

# Dynamic Neighborhood Taxonomy

*A Project of*

**Living Cities**

Presentation by

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RW Ventures, LLC

# Agenda

**DNT: Project Overview**

**Measuring Change: the RSI**

**Analytic Applications: Where to Invest; Pace,  
Degree of Change; Role of Region; Drivers**

**Evolution: Discovering Patterns of Change**

**Developing Tools: from Diagnostics to Investment**



# About Living Cities



“A partnership of financial institutions, national foundations and federal government agencies that invest capital, time and organizational leadership to advance America’s urban neighborhoods.”

## Living Cities Partners:

AXA Community Investment Program  
Bank of America  
The Annie E. Casey Foundation  
J.P. Morgan Chase & Company  
Deutsche Bank  
Fannie Mae Foundation  
Ford Foundation  
Bill & Melinda Gates Foundation

Robert Wood Johnson Foundation  
John S. and James L. Knight Foundation  
John D. and Catherine T. MacArthur Foundation  
The McKnight Foundation  
MetLife, Inc.  
Prudential Financial  
The Rockefeller Foundation  
United States Department of Housing & Urban Development



# Partners and Advisors



**... And Over 70 Advisors including Practitioners, Researchers, Funders, Civic Leaders and Government Officials**



# We Know Where We Want to Go...

Common Goal:



**BUILDING HEALTHIER COMMUNITIES**

# The Challenge: Scarce Resources, Many Options

- Community-Based Organizations: select interventions, identify assets and attract investment
- Governments: tailor policy and interventions
- Businesses: identify untapped neighborhood markets
- Foundations: evaluate interventions

**Need for Relevant, Timely and  
Accessible Information Resources**



# Information Resources



**Data**

**Increasingly available,  
but more progress to be made**

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**Knowledge**

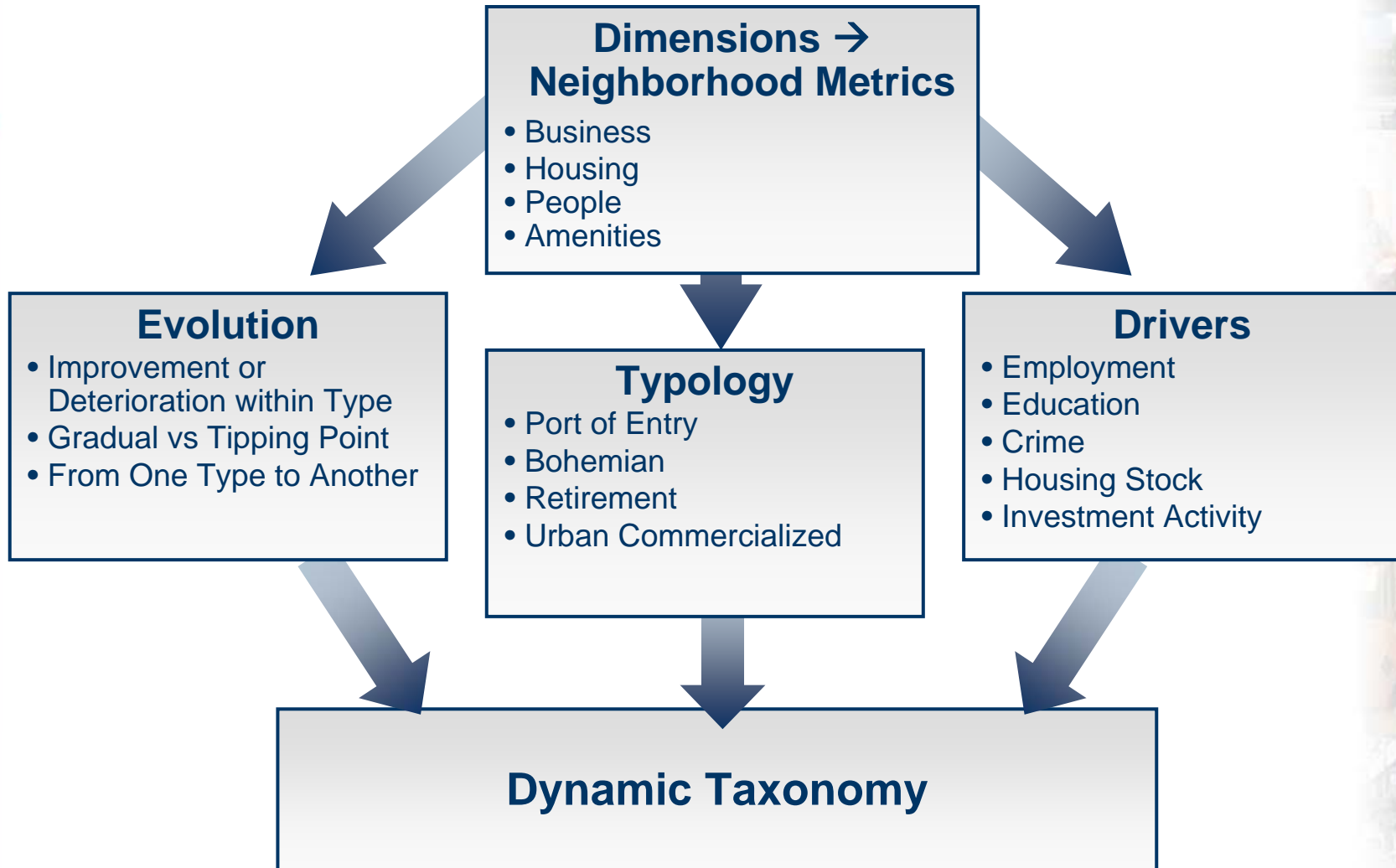
**Gap between  
practitioners and academics:  
need “Clinical Economics”  
(Sachs)**

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**Tools**

**Few decision systems for  
neighborhood practitioners  
and investors**

# Comprehensive Neighborhood Taxonomy





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**Measuring Change: the RSI**

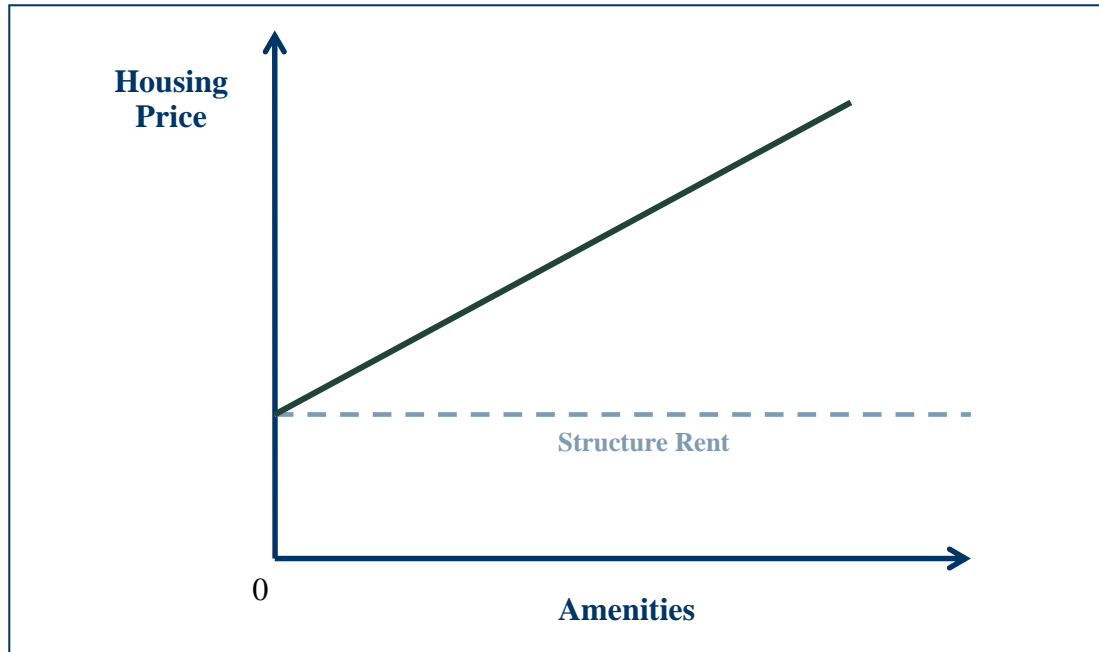
Analytic Applications: Where to Invest; Pace,  
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# Theoretical Framework



- Use Demand for Housing as Proxy for Neighborhood Health
- Look at Housing Values to Capture Neighborhood Amenities
- Look at Change in Quantity of Housing to Account for Supply Effects



# The Challenge: Finding a Metric that Works

## Issues:

- Measure change in prices controlling for change in quality of the housing stock
- Estimate at very small level of geography
- Track continuous change over time

## Solutions:

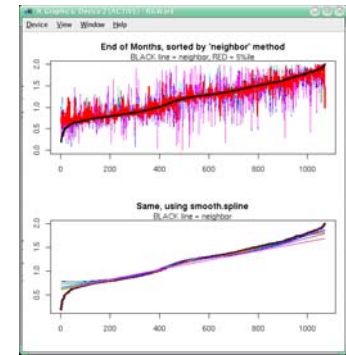
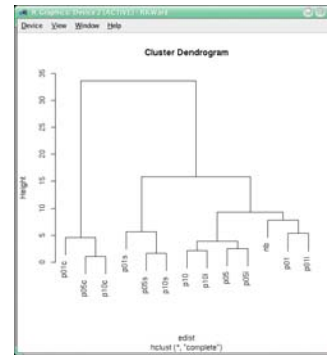
- Repeat Sales to Control for Changes in Neighborhood Housing Stock
- Spatial Smoothing: Locally Weighted Regression to account for “fluid” neighborhood boundaries and address sample size
- Temporal Smoothing: Fourier expansions to track change over time



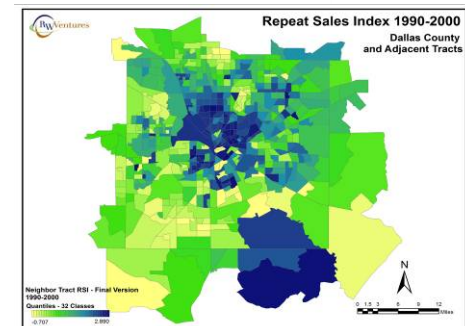
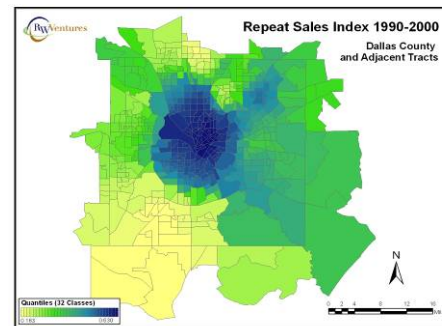
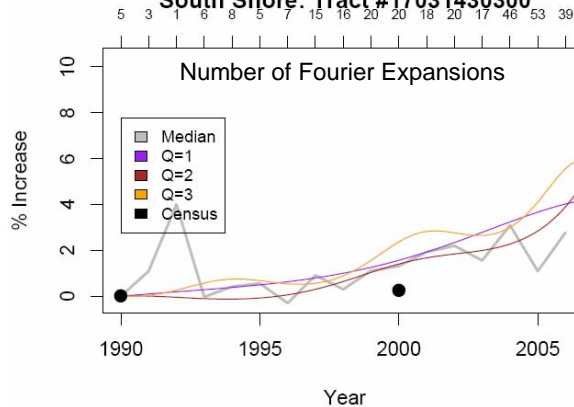
# Developing the Index: Spatial and Temporal Smoothing

## Correlations between different RSI Versions

|      | p01  | p01i | p01s | p01c | p05  | p05i | p05s | p05c | p10  | p10i | p10s | p10c | nb |
|------|------|------|------|------|------|------|------|------|------|------|------|------|----|
| p01  | 0.96 |      |      |      |      |      |      |      |      |      |      |      |    |
| p01i | 0.82 | 0.89 |      |      |      |      |      |      |      |      |      |      |    |
| p01s | 0.53 | 0.58 | 0.82 |      |      |      |      |      |      |      |      |      |    |
| p01c | 0.94 | 0.96 | 0.79 | 0.49 |      |      |      |      |      |      |      |      |    |
| p05  | 0.94 | 0.97 | 0.82 | 0.52 | 0.99 |      |      |      |      |      |      |      |    |
| p05i | 0.83 | 0.90 | 0.99 | 0.77 | 0.84 | 0.87 |      |      |      |      |      |      |    |
| p05s | 0.53 | 0.59 | 0.82 | 1.00 | 0.50 | 0.53 | 0.79 |      |      |      |      |      |    |
| p05c | 0.92 | 0.94 | 0.76 | 0.47 | 0.99 | 0.99 | 0.82 | 0.49 |      |      |      |      |    |
| p10  | 0.92 | 0.95 | 0.79 | 0.50 | 0.98 | 0.99 | 0.85 | 0.51 | 0.99 |      |      |      |    |
| p10i | 0.84 | 0.90 | 0.97 | 0.75 | 0.85 | 0.88 | 1.00 | 0.77 | 0.83 | 0.86 |      |      |    |
| p10s | 0.53 | 0.59 | 0.82 | 0.99 | 0.51 | 0.54 | 0.79 | 1.00 | 0.49 | 0.51 | 0.77 |      |    |
| p10c | 0.11 | 0.13 | 0.11 | 0.07 | 0.13 | 0.13 | 0.12 | 0.07 | 0.13 | 0.13 | 0.12 | 0.07 |    |
| nb   |      |      |      |      |      |      |      |      |      |      |      |      |    |



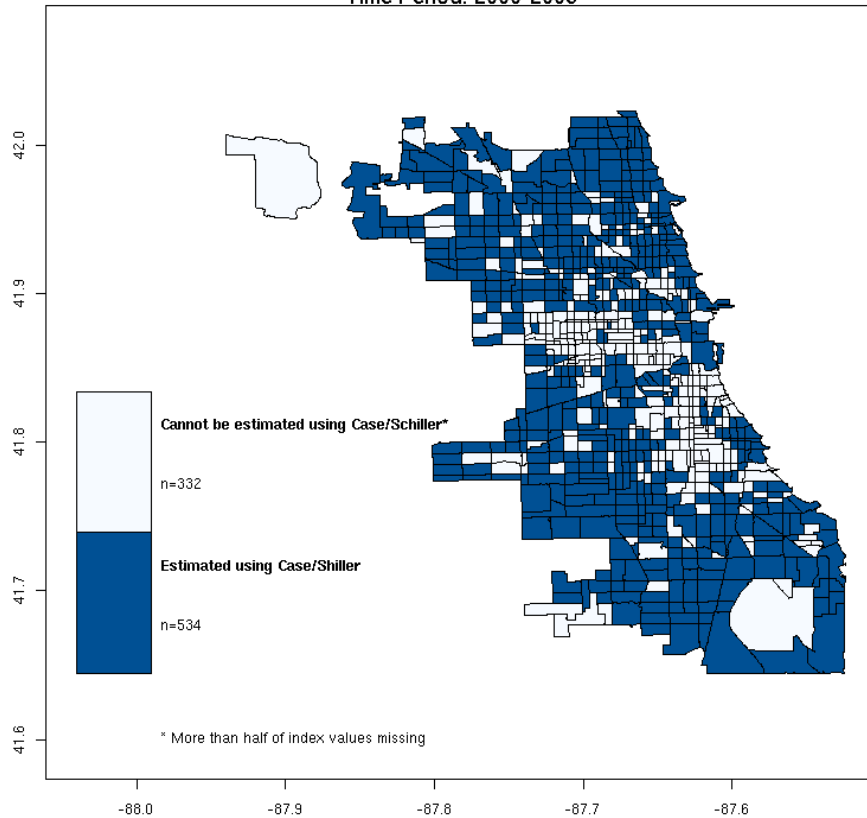
## South Shore: Tract #17031430300



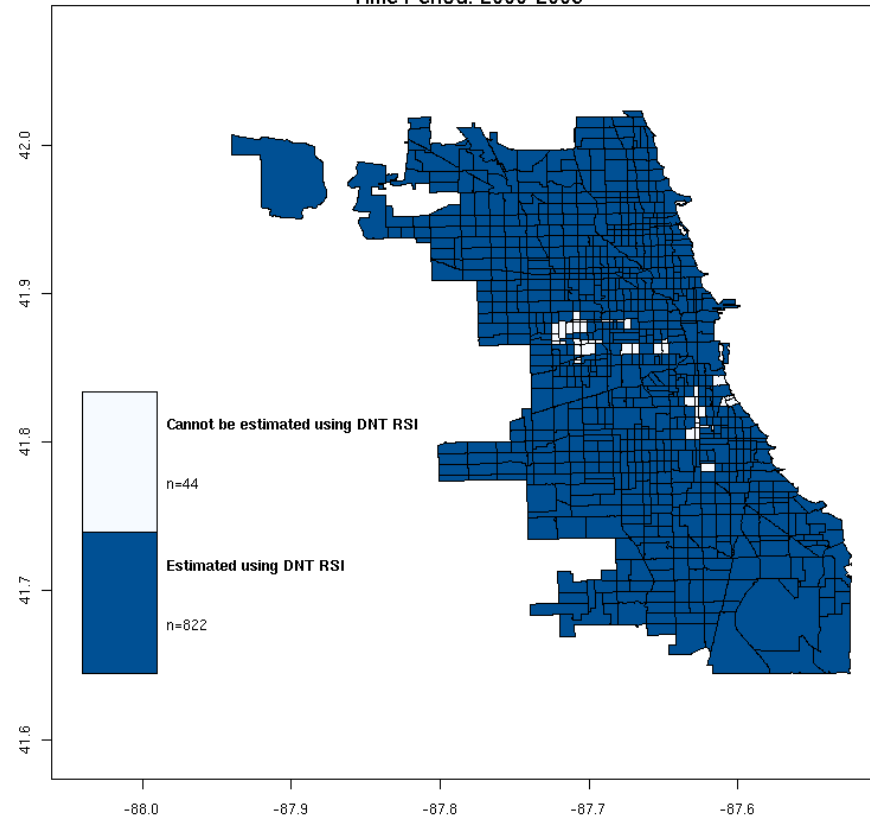
**Optimizing sample size and fluid boundaries through extensive modeling and cross-validation procedures**

# Final Product: The DNT RSI

RSI Estimation Coverage Using Case/Shiller Method  
Time Period: 2000-2006



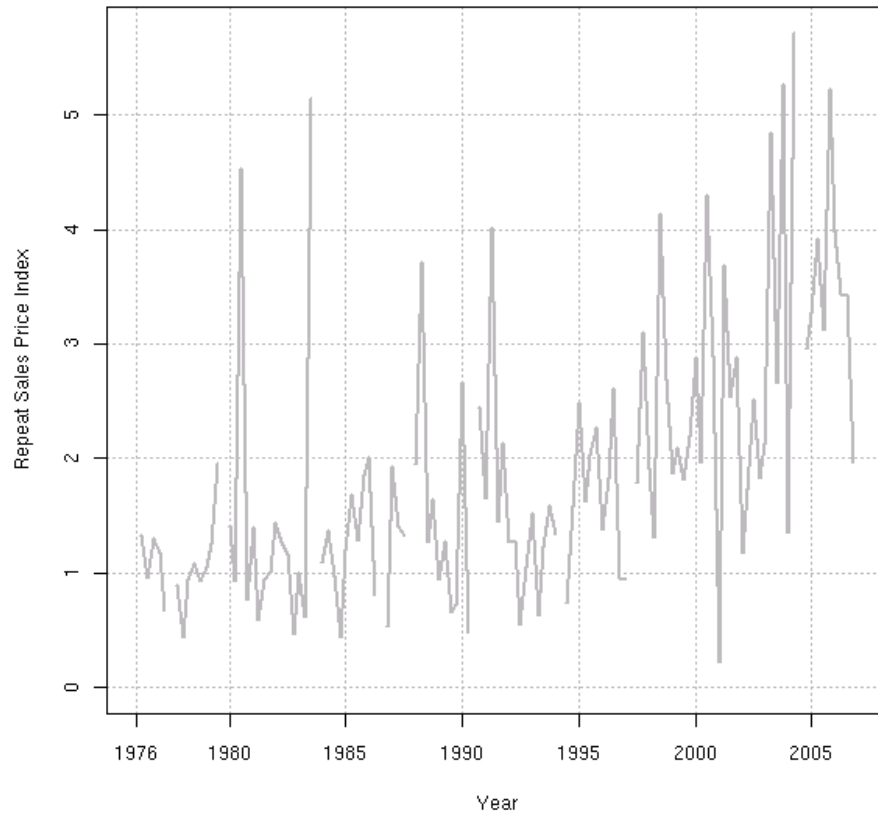
RSI Estimation Coverage Using DNT RSI Method  
Time Period: 2000-2006



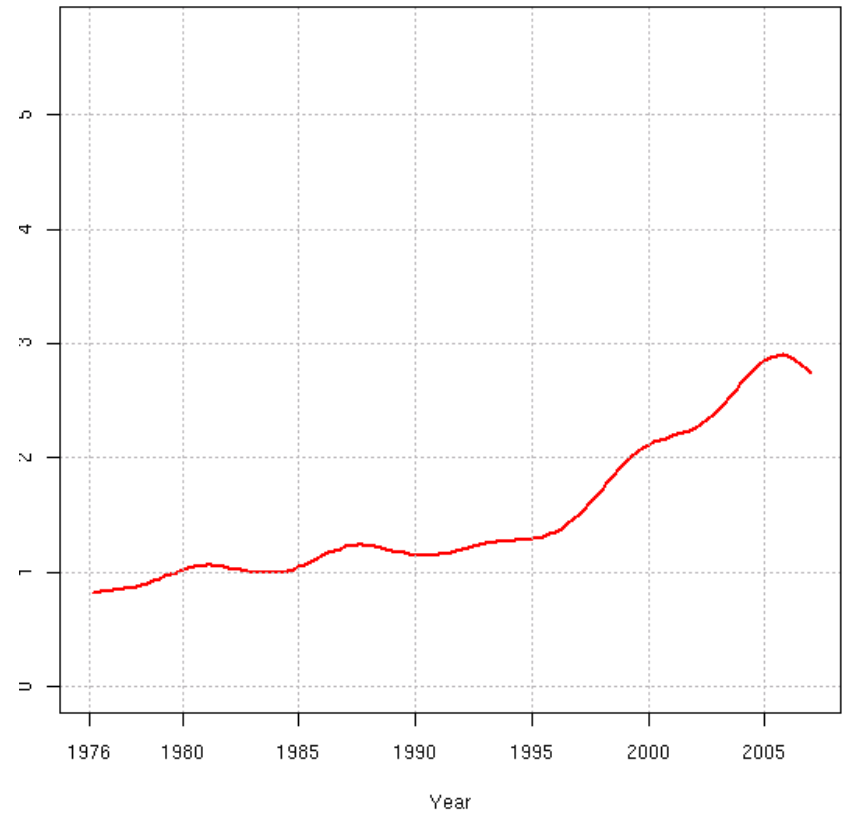
**Unlike traditional repeat sales indices, the DNT RSI can be estimated for very small levels of geography**

# Final Product: The DNT RSI

Case/Shiller Index for Tract 39035115200 in Cleveland

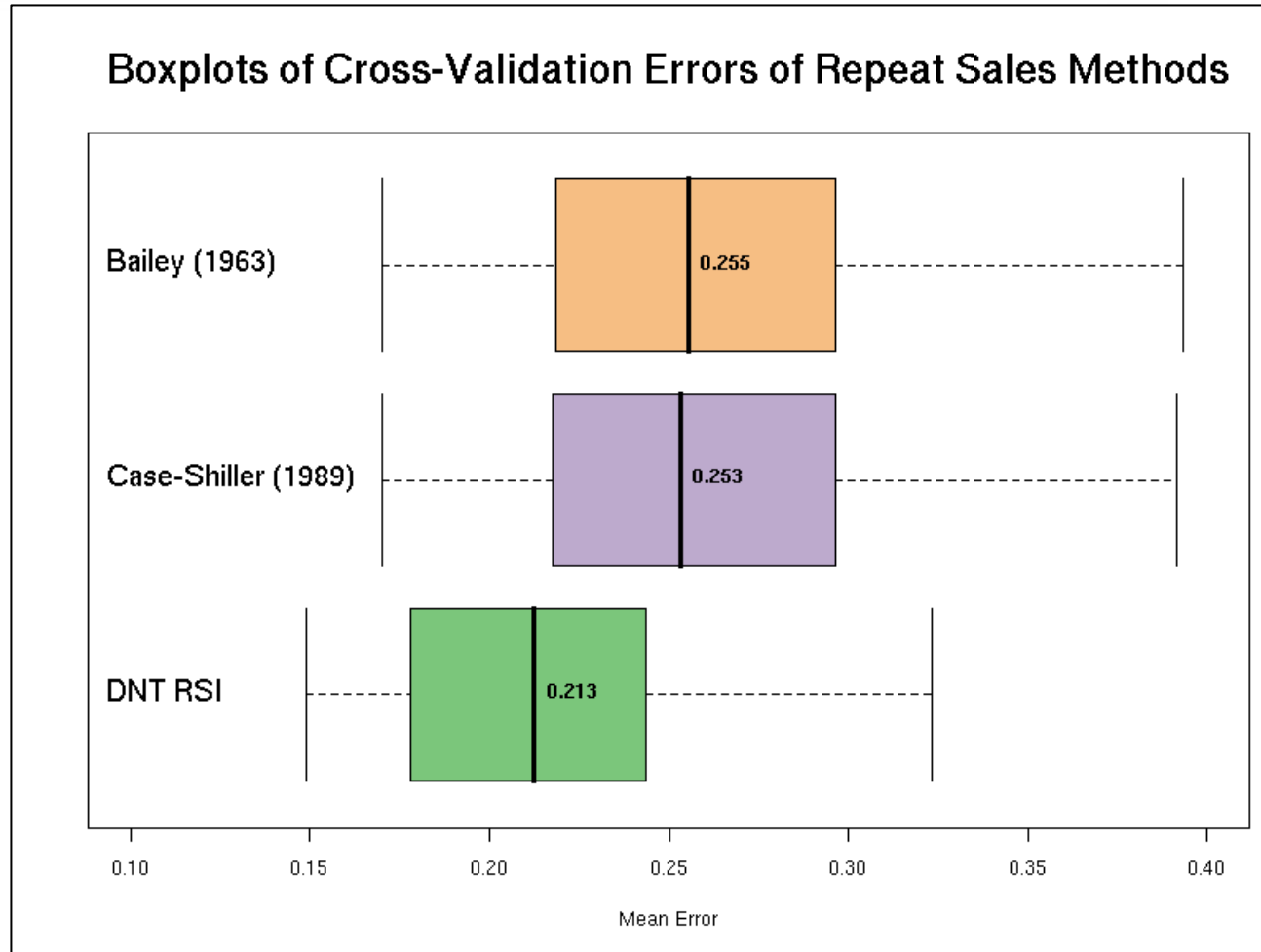


DNT Repeat Sales Index for Tract 39035115200 in Cleveland



**Less volatile than traditional RSIs**

# Final Product: The DNT RSI



**More robust than traditional repeat sales indices at the tract level**

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Measuring Change: the RSI

**Analytic Applications: Where to Invest; Pace,  
Degree of Change; Role of Region; Drivers**

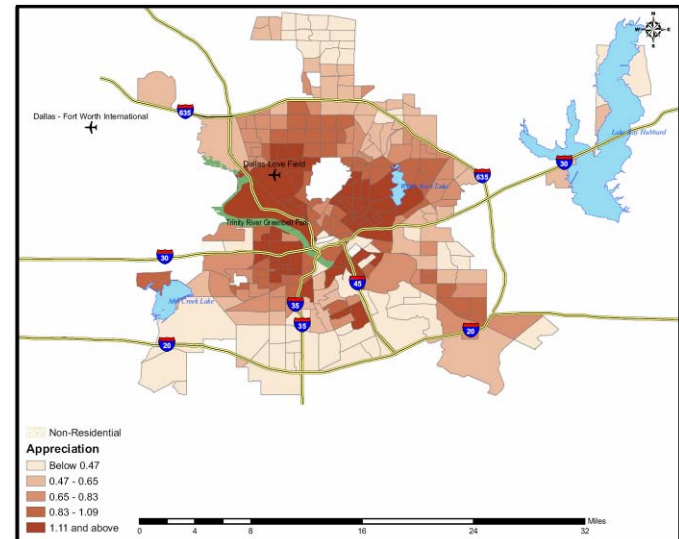
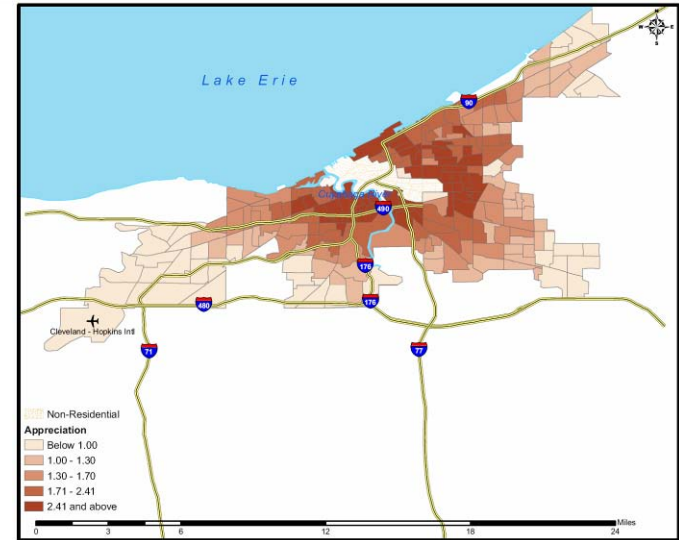
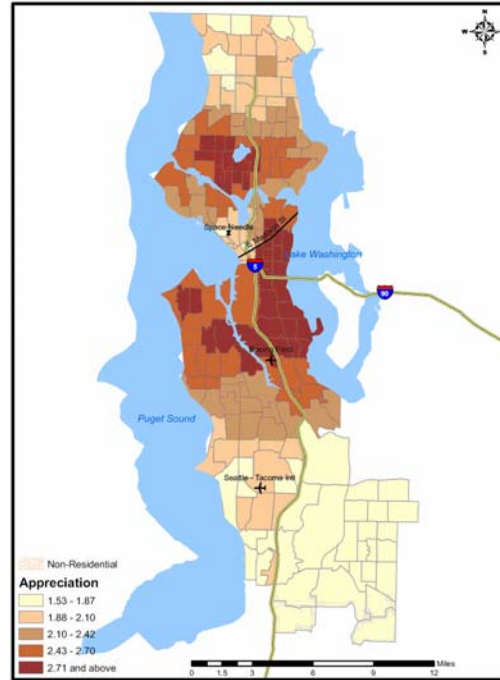
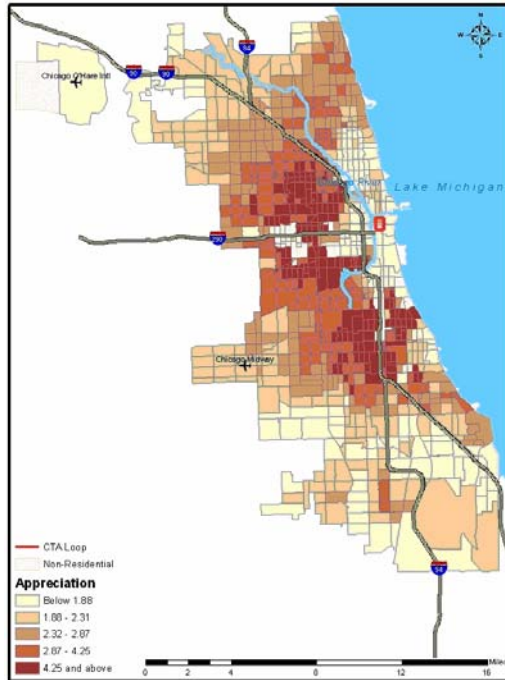
Evolution: Discovering Patterns of Change

Developing Tools: from Diagnostics to Investment



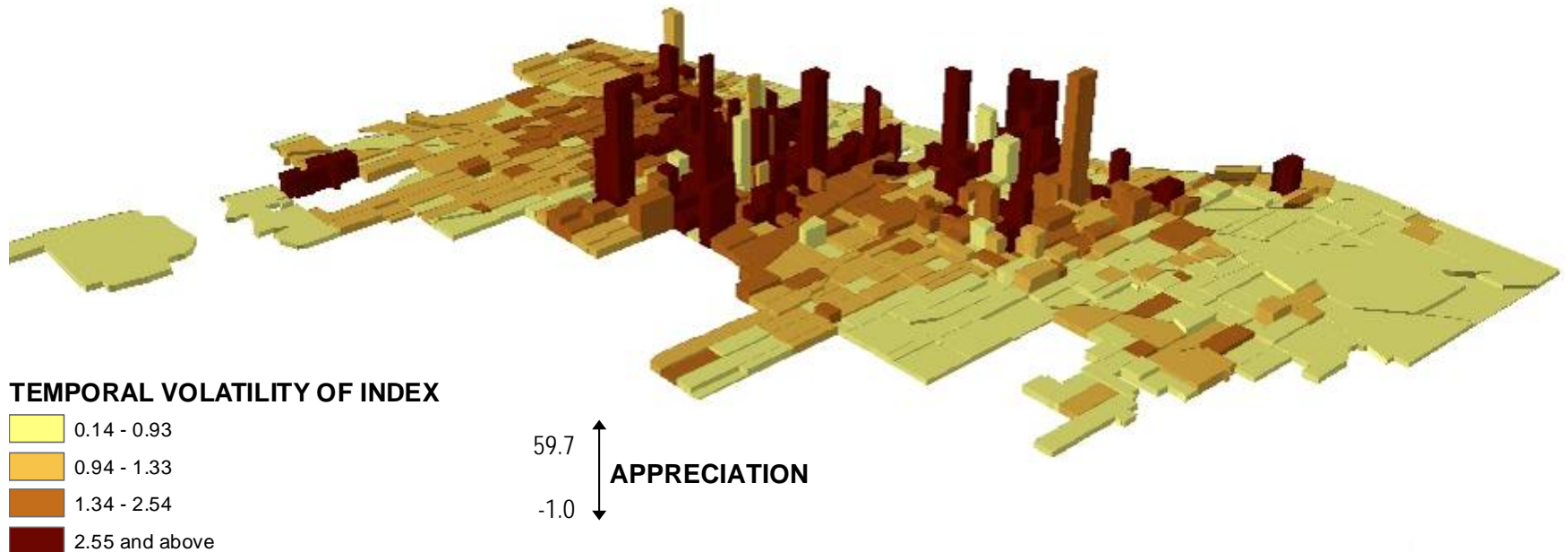


# Change in Price: Poor Neighborhoods Present the Most Opportunities for Investment



**Many of the poorest neighborhoods are the ones that grew the most, outperforming wealthier communities in each of the four sample cities**

# Partly Due to Lack of Information, These Areas Are Also the Most Volatile



***By increasing the availability of information on these markets, we could reduce risk, increase market activity, and help stabilize these communities, further strengthening their performance.***

# Using the RSI to Develop New Knowledge

## ■ How Much and How Fast do Neighborhoods Change?

- Neighborhood change is a slow process: over 15 years, most neighborhoods don't change their position relative to other neighborhoods in the region.

(Methodology: Transition Matrices)

## ■ How Important Is the Region?

- Across cities, 35% of all neighborhood change is accounted for by regional trends.

(Methodology: Correlations and Regressions)

## ■ Do Neighborhoods “Converge”?

- Overall, neighborhoods tend to “catch up” with each other, but there are important exceptions

(Methodology: Sigma and Beta Convergence)



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**Analytic Applications:** Where to Invest; Pace,  
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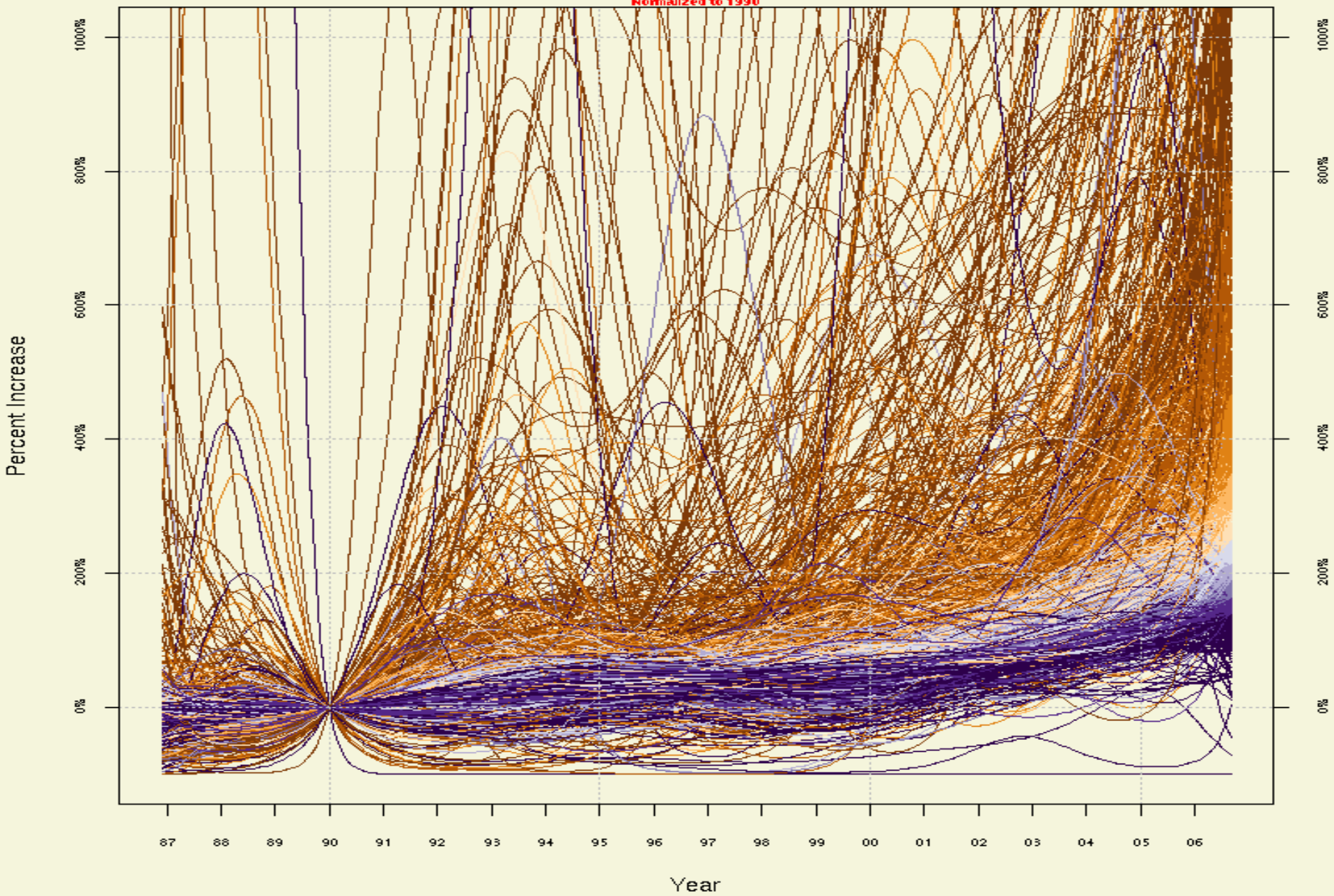
**Evolution: Discovering Patterns of Change**

Developing Tools: from Diagnostics to Investment



# Chicago Tract Indices, Neighbor

Normalized to 1990



# Identifying Patterns of Change

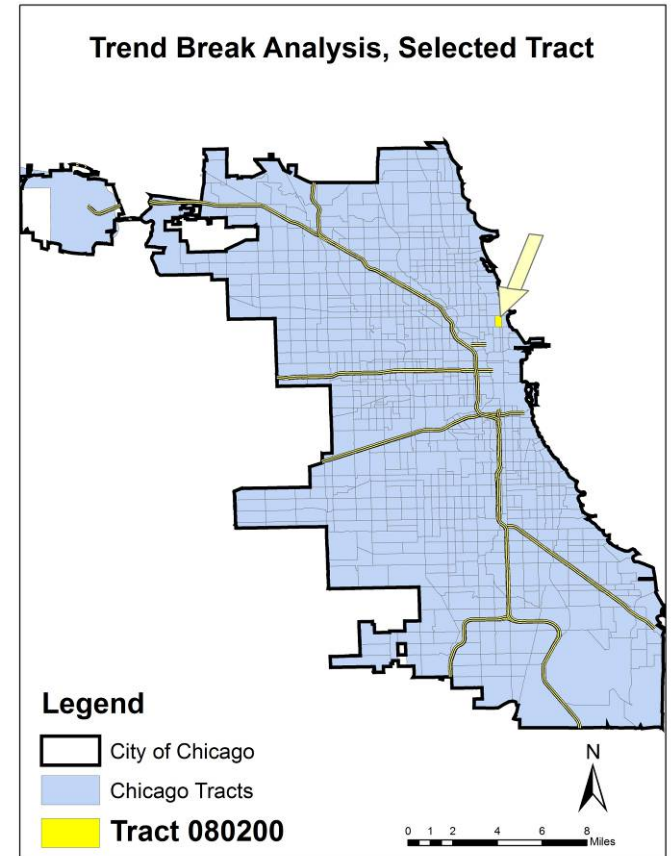
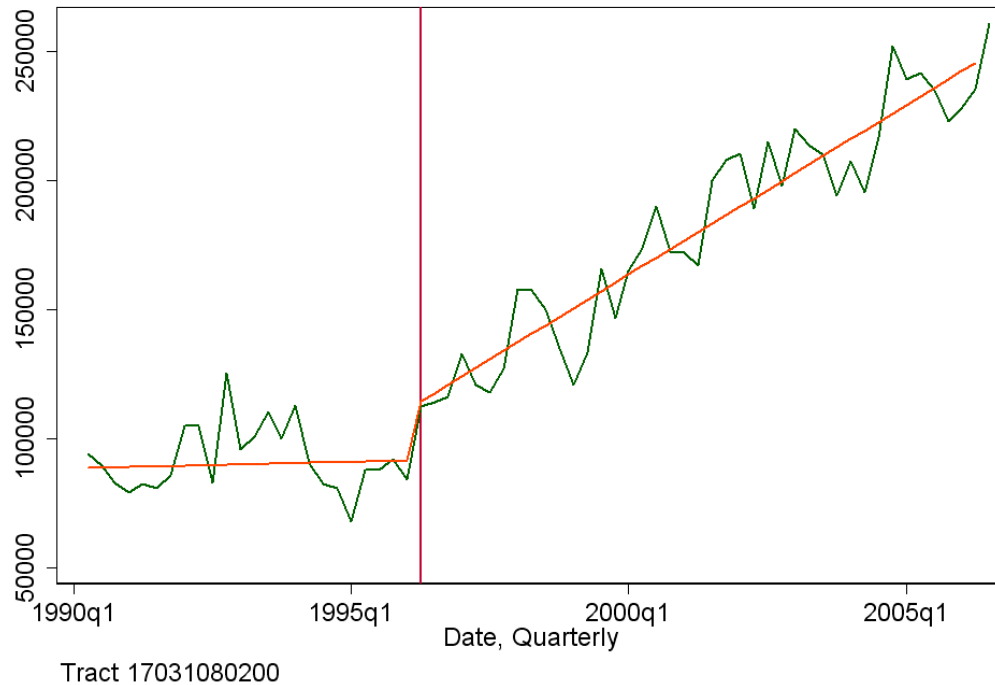
## Three Complementary Methodologies:

- **Cluster Analysis**: group all neighborhoods by overall pattern
- **Trend Breaks**: classify neighborhoods based on number and type of structural breaks
- **Pattern Search**: specify a pattern of interest and search for matches in the data



# Patterns of Interest: Tipping?

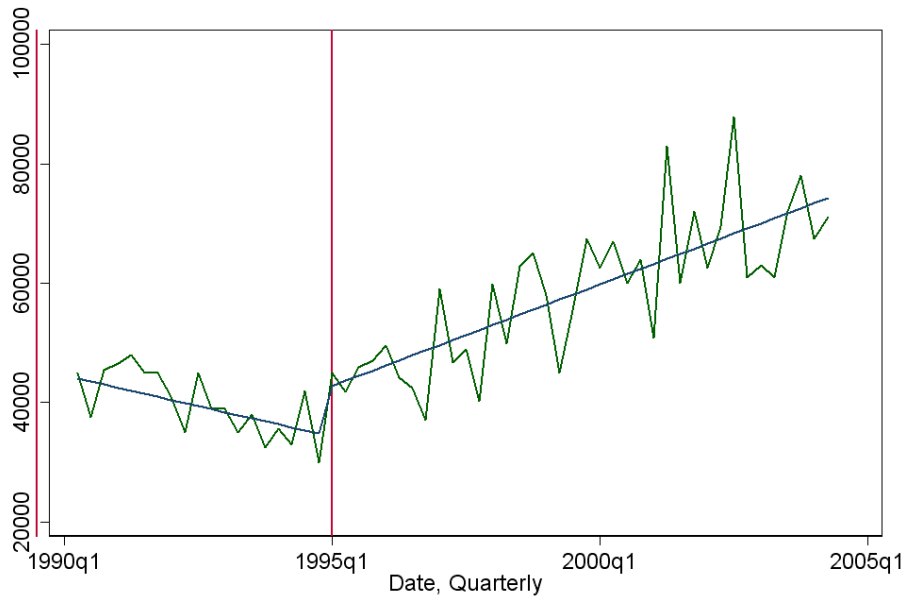
## Chicago, North Side



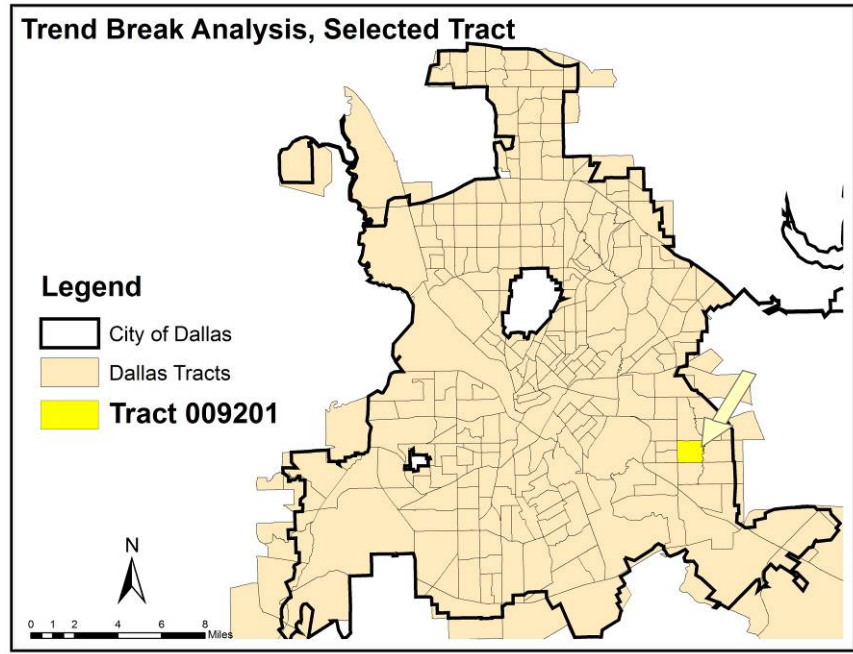
## Statistically Identifying Structural Breaks

# Patterns of Interest: Neighborhood Turnaround

## Dallas, Southeast Side



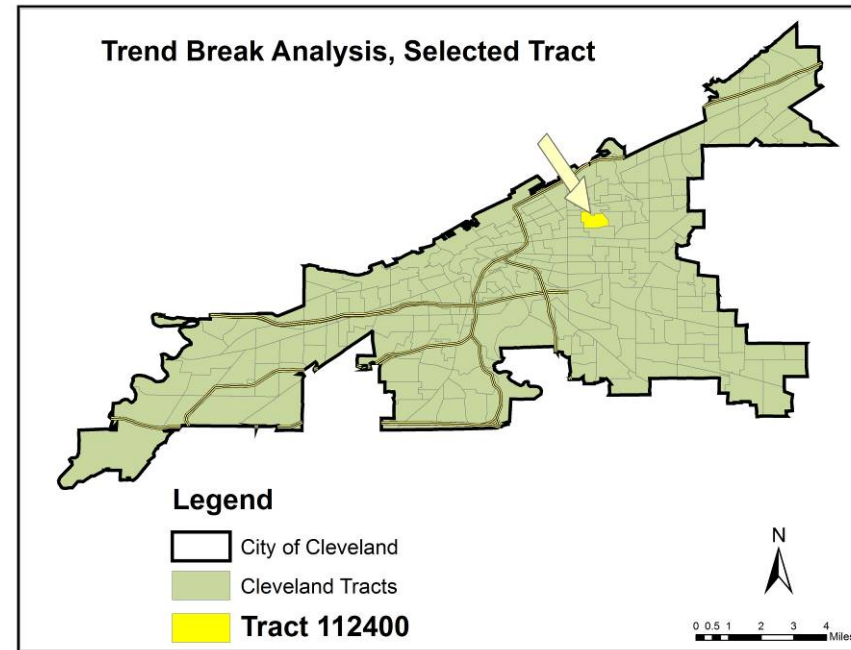
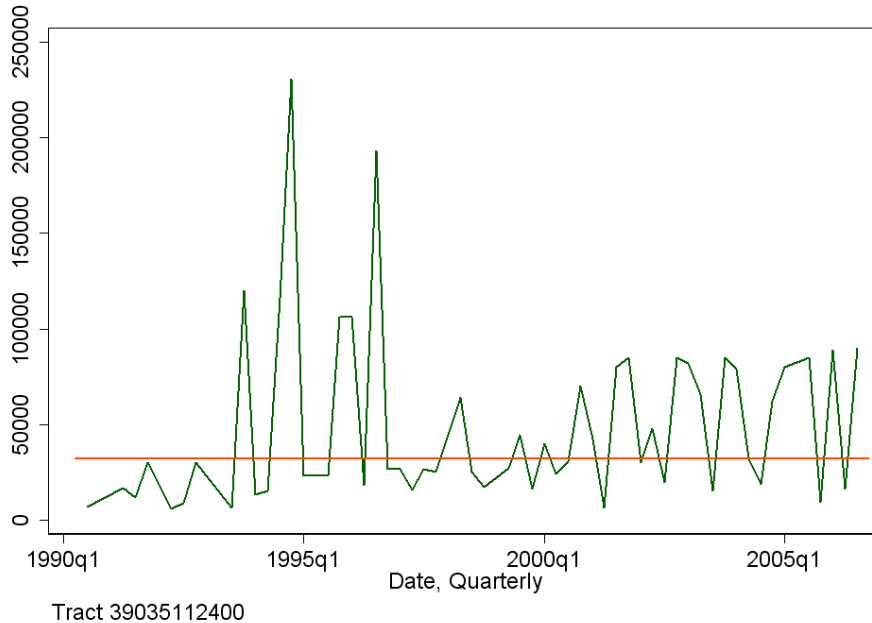
Tract 48113009201





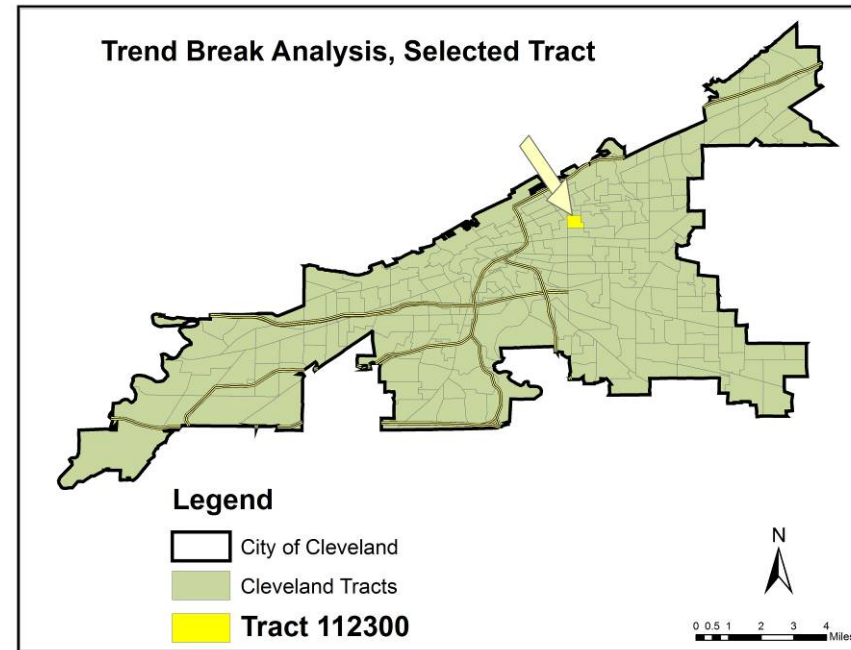
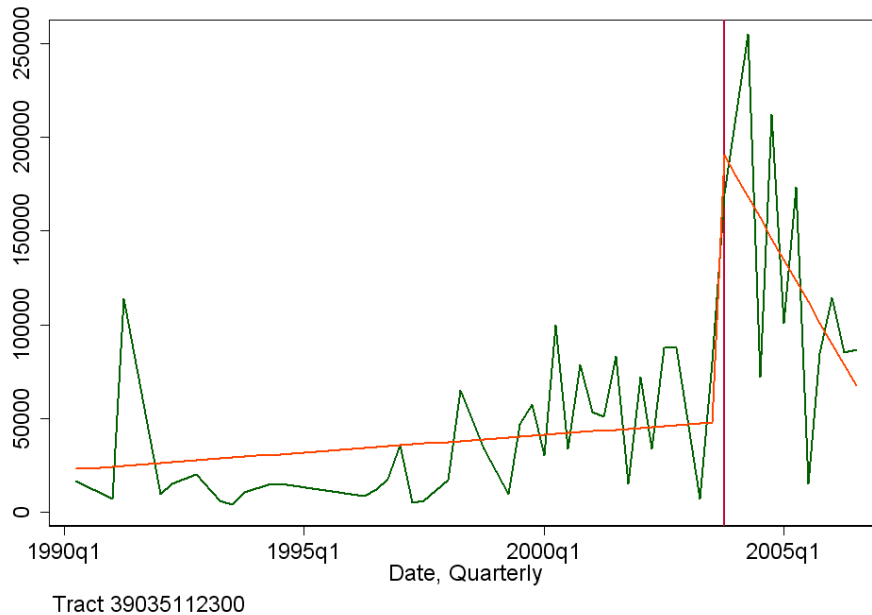
# Patterns of Interest: Neighborhood Decline

## Cleveland, East Side



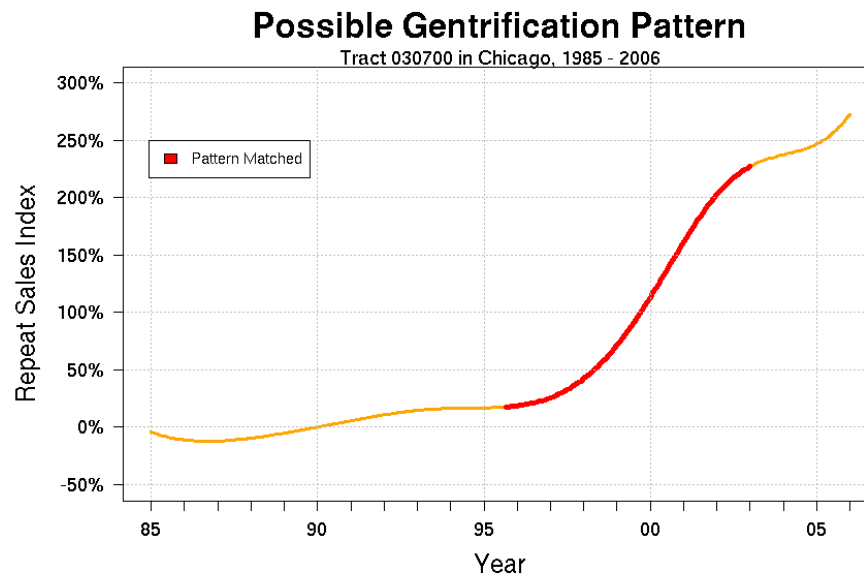
# Patterns of Interest: Speculation?

## Cleveland, East Side



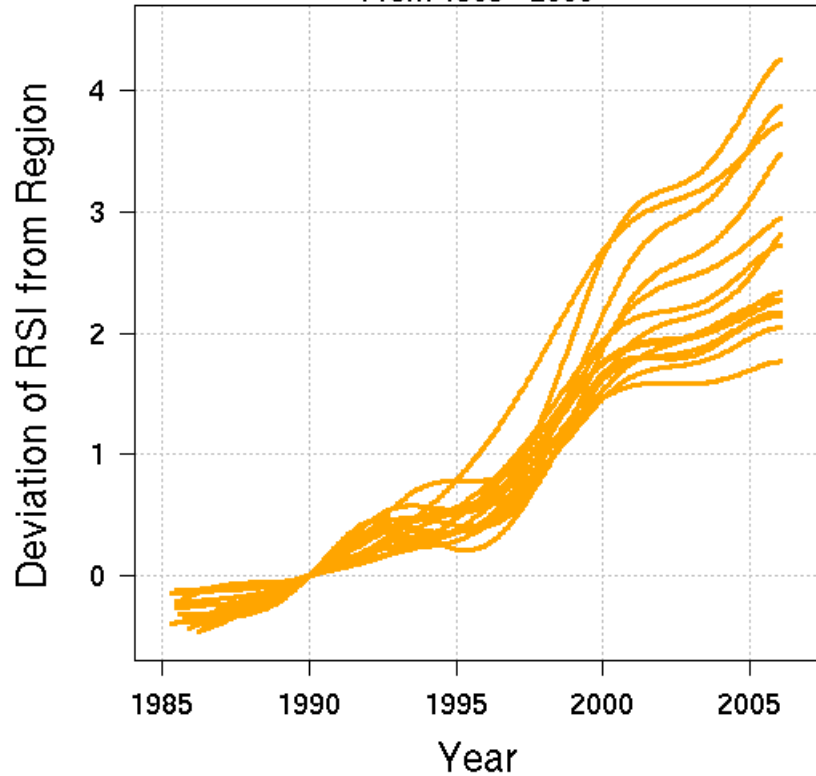
# Pattern Search Example: Gentrification in Chicago

- **Goal:** Anticipating Neighborhood Change
- **How it Works:** Define a Pattern and Find Matching Cases
- **Example:** Possible Gentrification Pattern Defined Based on a Neighborhood in Chicago



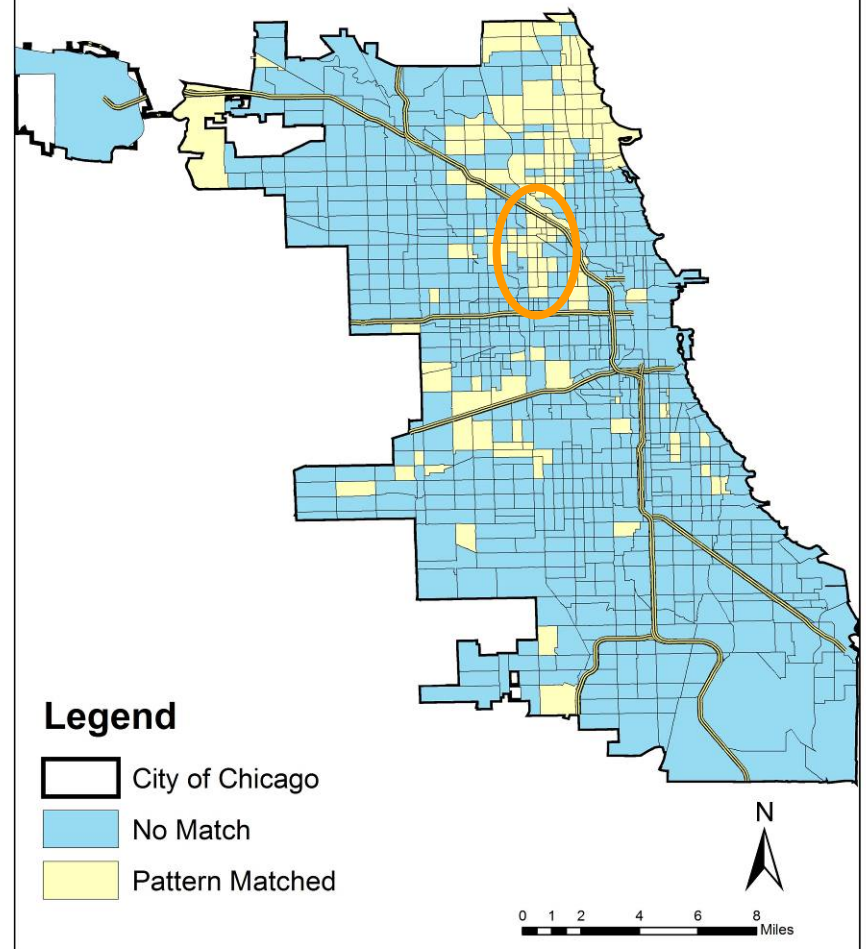
# Zooming In: Wicker Park Area

All Tracts in Wicker Park  
From 1985 - 2006

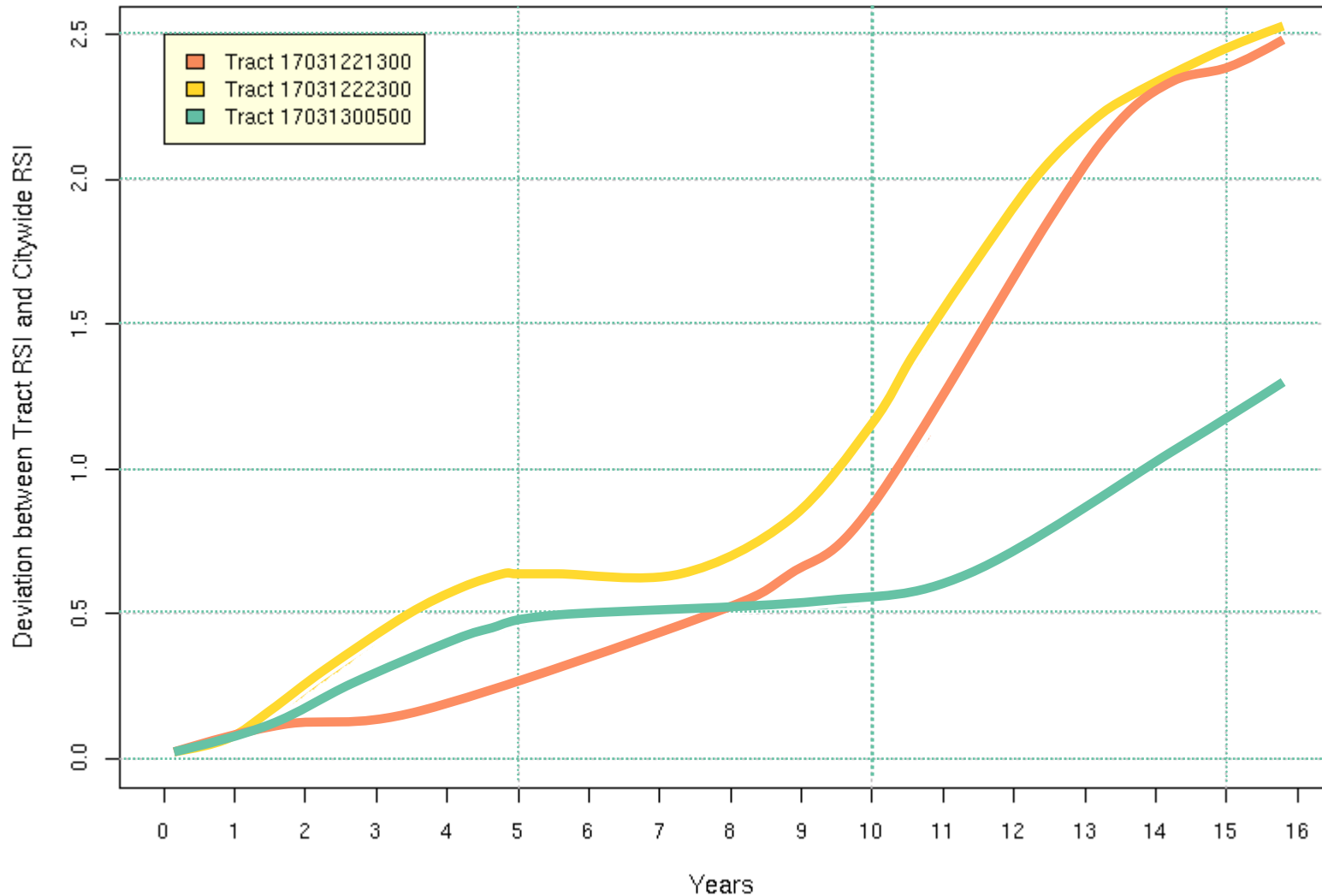


Possible Gentrification Pattern

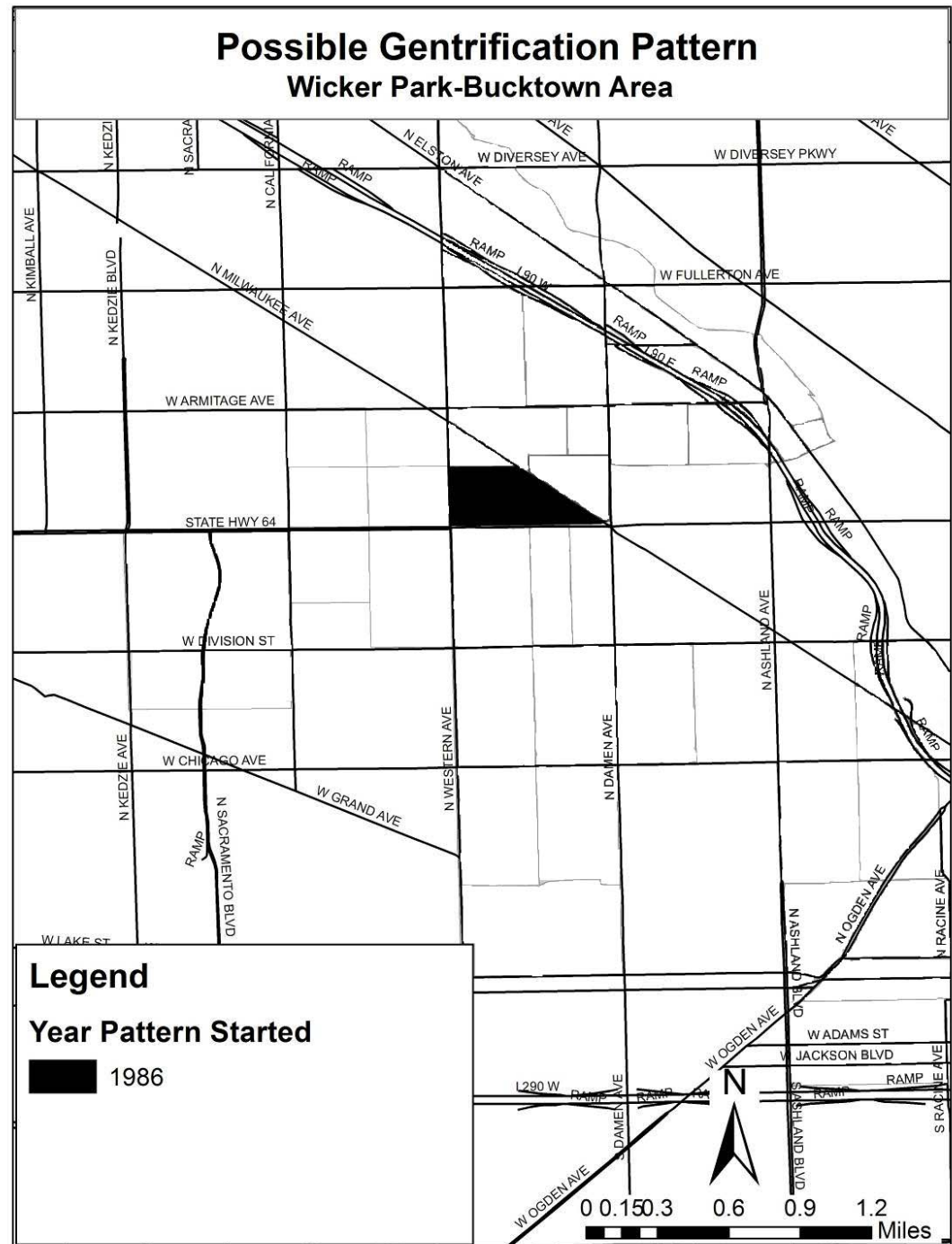
Chicago Tracts, 1985-2006



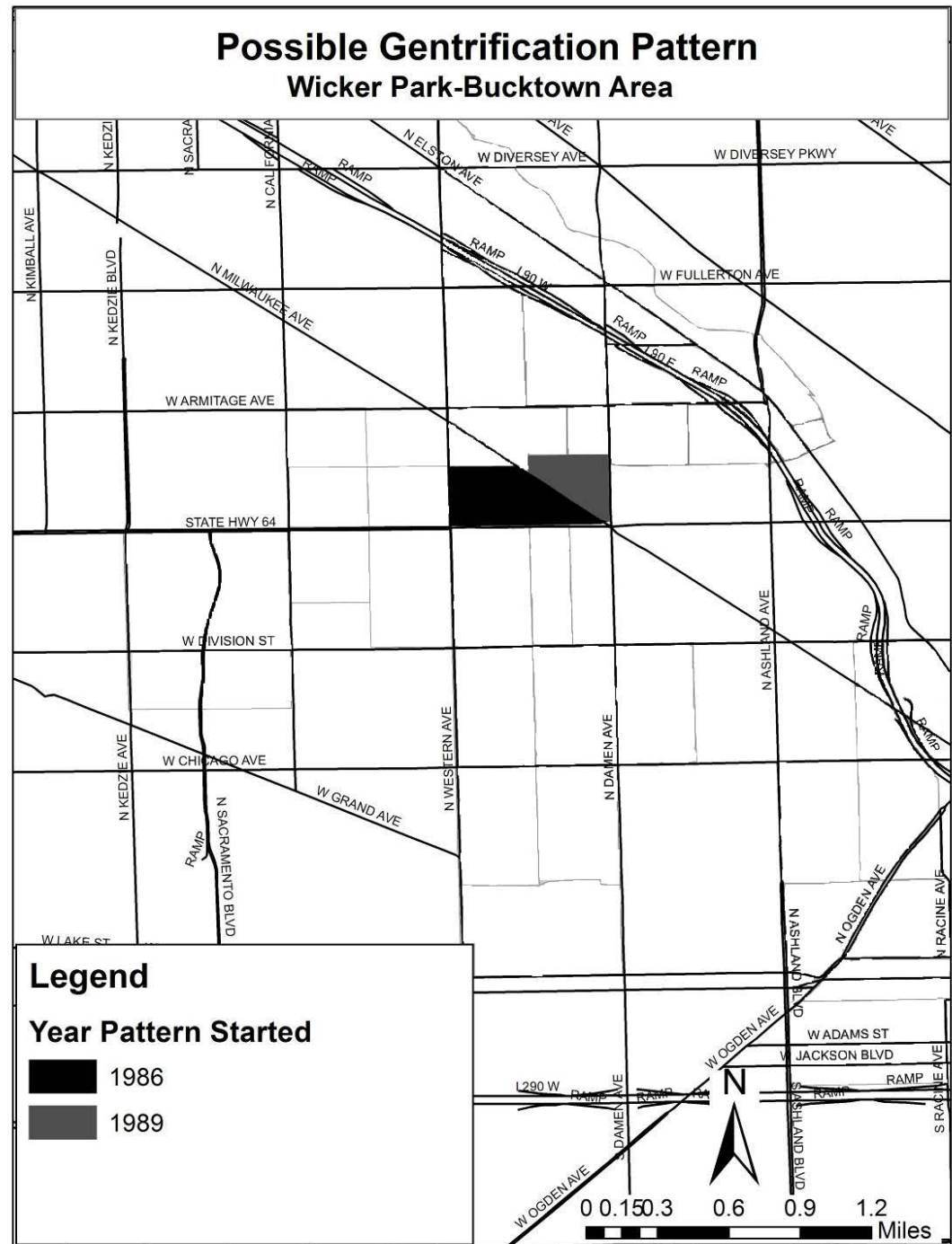
# Possible Application: Anticipating and Managing Gentrification



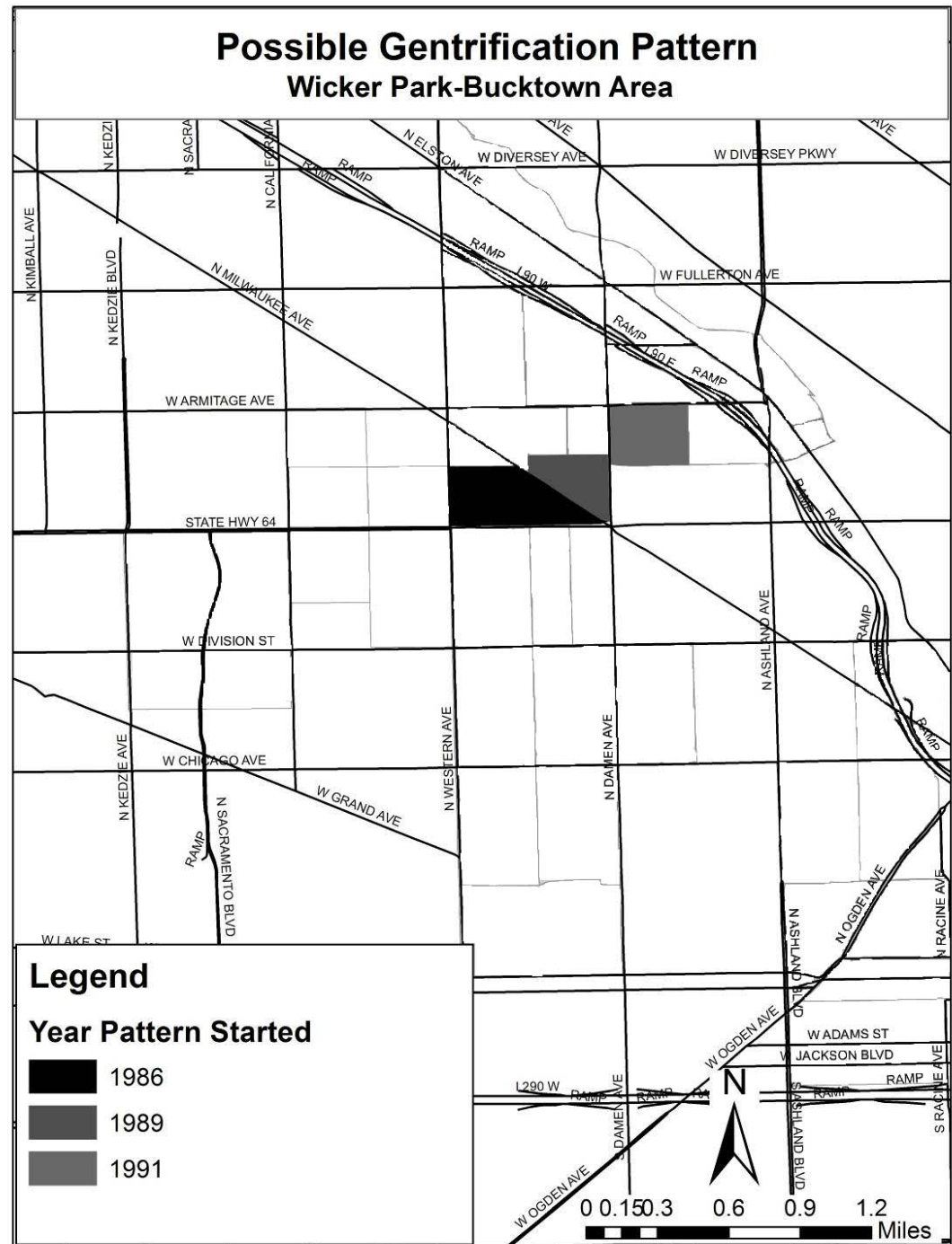
# Pattern “Spreading” to Nearby Tracts



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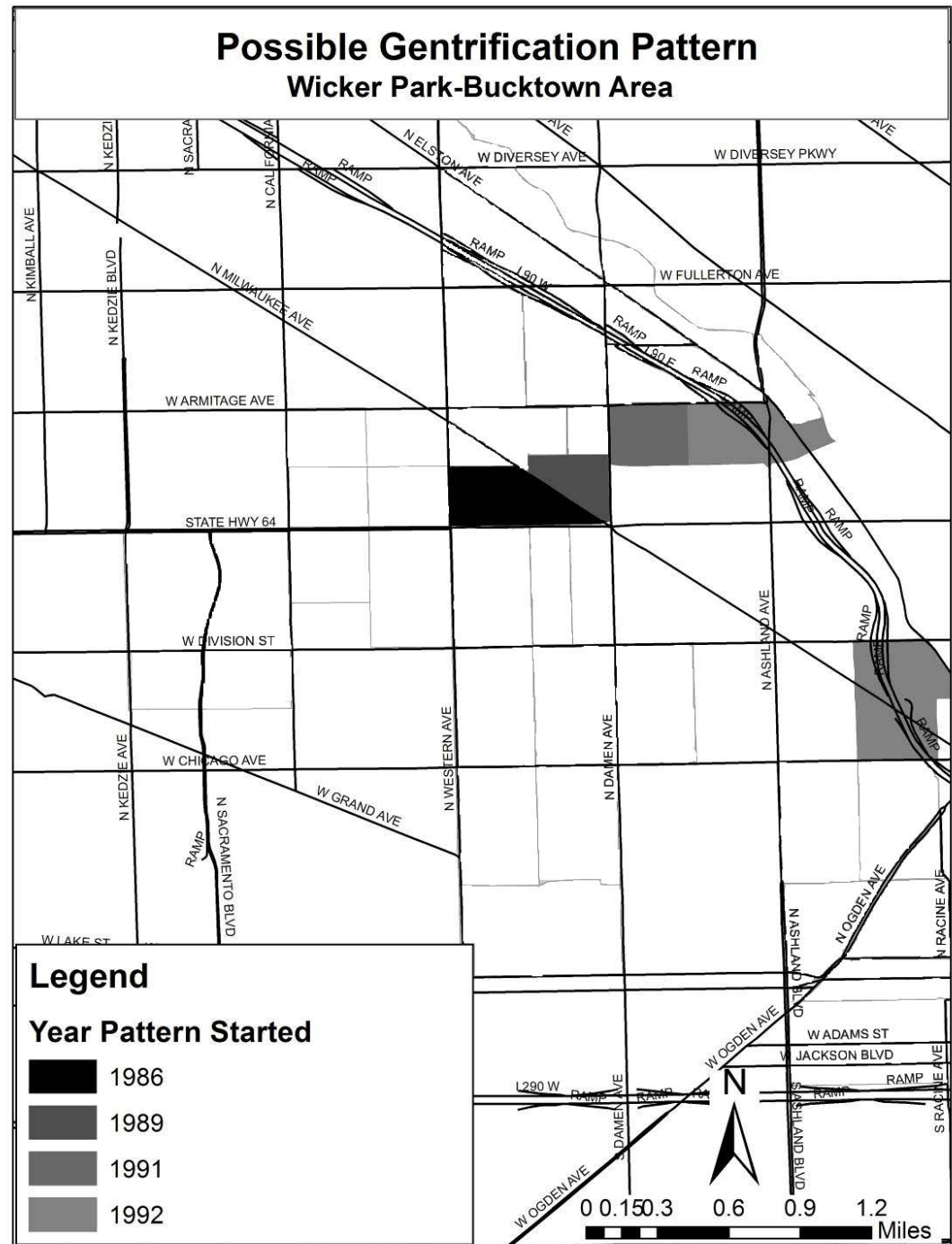


# Pattern “Spreading” to Nearby Tracts

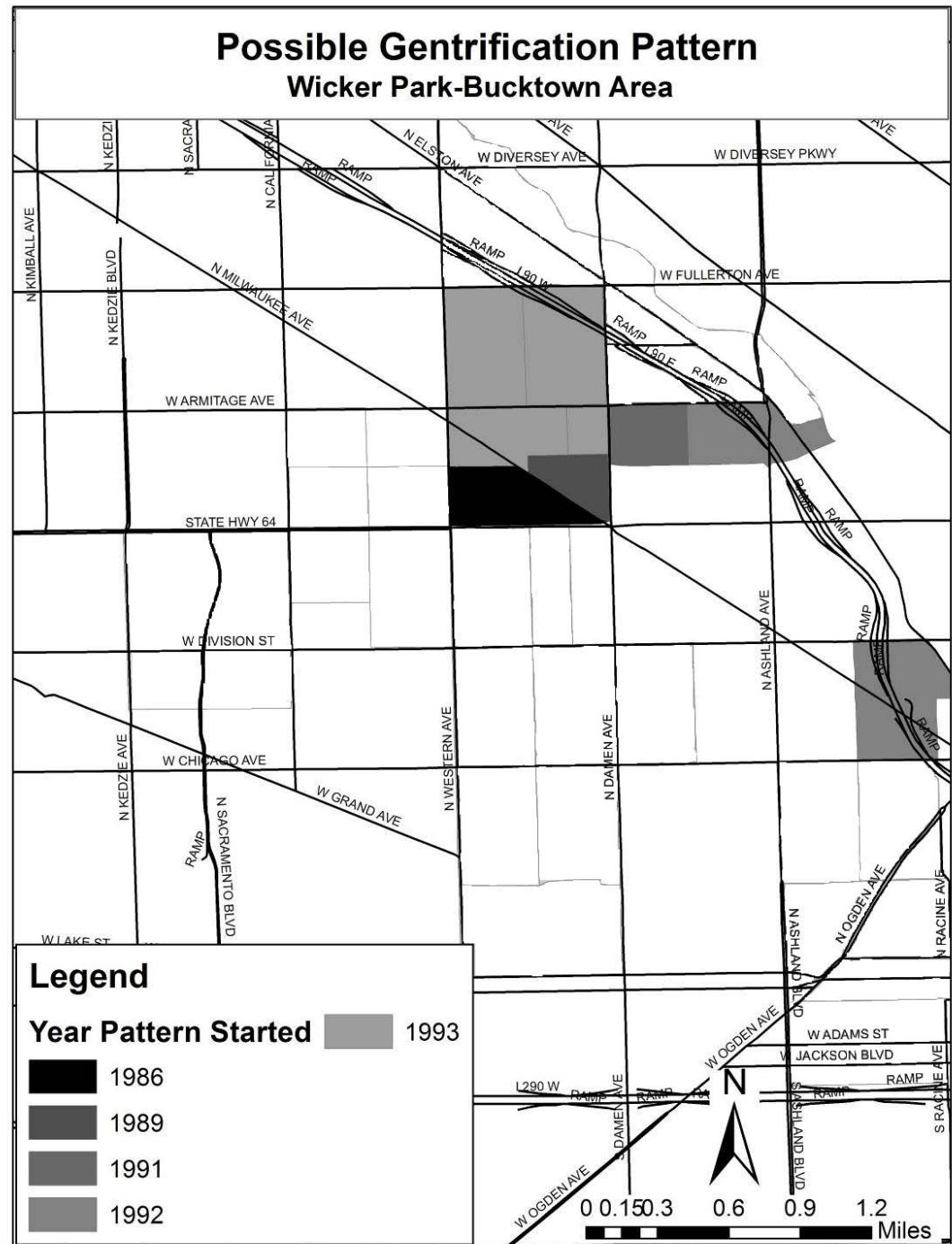




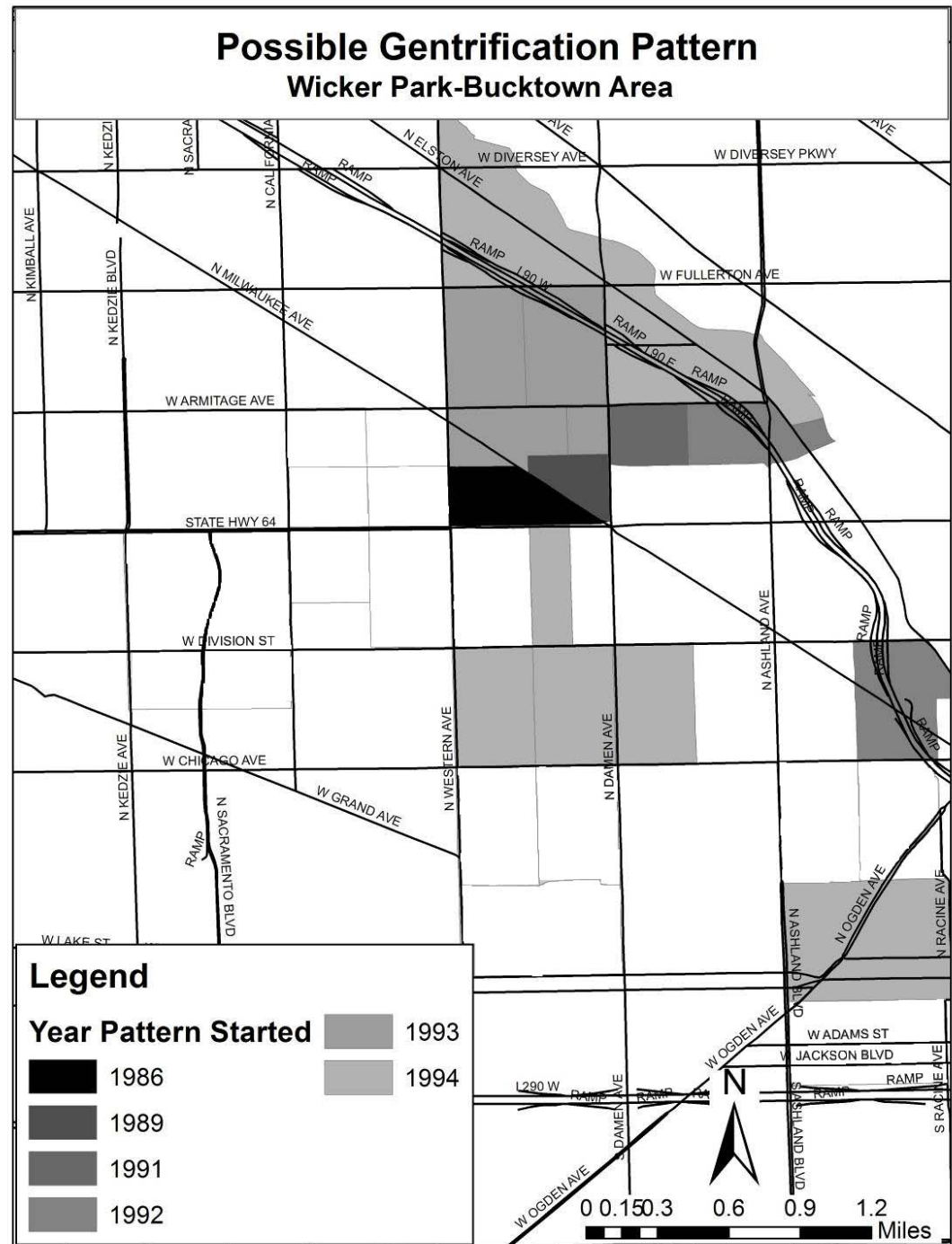
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**Developing Tools: from Diagnostics to Investment**



# Developing New Tools for the Field

| Question/Goal  | Tool                              |
|--|-----------------------------------|
| Enabling Investment in Inner City Real Estate Markets                                    | RSI → REIT                        |
| Track Affordability and Neighborhood Housing Mix   | Housing Diversity Metric          |
| Anticipate and Manage Gentrification   | Early Warning System              |
| Planning Community Development Interventions   | Neighborhood Change Simulation    |
| What neighborhoods are similar along multiple dimensions of interest?                    | Similarity Index/ Custom Typology |
| What drivers differentiate neighborhoods with respect to a specific outcome of interest? | CART                              |
| How will a specific intervention affect its surrounding area?                            | Impact Estimator                  |
| What locations will maximize the impact of an intervention?                              | Spatial Multiplier                |
| What is my “real” neighborhood?  | Semivariogram                     |

# Housing Diversity Metric

## What It Does:

- Tracks the affordability and mix of the housing stock (distribution, not just median)

## Applications:

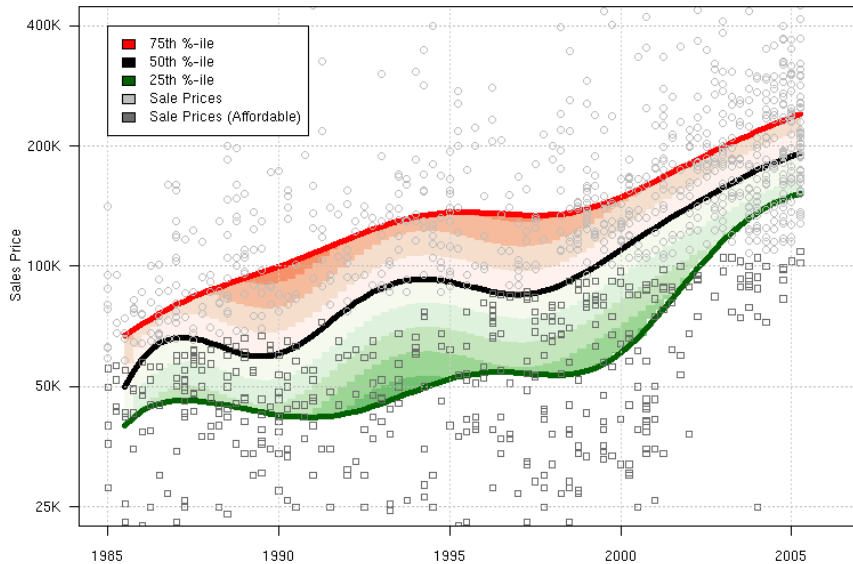
- Enables tracking the range of housing available in the neighborhood
- Better indicator of possible displacement than median prices alone





# Example: Tracking the Price Mix

Sale Prices at 25th, 50th, and 75th Percentiles of tract 17031010200 in Chicago

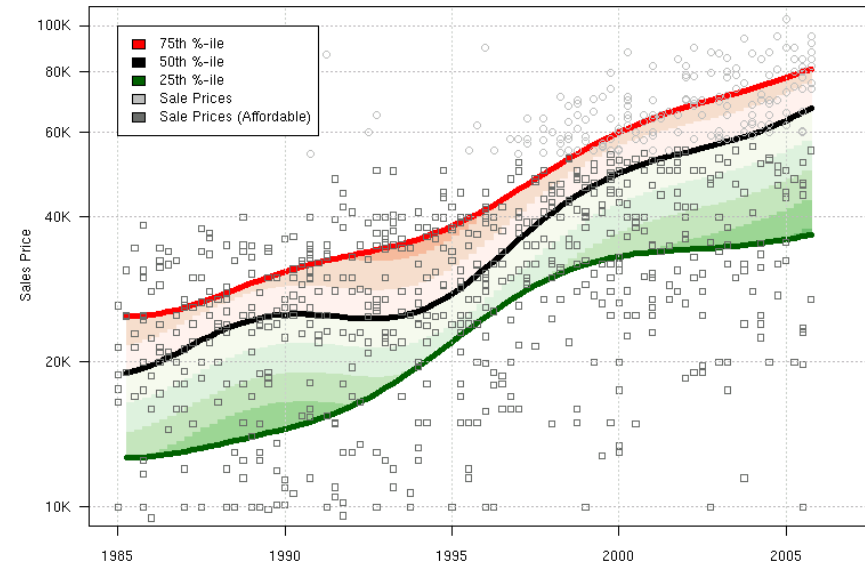


**Strong Overall Appreciation,  
Range of Housing Options Is Narrowing**



**Lack of Affordable Housing**

Sale Prices at 25th, 50th, and 75th Percentiles of tract 39035105100 in Cleveland



**Strong Overall Appreciation, but  
Range of Housing Options Is Still Wide**



**Large Share of Housing  
Remains Affordable**

# Classification and Regression Tree (CART)

## What It Does:

- Identify similar neighborhoods with respect to an outcome of interest and its drivers

## Applications:

- Identify leverage points to affect the desired outcome
- Meaningful comparison of trends and best practices across neighborhoods

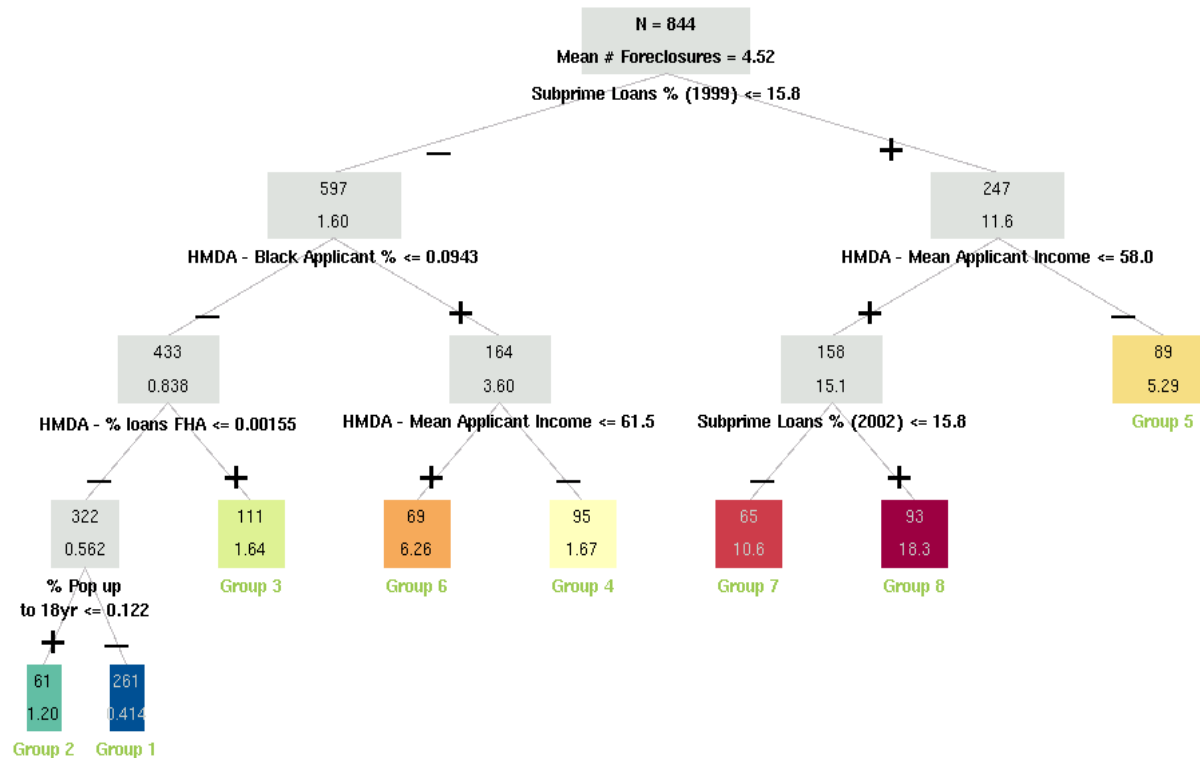


# Sample CART: Foreclosures

CART Tree built using "Number of Foreclosures in 2004" as the Dependent Variable

All Variables Measured in 2004 unless otherwise noted

## 40 Variables Tested



Overall Fit: R2 = 0.378

+/- signs indicate which side has greater/less mean value

Groups are color coded by # foreclosures in a color spectrum: highest = Red -> Yellow -> Green -> Blue = lowest

## Outcome:

- Number of Foreclosures (2004)

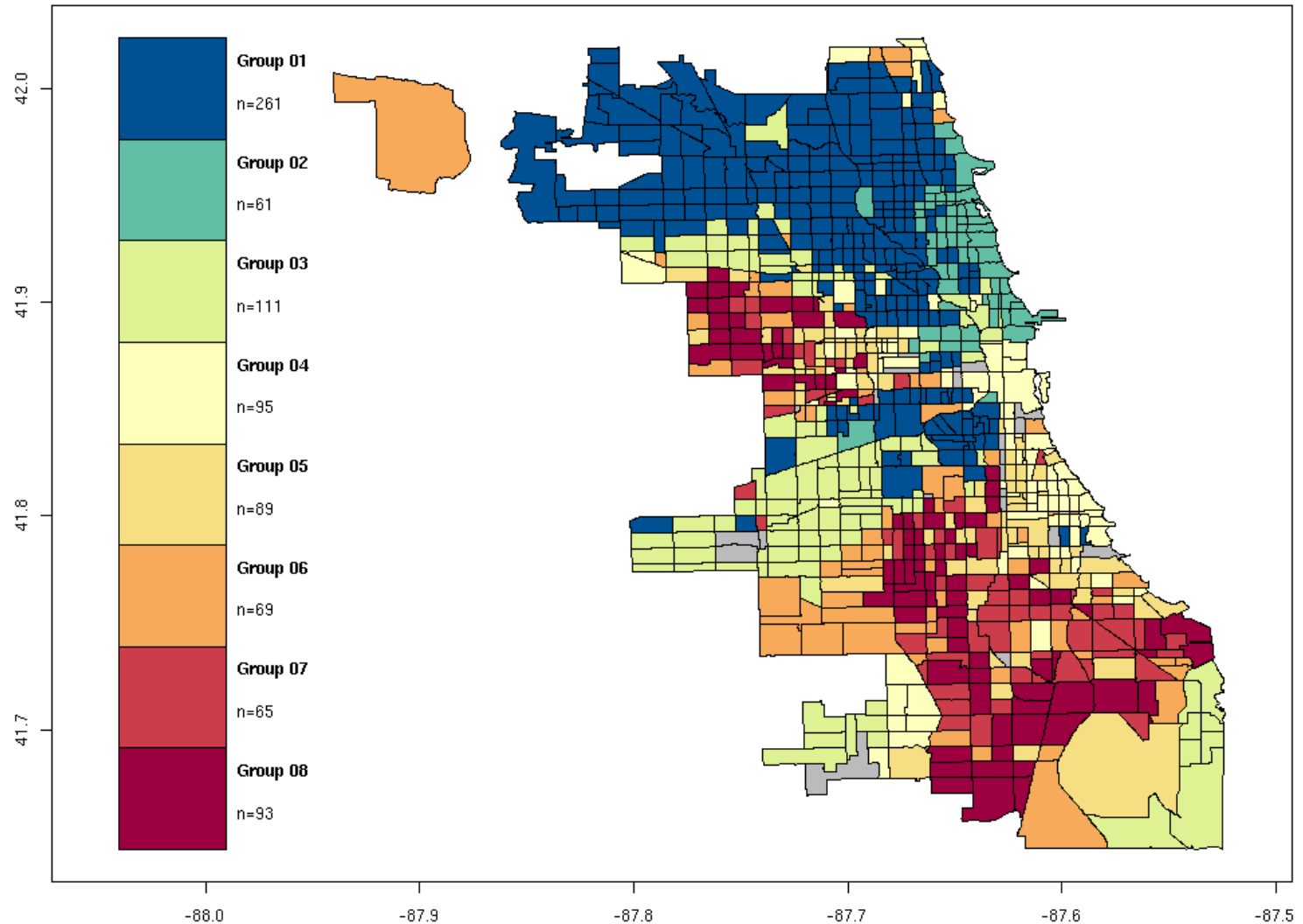
## Drivers:

- % Subprime Loans in Previous Years
- Mean Loan Applicant Income
- % FHA Loans
- % Black Borrowers

**What Neighborhoods Have Similar Numbers of Foreclosures, and Why?**

# CART Output: Chicago Segments

Geographic Distribution of CART Groups in Chicago, using Foreclosures as the Dependent Variable



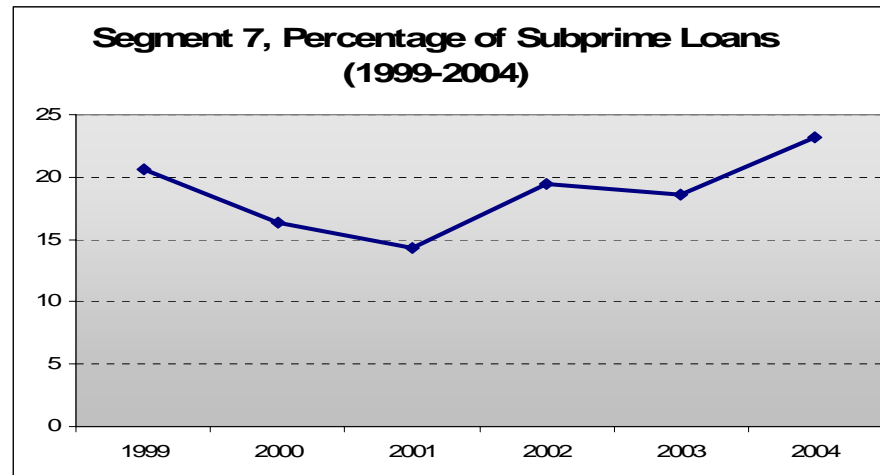
# Cluster 7: Defining Traits and Risk Factors

## Segment Profile:

- Isolated, underserved, predominantly African American communities. High rates of unemployment and subprime lending activity.

## Primary Risk Factor:

- Percentage of subprime loans (primary driver of foreclosures) is at its highest and still on the rise



# Impact Estimator

## What It Does:

- Estimate impact of an intervention on surrounding housing values (or on other outcome, e.g. crime)

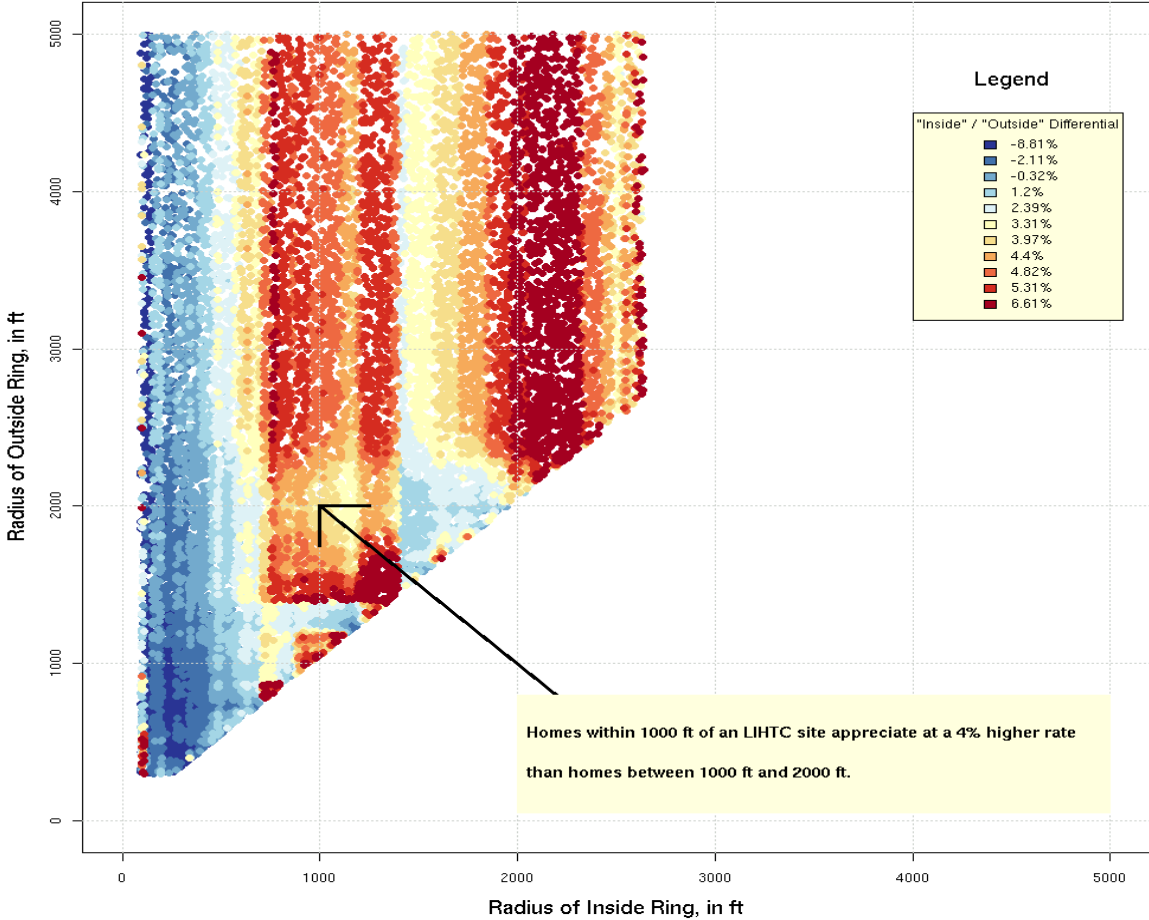
## Possible Applications:

- Evaluate the impact of a development policy
- Choose among alternative interventions based on estimated benefits to the surrounding community
- Advocate for a specific intervention



# Example: What is the effect over time and space of LIHTC housing?

Comparing the Distance Effects of LIHTC projects on Local Housing Appreciation

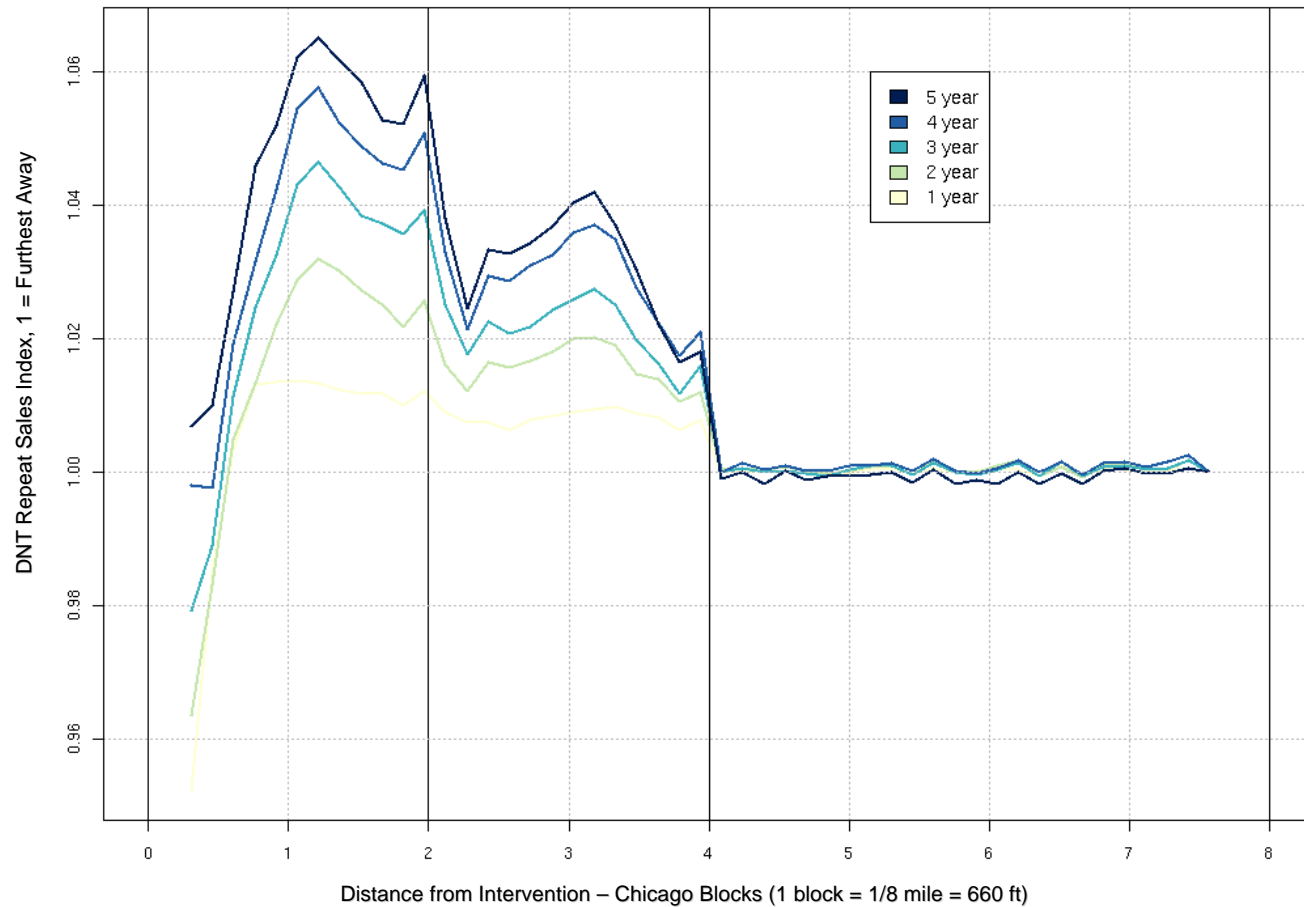


Monte Carlo Simulation to Estimate Impact Variation with Distance



# Impact of LIHTC on Surrounding Properties

Estimated Distance Decay Function – LIHTC Projects







# Ongoing and Inclusive Process

- **Positioning in the Field**
  - Project based on learning from other initiatives
  - Results intended to contribute to their work
- **Ongoing Process**
  - Project is iterative
  - Results need to be used and continually refined
- **Inclusiveness**
  - Multiple partners in various roles
  - Open Source



# Discussion

- General Comments and Questions?
- Patterns of Change of Particular Interest?
- What are People Trying to Better Understand About Neighborhoods?
- What Tools and Applications Would Be Most Useful?
- Partners: Corollary Research, Tool Development and Testing, Other?



# Dynamic Neighborhood Taxonomy

For more information, please visit:

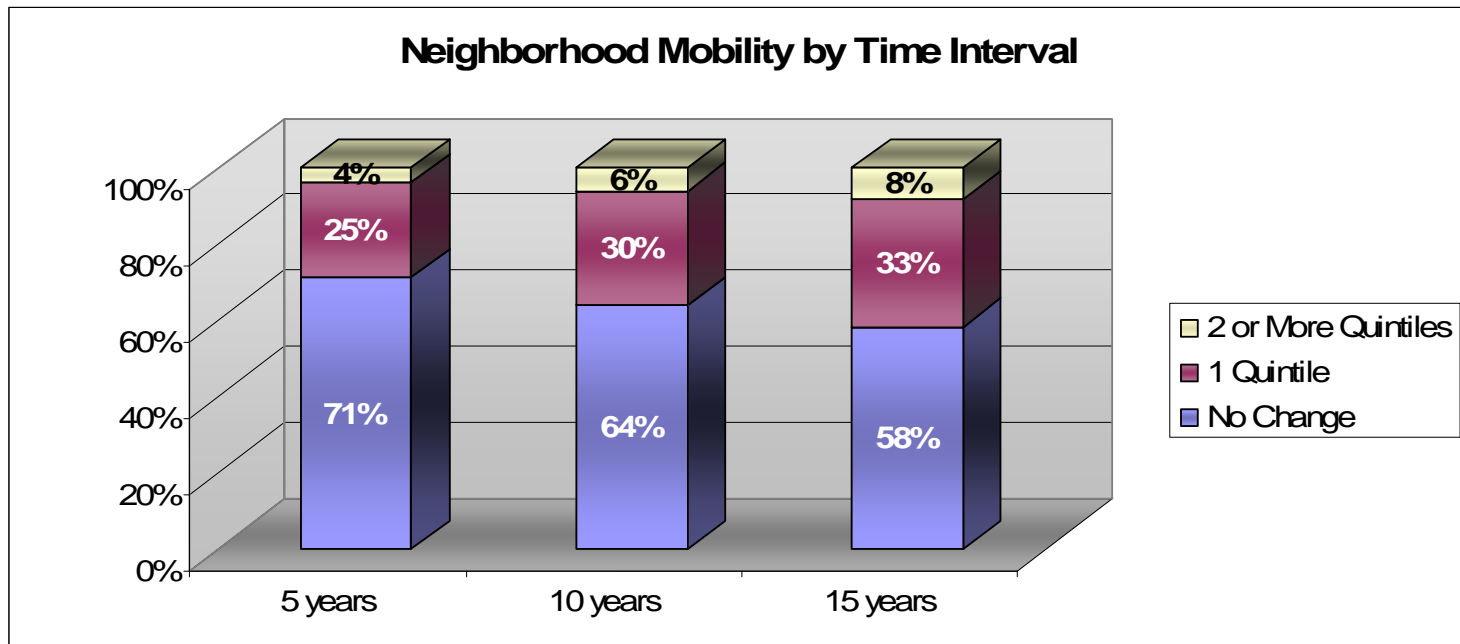
[www.rw-ventures.com/RWteam](http://www.rw-ventures.com/RWteam)

A Project of **Living Cities**

by  
RW Ventures, LLC



# Neighborhood Change Is a Slow Process



***Over 15 years, most neighborhoods do not change their position relative to other neighborhoods in the region.***

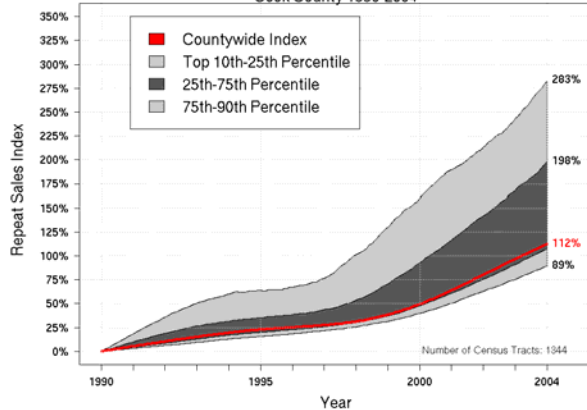
# Target Analysis to Neighborhoods with Different Degrees of Change

| Median Sales Price Transition Matrix<br>Cleveland, 1990-2004 |                |             |       |       |       |
|--|----------------|-------------|-------|-------|-------|
|  | Final Quintile |             |       |       |       |
| Initial Quintile   | 1              | 2           | 3     | 4     | 5     |
| 1  | 76.9%          | 15.4%       | 7.7%  | 0.0%  | 0.0%  |
| 2  | 5.1%           | 51.3%       | 25.6% | 15.4% | 2.6%  |
| 3  | 2.6%           | 26.3%       | 26.3% | 39.5% | 5.3%  |
| 4  | 7.7%           | 2.6%        | 28.2% | 23.1% | 38.5% |
| 5  | <b>7.7%</b>    | <b>5.1%</b> | 10.3% | 23.1% | 53.8% |

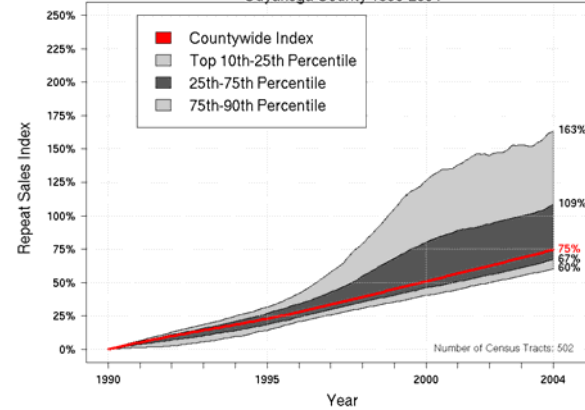
*In Cleveland, 13% of all the tracts at the bottom of the distribution in 1990 moved up to the top 2 quintiles 15 years later.*

# Neighborhoods and Regions

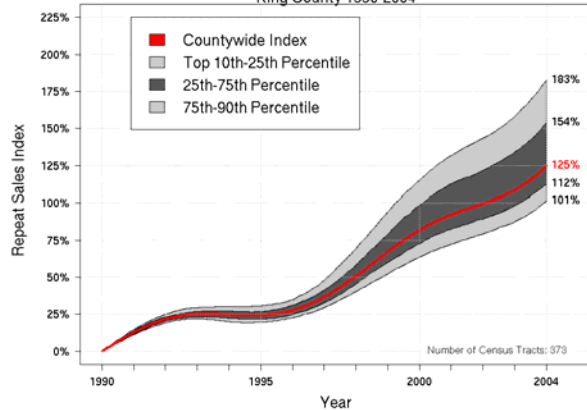
Variation of appreciation trends across Neighborhoods  
Cook County 1990-2004



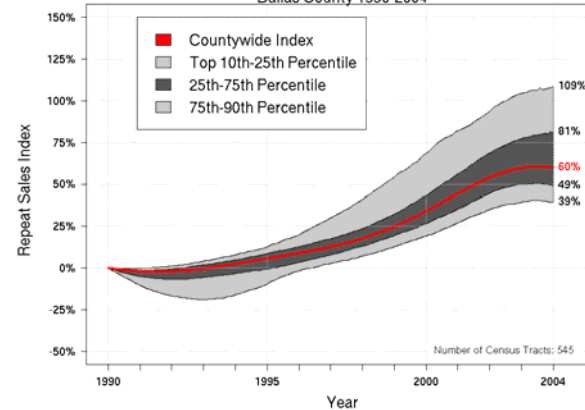
Variation of appreciation trends across Neighborhoods  
Cuyahoga County 1990-2004



Variation of appreciation trends across Neighborhoods  
King County 1990-2004



Variation of appreciation trends across Neighborhoods  
Dallas County 1990-2004



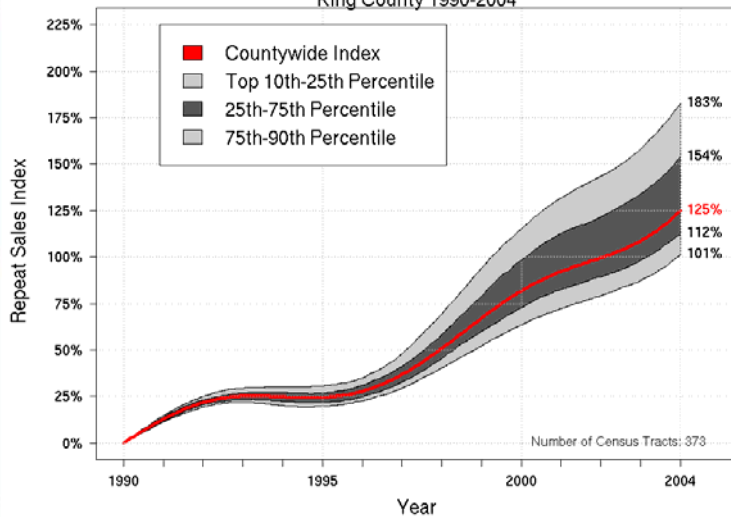
***Most neighborhoods follow their region closely, but there are some exceptions***

# Neighborhoods and Regions

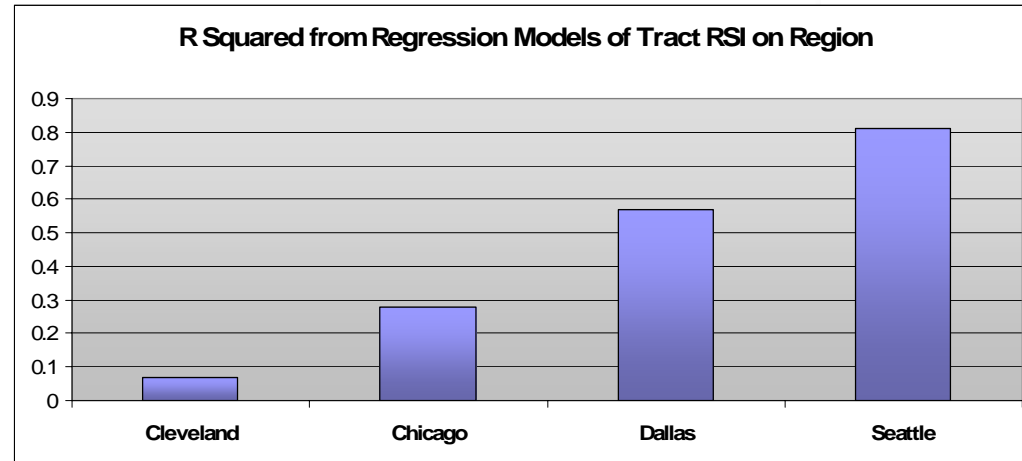
- Across Cities, 35% of Neighborhood Change is Accounted for by Regional Shifts
  - Regional shifts are more important in some regions than others

Variation of appreciation trends across Neighborhoods

King County 1990-2004



R Squared from Regression Models of Tract RSI on Region



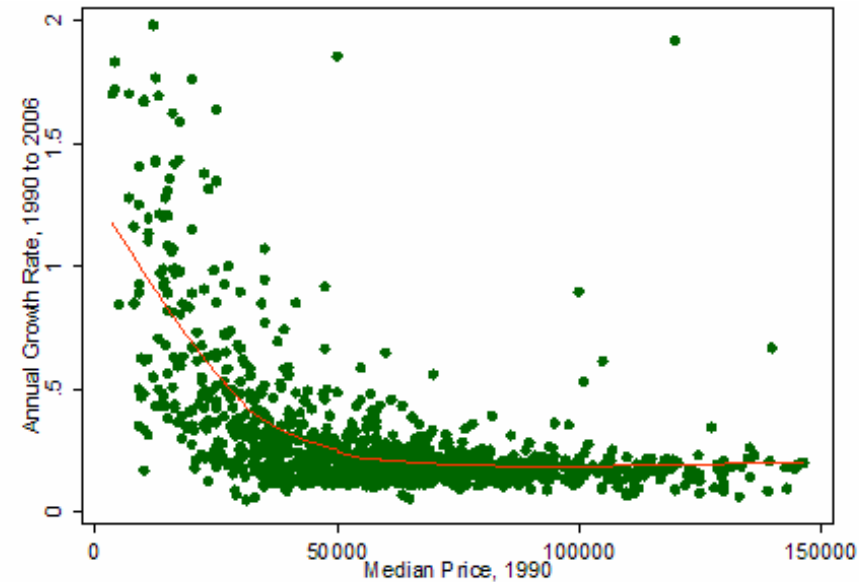
**Localized movement in Cleveland; large regional impact in Seattle**



# Neighborhood Convergence

## Sigma and Beta Convergence in Cook County, 1990-2006

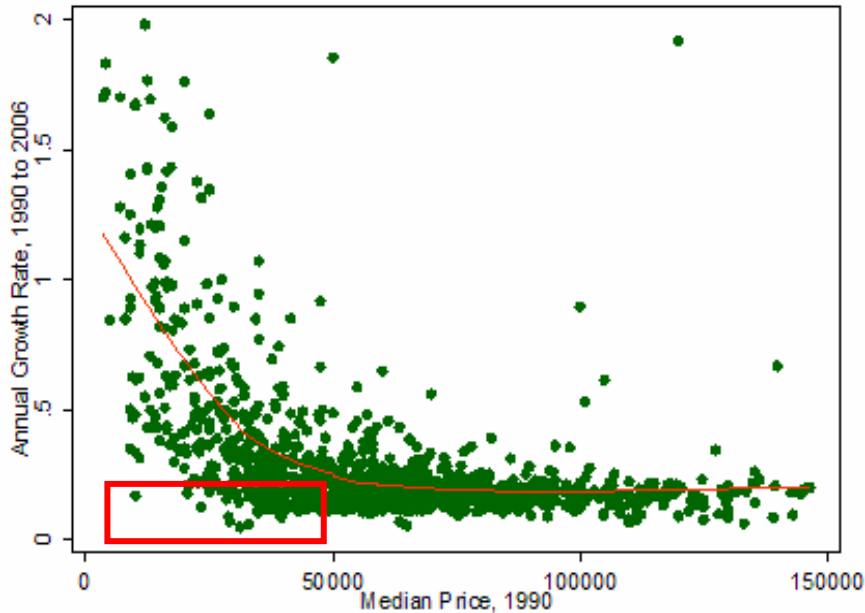
| Variables   | Obs. | Mean                            | Std. Err. | Std. Dev.         | [95% Conf. Int.] |        |
|---|------|---------------------------------|-----------|-------------------|------------------|--------|
| ln_med_1990   | 1231 | 11.326                          | .01781    | .62516            | 11.291           | 11.361 |
| ln_med_2006   | 1307 | 12.419                          | .01414    | .51126            | 12.391           | 12.447 |
| Combined  | 2538 | 11.889                          | .01566    | .78921            | 11.858           | 11.919 |
| Ratio = sd (ln_median_y1990) / sd (ln_median_y2006) |      |                                 |           | f = 1.4952        |                  |        |
| Ho: Ratio = 1                                       |      | Degrees of freedom = 1230, 1306 |           |                   |                  |        |
| Ha: ratio < 1                                       |      | Ha: ratio != 1                  |           | Ha: ratio > 1     |                  |        |
| Pr(F < f) = 1.0000                                  |      | 2*Pr(F > f) = 0.0000            |           | Pr(F > f) = 0.000 |                  |        |



*The economic theory of convergence appears to apply at the neighborhood level as well, as neighborhoods tend to “catch up” with each other.*

# Neighborhood Convergence

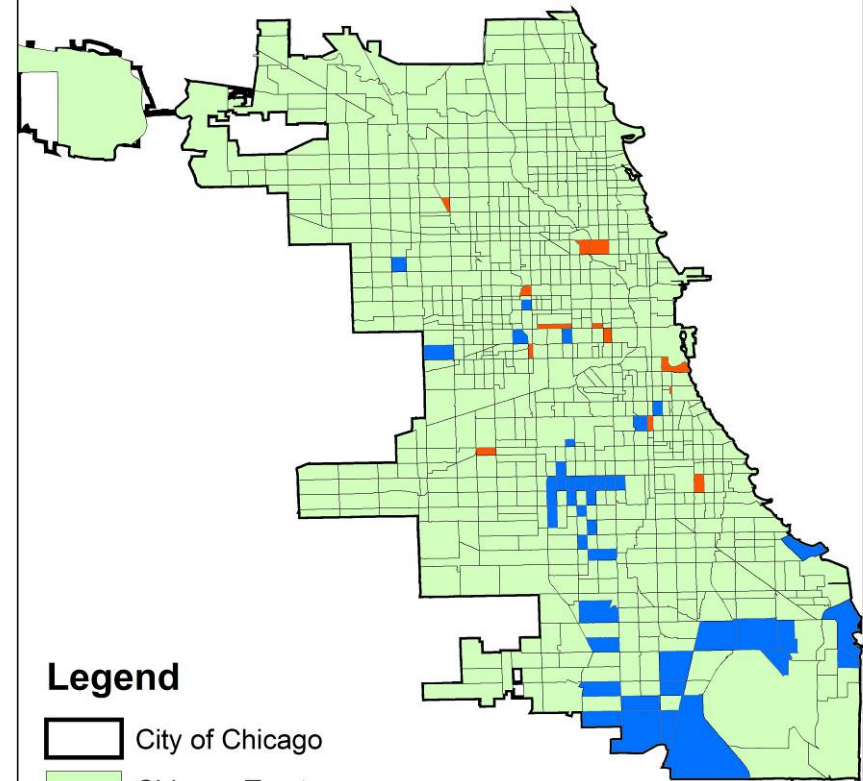
Beta Convergence in Cook County, 1990-2006



*Why Do Some  
Neighborhoods Converge  
while Others Don't?*

Neighborhoods Exhibiting "Divergence"

Chicago Tracts, 1990-2006



## Legend

- City of Chicago
- Chicago Tracts
- Low Initial Values, Low Growth
- High Initial Values, High Growth

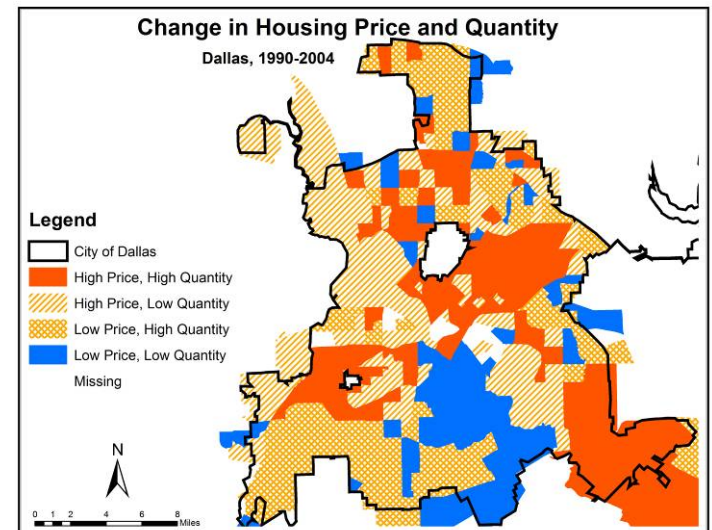
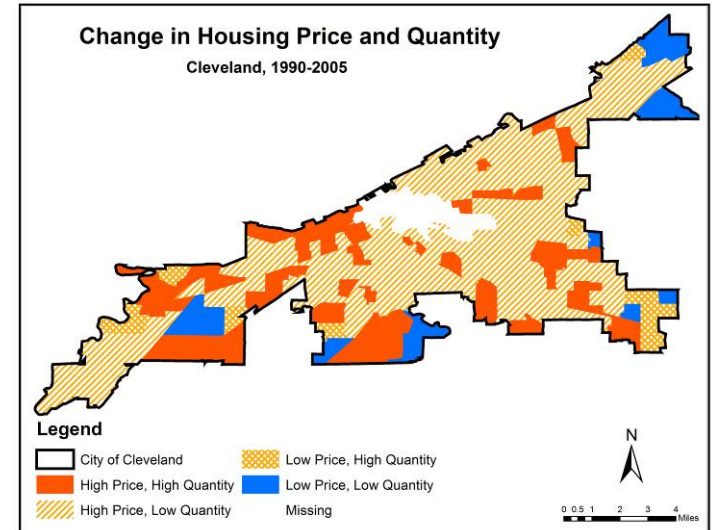
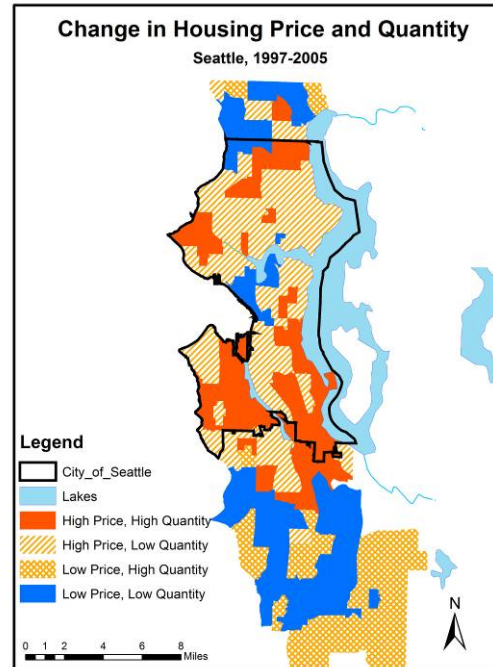
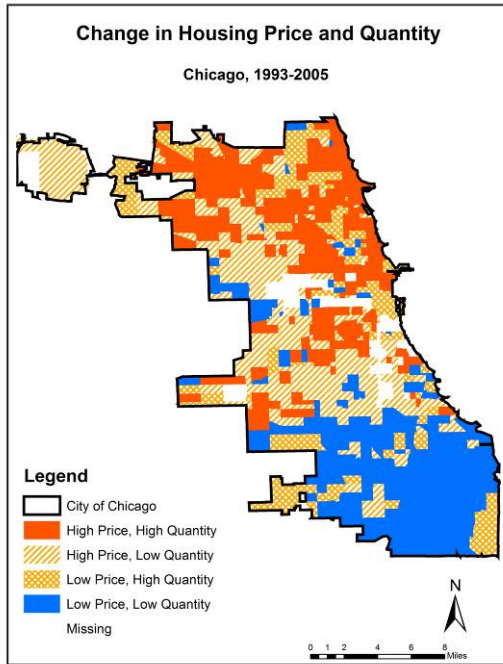


# Neighborhood Change in 3D

- **Change in Demand for a Neighborhood will Result in:**
  - Change in Price
  - Change in Quantity
  - Change in Quality
- **The Combination of these Three Dimensions Gives Rise to Different Types of Neighborhood Change**



# Combining the Dimensions

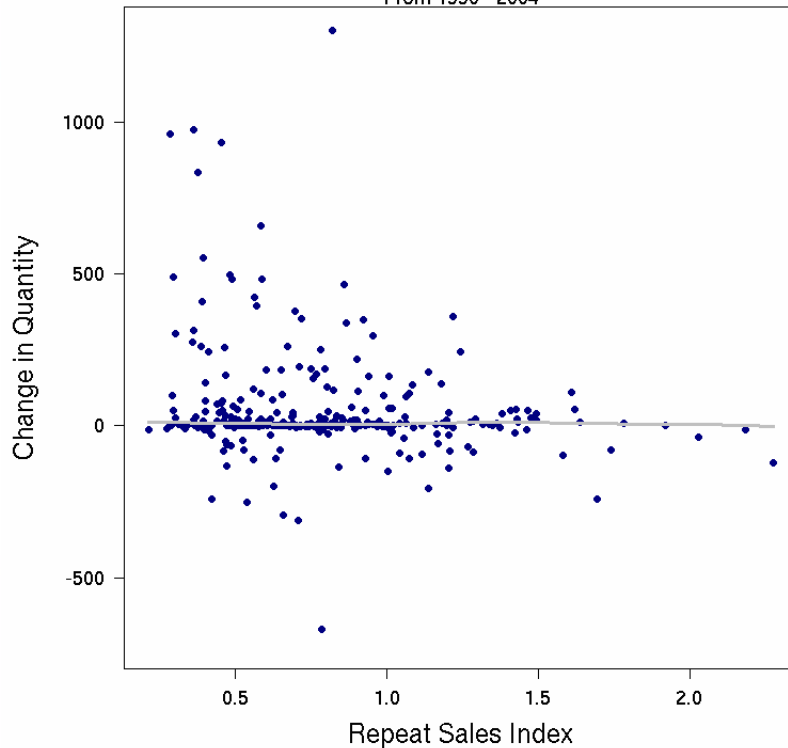


***Why Do Some Poor Neighborhoods Show Explosive Growth While Others Remain "Cold"?***

# Relationship of Price and Quantity

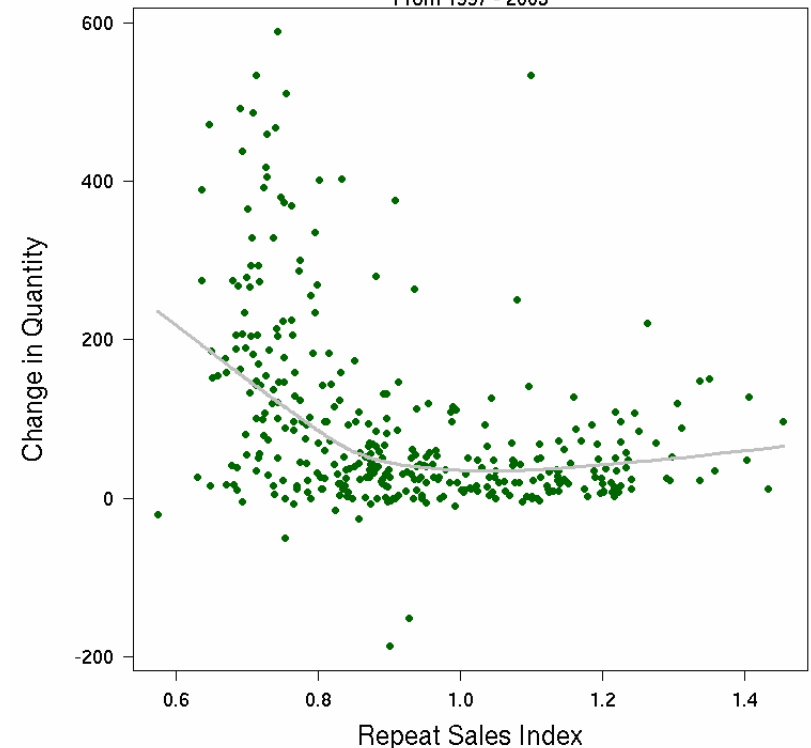
Appreciation vs. Change in Quantity in Dallas

From 1990 - 2004



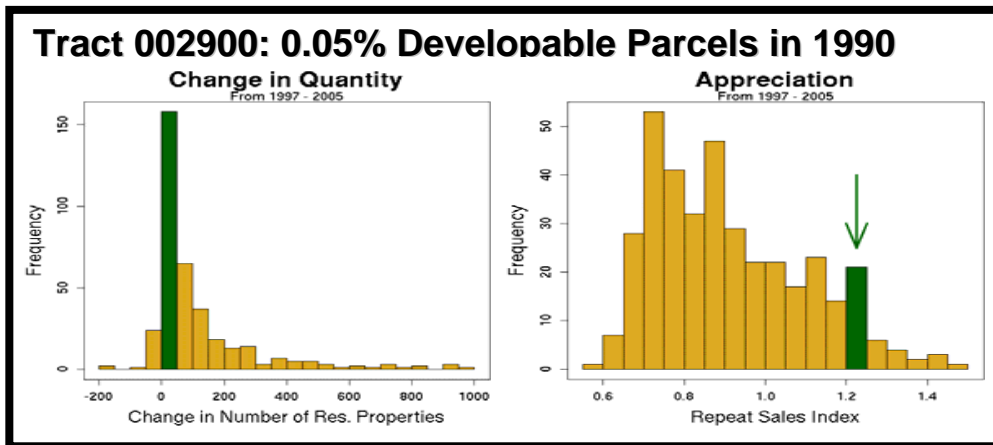
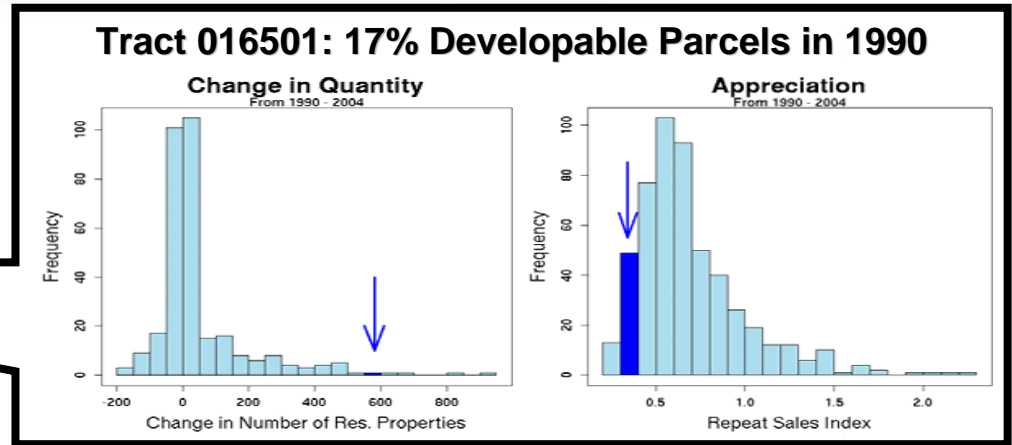
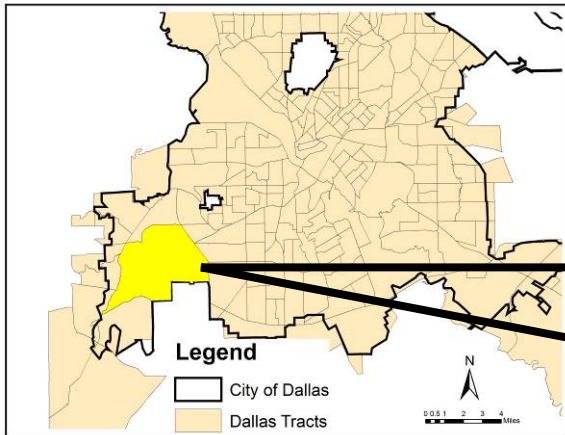
Appreciation vs. Change in Quantity in Seattle

From 1997 - 2005



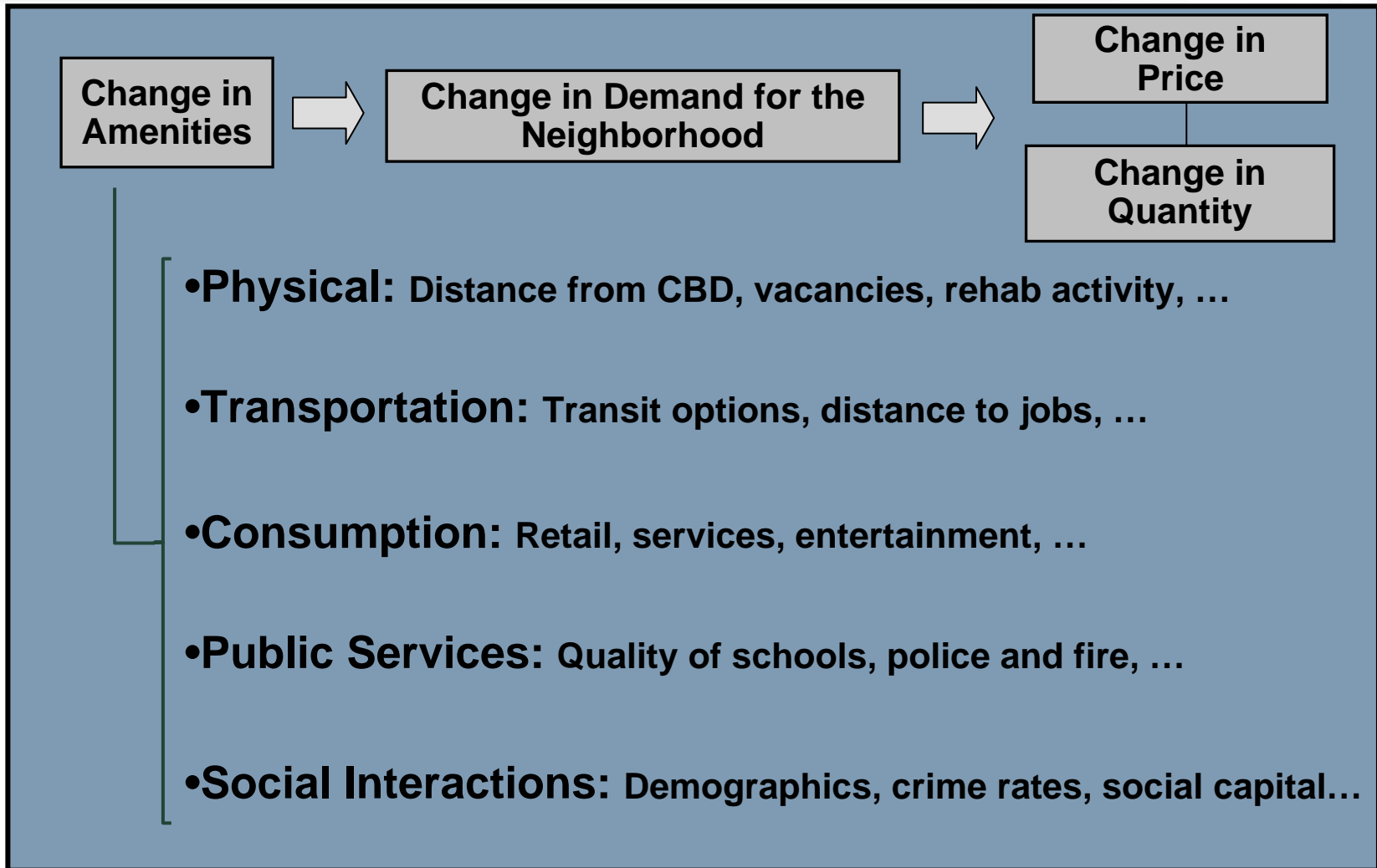
***Price and quantity are more negatively correlated in places where there are greater constraints on the supply of new housing units***

# New Development can Help Preserve Affordability



***Neighborhoods with lower supply elasticity are at greater risk of displacement, as housing prices will increase faster than in areas where more housing units can easily be developed***

# Drivers Model and Data



# Drivers Analysis: Emerging Context and Story Lines

- Cities and urban neighborhoods are coming back
  - In this period of transition, the drivers of neighborhood change are evolving
- Neighborhood change occurs primarily through mobility
- Density matters
- Race is still a factor
- Neighborhood spillovers are important
- Context matters (starting point, type, ...)

