Dynamic Neighborhood Taxonomy

A Project of Living Cities

Presentation by
Robert Weissbourd, Riccardo Bodini
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
- Knowledge: Gap between practitioners and academics: need “Clinical Economics” (Sachs)
- Tools: Few decision systems for neighborhood practitioners and investors
Comprehensive Neighborhood Taxonomy

**Dimensions → Neighborhood Metrics**
- Business
- Housing
- People
- Amenities

**Evolution**
- Improvement or Deterioration within Type
- Gradual vs Tipping Point
- From One Type to Another

**Typology**
- Port of Entry
- Bohemian
- Retirement
- Urban Commercialized

**Drivers**
- Employment
- Education
- Crime
- Housing Stock
- Investment Activity

**Dynamic Taxonomy**
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
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

<table>
<thead>
<tr>
<th></th>
<th>p01</th>
<th>p01i</th>
<th>p01s</th>
<th>p01c</th>
<th>p05</th>
<th>p05i</th>
<th>p05s</th>
<th>p05c</th>
<th>p10</th>
<th>p10i</th>
<th>p10s</th>
<th>p10c</th>
<th>nb</th>
</tr>
</thead>
<tbody>
<tr>
<td>p01</td>
<td>0.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p01i</td>
<td>0.82</td>
<td>0.96</td>
<td>0.82</td>
<td>0.99</td>
<td>0.79</td>
<td>0.49</td>
<td>0.99</td>
<td>0.82</td>
<td>0.82</td>
<td>0.96</td>
<td>0.79</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>p01s</td>
<td>0.83</td>
<td>0.90</td>
<td>0.99</td>
<td>0.77</td>
<td>0.84</td>
<td>0.87</td>
<td>0.83</td>
<td>0.90</td>
<td>0.97</td>
<td>0.94</td>
<td>0.86</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>p01c</td>
<td>0.53</td>
<td>0.59</td>
<td>0.82</td>
<td>1.00</td>
<td>0.50</td>
<td>0.53</td>
<td>0.79</td>
<td>0.99</td>
<td>0.99</td>
<td>0.82</td>
<td>0.51</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p05</td>
<td>0.92</td>
<td>0.95</td>
<td>0.79</td>
<td>0.50</td>
<td>0.98</td>
<td>0.99</td>
<td>0.85</td>
<td>0.51</td>
<td>0.99</td>
<td>0.98</td>
<td>0.50</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p05i</td>
<td>0.92</td>
<td>0.95</td>
<td>0.79</td>
<td>0.50</td>
<td>0.98</td>
<td>0.99</td>
<td>0.85</td>
<td>0.51</td>
<td>0.99</td>
<td>0.98</td>
<td>0.50</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p05s</td>
<td>0.53</td>
<td>0.59</td>
<td>0.82</td>
<td>1.00</td>
<td>0.50</td>
<td>0.53</td>
<td>0.79</td>
<td>0.99</td>
<td>0.99</td>
<td>0.82</td>
<td>0.51</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p05c</td>
<td>0.53</td>
<td>0.59</td>
<td>0.82</td>
<td>1.00</td>
<td>0.50</td>
<td>0.53</td>
<td>0.79</td>
<td>0.99</td>
<td>0.99</td>
<td>0.82</td>
<td>0.51</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p10</td>
<td>0.84</td>
<td>0.90</td>
<td>0.97</td>
<td>0.75</td>
<td>0.85</td>
<td>0.88</td>
<td>1.00</td>
<td>0.77</td>
<td>0.83</td>
<td>0.86</td>
<td>0.51</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p10i</td>
<td>0.84</td>
<td>0.90</td>
<td>0.97</td>
<td>0.75</td>
<td>0.85</td>
<td>0.88</td>
<td>1.00</td>
<td>0.77</td>
<td>0.83</td>
<td>0.86</td>
<td>0.51</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p10s</td>
<td>0.85</td>
<td>0.90</td>
<td>0.97</td>
<td>0.75</td>
<td>0.85</td>
<td>0.88</td>
<td>1.00</td>
<td>0.77</td>
<td>0.83</td>
<td>0.86</td>
<td>0.51</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>p10c</td>
<td>0.53</td>
<td>0.59</td>
<td>0.82</td>
<td>1.00</td>
<td>0.50</td>
<td>0.53</td>
<td>0.79</td>
<td>0.99</td>
<td>0.99</td>
<td>0.82</td>
<td>0.51</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>nb</td>
<td>0.11</td>
<td>0.13</td>
<td>0.11</td>
<td>0.07</td>
<td>0.13</td>
<td>0.13</td>
<td>0.12</td>
<td>0.07</td>
<td>0.13</td>
<td>0.13</td>
<td>0.12</td>
<td>0.07</td>
<td></td>
</tr>
</tbody>
</table>

---

**Optimizing sample size and fluid boundaries through extensive modeling and cross-validation procedures**
Unlike traditional repeat sales indices, the DNT RSI can be estimated for very small levels of geography.
Final Product: The DNT RSI

Less volatile than traditional RSIs
Final Product: The DNT RSI

More robust than traditional repeat sales indices at the tract level.
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
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)
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
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

Trend Break Analysis, Selected Tract

Legend
- City of Dallas
- Dallas Tracts
- Tract 009201

Tract 48113009201
Patterns of Interest: Neighborhood Decline

Cleveland, East Side

Trend Break Analysis, Selected Tract

Legend
- City of Cleveland
- Cleveland Tracts
- Tract 112400

Tract 39035112400
Patterns of Interest: Speculation?

Cleveland, East Side

Trend Break Analysis, Selected Tract

Legend
- City of Cleveland
- Cleveland Tracts
- Tract 112300

Tract 39035112300
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

Deviation of RSI from Region

Year


Possible Gentrification Pattern
Chicago Tracts, 1985-2006

Legend
City of Chicago
No Match
Pattern Matched
Possible Application: Anticipating and Managing Gentrification
Pattern “Spreading” to Nearby Tracts
Pattern “Spreading” to Nearby Tracts
Pattern “Spreading” to Nearby Tracts
Pattern “Spreading” to Nearby Tracts
Pattern “Spreading” to Nearby Tracts
Pattern “Spreading” to Nearby Tracts
Pattern “Spreading” to Nearby Tracts
Pattern “Spreading” to Nearby Tracts
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
## Developing New Tools for the Field

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

Strong Overall Appreciation, Range of Housing Options Is Narrowing

Lack of Affordable Housing

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

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?

40 Variables Tested
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?

Monte Carlo Simulation to Estimate Impact Variation with Distance

Comparing the Distance Effects of LIHTC projects on Local Housing Appreciation

Legend

"Inside" / "Outside" Differential

-8.91%
-7.33%
-5.93%
1.2%
2.33%
3.31%
3.37%
4.14%
4.62%
5.31%
6.31%

Homes within 1000 ft of an LIHTC site appreciate at a 4% higher rate than homes between 1000 ft and 2000 ft.
Impact of LIHTC on Surrounding Properties

Estimated Distance Decay Function – LIHTC Projects

Distance from Intervention – Chicago Blocks (1 block = 1/8 mile = 660 ft)

DNT Repeat Sales Index, 1 = Furthest Away

Preliminary – For Illustration Purposes Only
Applying the Estimator to a Specific Project:
New Shopping Center in Chicago

Estimated benefits to the community: $29 million in increased property values, or an average of $1,300 per home owner
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

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
**Cleveland, 1990-2004**

<table>
<thead>
<tr>
<th>Initial Quintile</th>
<th>Final Quintile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>76.9%</td>
</tr>
<tr>
<td>2</td>
<td>5.1%</td>
</tr>
<tr>
<td>3</td>
<td>2.6%</td>
</tr>
<tr>
<td>4</td>
<td>7.7%</td>
</tr>
<tr>
<td>5</td>
<td>7.7%</td>
</tr>
</tbody>
</table>

*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.*
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

![Graph showing variation of appreciation trends across neighborhoods in King County, 1990-2004.](chart)

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

![Bar chart showing R Squared from regression models of Tract RSI on region.](chart)
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

Why Do Some Neighborhoods Converge while Others Don’t?
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”?

Legend
- City of Chicago
- High Price, High Quantity
- High Price, Low Quantity
- Low Price, High Quantity
- Low Price, Low Quantity
- Missing
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

- **Physical**: Distance from CBD, vacancies, rehab activity, ...
- **Transportation**: Transit options, distance to jobs, ...
- **Consumption**: Retail, services, entertainment, ...
- **Public Services**: Quality of schools, police and fire, ...
- **Social Interactions**: Demographics, crime rates, social capital...
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, …)