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ARE MIXED NEIGHBORHOODS ALWAYS UNSTABLE? TWO-SIDED AND ONE-SIDED TIPPING

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ABSTRACT

A great deal of urban policy depends on the possibility of creating stable, economically and racially mixed neighborhoods. Many social interaction models – including the seminal Schelling (1971) model – have the feature that the only stable equilibria are fully segregated. These models suggest that if home-buyers have preferences over their neighborhoods' racial composition, a neighborhood with mixed racial composition is inherently unstable, in the sense that a small change in the composition sets off a dynamic process that converges to either 0% or 100% minority share. Card, Mas, and Rothstein (2008) outline an alternative "one-sided" tipping model in which neighborhoods with a minority share below a critical threshold are potentially stable, but those that exceed the threshold rapidly shift to 100% minority composition. In this paper we examine the racial dynamics of Census tracts in major metropolitan areas over the period from 1970 to 2000, focusing on the question of whether tipping is "two-sided" or "one-sided". The evidence suggests that tipping behavior is one-sided, and that neighborhoods with minority shares below the tipping point attract both white and minority residents.

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I. Introduction

Racial segregation is a defining feature of urban neighborhoods in the United States. A large body of social science research has established that black children raised in more segregated areas have worse outcomes, including lower levels of completed education, lower test scores, lower marriage rates, lower employment and earnings, and higher crime rates (e.g., Denton and Massey, 1993; Cutler and Glaeser, 1997). Though researchers do not agree about the extent to which the observed correlations between segregation and outcomes are causal, a major goal of public policy over the past four decades has been to reduce racial segregation in neighborhoods, schools, and workplaces.

The efficacy of integration policies depends critically on the underlying forces that have led to and sustained segregation. While institutional and legal forces played an important part in enforcing segregation in the Jim Crow era, many analysts have argued that the preferences of white families for neighborhoods with a lower fraction of minority residents are the driving force in explaining segregation today (e.g., Cutler and Glaeser, 1997). In a highly influential contribution Schelling (1971) showed that even when most whites have relatively weak preferences for lower minority shares, social interactions in preferences are likely to lead to a fully segregated equilibrium. More recent theoretical studies (e.g., Brock and Durlauf, 2001, Glaeser and Scheinkman, 2003) have established that social interaction models will typically have multiple equilibria, some stable and others– like the integrated equilibrium in Schelling (1971) – unstable.

In this paper we use data on the evolution of Census tracts from 1970 until 2000 to investigate whether integrated neighborhoods are sustainable in the long run, or whether they are inherently unstable and destined to either become 100% minority or 100% white. Our analysis builds on a companion paper (Card, Mas, and Rothstein, 2008; hereafter CMR) in which we found that most major metropolitan areas are characterized by a city-specific "tipping point," a level of the minority share in a neighborhood that once exceeded sets off a rapid exodus of the white population. To illustrate this finding, Figure 1 plots mean percentage changes in the white population of Chicago Census tracts from 1970 to 1980 against the tract's minority share in 1970.[1] The graph shows clear evidence of a critical threshold at around a 5% minority share: Neighborhoods with 1970 minority shares below this threshold experienced gains in their white populations over the next decade, while those with initial shares above the threshold experienced substantial outflows. These patterns hold on average for a broad sample of U.S. cities in each of the past three decades.

Most common understandings of neighborhood tipping envision a transition from virtually all-white composition to virtually 100% minority. This is certainly the historical experience. Northern cities had relatively low numbers of racial minorities in 1940, but as African Americans migrated from the South, many neighborhoods within these cities tipped from all-white to all-black. In contrast to this one-sided view of tipping, many theoretical models of neighborhood composition – including the one originally proposed by Schelling – predict "two-sided" tipping. Neighborhoods can experience white flight, rapidly transitioning to all-minority composition, or minority flight, moving to all-white status. In these models, any integrated neighborhoods are either out-of-equilibrium or unstable, prone to tip in response to even small changes in the neighborhood composition. Nevertheless, a class of alternative models -- including the one developed in CMR – allow for stable integrated neighborhoods at minority shares below the tipping point. In these models, the tipping point is not an unstable

[1] We express the change in white population as a fraction of the total tract population in 1970. Minorities are defined as nonwhites and white Hispanics.

equilibrium (as in Schelling's model) but a bifurcation, representing the maximum minority share at which a neighborhood can be in stable equilibrium.

The distinction between these views of tipping is quite important for policy purposes. Under Schelling's model, planners hoping to create and maintain vital integrated neighborhoods must fight continuously against market forces, which are always pulling the neighborhood toward complete segregation. By contrast, under the alternative models, a neighborhood can remain stable with a moderate minority share. These models would provide a justification, for example, for zoning and low-income-housing development policies meant to ensure that neighborhoods retain mixtures of different types of families. If integrated neighborhoods are inherently unstable, these efforts are likely to be futile.

This paper investigates whether integrated neighborhoods with minority shares below the tipping point are dynamically stable, or whether these neighborhoods experience rapid minority flight. The answer to this question is of growing importance because tipping points appear to have risen. If neighborhoods below the tipping point are stable, increases in the tipping point can lead to increasingly integrated neighborhoods, all else equal. CMR document average tipping points in the range of 13% minority over the 1970 – 1990 period, with slight increases over time. This contrasts sharply with earlier experience, where neighborhoods in many cities seemed prone to tip in response to even a small minority presence. Applying the same methods as in CMR, we estimated the tipping points for three large Midwestern cities (Chicago, Cleveland, and Detroit) for the 1940-1970 period. Figure 2 shows the evolution of the tipping points in these cities since 1940.[2] In two of the three cities, the tipping point was near zero in 1940 and 1950 (in the third, Cleveland, it was near 10% in 1940 but fell to near zero in 1950), and in each case it rose

[2] The older data is available for only a small fraction of the cities studied by CMR, and it can be difficult to harmonize census tract definitions across decades. These three cities were among the earliest to be tracted, and had fairly stable tract boundaries between 1940 and 1960.

substantially by 1970 and further in the later years. Although 1940 and 1950 tipping points are not available for other cities, the figure also shows that the average tipping point across all large cities in the country was around 12% in 1970 and rose somewhat over the next two decades.

Changes in tipping points have been accompanied by dramatic changes in the cross-sectional distribution of minority shares across tracts. Figure 3 shows the distribution of tract minority shares for the pooled sample of tracts from the three cities in 1950, 1970, 1990, and 2000. In 1950, this distribution is highly bimodal, with many all-white neighborhoods, a few all-minority (almost entirely black) neighborhoods, and essentially no integrated neighborhoods. This distribution would be expected from a tipping point at a very low minority share. In more recent decades, we see two key changes. First, there are more neighborhoods with very high minority shares, as each city's black (and more recently Hispanic) population expanded over the second half of the twentieth century. Second, we increasingly see neighborhoods with intermediate minority shares, neither all-white nor all-minority. Many of these integrated neighborhoods have minority shares below the (now higher) tipping points. The histograms suggest the possibility that neighborhoods below the tipping points might be stable, though because they represent only cross sections they are also consistent with instability of integrated tracts.

In what follows we present a series of tests for the stability of neighborhoods with minority shares below the tipping points identified by CMR. We focus on the 1970 tipping point. As indicated in Figure 2, 1970 seems to represent the beginning of the modern era for this sort of analysis, with tipping points that more closely resemble those seen most recently and are sharply higher than the tipping points observed in the 1940s and 1950s.[3] Importantly for our

[3] Because tract boundaries changed in many cities between 1960 and 1970, we have not calculated 1960 tipping points.

purposes, a focus on 1970 allows us to observe neighborhoods' outcomes over a thirty year period. We examine the racial/ethnic composition of Census tracts in 1980, 1990, and 2000, relating this to a tract's location relative to the 1970 tipping point. Overall, we conclude that tipping is one-sided: While neighborhoods with minority shares above the 1970 tipping point appear to move toward high minority concentrations in later decades, those that remain below the tipping point are more stable, and show no indication of substantial minority flight.

In Section II we will outline two theoretical frameworks of tipping and discuss their contrasting implications for the prospects of integrated neighborhoods. In Section III we outline the methods used in CMR. In Section IV we discuss the findings. Section V concludes.

II. Theoretical Framework

We consider a neighborhood with a homogenous stock of N homes and two groups of potential buyers: whites (w) and minorities (m). Let $b^w(n^w, m)$ represent the inverse demand function of white potential buyers for homes in the neighborhood, where n^w is the number of units purchased by whites and m is the minority share in the neighborhood. Similarly, let $b^m(n^m, m)$ represent the inverse demand of minority buyers, which depends on the number of homes held by minorities, n^m, and the minority share. The two arguments of the inverse demand functions reflect two distinct forces: the <u>specificity of demand</u> for homes in the neighborhood (reflected in the rate that prices have to fall to induce more sales to members of each group); and <u>social interaction effects</u> (reflected in the sensitivity of demand to the minority share in the neighborhood). If potential buyers have individual-specific valuations for a given neighborhood – due to local amenities that are valued differently by different buyers, for example – then the neighborhood demand curves will be downward-sloping (i.e., $\partial b^w(n^w, m)/\partial n^w < 0$ and $\partial b^m(n^m,$

$m)/\partial n^m<0)$. In the absence of such effects the demand curves will be perfectly elastic and inverse demands will be independent of the quantities of homes held by the two groups in the neighborhood.[4] Turning to the second argument of the inverse demand functions, if white buyers prefer neighborhoods with lower minority shares then $\partial b^w(n^w, m)/\partial m<0$, while in the absence of such effects $\partial b^w(n^w, m)/\partial n^w=0$. Likewise if minority buyers prefer a higher minority share then $\partial b^m(n^m, m)/\partial m>0$; in the absence of social interaction effects, $\partial b^m(n^m, m)/\partial m=0$.

In an integrated equilibrium whites and minorities must be willing to pay the same price, implying that $b^w(n^w, m) = b^m(n^m, m)$, with $n^m+n^w=N$ and $m= n^m/(n^m+n^w)$. Normalizing the total supply of houses (N) to unity, these conditions imply

(1a) $$b^w(1-m, m) = b^m(m, m) .$$

There may also be "corner" equilibria. At an all-white neighborhood equilibrium,

(1b) $$b^w(1, 0) > b^m(0, 0) ,$$

whereas at an all-minority equilibrium,

(1c) $$b^w(0, 1) < b^m(1, 1) .$$

Four types of equilibrium are shown in panels A-D of Figure 4, depending on whether buyers have neighborhood-specific valuations and whether social interactions play a role in white buyers' demands. The X-axis of each panel is the minority share in the neighborhood, while the Y-axis represents the price of homes in the neighborhood. The minority inverse demand should be read as a conventional demand curve from left (the m=0 axis) to right. The white inverse demand should be read from right to left (starting at m=1, where white demand is 0). Panel A shows the benchmark case where there is no neighborhood specificity in demand and social interactions are unimportant. In this case the two inverse demands are simply horizontal lines.

[4] Demand specificity will be less important when a neighborhood is small relative to the set of close substitutes, with few unique locational, cultural, or other amenities. These conditions may be more likely to arise in suburbs than in central city areas.

As drawn in Figure 4A, white buyers value the neighborhood more than minority buyers, and the neighborhood is all-white. Clearly, if the minority demand curve for a neighborhood lies above the white demand curve, the neighborhood will be all-minority.

Panel B shows the case where the demand for the neighborhood from each group is less than perfectly elastic but there are no social interactions. In this situation the minority demand curve is downward-sloping as a function of m, whereas white demand – which is a downward sloping function of (1−m) – is *increasing* in m. If the demand curves intersect, as is shown in Panel B, there is an integrated equilibrium, though segregated equilibria are also possible if the demand curves are non-intersecting. Importantly, in the absence of social interaction effects, any integrated equilibrium is unique and stable.[5] At the equilibrium shown in the figure, a small increase in the fraction of minority homeowners opens up a positive gap between the white and minority bid-prices, ultimately causing a transaction that restores the equilibrium.

Panel C shows the case that was considered by Schelling (1971): no specificity in the demand for the neighborhood, but negative social interaction effects in white demand.[6] Here, assuming that in the absence of the interaction effect whites would bid more for homes in the neighborhood than minorities, there are three possible equilibria: an all-white equilibrium; an all-minority equilibrium; and a mixed equilibrium. The two segregated equilibria are stable whereas the integrated equilibrium is not: Starting from the integrated equilibrium, a small increase in the fraction of minority owners would lead to a positive gap between the willingness to pay of minorities and whites, stimulating further sales that lead to "white flight" and ending at

[5] This is a consequence of the fact that market-level inverse demand functions (also known as "bid-rent" curves) are non-increasing functions of the quantity sold.

[6] Schelling (1971) considered a case where there are N current white owners of the homes in a neighborhood, and each white has a threshold m_i beyond which his or her demand falls to 0. In this case, assuming m_i is distributed with distribution function F, the white inverse demand (of current owners) is horizontal for m in the interval from 0 to m^*, where $F(m^*)=1-m^*$, and then falls to 0.

the all-minority equilibrium. Again starting from the integrated equilibrium, a small increase in the fraction of white owners would lead to an opposite gap in willingness to pay, initiating a cascade of "minority flight" that culminates in the all-white equilibrium.

Panel D shows the more general case where there is both specificity in the neighborhood demand functions and a social interaction effect in white demand. In this case the inverse-demand function for whites can be non-monotonic, reflecting two countervailing forces: the downward sloping demand for housing, which in isolation causes b^w to be upward-sloping in m, and the social interaction effect, which causes b^w to be downward-sloping. As we have drawn the graph, at low levels of the minority share the demand effect dominates, and as m rises from 0 the move up the inverse demand curve yields a rise in the marginal willingness to pay by white buyers. At higher levels of the minority share, however, the social interaction effect dominates and further increases in the minority share lead to reductions in the marginal white bid. As drawn, there are three equilibria: two mixed and one all- minority. The first mixed equilibrium, at a relatively low minority share, is locally stable, while the second, at a higher minority share, is not.

The comparison between Panel C (with a single unstable mixed equilibrium) and Panel D (with two mixed equilibria, one stable) suggests that some specificity in white demand is necessary to support a stable integrated equilibrium when whites treat a higher minority share as a pure disamenity.[7] Specificity might arise from locational features – individuals whose jobs are located nearby may have particular demand to live in the neighborhood, but once all of these individuals have purchased houses the marginal buyer must work farther away – or from fixed local amenities, like cultural institutions, that appeal more to some potential buyers than to

[7] In principle whites may view a modest minority share as a positive amenity. In that case, the social interaction effect will cause b^w to be increasing in m for low levels of m, even in the absence of demand specificity.

others. The key feature is that, holding the minority share fixed, the white demand curve for the neighborhood is downward-sloping, rather than horizontal (corresponding to perfectly elastic demand), as it would be if the neighborhood was perfectly substitutable with many others. In the presence of specificity, some whites are willing to remain in a neighborhood even if the minority share is positive. In the absence of specificity, white demand is *monotonically decreasing* in the minority share, eliminating the stable integrated equilibrium shown in Figure 4D and leaving only the unstable equilibrium, as in 4C.

In CMR, we defined the "tipping point" for a model like the one shown in Panel D as the maximum minority share at which a neighborhood can be in stable equilibrium, assuming that the white and minority demand curves are subject to vertical displacements over time.[8] As shown in Panel E of Figure 4, this is the point of tangency between b^m and b^w, marked as m^* in the figure. When a neighborhood is at this point, any relative increase in minority demand for the neighborhood eliminates the integrated equilibria, leaving only the all-minority equilibrium. The process may be irreversible once it has begun: Note that in Panel D, the zone of attraction for the all-minority neighborhood is the entire range of m above the unstable mixed equilibrium. Once a neighborhood has begun tipping, and has a minority share in excess of m^*, even a downward relative shift in the minority demand function may leave the integrated equilibria to the left of the neighborhood's position. If so, the neighborhood will continue its transition toward the all-minority equilibrium.

In contrast to this definition, Schelling (1971) and others have defined an unstable integrated equilibrium, such as that shown in Panel C or the right-most mixed equilibrium in

[8] CMR assume that the inverse demand functions for whites and minorities for homes in neighborhood n in city c can be written as $b^w_{nc} = b^w_c(1-m_{nc}, m_{nc}) + e^w_{nc}$, $b^m_{nc} = b^m_c(m_{nc}, m_{nc}) + e^w_{nc}$. , where e^w_{nc} and e^m_{nc} represent neighborhood-specific demand shocks. Thus, the demand curves in different neighborhoods are all vertical translations of city-specific base functions. This implies that there is a city-specific tipping point.

Panel D, as the "tipping point." By this definition, "tipping" is the movement away from an unstable equilibrium, and is two-sided.

It is worth emphasizing the very different nature of the integrated equilibria and the tipping process in these different models. In the original Schelling model, an integrated neighborhood in equilibrium is like a marble placed precisely at the peak of a ridge. The marble is stable only so long as it does not move to either side. If it is perturbed even slightly via a random shock, it will inevitably roll off the ridge and will wind up either in the $m=0$ or the $m=1$ valley. In the class of models illustrated by Figures 4D and 4E, however, dynamic behavior is analogous to a marble on an elevated plateau. The marble's position is stable so long as it is not too close to the edge of the plateau. Once it reaches the edge, however, it will roll down to the $m=1$ valley.

This analogy illustrates the nature of our test for the distinction between two-sided and one-sided tipping (or, phrased differently, between unstable and semi-stable understandings of the tipping point equilibrium). If integrated neighborhoods are inherently unstable, as in Figure 4C, then they will tend to experience either rapid losses of white residents or rapid losses of minority residents depending on whether they are to the left or the right of the tipping point. If integrated neighborhoods are stable so long as their minority shares remain below the tipping point, however, then a neighborhood with $m < m^*$ in a base year will not typically experience large losses of minority residents (or gains of white residents) in the following years.

We implement this test by focusing on the dynamics of neighborhoods with minority shares that are close to the set of city-and-decade-specific tipping points identified in CMR. These tipping points are identified by searching for "break points" in the relation between the minority share in a neighborhood in some base year (the Census years 1970, 1980, or 1990) and the subsequent change in the white population of the neighborhood over the next 10 years. Although one-sided and two-sided tipping models both predict a sharp, discontinuous decrease in the number of white residents once a neighborhood is beyond either definition of a tipping point, they differ in their implications for the behavior of the minority share, and the number of minority residents, to the left of the tipping point. Two-sided models imply sharp losses in the number of minority residents, and a sharp decline in the minority share, for neighborhoods just to the left of the tipping point. One-sided models suggest that neighborhoods with a minority share below the tipping point can have stable minority shares and total minority population.

III. Data and Methodology

CMR estimated tipping points for each large metropolitan statistical area in 1970, 1980, and 1990. They documented a discontinuity in neighborhood evolution at these tipping points. In each decade, the tracts with minority shares just above the city- and decade-specific tipping point saw large declines in their white populations relative to tracts that began just below the tipping point. CMR do not investigate, however, whether this reflects symmetric movements away from the tipping point on each side, or simply a contrast between rapid losses of white residents in tracts beyond the tipping point and approximate stability in tracts to the left of it. They also discuss only briefly the dynamics of *minority* populations around the tipping point. A closer investigation of these dynamics is important for distinguishing between the semi-stable and unstable models of tipping points, as in the latter model neighborhoods just to the left of the tipping point will experience "minority flight" and in the former they are likely to remain approximately stable.

The models above, for purposes of analytical simplicity, treat neighborhood size as fixed. This is a major obstacle in taking these models directly to the data, as many metropolitan neighborhoods see rapid changes in their populations and housing stocks over time. CMR document that the neighborhood growth rate changes discontinuously at the tipping point, with tracts to the right of the tipping point ($m>m^*$) seeing relatively slower growth over the next decade than those to the left of it, at least in the subset of neighborhoods in which there is remaining undeveloped land. To abstract from this differential neighborhood growth, CMR focus on the implications of tipping for the rate of growth in the white population of a neighborhood rather than for the neighborhood minority share. They document rapid growth of the white population in tracts to the left of the tipping point and rapid declines in tracts to the right. The former would seem to support the “two-sided” tipping model. However, because minority populations may also be growing at a similar rate, the facts in CMR are also consistent with stable minority shares for tracts with minority shares just below the tipping point.

We consider alternative measures of neighborhood evolution – the growth rate of the tract minority population or the change in the tract minority share – to differentiate between the alternative accounts of tipping, focusing on the question of whether tracts that are below the tipping point trend quickly towards 100% white. As in CMR, we use Census tract data for the 1970-2000 Censuses from the Urban Institute’s Neighborhood Change Database (NCDB) as our source of data on neighborhoods. We treat metropolitan statistical areas (MSAs) and primary metropolitan statistical areas (PMSAs) as defined in 1999 as “cities,” and we define our sample identically to that used in CMR. We define minorities as non-white and Hispanics. We refer the reader to CMR for further details on the sample and variable construction.

We also follow CMR in the definition and estimation of a tipping point. That paper used two different methods to estimate candidate tipping points. In this paper, we focus on the "fixed point" definition: A candidate tipping point is a fixed point in the differential equation describing the evolution of the neighborhood's composition. To identify this point, we fit a flexible model of racial dynamics in each city and find the initial minority share at which the predicted rate of change of the white share equals the city-level average. Details are available in CMR. Because this approach involves intensive "data mining," CMR adopted a split-sample approach, using a random sub-sample of tracts in a city to identify the potential tipping points and using only the remaining tracts to examine racial dynamics around those points. As we found evidence in CMR that most cities exhibit true tipping, the fact that the tipping points are estimated is not likely to induce bias in estimates of the city dynamics. Accordingly, in this paper we use the full sample of tracts to estimate the tipping points and for our remaining analysis.

Table 1 presents summary measures of the estimated tipping points using the procedure from CMR. Tipping points vary by city, averaging 13%, with a standard deviation of approximately 10%. In CMR we find evidence that cities with more racially tolerant whites have higher tipping points.

IV. Testing for the Stability of Tracts Below the 1970 Tipping Point

In order to distinguish between one-sided and two-sided tipping we examine the evolution of racial/ethnic composition in tracts on either side of the 1970 tipping point. Specifically, we examine the racial/ethnic composition of Census tracts in 1980, 1990, and 2000, relating this to a tract's location relative to the 1970 tipping point. By focusing on the 1970 tipping point, we allow for a relatively long time horizon over which we can follow the tract's evolution.

We begin by selecting census tracts that are within three percentage points of their MSA tipping point in 1970. From this subset of tracts we subdivide the sample between tracts where m_{70}-m_{70}*>0 (hereafter the ≥ m_{70}* group) and tracts where m_{70}-m_{70}*<0 (hereafter the < m_{70}* group). We compare the distributions of the minority share deviated from m_{70}* in these two samples between 1970 and 2000.

In Figure 5 we show CDF's of m_t-m_{70}* (t = 70, 80, 90 and 00), comparing the ≥m* and <m* samples. The compression seen in the distributions of Panel A is an artifact of the sample selection criteria: In both the ≥m* and <m* samples all tracts are within three percentage points of the MSA-specific tipping point in 1970, so the latter sample is merely shifted to the left three percentage points relative to the former sample.

The CDFs corresponding to years 1980-2000 are more interesting. If tipping points are unstable rather than merely semi-stable, we expect to see that the <m* group will spread to the left of m_{70}^* over the following decades, producing negative m_t-m_{70}*. Panel B shows 1980. Between 1970 and 1980, both tracts that began to the left and tracts that began to the right of m_{70}* tended to gain minorities: 60% of the tracts that were just to the left of the 1970 tipping point crossed it by 1980.[9] While it is surprising that such a large number of tracts below <m* eventually tip, this pattern is consistent with the semi-stable view of tipping points. If indeed tracts just below the tipping point are approximately stable but are subject to random shocks, a fraction will eventually be shocked above the tipping point, off the edge of the plateau.

[9] not necessarily mean that these tracts were also n the process of tipping as the city's tipping point may have risen as well. However, because average tipping points rose only slightly between 1970 and 1980, some of the tracts are indeed beyond the 1980 tipping point. Recall that in the "plateau" model tracts near the edge of the plateau risk falling off the edge in response to relatively small positive shocks to their minority shares.

Nevertheless, consistent with the tipping phenomenon, the minority share tended to rise by more in the ≥m* ("tipping") group than in the <m* (non-tipping) group: The distribution of m_{80}-m_{70}* in the ≥m* group stochastically dominates the distribution in the <m* group.

Not all tracts in the ≥m* group tip immediately. In this group the median value of m_{80}-m_{70}* is close to the median of value m_{70}-m_{70}*, though differences at upper percentiles are substantial, with the 75th percentile of m_{80}-m_{70}* about 10 percentage points larger than that of m_{70}-m_{70}*. The tipping process becomes more pronounced in 1990 and 2000, with tracts in the ≥m* group showing increases in minority share at all points in the distribution. Nevertheless, while tipping is present, the rate of tipping (towards 100% minority) varies quite a bit, and can be very slow in some tracts.

There is no evidence in Figure 5 of "minority flight" from the $<m^*$ group. There is no leftward spread in the distribution of minority share (deviated from the 1970 tipping point) in any of the decades. Most tracts, even in the $<m^*$ group, saw rising rather than falling minority shares, and essentially no tracts had minority shares more than 5 percentage points below the 1970 tipping point at any point in the three decades.

A possible concern with this analysis is that there is limited potential for declines in minority share if tipping points are small. For example, in a city with a tipping point at 5 percent minority, -5 is the theoretical lower bound for $m_t - m_{70}^*$. To assess whether the absence of leftward spread in the m_i-m_{70}* distribution is due to cities with low tipping points, we limit the sample to MSA's where the tipping point, m_{70}^*, exceeds 10. This excludes approximately half of the MSA's in the sample. We present the CDF's of m_t-m_{70}* for this restricted sample in Figure 6. Among these higher-tipping point MSA's, the rightward shift in the distribution of m_i-m_{70}* in the ≥m* sample is somewhat attenuated, though there remains a divergence between the ≥m* and <m* samples in the growth of minority share.[10] As we would expect, there is now more leftward spread of m_i-m_{70}*, as compared to Figure 5. However, this leftward spread is almost identical in the ≥m* and <m* groups--the difference between the two distributions at the 10th percentile is less than 5 percentage points in 1980 and 1990, and close to zero by 2000. Only a relatively small fraction of tracts lose minority share—about 40% in 1980, 20% in 1990, and 10% in 2000. Moreover, the reduction in minority share tends to be small. Even in 1980, only about 10% of tracts in the <m^* group had lost more than 5 percentage points in minority share since 1970.

From this analysis there is little indication that tracts to the left of the 1970 tipping point are tending quickly – or at all – toward an all-white equilibrium. However, changes in the tract minority share reflect both changes in the numerator – the number of minority residents – and changes in the denominator – the total number of tract residents. As a consequence, changes in minority share need not reflect changes in minority populations.

Figure 7 provides another look at the data that helps resolve this ambiguity. Here, we examine the tract's minority population in year t as a percentage of the tract's minority population in 1970. A tract that is hemorrhaging minority residents will tend to have values well under 100, while one with a growing minority population will have a value in excess of 100. To focus attention on the relevant portion of the distribution, we censor the ratio at 200, corresponding to a doubling of the tract's 1970 minority population. A large fraction of tracts in both the ≥m* and <m* groups are censored, about half in 1980 and rising to 80% in 2000. This

[10] One reason for this attenuation is that our procedure for identifying tipping points typically picks out a candidate point even if the city is not tipping. While there are extreme non-linearities in the change in white population around candidate tipping points, on average, and most cities have tipping points, there may be cities for which we have identified a candidate tipping point where neighborhoods are not actually tipping. In these cases the change in white population in relation to initial minority share exhibits smoothness, whereby low minority areas tend to experience higher growth of white population relative to higher minority areas, but without any pronounced non-linearities. In such cases, the candidate tipping point will be relatively large, so that when we restrict the sample to high tipping points, these non-tipping cities tend to be disproportionately represented in the sample.

is not surprising for the ≥m* group—a tract that begins with a minority share around 10% and begins transiting quickly toward an all-minority equilibrium will certainly double its minority population over thirty years. It is somewhat more surprising to see large increases in the number of minorities. This pattern is consistent, however, with the semi-stable view of tipping points. If indeed tracts just below the tipping point are approximately stable but are subject to random shocks, a fraction will eventually be shocked above the tipping point, off the edge of the plateau. These tracts will roll quickly toward the all-minority valley. This appears to have happened to at least half of the tracts in the <m* group by 1980, and to much larger shares by 2000.

The density of the two groups to the left of 100 is of even greater interest for our purpose. Only a very small fraction of tracts lose minority residents on net in the years after 1970, never more than 20% of any group. Of those that do lose minority residents, most lose only a fairly small portion of their initial populations; essentially none lose more than half of their 1970 minority populations. There is thus no evidence whatsoever for rapid minority flight from tracts on either side of the tipping point.

Indeed, the contrast between the <m* and the ≥m* groups, at least in 1980, shows the opposite of the pattern that would be predicted by the "unstable equilibrium" model of tipping. The distribution of the proportional change in minority populations in the <m* stochastically dominates that in the ≥m* group. Rather than losing their minority communities, tracts to the left of the tipping point seem to be *attracting* new minority residents at a *faster* rate than those to the right of the tipping point. The evidence for tipping seen in CMR and in Figures 5-6 here apparently reflects substantial differences in population growth rates, with relative inflows of white residents into <m* tracts that are even larger in proportion to the initial white population than are the minority inflows in proportion to the initial minority population.

V. Conclusion

Tipping points remain an important part of the dynamics of racially mixed urban neighborhoods. Those with minority shares in excess of the tipping point tend to experience rapid white flight, transitioning quickly toward being 100% minority. By contrast, neighborhoods with non-trivial minority populations but minority shares below the tipping point appear to be relatively stable, gaining minority residents but doing so more slowly than do tipping tracts. There is no evidence of the "minority flight" that would be predicted by at least some models of tipping.

Our conclusion is that tipping points are semi-stable, and that neighborhoods can retain an integrated character so long as they remain below the tipping point. Policies that are oriented toward maintaining stable neighborhoods can derive some justification from this result; these efforts need not contend forever against market forces that are pushing neighborhoods toward perfect segregation.

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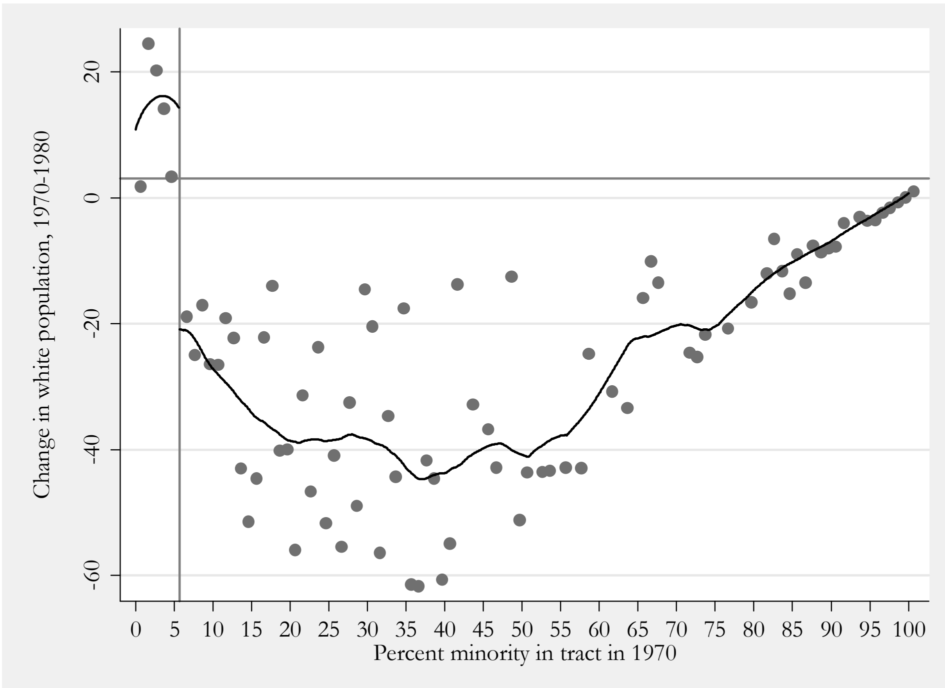
Figure 1. Neighborhood change in Chicago, 1970-1980



Notes: Reproduced from Card, Mas, and Rothstein (2008). Dots show mean of the change in the tract-level white population between 1970 and 1980 as a share of the total tract population in 1970, grouping tracts into cells of width 1% by the 1970 minority share. The horizontal line depicts the unconditional mean. Fitted series is a local linear regression fit to the underlying data, using an Epanechnikov kernel and a bandwidth of 3.5 and allowing for a discontinuity at 5.7%. This point is chosen using a search procedure and a 2/3 sample of Chicago tracts. Only the remaining 1/3 subsample is used for the series depicted here. See text for details.

Figure 2. Tipping points in Chicago, Cleveland, and Detroit over time

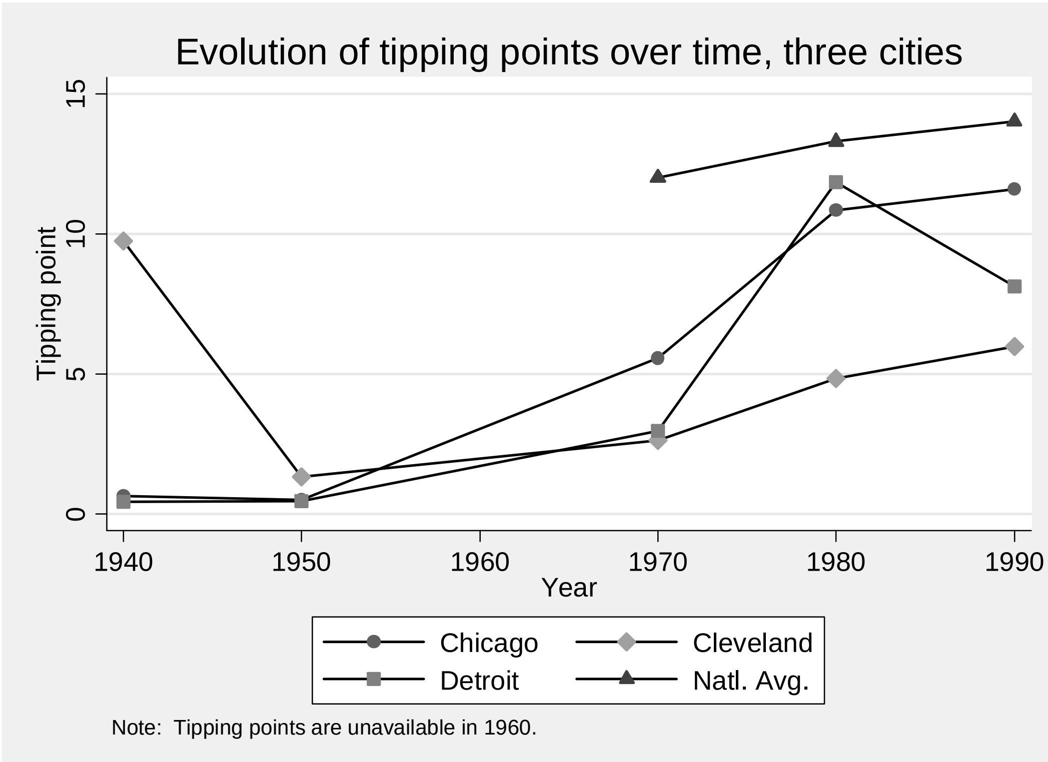


Figure 3. Pooled histogram of tract minority shares in Chicago, Cleveland, and Detroit, 1950-1990.

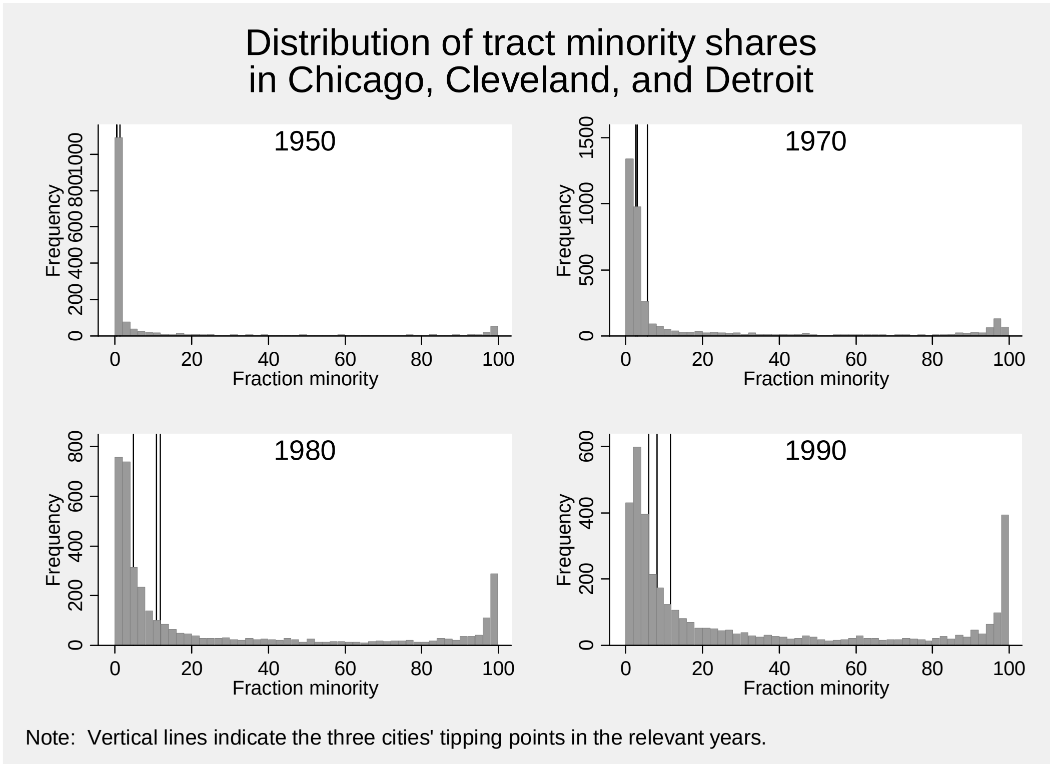
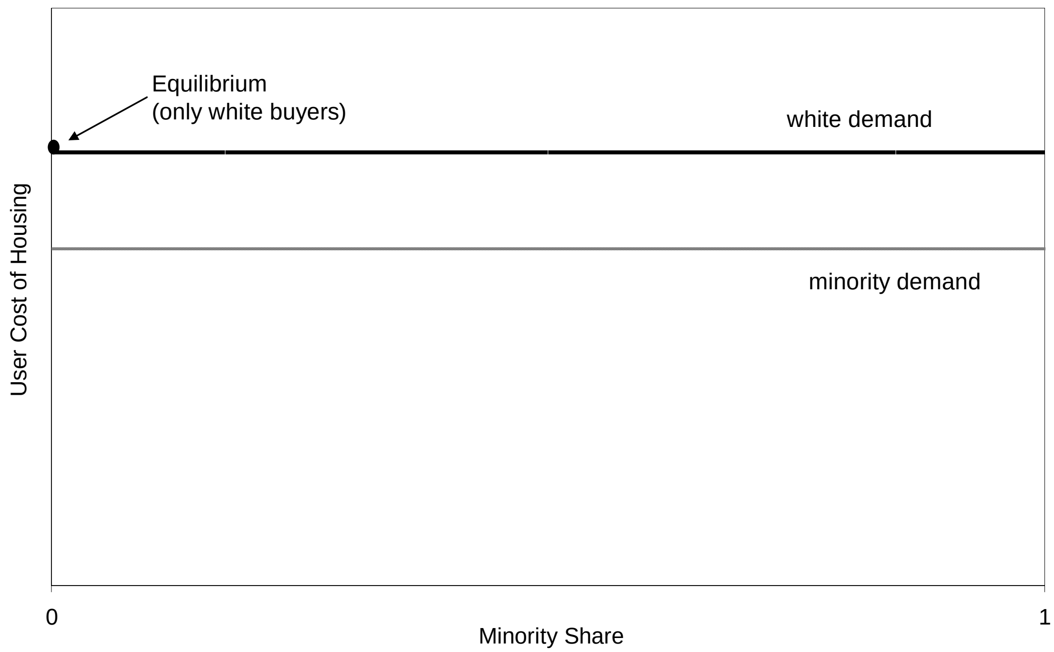
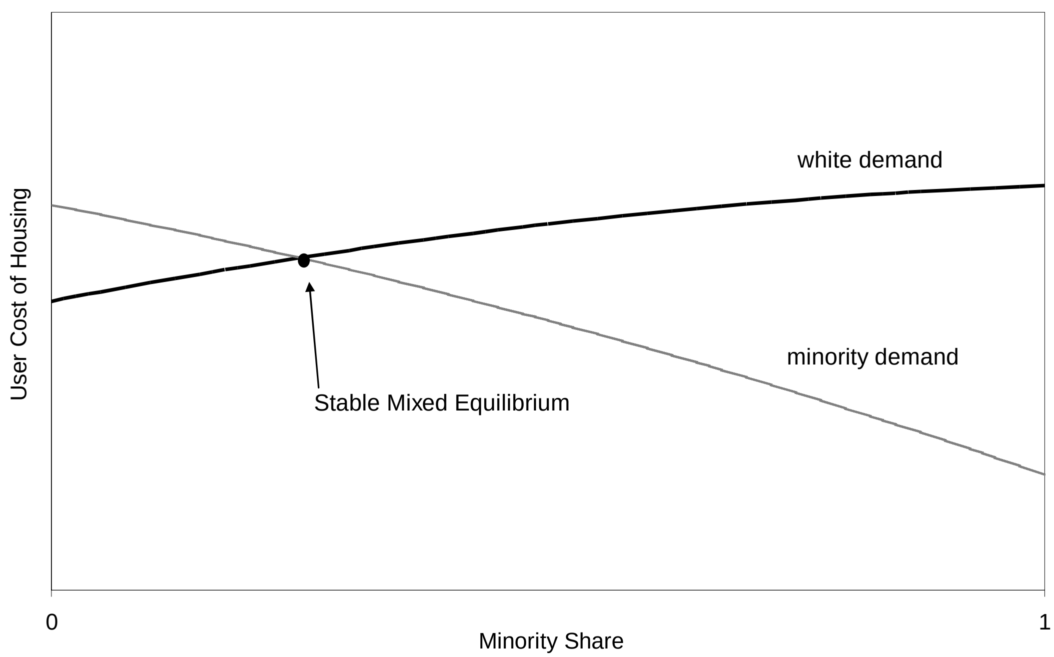


Figure 4: Graphical depictions of tipping

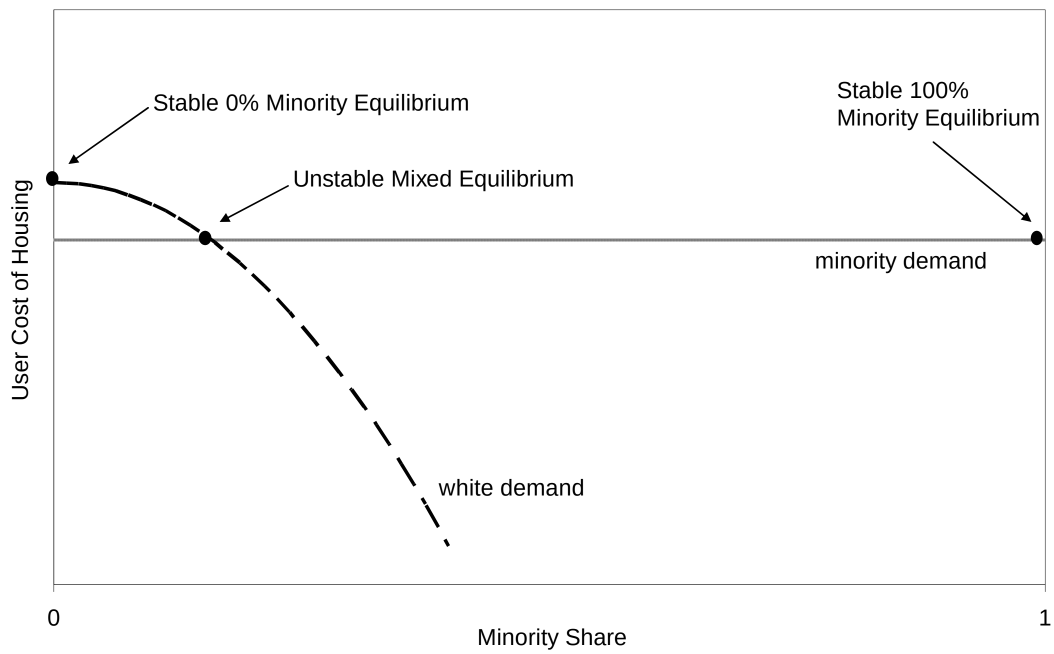
Panel A: No Neighborhood-specific Valuations or Social Interactions



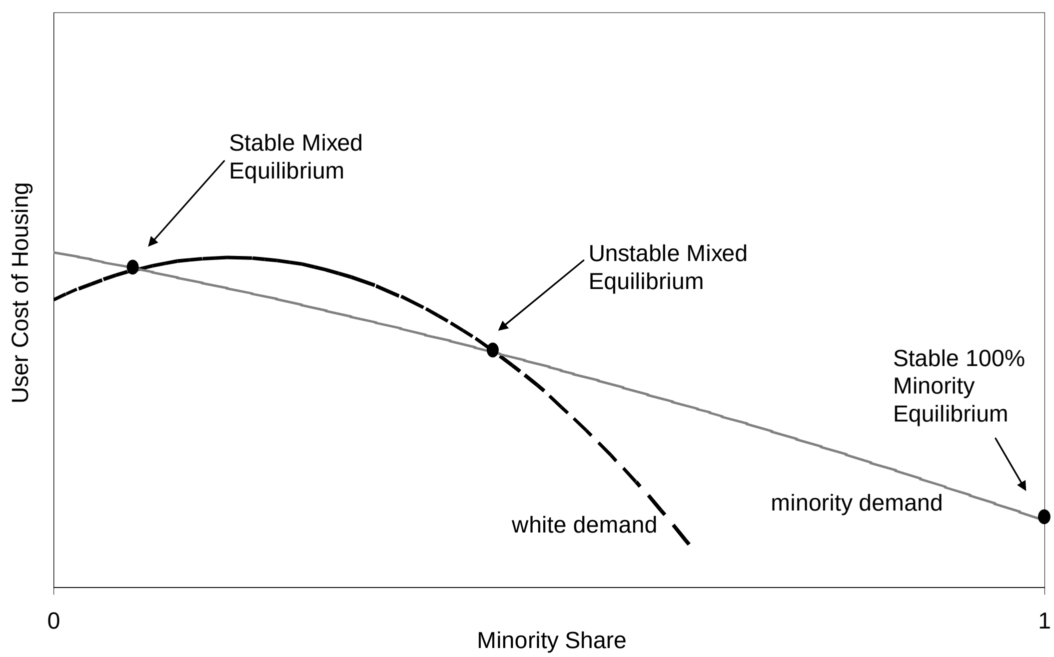
Panel B: Neighborhood-specific Valuations, No Social Interactions



Panel C: No Neighborhood-specific Valuation, Social Interaction in White Demand



Panel D: Neighborhood-specific Valuations and Social Interaction in White Demand



Panel E: Tipping Point in Neighborhood Minority Share

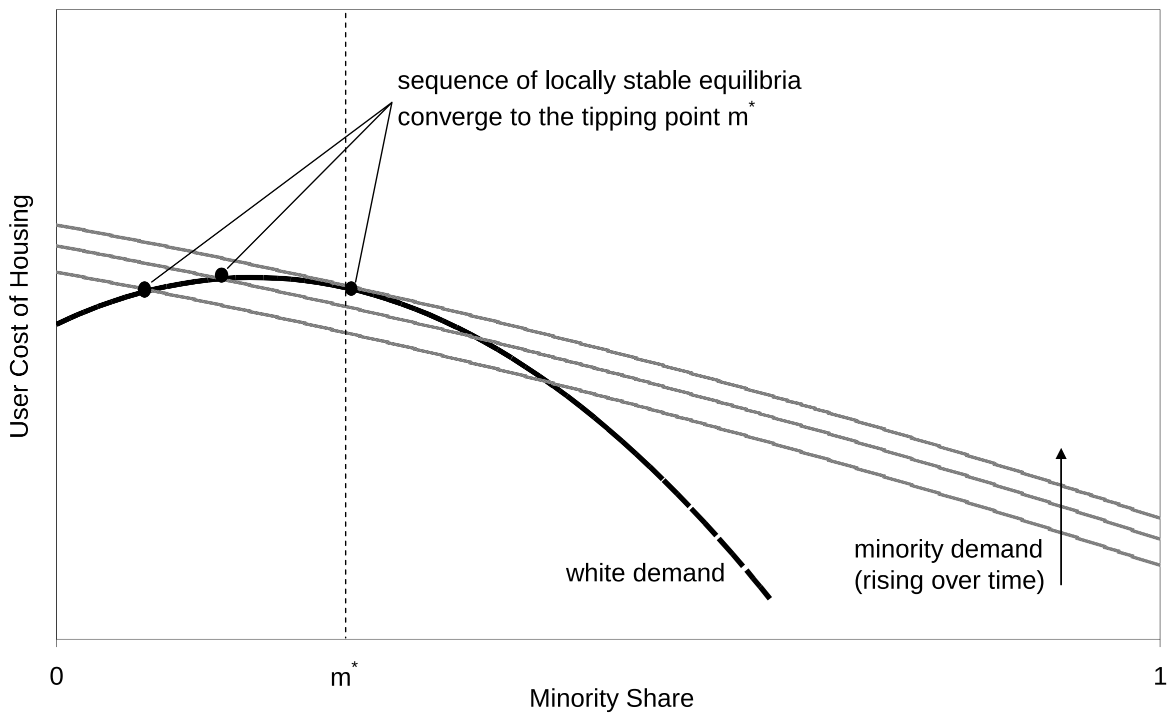


Figure 5: CDFs of minority shares of tracts near the 1970 tipping point in 1970, 1980, 1990, and 2000

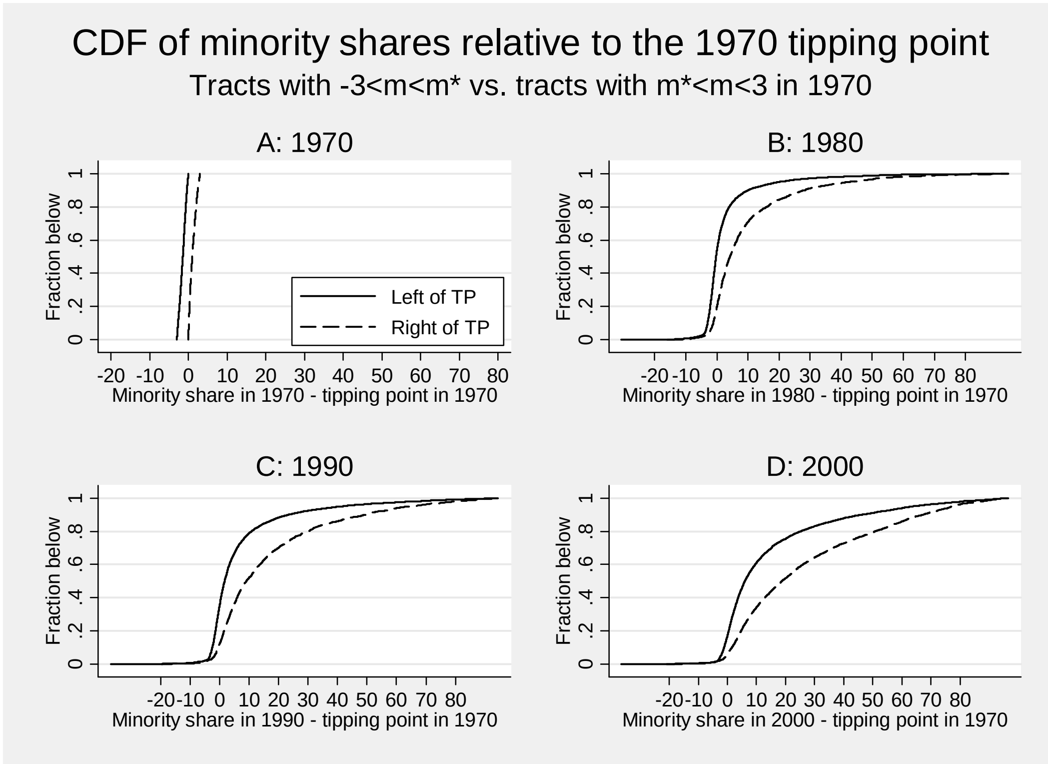


Figure 6: CDFs of minority shares of tracts near the 1970 tipping point in 1970, 1980, 1990, and 2000, MSAs with tipping points above 10%.

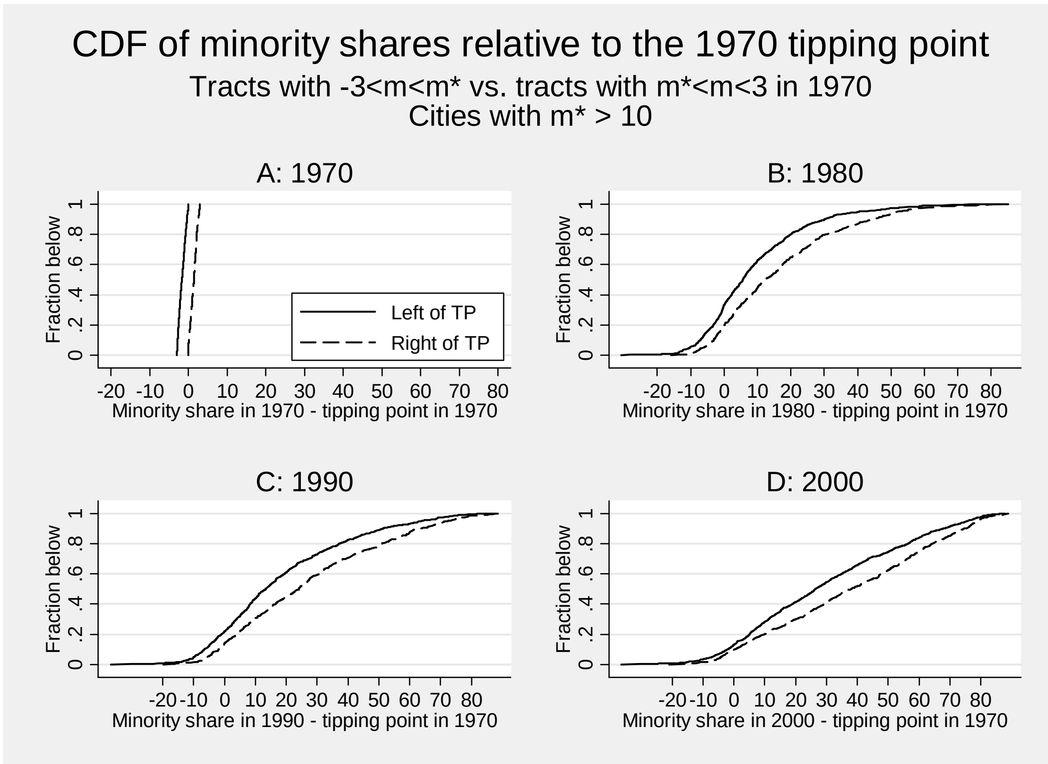


Figure 7: CDFs of tract minority population in 1980, 1990, and 2000 as a share of the 1970 minority population, tracts near the 1970 tipping point

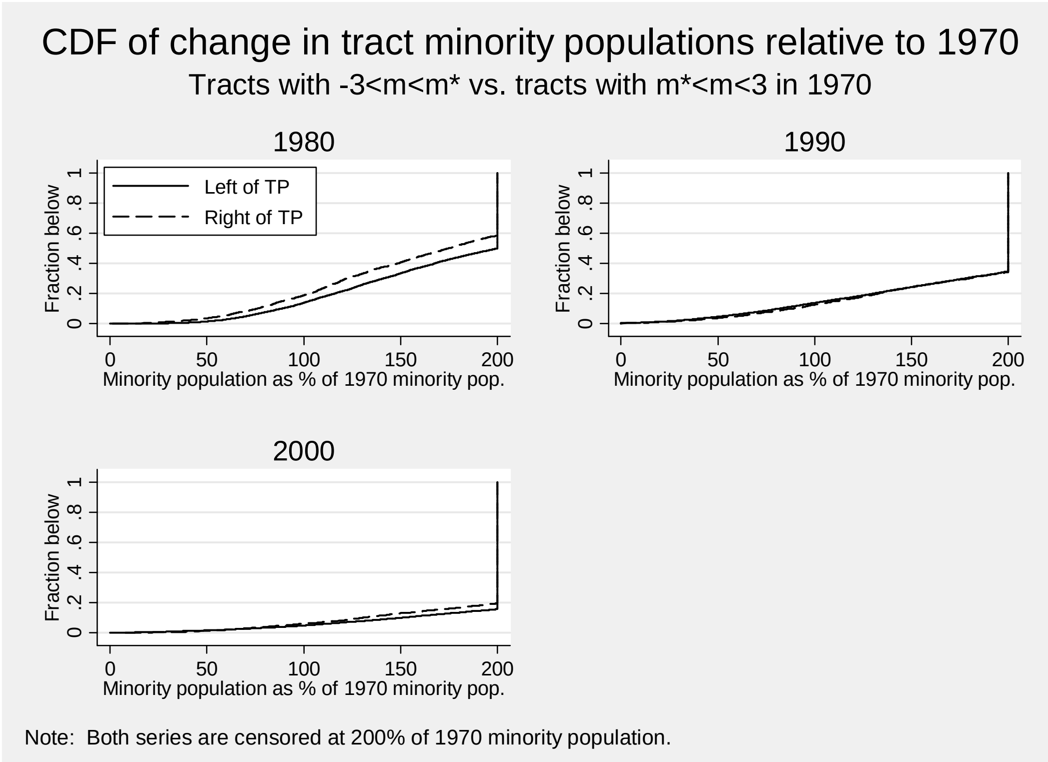


Table 1: Overview of candidate tipping points

	1970-1980	1980-1990	1990-2000
	(1)	(3)	(5)
Mean	11.87	13.53	14.46
SD	9.51	10.19	9.00
# of MSAs in sample	104	113	114
Correlations			
1970-1980	1.00		
1980-1990	0.46	1.00	
1990-2000	0.50	0.59	1.00