Social Interactions, Tipping, and Segregation

David Card, UC Berkeley

Introduction

Many choices and behaviors are affected by what other people do:

- -choice of Mac vs PC
- -smoke, drink, attend a party
- -live in a neighborhood

An interesting and important feature of choice models with “social interactions” is that there can be:

- -multiple equilibria
- -“tipping” – unstable or knife-edge equilibria

In contrast, in conventional situations where each person makes a decision independent of what her peers do:

- -there is a unique “equilibrium”
- -the equilbrium changes smoothly

In this lecture we will discuss simple models of:

- -social interactions in individual choice
- -social interactions in a "market" setting

We will then look at some data on neighborhood segregation in major cities, and ask whether we see evidence of a particular kind of "tipping." (The data are drawn from a recent paper by D.Card, A. Mas, and J. Rothstein).

I will argue that in most cities there is a critical threshold – "the tipping point" – such that if the minority share in a neighborhood exceeds this level, nearly all the whites leave.

I. Individual Choice

Consider the choice of a Mac or a PC. Assume they cost the same, and that everyone has to have either one or the other. Person i will get utility

$$u_i(0) = \epsilon_i$$

from owning a Mac. She will get utility

$$u_i(1) = \alpha + \beta p$$

from owning a PC, where p is the fraction of her friends that have a PC, and $\beta>0$ reflects the social interaction effect.

She buys a PC if $u_i(1) > u_i(0)$, or if $\epsilon_i < \alpha + \beta p$.

If a fraction p of people already own a PC, then everyone with $\epsilon_i < \alpha + \beta p$ will buy a PC. The rest buy a Mac.

If no one else has a PC, the cut-off is

$$\epsilon_i < \alpha$$

Suppose that the lowest value of ϵ_i is ϵ_{Low} . If $\alpha < \epsilon_{Low}$ then when p=0, there is no one in the entire population who would buy a PC. But if p>0, there will be some who want to get a PC.

So the fraction of people who want a PC depends on how many people already have a PC. This can lead to multiple equilibria.

Call $F(\epsilon)$ the "distribution function" of ϵ_i. For any value ϵ

$$F(\epsilon) = \text{fraction with } \epsilon_i \leq \epsilon \text{ .}$$

We'll assume F is "S-shaped" as it is if the distribution of ϵ_i is "bell shaped".

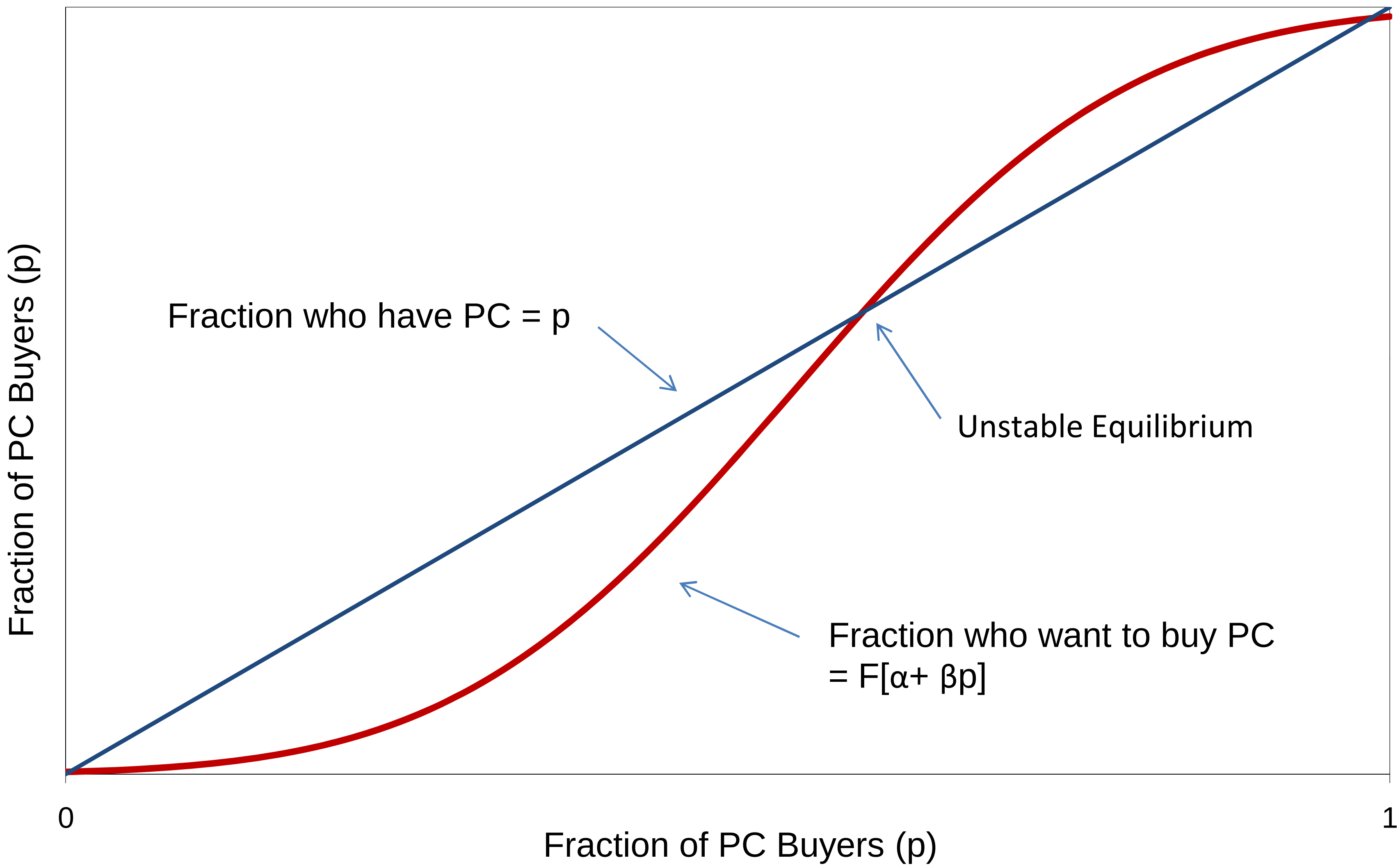
At an equilibrium:

$$p = F(\alpha + \beta p) = \text{fraction of people with } \epsilon_i < \alpha + \beta p$$

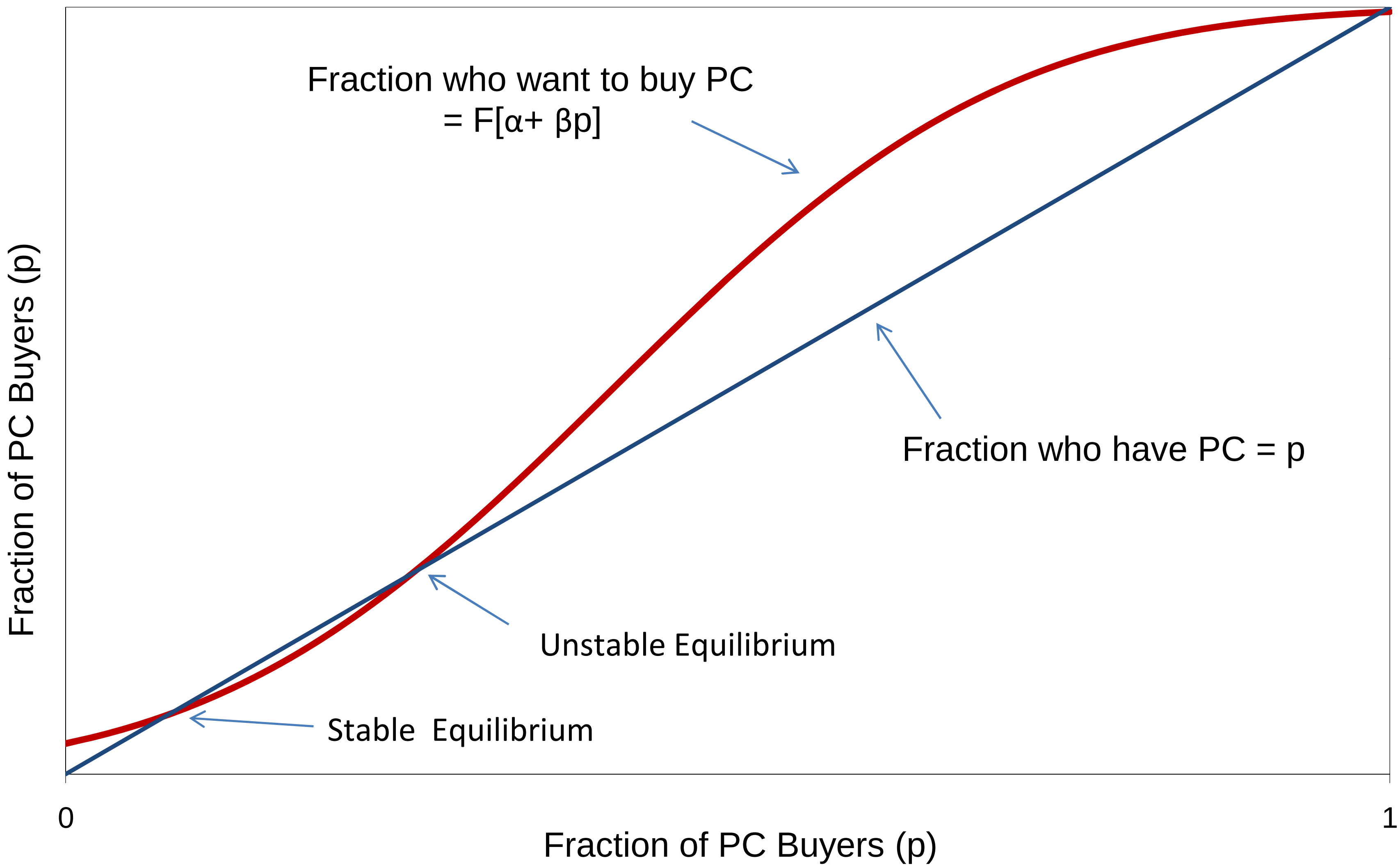
Think of p as the fraction of people who have a PC, and $F(\alpha + \beta p)$ as the fraction who want a PC, given p.

The next slides give examples assuming F is S-shaped.

Determination of Equilibrium for p=Fraction of PC Buyers



Determination of Equilibrium for p=Fraction of PC Buyers



II. Market Choice

Now we'll look at a market version of social interactions. Assume we have a neighborhood with 100 houses, all identical (Levittown), and two groups of buyers: W and M

If we want to sell a fraction $N^w/100$ of the houses to W's, the price has to be

$$p = b^w(N^w/100)$$

This is W's "inverse demand" function giving p as a function of the fraction of homes sold to W's. b^w is negatively sloped.

There is also a function for the price if we want to sell a fraction $N^m/100$ houses to M's, $b^m(N^m/100)$, that is negatively sloped in $N^m/100$.

In an equilibrium, W and M pay the same price and

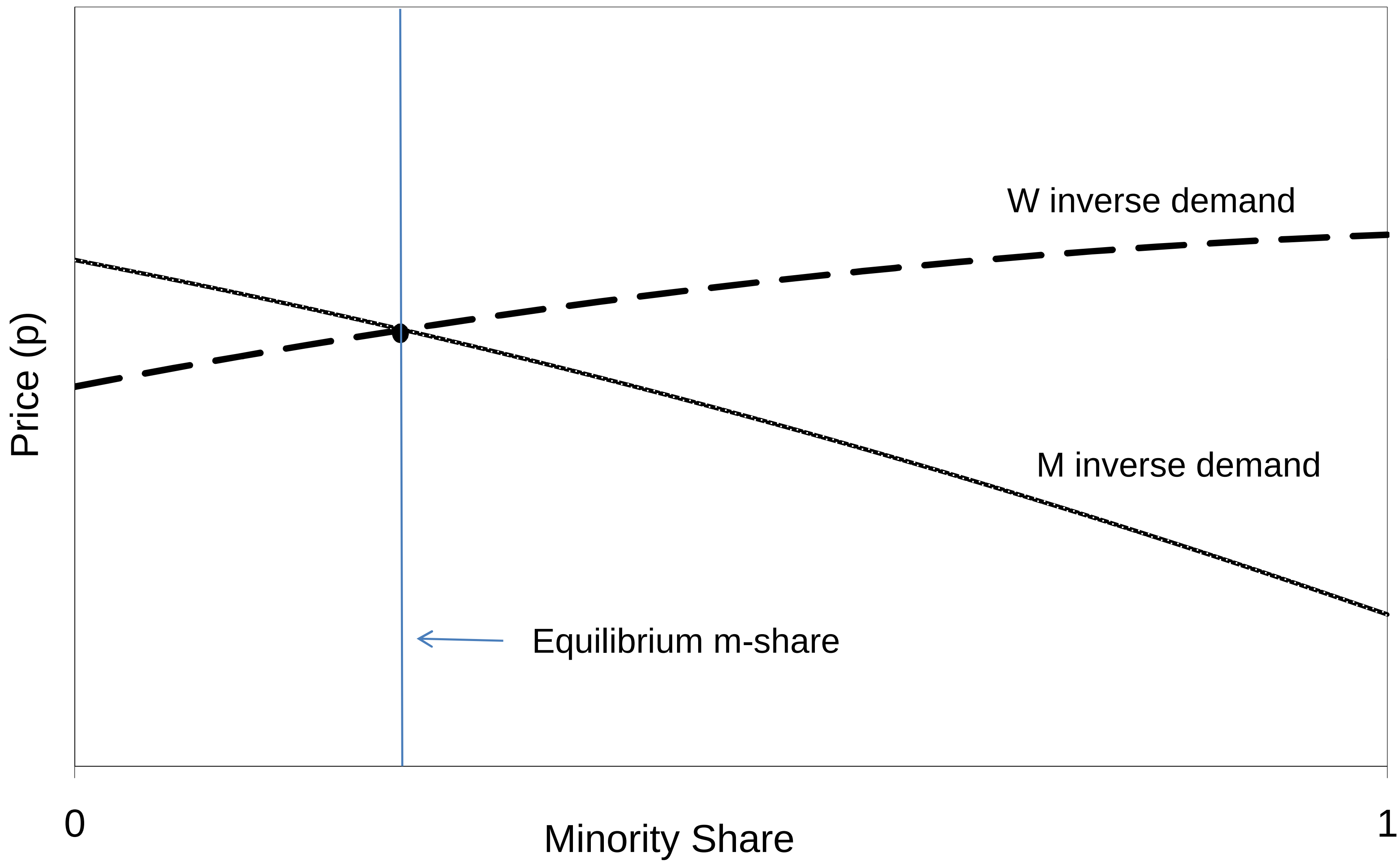
$$N^w/100 + N^m/100 = 1.$$

So we can write $N^w/100 = 1 - m$, where $m=N^m/100$ is the "minority share" in the neighborhood. At a neighborhood equilibrium we must have

$$b^w(1 - m) = b^m(m)$$

The graph is shown on the next slide. We graph b^m as a function of m, reading from left (m=0) to right (m=1) this is downward sloping. For W's we read from left (m=1, so no W's in the neighborhood) to right.

Market Equilibrium (no social interactions)



Now lets introduce a social interaction effect. Suppose that the price that W's will pay depends on how many units they buy, and on the m-share:

$$p = b^w(N^w/100, m)$$

Again, $\partial b^w/\partial N^w < 0$ if you have to lower the price (holding constant m) to get W's to fill all the houses. Call this the "demand effect".

The effect of m is the "social interaction" and depends on W's preferences. Enlightened W's might prefer a neighborhood with higher m, at least up to a point. But eventually, we might expect that b^w will fall if m becomes "too big".

Again, in equilibrium we have to fill all the houses, so

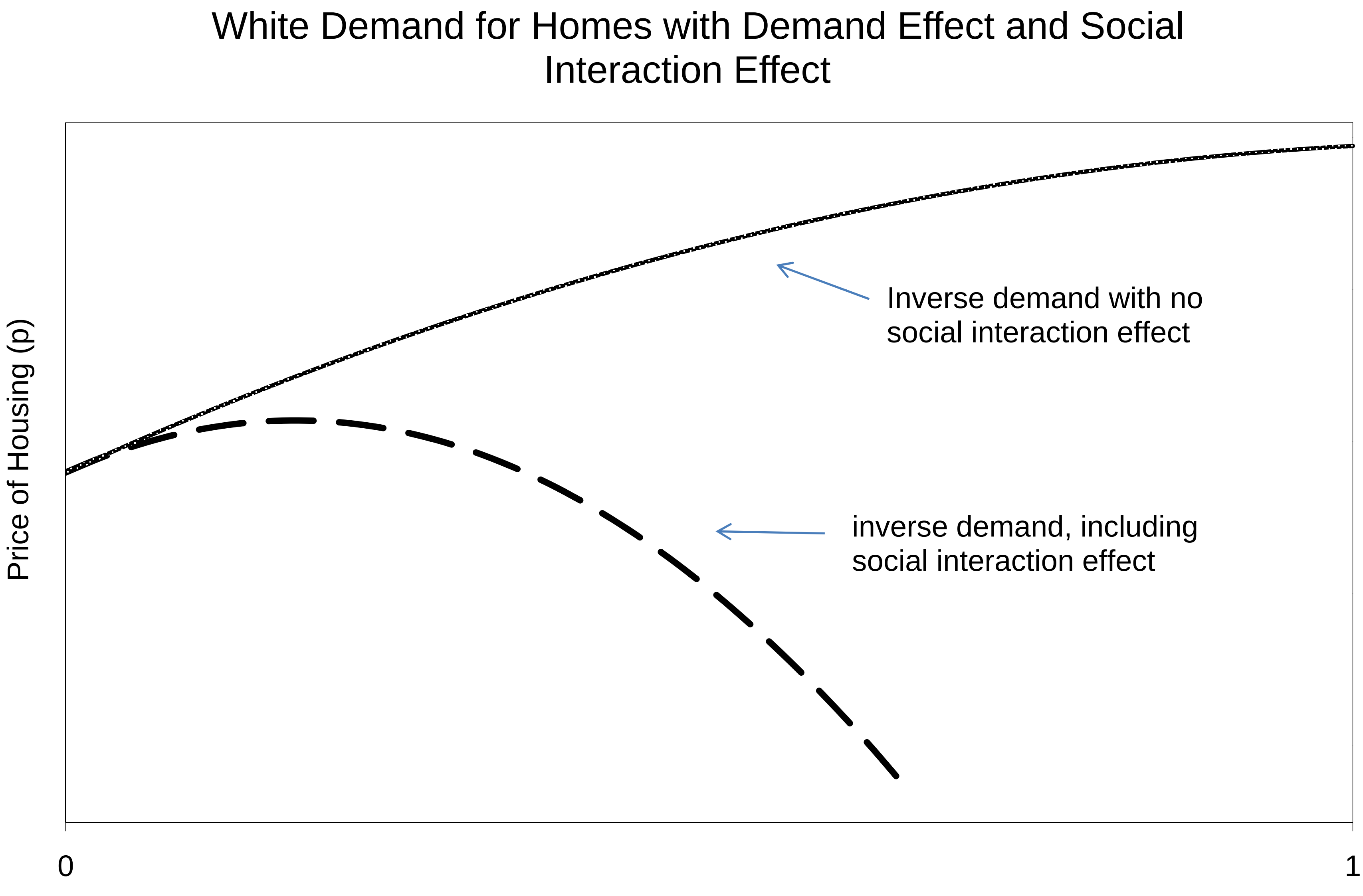
$$N^w/100 = 1 - m \ .$$

Thus we can write:

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

As we increase m we get 2 effects. First, the "demand" effect says b^w will rise, because now <u>fewer</u> houses are sold to W's. But the "social interaction" effect adds a second dimension.

We could have a picture like the next slide:

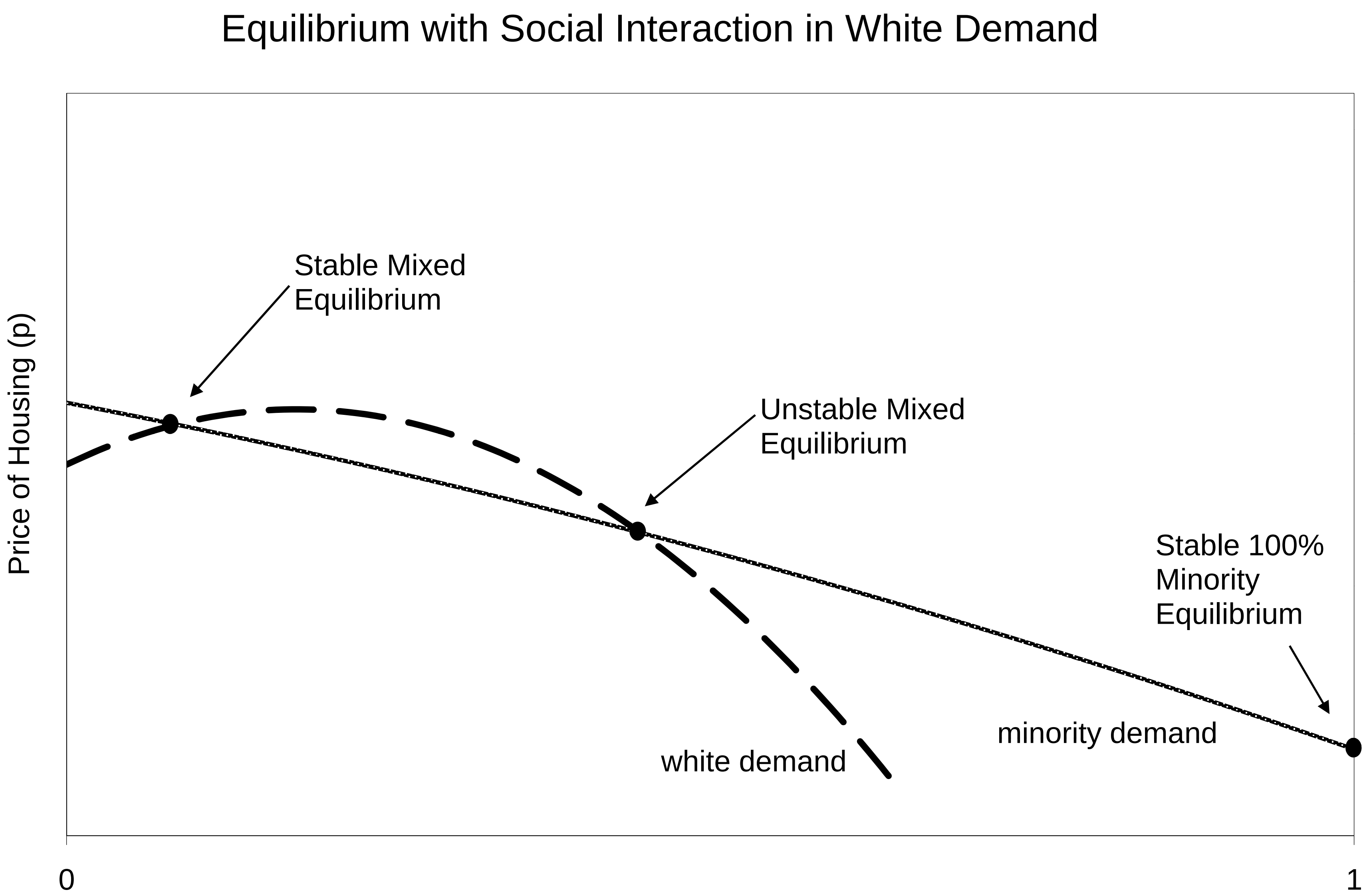


White Demand for Homes with Demand Effect and Social Interaction Effect
Price of Housing (p)
Inverse demand with no social interaction effect
inverse demand, including social interaction effect
0
1

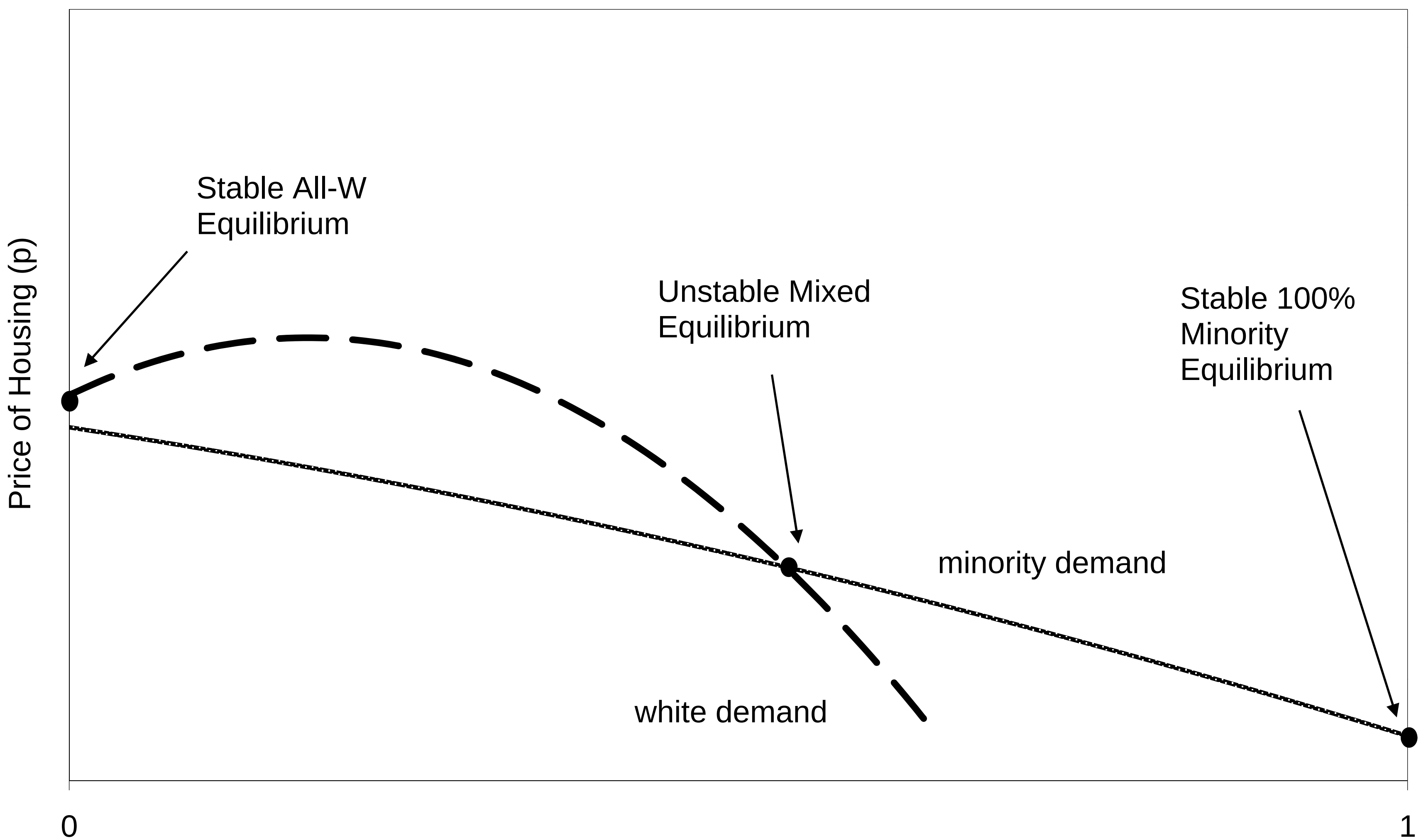
Now lets look at the equilibrium, where W's and M's pay the same price and all homes are occupied:

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

The next slides shows that this can have multiple solutions (or solutions at m=0 or m=1 only). The reason is that now b^w is highly non-linear, first rising with m, then falling.

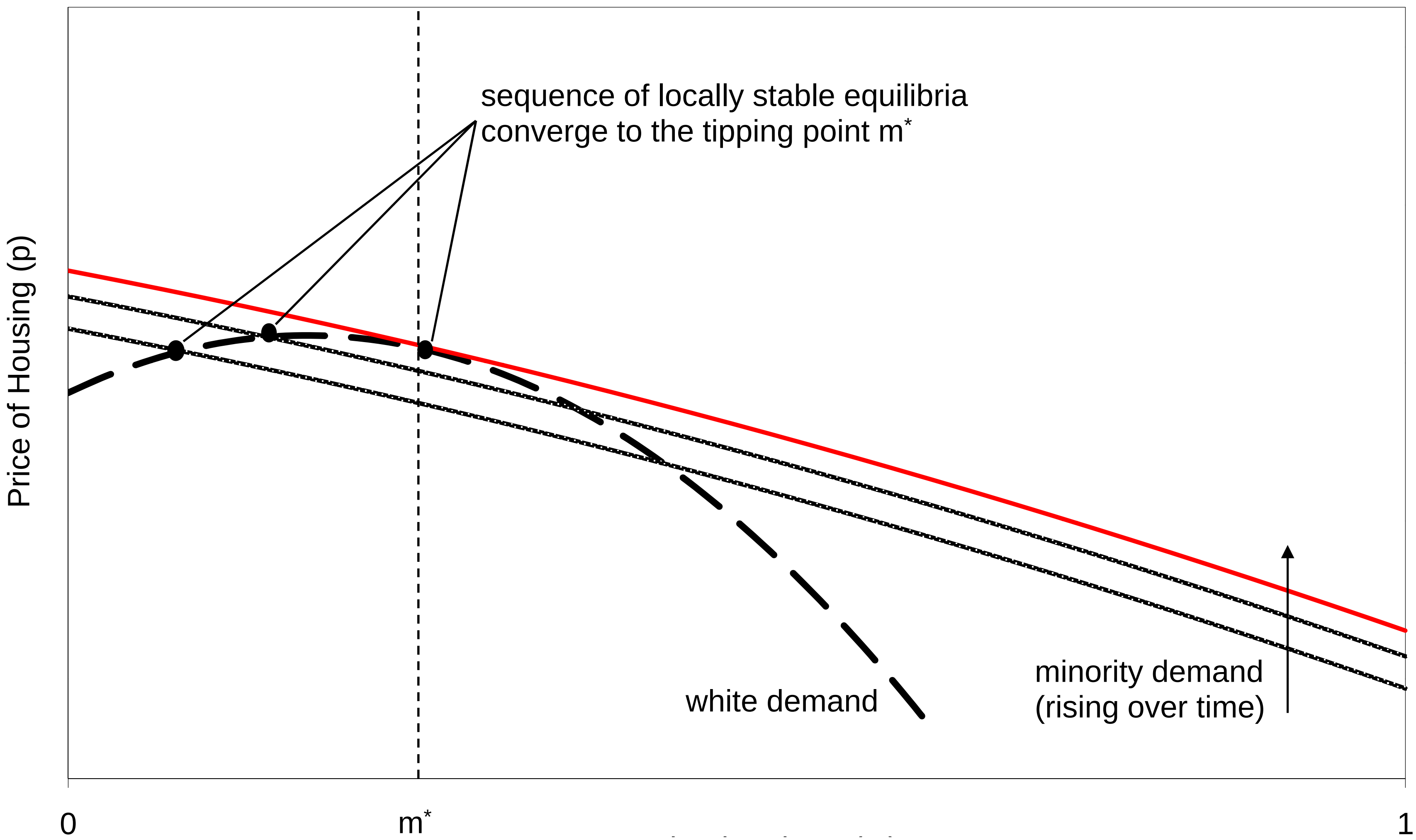

Equilibrium with Social Interaction in White Demand
Price of Housing (p)
Stable Mixed
Equilibrium
Unstable Mixed
Equilibrium
Stable 100%
Minority
Equilibrium
minority demand
white demand
0
1

Equilibrium with Social Interaction in White Demand



Now lets consider a “dynamic” city, where M’s are gradually becoming richer. This will cause the b^m function to shift vertically. Starting from an in initial 100% W situation, eventually M’s will start to move in. At first this is stable, but eventually the b^m function “pulls away” and once this happens, all the W’s leave.

Illustration of Tipping Point in Neighborhood Minority Share

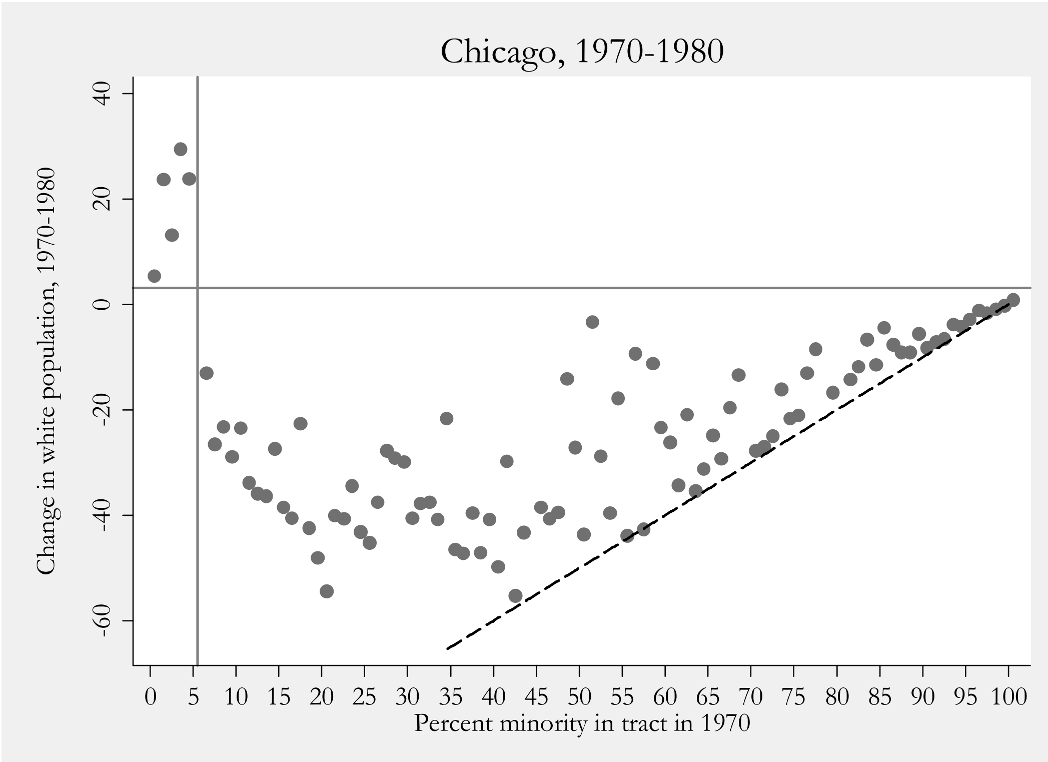


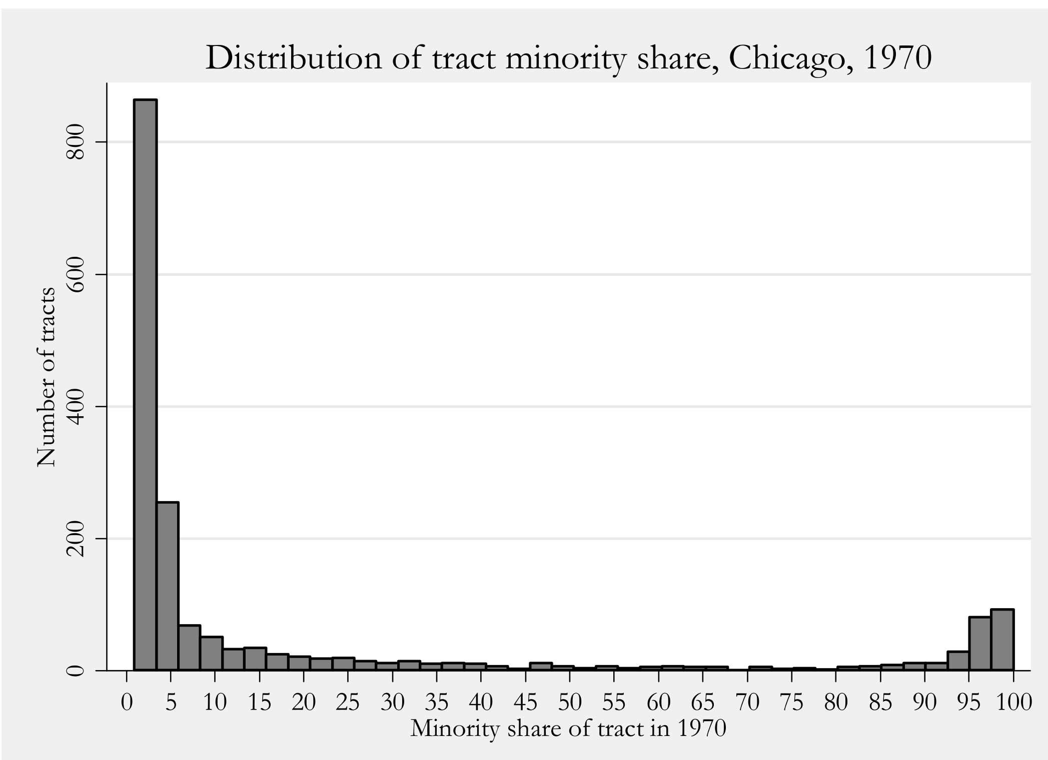
What are the implications?

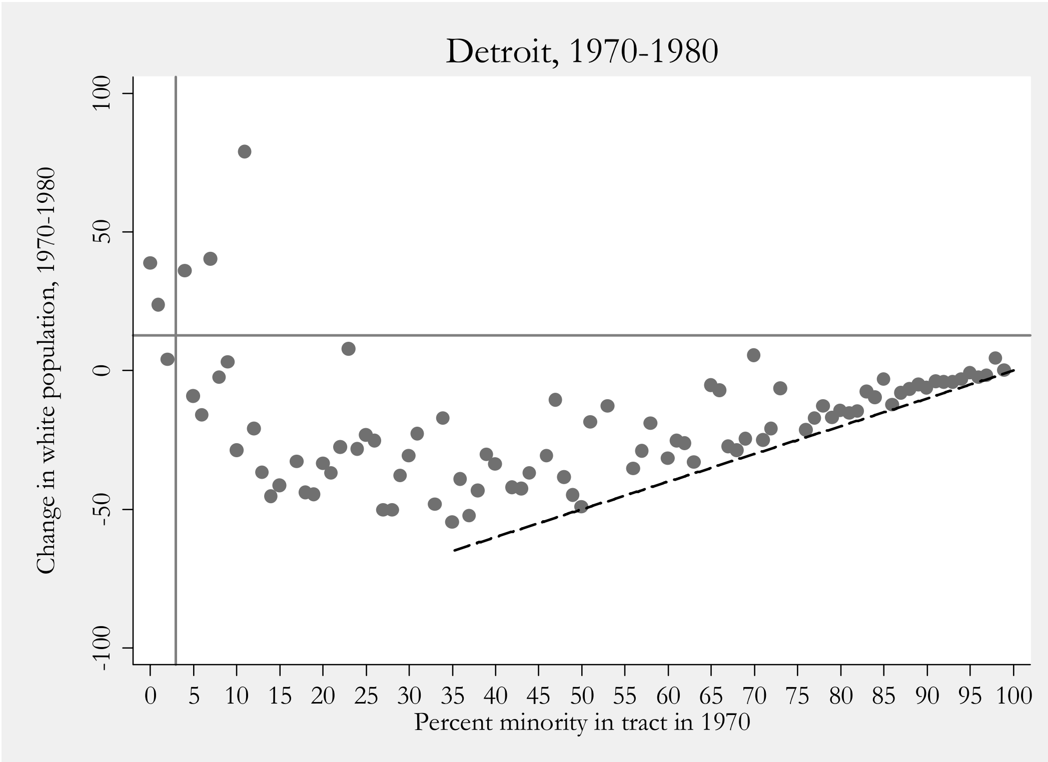
If the tipping point m^* is (roughly) constant for all the neighborhoods in a city, then we will see some stable neighborhoods with $m<m^*$. We may see a few with m “close to m^*. But once a neighborhood gets too close, it changes rapidly to 100% m-share.

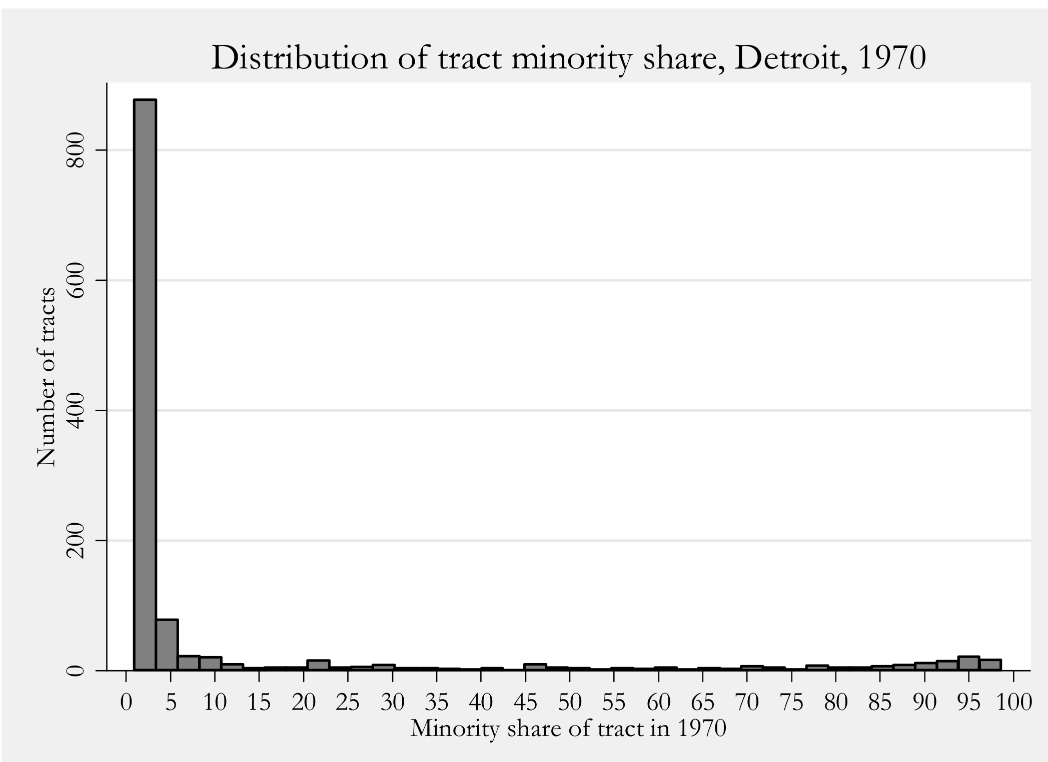
Data: Decennial Censuses

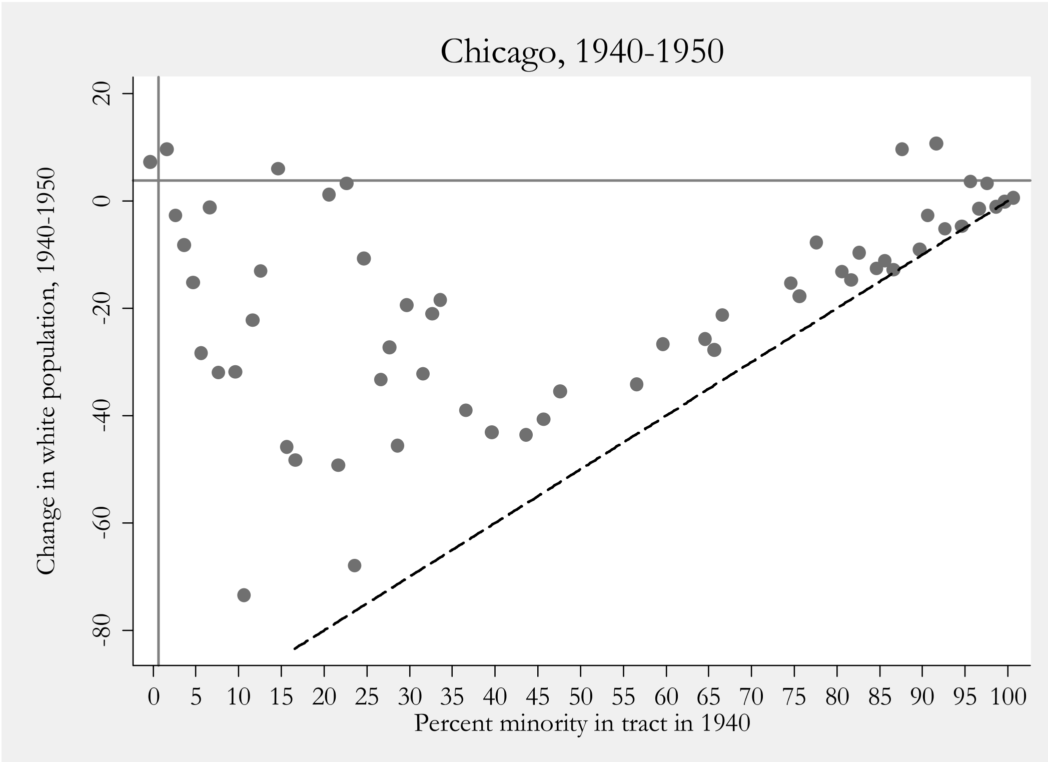
-each city divided into “tracts”
-track tracts over time, looking at how white population change from one census to the next (10 years later) varies with initial m-share
-look for “discontinuity” at some (relatively low) share


Chicago, 1970-1980
Change in white population, 1970-1980
-60
-40
-20
0
20
40
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent minority in tract in 1970

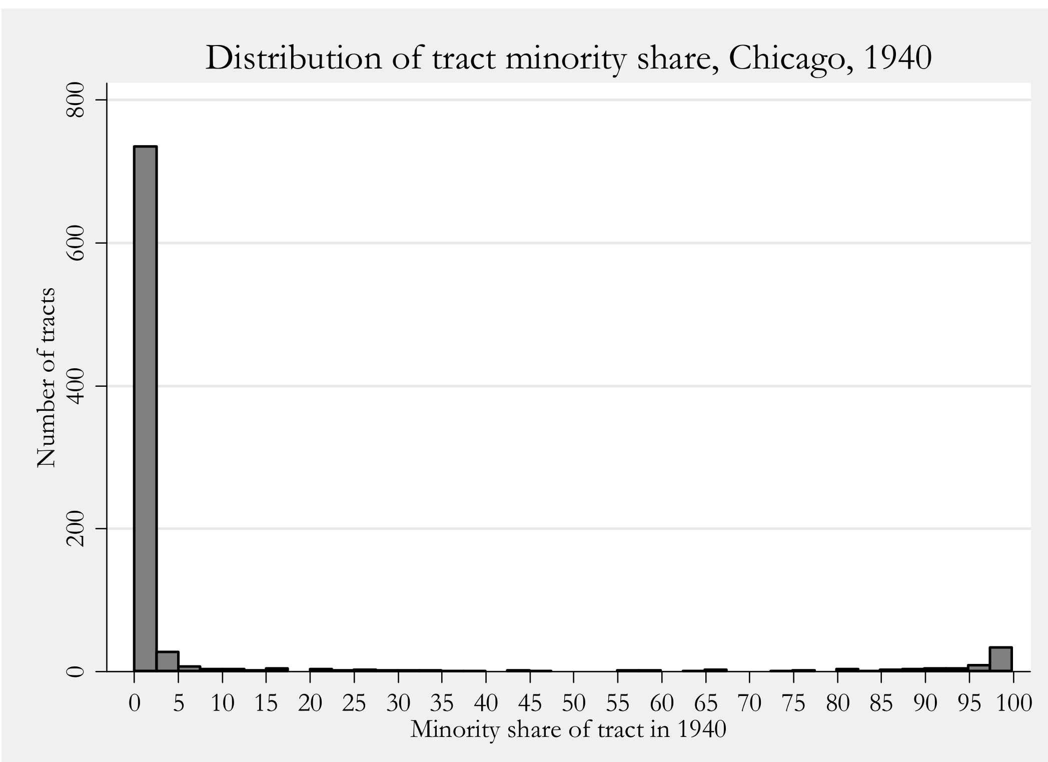

Distribution of tract minority share, Chicago, 1970
Number of tracts
0
200
400
600
800
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Minority share of tract in 1970


Detroit, 1970-1980
Change in white population, 1970-1980
100
50
0
-50
-100
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent minority in tract in 1970

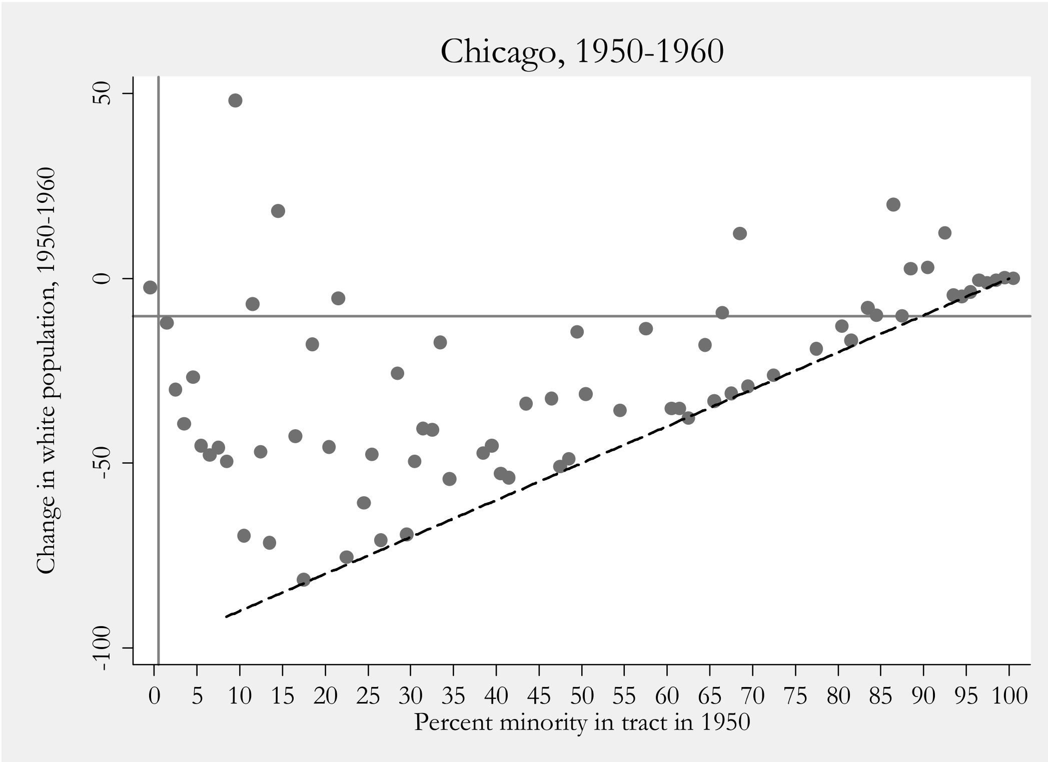

Distribution of tract minority share, Detroit, 1970
Number of tracts
800
600
400
200
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Minority share of tract in 1970

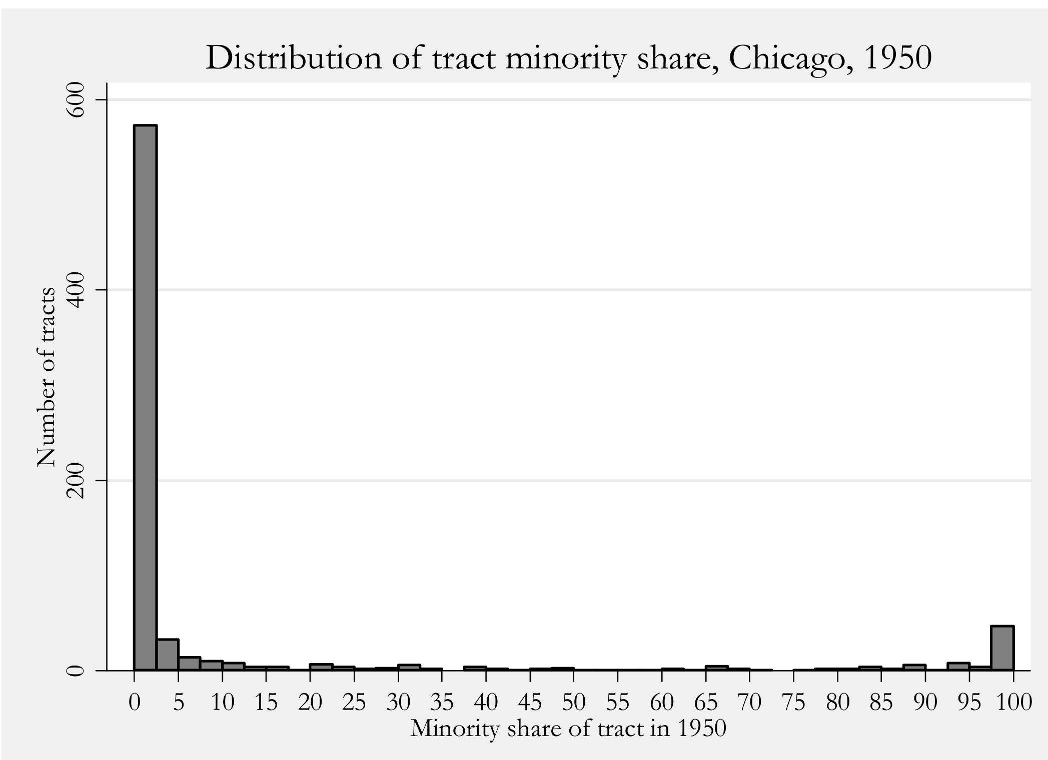


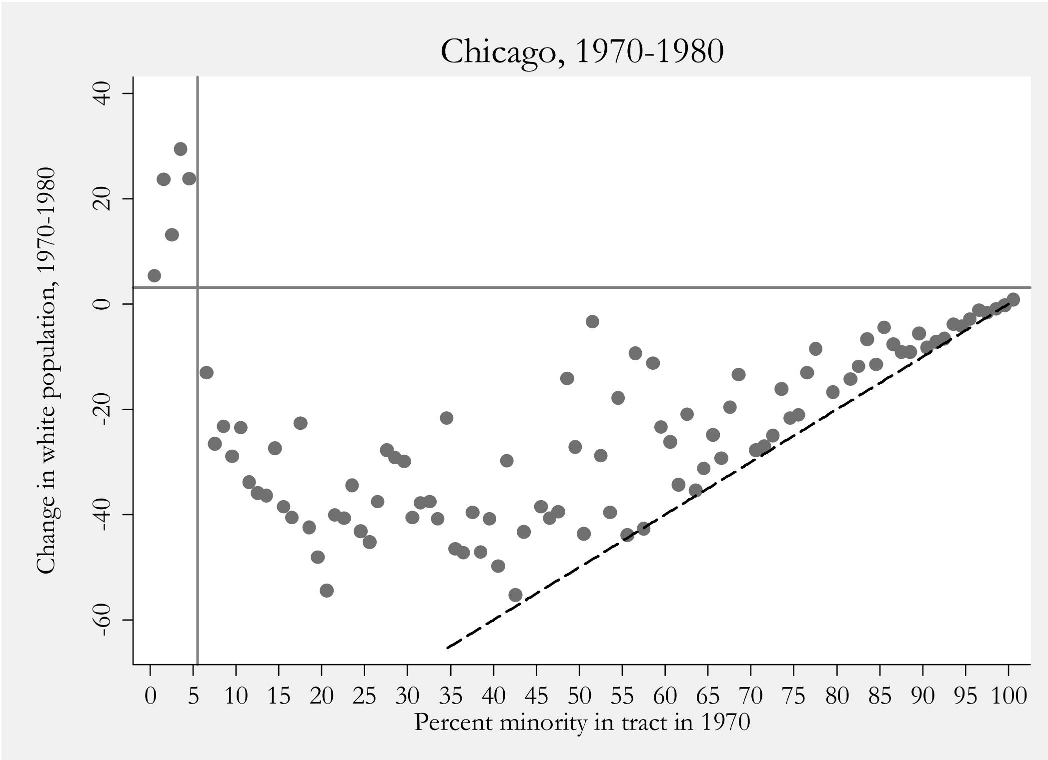
Chicago, 1940-1950
Change in white population, 1940-1950
Percent minority in tract in 1940
20
0
-20
-40
-60
-80
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

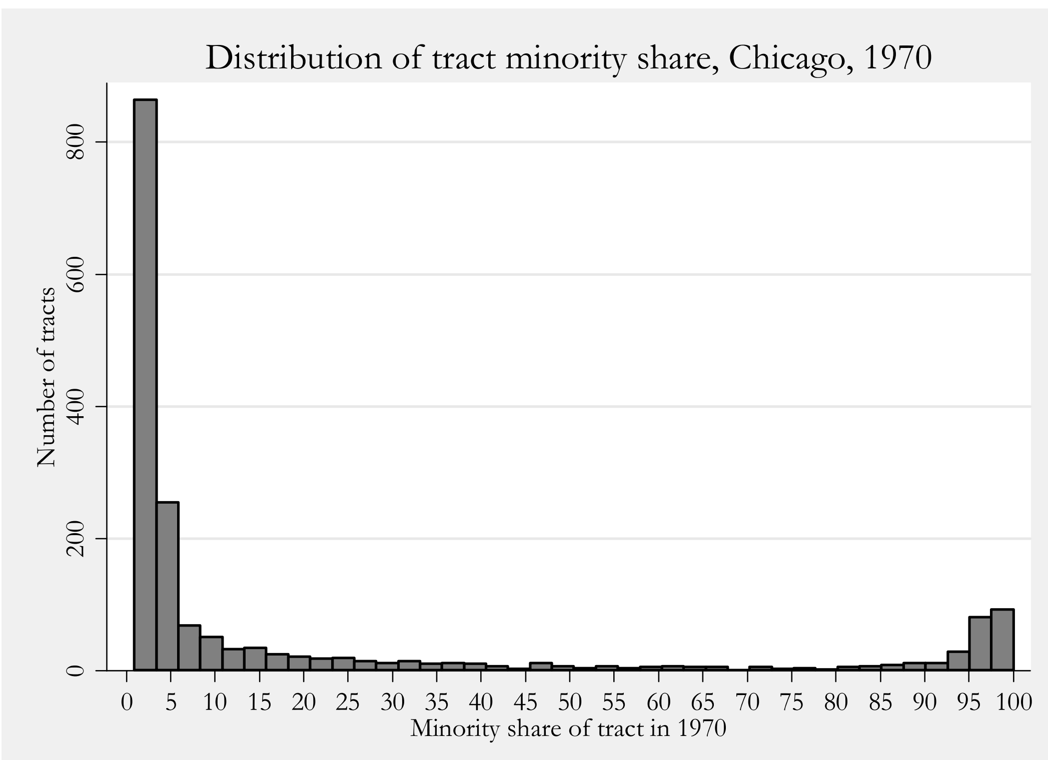


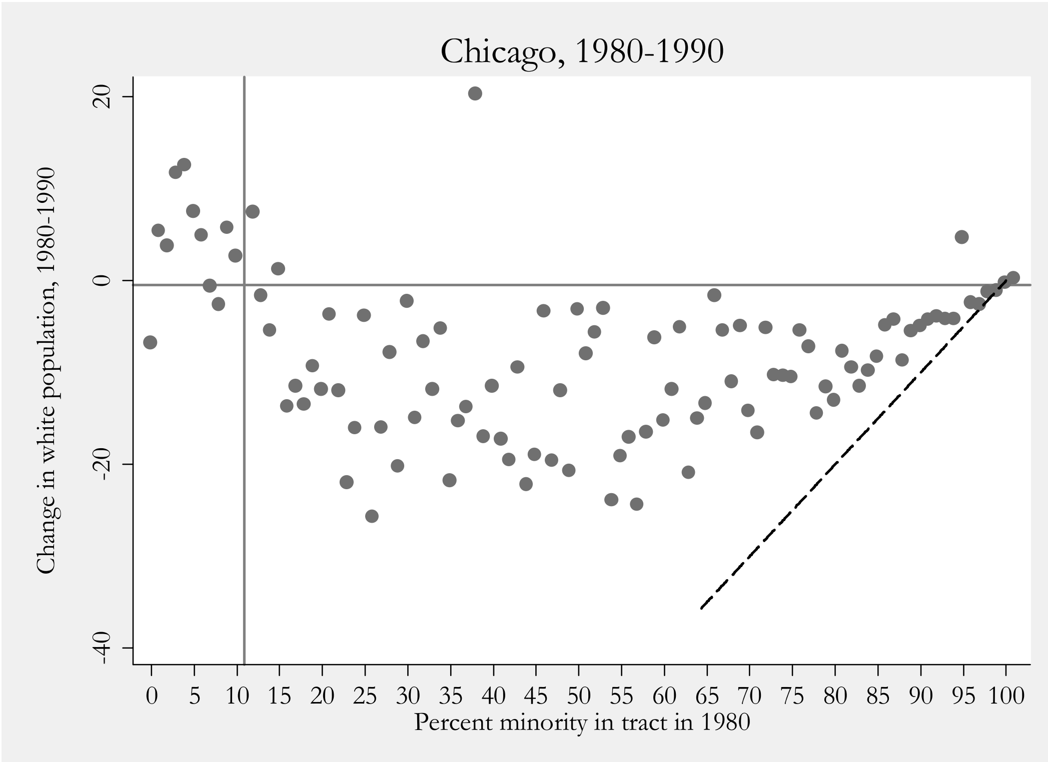
Distribution of tract minority share, Chicago, 1940
Number of tracts
Minority share of tract in 1940
800
600
400
200
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

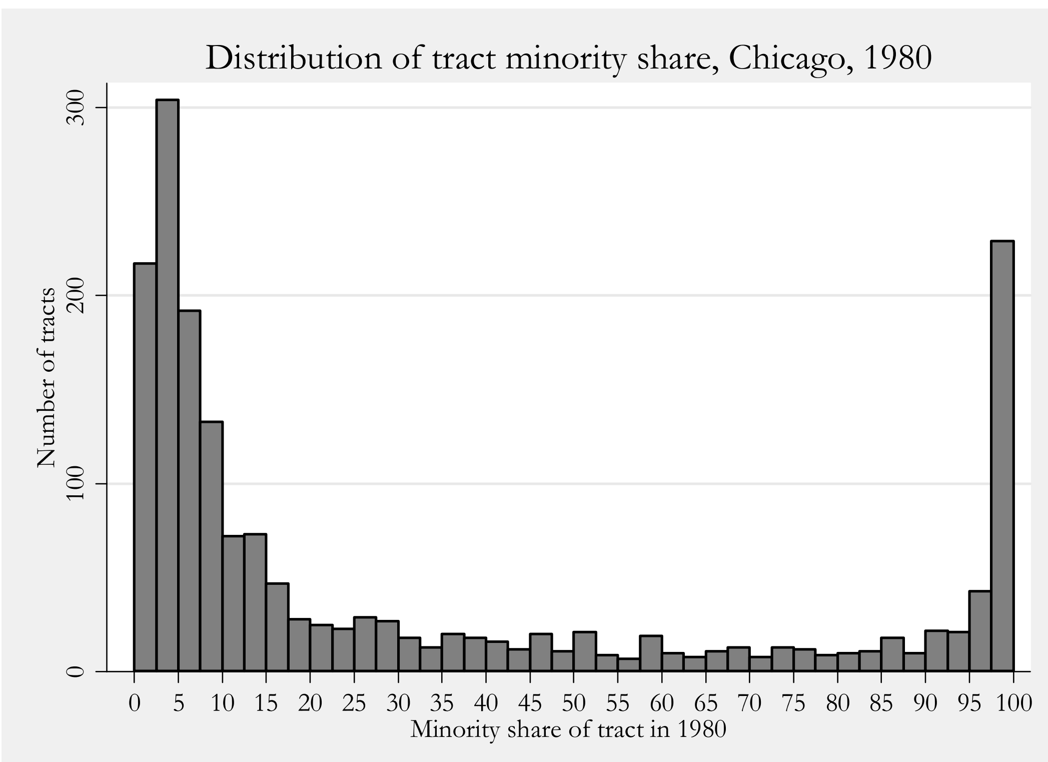

Chicago, 1950-1960
Change in white population, 1950-1960
50
0
-50
-100
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent minority in tract in 1950

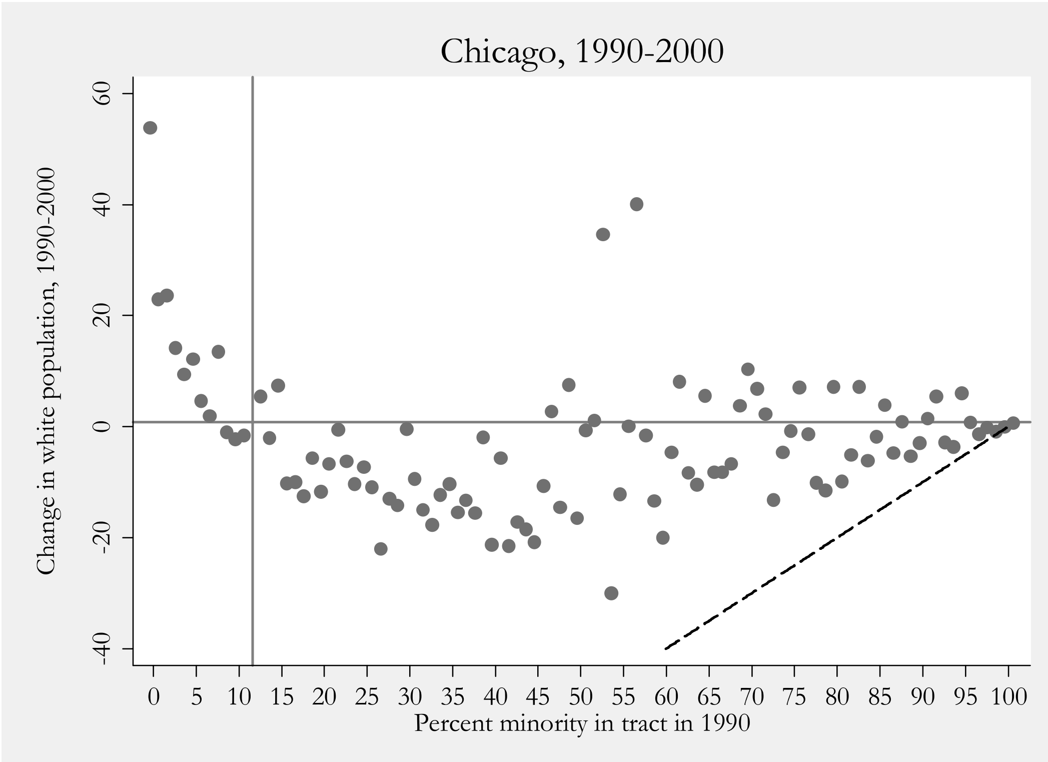

Distribution of tract minority share, Chicago, 1950
Number of tracts
600
400
200
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Minority share of tract in 1950


Chicago, 1970-1980
Change in white population, 1970-1980
-60
-40
-20
0
20
40
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent minority in tract in 1970

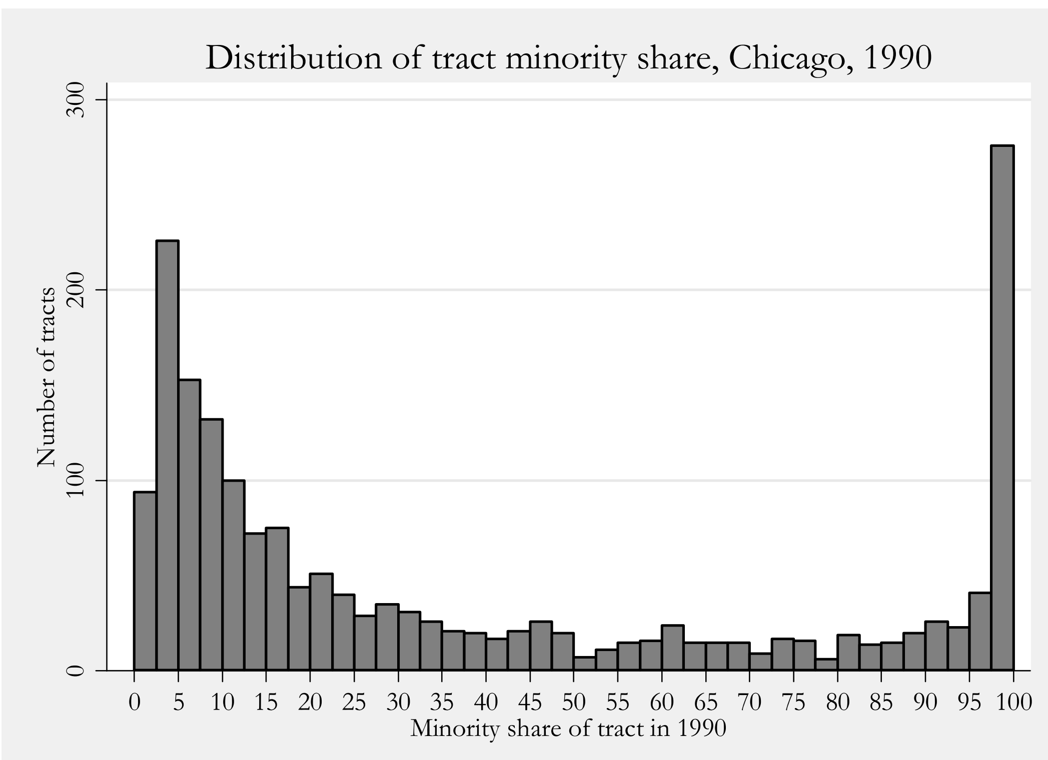

Distribution of tract minority share, Chicago, 1970
Number of tracts
0
200
400
600
800
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Minority share of tract in 1970


Chicago, 1980-1990
Change in white population, 1980-1990
20
0
-20
-40
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent minority in tract in 1980


Distribution of tract minority share, Chicago, 1980
Number of tracts
300
200
100
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Minority share of tract in 1980



Chicago, 1990-2000
Change in white population, 1990-2000
60
40
20
0
-20
-40
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent minority in tract in 1990



Distribution of tract minority share, Chicago, 1990
Number of tracts
300
200
100
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Minority share of tract in 1990