NBER WORKING PAPER SERIES

BEYOND RACIAL ATTITUDES:
THE ROLE OF OUTSIDE OPTIONS IN THE DYNAMICS OF WHITE FLIGHT

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Working Paper 31136
http://www.nber.org/papers/w31136

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
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April 2023

This paper previously circulated under the title: “Outside Options (now) More Important than Race in Explaining Tipping Points in US neighborhoods.” I received helpful comments from: Dionissi Aliprantis, Kerwin Charles, Raj Chetty, William Darity Jr., Anthony Defusco, William Dougan, Gilles Duranton, Steven Durlauf, Molly Espey, Fernando Ferreira, Robert Fleck, Matthew Gentzkow, Edward Glaeser, Joseph Gyourko, Jessie Handbury, Joseph Harrington, Nathaniel Hendren, Bill Kerr, Damon Jones, Glenn Loury, Clarence Lee, Corinne Low, Michael Makowsky, Conrad Miller, Albert Saiz, Jesse Shapiro, Mark Shepard, Curtis Simon, Todd Sinai, Kent Smetters, Robert Tollison, Susan Wachter, Maisy Wong and the seminar participants at NBER Summer Institute, MIT, Wharton, Purdue, Swarthmore, Clemson, Emory, the Cleveland Fed, University of Chicago Summer School for Socioeconomic Inequality, the ASSA meetings, and the Southern Economic Association Conference. Mickey Whitzer, Kinde Wubneh, Lynn Selhat, Jennifer Moore, Julian Blair, Judith Blair, Rafael Luna (Luna Scientific Story Telling), Daniel DeVougas and Anne Korte provided excellent help with preparation of the manuscript. All remaining errors are mine. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

Beyond Racial Attitudes: The Role of Outside Options in the Dynamics of White Flight
Peter Q. Blair
NBER Working Paper No. 31136
April 2023
JEL No. J60,R21,R23

ABSTRACT

When the fraction of minorities in a neighborhood exceeds the tipping point white flight accelerates. I develop a revealed-preference method to estimate the tipping points of 38,000 census tracts and the preferences of households for minority neighbors in the 123 Metropolitan Statistical Areas (MSA) covered by these census tracts over 40 years (1970-2010). I find that the average tipping point in an MSA initially covaries more with the racial attitudes of households than the outside options that they face but that this relationship reverses overtime. Ignoring outside options would obscure the declining role that racial attitudes play in understanding segregation.

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1 Introduction

A neighborhood tips when a marginal increase in its minority population leads to white flight from the neighborhood. During the Great Migration, for example, Boustan (2010) finds that the arrival of each new black resident to a Northern destination city resulted in the exit of 2.7 white residents from the city to the suburbs.

Historically, the debate between economists and other social scientists on neighborhood tipping centered on whether neighborhood tipping reflects racial animus of non-minorities toward minorities. In a seminal essay, "The Metropolitan Areas as Racial Problem," University of Chicago political scientist Morton Grodzins asserted that neighborhood tipping reflects "the unwillingness of white groups to live in proximity to large numbers of [African Americans]" (Grodzins, 1958). Schelling (1969, 1971) challenged this view, demonstrating with a set of intuitive models that neighborhood segregation could occur even if individual white households did not possess a strong aversion to living with minorities. One of the limitations of this model, as Schelling himself noted, was that it did not include a role for outside options: "This is but a small sample of possible results, using straight-line schedules and simple dynamics. There are no expectations in the model, no speculation, no concerted action, no restriction on the alternative localities available" (Schelling, 1969).

My paper highlights the role that outside options, i.e., the "alternative localities available," play in neighborhood tipping. The key insight of this paper is that a household's outside options discipline its ability to act on its preferences over the racial composition of the neighborhood. In some cases, the dearth of preferable outside options results in a tipping threshold that is high (more racial integration is tolerated) even though non-minority households have a strong relative preference not to live with minorities. For example, an MSA with a choice-set of two census tracts: tract W, which is 100% non-minority, and tract M, which is 100% minority. Suppose further that non-minority households in the city have a relative preference for non-minority neighbors. What would happen if minorities were to integrate tract W? Would non-minority households exit tract W in preference for tract M? Contrary to the intuition that a stronger relative preference for same-race neighbors leads to more white flight, the stronger a white household's preferences for white neighbors, the more likely it remains in tract W even as the neighborhood integrates. In the same way that Becker and Murphy (2000) and Charles and Guryan (2008) show that competition for employees among firms sets the cost of discriminating against minority employees in the labor market, I argue that the availability of preferable outside options sets the cost of acting on racial preferences in the housing market.

In my model, I follow the literature by focusing on the housing demand side and abstracting from the influence of changes in housing supply on tipping points (Card et al., 2008; Caetano and Maheshri, 2013). I define a household's *neighborhood* as the census tract where it resides, and its *outside options* as the set of all of the other census tracts in its MSA of residence. In practice, 90% of all moves occur across census tracts in the same MSA. With this definition of households choice-set, I use a discrete choice model to exploit within-MSA sorting patterns in the data to obtain tipping points for each census tract-year observation and the preferences for the fraction of minority neighbors at the MSA-level (McFadden, 1978; Berry et al., 1995; Bayer et al., 2007).

Caetano and Maheshri (2013) pioneered the procedure of using counter-factual changes in the fraction minority and pairing it with a structural model to estimate tipping points in the racial composition of schools. I implement an approach that is similar in spirit to theirs and adapt it to for my context of estimating neighborhood tipping points. In the model, I construct the tipping point in two steps. First, I use the estimates of the sorting model to compute an exit function of white households from the neighborhood. For a given exogenous change in the mean utility of whites in neighborhood, τ, the exit function measures the probability that a white household exits its current neighborhood for its best alternative in its choice-set. I refer to τ as the utility tolerance of white households since it parameterizes the exit probability as a function of changes in the mean utility of whites. The first derivative of the exit function is the exit rate. At the tipping point, defined by a change in mean utility τ^*, the exit rate is maximal, i.e., the second derivative of the exit probability equals zero. This definition tipping is mirrors the approach in Card et al. (2008), which associates the tipping point with the share of minorities for which the rate of decline in white population is maximal. I get the tipping point by converting the utility tolerance into a percent minority by using an empirical relationship between the percent minority and the mean utility as a conversion factor. My approach buildings on the work of Card et al. (2008) who use similar data to generate tipping points at the MSA-level.

To measure the extent to which the average census tract tipping point in an MSA depends on preferences of households for neighborhood minority composition versus the outside options that they face, I first define the MSA tipping point as the average of the census tract tipping points in each MSA-year observation. Second, I normalize the preference for fraction minority in an MSA, which I previously estimated in the discrete choice model, to have mean zero and standard deviation one in each year. Next, I use the minority and non-minority share of each census tract in an MSA to construct normalized measures of the minority and the non-minority dispersion in each MSA. The dispersion measure is based on the Herfindahl-Hershman index (HHI), and the normalization procedures is identical to what I did for racial preferences. Finally, for each census year I regress the MSA tipping point on the normalized dispersion of minorities and non-minorities, and on the normalized racial preferences. The coefficients from this regression capture the impact of a one standard deviation change in racial preferences or the outside option on the average census tract tipping point in an MSA.

A key contribution of this paper to the literature is the finding is that outside options are increasingly important for explaining cross-sectional variation in MSA tipping points, while racial preferences appear to be declining its significance. In 1970, a one standard deviation increase in the relative racial preference for minority neighbors in an MSA was associated with a statistically significant 7 percentage point increase in the MSA tipping point, whereas a one standard deviation increase in the concentration of minorities across in an MSA was associated with a statistically insignificant 1 percentage point increase in the MSA tipping points. As shown in Figure 1, in the years between 1970 to 2010, the association between the MSA tipping points and racial preferences weakened almost monotonically whereas the association between the minority HHI and the tipping point monotonically strengthened. By 2010, a one standard deviation change in preference for minority neighbors was associated with a statistically insignificant -0.5 percentage point change in the MSA tipping point, while a one standard deviation change in the outside option was associated with a statistically significant 14 percentage point increase in the MSA tipping point.

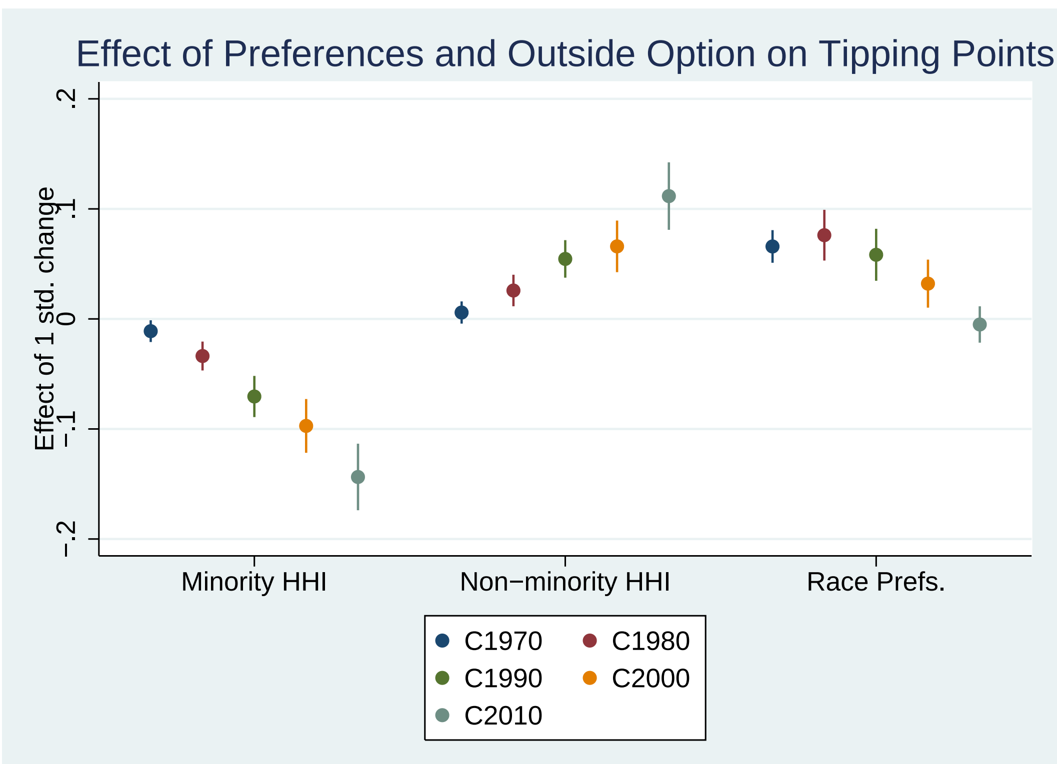

Figure 1: A plot of coefficient estimates from a regression of MSA tipping points on standardized measures of racial preferences and Herfindahl-Hirschman Indices (HHI) of the minority and non-minority concentration of the MSA in census years C1970-C2010.

2 Model

The key goal of my model is to elucidate the relationship between the neighborhood tipping point and two quantities: (a) the utility wedge between an agent's current neighborhood and her outside options; and (b) the difference in marginal utility for minority neighbors between non-minority and minority households.

In the model, there are 'C' MSAs indexed $c \in \{1, 2, ..., C\}$, and two types of households that are differentiated by a type index, $r \in \{w, m\}$. The type index $r = w$ references white households, while the type index $r = m$ references minority households. Each city is exogenously assigned a total of Q^w_{tot} white households and total of Q^m_{tot} minority households. Each household, in turn, endogenously sorts into one of the N neighborhoods in that MSA, indexed by $n \in \{1, 2, ..., N\}$. A household's problem is to choose the neighborhood that delivers the maximum utility. Solving the household's problem requires first solving for the indirect utility for each of the N possible neighborhoods, and then choosing the neighborhood that delivers the maximum indirect utility. The utility function takes the form:

$$U_{hnr} = V_{hnr} + \epsilon_{hnr.(1)}$$

The neighborhood, n^*_{hr}, that delivers the highest indirect utility satisfies:

$$n^*_{hr} = \text{arg max}\{U_{hnr}\} \tag{2}$$

The household's utility-maximizing behavior across the N neighborhoods in the city generates a conditional demand function, Q^r_n, for each neighborhood. The conditional demand functions take the form:

$$Q^r_n = Q^r_{tot}\left(\frac{\exp(V_{hnr})}{\sum\limits_{n'=1}^{N}\exp(V_{hn'r})}\right), \quad \text{for } r \in \{w, m\}. \tag{3}$$

We choose a normalization where $\sum_{n'=1}^{N} \exp(V_{hn'r}) = 1$. Therefore, the indirect utility becomes the log of the market share:

$$V_{hnr} = \log\left(\frac{Q_n^r}{Q_{tot}^r}\right). \tag{4}$$

2.1 Conditional Exit Functions

Following the arrival of new minority households to a census tract n, some white households may find it preferable to exit the neighborhood and relocate to the best alternative among the other N-1 census tracts in its MSA, neighborhood *a(n)* $\in \{1, 2, ..n-1, n+1, ...N\}$, instead of remaining in neighborhood n. I use τ_{nw} to represent the loss in indirect utility that white households experience due to the arrival of new minority households to their host neighborhood n. The conditional exit function of whites is given by:

$$E(\tau_{nw}) = \sum_{a(n)} \left[\underbrace{\text{Prob}(V_{hnw} - \tau_{nw} + \epsilon_{hnw}^{n} < V_{ha(n)w} + \epsilon_{ha(n)w})}_{\text{Prob. exit n for a(n)}} \times \underbrace{\omega_{a(n)}}_{\text{Prob. a(n) is best opt.}} \right] \tag{5}$$

$$= \sum_{a(n)} \left(\left[\int_{-\infty}^{\infty} F(V_{ha(n)w} - V_{hnw} + \tau_{nw} + \epsilon_{ha(n)w}) f(\epsilon_{ha(n)w}) d\epsilon_{ha(n)w} \right] \omega_{ha(n)w} \right), \tag{6}$$

where $\omega_{ha(n)w}$ is the probability that neighborhood *a(n)* is the best alternative among the N-1 options in the household's choice-set, and $F(\cdot)$ is the cumulative distribution function for the taste shocks, which I assume follow a type 1 extreme value distribution. The probability weight $\omega_{ha(n)w}$ is assumed to be the share of whites in the alternative neighborhood $a(n)$ relative to the total number of whites in the MSA excluding the current tract n:

$$\omega_{ha(n)w} = \frac{\exp(V_{ha(n)w})}{\sum_{a \in \{a(n)\}} \exp(V_{haw})}. \tag{7}$$

Each non-minority household living in each tract will have a single best alternative. However, since I do not observe all the covariates of an individual non-minority household, I average over all the non-minority households in a neighborhood to obtain a probability that a given tract in the MSA is best alternative for non-minority households in this tract. The probability weights in equation (7) are a type of counter-factual market shares for utility maximizing non-minority households who face a choice-set of the N-1 census tracts in the MSA, where census tract n has been excluded from consideration. As such, these weights present the probability that a tract $a(n)$ is the best option of the N-1 tracts for non-minority households.[1] In the paper, we follow the literature and restrict our analysis to MSAs with at least 100 census tracts Card et al. (2008).

The tipping point of the neighborhood is the percent minority at the inflection point of the exit function. This is the point at which the exit function changes concavity and the exit rate (the derivative of the exit function with respect to τ_{nw}) is maximal:

$$\frac{d^2 E(\tau_{nw}^*; \vec{V})}{d\tau_{nw}{}^2} = 0. \tag{8}$$

At the tipping point, the mean utility of white households in neighborhood n has decreased by an amount $-\tau_n^*$. I use the relative marginal utility for minority neighbors to convert this decrement in mean utility into a change in the percent minority. Accordingly, the percent minority at the tipping point is given by:

$$\boxed{f_n^* = f_n - \frac{\tau_n^*}{\gamma_w - \gamma_m}} \tag{9}$$

The first component of the tipping point is the initial percent minority in the census tract, $f_n = \frac{Q_n^m}{Q_n^m + Q_n^w}$. The second component of the tipping point is the change in the percent minority that takes the neighborhood to the critical point of the exit function. The key

[1]This assumption is reasonable for cases where there are a large number of census tracts in the MSA. In these cases, the removal of a single census tract has a diminishing effect on the overall sorting in the MSA as the number of tracts in the MSA increases.

take-away from equation (9) is that the tipping point is directly proportional to the utility tolerance of non-minorities for minorities, τ, and inversely proportional to the relative preference of non-minority households for minority neighbors, $\gamma_w - \gamma_m$, in the MSA. If $\tau_n^* > 0$, then the neighborhood n is a more desirable neighborhood than the alternatives in the choice-set. For this neighborhood to tip, minorities must move in to lower the utility of non-minorities to the point where the neighborhood tips. If $\tau < 0$, the opposite is true, and the tipping point is lower than the current fraction of minorities. One merit of estimating tipping points in this manner is that it allows researchers to estimate the tipping point of census tracts that have tipped, that have yet to tip ($\tau > 0$), and that are beyond their tipping points ($\tau < 0$). The preference parameter, $\gamma_w - \gamma_m$, is identified from the differential sorting of non-minorities into neighborhoods as a function of the fraction of minorities in the neighborhood. We estimate the $\gamma_{w,c} - \gamma_{m,c}$ by running the following regression for each MSA-census year:

$$\underbrace{\log\left(\frac{Q_n^w}{Q_{tot,c}^w}\right) - \log\left(\frac{Q_n^m}{Q_{tot,c}^m}\right)}_{\text{Diff. in white and minority mean utility for n}} = \underbrace{(\gamma_{w,c} - \gamma_{m,c})}_{\text{Racial Preference in c}} \times \underbrace{\left(\frac{Q_n^m}{Q_n^m + Q_n^w}\right)}_{\text{Fraction minority in n}} + e_{n,m}. \quad (10)$$

The term on the left-hand side is the relative market share of whites to minorities in neighborhood n, which captures the utility difference between white and minority household for living in the neighborhood. The regressor on the right-hand side is the percent minority in the census tract. We interpret the preference parameter, $\gamma_w - \gamma_m$, as the difference between non-minority and minority households in preference for the fraction minority in a tract and the bundle of neighborhood attributes that are correlated with the fraction minority.

2.2 Semi-Parametric Estimate of Tipping Point

I also use the relative market shares to develop a semi-parametric estimate of the tipping point, which is non-linear parallel to equation (9). In equation (10), the relative market shares are a linear function of the fraction of minorities, f_n. One limitation of this specification is that it can produce tipping points that lie outside of the interval $[0, 1]$. I relax this assumption by allowing the percent minority in a neighborhood to depend flexibly on the relative market shares in each MSA. I obtain this relationship, empirically, by regressing the percent minority in the census tract on powers of the log of the relative market shares:

$$\underbrace{\frac{Q_n^m}{Q_n^m + Q_n^w}}_{\text{fraction minority}} = \alpha_0 + \sum_{j=1}^{5} \alpha_{j,c} \underbrace{\left[\log\left(\frac{Q_n^w}{Q_{tot,c}^w}\right) - \log\left(\frac{Q_n^m}{Q_{tot,c}^m}\right)\right]^j}_{\text{Diff. in white and minority mean utility for n: } V_{nw} - V_{nm}} \tag{11}$$

The coefficients of this regression define the inverse mapping from the ratio of the non-minority to minority market shares to the percent minority in the tract for each MSA. This inverse mapping is important because I have calculated the mean utility of white households at the tipping point, but the ultimate quantity of interest is the percent minority, which defines the tipping point; therefore, we need the inverse mapping of the relative utility to percent minority. I use the estimated parameters to obtain the percent minority at the tipping point by replacing $\log\left(\frac{Q_n^w}{Q_{tot,c}^w}\right) - \log\left(\frac{Q_n^m}{Q_{tot,c}^m}\right)$ in equation (11) with $\log\left(\frac{Q_n^w}{Q_{tot,c}^w}\right) - \log\left(\frac{Q_n^m}{Q_{tot,c}^m}\right) - \tau_{nw}^*$. The resulting fraction minority is the estimated tipping point.

3 Estimates of Census Tract Tipping Points

To estimate the model, I use data from the U.S. census covering five decades: 1970, 1980, 1990, 2000, and 2010. This data consists of the demographic characteristics of the households living in each of the census tracts, as well as tract-level measures of the local housing stock and local economic conditions. I follow Card et al. (2008) in making the following cuts in the data. First, I eliminate any tracts whose population growth between consecutive census years surpasses average population growth in the MSA by more than five standard deviations. Second, I drop all tracts that experience an increase of more than 500% in their white population between consecutive census years. These first two cuts reduce the effect of outliers on the results of this study. For the final cut, I focus my analysis on MSAs that have 100 census tracts or more, also following Card et al. (2008). There are 123 MSAs that satisfy these criteria, and these MSAs cover the 38,489 census tracts that comprise my final data set.

In Table 1, I report summary statistics for the census tract tipping points semi-parametric method of equation (11). The table is divided into three panels. In the first panel I report the mean, median, and standard deviation of the census tract tipping points for the full sample in each of the census years. In the second panel I report the identical statistics for the census tract tipping points that are in the allowable [0,1] range for the given census year. In the third panel, I report the identical statistics for each census tract that is in range in 2010. This restriction gives a consistent set of tracts across all census years. The census tract tipping points have a mean of 15% in 1970, 22% in 1980, 28% in 1990, 36% in 2000, and 41% in 2010. The median-tract tipping point also monotonically increased from 1970 to 2010. In 1970, the median-tract tipping point was 13% and by 2010 it was 34%. The inter-censual correlation between the tract tipping points is between 0.71 and 0.78. This demonstrates that while the mean tipping points of the tracts has increased over time, there has been strong persistence in the ranking of tracts across time.

Table 1: **Census Tract Tipping Point (Semi-Parametric)**

All	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.15	0.22	0.28	0.36	0.42
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
p50	0.13	0.16	0.20	0.28	0.34
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
N	38,489	38,489	38,489	38,489	38,466
Correlation w/ 1970	1.00	0.77	0.40	0.25	0.18

In Range (Current Year)	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.15	0.22	0.28	0.36	0.41
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
p50	0.13	0.16	0.21	0.28	0.34
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	38,333	38,085	37,941	37,803	37,694

In Range (Census 2010)	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.16	0.23	0.28	0.36	0.41
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
p50	0.13	0.16	0.21	0.29	0.34
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	37,694	37,694	37,694	37,694	37,694

This table reports the average and median census tract tipping points for each census year 1970 to 2010 calculated using the procedure in this paper. We use an $N = 1,000$ bootstrap to calculate standard errors. In 2010, we removed 23 outliers.

Using the census tract tipping points, I construct two measures of MSA tipping points. The first is a mean MSA tipping point and the second is a median MSA tipping point. The mean MSA tipping point is the average tipping point of the census tracts in the MSA. The median MSA tipping point is the median census tract tipping point in the MSA. In Table 2, I report the average of the mean and median MSA tipping points for all MSAs and by geographic region.

From 1970 to 2010, both MSA tipping points increased monotonically over time. In 1970 the mean MSA tipping point was 11%; by 2010 it rose to 33%. This increase in the MSA tipping points over time was undergirded by an increasing time trend in tipping points in all regions of the US. MSA tipping points in the West increased fastest, at a rate of 7.5 percentage points per decade, while MSA tipping points increased slowest in the Midwest - 3.25 percentage points per decade. The distribution of tipping points in the Northeast parallels the distribution of MSA tipping points in the Midwest. The mean tipping points in both regions over time were (9%/9%) (12%/12%), (15%/14%), (22%/19%), (26%/22%) in 1970, 1980, 1990, 2000, and 2010, respectively. Likewise, the MSA tipping points in the South mirrored those in the West. The MSA tipping points exhibited a high degree of correlation across consecutive census periods, notwithstanding the fact that they increased substantially across time.

Table 2: **Average MSA Tipping Points**

All	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.13	0.18	0.22	0.30	0.35
	(0.007)	(0.010)	(0.011)	(0.012)	(0.013)
median	0.11	0.16	0.21	0.28	0.33
	(0.007)	(0.010)	(0.010)	(0.013)	(0.013)
Correlation w/ 1970	1.00	0.88	0.84	0.79	0.65
N	123	123	123	123	123

Northeast ($N = 23$)	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.09	0.13	0.17	0.24	0.28
	(0.014)	(0.019)	(0.022)	(0.026)	(0.028)
median	0.09	0.12	0.15	0.22	0.26
	(0.013)	(0.017)	(0.019)	(0.025)	(0.025)

Midwest ($N = 27$)	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.10	0.14	0.16	0.21	0.24
	(0.010)	(0.011)	(0.012)	(0.012)	(0.012)
median	0.09	0.12	0.14	0.19	0.22
	(0.009)	(0.009)	(0.09)	(0.010)	(0.010)

South ($N = 45$)	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.17	0.22	0.26	0.34	0.41
	(0.012)	(0.017)	(0.020)	(0.020)	(0.020)
median	0.14	0.20	0.25	0.32	0.38
	(0.013)	(0.017)	(0.020)	(0.022)	(0.022)

West ($N = 28$)	**1970**	**1980**	**1990**	**2000**	**2010**
mean	0.12	0.20	0.26	0.36	0.43
	(0.013)	(0.021)	(0.025)	(0.027)	(0.028)
median	0.11	0.19	0.25	0.36	0.42
	(0.013)	(0.021)	(0.025)	(0.027)	(0.028)

This table reports the average and median MSA tipping points for each census year 1970 to 2010 calculated using the procedure in this paper. We use a bootstrap procedure to calculate standard errors.

4 Preferences versus Outside Options

The motivating insight of this paper is that the tipping point could depend on the outside options that a household faces because the configuration of outside options affects the household's ability to act on their preferences when the demographic composition of the neighborhood changes. For each census year, I decompose the mean MSA tipping point into a component due to the mean preferences of the households and a measure of their outside options, which depends on the extent of clustering in the city by race. I will describe how I construct standardized measures of the racial preferences and the outside options for the purpose of implementing the decomposition.

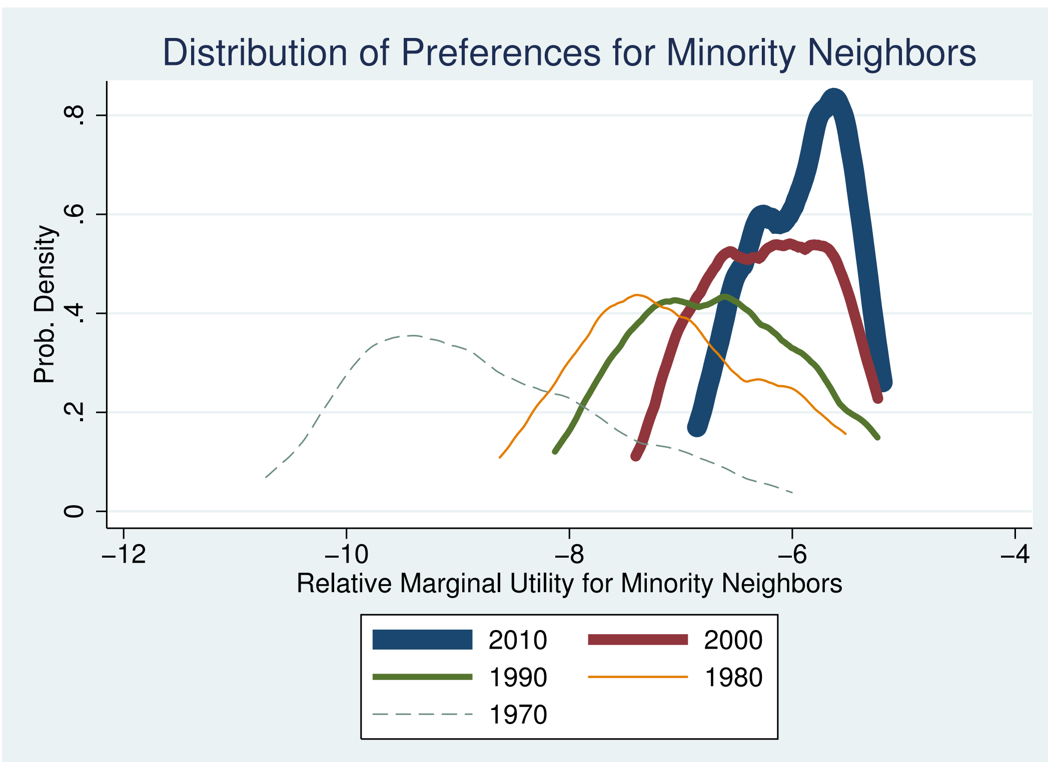

Figure 2: Kernel density plot of the racial preference parameter for each MSA from 1970 to 2010, using the diff-in-diff estimates. Each of the kernel density plots uses data from the 5th to 95th percentile to limit the effect of outliers on the shape of the graphs.

In Figure 2, I graph the distribution of the relative racial preference parameters across the MSAs in my sample. The preference parameters are estimated from equation (10).

In each ten-year period, the distribution of preferences shifts to the right, indicating that the mean is decreasing over time. A decreasing mean over time is consistent with white households becoming more tolerant of living with minorities. Over time, the distribution of preferences also narrows. This suggests that, on average, white households increase in tolerance is occurring across all levels of the preference distribution. The average estimates for $\gamma_{w,c} - \gamma_{m,c}$ range from -8.84 (0.79) in 1970 to -6.11 (0.10) in 2010.[2] For 1970, the point estimate of -8.84 means that a 7.8 percentage point increase in the fraction of minorities was associated with a 50% reduction in the non-minority population of the average neighborhood. The point estimate of -6.11 for 2010 indicates that an 11.3 percentage point increase in the fraction of minorities was needed for the non-minority population in a neighborhood to halve.

To construct the standardized measure of racial preferences ($\Delta\gamma^c_{z,y}$), I de-mean the relative marginal utility for minority neighbors from equation (10) and normalize it to have standard deviation 1 in each year. A one standard deviation *increase* in the race preferences is interpreted as moving non-minorities to have preferences for minority neighbors that is more similar to the preferences that minorities have for minority neighbors. To construct an MSA-level measure of minority clustering in the outside option, I use a Herfindahl-Hirschman Index (HHI). To compute the index, I construct the minority market share of each census tract n in a given census year y by dividing the number of minorities in the tract by the total number of minorities in its MSA c: $s^c_{n,m,y} = \frac{Q^c_{n,m,y}}{Q^c_{tot,m,y}}$. I then square the minority market shares, $s_{n,m,y}$ and sum over them for each MSA, c, to get the MSA HHI^c :

$$HHI_c = \sum_n (s^c_{n,m,y})^2. \tag{12}$$

Finally, I de-mean the Minority HHI and normalize it to have variance 1 in each year. This

[2] To compute standard errors on the point estimate and preference parameters, I use an N=1000 bootstraps.

yields a minority HHI z-score ($HHI^c_{m,z,y}$) for each MSA in each census year from 1970-2010. A one standard deviation *decrease* in the minority HHI corresponds to less clustering of minorities in the MSA, or more census tracts in the MSA having some minority households. Less clustering of minorities creates a choice-set in which many census tracts are sprinkled with at least some minorities, making it difficult for non-minority households to sort into all-white neighborhoods. I construct a standardized non-minority HHI using an identical procedure ($HHI^c_{w,z,y}$). A one standard deviation *increase* in the non-minority HHI corresponds to more clustering of non-minorities into fewer census tracts within an MSA.

In Table 3, I report the results of a regression of mean MSA tipping points (T^c_y) on the standardized minority HHI ($HHI^c_{m,z,y}$), non-minority HHI ($HHI^c_{w,z,y}$), and race preferences ($\Delta\gamma^c_{z,y}$):

$$T^c_y = \eta^y_1 HHI^c_{m,z,y} + \eta^y_2 HHI^c_{w,z,y} + \phi^y \Delta\gamma^c_{z,y}, \tag{13}$$

and include a control variable for region fixed effects. Given how the concentration measure and racial preferences are calculated, conceptually, the concentration measures map onto measures of the variance of the indirect utility that households get from living in the MSA and the racial preferences map on to differences in the mean of the indirect utility. The presence of a more disperse choice-set, is associated with a higher tipping point. In 1970, for example, a one standard deviation decrease in the minority HHI results in a $\eta^{1970}_1 = 1.1$ percentage point increase in the tipping point. From 1970 to 2010, this effect of a reduction in minority clustering on mean MSA tipping points strengthens monotonically. By 2010, a one standard deviation decrease in minority clustering is associated with an increase in the mean tipping point of 14 percentage points, which is roughly 50% of the base tipping point of 30% in 2010. Since reductions in the clustering of minorities result in many tracts having at least some minorities, this reduces the number of all-white tracts, which in turn creates a barrier to neighborhood exit by non-minorities.

	1970	1980	1990	2000	2010
Minority HHI	-0.011	-0.034	-0.070	-0.097	-0.144
	(0.005)	(0.007)	(0.009)	(0.012)	(0.015)**
Non-minority HHI	0.006	0.026	0.055	0.066	0.112
	(0.005)	(0.007)	(0.009)	(0.012)	(0.015)
Race Prefs.	0.066	0.076	0.058	0.032	-0.005
	(0.007)	(0.012)	(0.012)	(0.011)	(0.008)
Constant	0.128	0.169	0.218	0.293	0.300
	(0.012)	(0.016)	(0.018)	(0.020)	(0.020)
Region Fixed Effects	Y	Y	Y	Y	Y
R^2	0.55	0.52	0.57	0.55	0.58
N	116	116	118	118	119

Table 3: This table reports the results from a regression of the MSA tipping point on a standardized measures of the racial preferences in the MSA and the standardized measures of non-minority and minority concentration in the MSA.

While the role of outside options becomes increasingly important over time, the role of racial preferences diminishes. This is illustrated by the negative downward slope of the racial preferences coefficients. In 1970, a one standard deviation increase in racial preferences was associated with a $\phi^{1970} = 6.6$ percentage point increase in the tipping point, which is statistically significant and equal to more than 50% increase in the tipping point. In 2010, a one standard deviation increase in racial preferences had no statically significant effect on the tipping point. The decline in the effect of racial preferences on the tipping point is nearly monotonic over time.

5 Conclusion

A neighborhood tips when non-minorities exit in response to integration. Prior literature has focused on racial preferences as a key driver for tipping. I show that in addition, the outside options of households also matter. To incorporate outside options into a model of tipping, I start with the assumption that a household's outside options are the other neighborhoods in its city of residence. I further require that a household's response to integration is incentive compatible – the household only exits its current neighborhood if relocating delivers higher utility than staying. I pair this assumption about the choice-set and the incentive compatibility constraint with a discrete choice model to exploit the sub-MSA sorting patterns in the data to estimate census tract tipping points.

Interestingly, 1970 and 2010 are opposite sides of the coin when it comes to the respective roles of racial preferences and outside options in MSA tipping points. In 1970, the clustering of minorities and non-minorities had a small effect on tipping points, whereas racial preferences were at the zenith of their importance. In 2010, the opposite was true – the configuration of the outside options was paramount, and racial preferences appear to have played no role in explaining cross-sectional differences in MSA tipping points.

The fundamental insight in this paper on the role that outside options and racial preference play in neighborhood tipping is buttressed by one additional contribution to the literature. I provide a method for computing census tract tipping points and produce estimates of census tract tipping points for $>$38,000 census tracts over a 40-year period (1970-2010). Our estimates census tract tipping points progresses the empirical literature on estimating neighborhood tipping in the context of housing which has progressed from treating tipping as a national phenomenon (Easterly, 2009) to estimating tipping points at the MSA level (Card et al., 2008). In practice, MSAs with the same average tipping point can vary substantially in underlying the distribution of census tract tipping points as was the case with Mobile, AL and Jersey City, New Jersey, which have an average tipping point of 22% (Figure 3 in the appendix). In place-based programs where the treatment is the destination neighborhood, it may be important to discern whether the act of assigning minority households to a destination might itself result in the neighborhood tipping, thereby undermining the intended treatment (Kling et al., 2007; Andrews et al., 2017; Chetty and Hendren, 2018).

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6 Appendix

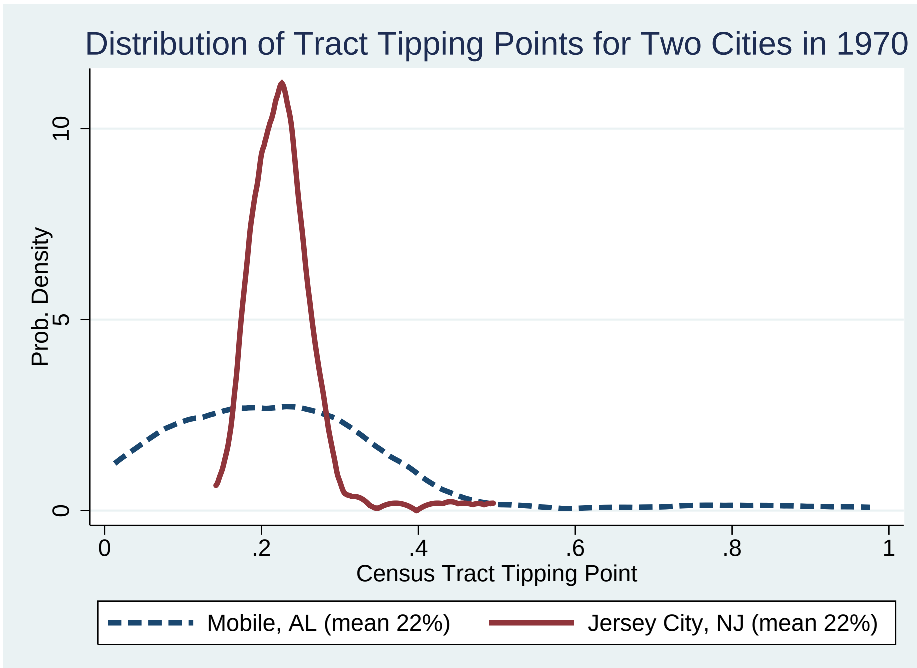

Figure 3: Kernel density plot of estimated census tract tipping points of Jersey City, NJ and Mobile, AL in 1970.

6.1 Comparison with Prior Estimates of MSA Tipping Points

The seminal estimate of MSA tipping points in the literature are from Card et al. 2008 (CMR) tipping points cover three decades. They cover census years 1970, 1980, and 1990.

The CMR tipping points are the result of a fixed-point procedure. To obtain the MSA tipping point, the CMR fits a polynomial of the change in the percent of whites between census years (above the MSA average) as a function of the fraction of minorities in the base census year. Each observation used to fit this function is a census tract in the MSA which is appears into consecutive periods. The first method for determining the tipping point is to solve for the zeros of this polynomial. The key point is that tracts below the tipping point experience above-average growth in their non-minority (white) populations, whereas tracts beyond the tipping point experience below average growth in their non-minority populations. The minority fraction at the zero of this polynomial is taken to be the MSA tipping point.

In cases where there are multiple zeros, the authors took the zero that delivered the most negative first derivative. This equilibrium selection procedure parallels the approach that I take in this paper, where for each tract I stipulate that the tipping point occurs at the level of utility for which the exit rate of non-minorities is maximal (and the marginal exit rate equals zero). Since the CMR tipping point is the zero of a fitted polynomial, it depends crucially on the behavior of the census tracts in the vicinity of this zero. I call these census tracts the "marginal census tracts." These are tracts that are close to their tipping points. I call tracts that are farther away from the zero of the polynomial "infra-marginal census tracts" because changes in the behavior the infra-marginal tracts have less bearing on the estimated value of the CMR MSA tipping points.The setup of the CMR procedure suggests that the CMR tipping points are local averages of the tipping points of the marginal tracts, or perhaps the median of the tipping points of the marginal census tracts in the MSA. Since I have estimates of tipping points for each census tract in an MSA, I can test the hypothesis that the CMR tipping points are local averages of the tipping points of marginal census tracts or the median of the tipping points of the marginal tracts.

In Table 4, I present results from a regression of the difference between the CMR and Revealed-Preference (PR) MSA tipping points, which I call the *tipping difference*,[3] and the fraction of marginal census tracts in the MSA. In 1990, the tipping difference was -15%. It was -10% in 1980 and -8% in 1970. Here, a marginal census tract is a tract whose percent minority is within ± 5 percentage points of its estimated tract tipping point. For example, if a tract has a tipping point of 11% and a current percent minority of 8% it is considered a marginal tract. To allow for asymmetry in the impact of marginal tracts that lie to the left

[3] I do not call this quantity a bias because my hypothesis is that the CMR tipping points measure the distribution of the marginal census tracts, which in and of itself is an important quantity. We care about which tracts are marginal and how the distribution of marginal tracts varies across time and across space.

and to the right of their respective tipping points, I include separate explanatory variables for (a) the fraction of tracts in the MSA that are marginal and have minority fractions below their tipping points; and (b) the fraction of tracts in the MSA that are marginal and have minority fractions greater than their tipping points.

Table 4: **Comparison of CMR and Revealed Preference Tipping Points**

	1990	1980	1970
% Marginal Tracts in MSA (below TP)	0.212	0.193	-0.015
	(0.069)**	(0.067)**	(0.055)
% Marginal Tracts in MSA (above TP)	0.311	0.121	0.603
	(0.169)	(0.157)	(0.123)**
Constant (Avg. Diff in CMR & RP MSA TP)	-0.153	-0.102	-0.077
	(0.021)**	(0.020)**	(0.017)**
R^2	0.17	0.12	0.26
N	101	100	93

This table reports the results from a regression of the MSA tipping points from the CMR paper on the fraction of marginal census tracts in the MSA. I define a marginal census tract as one with a racial composition that is within 5 percentage points of its tipping point.

The constant terms from the regressions in Table 4 capture the mean *tipping difference*. These regression results accord with the -13%, -9%, and -3% tipping differences from the raw data. Based on the regression results, the marginal tracts that were below the tipping point drove the tipping difference in 1990 and 1980. In 1970, the marginal tracts that were above the tipping point (i.e., those that had already tipped), drove the tipping difference. One reason there is a tipping difference at all is that there were few marginal tracts, and so an average of the marginal tracts is different from an average of all tracts. To illustrate this point, I combine the constant term from the regression and the significant coefficient on the marginal tracts to compute the threshold fraction of marginal tracts, $\tilde{f}$ required for there to be no tipping difference in each year:

$$\tilde{f} = \frac{\text{\# marginal tracts in MSA}}{\text{Total \# tracts in MSA}}. \tag{14}$$

To solve for $\tilde{f}$, I set the sum the constant term from the regression and the product of the (significant) coefficient on the marginal tracts times $\tilde{f}$ equal to zero. At this value of $\tilde{f}$, the tipping difference is zero, and the CMR tipping points and the tipping points that I obtain are equal. In 1990, 72% of the tracts would have to be marginal for there to be no tipping difference. In 1980, 53% of the tracts would have to be marginal; and in 1970, 13% of tracts would have to be marginal. In the reality, the average MSA consisted of 14% of marginal tracts (below) in 1990, 13% of marginal tracts (below) in 1980, and 11% of marginal tracts (above) in 1970. Since the mean number of marginal tracts was closest to the required level in 1970, it is not surprising that the tipping difference was smallest in 1970. The opposite is true for 1990, the year when the difference between the required threshold and the fraction of tracts that were marginal was largest. When I restrict my sample of census tract tipping points to only the marginal tracks, I find further evidence that the tipping difference is reduced. With this sample restriction, the tipping difference of the median MSA is reduced from -11.2% to -1.7% in 1990, from -7.8% to 0.1% in 1980, and does not substantively change in magnitude in 1970 (from -3.7% to 4%).

To verify this, I perform a similar exercise, this time changing the definition of the tipping difference to be the difference between the CMR tipping point and the tipping point of the median census tract in each MSA. When I restrict the sample to only the marginal tracts, the tipping difference equals the difference between the CMR tipping point and the median tipping point of the marginal census tracts. Apart from this change in the definition of the tipping difference, Figure 5 is laid out identically to Figure 4. The dashed lines peak to the left of zero, reflecting the fact that the CMR tipping points are smaller, on average, than the MSA tipping points that I compute from the median. The solid lines, however, peak even more sharply around zero than the solid lines using the mean. This reflects the fact that the tipping difference also disappears when I compute MSA tipping points using only the marginal tracts. With this sample restriction, the tipping difference of the median MSA is reduced from -11.2% to -1.7% in 1990, from -7.8% to 0.1% in 1980, and does not substantively change in magnitude in 1970 (from -3.7% to 4%). Taking the

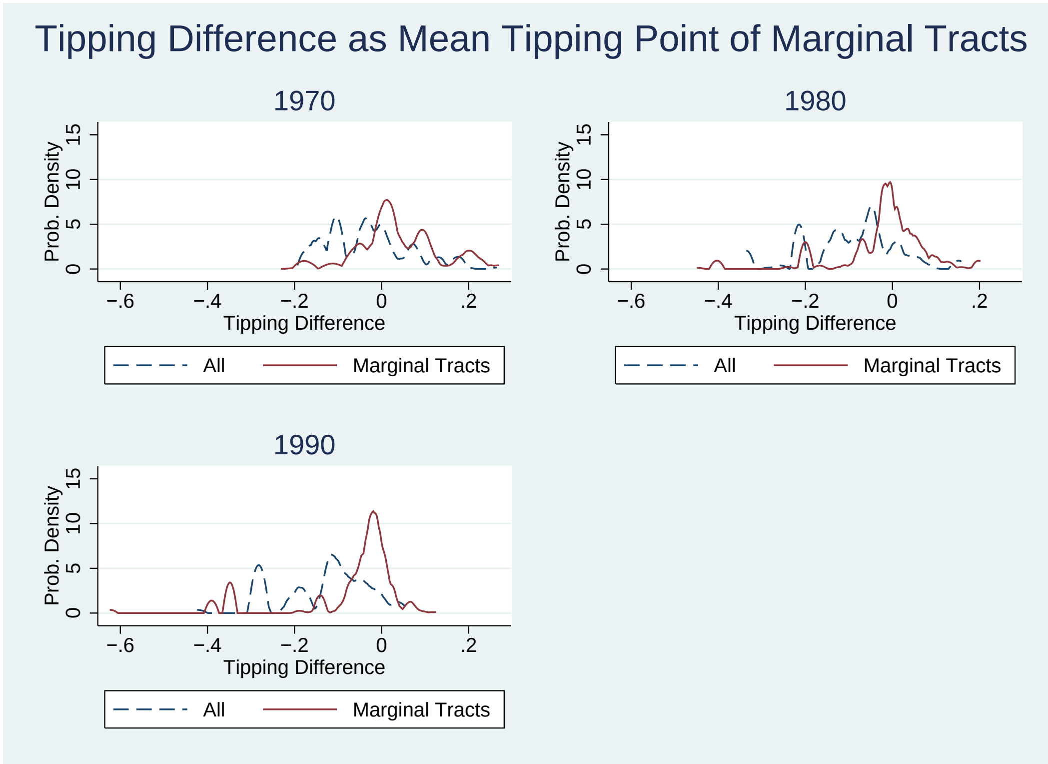

Figure 4: Kernel density plot of the difference between the CMR tipping points and mean MSA tipping points using all tracts, and using the marginal census tracts that are within 5 percentage points of their tipping point.

best of the local mean and median results, the tipping difference of the median MSA is bounded above by 1.9% and bounded below by -0.1%. These results provide further support for the hypothesis that the CMR tipping points capture the shape of the distribution of marginal census tracts in an MSA.

From this comparison of marginal and infra-marginal tracts, we learn that the tipping points of the marginal census tracts evolve more slowly over time than those of the infra-marginal tracts. The CMR tipping points, which were shown to be an average of the marginal tipping points, increased an average of 1 percentage point per decade (1970–1990). We also learn that the infra-marginal tracts play an important role in the secular time trend of tipping points. The MSA tipping points using all tracts (both marginal and infra-marginal) increased at an average rate of 5.5 percentage points per decade (1970–2010), which is substantially higher than the growth rate of the tipping points of infra-

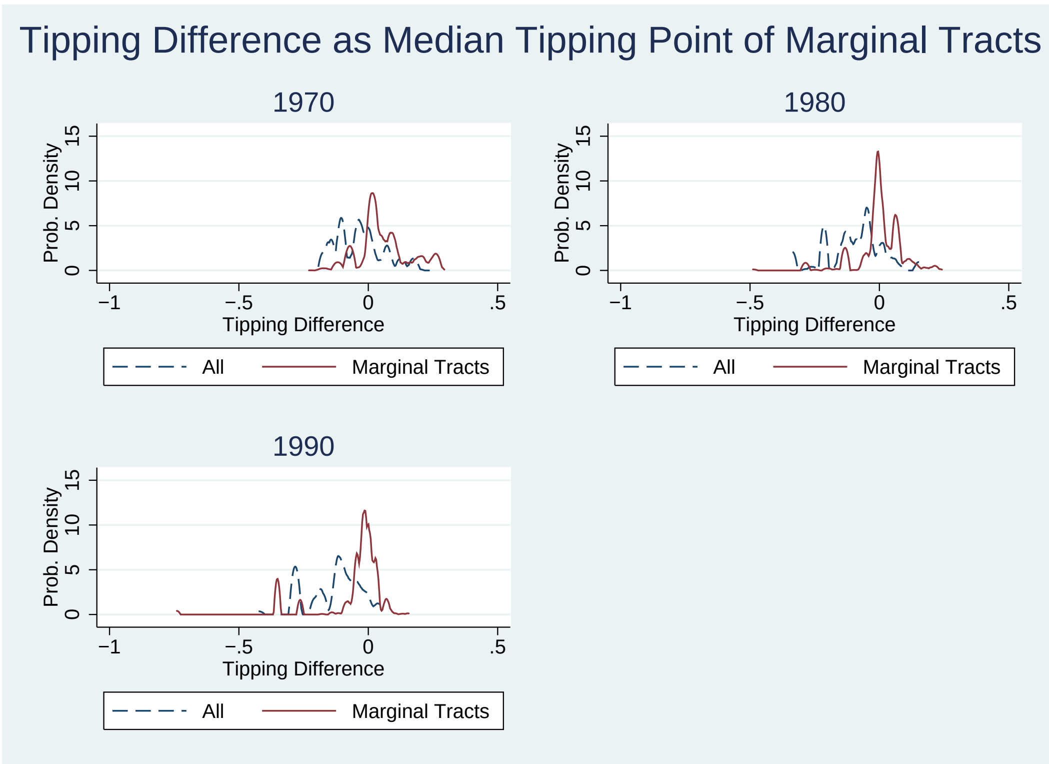

Figure 5: Kernel density plot of the difference between the CMR tipping points and median MSA tipping points using all tracts, and using just the marginal census tracts that are within 5 percentage points of their tipping point.

marginal tracts. An important contribution of the method in this paper is that it enables researchers to compute the tipping points of all census tracts and derived MSA tipping points, which are aggregates of the underlying census tract tipping points. The dynamics of these MSA tipping points better reflect the dynamics of the underlying census tracts.[4]

From this comparison of marginal and infra-marginal tracts, we learn that the tipping points of the marginal census tracts evolve more slowly over time than those of the infra-marginal tracts. The CMR tipping points, which were shown to be an average of the marginal tipping points, increased an average of 1 percentage point per decade (1970–1990). We also learn that the infra-marginal tracts play an important role in the secular time trend of tipping points. The MSA tipping points using all tracts (both marginal and infra-marginal) increased at an average rate of 5.5 percentage points per decade (1970–2010), which is substantially higher than the growth rate of the tipping points of infra-marginal tracts. An important contribution of the method in this paper is that it enables researchers to compute the tipping points of all census tracts and derived MSA tipping points, which are aggregates of the underlying census tract tipping points. The dynamics of these MSA tipping points better reflect the dynamics of the underlying census tracts.

[4]The mean tipping point of census tracts in the data increased by 6.75 percentage points per decade (19702010)