municipality fixed effects and a quartic polynomial of the minority share in 1987, measured relative to the city-specific tipping point. The results of this exercise are reported in Table 6.

[Insert Table 6 here]

The first column in Table 6 reports the results when we pool all the income deciles. As expected, the results of this specification are very similar to those obtained with the aggregated data (see column 5 in Table 2). The results for the different income deciles are reported in columns 2-11. Individuals with higher income (those in the 8th, 9th and 10th deciles) are those individuals leaving the neighborhoods that are tipping. The negative effect of tipping on the growth rate of the population in the top income decile is as high as 10 percent. These results indicate that the population of rich individuals decreases abruptly once the neighborhood has tipped. This implies that tipping increases the income segregation of white residents, since the relatively poor will tend to stay in immigrant dense areas.

Does white flight cause increased segregation among kids? (in schools?)

Individuals may not only be heterogeneous in terms of income but also in terms of preferences. Families with kids may put particular emphasis on environmental variables that could influence their kids such as neighborhood immigrant density. In Table 7 we show the effect of tipping on the population growth of white individuals cohabiting with kids and for individuals not cohabiting with kids. The results indicate that tipping has a negative effect on population growth of the former group but no significant effect on the population growth of the latter. Among those having kids, the negative effect of tipping is stronger for those whose kids were 1 to 7 years old in 1987.

The fact that individuals that are rich and have kids leave the neighborhood once it has tipped suggests that tipping can increase the segregation of whites in a number of characteristics. A very interesting exercise would be to look at the school grades of kids and test if these are similar between kids that move out and those that stay in neighborhoods that have tipped. Unfortunately, we can not observe the school grades of kids who are moving out from neighborhoods. However, we can observe average school grades of those 16 year olds graduating in 1989. We have a total of 22,657 relevant observations. Average school grades range from 0 to 5. The mean of this variable is 3.25 whereas the median is slightly lower, 3.2. We define the dependent variable to be the average school grade of white kids in each neighborhood and estimate the effect of tipping on this variable. The results are reported in Table 8.

[Insert Table 8 here]

The different specifications in Table 8 differ in the degree of the polynomial of the minority share. The different specifications suggest that neighborhoods that have tipped (in 1987 their minority share surpassed the tipping point) show a lower average school grade. Based on the specification where the included polynomial of the minority share in 1987 is quartic, the estimates imply that in neighborhoods that have tipped, the school grades of whites are lower by 9% of a standard deviation. These effects are consistent with the hypothesis that families with kids that do well in school are more likely to leave neighborhoods that are tipping. Hence, these results suggest that neighborhood tipping can increase the segregation of good and bad white students across neighborhoods and schools.

6. Summary and conclusions

Card et al (2008a) find tipping behavior is a salient feature of the neighborhood dynamics in the US. In this paper, we provide a more complete picture of neighborhood tipping by using (individual level) register data from Sweden. Based on the empirical methods proposed by Card et al (2008a) to identify tipping points, we find city-specific tipping points in (some) Swedish cities (Stockholm, Uppsala, Linköping, Norrköping and Örebro). We then use RD techniques to quantify the effect of tipping on white neighborhood

growth. The micro nature of the data enables us to answer question such as: Is tipping behavior explained by out-migration decisions (white flight)? Which individuals are leaving those neighborhoods that are tipping? Do kids that do well in school move out of the tipping neighborhoods? These questions can not be answered with the neighborhood population counts (drawn from US Censuses) used in Card et al (2008a).

The results of this study can be summarized as follows. We find that neighborhood tipping decreases white population growth by 4.3 percent (measured over a two-year period). Tipping seems to be explained by both increased out-migration and decreased in-migration of whites, although increased out-migration seems to be more important (it accounts for 2/3 of tipping). Tipping seems to be driven by relatively rich individuals (those in the 8th, 9th and 10th income deciles). The negative effect of tipping on the neighborhood population growth of white individuals in the top income decile is as high as 10 percent. We also find evidence that the school grades of white students in neighborhood that have tipped are lower, suggesting that families with kids that do well in school leave neighborhoods that are tipping. Our results suggest that white flight may increase the income segregation of whites and the segregation of white kids in schools.

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Table 1. Municipalities with at least 50 SAMS with more than 400 inhabitants in 1987. Municipalities where we find a tipping point in bold case.

Municipality	No. of SAMS	Mean population in SAMS	Min/Max population in SAMS	Estimated tipping point
Stockholm	120	3,530	419/11,900	5(0.08)
Göteborg	285	649	400/2,030	a
Malmö	136	854	404/3,595	a
Uppsala	88	881	404/2,287	17(0.023)
Eskilstuna	69	713	415/1,699	5(0.300)
Linköping	65	971	437/1,957	4(0.067)
Norrköping	67	1,057	472/3,008	2(0.008)
Borås	59	836	407/1,714	3(0.102)
Örebro	61	911	401/3,388	1(0.077)
Västerås	69	953	408/2,893	8(0.173)
Gävle	61	872	400/1,643	3(0.108)
Sundsvall	53	1,061	415/2,849	b
Luleå	57	746	409/1,496	c
Umeå	59	946	413/2,198	b

Figures within parenthesis are p-values. a) In Göteborg and Malmö white population growth is not a decreasing function of the minority share at the base year. In fact, at the identified tipping point, the white population growth increases. b) In Sundsvall and Umeå there is only one municipality to the right of the tipping point. c) In Luleå the identified tipping point is zero.

Table 2. RD estimates for the effect of tipping on white population growth.

Variables	I	II	III	IV	V
Tipping point	-0.035*** (0.007)	-0.035*** (0.008)	-0.036*** (0.008)	-0.037*** (0.009)	-0.043*** (0.010)
Polynomial of minority share in 1987:	No	Linear	Quadratic	Cubic	Quartic
Municipality Fixed-effects	Yes	Yes	Yes	Yes	Yes
No. Observations	401	401	401	401	401

Notes: The dependent variable is the white population growth in 1987-1989. Municipalities included are Stockholm (5), Uppsala (17), Linköping (4), Norrköping (2) and Örebro (1) where the numbers within brackets are the estimated tipping points. The minority share is measured relative to the tipping point in each municipality. Robust standard errors within parenthesis. *** and ** statistically significant at 1 and 5%.

Table 3. RD estimates of the effect of tipping on the probability to move out

Variables	I	II	III	IV	V
Tipping point	0.071*** (0.007)	0.038*** (0.009)	0.031*** (0.008)	0.027** (0.009)	0.029** (0.010)
Polynomial of minority share in 1987:	No	Linear	Quadratic	Cubic	Quartic
Municipality Fixed-effects	Yes	Yes	Yes	Yes	Yes
No. Observations	401	401	401	401	401

Notes: The dependent variable is the probability to move out between 1987 and 1989. Municipalities included are Stockholm (5), Uppsala (17), Linköping (4), Norrköping (2) and Örebro (1) where the numbers within brackets are the estimated tipping points. The minority share is measured relative to the tipping point in each municipality. Robust standard errors within parenthesis. *** and ** statistically significant at 1 and 5%.

Table 4. RD estimates of the effect of tipping on the immigrant density of the destination neighborhood for those white individuals moving out.

Variables	I	II	III	IV	V
Tipping point	0.404*** (0.016)	0.273*** (0.022)	0.252*** (0.019)	0.242*** (0.022)	0.233*** (0.026)
Polynomial of minority share in 1987:	No	Linear	Quadratic	Cubic	Quartic
Municipality Fixed-effects	Yes	Yes	Yes	Yes	Yes
No. Observations	401	401	401	401	401

Notes: The dependent variable is the share of individuals for which migration reduced immigrant density in the neighborhood. Municipalities included are Stockholm (5), Uppsala (17), Linköping (4), Norrköping (2) and Örebro (1) where the numbers within brackets are the estimated tipping points. The minority share is measured relative to the tipping point in each municipality. Robust standard errors within parenthesis. *** statistically significant at 1%.

Table 5. Summary statistics of individual characteristics in 1987.

Variables	All individuals	Movers	Stayers
Age	40.3 (10.2)	35.0 (9.0)	41.5(10.01)
Males (share)	49.3	53.2	48.4
Labor Income (in hundred SEK)	1,034.6 (755.5)	964,0 (709.2)	1,051 (764.8)
Kids (share)	31.0	24.8	32.4
Kids aged 1 to 7 (share)	19.5	18.8	19.6
Kids aged 8 to 14 (share)	18.4	10.6	20.2
No. Individuals	470,825	88,205	382,620

Notes: White individuals aged 25 to 64 in all neighborhoods with more than 400 inhabitants in the municipalities where we find a tipping point. Standard deviations in parenthesis.

Table 6. RD estimates of the effect of tipping on white population growth per income deciles.

Variables	Pooled obs.	1 st decile	2 nd decile	3 rd decile	4 th decile	5 th decile	6 th decile	7 th decile	8 th decile	9 th decile	10 th decile
Tipping point	-0.043*** (0.012)	-0.012 (0.024)	-0.045 (0.028)	-0.053* (0.027)	-0.015 (0.029)	-0.016 (0.029)	-0.013 (0.028)	-0.036 (0.027)	-0.074*** (0.025)	-0.059** (0.024)	-0.100*** (0.026)
4 th order polynomial of the minority share in 1987	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality Fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	4,010	401	401	401	401	401	401	401	401	401	401

The dependent variable is white population growth in 1987-1989 by income deciles. Municipalities included are Stockholm (5), Uppsala (17), Linköping (4), Norrköping (2) and Örebro (1) where the numbers within brackets are the estimated tipping points. The minority share is measured relative to the tipping point in each municipality. Robust standard errors within parenthesis. *** statistically significant at 1%. Standard errors are clustered at the neighborhood (SAMS) level in the pooled regression to account for within-group error correlation.

Table 7. RD estimates of the effect of tipping on white population growth for families with and without kids

Variables	Pooled obs.	No Kids	With kids aged 1 to 14	With kids aged 1 to 7	With kids aged 8 to 14
Tipping point	-0.039*** (0.014)	-0.011 (0.013)	-0.049*** (0.017)	-0.071*** (0.023)	-0.012 (0.018)
4 th order polynomial of the minority share in 1987	Yes	Yes	Yes	Yes	Yes
Municipality Fixed-effects	Yes	Yes	Yes	Yes	Yes
No. Observations	401	401	401	401	401

The dependent variable is white population growth in 1987-1989. Municipalities included are Stockholm (5), Uppsala (17), Linköping (4), Norrköping (2) and Örebro (1) and the numbers within brackets are the estimated tipping points. Individuals younger than 25 years old are excluded from the sample. Robust standard errors within parenthesis. *** statistically significant at 1.

Table 8. RD estimates of the effect of tipping on neighborhood school grades for natives.

Variables	I	II	III	IV	V
Tipping point	-0.203*** (0.026)	-0.103*** (0.030)	-0.094*** (0.031)	-0.091** (0.033)	-0.089** (0.038)
Polynomial of minority share in 1987:	No	Linear	Quadratic	Cubic	Quartic
Municipality Fixed-effects	Yes	Yes	Yes	Yes	Yes
No. Observations	401	401	401	401	401

The dependent variable is the average school grade at graduation in 1989. Municipalities included are Stockholm (5), Uppsala (17), Linköping (4), Norrköping (2) and Örebro (1) and the numbers within brackets are the estimated tipping points. Individuals younger than 25 years old are excluded from the sample. Robust standard errors within parenthesis. *** and ** statistically significant at 1 and 5%.

Figure 1. Accumulated share of the stock of immigrants in 1985 (dashed lined) and the 1986-1987 influx of refugees (solid line). Municipalities are sorted according to immigrant density in 1985.

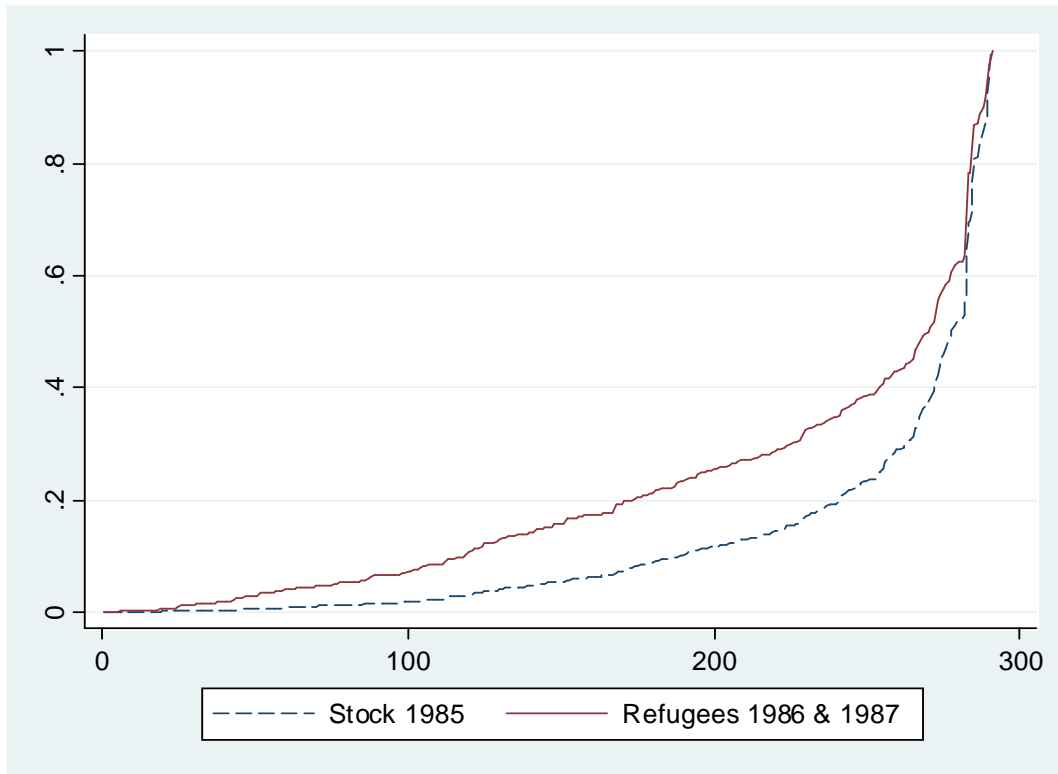


Figure 2. An example of “tipping point” in the one-sided tipping model developed in Card et al (2008a)

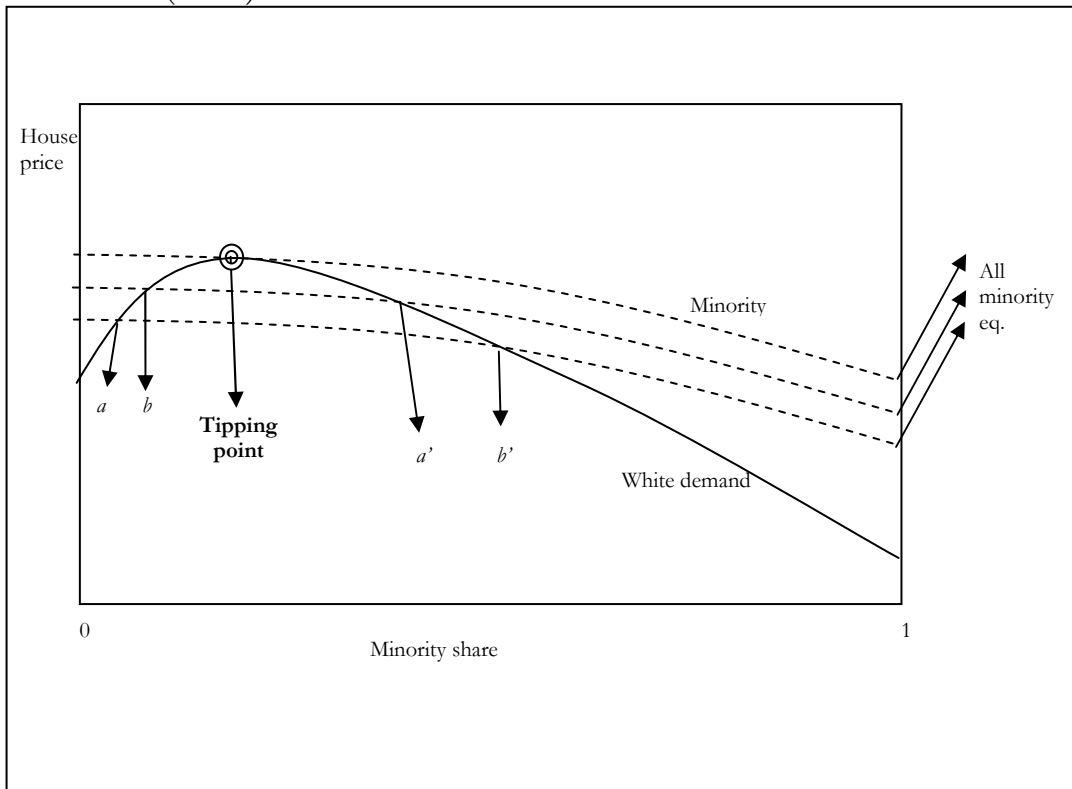
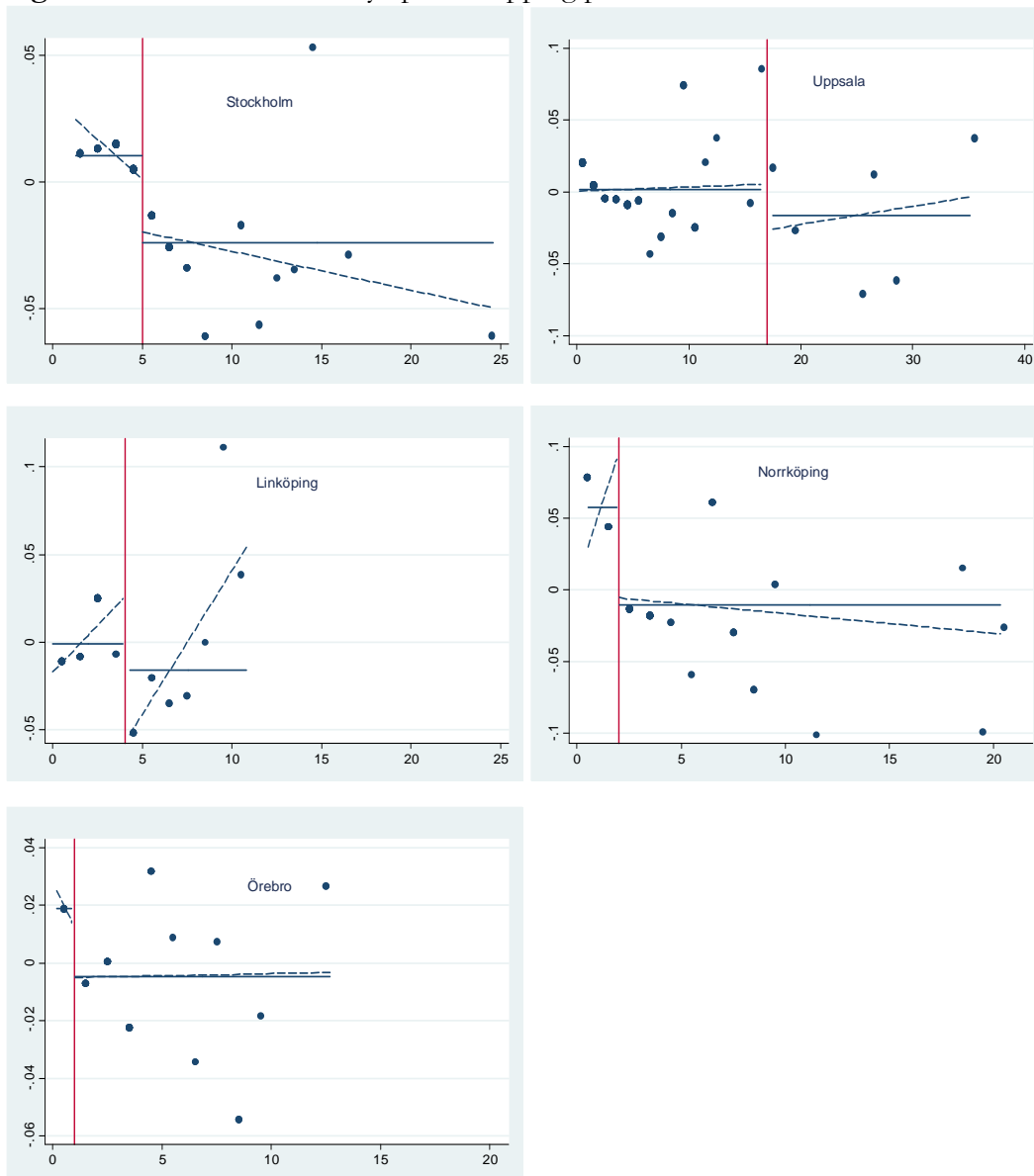


Figure 3. Identification of city-specific tipping points.



Notes: 1) The solid lines represent the average white population growth in the 1987-1989 period to the left and to right of the tipping points. 2) The dots represent the average white population growth in the 1987-1989 period of each minority share (rounded to 1 percent) in the city, where the white population growth has been appropriately residualized, i.e. $(Whites_{ic89} - Whites_{ic87}) / Population_{ic87} - \hat{p}(m_{ic85})$. 3) The dashed lines represent a linear trend of the white population growth in the 1987-1989 period as a function of the minority share in 1987.

Annex 1. List of “western” countries. We do not consider that people born in these countries and living in Sweden belong to an ethnic minority.

- The Nordic Countries (Finland, Norway, Denmark, Iceland)
 - The rest of EU 15 countries, Switzerland, Andorra, Malta, Liechtenstein and the Vatican
 - US and Canada
 - Japan, Korea and China
 - Australia, New Zealand and the rest of countries in Oceania.
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