Measuring Neighborhood Stability

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Introduction

As a result of the increasing availability of public data, advances in computing technology, and the development of specialized spatial analysis software packages such as ArcGIS, communities increasingly rely on data to inform planning decisions and to target neighborhood investments. With the increasing democratization of data, developing neighborhood indicators has become something of a cottage industry.

The National Neighborhood Indicators Partnership (NNIP, http://www.neighborhoodindicators.org) was formed in 1995 by the Urban Institute and other partners as a resource for communities wishing to take advantage of these developments to better understand and plan for their communities. The Baltimore Neighborhood Indicators Alliance (http://bniajfi.org) is a local NNIP partner and prepares its well-publicized *Vital Signs* reports that rely on a variety of indicators to assess the health of Baltimore's neighborhoods. Other NNIP partners in other cities have developed similar initiatives.

As part of Partnership for Action Learning in Sustainability (PALS), the spring 2016 semester of the URSP601 Research Methods course was organized to assist Howard County Housing and the Columbia Association with defining and measuring neighborhood stability. The class developed a neighborhood stabilization index (or multiple indices if appropriate) that can identify County neighborhoods at risk for declining property values, property abandonment, out-migration, and other economic and social problems that often send neighborhoods into a downward cycle of decay and disinvestment.

The project's goal was to identify reliable early warning indicators that can be used to identify potential signs of decline and disinvestment before a neighborhood actually begins to experience more widespread social disorder and economic decline. By identifying signals of future neighborhood instability, County planners can target housing and community development resources to ward off future decline.

The challenge is that neighborhood stability is an inherently dynamic concept, yet time series data are often not available. To overcome this limitation, the class relied on cross-sectional data to identify neighborhoods exhibiting low scores on static measures that have been associated with neighborhood instability. These static measures were then supplemented by time series data describing neighborhood conditions and housing sale prices, where feasible. All measures have been constructed at the census tract level, using the most recently available data from the U.S. Census, Howard County, and other sources.

In the project, students defined, constructed, mapped, and tested a theoretically-driven and empirically-sound neighborhood stability index. The index was developed in four interim reports completed throughout the semester each addressing different stages in the development of neighborhood stabilization indicators. The interim report assignments and their inter-relationships were:

Interim Report 1
Each student prepared this initial report individually; they are not included in this final report but were used to inform group-based interim reports that followed. Students individually surveyed neighborhood indicator literature to understand how to define, identify, and measure neighborhood stability based on U.S. Census data used in previous studies. Each report briefly summarized selected literature and recommended parsimonious indicators of neighborhood stability, that is, indicators based in the simplest explanation of the data.

Interim Report 2
In groups of four, students discussed the literature reviews completed individually and used the individual reports to identify parsimonious indicators of neighborhood stability. They selected variables that were combined into a neighborhood stability index or indices that were used to rank all County neighborhoods and identify census tracts exhibiting conditions of stability and instability. The results were mapped and shown in tabular form.

Interim Report 3
In the same groups, students described housing sale price trends for all County census tracts and examined the relationship between housing sale price trends and the neighborhood stability indicators constructed in Interim Report 2.

Interim Report 4
In the same groups, students used linear regression to estimate an index of neighborhood stability. Each regression provided an estimate of the average change housing prices by census tract, controlling for individual housing unit characteristics (housing type and unit age).

Each group compared the methods used in Interim Reports 2-4 and provided recommendations for measuring neighborhood stability in Howard County.

Each group's Interim Reports are provided in the pages that follow. Several key findings and considerations emerge from their work:

- There is no simple way to define neighborhood stability, but at a minimum, any conception should correspond with local intuitive knowledge about prevailing neighborhood conditions and should consider changes in neighborhood characteristics over time.
- Housing prices are useful proxy variables for a wide range of neighborhood conditions that are capitalized into housing prices, but trends in average housing prices (Interim Report 3) do not control for differences in housing unit characteristics that may also impact housing prices. Interim Report 4 corrects for this limitation to some degree, but any regression-based housing price index also has further limitations that should be considered:
    - The class's regression analysis provided a way to determine the marginal impact of changes in neighborhood conditions on housing prices, but a hedonic approach, which attempts to

value housing characteristics, is constrained by the availability of control data. A more precise estimate would rely on controls for a full range of structural unit characteristics.
    - The Case-Shiller "repeat sales" index has some advantages over the hedonic approach, because it does not require observations on housing unit characteristics. Under this approach, housing price changes are estimated by examining changes in housing prices for the same units that sold twice. This approach is limited in two important ways that rendered it infeasible for this project. First, repeat sales data requires a longer time series to construct a large enough sample, and second, there is an implicit bias in the repeat sales approach in measuring neighborhood stability, because unstable neighborhoods are likely to have few home sales.
- To describe non-housing price characteristics students were limited to U.S. Census data, primarily the American Community Survey. Several considerations emerge from the emphasis on this data source:
    - The class used the Geolytics Neighborhood Change Database to examine trends in census tract characteristics while holding census tract boundaries constant. Any future investigations of neighborhood stability by the County should rely on a similar method to adjust for changes in census tract boundaries over time.
    - The class did not rely on non-census measures of neighborhood conditions, but the County and Columbia Association may wish to supplement the indicators with additional local information sources, particularly on local code violations, vacancies, and crime. To ensure consistency with the approach used here, it is advisable to rely on time series data where possible.
    - The class defined neighborhoods in terms of census tract, but census tracts do not always correspond with the neighborhood boundaries recognized by local residents. For example, census tracts do not neatly correspond to Columbia Village boundaries. While census tracts are not ideal, we chose census tracts due to the larger number of ACS variables available at that geography and the smaller margins of error for certain variables, compared to block group estimates.
- The class did not examine data on home foreclosures due to the lack of available data, but some housing experts have suggested that changes in foreclosure rates are useful leading indicators of neighborhood change.
- The conceptual basis for much of this work draws on the neighborhood change literature. Several references cited in the Interim Reports are worthy of further examination, particularly the work by Galster, Quercia & Cortes (2000).

Executive Summary

In their work, students made two types of conclusions—about the effectiveness of the measured characteristics in revealing neighborhood stability and about the stability of particular census tracts in the County.

Measured Characteristics

- Given that housing sales prices and household incomes are higher than average in Howard County, the typical measures of neighborhood stability are not well-suited to the County.

- In some measures, for example, between the initial Neighborhood Stability Index and the housing price analysis, the majority of the data did not align. Census tracts identified by the Index as stable were identified as unstable in the housing price analysis.

Neighborhood Stability in Howard County

- The County's southwestern section, including Columbia, had the greatest concentration of extreme results: both high and low performing tracts. Its north and west sections were more uniform in their distribution, containing both stable and declining housing prices.

- Between 2000 and 2010, approximately 80% of Howard County experienced increases in average housing sales prices, with 25 census tracts experiencing increases of more than $100,000. Three census tracts, two located in the north of the County and one south of Columbia, showed increases in average housing sales prices of more than $300,000.

- Only two census tracts showed a decrease in average housing sales prices, with one of those census tracts experiencing an almost $350,000 decrease in average sales price of homes.

- The census tracts showing high increases in predicted home sales prices are clustered in the southern part of the County and around Columbia. Two are in the southern part of Columbia in the Owen Brown and Greenleaf areas (census tracts 606707 and 606704).

- Other census tracts with high increases in prices are west of the Patuxent Parkway and east of Columbia toward Waterloo Park.

- Roughly half of the County, those census tracts north and west of Columbia, exhibit low to moderate changes in sales prices. Only one census tract (601203), located southeast of Columbia, showed a decrease in sales price.

- Neighborhoods or census tracts directly within and around Columbia show the least stability, especially those census tracts south of Columbia and along the County's southern border. Given that this pattern has repeatedly resulted in our analyses, we recommend that the County further assess conditions in these census tracts to verify our findings.

- Although Columbia is often among the top 10 "Best Places to Live," the highest concentration of tracts at risk of decline are within the boundaries of Columbia.

- Census tract 6067.04 is the bottom-performing tract, is located in Columbia's Owen Brown Village area a community with some of the most dated housing stock in Columbia that also has crime issues.

- There are also several tracts at risk of decline in Columbia's Long Reach Village area where there are plans to revamp the center, which was declared a blight zone by the Howard County Council.

- Other tracts at risk of decline are in Clarksville, Laurel and Elkridge. However, with the exception of Clarksville, these areas also consist of stable tracts and those experiencing improvement or upgrade.

INTERIM REPORT 2 – CENSUS-DEFINED INDICES

Research documents the importance of place, specifically how a neighborhood's social, economic, and physical characteristics shape residents' experiences and quality of life. Furthermore, current research suggests that measuring certain characteristics can provide strong indicators of a neighborhood's overall health and "stability."[1] Such indicators can be used to identify the needs and disadvantages of declining or challenged neighborhoods, as well as highlight the strengths and advantages of more stable neighborhoods. However, to effectively identify and measure these indicators and their effects, a solid conception of what neighborhood well-being or stability is must first be formulated.

Most of the literature examines how neighborhoods weather change; a primary feature of neighborhood stability is a community's capacity to maintain healthy socioeconomic conditions amid changes.[2] Neighborhood stability is also often described in contrast to its inverse, neighborhood decline. Whereas decline represents the degradation of neighborhood qualities, stability may be defined by protective features such as steady housing values, economic growth, and high civic engagement. As Jane Jacobs said, "a successful city neighborhood is a place that keeps sufficiently abreast of its problems so it is not destroyed by them."[3] Thus, neighborhood stability implies a community that is not only healthy to begin with, but one that can also maintain its health and assets amid minor and major changes.

Approach

Measuring neighborhood stability can help communities establish early warning indicators of decline, and design appropriate strategies to address identified challenges. One of the most accessible and reliable ways of measuring neighborhood stability is by using datasets from the U.S. Census' American Community Survey (ACS). While the ACS is readily available and free, it is important to note that the measurement of neighborhood stability and how changes affect neighborhoods is a complex, multifaceted, cumulative process that makes it challenging to distinguish causes and effects.[4] Each context is also different; therefore, it is important to thoughtfully select and design analysis that tells the unique story of that place and population. Moreover, conclusions must recognize the limitations of the datasets and determine the best choice and use of given datasets. The ACS provides timely estimates between decennial census forms; however since the ACS collects a smaller sample size, it has a larger margin of error that should be considered when interpreting data outputs.

In this report, we have selected relevant ACS variables for the formation and analysis of neighborhood stability indices for Howard County, a relatively affluent suburban county with high levels of opportunity to housing and neighborhood quality, education, social capital, public health, and safety.[5] Datasets were carefully selected and outputs examined to construct contextually appropriate indices. This allowed for the process to more fully capture and describe possibly nuanced but important results. We measured neighborhood stability by analyzing each variable as a separate index or score, and then, with selected variables measuring socioeconomic and physical housing conditions, one index to specifically measure housing affordability, and the last Simpson's index to measure the impact of racial and ethnic diversity.

Measurement of each variable was designed to highlight patterns of neighborhood decline. For instance, if an "increase in the poverty rate" and a "decrease in housing affordability" occurred, then we hypothesized that the neighborhood would be at greater risk of decline. The only exception was in the case of the Simpson diversity index, which measures the probability that individuals randomly selected from a geographic unit will belong to the same racial or ethnic group[6]. The measurement of this index is

context-sensitive, and therefore an increase or decrease in racial and ethnic diversity does not always necessarily or consistently correlate with an increase or decrease in neighborhood decline. Based on our definition of neighborhood stability, we postulate that the following signs are indicators of decline or instability in a census tract:

1. *Increase in Poverty Rate* - the percent point change between 2000 and 2010 of persons living below the poverty level for the past 12 months.

2. *Increase in Percentage of Persons with Low Level of Educational Attainment* - the percent point change between 2000 and 2010 of persons 25 years or older with less than a bachelor's degree, including those with a high school education or less.

3. *Increase in Percentage of Persons with Lower Occupational Status* - the percent point change between 2000 and 2010 of persons employed in nonprofessional or non-managerial occupations (Galster, Quercia, and Cortes 709-715).

4. *Decrease in Median Family Income* - the percent difference between 2000 and 2010 in median family income.[7]

5. *Decrease in Housing Affordability* - the percent point change between 2000 and 2010 in owner-occupied and renter-occupied housing units for households whose housing costs are 30% or more of their income (Williams, Galster, Quercia, and Cortes, 714-719).

6. *Lack of Construction Growth in Housing Stock*- the percent of new housing units constructed within the last 10 years as calculated from 2010 ACS data.

7. *Increase in Renter-Occupied Housing Units* - the percent point change between 2000 and 2010 of renter-occupied housing units.

8. *Increase in Vacant Housing Units* - the percent point change between 2000 and 2010 of vacant housing units.[8]

9. *Increase in Housing Density Indicative of Overcrowding* - calculated as change in dwelling unit per acre (cross-checked with percentage of multi-family housing units).

10. *Change in Racial and Ethnic Diversity* - the difference between 2000 and 2010 as calculated by the Simpson's Diversity Index.

See Appendix for details on exact ACS datasets and calculations used for indices.

To obtain the most meaningful measures of the variables chosen, we collected data and calculated z-scores in both absolute value and percentage change for all census tracts. We used absolute values for Household Income and Median Income, and percentage change for Housing Density, Education Attainment, Poverty, Employment by Occupation, Renter-Occupied Housing Units, Vacant Housing Units, New Construction, and the Race and Ethnicity of Population. Galster, Quercia and Cortes' research has demonstrated that percentage change is a strong form of measuring threshold levels of change in neighborhoods (708-709). Therefore, we have analyzed the amount of percentage change in chosen variables locally and countywide, as well as at the census tract level. We then separated the census tracts

into quartiles of ranked change and use the highest quartiles of percent change to determine the threshold levels of change related to policy-relevant neighborhood decline.

It should also be noted that we adjusted the construction growth index—from calculating the change in percentage of new construction between 2000 and 2010 to looking at the percentage of new construction in 2010 alone. The former approach was misleading and didn't allow for a strong comparison because it didn't accurately attribute new construction to the two time periods measured. We also decided not to use the percentage of in-moving population as an indicator because it was difficult to correlate changes in this variable with a certain direction of stability without supplemental data about the out-moving population or change in total population.

Results

Our calculation of the separate indicators showed that while all indicators were good predictors of decline, some were stronger than others. For instance, increased rates of low educational attainment appeared to have a strong effect, and usually appeared alongside other indicators of neighborhood decline. Increased rates of poverty and persons employed in non-professional and non-managerial occupations predicted similar risks for decline. Indicators of decline also tended to cluster in certain census tracts, showing something of a domino effect. In fact, the maps of indicators' effects show that less stable census tracts with a greater potential for decline overlap across multiple indices and are highly concentrated around Columbia and the south central part of the county.

On the other hand, increased rates of new construction in the last 10 years tend to be less related to the other indicators. For new construction rates, higher values indicated greater neighborhood stability and lower values indicated decline; however, outputs that indicated decline did not always coincide with other forms of decline. Moreover, sometimes a census tract that appeared to face risk factors for decline such as increased rates of poverty or decreased housing affordability, would show increased rates of new construction. We hypothesize that this outcome might point to an imbalance of growth and stability, whereas an apparent overall increase in stability due to construction of new housing units may eclipse other forms of decline, such as a decrease in housing affordability or median household income.

Upon computation and further research, the housing density variable proved to be a weak indicator of stability in Howard County. Reflecting the County's strict density zoning regulations, our housing density calculations showed a very low level of density across all census tracts, with the highest density levels of among all census tracts at 5.4 dwelling units per acre. We considered this far too low to be indicative of housing overcrowding, and therefore removed this indicator from final list of neighborhood stability indicator calculations and maps.

Our calculations of the Simpson's diversity index showed that, at least in Howard County, an increase in racial and ethnic diversity correlated with greater overall neighborhood stability. This was a particularly interesting finding, because other case studies and popular perception often depict the opposite to be true—that any change in diversity may indicate instability.[8] Further research could show the composition and amount of diversity that maximize neighborhood stability, which may underscore current levels of existing socioeconomic bias and inequality in the County.

While the calculation of chosen indices produced meaningful outputs, there are nonetheless limitations to our approach, and suggestions for improvement. For example, since poverty is determined at a national scale, it may not be the best indicator of those under financial distress at the local scale. Considering the high cost of living and standards in Howard County, this is very likely, and our poverty

rate index may not be sufficient in showing those living above the poverty line yet still in financial distress. One way to improve this, while still using on ACS data, may be to include people with a certain ratio of income to poverty level to capture those in slightly higher level income groups.

Some of the indices measure a similar characteristic of neighborhood stability in different ways, and may offset one another when examined together. For example, if there is an increase of persons with less than a bachelor's degree but a decrease of those employed in non-professional or non-managerial occupations in a certain census tract, such changes may cancel each other out. Similarly, an increased vacancy rate in a census tract experiencing high construction growth may mean a different thing than a similar change in a tract with little to no construction growth. Formulating an index that measures a combined effect of these changes may help focus on such characteristic of stability itself.

While a housing to income ratio of 30% or more is considered the threshold for measuring housing affordability, that ratio is not an equal burden across all income levels. For an average Howard County household, where median household incomes are among the highest in the country, a housing to income ratio higher than 30% may still be considered affordable. But the ACS data does not breakout households with income as high as the County's median household income.

Lastly, while the Simpson's Diversity Index is useful in measuring levels of diversity, it does not give a full picture of an area's racial and ethnic makeup. Not all changes in diversity have the same effect on neighborhood stability, and without information on the direction and racial categories contributing to change, it is difficult to predict how increases or decreases might be associated with stability. Comparing change in diversity across each racial group may help depict the type of change occurring, but that approach was outside this study's scope.

Overall, the selected mix of socioeconomic and physical variables and indices are good measures of neighborhood stability. With careful analysis, such measures can help communities identify areas at greater risk of decline and pinpoint the factors contributing to decline. Such analysis can help local governments develop more effective planning strategies. However, perhaps just as interesting and meaningful are the nuanced relationships among variables that may help emphasize socioeconomic disparities, patterns of growth imbalance, and persistent inequality.

Citations

[1] Galster, George C., Quercia, Roberto G. and Cortes, Alvaro. "Identifying neighborhood thresholds: An empirical exploration." *Housing Policy Debate* 11.3, (2000): 701-732. Print.

[2] Jennings, James. "Measuring neighborhood distress: a tool for place-based urban revitalization strategies", *Community Development*, 43.4, (2012): 465-466. Print.

[3] Jane Jacobs. "The Death and Life of Great American Cities." (Chapter 2) in Campbell and Feinstein (eds.), *Readings in Planning Theory*. Cambridge, MA: Blackwell Publishers, 3rd Edition, 2012.

[4] Williams, Sonya, George Galster, George, and Verma, Vandita. "Home Foreclosures as Early Warning Indicator of Neighborhood Decline." *Journal of the American Planning Association*, 79:3, (2013): 201-210. Print.

[5] Knaap, G. "Technical Memorandum #2 [Memorandum]". *National Center for Smart Growth Research and Education*. 2013. Print.

[6] NijKamp, Peter and Poot, Jacques. "Cultural Diversity: A Matter of Measurement." *Institute for the Study of Labor (IZA) Discussion Paper Series*, January 2015. Web, http://ftp.iza.org/dp8782.pdf.

[7] Schachtel, M. & Spruill, S. Making Ends Meet in Howard County. *Policy Analysis Center*, June 2011. Web, http://www.acshoco.org/Resources/Documents/makingendsmeet3.pdf.

[8] Hillier, Amy E., Culhane, Dennis P., Smith, Tony E., and Tomlin, C. Dana. "Predicting Housing Abandonment with the Philadelphia Neighborhood Information System." *Journal of Urban Affairs* 25.2, (2003): 91-105. Print.

[8] Galster, George C. and Tatian, Peter. "Modeling housing Appreciation Dynamics in Disadvantaged Neighborhoods." *Journal of Planning Education and Research* 29, (2009): 7-22. Print.

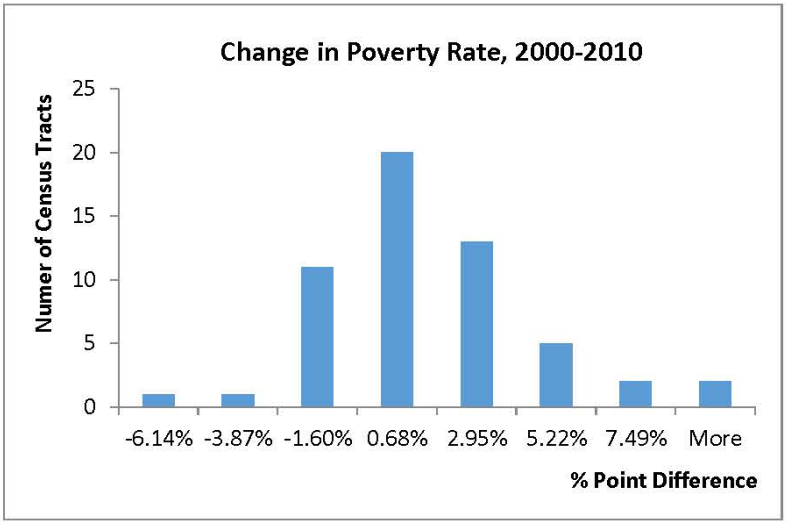
APPENDIX

A. Table of Indices

#	Abbv	Description	2000 Variables	2010 Variables	Calculation
1	POV	% point difference, persons below poverty level	POVRAT0N / POVRAT0	POVRAT1AN / POVRAT1AD	2010-2000
2	EDU	% point difference, persons 25+ years old with LESS than a bachelors degree	1 - EDUC160 / EDUCPP0	1 - EDUC161A / EDUCPP1A	2010-2000
3	EMP	% point difference, persons 16+ years old NOT employed in professional and technical occupations or as executives, managers, and administrators	1 - (OCC10 + OCC20) / INDEMP0	1 - (OCC11A + OCC21A) / INDEMP1A	2010-2000
4	INC	% change, median family income	MDFAMY0	MDFAMY1A	(2010-2000) / 2000
5	AFF	% point difference, housing units whose housing costs are 30% or above of their income, across all income levels	(M39PI0 + M49PI0 + M50PI0 + R39PI0 + R49PI0 + R50PI0) / OCCHU0	(M39PI1A + M49PI1A + M50PI1A + R39PI1A + R49PI1A + R50PI1A) / OCCHU1A	2010-2000
6	CON	% of housing units built between 2000-2010		(BLTYR051A + BLTYR041A) / TOTHSUN1A	2010
7	RENT	% point difference, renter-occupied housing units	RNTOCC0/OCCHU0	RNTOCC1A/OCCHU1A	2010-2000
8	VAC	% point different, vacant housing units	VACHU0 / TOTHSUN0	VACHU1A / TOTHSUN1A	2010-2000
9	DIV	Change in Simpson's Diversity Index	Wh:MINNHW0N, Bl:MINNHB0N, As:MINNHI0N+MINNHA0N, His:SHRHSP0N, Oth:MINNHO0N+MRANHS0N	Wh:MINNHW1AN, Bl:MINNHB1AN, As:MINNHI1AN+MINNHA1AN, His:SHRHSP1AN, Oth:MINNHO1AN+MRANHS1AN	2010-2000
*	DEN	change in dwelling units per acre	TOTHSUN0/AREALAND(in acreage)	TOTHSUN1A/AREALAND(in acreage)	(2010-2000) / 2000
*	MOB	% of householders who moved between 2000-2010	(YMVT0041A + YMVT0051A) / PRSOCU1A	(YMVT0041A+YMVT0051A) /PRSOCU1A	2010

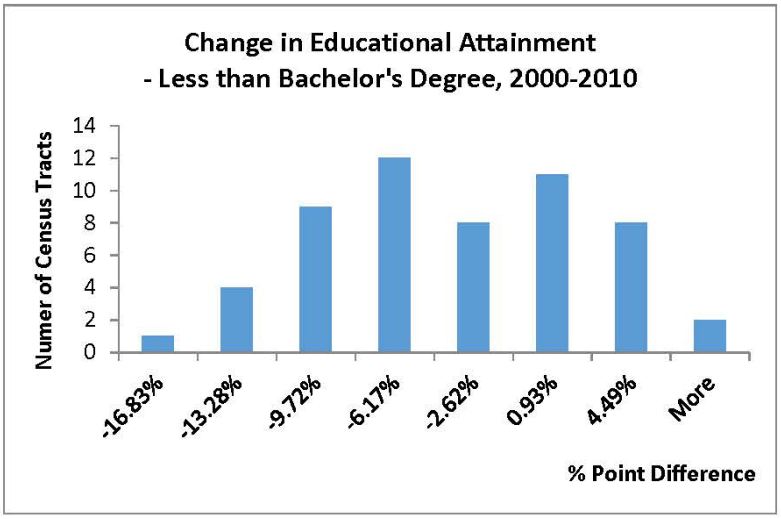
B. Index Calculations

1 Poverty Rate Index



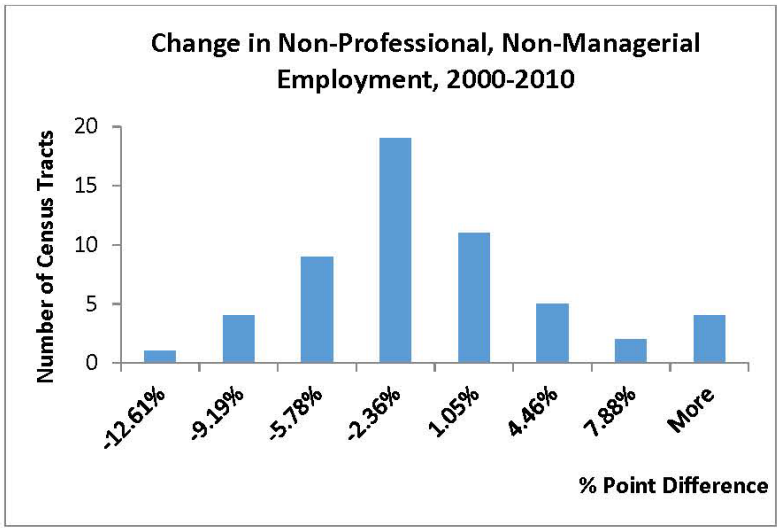
Mean	0.43%
Median	0.28%
Standard Deviation	3.05%
Sample Variance	0.09%
Range	15.90%
Minimum	-6.14%
Maximum	9.76%

2 Educational Attainment Index



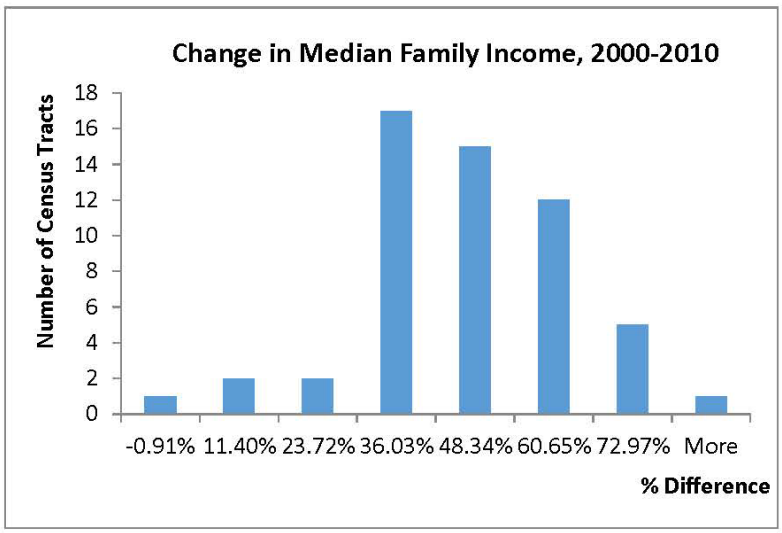
Mean	-5.16%
Median	-5.95%
Standard Deviation	6.17%
Sample Variance	0.38%
Range	24.87%
Minimum	-16.83%
Maximum	8.04%

3 Employment Index



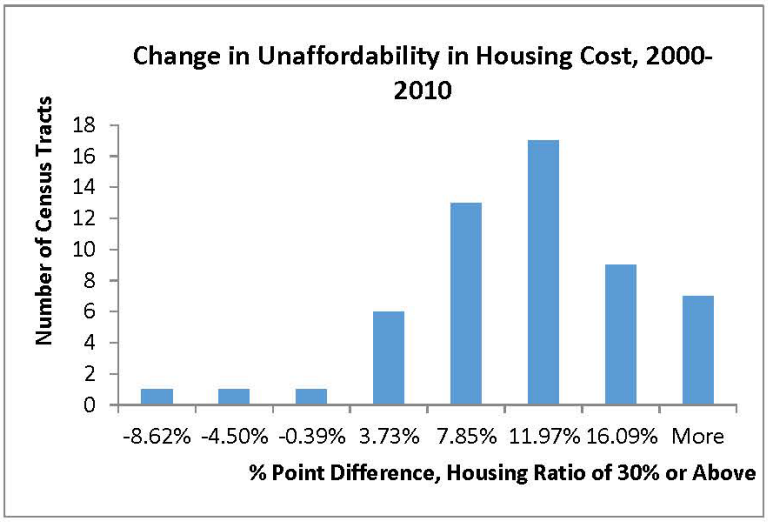
Mean	-2.55%
Median	-3.28%
Standard Deviation	5.42%
Sample Variance	0.29%
Range	23.90%
Minimum	-12.61%
Maximum	11.29%

4 Median Income Index



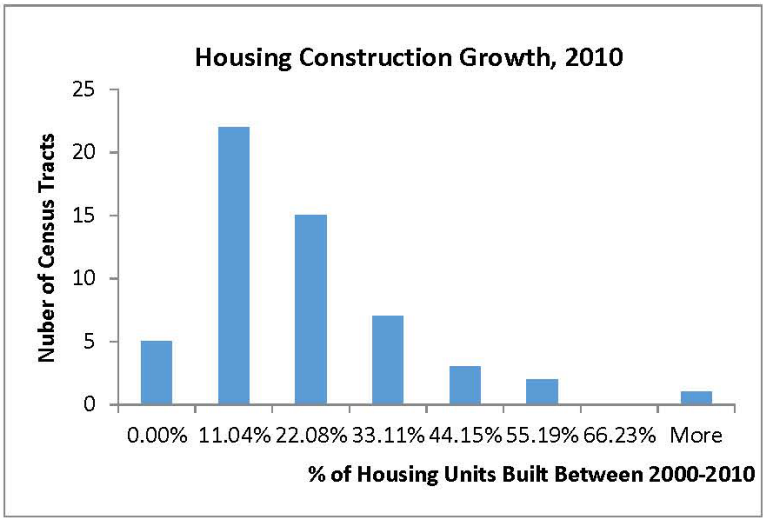
Mean	41.18%
Median	42.16%
Standard Deviation	16.96%
Sample Variance	2.88%
Range	86.19%
Minimum	-0.91%
Maximum	85.28%

5 Housing Affordability Index



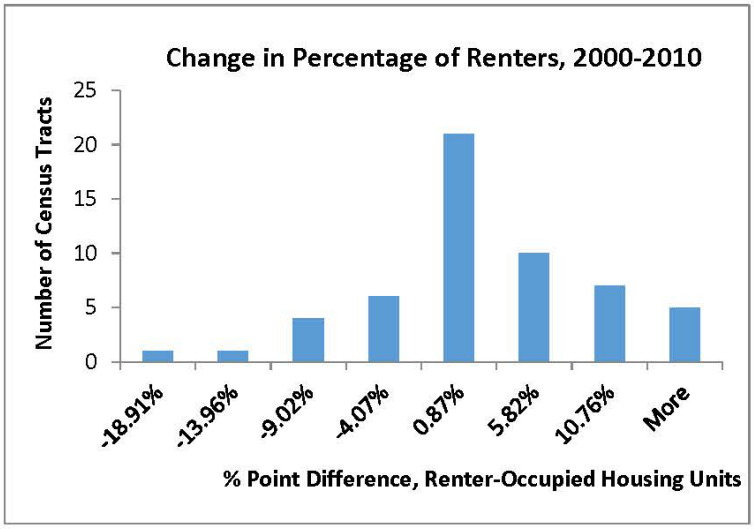
Mean	8.85%
Median	8.25%
Standard Deviation	5.83%
Sample Variance	0.34%
Range	28.82%
Minimum	-8.62%
Maximum	20.20%

6 Construction Growth Index



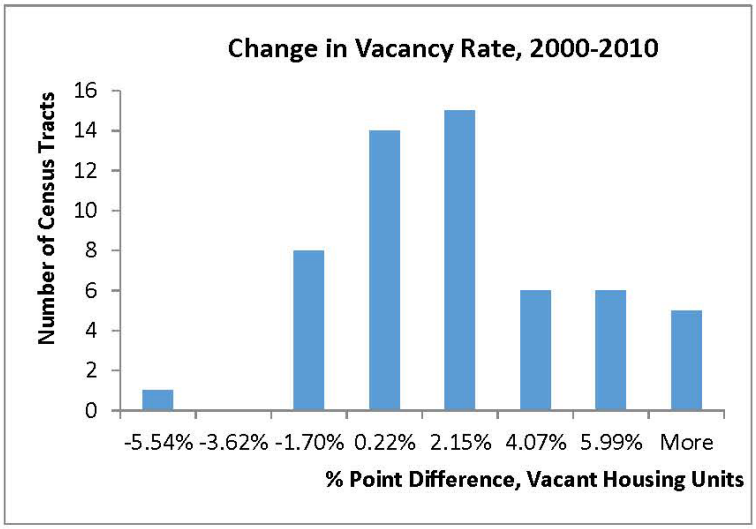
Mean	14.77%
Median	11.09%
Mode	0.00%
Standard Deviation	14.98%
Sample Variance	2.24%
Range	77.27%
Minimum	0.00%
Maximum	77.27%

7 Renter Index



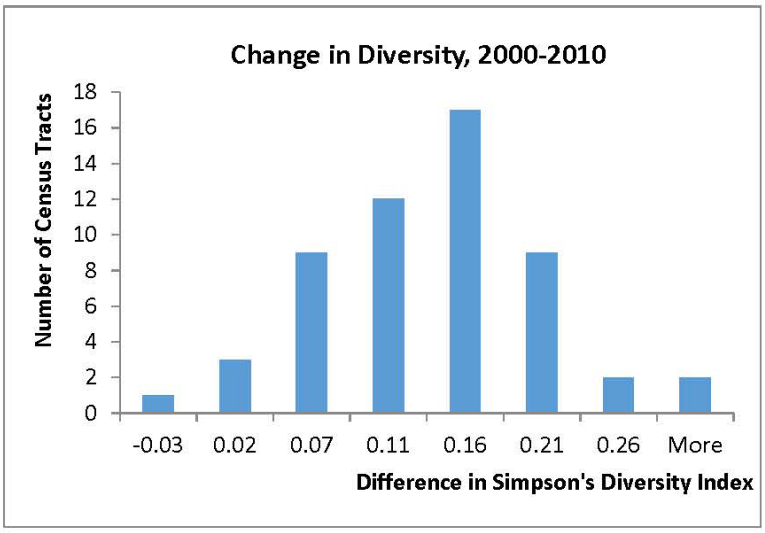
Mean	0.49%
Median	0.09%
Mode	2.25%
Standard Deviation	7.83%
Sample Variance	0.61%
Range	34.62%
	-
Minimum	18.91%
Maximum	15.71%

8 Vacancy Index



Mean	1.15%
Median	0.93%
Mode	1.76%
Standard Deviation	3.15%
Sample Variance	0.10%
Range	13.45%
Minimum	-5.54%
Maximum	7.91%

9 Diversity Index



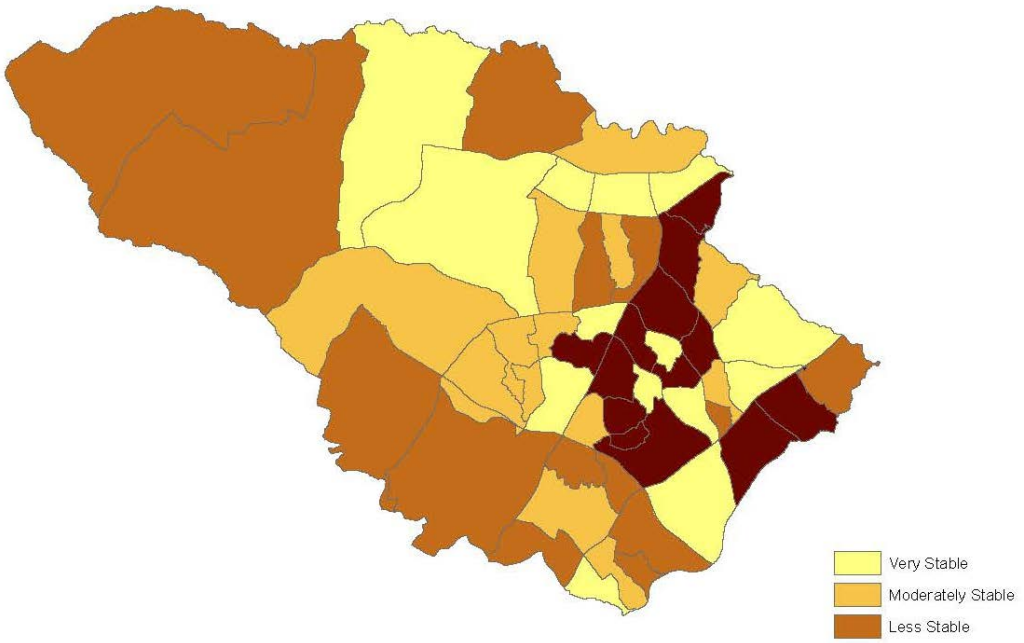
Mean	0.11
Median	0.12
Standard Deviation	0.07
Sample Variance	0.00
Range	0.33
Minimum	-0.03
Maximum	0.30

C. Z-Score Calculations of Neighborhood Stability Variables

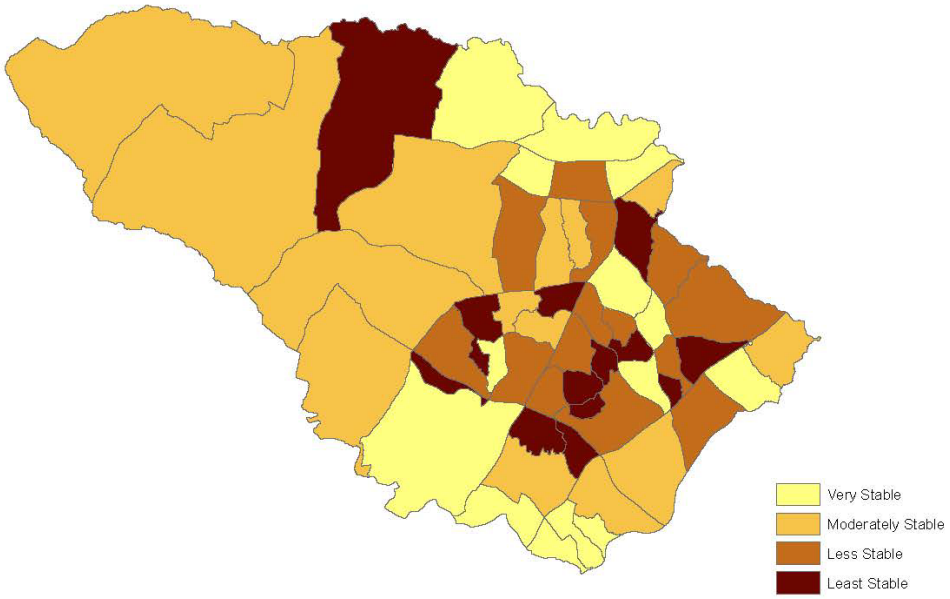
Z Score Comparison of Neighborhood Stability Indices

Census Tract	1 POV	2 EDU	3 EMP	4 INC	5 AFF	6 CON	7 RENT	8 VAC	9 DIV
24027601103	-0.83	1.28	-0.35	0.06	-1.06	0.49	-0.29	-0.24	0.150
24027601104	-0.70	0.61	-0.47	1.65	-1.07	1.28	0.64	-0.20	0.12
24027601105	0.78	-1.44	-0.33	2.60	0.49	-0.73	0.49	-0.34	0.12
24027601107	0.03	1.06	1.28	-2.41	1.17	-0.33	1.67	1.26	0.2
24027601108	-0.50	0.00	-0.53	0.25	-0.42	-0.88	-2.48	-0.71	0.13
24027601201	0.51	-0.33	-0.13	0.10	0.59	-0.32	-0.30	-0.15	0.23
24027601203	0.80	-0.12	-0.74	0.32	1.25	4.17	-0.35	0.72	0.22
24027601204	1.09	-1.54	-0.81	0.34	1.62	0.18	1.62	-1.15	0.01
24027602100	-0.24	-0.95	-0.20	0.85	-1.26	0.02	-0.04	0.31	0.15
24027602201	-0.95	-0.98	-0.63	0.49	-2.59	0.23	1.82	-0.84	0.14
24027602202	-0.86	0.87	0.42	-0.73	-0.16	-0.99	-0.24	-0.68	0.14
24027602302	1.00	-1.03	-1.25	-0.31	0.37	0.43	1.95	0.19	0.14
24027602303	-0.32	-0.12	0.19	0.66	-3.00	-0.04	0.38	-0.64	0.05
24027602304	0.36	-0.30	-1.05	0.06	-0.43	-0.71	-0.13	-0.73	0.07
24027602305	-0.05	-0.32	-1.36	-0.40	-0.73	-0.85	-0.13	-0.57	0.17
24027602306	0.33	0.43	0.18	-0.61	0.32	-0.22	1.30	-2.12	0.07
24027602600	-2.15	-1.10	-1.02	0.08	-1.04	1.50	-0.99	-0.22	0.09
24027602700	-0.19	-0.07	-1.04	0.84	-0.29	2.09	0.02	1.07	0.26
24027602800	0.86	0.93	-0.13	0.64	-1.97	-0.48	0.06	0.03	0.14
24027602900	2.19	-0.62	-0.75	-2.48	-0.22	-0.05	-0.05	1.76	0.11
24027603001	0.12	-1.33	-0.55	-0.76	0.49	1.99	0.61	-1.31	0.19
24027603003	-0.91	1.21	-0.44	1.54	-0.34	-0.02	0.05	-0.75	0.01
24027603004	-0.78	-0.58	-0.14	1.00	0.27	0.74	-0.44	1.46	0.14
24027604001	-0.05	-0.27	-1.03	-0.38	-0.27	-0.25	-0.30	0.84	0.02
24027604002	0.22	-0.14	-0.35	0.18	0.75	0.81	-0.60	-0.04	0.19
24027605102	0.55	-1.01	-0.52	0.52	0.64	0.64	0.04	0.42	0.17
24027605103	-0.04	-0.51	1.02	0.03	0.22	-0.60	-0.16	0.08	0.14
24027605104	-0.48	-0.57	0.15	1.37	1.13	0.55	-0.46	0.42	0.13
24027605401	-2.11	2.14	1.38	0.26	-0.12	-0.95	-1.09	2.14	0.06
24027605402	0.86	-0.68	-1.08	0.98	1.56	0.38	0.45	-1.20	0.1
24027605502	-0.32	1.53	-0.53	-1.51	-0.80	-0.89	0.23	-1.44	0.07
24027605503	-0.12	-0.13	1.83	-0.31	0.80	-0.85	-0.98	0.13	0.04
24027605504	-0.54	1.37	0.02	0.61	-0.55	0.24	-0.17	-0.85	0.18
24027605505	-0.16	0.06	0.32	-0.01	-0.11	1.92	1.29	-0.70	0.15
24027605601	-0.34	-0.93	2.03	-0.48	-1.09	-0.76	-1.02	0.12	0.03
24027605602	-1.22	0.82	0.18	-0.29	1.00	-0.60	-1.72	2.11	0.07
24027606601	0.84	0.31	0.93	0.18	-0.10	-0.54	1.23	-0.07	0.13
24027606603	0.57	0.58	2.18	-0.68	1.37	-0.99	-0.01	0.27	0.03
24027606604	-1.05	0.98	2.09	-2.25	1.95	-0.49	0.23	0.19	0.1
24027606606	0.60	1.20	0.63	-0.70	-0.42	-0.74	1.35	1.46	0
24027606607	-0.64	0.74	0.51	0.47	-0.85	-0.99	-2.39	-0.90	0.02
24027606701	-0.38	0.68	0.65	-0.46	-0.34	-0.99	-0.22	-0.86	-0.03
24027606704	3.06	1.55	0.45	-0.72	-0.11	-0.79	-0.27	0.28	0.18
24027606705	2.64	0.97	-0.03	0.47	0.19	-0.78	1.13	-1.22	0.02
24027606706	-1.28	-1.25	-1.86	0.98	1.30	0.85	-1.68	-1.48	0.03
24027606707	1.63	0.82	-0.16	-0.57	0.13	0.42	1.19	-0.61	0.07
24027606803	0.20	1.15	2.55	-0.10	1.25	-0.83	-0.14	-0.92	0.12
24027606804	0.05	2.01	0.97	-0.95	0.00	-0.99	-0.82	0.58	0.11
24027606805	-0.02	-1.35	-1.72	1.75	-0.48	0.84	0.17	-0.81	0.13
24027606806	-0.09	-0.59	-0.01	-0.46	-0.10	0.70	0.99	-0.40	0.3
24027606901	-1.29	-0.36	0.47	-0.28	-0.08	-0.55	0.51	1.09	0.12
24027606904	0.37	-1.30	0.96	-0.78	0.45	-0.73	-1.23	2.01	0.18
24027606905	0.56	-0.43	-0.47	-0.38	-1.01	-0.67	-0.22	1.05	0.16
24027606906	-1.18	-1.05	-0.40	1.40	1.10	-0.08	-1.62	0.53	0.08
24027606907	-0.41	-1.89	-1.36	-1.65	0.60	0.14	1.12	1.62	0.1

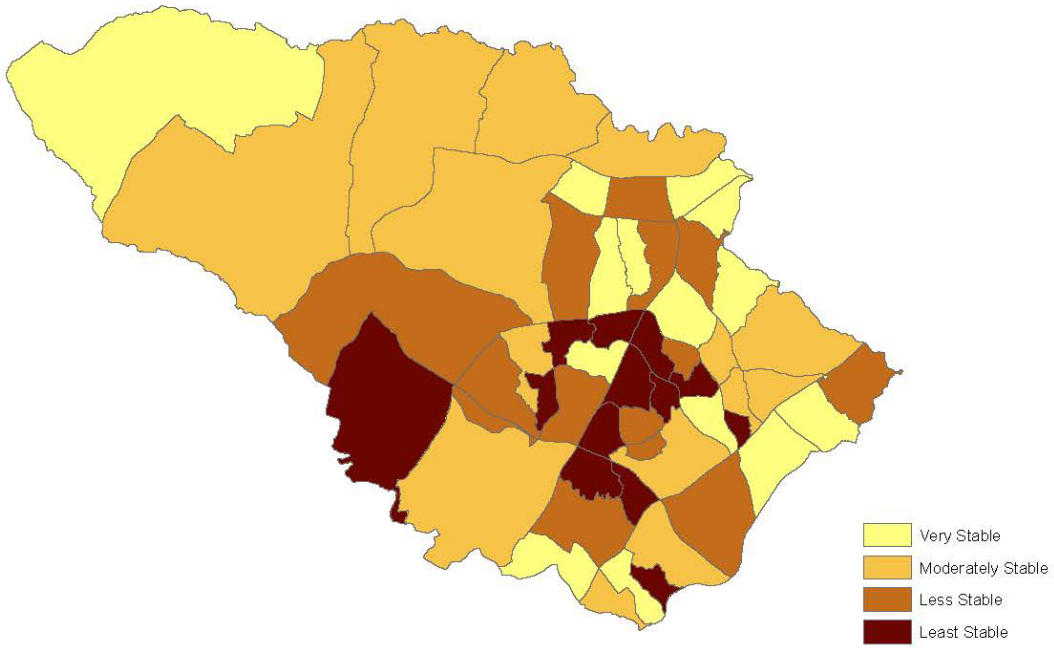
D. Neighborhood Stability Index Maps



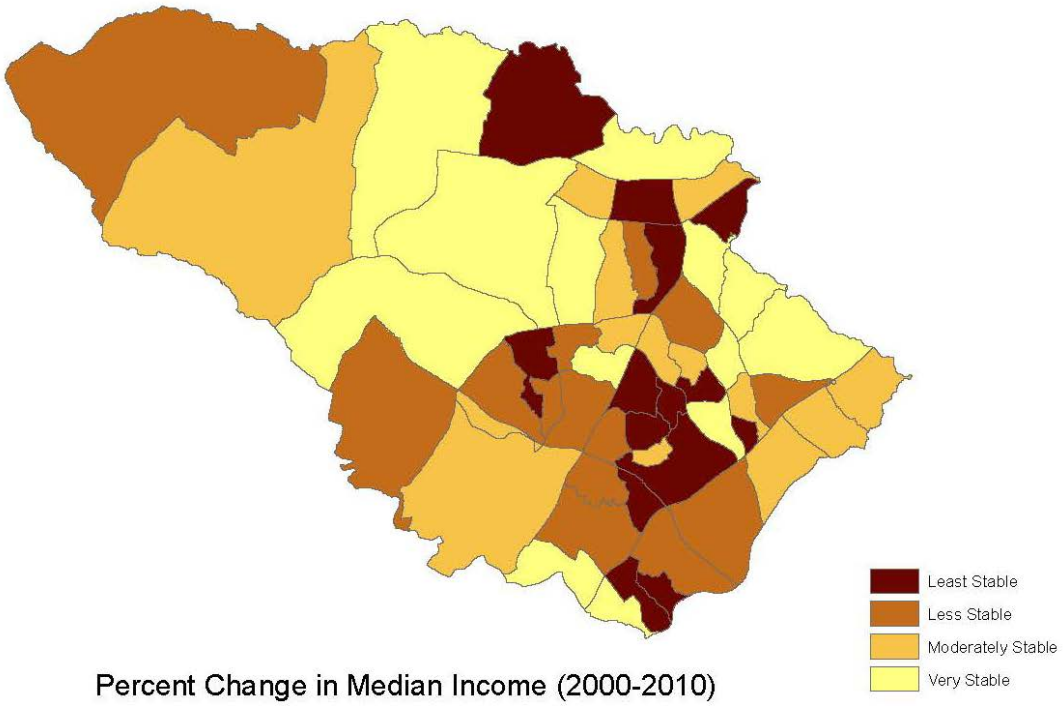
Percent Change in Poverty Rate (2000-2010)



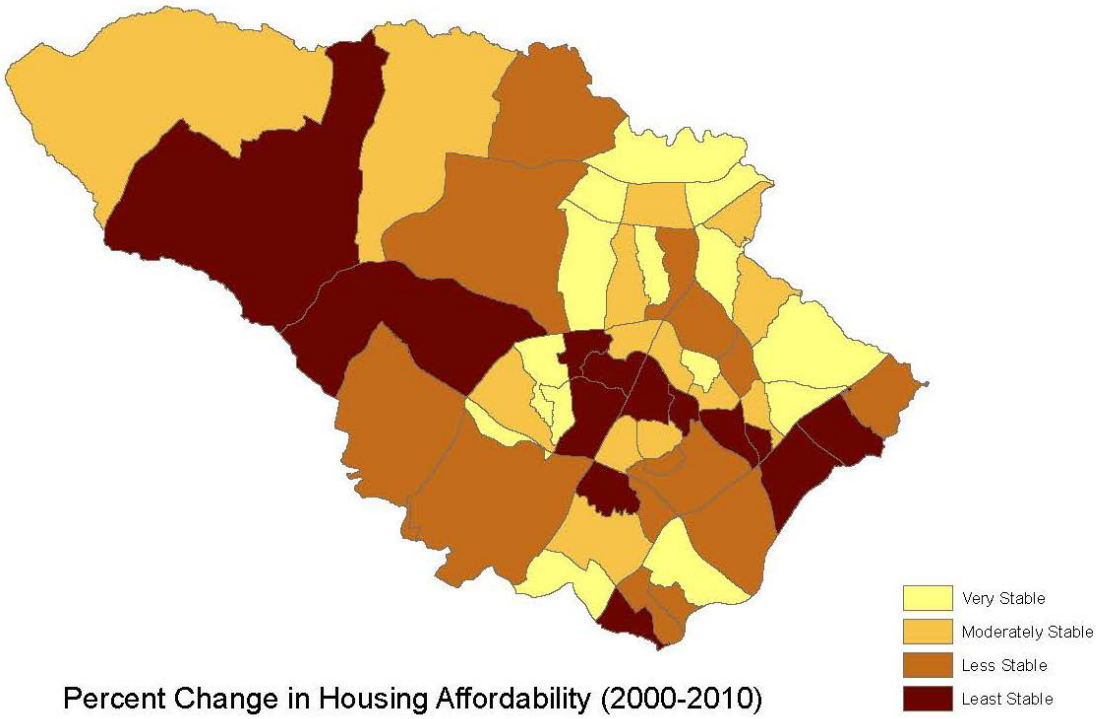
Percent Change in Population w/ Less than Bachelor's Degree (2000-2010)



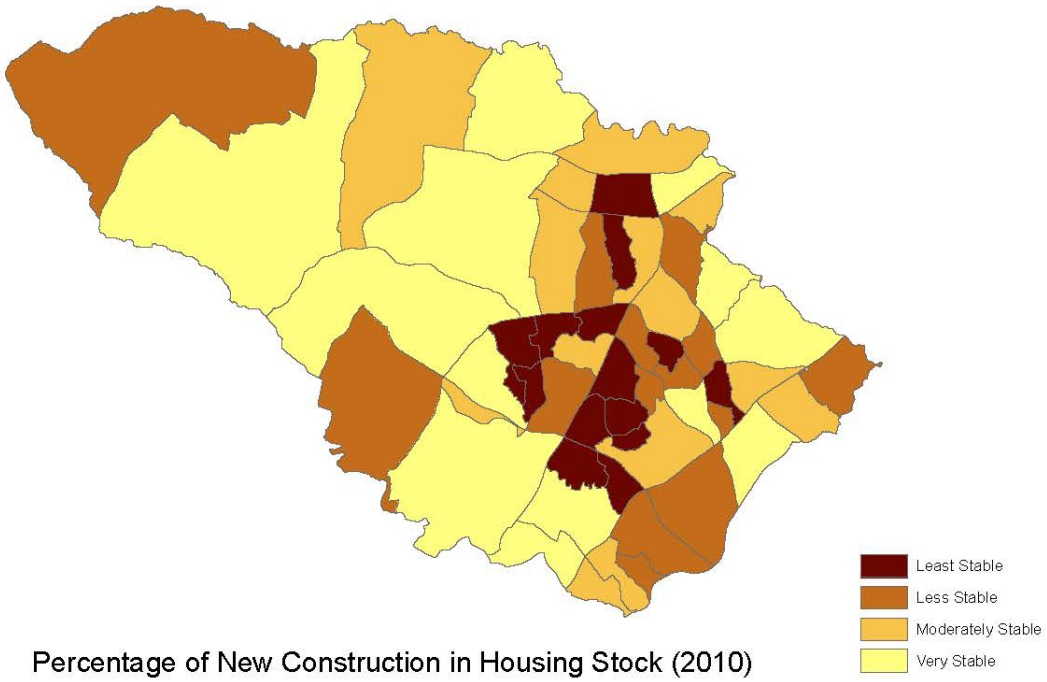
Percent Change in Non-Professional, Non-Managerial Employment (2000-2010)



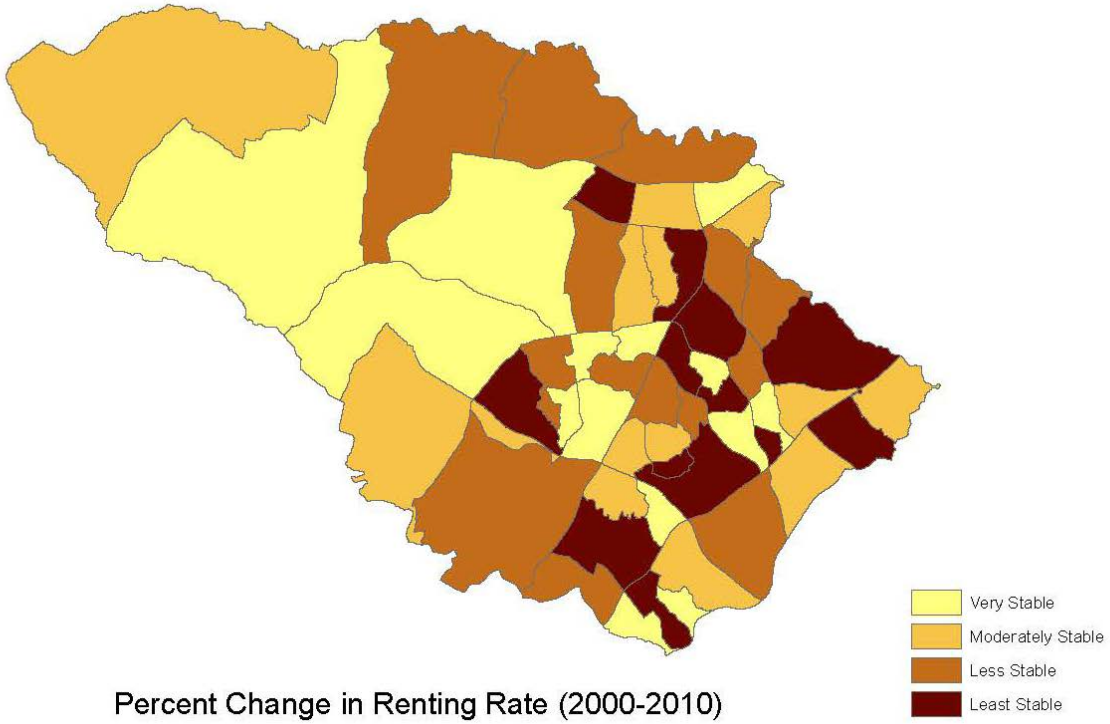
Percent Change in Median Income (2000-2010)



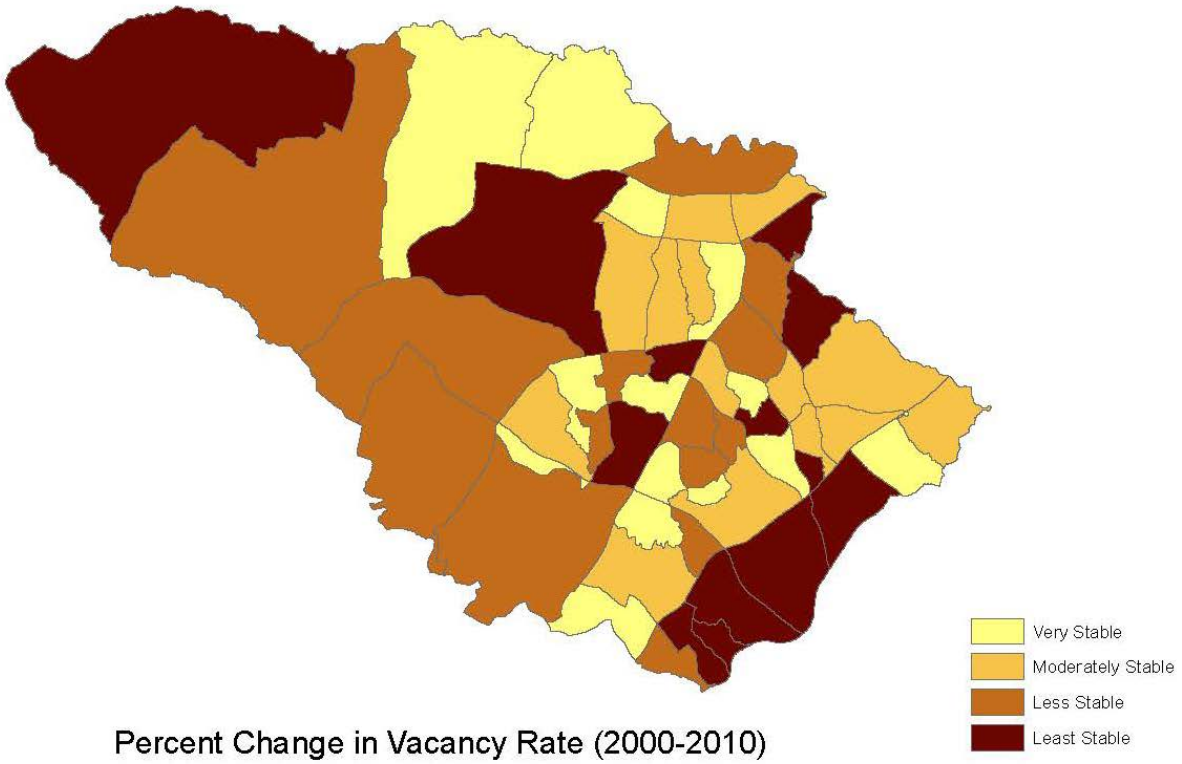
Percent Change in Housing Affordability (2000-2010)



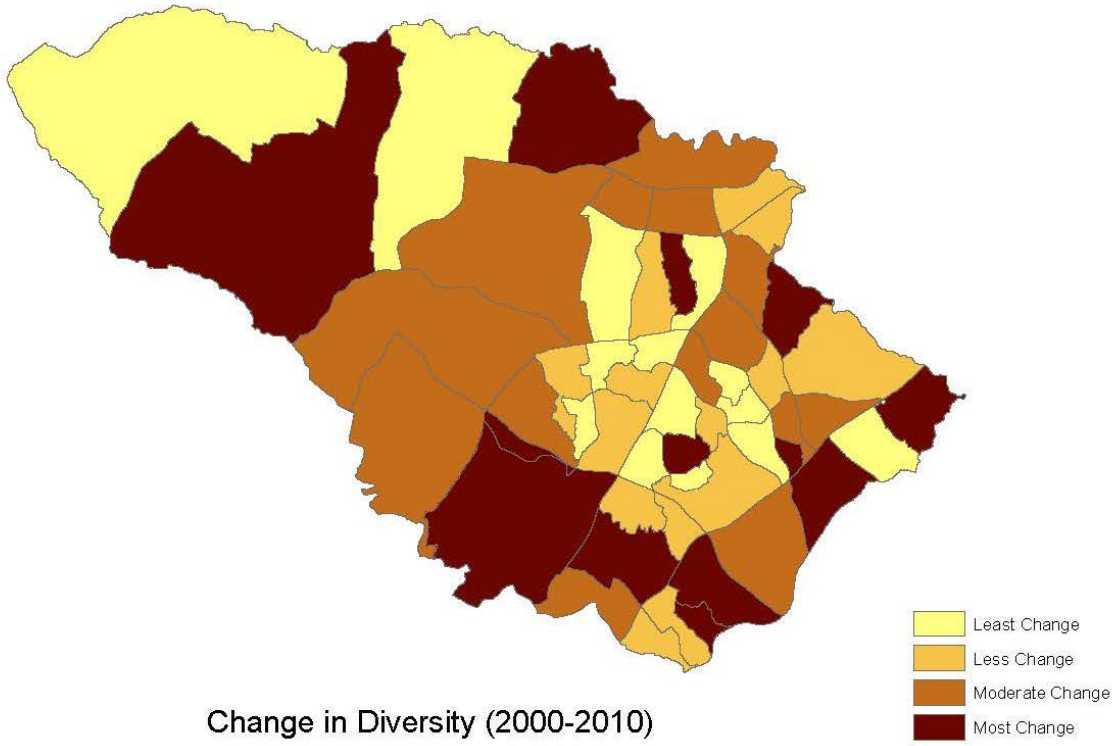
Percentage of New Construction in Housing Stock (2010)



Percent Change in Renting Rate (2000-2010)



Percent Change in Vacancy Rate (2000-2010)



Change in Diversity (2000-2010)

INTERIM REPORT 3 – HYPOTHESIS TESTING AND CORRELATIONS

Introduction

This report examines changes in average housing prices for all Howard County census tracts between 2000 and 2010 to identify where housing prices have been stable over time. To determine if there is consistency and a significant relationship among variables measured, we compared these results with the results from the neighborhood stabilization indices created and calculated in Interim Report 2. This comparison enabled us to verify whether the census tracts identified as stable would continue to exhibit such characteristics. This process has been an important step in analyzing neighborhood stability because it requires critical thinking about the indices and refining the overall approach for assessing neighborhood stability.

Summary of Indices

In this report, we identified the variables below as indicators for a stable neighborhood and calculated each as a separate index to measure their effects on stability within each census tract or neighborhood. Our calculations showed that increased levels of low educational attainment, poverty rates, and renter burden appeared to have strong effects on neighborhood decline. A strong effect is defined as decline in a given variable associated with, or occurring alongside, decline in other indices.

1. Increase in Poverty Rate
2. Increase in Percentage of Persons with Low Level of Education Attainment
3. Increase in Percentage of Persons with Lower Occupational Status
4. Decrease in Median Family Income
5. Decrease in Housing Affordability
6. Lack of Construction Growth in Housing Stock
7. Increase in Renter-Occupied Housing Units
8. Increase in Vacant Housing Units
9. Increase in Housing Density Indicative of Overcrowding of Houses
10. Diversity

Observations of potential associations among the indices in Interim Report 2 piqued our interest in testing relationships among variables more generally. Therefore, we used the Chi-Square Test to analyze the degree of association between the neighborhood stability indices formulated in Interim Report 2 and the change in average home sales prices[1]. This allowed us to test whether instability in any of the Interim Report 2 indices, such as an increase in poverty rate or percent change in income, show any relation to instability in housing sales prices in Howard County. Despite its limitation in testing the direction or magnitude of causality between the indicators in question, our objective was to first test the probability of association against a 95% significance level. Data on average housing sales prices were sourced from the Maryland Property View database, which provides sales prices of all housing units sold in Maryland.

Hypotheses

The calculations were based on these formulas:

$$\text{d.f.} = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)}.$$

Standard Error = $\sqrt{\frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}}$

Chi-Square = $\chi^2 = \sum \frac{(\text{Observed Value} - \text{Expected Value})^2}{(\text{Expected Value})}$

The process involved the following steps:

Step 1: *Grouping census tracts by level of change in home sales price between 2000 and 2010*

A double sequence, two sample hypothesis test for independent samples with assumed unequal population variances was conducted on the 2000 and 2010 average home sales prices in each County census tract.[2] The first hypothesis test examined change in home sales prices. A second hypothesis test was conducted on census tracts where home prices increased, based on Hypothesis Test 1, to test for a change in home sales price greater than $100K.

Hypothesis Test 1

H0: X.10 = X.00

H1: X.10 ≠ X.00

Significance Level: 0.025 (2-tailed)

If p-value >= significance level: '**=**' (H0: X.10 = X.00)

If p-value < significance level:

& t_test.stat.0 < 0:

& t_test.stat.0 > 0:

Hypothesis Test 2

H0: X.10 =< X.00 + 100K

H1: X.10 > X.00 + 100K

Significance Level: 0.05 (1-tailed)

If p-value >= significance level: '**+**' (H0: X.10 =< X.00 + 100K)

If p-value < significance level: '++' (H0: X.10 > X.00 + 100K)

The results of all census tracts were classified into four levels of change in sales prices: decrease (-), no change (=), moderate increase (+), and high increase (++).

Step 2: *Grouping census tracts by level of stability*

We maintained the quartile grouping methods used in Interim Report 2. For each index, census tracts were classified into least stable, less stable, moderately stable, and very stable.

Step 3: *Chi-Square Test*

We conducted chi-square tests on each index created from Interim Report 2, with the neighborhood stability index as dependent variable (rows) and the change in average home sales prices as the independent variable (columns). All indices were then summarized into 4 x 4 contingency tables, and chi-square statistics were calculated.

We used the Chi-Square test because it is for a two-tailed test and for larger than 2 x 2 tables, and the variables under the study are each categorical.

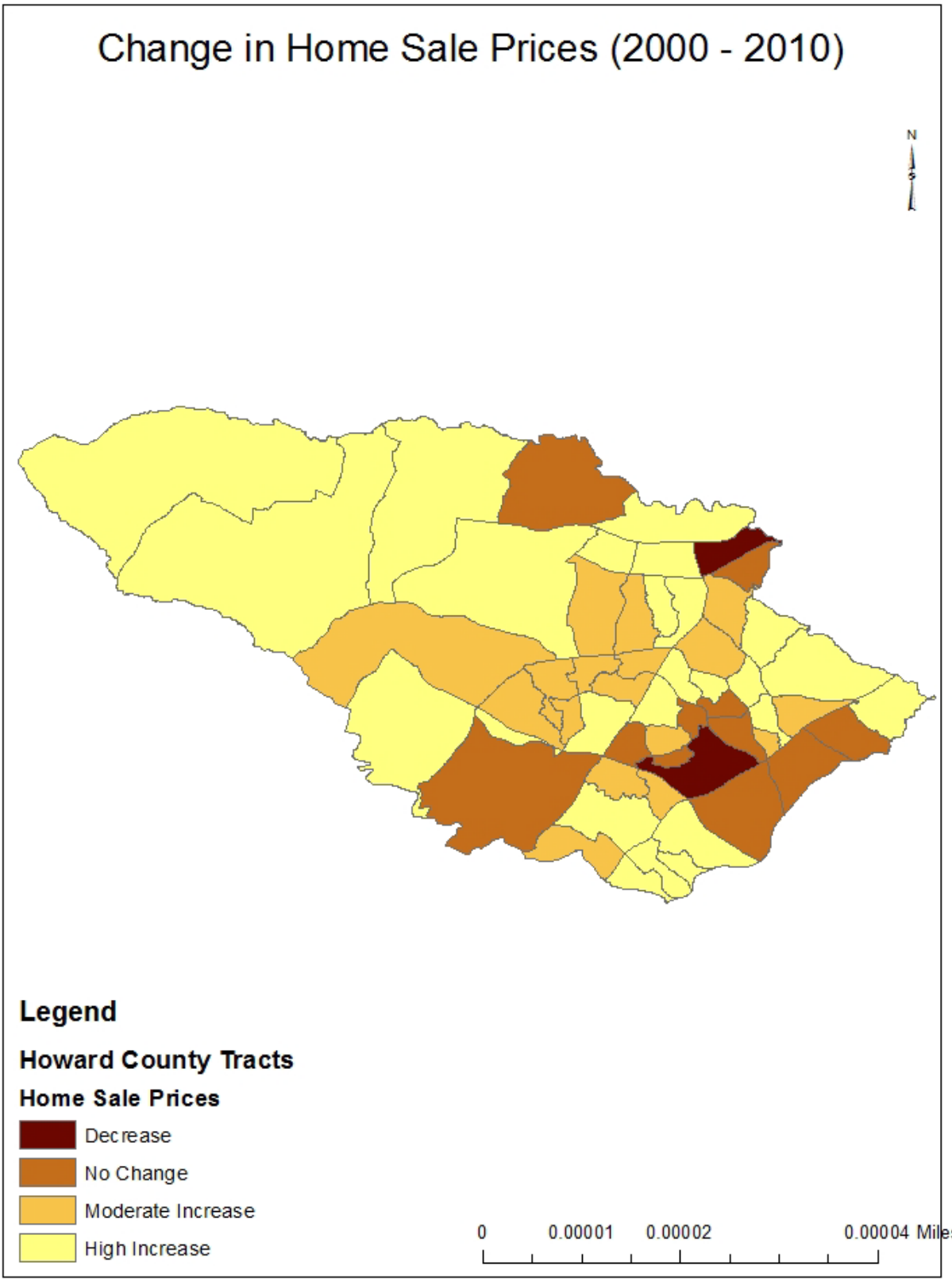
The theoretical value of chi-square for 9 degrees of freedom is 16.92. Therefore, indices with a chi-square value lower than 16.92 is determined to be unrelated to the change in average home sales prices.

To test the statistical significance of the indicators and compare it with home sale prices, we used the two-sample hypothesis test in which the critical area of a distribution is two sided and tests whether a sample is either greater than or less than a certain range of values. We formulated a null and alternative hypothesis about the difference while comparing for all the indicators, comparing two each time.

Results
As mentioned in Step 1, the results were classified into four groups and we found the changes in home sale prices in the census tracts:

Change	Frequency of tracts
Decrease	2
No Change	11
Increase	17
100k+ Increase	25
Total Tracts	55

According to these results, approximately 80% of Howard County experienced increases in average housing sales prices, with 25 census tracts experiencing significant increases of more than $100,000. Three census tracts, two located in the north of the County and one south of Columbia, showed increases in average housing sales prices of more than $300,000. Only two census tracts experienced a decrease in average housing sales prices, with one of those census tracts experiencing an almost $350,000 decrease in average sales price of homes.


Change in Home Sale Prices (2000 - 2010)
N
Legend
Howard County Tracts
Home Sale Prices
Decrease
No Change
Moderate Increase
High Increase
0
0.00001
0.00002
0.00004 Miles

Based on Step 2, results of the hypothesis for each neighborhood stability indicator are:

Variable	Description	Chi-Square	Result
Increase in Poverty Rate	% point difference, persons below poverty level	8.25	Unrelated
Increase in Percentage of Persons with Low Level of Education Attainment	% point difference, persons 25+ years old with LESS than a bachelor's degree	10.4885	Unrelated
Increase in Percentage of Persons with Lower Occupational Status	% point difference, persons 16+ years old NOT employed in professional and technical occupations or as executives, managers, and administrators	7.3727	Unrelated
Decrease in Median Family Income	% change, median family income	5.8	Unrelated
Decrease in Housing Affordability	% point difference, housing units whose housing costs are 30% or above of their income, across all income levels	9.66	Unrelated
Lack of Construction Growth in Housing Stock	% of housing units built between 2000-2010	6.56	Unrelated
Increase in Renter-Occupied Housing Units	% point difference, renter-occupied housing units	5.8329	Unrelated
Increase in Vacant Housing Units	% point different, vacant housing units	13.8159	Unrelated
Diversity	Change in Simpson's Diversity Index	13.54	Unrelated

All of our indices proved to be unrelated to one another, meaning that changes in one variable are not associated with changes in other variables. For instance, an increase in persons with low educational attainment does not correlate with or cause a decrease in average home sales prices. Instead, the home sales price indicators developed in Interim Report 2 appear to measure and describe different areas of stability.

Conclusion

Given the higher than average sales prices of housing units in Howard County, paired with higher than average household incomes, it is possible that measures typically used in research into neighborhood stability are not as well-suited for the County. The levels at which different socioeconomic and physical housing variables are measured may warrant changing to ones more meaningful for Howard County. In this way, neighborhood stability becomes a more complex quality or set of conditions to both define and measure. Different variables may also have different impacts across, and perhaps even within, census tracts. Comparison with other control neighborhood stability models may potentially provide additional insight on our resulting outputs.[3]

Since we had separate indices for each indicator we confirmed whether the indices show a relationship by grouping them. To test this we grouped two indicators into one to verify if results change. The increase in vacant housing units indicator had the highest Chi-Square value (13.8159) and was the closest to the Critical Value. We grouped the vacant housing unit indicator with the construction indicator as a single index. We conjectured that the high rates of new construction in some census tracts may be affecting vacancy rates and falsely rendering the tract as unstable. We hypothesized that the vacancy rate index may show a more significant association with home sales prices if controlling for construction rates.

To test this hypothesis, we normalized the construction and vacancy indices into standard z-scores ($z = \frac{x - \mu}{\sigma}$), subtracted the construction z-score from the vacancy z-score, and calculated the chi-square statistics. The Chi-Square value was smaller than the Critical Value, and thus not significant enough to indicate that a relationship between this index and the Home Sales Prices index.

Given that grouping indices with higher Chi-Square values did not confirm a relationship, it is unlikely that the indices with lower Chi-Square values will exhibit associations with the Home Sales Price index. Nonetheless, it is important to note that Chi-Square, like other tests for statistical significance, does not provide absolute, conclusive proof of a relationship. Thus, this does not mean that these indexes are independent. Rather, we can only say that we do not have evidence that they are dependent. In future analyses, we would explore the dynamics among the different indices used thus far to measure neighborhood stability.

Citations

[1] Ross, Catherine E., Mirowsky, John, and Pribesh, Shana. "Powerlessness and the Amplification of Threat: Neighborhood Disadvantage, Disorder, and Mistrust." American Sociological Review. Vol. 66, No. 4, Aug., 2001: 568-591

[2] Crane, Jonathon. "The Epidemic Theory of Ghettos and Neighborhood Effects on Dropping Out and Teenage Childbearing." American Journal of Sociology. Vol. 96, No.5, Mar., 1991: 1226-1259

[3] Liu, Feng. "Dynamics and Causation of Environmental Equity, Locally Unwanted Land Uses, and Neighborhood Changes." Environmental Management 21.5, September 1997: 643-656.

INTERIM REPORT 4 – LINEAR REGRESSION, PEARSON CORRELATION MODEL, AND COMPOSITE INDEX

Introduction

This report examines changes in housing prices in Howard County census tracts using multiple linear regression to model the relationships between housing prices and the neighborhood stability indicators previously constructed. Multiple linear regression is a powerful tool for describing the strength of relationships between a continuous dependent variable and independent variables, as well as whether that relationship is positive or negative. For our purposes, we aimed to pinpoint neighborhood stability indicators that best explained changes in housing prices. This helped us not only further understand and define neighborhood stability within the context of Howard County, but allowed us to provide more concrete guidelines for identifying at-risk neighborhoods.

Data and Empirical Approach

We used Maryland PropertyView to assemble data on the sales price of all homes sold in Maryland, as well as basic information on the characteristics of the homes sold. We converted the 2000 sales prices into 2010 dollars to have a consistent and current figure. We also filtered out only houses with prices above $10,000 to remove housing transactions not likely to be standard commercial and market-rate transactions, such as family inheritances or exchanges.

Multiple Linear Regression and Changes in Sales Prices of New Homes Index

For our regression models, we controlled the housing unit type, age, and location based on census tract to isolate and demonstrate variable relationships. We examined specific price changes in newly constructed single-family housing using the following hedonic regression method. This method statistically estimates the relationship between a property's characteristics and its market value, and so, is a way of determining the value of the property itself. Based on estimates generated from the changes in the sales prices of new homes in the years of 2000 and 2010, we constructed a new measure, or index, of neighborhood stability.

The first step was calculating the predicted sales prices of new homes in both 2000 and 2010, using these equations:

[PredSales_00] Predicted sales price of new single family homes by census tract in 2000
= 130421.37 – 631.77 * (Age of structure) + 69898.20 * (Single-Family) + (Coefficient of Census Tract)

[PredSales_10] Predicted sales price of new single family homes by census tract in 2010
= 343213.34 – 3398.72 * (Age of structure) + 187824.89 * (Single-Family) + (Coefficient of Census Tract)

[11NewSF] = [Predict_10] – [Predict_00]

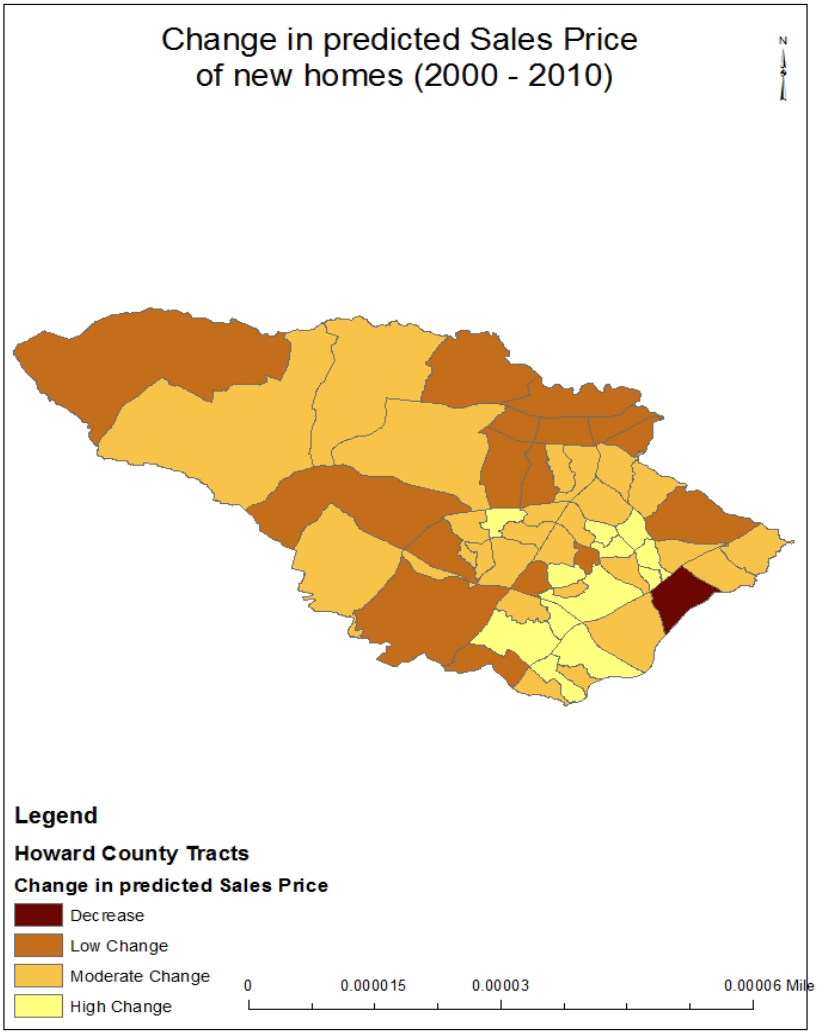
*Values represent the unstandardized coefficients from the multiple regression report generated by SPSS. The first number is the constant. The second number is the coefficient for the age of a housing structure. The third number is the coefficient for the housing unit type. *For example, for every additional year in the age of structure, the predicted sales price changes by -631.77 in 2000, etc.**

Since we compared the predicted sales price for new construction, the age of structure input value was 1 in both of the above equations. We calculated the predicted sales price of new homes (1-year old structures) for each census tract in 2000 and 2010 respectively, and then subtracted the predicted 2000

sales price of new homes from that of 2010. Our last index is therefore a measure of change in predicted sales price of newly constructed homes:

Changes in price = Predicted sales price of new homes by census tract in 2010 – Predicted sales price of new homes by census tract in 2000.

Results from the calculation of this new *Changes in Sales Prices of New Homes index* are ranked into four categories, where changes seen in census tracts are summarized as a decrease in price, a low change (or low increase) in price, a moderate change (or moderate increase) in price, or a high change (high increase) in price between 2000 and 2010. *See tables 1-3 in the Appendix for a more detailed breakdown of the index and outputs.*



Pearson Correlation Model

We used the Pearson Product Moment Correlation (PPMC) method to examine bivariate correlations among the different measures of neighborhood stability thus far constructed. Based on the Pearson Correlation model, we found the following positive and negative relationships between the indicators, whereby the larger and more positive or negative the coefficient, the stronger the relationship is

between the given variables examined. Values range from -1 to 1, with higher correlations ranging from 0.5-1.0 or -0.5-1.0 and lower correlations ranging from 0.1–0.3 or -0.1 to -0.3.

1. Poverty and Rent (Pearson's r = .383) moderate correlation
   Census tracts with higher increases in their poverty rate also had a higher increase in the percent of renters between 2000 and 2010.

2. Education and Employment (Pearson's r = .478) moderate correlation
   Census tracts with higher increases in the number of persons with less than a Bachelor's degree, also had higher increases in the number of persons employed in non-professional/non-managerial jobs between 2000 and 2010.

3. Education and Construction (Pearson's r = -.334) low correlation
   Census tracts with higher increases in the number of persons with less than a Bachelor's degree between 2000 and 2010, also had a lower percentage of housing stock built in the last 10 years.

4. Employment and Income (Pearson's r = -.330) low correlation
   Census tracts with higher increases in people employed in non-professional/non-managerial jobs also experienced a decrease or lower increase in their median income between 2000 and 2010.

5. Employment and Construction (Pearson's r = -.464) moderate correlation
   Census tracts with higher increase in population employed in non-professional/non-managerial jobs between 2000 and 2010 have a lower percentage of housing stock built in the last 10 years.

6. Construction and Diversity (Pearson's r = .432) Moderate correlation
   Census tracts with higher percentage of housing stock built within last 10 years have more change in diversity.

7. Construction and New Home Sales Price (Pearson's r = -.624) High correlation
   Census tracts with higher percentage of housing stock built within last 10 years have less increase or decrease in sales price of new homes built in 2010.

8. Diversity and Average Home Sales Price (Pearson's r = .268) Low correlation
   Census tracts with a higher change in diversity have a higher increase in average home sales price of structures of all age.

See table 4 in the Appendix for a more detailed breakdown of indicator correlations.

Isolation and Interaction Indices

To further analyze the diversity indicator and understand the spatial distribution of race and ethnicity we calculated the Isolation index and interaction index. The isolation index represents the probability Pxx that a person from group x will interact with a person from the same group x. The maximum value of the isolation index is 100. The interaction index represents the probability that a person from group x will interact with a person from a different group y, Pxy. The minimum value of the interaction index is zero.

When there are only two groups, the isolation and interaction index will sum to 1.0. As such, lower values of interaction and higher values of isolation each indicate higher segregation.

Based on the changes in Diversity from 2000 to 2010, we identified six census tracts that have the highest diversity value and seven census tracts that have the lowest diversity value.

		Change in Interaction				Change in Isolation				
Census Tract	**Change in Diversity 2000-2010**	**White vs. Black**	**White vs. Asian**	**White vs. Hispanic**	**White vs. Other**	**White**	**Black**	**Asian**	**Hispanic**	**Other**
24027606701	-0.054	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
24027606606	-0.023	0.000	0.001	0.000	0.000	-0.001	-0.002	-0.001	-0.001	0.000
24027606607	-0.010	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001	0.000
24027603003	-0.003	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001
24027601204	0.011	0.000	-0.002	0.000	0.000	0.005	-0.002	0.002	0.000	0.000
24027604001	0.016	0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24027601107	0.208	0.000	-0.003	-0.002	0.000	0.002	0.000	0.006	0.004	0.000
24027601201	0.211	-0.002	-0.001	-0.001	0.000	-0.006	0.003	0.001	0.001	0.000
24027603001	0.212	-0.001	-0.003	0.000	0.000	0.005	0.001	0.003	0.000	0.000
24027604002	0.212	-0.001	-0.003	-0.002	0.000	0.001	0.000	0.001	0.002	0.000
24027601203	0.243	-0.001	0.000	-0.001	0.000	-0.008	0.016	0.000	0.007	0.000
24027602700	0.269	0.000	-0.003	-0.001	0.000	0.002	0.000	0.003	0.000	0.000
24027606806	0.287	-0.002	-0.003	-0.001	0.000	-0.006	0.002	0.006	0.001	0.000

Findings and Recommendations

Changes in Predicted Sales Prices of New Homes, 2000-2010

Calculations show several census tracts with moderate to high increases in the predicted sales prices of new homes. The census tracts showing high increases in predicted sales prices are clustered in the southern part of the County and around Columbia. Two are in the southern part of Columbia in the Owen Brown and Greenleaf areas (census tracts 606707 and 606704). Other census tracts with high increases in prices are west of the Patuxent Parkway and east of Columbia toward Waterloo Park. Roughly half of the County, those census tracts north and west of Columbia, exhibit low to moderate changes in sales prices. Only one census tract (601203), located southeast of Columbia, showed a decrease in sales price.

A major difference between this change in housing sales prices index and the one created for Interim Report 3 is that this index only compares new housing sales, whereas the Interim Report 3 index

compared the average sales price change for houses of all ages. Measure only new housing sales better portrays the change in sales prices for homes with similar characteristics by controlling for housing type and age. However, an examination of the number of sales for single-family homes built in 2000 and 2010 reveals that the sample size used in the regression model was too small, and may have underpowered the effect of a newly constructed unit on its sales price. Also, for some census tracts, the level of significance is too high to reject the possibility that the location coefficient may be irrelevant (B=0).

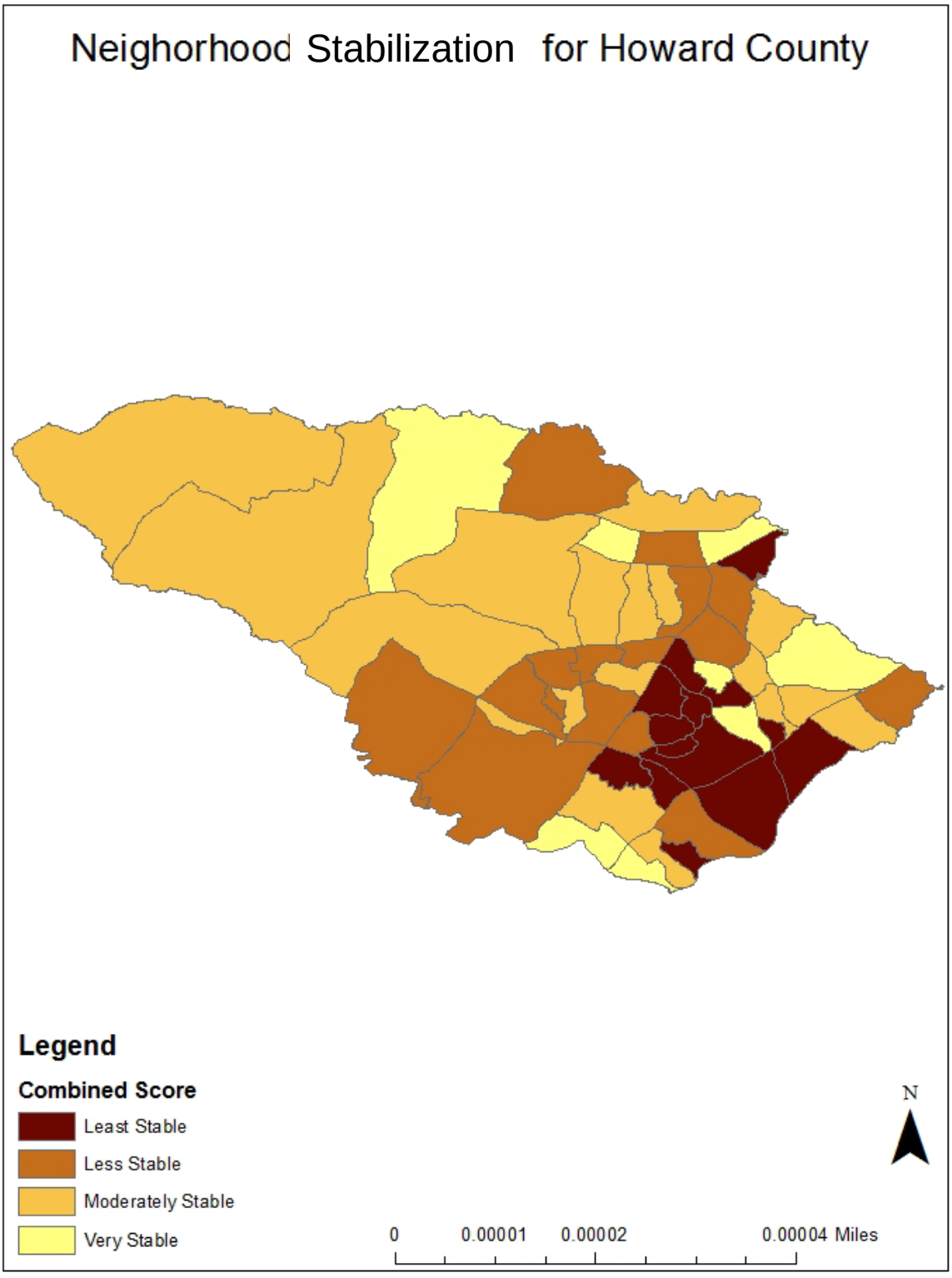
Pearson Correlations

Although there is a degree of association between some of the indices, each of the individual indices created through the three reports mostly depict different areas of distress or improvement in neighborhood characteristics. The combined effect of each of these indicators may therefore create a stronger overall measure of neighborhood stability. A neighborhood consistently categorized as "least stable" across multiple indices is more likely to be vulnerable to the changes occurring than a neighborhood only being categorized as "least stable" at a limited frequency.

Thus, our recommendation is to sum the power of each stability level across all indices per census tract by assigning a score system of 1 for least stable, 2 for less stable, 3 for moderately stable, and 4 for very stable. A lower score across all indices indicates a lower level of stability. The map below categorizes neighborhoods as least, less, more, and very stable based on the combined scores calculated for all the indicators. The lowest score for these tracts was 18 where the tract is categorized as Least Stable and the highest score is 38 where the tract is categorized as Most Stable. The median score is 28 with a mode score of 30.

Combining the indices and scoring census tracts according to their outcomes in the various neighborhood stability measures showed that neighborhoods or census tracts directly within and around Columbia show the least stability, especially those census tracts south of Columbia and along the County's southern border. Given that this pattern has repeatedly resulted in our analyses, we recommend that the County further assess conditions in these census tracts to verify our findings.

See tables 5 and 6 in the Appendix for a more detailed breakdown of raw data for the individual indices, as well as the composite ranking of indices.


Neighorhood Stabilization for Howard County
Legend
Combined Score
Least Stable
Less Stable
Moderately Stable
Very Stable
N
0
0.00001
0.00002
0.00004 Miles

Citations

Green, Richard K. and Malpezzi, Stephen. A Primer on U.S. Housing Markets and Housing Policy. Urban Institute Press: 2003.

Coulson, Edward. “A Brief Survey and Interpretation of Hedonic Parameters.” Chapter 2 in Hedonic Methods and Housing Markets. Draft Manuscript. 2010.

“Pearson Correlation: Definition and Easy Steps for Use.” Statistics How To. 2016. Web. 08 MAY 2016; http://www.statisticshowto.com/what-is-the-pearson-correlation-coefficient/

U.S Census Bureau. Racial and Ethnic Residential Segregation in the United States. 1980-2000.

Appendix

Table 1. 2000 Sales Regression Model Report

R Square	.404			
Adjusted R Square	.400			
	Unstandardized Coefficients	Standardized Coefficients		
	B	Beta	t	Sig.
(Constant)	130421.370		10.461	.000
Age	-631.768	-.059	-6.103	.000
SF_Dummy	69898.202	.150	14.583	.000
ct10=24027601103	64915.390	.058	4.025	.000
ct10=24027601104	188456.633	.116	9.837	.000
ct10=24027601105	56646.749	.047	3.512	.000
ct10=24027601107	19332.304	.006	.662	.508
ct10=24027601108	5925.301	.007	.402	.688
ct10=24027601201	16776.712	.017	1.124	.261
ct10=24027601203	371578.009	.089	9.603	.000
ct10=24027601204	26311.171	.021	1.587	.113
ct10=24027602100	201553.769	.191	12.843	.000
ct10=24027602201	304703.217	.201	16.628	.000
ct10=24027602202	148568.886	.105	8.339	.000
ct10=24027602302	86104.943	.078	5.449	.000
ct10=24027602303	233557.992	.163	13.026	.000
ct10=24027602304	179143.225	.124	9.947	.000
ct10=24027602305	125550.381	.083	6.796	.000
ct10=24027602306	93698.825	.071	5.504	.000
ct10=24027602600	106326.327	.057	5.208	.000
ct10=24027602700	124474.196	.064	5.865	.000
ct10=24027602800	73060.583	.065	4.552	.000
ct10=24027602900	207282.060	.097	9.110	.000
ct10=24027603001	142949.198	.111	8.409	.000
ct10=24027603003	286277.792	.178	15.089	.000
ct10=24027603004	339553.821	.215	18.016	.000
ct10=24027604001	140554.657	.095	7.750	.000
ct10=24027604002	329783.788	.241	18.878	.000
ct10=24027605102	269993.247	.200	15.521	.000
ct10=24027605103	284346.189	.173	14.758	.000
ct10=24027605104	514457.055	.280	25.051	.000
ct10=24027605401	101491.707	.069	5.682	.000
ct10=24027605402	34094.845	.026	2.039	.042
ct10=24027605502	145705.292	.129	9.057	.000
ct10=24027605503	12252.737	.010	.726	.468

ct10=24027605504	237052.203	.133	11.677	.000
ct10=24027605505	272708.921	.205	15.781	.000
ct10=24027605601	33658.824	.031	2.162	.031
ct10=24027605602	60078.870	.052	3.732	.000
ct10=24027606601	47416.332	.029	2.488	.013
ct10=24027606603	-7303.641	-.007	-.474	.636
ct10=24027606604	65420.588	.044	3.598	.000
ct10=24027606606	-431.950	.000	-.027	.979
ct10=24027606607	21698.157	.016	1.245	.213
ct10=24027606701	96164.221	.053	4.707	.000
ct10=24027606704	-8468.367	-.009	-.554	.579
ct10=24027606705	14731.101	.009	.766	.444
ct10=24027606706	86174.107	.080	5.530	.000
ct10=24027606707	-33961.654	-.027	-2.001	.045
ct10=24027606803	29960.227	.024	1.823	.068
ct10=24027606804	30660.862	.023	1.769	.077
ct10=24027606805	161411.047	.088	7.869	.000
ct10=24027606806	53587.514	.039	3.041	.002
ct10=24027606901	-11664.370	-.009	-.684	.494
ct10=24027606904	8015.269	.006	.463	.643
ct10=24027606905	12988.111	.012	.806	.420
ct10=24027606906	-19725.696	-.018	-1.239	.215

Table 2. 2010 Sales Regression Model Report

R Square	.676			
Adjusted R Square	.670			
	Unstandardized Coefficients	Standardized Coefficients		
	B	Beta	t	Sig.
(Constant)	343213.338		20.250	.000
Age	-3398.722	-.321	-25.663	.000
SF_Dummy	187824.892	.489	37.602	.000
ct10=24027601103	6313.021	.005	.303	.762
ct10=24027601104	66027.663	.052	3.102	.002
ct10=24027601105	41908.091	.038	2.075	.038
ct10=24027601107	11998.020	.004	.354	.724
ct10=24027601108	6770.306	.006	.324	.746
ct10=24027601201	-49286.543	-.041	-2.360	.018
ct10=24027601203	-97559.980	-.062	-4.193	.000
ct10=24027601204	-31873.003	-.023	-1.438	.150
ct10=24027602100	96700.587	.093	4.856	.000
ct10=24027602201	141575.372	.071	5.333	.000
ct10=24027602202	39707.239	.026	1.705	.088
ct10=24027602302	32623.723	.029	1.596	.111
ct10=24027602303	90995.616	.067	4.171	.000
ct10=24027602304	77653.520	.043	3.085	.002
ct10=24027602305	77184.593	.044	3.131	.002
ct10=24027602306	57658.049	.045	2.681	.007
ct10=24027602600	16535.826	.009	.672	.501
ct10=24027602700	61606.687	.059	3.090	.002
ct10=24027602800	46116.645	.035	2.137	.033
ct10=24027602900	82934.394	.030	2.510	.012
ct10=24027603001	39688.993	.040	2.027	.043
ct10=24027603003	236858.197	.110	8.509	.000
ct10=24027603004	296613.018	.204	13.144	.000
ct10=24027604001	55683.069	.027	2.070	.039
ct10=24027604002	261964.838	.197	12.052	.000
ct10=24027605102	176682.174	.222	9.509	.000
ct10=24027605103	224090.253	.116	8.585	.000
ct10=24027605104	372953.747	.249	16.325	.000
ct10=24027605401	57235.185	.033	2.324	.020
ct10=24027605402	-9442.790	-.008	-.441	.659
ct10=24027605502	67406.076	.048	3.037	.002
ct10=24027605503	2858.346	.002	.119	.905
ct10=24027605504	184132.017	.080	6.354	.000
ct10=24027605505	130068.337	.094	5.925	.000

ct10=24027605601	3912.488	.003	.174	.862
ct10=24027605602	17503.679	.013	.799	.425
ct10=24027606601	-22297.901	-.014	-.922	.356
ct10=24027606603	-51862.038	-.036	-2.283	.023
ct10=24027606604	-48054.683	-.032	-2.110	.035
ct10=24027606606	-7617.258	-.004	-.292	.770
ct10=24027606607	6575.144	.004	.260	.795
ct10=24027606701	-5111.745	-.002	-.157	.875
ct10=24027606704	1303.416	.001	.059	.953
ct10=24027606705	-61497.398	-.030	-2.285	.022
ct10=24027606706	22845.416	.020	1.111	.267
ct10=24027606707	-18506.307	-.010	-.740	.459
ct10=24027606803	-3402.061	-.002	-.142	.887
ct10=24027606804	19051.793	.009	.701	.484
ct10=24027606805	44887.606	.020	1.593	.111
ct10=24027606806	63844.618	.049	2.986	.003
ct10=24027606901	-63041.701	-.052	-3.022	.003
ct10=24027606904	-51891.980	-.038	-2.366	.018
ct10=24027606905	122100.806	.077	5.203	.000
ct10=24027606906	-52039.926	-.027	-2.018	.044

Table 3. Change in Predicted Sales Price of New Homes, 2000-2010 [new square footage]

	Predicted sales price of new homes by census tract in 2000	Predicted sales price of new homes by census tract in 2010	Change in predicted sales price of new homes, 2000-2010	
Census Tract	Predict_00	Predict_10	NewSF	Stability Level
ct10=24027601103	264,603.19	533,952.53	269,349.34	3
ct10=24027601104	388,144.44	593,667.17	205,522.73	2
ct10=24027601105	256,334.55	569,547.60	313,213.05	4
ct10=24027601107	219,020.11	539,637.53	320,617.42	4
ct10=24027601108	205,613.10	534,409.81	328,796.71	4
ct10=24027601201	216,464.52	478,352.96	261,888.45	3
ct10=24027601203	571,265.81	430,079.53	-141,186.28	1
ct10=24027601204	225,998.97	495,766.50	269,767.53	3
ct10=24027602100	401,241.57	624,340.10	223,098.52	2
ct10=24027602201	504,391.02	669,214.88	164,823.86	2
ct10=24027602202	348,256.69	567,346.75	219,090.06	2
ct10=24027602302	285,792.75	560,263.23	274,470.48	3
ct10=24027602303	433,245.80	618,635.12	185,389.33	2
ct10=24027602304	378,831.03	605,293.03	226,462.00	2
ct10=24027602305	325,238.18	604,824.10	279,585.92	3
ct10=24027602306	293,386.63	585,297.56	291,910.93	3
ct10=24027602600	306,014.13	544,175.33	238,161.20	2
ct10=24027602700	324,162.00	589,246.19	265,084.20	3
ct10=24027602800	272,748.39	573,756.15	301,007.77	3
ct10=24027602900	406,969.86	610,573.90	203,604.04	2
ct10=24027603001	342,637.00	567,328.50	224,691.50	2
ct10=24027603003	485,965.60	764,497.70	278,532.11	3
ct10=24027603004	539,241.63	824,252.53	285,010.90	3
ct10=24027604001	340,242.46	583,322.58	243,080.12	2
ct10=24027604002	529,471.59	789,604.35	260,132.76	3
ct10=24027605102	469,681.05	704,321.68	234,640.63	2
ct10=24027605103	484,033.99	751,729.76	267,695.77	3
ct10=24027605104	714,144.86	900,593.25	186,448.40	2
ct10=24027605401	301,179.51	584,874.69	283,695.18	3
ct10=24027605402	233,782.65	518,196.72	284,414.07	3
ct10=24027605502	345,393.10	595,045.58	249,652.49	3
ct10=24027605503	211,940.54	530,497.85	318,557.31	4
ct10=24027605504	436,740.01	711,771.53	275,031.52	3
ct10=24027605505	472,396.72	657,707.84	185,311.12	2
ct10=24027605601	233,346.63	531,552.00	298,205.37	3
ct10=24027605602	259,766.67	545,143.19	285,376.51	3

ct10=24027606601	247,104.14	505,341.61	258,237.47	3
ct10=24027606603	192,384.16	475,777.47	283,393.31	3
ct10=24027606604	265,108.39	479,584.82	214,476.43	2
ct10=24027606606	199,255.85	520,022.25	320,766.40	4
ct10=24027606607	221,385.96	534,214.65	312,828.69	4
ct10=24027606701	295,852.03	522,527.76	226,675.74	2
ct10=24027606704	191,219.44	528,942.92	337,723.49	4
ct10=24027606705	214,418.90	466,142.11	251,723.20	3
ct10=24027606706	285,861.91	550,484.92	264,623.01	3
ct10=24027606707	165,726.15	509,133.20	343,407.05	4
ct10=24027606803	229,648.03	524,237.45	294,589.42	3
ct10=24027606804	230,348.67	546,691.30	316,342.64	3
ct10=24027606805	361,098.85	572,527.11	211,428.26	2
ct10=24027606806	253,275.32	591,484.13	338,208.81	4
ct10=24027606901	188,023.43	464,597.81	276,574.37	3
ct10=24027606904	207,703.07	475,747.53	268,044.46	3
ct10=24027606905	212,675.91	649,740.31	437,064.40	4
ct10=24027606906	179,962.11	475,599.58	295,637.47	3
ct10=24027606907	199,687.80	527,639.51	327,951.70	4

Table 4. Measure of Association between Indices by Pearson's r

		1 POV	2 EDU	3 EMP	4 INC	5 AFF	6 CON	7 RENT	8 VAC	9 DIV	10 AVE$	11 NEWSF
1 POV	Pearson Correlation	1	.011	-.041	-.166	.134	-.058	.383**	-.081	.100	-.170	.050
	Sig. (2-tailed)		.936	.764	.226	.330	.673	.004	.556	.468	.214	.719
	N	55	55	55	55	55	55	55	55	55	55	55
2 EDU	Pearson Correlation	.011	1	.478**	-.239	-.101	-.334*	-.070	.001	-.158	-.020	.121
	Sig. (2-tailed)	.936		.000	.079	.464	.013	.613	.996	.248	.885	.380
	N	55	55	55	55	55	55	55	55	55	55	55
3 EMP	Pearson Correlation	-.041	.478**	1	-.330*	.171	-.464**	-.096	.184	-.153	.027	.174
	Sig. (2-tailed)	.764	.000		.014	.212	.000	.483	.178	.265	.843	.203
	N	55	55	55	55	55	55	55	55	55	55	55
4 INC	Pearson Correlation	-.166	-.239	-.330*	1	-.150	.254	-.162	-.260	-.022	.232	-.130
	Sig. (2-tailed)	.226	.079	.014		.275	.061	.238	.055	.872	.088	.342
	N	55	55	55	55	55	55	55	55	55	55	55
5 AFF	Pearson Correlation	.134	-.101	.171	-.150	1	.094	-.038	.113	.018	-.149	-.015
	Sig. (2-tailed)	.330	.464	.212	.275		.494	.781	.411	.897	.278	.916
	N	55	55	55	55	55	55	55	55	55	55	55
6 CON	Pearson Correlation	-.058	-.334*	-.464**	.254	.094	1	.172	-.047	.432**	-.236	-.624**
	Sig. (2-tailed)	.673	.013	.000	.061	.494		.209	.731	.001	.083	.000
	N	55	55	55	55	55	55	55	55	55	55	55
7 RENT	Pearson Correlation	.383**	-.070	-.096	-.162	-.038	.172	1	-.173	.117	-.167	-.065
	Sig. (2-tailed)	.004	.613	.483	.238	.781	.209		.206	.395	.224	.637
	N	55	55	55	55	55	55	55	55	55	55	55
8 VAC	Pearson Correlation	-.081	.001	.184	-.260	.113	-.047	-.173	1	.166	.099	.070
	Sig. (2-tailed)	.556	.996	.178	.055	.411	.731	.206		.226	.470	.612
	N	55	55	55	55	55	55	55	55	55	55	55
9 DIV	Pearson Correlation	.100	-.158	-.153	-.022	.018	.432**	.117	.166	1	.268*	-.127
	Sig. (2-tailed)	.468	.248	.265	.872	.897	.001	.395	.226		.048	.354
	N	55	55	55	55	55	55	55	55	55	55	55
10 AVE$	Pearson Correlation	-.170	-.020	.027	.232	-.149	-.236	-.167	.099	.268*	1	.236
	Sig. (2-tailed)	.214	.885	.843	.088	.278	.083	.224	.470	.048		.083
	N	55	55	55	55	55	55	55	55	55	55	55
11 NEWSF	Pearson Correlation	.050	.121	.174	-.130	-.015	-.624**	-.065	.070	-.127	.236	1
	Sig. (2-tailed)	.719	.380	.203	.342	.916	.000	.637	.612	.354	.083	
	N	55	55	55	55	55	55	55	55	55	55	55

Table 5. Raw Data of Individual Indices

Census Tract	1 POV	2 EDU	3 EMP	4 INC	5 AFF	6 CON	7 RENT	8 VAC	9 DIV	10 AVE.$	11 NEWSF
24027601103	-2.10%	2.71%	-4.45%	42.16%	2.65%	22.04%	-1.81%	0.41%	0.15	≤100K	269,349.34
24027601104	-1.69%	-1.37%	-5.10%	69.11%	2.59%	34.02%	5.51%	0.53%	0.12	>100K	205,522.73
24027601105	2.80%	-14.07%	-4.31%	85.28%	11.72%	3.88%	4.35%	0.09%	0.12	>100K	313,213.05
24027601107	0.54%	1.40%	4.36%	0.38%	15.66%	9.86%	13.54%	5.13%	0.20	≤100K	320,617.42
24027601108	-1.09%	-5.18%	-5.43%	45.38%	6.40%	1.52%	-18.91%	-1.09%	0.13	>100K	328,796.71
24027601201	1.98%	-7.20%	-3.24%	42.80%	12.30%	9.97%	-1.89%	0.68%	0.23	>100K	261,888.45
24027601203	2.89%	-5.91%	-6.58%	46.64%	16.13%	77.27%	-2.24%	3.41%	0.22	No Change	-141,186.28
24027601204	3.77%	-14.68%	-6.96%	46.94%	18.28%	17.47%	13.17%	-2.47%	0.01	No Change	269,767.53
24027602100	-0.30%	-11.05%	-3.64%	55.64%	1.52%	15.09%	0.21%	2.13%	0.15	>100K	223,098.52
24027602201	-2.47%	-11.19%	-5.95%	49.55%	-6.27%	18.23%	14.76%	-1.50%	0.14	>100K	164,823.86
24027602202	-2.21%	0.19%	-0.26%	28.76%	7.90%	0.00%	-1.36%	-1.00%	0.14	>100K	219,090.06
24027602302	3.49%	-11.49%	-9.33%	36.00%	10.99%	21.18%	15.71%	1.76%	0.14	≤100K	274,470.48
24027602303	-0.54%	-5.93%	-1.52%	52.43%	-8.62%	14.20%	3.45%	-0.87%	0.05	≤100K	185,389.33
24027602304	1.54%	-7.04%	-8.23%	42.20%	6.36%	4.08%	-0.53%	-1.14%	0.07	≤100K	226,462.00
24027602305	0.28%	-7.16%	-9.89%	34.34%	4.61%	2.06%	-0.50%	-0.63%	0.17	>100K	279,585.92
24027602306	1.43%	-2.53%	-1.55%	30.81%	10.72%	11.52%	10.67%	-5.54%	0.07	>100K	291,910.93
24027602600	-6.14%	-11.93%	-8.06%	42.55%	2.76%	37.29%	-7.26%	0.47%	0.09	Decrease	238,161.20
24027602700	-0.14%	-5.57%	-8.15%	55.50%	7.19%	46.04%	0.67%	4.52%	0.26	>100K	265,084.20
24027602800	3.04%	0.59%	-3.24%	51.98%	-2.62%	7.65%	0.96%	1.26%	0.14	≤100K	301,007.77
24027602900	7.11%	-8.98%	-6.59%	-0.91%	7.58%	14.03%	0.09%	6.71%	0.11	No Change	203,604.04
24027603001	0.80%	-13.39%	-5.53%	28.34%	11.74%	44.57%	5.26%	-2.99%	0.19	No Change	224,691.50
24027603003	-2.35%	2.29%	-4.91%	67.25%	6.87%	14.45%	0.85%	-1.22%	0.01	>100K	278,532.11
24027603004	-1.96%	-8.71%	-3.28%	58.18%	10.43%	25.88%	-2.92%	5.76%	0.14	>100K	285,010.90
24027604001	0.29%	-6.82%	-8.14%	34.76%	7.28%	11.09%	-1.84%	3.79%	0.02	>100K	243,080.12
24027604002	1.11%	-6.03%	-4.46%	44.25%	13.24%	26.92%	-4.22%	1.03%	0.19	>100K	260,132.76
24027605102	2.10%	-11.41%	-5.34%	50.09%	12.56%	24.42%	0.79%	2.49%	0.17	No Change	234,640.63
24027605103	0.32%	-8.30%	3.00%	41.67%	10.16%	5.85%	-0.80%	1.39%	0.14	>100K	267,695.77
24027605104	-1.03%	-8.66%	-1.72%	64.45%	15.47%	23.03%	-3.15%	2.48%	0.13	≤100K	186,448.40
24027605401	-6.00%	8.04%	4.94%	45.63%	8.13%	0.59%	-8.04%	7.91%	0.06	≤100K	283,695.18
24027605402	3.05%	-9.34%	-8.37%	57.86%	17.94%	20.50%	3.97%	-2.64%	0.10	≤100K	284,414.07
24027605502	-0.55%	4.28%	-5.40%	15.57%	4.20%	1.48%	2.25%	-3.39%	0.07	≤100K	249,652.49
24027605503	0.05%	-5.95%	7.37%	35.95%	13.54%	2.04%	-7.15%	1.55%	0.04	≤100K	318,557.31
24027605504	-1.22%	3.28%	-2.42%	51.49%	5.65%	18.42%	-0.88%	-1.52%	0.18	>100K	275,031.52
24027605505	-0.06%	-4.78%	-0.79%	40.97%	8.19%	43.59%	10.56%	-1.06%	0.15	≤100K	185,311.12
24027605601	-0.60%	-10.91%	8.44%	32.96%	2.49%	3.31%	-7.52%	1.53%	0.03	≤100K	298,205.37
24027605602	-3.30%	-0.09%	-1.58%	36.35%	14.71%	5.83%	-13.00%	7.81%	0.07	>100K	285,376.51
24027606601	3.00%	-3.22%	2.50%	44.21%	8.25%	6.69%	10.08%	0.93%	0.13	>100K	258,237.47
24027606603	2.16%	-1.59%	9.26%	29.65%	16.85%	0.00%	0.37%	2.00%	0.03	>100K	283,393.31
24027606604	-2.77%	0.90%	8.76%	2.98%	20.20%	7.48%	2.25%	1.76%	0.10	No Change	214,476.43
24027606606	2.28%	2.25%	0.89%	29.39%	6.41%	3.69%	11.02%	5.75%	0.00	No Change	320,766.40
24027606607	-1.53%	-0.57%	0.23%	49.10%	3.91%	0.00%	-18.18%	-1.70%	0.02	>100K	312,828.69
24027606701	-0.74%	-0.96%	1.00%	33.31%	6.86%	0.00%	-1.22%	-1.55%	-0.03	No Change	226,675.74
24027606704	9.76%	4.39%	-0.11%	28.94%	8.21%	2.96%	-1.60%	2.05%	0.18	≤100K	337,723.49
24027606705	8.49%	0.84%	-2.73%	49.13%	9.93%	3.11%	9.35%	-2.69%	0.02	No Change	251,723.20
24027606706	-3.48%	-12.89%	-12.61%	57.87%	16.41%	27.49%	-12.66%	-3.52%	0.03	No Change	264,623.01
24027606707	5.40%	-0.11%	-3.42%	31.45%	9.60%	21.03%	9.81%	-0.77%	0.07	Decrease	343,407.05
24027606803	1.04%	1.91%	11.29%	39.47%	16.14%	2.33%	-0.58%	-1.76%	0.12	≤100K	294,589.42
24027606804	0.58%	7.26%	2.70%	24.99%	8.87%	0.00%	-5.95%	2.98%	0.11	≤100K	316,342.64
24027606805	0.38%	-13.51%	-11.86%	70.78%	6.07%	27.36%	1.85%	-1.41%	0.13	≤100K	211,428.26
24027606806	0.15%	-8.80%	-2.58%	33.33%	8.24%	25.27%	8.25%	-0.12%	0.30	>100K	338,208.81
24027606901	-3.51%	-7.36%	0.02%	36.42%	8.39%	6.48%	4.45%	4.60%	0.12	No Change	276,574.37
24027606904	1.57%	-13.20%	2.65%	28.01%	11.46%	3.83%	-9.15%	7.49%	0.18	>100K	268,044.46
24027606905	2.15%	-7.80%	-5.12%	34.74%	2.96%	4.77%	-1.20%	4.47%	0.16	>100K	437,064.40
24027606906	-3.17%	-11.61%	-4.71%	64.90%	15.25%	13.49%	-12.21%	2.83%	0.08	>100K	295,637.47
24027606907	-0.83%	-16.83%	-9.93%	13.19%	12.34%	16.88%	9.27%	6.27%	0.10	>100K	327,951.70

Table 6. Level of Stability - Individual Indices and Composite Ranking

Census Tract	1 POV	2 EDU	3 EMP	4 INC	5 AFF	6 CON	7 RENT	8 VAC	9 DIV	10 AVE.$	11 NEWSF	Stability Level
24027601103	4	1	3	3	4	3	3	3	2	3	3	Very Stable
24027601104	4	2	3	4	4	4	1	3	2	4	2	Very Stable
24027601105	1	4	3	4	2	2	2	3	3	4	4	Very Stable
24027601107	2	1	1	1	1	2	1	1	1	3	4	Least Stable
24027601108	3	2	3	3	3	1	4	3	2	4	4	Very Stable
24027601201	2	3	2	3	2	2	3	3	1	4	3	Less Stable
24027601203	1	2	4	3	1	4	3	1	1	2	1	Least Stable
24027601204	1	4	4	3	1	3	1	4	4	2	3	Moderately Stable
24027602100	3	4	3	4	4	3	2	2	1	4	2	Very Stable
24027602201	4	4	3	3	4	3	1	4	2	4	2	Very Stable
24027602202	4	1	2	1	3	1	3	3	2	4	2	Less Stable
24027602302	1	4	4	2	2	3	1	2	2	3	3	Less Stable
24027602303	3	2	2	4	4	3	2	3	4	3	2	Very Stable
24027602304	2	3	4	3	3	2	3	3	3	3	2	Moderately Stable
24027602305	2	3	4	2	4	1	3	3	1	4	3	Moderately Stable
24027602306	2	2	2	1	2	3	1	4	3	4	3	Less Stable
24027602600	4	4	4	3	4	4	4	3	3	1	2	Very Stable
24027602700	3	2	4	4	3	4	2	1	1	4	3	Moderately Stable
24027602800	1	1	2	4	4	2	2	2	2	3	3	Less Stable
24027602900	1	3	4	1	3	3	2	1	3	2	2	Least Stable
24027603001	2	4	3	1	2	4	1	4	1	2	2	Less Stable
24027603003	4	1	3	4	3	3	2	3	4	4	3	Very Stable
24027603004	4	3	2	4	2	4	3	1	2	4	3	Very Stable
24027604001	2	3	4	2	3	2	3	1	4	4	2	Moderately Stable
24027604002	2	3	3	3	1	4	4	2	1	4	3	Moderately Stable
24027605102	2	4	3	3	1	4	2	2	1	2	2	Less Stable
24027605103	2	3	1	2	2	2	3	2	2	4	3	Less Stable
24027605104	3	3	2	4	1	4	4	2	2	3	2	Moderately Stable
24027605401	4	1	1	3	3	1	4	1	4	3	3	Less Stable
24027605402	1	3	4	4	1	3	2	4	3	3	3	Moderately Stable
24027605502	3	1	3	1	4	1	2	4	3	3	3	Less Stable
24027605503	3	2	1	2	1	1	4	2	4	3	4	Less Stable
24027605504	3	1	2	4	4	3	3	4	1	4	3	Very Stable
24027605505	3	2	2	2	3	4	1	3	2	3	2	Less Stable
24027605601	3	3	1	2	4	1	4	2	4	3	3	Moderately Stable
24027605602	4	2	2	2	1	2	4	1	3	4	3	Less Stable
24027606601	1	2	1	3	2	2	1	2	2	4	3	Least Stable
24027606603	1	2	1	1	1	1	2	2	4	4	3	Least Stable
24027606604	4	1	1	1	1	2	2	2	3	2	2	Least Stable
24027606606	1	1	1	1	3	2	1	1	4	2	4	Least Stable
24027606607	3	2	1	3	4	1	4	4	4	4	4	Very Stable
24027606701	3	2	1	2	3	1	3	4	4	2	2	Less Stable
24027606704	1	1	2	1	3	1	3	2	1	3	4	Least Stable
24027606705	1	1	2	3	2	1	1	4	4	2	3	Least Stable
24027606706	4	4	4	4	1	4	4	4	4	2	3	Very Stable
24027606707	1	2	3	2	2	3	1	3	3	1	4	Least Stable
24027606803	2	1	1	2	1	1	3	4	3	3	3	Least Stable
24027606804	2	1	1	1	2	1	4	1	3	3	3	Least Stable
24027606805	2	4	4	4	3	4	2	4	2	3	2	Very Stable
24027606806	3	3	2	2	3	4	1	3	1	4	4	Moderately Stable
24027606901	4	3	2	2	2	2	2	1	2	2	3	Least Stable
24027606904	2	4	1	1	2	2	4	1	1	4	3	Least Stable
24027606905	1	3	3	2	4	2	3	1	1	4	4	Less Stable
24027606906	4	4	3	4	1	3	4	2	3	4	3	Very Stable
24027606907	3	4	4	1	2	3	1	1	3	4	4	Moderately Stable

Group 2 Final Report

Introduction
Howard County, located in central Maryland, with a population of 287,085 as of the 2010 Census, aims to develop a "Neighborhood Stability Index" to identify neighborhoods that are at risk of decline. Throughout the Spring 2016 semester, our team produced three reports looking at various ways to construct such an index, and analyzed which approach may best suit the County's needs.

Regional Context
According to the Howard County Economic Development Authority (HCEDA) the County is one of the most affluent and educated communities in the United States, and it is regularly considered a "best place to live" by publications such as *Money Magazine*. However, best places don't become best places by chance, and they also have their challenges. So, as the County continues to experience economic and population growth, it is important to ensure that growth is equitable, and that County resources are directed in a timely manner toward areas that need them most.

Why Develop a Neighborhood Stability Index?
Relevant literature on neighborhood stability suggests that stable neighborhoods are created and sustained by many factors. Conversely, unstable neighborhoods find it difficult to achieve and maintain stability when faced with factors like deteriorating housing stock, population loss, and troubled school systems (Kinney & Winter, 2006). Early identification of neighborhoods at risk of decline could therefore help prevent and reverse a downward cycle of social and economic disinvestment.

Many organizations identify variables that may serve as indicators to quantify neighborhood stability, including the National Neighborhood Indicators Partnership (NNIP.org). Most of these organizations, including NNIP, acknowledge that such variables will vary from city to city (and even from neighborhood to neighborhood). Therefore, using variables that can be addressed is important since the goal of developing such indicators is to spur better performance from municipal agencies.

Because most industry professionals are concerned with neighborhood decline, and because John Landis' research demonstrated that neighborhood decline was the predominant form of socioeconomic change from 1990 to 2010, our reports elucidated factors that can be used to describe and predict decline.

Definition of Neighborhood Stability
Defining "neighborhood stability" was an important part of developing a "Neighborhood Stability Index;" the definition helped guide the decisions in selecting variables, determining approaches, and analyzing results. As noted in *Interim Report 2*, each team member had developed individual definitions of neighborhood stability in previous work, and a group definition was subsequently determined. Our team defined neighborhood stability as follows:

Neighborhood stability is the extent to which an area within a defined boundary can adapt over time when confronted with change, or the likelihood of change.

According to Jane Jacobs "A successful city neighborhood is a place that keeps sufficiently abreast of its problems so it is not destroyed by them. An unsuccessful neighborhood is a place that is overwhelmed by its defects and problems and is progressively more helpless before them." Therefore, neighborhood stability can be associated with maintaining some level of permanence, durability and resilience against

neighborhood change. However, stability is not always an indication of neighborhood prosperity because depressed neighborhoods can be "stable" and have strong social ties, but this stability isn't beneficial to residents because it is characterized by higher levels of actual and perceived disorder (Ross, Reynolds & Geis, 2000). As well, rapidly upgrading neighborhoods could also be considered unstable if these processes cause gentrification and displacement of low-income residents. For this reason it should be noted that while neighborhoods may exhibit signs of stability, they may also exhibit signs of instability in the form of either decline or upgrade/improvement.

Overview of Previous Reports

In its first report, *Interim Report 2*, the group developed and tested an index that used changes in selected census variables between 2000 and 2010 to capture neighborhood stability across all census tracts in Howard County.

In the next report, *Interim Report 3*, we analyzed changes in average housing prices from 2000 to 2010 across the County and compared those results to a revised version of the index developed in *Interim Report 2* to determine whether stable census tracts tend to also exhibit stability in home prices.

In the most recent report, *Interim Report 4*, we again constructed a measure of neighborhood stability by analyzing changes in housing sale prices between 2000 and 2010. In contrast to *Interim Report 3*, for this index we controlled for housing type and age of unit, and used a multiple linear regression to calculate predicted home sale values. We then compared the results to those in our previous reports to recommend the most suitable approach.

In the following sections, we summarize the approach, methodology, results, findings, and interpretation of each report, and then offer overall conclusions and recommendations.

INTERIM REPORT 2

Approach

The first step in developing the Neighborhood Stability Index was a series of literature reviews as well as a review of existing indices and approaches to reference and learn from previous successes and challenges in developing indices. Having conceptualized an operational definition of neighborhood stability and conducted literature reviews, the absolute and percentage changes for census variables between 2000 and 2010 were then examined.

Referencing both lessons learned from the literature reviews and the analysis of the census variables, a set of indicators were chosen and grouped into group four categories: Social Capital, Education, Housing, and Employment and Workforce (see Appendix for details). The indicators were acquired from the 2010 Neighborhood Change Database, which provides longitudinal U.S. Census data, normalized to 2010 census tracts. For each of the chosen indicators, an increase in percent point change from 2000-2010 represents an undesirable impact and indicates the potential for the risk of decline. Positive indicators, for which percent point increases from 2000-2010 would be viewed as improvements, were not included to ensure accuracy and avoid distorting the outcomes of the index.

Methodology

We used a method developed jointly by two groups—Measure of America and Opportunity Nation—to calculate the index where first, the percent point changes for the chosen indicators were normalized to ensure they were on a defined scale; 0–10 where 10 indicates the highest potential for instability. The following formula was used for each tract:

(Observed % Change - Lowest % Change / Highest % Change - Lowest % Change) x10
Source: Opportunity Index.org, 2014

After reviewing the results and receiving feedback, we determined that using Z-scores to describe neighborhood stability was a more intuitive approach. Because a Z-score is "a statistical measure that captures the relative distance between an indicator's value for an individual census tract and the mean value of the indicator across all census tracts in the region," (Knapp, 2009) we also hoped that this approach would yield more variation in our results, helping us draw more definite conclusions on neighborhood stability. As a result, for *Interim Report 3* the following equation was used to determine stability scores (with lower scores serving as an indication of greater stability and higher scores serving as an indication of less stability):

Z = (score of interest - mean) / standard deviation

It should also be noted that the census variables initially chosen for the stability index were also reviewed. For the Education dimension in particular the variable "Persons 25+ years old without a bachelor's or graduate/professional degree" was replaced with the variable "Persons 25+ years old with only a middle/elementary school education." This decision was made so that the score for this dimension would be a more holistic representation of the educational state of each tract. Additionally, based on feedback and group discussion, we renamed the Social Capital dimension "Demographics," which better represents what this dimension is addressing.

Next, the averages of these rescaled scores were determined for each tract to arrive at an overall score for each specific category. For example, the Social Capital category score for each tract is the average of

rescaled scores for the tract on Persons 65+ years old; Female-headed families with own children; Households with public assistance income in past 12 month; and Persons below the poverty level in the past 12 months. Lastly, the averages of the four category scores were calculated for each tract to determine its overall neighborhood stability score. All of the indicators in the Neighborhood Stabilization Index are weighted equally.

Results

Table 1 - Howard County Neighborhood Stability Scores

Howard County Neighborhood Stability Scores					
Census Tract	Housing	Education	Demographics	Employment	Average
6011.03	-0.307	-0.169	-0.106	-0.087	-0.167
6011.04	-0.118	-0.147	-0.197	0.214	-0.062
6011.05	-0.397	-0.222	0.261	-0.388	-0.186
6011.07	0.899	0.586	0.376	0.625	0.622
6011.08	-1.016	0.079	0.260	-0.414	-0.273
6012.01	-0.154	0.184	-0.369	-0.241	-0.145
6012.03	0.927	1.712	0.088	-1.235	0.373
6012.04	1.517	-1.336	-0.333	-0.740	-0.223
6021.00	-0.316	-0.312	-0.025	0.233	-0.105
6022.01	0.090	-0.560	-1.230	-0.766	-0.616
6022.02	-0.136	-0.385	-0.224	-0.163	-0.227
6023.02	0.285	-0.265	0.491	0.114	0.156
6023.03	-0.185	-0.207	-0.321	0.621	-0.023
6023.04	-0.418	0.415	0.267	-0.877	-0.153
6023.05	-0.266	-0.217	0.252	-0.982	-0.303
6023.06	-0.279	0.336	0.483	0.012	0.138
6026.00	0.290	-1.031	-1.675	-0.530	-0.737
6027.00	0.331	-0.454	-0.319	-0.467	-0.227
6028.00	-0.386	0.483	0.116	-0.170	0.011
6029.00	-0.216	-0.586	1.155	-0.647	-0.073
6030.01	0.019	-0.511	-0.182	-0.239	-0.228
6030.03	-0.519	-0.276	-0.516	-0.550	-0.465
6030.04	0.425	-0.307	-0.576	0.071	-0.097
6040.01	0.220	-0.739	0.034	-0.204	-0.172
6040.02	-0.018	0.085	-0.113	0.079	0.008
6051.02	0.160	-0.325	0.153	-0.539	-0.138
6051.03	-0.134	-0.011	0.265	0.935	0.264
6051.04	-0.155	0.120	0.667	0.018	0.163
6054.01	0.120	0.118	-0.422	-0.408	-0.148
6054.02	-0.150	0.064	-0.367	-0.186	-0.160
6055.02	-0.502	0.453	0.257	-0.921	-0.178
6055.03	-1.174	0.721	0.171	-0.145	-0.107
6055.04	-0.259	0.939	0.232	-0.162	0.187
6055.05	0.197	0.386	0.227	0.734	0.386
6056.01	-0.487	-0.276	-0.707	0.557	-0.228

6056.02	0.224	0.171	-0.144	0.158	0.102
6066.01	0.212	0.335	0.715	1.030	0.573
6066.03	0.072	-0.341	-0.670	0.528	-0.103
6066.04	-0.156	0.696	0.244	1.191	0.494
6066.06	0.934	0.371	0.665	1.019	0.747
6066.07	-1.133	0.067	-0.112	0.075	-0.276
6067.01	-0.248	0.476	0.049	0.915	0.298
6067.04	1.298	1.299	0.764	-0.331	0.758
6067.05	-0.027	0.689	0.781	0.593	0.509
6067.06	-0.626	-0.012	-0.250	-0.282	-0.292
6067.07	0.155	0.777	0.288	0.031	0.313
6068.03	-0.012	1.485	0.307	0.677	0.615
6068.04	-0.144	0.144	0.018	0.512	0.132
6068.05	-0.373	-0.619	0.140	0.204	-0.162
6068.06	0.210	-0.239	-0.094	0.586	0.116
6069.01	0.551	-1.065	-0.832	-0.186	-0.383
6069.04	0.120	-0.169	0.202	0.758	0.228
6069.05	0.046	-0.931	0.148	0.158	-0.145
6069.06	-0.195	-0.351	-0.553	-0.645	-0.436
6069.07	1.207	-1.128	0.259	-0.141	0.049

Housing

Cost-burden, overcrowding and a neighborhood's overall physical condition can impact stability. Good physical condition is an indication of active building use and as a result, the physical condition of a neighborhood's housing stock is indicative of stability in urban communities (Kinney & Winter). Conversely, uninhabited or unattended buildings can pose threats to neighborhood stability. With this in mind, the indicators used to determine the Housing score of the Neighborhood Stability Index were: Total renter-occupied housing units; Renter-occupied housing units with more than two occupants per room; Owner-occupied housing units whose monthly owner costs are 50% or more of their income; and Total vacant housing units.

As shown in the above table, the census tract with the highest Housing score at the greatest risk of facing decline was 6012.04 with a score of 1.517. Interestingly, this tract scored at the top in the education category. Census tract 6055.03 had the lowest score of -1.174 and is therefore facing improvement or upgrading in this category.

Education

According to Kenworthy, (2014) education makes individuals more productive and thereby boosts their income, suggesting that a better-educated population will generate faster economic growth for any given area. Furthermore, "education can help to enhance technological progress, which is vital for growth in a modern knowledge-driven economy" (Kenworthy, 2014). For this reason the following indicators were chosen as a measure of educational neighborhood stability: Persons of age 25+ who completed high school but not college; Persons 16–19 years old neither enrolled in nor graduated from high school; Persons of age 25+ who completed 9–12 years of study but with no diploma; and Persons of age 25+ with no bachelor's or graduate/professional degree.

The top and bottom performing tracts in this category are both located in Elkridge, adjacent to each other. The census tract with the highest Education score at the greatest risk of facing decline was 6012.03, with a score of 1.712. Census tract 6012.04 is experiencing improvement with a score of -1.336.

Social Capital

Temkin & Rohe (1998) argue that neighborhoods with high levels of social capital are expected to respond effectively to changes in the community and in doing so, maintain or enhance stability. Contrarily, areas with little social capital are expected to "succumb to the forces of change and experience decline." It was therefore essential to include indicators that could contribute to or threaten neighborhood social capital in the Neighborhood Stability Index. The indicators used to determine the Social Capital score for our index were: Persons 65+ years old; Female-headed families with own children; Households with public assistance income in past 12 month; and Persons below the poverty level in the past 12 months.

The census tract with the highest Social Capital score, at the greatest risk of facing decline was 6029.00 with a score of 1.155. Census tract 6026.00 had the lowest score of -1.675 and therefore is experiencing upgrade in this category. Both tracts are located in Ellicott City, adjacent to each other and to the Patapsco Valley State Park.

Employment and Workforce

Changes in employment and the workforce can affect resident income and subsequently, economic neighborhood stability. According to Stegman & Rasmussen (1980), a neighborhood is stable if normal profits can be earned after a period of market adjustment. The indicators used to determine the Employment and Workforce score were: Persons 16+ years old in the civilian labor force and unemployed; Persons 16+ years old not employed in professional/technical/managerial occupations; Occupied housing units with no car available; and Persons 16–64 years old who worked 1–26 weeks last year.

The census tract with the highest Employment and Workforce score, at the greatest risk of experiencing decline was 6066.04, with a score of 1.191. This tract is located in Long Reach, Columbia. Census tract 6012.03 is experiencing improvement with a score of -1.235 and is located in Elkridge. Interestingly, this Census tract had the highest score in the Education category, at the greatest risk of decline.

Overall Scores

Table 2 - Top & Bottom Performing Tracts 2000–2010

Top & Bottom Performing Tracts 2000–2010		
Category	Top Performing Tract	Bottom Performing Tract
Overall	6026.00	6067.04
Education	6012.04	6012.03
Demographics	6026.00	6029.00
Employment	6012.03	6066.04
Housing	6055.03	6012.04

As cited above, the scores across the four categories were averaged to arrive at an overall neighborhood stability score for each census tract. In doing so, and as reflected in the associated maps in the appendix, we found that census tract 6066.06 was the bottom performing tract in our index, with a score of 0.747.

While this tract did not score highest in any of the four categories, it did have consistently high scores across each of them. Census tract 6030.03 was the top performing tract with a score of -0.465.

Findings and Interpretation

In interpreting the results of our findings above, we saw a relatively high rate of consistency across the four categories as census tracts showing a high risk of instability in one category tended to show instability in another category as well. According to Yeager (2014) in the *Baltimore Sun*, Columbia and Ellicott City jointly placed among the top 10 "Best Places to Live," in *Money Magazine's* biennial ranking of small cities for the fifth consecutive time since 2006. The analysis takes into account "great jobs, strong economies, affordable homes, excellent schools and much more," according to the magazine.

However, the highest concentration of tracts at risk of decline are within the boundaries of Columbia. Census tract 6067.04, the bottom performing tract, is also located in Columbia's Owen Brown Village area. According to Spence (2009), Owen Brown has some of the most dated housing stock in all of Columbia and has seen its share of crime over the years, with a blighted appearance especially in Greenleaf where many small establishments have been victim to theft and robberies. There are also several tracts at risk of decline within Columbia's Long Reach Village area. In recent years the Long Reach Village Center has "struggled with crime and empty storefronts" (Yeager, 2015), and plans to revamp the center began in 2014, when it was declared a blight zone by the Howard County Council. Although it was the first Village Center to have a Howard County Police Satellite Office, significant decreases in crime rates have occurred only in the other Village Centers that followed suit (Lean, 2010). The poor performance of 6067.04 and others in the immediate surroundings may be attributed to the crime rate and blight in the areas discussed above.

Other tracts at risk of decline occur in Clarksville, Laurel and Elkridge. However, with the exception of Clarksville, these areas also consist of stable tracts and those experiencing improvement or upgrade. There is some balance, as none of these areas are showing widespread signs of instability. According to Cross (2013), Clarksville is the fifth safest town in Maryland and is also home to the top performing River Hill High School. Dayton, located within Clarksville, is an "unincorporated community" and the third safest community in Maryland.

Perhaps if the index could have incorporated crime and safety statistics, the results would be somewhat different, however this information is not available in the decennial census or ACS data. The top performing tract, 6026.00 experiencing the greatest extent of improvement or upgrading, is located in the northeast of Ellicott City. Similarly, most of the West Friendship neighborhood is also experiencing improvement or upgrade. In 2012, West Friendship was ranked as the most expensive suburb in the Baltimore metropolitan area according to the *Baltimore Sun's* analysis of average sale price data from Metropolitan Regional Information Systems' Real Estate Business Intelligence (Hopkins, 2012). Perhaps these high average home sales prices are indicative of the area's desirability; changes in home sales prices will be addressed further along in this paper.

INTERIM REPORT 3

Approach

In this report, we analyzed changes in average housing prices from 2000 to 2010 across the County to identify which census tracts saw statistically significant changes in housing prices and compared those results to the index developed in *Interim Report 2* to determine whether stable census tracts tend to also exhibit stability in home prices.

Methodology

The Housing sales price data was obtained from Maryland Property View. These data provide sales price for all homes sold in Maryland, along with basic information on the characteristics of the home sold. For the housing price analysis, using SPSS we adjusted for inflation by converting 2000 sales prices to 2010 dollars; omitted "arm's length" transactions; aggregated sales prices for single family homes, townhouses, condominiums, mobile homes, uncategorized and rentals for 2000 and 2010; and created an aggregated file with mean and standard deviations for 2010 and 2000 sales prices. Then, in Excel we performed two-tailed independent samples with an assumed unequal variances test for the following alternative hypothesis:

H1: 2000 average home sale prices ≠ 2010 average home sale prices.

After testing this hypothesis, stable tracts were determined and then compared with *Interim Report 2* results. To compare both, the T scores of Interim report 3 were compared to Z scores of Interim Report 2.

Results

Summary of Hypothesis Test Results

After analyzing sales prices based on the above hypothesis, we rejected the null hypothesis, *H0: 2000 Average home sale prices = 2010 Average home sale prices* for P- values (two-tailed test) less than 0.025 and therefore concluded that change in the home sale price was an indication of instability. All other tracts for which the P-value was greater than 0.025, were identified as stable. The tracts identified stable under this assumption are displayed in the table below.

Table 3 Howard County Change in Home Sales Price 2000-2010

Howard County Change In Average Home Sale Price 2000-2010											
	2000 Home Sale Price			2010 Home Sale Price			H1:2000 Average home sale price<>2010 Average home sale price H0:2000 Average home sale price=2010 Average home sale price				
Census Tract	2000_mean	2000_sd	No_2000	2010_mean	Sales_2010_sd	No_2010	Std. Error	Degree of freedom	Test Statistics	P value	Reject H0 if pvalue < 0.025
	X0	s0	n0	X10	s10	n10	S.E	f	(X10-X0)/S.E	Sig.lvl 0.025	Stability
6011.03	303242.5	337714	363	378540.6	118719.3	81	22095.0827	366.01295	3.407914589	0.001	
6011.04	401328.3	172761.3	293	562160.9	93948.99	76	14764.8923	220.66287	10.89290365	0.000	
6011.05	208049.9	130822	195	373642.5	119062.7	99	15197.2851	214.28464	10.89619691	0.000	
6011.07	232979.7	82344.7	41	339073.9	92067.67	14	27764.0568	20.572976	3.821278087	0.001	
6011.08	178895.6	44614.87	312	295403.7	53833.56	83	6426.20085	113.70214	18.130178	0.000	
6012.01	188916.4	86235.45	445	342493.8	134494.8	81	15492.9219	92.327893	9.912743467	0.000	
6012.03	317524.2	295432	99	266110.6	49456.3	47	30555.8144	109.10126	-1.682613206	0.095	Stable
6012.04	444625.2	1028749	205	296690.5	69459.08	59	72417.7498	210.32809	-2.042796229	0.042	Stable
6021.00	380325.1	111741.3	426	515591	101181.9	111	11024.6258	186.15593	12.26943558	0.000	
6022.01	395267.7	172374.4	230	599975.9	113096.6	29	23879.9046	46.318562	8.572400789	0.000	
6022.02	323602.9	83237.2	127	456751.2	87585.62	50	14421.4912	85.822225	9.232633274	0.000	
6023.02	304356.6	270673.9	219	392507.6	108023.8	92	21479.7297	308.43049	4.103919102	0.000	
6023.03	388780.6	241002.6	145	473311	115091.4	65	24583.5807	207.1535	3.438487025	0.001	
6023.04	381812.7	206826.2	172	472151.6	130871.2	39	26227.1734	87.024941	3.444477243	0.001	
6023.05	310595.8	95937.23	108	458788.5	117909.1	39	21016.5971	57.180351	7.051222582	0.000	
6023.06	222065	162665.9	255	396684.5	122303.6	71	17732.5651	146.16356	9.847394684	0.000	
6026.00	421376.9	260688.8	226	340157.9	108677.7	39	24567.1375	129.38387	-3.30599802	0.001	
6027.00	306728.3	325932.8	103	522741.3	154552.9	111	35306.8724	143.22286	6.118157449	0.000	
6028.00	288085.7	173793.9	310	369906.6	115720.9	81	16209.8258	185.40861	5.047614108	0.000	
6029.00	468284.6	590884.2	75	491956.8	153762.9	16	78313.1211	85.790651	0.302277003	0.763	Stable
6030.01	354262.2	381531.7	513	403336.8	180688	132	23045.3878	451.83968	2.129478283	0.034	Stable
6030.03	384202.7	215103.4	172	695843.5	212243.5	25	45507.1563	31.602083	6.848171677	0.000	
6030.04	465144.3	252704.9	213	752105.3	366592.9	55	52376.2553	67.804493	5.478836501	0.000	
6040.01	291915.3	144154.8	233	480004.3	197747.2	32	36210.2951	35.664797	5.194350594	0.000	
6040.02	407914.4	340094.8	311	736840.5	217396.4	70	32358.4834	155.45502	10.16506534	0.000	
6051.02	519242.4	393779	276	576987.6	167321.7	199	26504.807	395.52391	2.178671017	0.030	Stable
6051.03	394666.7	204076.7	141	654755.1	182469.4	34	35702.0749	54.735681	7.284965933	0.000	
6051.04	542631	354933.5	126	734699.1	338472	70	51346.2958	148.47022	3.740642773	0.000	
6054.01	218378.1	78113.31	147	354430.8	147323.5	39	24454.5818	43.816433	5.563484407	0.000	
6054.02	173360	376491	327	256832.8	88316.85	74	23213.7034	398.57389	3.595841673	0.000	
6055.02	308128.1	159543.8	241	417736.5	156341.3	60	22649.4067	92.038485	4.839351577	0.000	
6055.03	171903.4	83363.05	199	290338.6	102894.5	44	16599.4445	56.130291	7.134891382	0.000	
6055.04	451433.1	90942.25	155	672068.3	87256.09	22	19985.7916	27.884421	11.03960183	0.000	
6055.05	424328.1	191095	755	555174.1	164491.2	61	22179.5047	73.728767	5.899409022	0.000	
6056.01	179381.6	87889.3	240	310299.1	124477.3	56	17574.8298	68.327076	7.449146539	0.000	
6056.02	240911.7	173779.9	234	379788.9	119032.3	64	18720.1289	144.57694	7.418600813	0.000	
6066.01	238032.4	75894.88	96	368602.3	57515.01	43	11701.7107	104.86242	11.15819483	0.000	
6066.03	173635.2	65768.06	255	303063.6	102059.6	55	14364.7914	63.997216	9.010115276	0.000	
6066.04	191316.3	401507.6	179	262802	126721.4	54	34611.8702	230.53941	2.065352489	0.040	Stable
6066.06	285400.6	730332.8	195	307598.7	127148.9	31	57068.5908	222.68214	0.38897159	0.698	Stable
6066.07	206082.1	71355.14	134	338938.6	89229.77	35	16293.5881	45.978676	8.153911893	0.000	
6067.01	483193.4	947135.2	83	402722.8	66641.52	16	105288.09	85.955966	-0.764289956	0.447	Stable
6067.04	186800.9	170576.1	267	301937.7	56908.41	61	12730.509	286.6687	9.044166817	0.000	
6067.05	394611.4	1438274	95	333310.7	71951.02	28	148188.926	95.579085	-0.413665714	0.680	Stable
6067.06	305428.6	744061.8	242	354033.5	80785.65	90	48582.2344	255.82426	1.000466957	0.318	Stable
6067.07	628603	2483936	384	282983.3	58654.89	36	127134.231	387.41959	-2.718541079	0.007	
6068.03	209043.8	177150.8	176	315205.1	104187.3	43	20754.5305	109.21006	5.115093599	0.000	
6068.04	219764.3	74107.64	138	329583.3	83414.82	27	17248.2339	34.494149	6.366974754	0.000	
6068.05	350602	199657.4	315	479412.5	114248.9	24	25892.4058	34.810696	4.974838564	0.000	
6068.06	242839.4	115848.6	135	440437.4	119265.9	70	17395.9504	136.2379	11.35885183	0.000	
6069.01	335382.7	738051.1	191	283065.9	52735.61	83	53716.2952	194.42855	-0.97394667	0.331	Stable
6069.04	205206.8	54427.95	183	339127.3	73377.65	63	10082.2987	86.652302	13.28273771	0.000	
6069.05	239890.8	296326.9	202	475939.2	224806.2	47	38858.3902	87.440358	6.074579924	0.000	
6069.06	169512.7	70857.87	293	309704.7	82921.61	32	15231.8992	36.117183	9.20384403	0.000	
6069.07	178603.6	141505.3	190	403384	114223	43	20218.9067	74.252838	11.11733731	0.000	

Comparison Between Hypothesis Tests Results and Interim Report 2 Findings

Based on the T scores of the housing price analysis and Z scores of the overall neighborhood stability index of *Interim Report 2*, a comparison identified the top performing and bottom performing tracts for each.

Table 4 - Top & Bottom Performing Tracts 2000–2010

Top & Bottom Performing Tracts 2000–2010		
Category	**Top Performing Tract**	**Bottom Performing Tract**
Z scores Report 2	6026.00	6067.04
T scores Report 3	6011.08	6026.00

As per the change in home sale prices, considering the T scores, the top performing tract is 6011.08, home to Bellow Spring Elementary School and Mayfield Woods Middle School. The bottom performing tract, 6026.00, is located northeast of Ellicott City, adjoining the Patapsco valley. Census tract 6011.08 had 97% owner occupied housing units while the 6026.00 had only 32% owner occupied housing units. More tracts within the Columbia area exhibited instability in terms of change in housing sales price, as well as overall stability score. Areas such as Glenwood, West Friendship, Laurel, and Elkridge did not display much change in housing sales price and hence can be identified as stable. West Friendship and Laurel were observed to be stable in terms of overall neighborhood stability score as well. Aside from the area northeast of Ellicott City, tracts within Woodstock, Fulton, Hanover and Jessup areas were also identified for instability in Housing sales prices. Aside from Hanover, instability in these areas is due to the increase in home sale prices, and could be experiencing improvement rather than decline.

Findings and Interpretation

While we founds some similarities between the initial Neighborhood Stability Index and the housing price analysis, the majority of the data did not align. There were census tracts identified as stable in the Neighborhood Stability Index that were identified as unstable in the housing price analysis, and many census tracts that were identified as unstable in the initial Neighborhood Stability Index that were identified as stable in the housing price analysis.

With those results in mind, our group discussed whether our definition of neighborhood stability should be revised or whether housing price changes fail to capture dimensions of neighborhood stability that were captured by our index. After evaluating those questions, the group determined that our definition of neighborhood stability was still strong, that some further adjustments could be made to the initial Neighborhood Stability Index, and that housing prices alone are not necessarily an accurate indicator of overall stability.

When considering further adjustments that could be made to the initial Neighborhood Stability Index, considered that the Housing dimension of our index did not cover a broad enough range of

characteristics such as home values and prices, and that in future analyses the “Aggregate value for specified owner-occupied housing units” census variable could be included in the Housing dimension. This shortcoming could have contributed to inconsistencies in the comparison results.

Additionally, we determined that for *Interim Report 4* we could test another hypothesis to determine if the 2010 housing prices were less than the 2000 housing prices rather than “not equal to.” These results may have assisted in further comparisons to our *Interim Report 2* results.

Lastly, a decrease in housing prices is often intuitively linked to instability and decline, but this does not always tell the whole story. We concluded that census tracts in Howard County can still be considered stable even with a decline in housing prices; it is housing turnover and foreclosures that are a red flag for decline. This notion is supported by Hipp, Tita and Greenbaum (2009) in their model that identified crime and poverty as precursors to housing turnover, as well as Williams, Galster & Verma (2013) who found that home foreclosures are precursors to crime. As a result, crime and foreclosure data for Howard County census tracts would be powerful additions to the neighborhood change indices.

INTERIM REPORT 4

Approach

In this report, we constructed a measure of neighborhood stability again by analyzing changes in housing sale prices between 2000 and 2010. But in contrast to Report 3, this index was controlled for housing type and age of unit, and used a multiple linear regression, to calculate predicted home sale values. We compared the results to those in our previous reports to determine a final recommended approach.

Methodology

A multiple linear regression was performed using SPSS to identify the changes based on data from Maryland Property View database, which provides the sales price of all homes sold in Maryland along with the basic information on their characteristics. We then constructed two linear regression models, for 2000 and for 2010 sales prices. All values that were not likely to be arm's length transactions were removed from the analysis and the 2000 values were expressed in 2010 dollar values by adjusting for inflation.

Because there were several independent variables, a multivariate linear regression was used to calculate the marginal effect of all of these different variables on the predicted sales price which was the dependent variable.

Sample regression equation:

yi = b0 + b1*1i + b2*2i + . . . + bk*ki + ei
(The term ei is the "residual" or "error term." It is an estimate of the difference between each yi and each predicted yi.)

For both models, the dependent variable (yi) was the home sale price (considr1), and the independent variables (b1-bk) were:

A. CTRACTk: 1 dummy variable for each of 54 census tracts in Howard County (excluding one census tract).
B. SF: A dummy variable equal to 1 if the housing unit is a single-family home.
C. AGE: Age of housing unit calculated as the current year +1 minus the year built.

Dummy variables were created for each census tract. To avoid perfect multicollinearity, one census tract (6011.03) was omitted, and became the constant. The tables below record the outputs of the regression model for both 2000 and 2010 sales prices. The unstandardized coefficients generated from the output of the regression were used to calculate the predicted sales price for a five-year old single-family house in each census tract in 2000 and 2010, using the following equation:

Predicted sales price = Constant + (SF x 1) + (AGE x 5) + (CTRACTk x 1)

After calculating the predicted sales prices for 2010 and 2000 for each census tract, the difference between both was calculated. We used these changes in predicted home sales prices to identify census tracts that appeared to be in risk of decline, those that are stable, and those that appear to be upgrading or improving.

Results

Table 5: 2000 Predicted Home Sales Prices

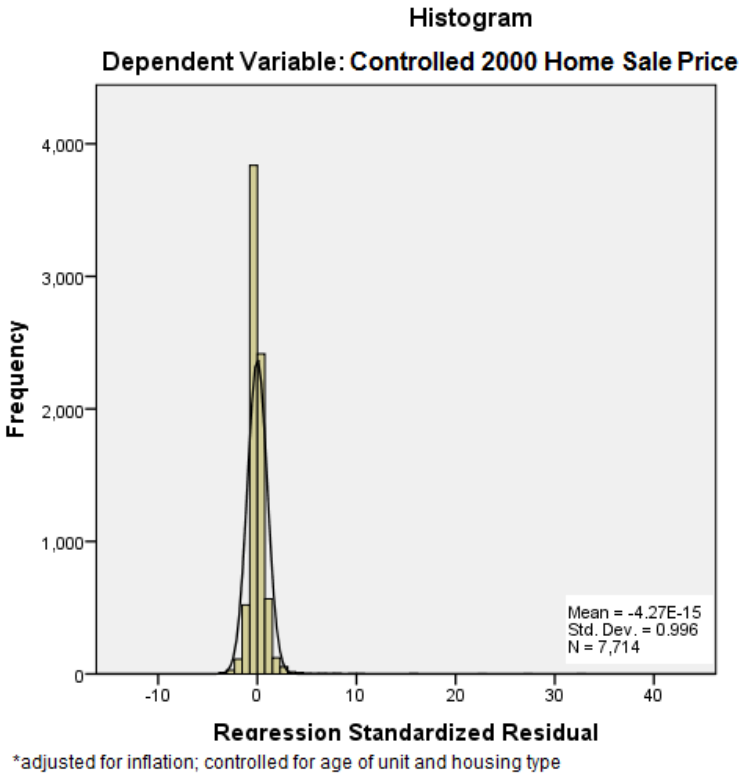
Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	0.636a	0.404	0.400	136968.54705

2000 Predicted Home Sale Price Values

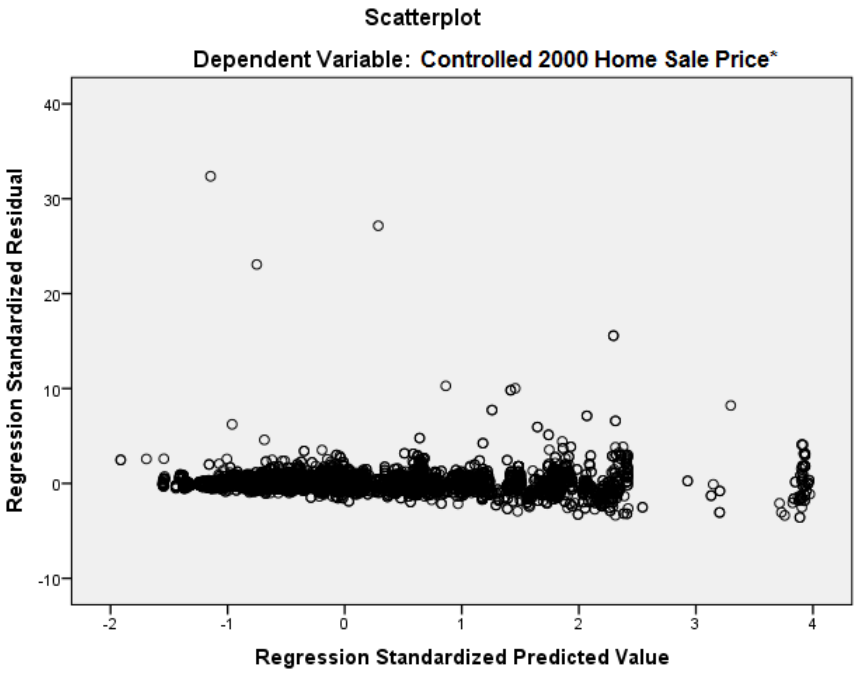
	Coefficients a					
	Unstandardized Coefficients		Standardized Coefficients			
Model	**B**	**Std. Error**	**Beta**	**T**	**Sig.**	**Sale***
(Constant)	195336.76	10763.26		18.15	0	$262,076.12
AGE	-631.77	103.51	-0.06	-6.10	0	
SF	69898.20	4793.11	0.15	14.58	0	
6011.04	123541.24	17368.83	0.08	7.11	0	$385,617.37
6011.05	-8268.64	14568.73	-0.01	-0.57	0.57	$253,807.48
6011.07	-45583.09	28136.77	-0.02	-1.62	0.105	$216,493.04
6011.08	-58990.09	12547.25	-0.07	-4.70	0	$203,086.03
6012.01	-48138.68	13121.15	-0.05	-3.67	0	$213,937.44
6012.03	306662.62	38265.50	0.07	8.01	0	$568,738.74
6012.04	-38604.22	15012.62	-0.03	-2.57	0.01	$223,471.90
6021.00	136638.38	13432.05	0.13	10.17	0	$398,714.50
6022.01	239787.83	16549.14	0.16	14.49	0	$501,863.95
6022.02	83653.50	15898.72	0.06	5.26	0	$345,729.62
6023.02	21189.55	13772.04	0.02	1.54	0.124	$283,265.68
6023.03	168642.60	15958.45	0.12	10.57	0	$430,718.72
6023.04	114227.84	16062.17	0.08	7.11	0	$376,303.96
6023.05	60634.99	16557.56	0.04	3.66	0	$322,711.11
6023.06	28783.44	15300.34	0.02	1.88	0.06	$290,859.56
6026.00	41410.94	19094.62	0.02	2.17	0.03	$303,487.06
6027.00	59558.81	19756.40	0.03	3.02	0.003	$321,634.93
6028.00	8145.19	13972.81	0.01	0.58	0.56	$270,221.32
6029.00	142366.67	21237.79	0.07	6.70	0	$404,442.79

6030.01	78033.81	14906.16	0.06	5.24	0	$340,109.93
6030.03	221362.40	17264.16	0.14	12.82	0	$483,438.52
6030.04	274638.43	16980.99	0.17	16.17	0	$536,714.55
6040.01	75639.27	16362.68	0.05	4.62	0	$337,715.39
6040.02	264868.40	15582.57	0.19	17.00	0	$526,944.52
6051.02	205077.86	15417.65	0.15	13.30	0	$467,153.98
6051.03	219430.80	17533.60	0.13	12.52	0	$481,506.92
6051.04	449541.67	18959.57	0.24	23.71	0	$711,617.79
6054.01	36576.32	16396.14	0.03	2.23	0.026	$298,652.44
6054.02	-30820.55	15147.88	-0.02	-2.04	0.042	$231,255.58
6055.02	80789.90	13888.29	0.07	5.82	0	$342,866.02
6055.03	-52662.65	14880.14	-0.04	-3.54	0	$209,413.47
6055.04	172136.81	18444.52	0.10	9.33	0	$434,212.93
6055.05	207793.53	15206.98	0.16	13.66	0	$469,869.65
6056.01	-31256.57	13781.04	-0.03	-2.27	0.023	$230,819.56
6056.02	-4836.52	14078.86	0.00	-0.34	0.731	$257,239.60
6066.01	-17499.06	17335.08	-0.01	-1.01	0.313	$244,577.06
6066.03	-72219.03	13266.68	-0.07	-5.44	0	$189,857.09
6066.04	505.20	16432.39	0.00	0.03	0.975	$262,581.32
6066.06	-65347.34	14203.12	-0.06	-4.60	0	$196,728.78
6066.07	-43217.23	15467.06	-0.03	-2.79	0.005	$218,858.89
6067.01	31248.83	18840.95	0.02	1.66	0.097	$293,324.95
6067.04	-73383.76	13028.26	-0.08	-5.63	0	$188,692.37
6067.05	-50184.29	17563.46	-0.03	-2.86	0.004	$211,891.83
6067.06	21258.72	13720.70	0.02	1.55	0.121	$283,334.84
6067.07	-98877.04	14891.96	-0.08	-6.64	0	$163,199.08
6068.03	-34955.16	14571.11	-0.03	-2.40	0.016	$227,120.96
6068.04	-34254.53	15269.31	-0.03	-2.24	0.025	$227,821.59
6068.05	96495.66	18848.40	0.05	5.12	0	$358,571.78
6068.06	-11327.88	15630.50	-0.01	-0.73	0.469	$250,748.25
6069.01	-76579.76	15005.34	-0.06	-5.10	0	$185,496.36
6069.04	-56900.12	15146.45	-0.04	-3.76	0	$205,176.00
6069.05	-51927.28	13938.35	-0.05	-3.73	0	$210,148.84
6069.06	-84641.09	13856.54	-0.08	-6.11	0	$177,435.04
6069.07	-64915.39	16126.77	-0.05	-4.03	0	$197,160.73

a. Dependent Variable: considr12010 (2000 sales price adjusted for inflation to 2010)					
* For 5 year old single family home					
not significant					



*adjusted for inflation; controlled for age of unit and housing type



*adjusted for inflation; controlled for age of unit and and housing type

Table 6: 2010 Predicted Home Sales Prices

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.691a	0.478	0.477	138568.1291

2010 Predicted Home Sale Price Values

	Coefficients a					
	Unstandardized Coefficients		**Standardized Coefficients**			
Model	**B**	**Std. Error**	**Beta**	**T**	**Sig.**	**Sale***
(Constant)	349526.36	12517.23		27.92	0	$520,357.64
AGE	-3398.72	132.44	-0.32	-25.66	0	
SF	187824.89	4995.10	0.49	37.60	0	
6011.04	59714.64	18000.06	0.05	3.32	0.001	$580,072.28
6011.05	35595.07	16588.72	0.03	2.15	0.032	$555,952.71
6011.07	5685.00	31906.63	0.00	0.18	0.859	$526,042.64

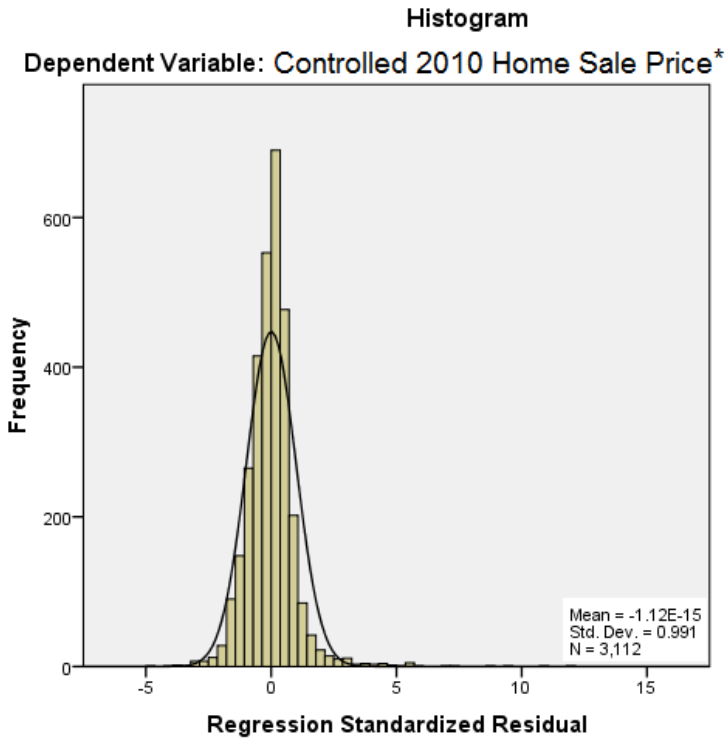
6011.08	457.29	17320.31	0.00	0.03	0.979	$520,814.93
6012.01	-55599.56	17379.27	-0.05	-3.20	0.001	$464,758.08
6012.03	-103873.00	20239.27	-0.07	-5.13	0	$416,484.64
6012.04	-38186.02	18880.12	-0.03	-2.02	0.043	$482,171.62
6021.00	90387.57	16222.90	0.09	5.57	0	$610,745.21
6022.01	135262.35	23938.27	0.07	5.65	0	$655,619.99
6022.02	33394.22	20161.20	0.02	1.66	0.098	$553,751.86
6023.02	26310.70	16868.99	0.02	1.56	0.119	$546,668.34
6023.03	84682.60	18506.49	0.06	4.58	0	$605,040.24
6023.04	71340.50	22291.79	0.04	3.20	0.001	$591,698.14
6023.05	70871.57	21727.83	0.04	3.26	0.001	$591,229.21
6023.06	51345.03	18024.38	0.04	2.85	0.004	$571,702.67
6026.00	10222.81	21681.99	0.01	0.47	0.637	$530,580.45
6027.00	55293.67	16350.17	0.05	3.38	0.001	$575,651.31
6028.00	39803.62	18126.76	0.03	2.20	0.028	$560,161.26
6029.00	76621.37	30981.36	0.03	2.47	0.013	$596,979.01
6030.01	33375.97	15863.58	0.03	2.10	0.035	$553,733.61
6030.03	230545.18	25336.98	0.11	9.10	0	$750,902.82
6030.04	290300.00	19403.15	0.20	14.96	0	$810,657.64
6040.01	49370.05	24291.07	0.02	2.03	0.042	$569,727.69
6040.02	255651.82	18507.58	0.19	13.81	0	$776,009.46
6051.02	170369.15	14651.69	0.21	11.63	0	$690,726.79
6051.03	217777.23	23411.40	0.11	9.30	0	$738,134.87
6051.04	366640.73	19773.24	0.25	18.54	0	$886,998.37
6054.01	50922.16	21617.49	0.03	2.36	0.019	$571,279.81
6054.02	-15755.81	17903.54	-0.01	-0.88	0.379	$504,601.83
6055.02	61093.06	18884.38	0.04	3.24	0.001	$581,450.70
6055.03	-3454.68	20835.62	0.00	-0.17	0.868	$516,902.97
6055.04	177819.00	26635.94	0.08	6.68	0	$698,176.64
6055.05	123755.32	18713.57	0.09	6.61	0	$644,112.96
6056.01	-2400.53	19220.99	0.00	-0.13	0.901	$517,957.11
6056.02	11190.66	18556.02	0.01	0.60	0.547	$531,548.30
6066.01	-28610.92	21112.35	-0.02	-1.36	0.175	$491,746.72
6066.03	-58175.06	19434.49	-0.04	-2.99	0.003	$462,182.58
6066.04	-54367.70	19530.39	-0.04	-2.78	0.005	$465,989.94

6066.06	-13930.28	23312.32	-0.01	-0.60	0.55	$506,427.36
6066.07	262.12	22403.95	0.00	0.01	0.991	$520,619.76
6067.01	-11424.77	30308.86	0.00	-0.38	0.706	$508,932.88
6067.04	-5009.61	18812.32	0.00	-0.27	0.79	$515,348.04
6067.05	-67810.42	24249.55	-0.03	-2.80	0.005	$452,547.22
6067.06	16532.40	17013.54	0.01	0.97	0.331	$536,890.04
6067.07	-24819.33	22129.60	-0.01	-1.12	0.262	$495,538.31
6068.03	-9715.08	20831.51	-0.01	-0.47	0.641	$510,642.56
6068.04	12738.77	24538.88	0.01	0.52	0.604	$533,096.41
6068.05	38574.59	25697.29	0.02	1.50	0.133	$558,932.23
6068.06	57531.60	17975.82	0.05	3.20	0.001	$577,889.24
6069.01	-69354.72	17392.96	-0.06	-3.99	0	$451,002.92
6069.04	-58205.00	18688.79	-0.04	-3.11	0.002	$462,152.64
6069.05	115787.79	20366.26	0.07	5.69	0	$636,145.43
6069.06	-58352.95	23015.61	-0.03	-2.54	0.011	$462,004.69
6069.07	-6313.02	20806.99	0.00	-0.30	0.762	$514,044.62

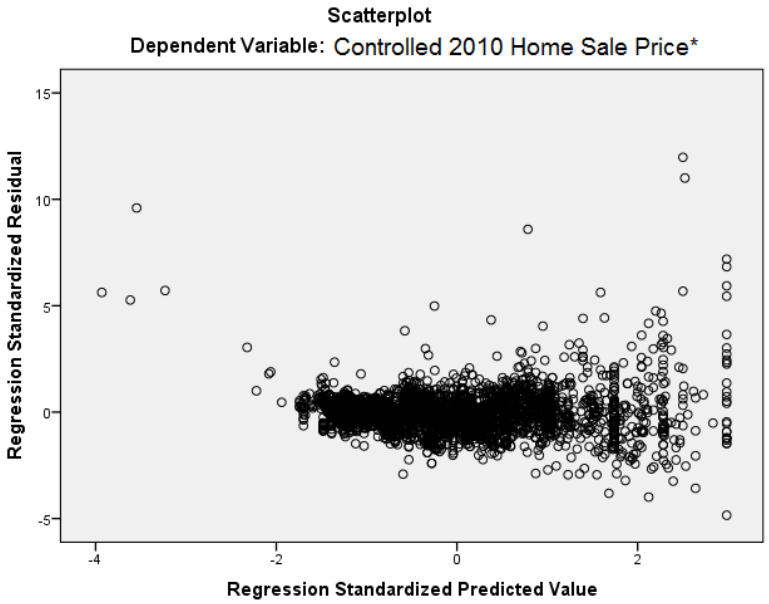
a. Dependent Variable: considr1 (2010 sales price

* For 5 year old single family home

not significant



*controlled for age of unit and housing type



*controlled for age of unit and housing type

Adjusted R Square (2000) = 0.400 Adjusted R Square (2010) = 0.670

This finding implies that 40% of the variation in the 2000 sales prices, and 67% of the variation in the 2010 sales prices can be attributed to these independent variables. To assess if our regression was the

best linear unbiased estimator of the actual population, coefficients (βk) analyzed, we addressed several assumptions of the Classical Linear Regression Model:

Assumption 1: *The regression model is linear in the parameters.*
Our coefficients were housing sales prices, age of the unit, whether or not the unit was a single family home, and the census tracts. None of these coefficients were raised only to a power of one, and none were multiplied or divided by another coefficient.

Assumption 2: *The regression model is correctly specified.*
It is possible that some of the X variables were measured with error (as there is always a margin of error). Other relevant variables that affect housing price could have been omitted, such as the number of bedrooms or unit square footage, and unique features including external siding, or a basement or garage. However, no irrelevant variables were included, the correct functional form was adopted, and none of the X variables are endogenous.

Assumption 3: *Given the value of X, the variance of the population error term is the same for all observations.*
In analyzing the 2000 scatterplot of residuals, the variance is mostly clustered around zero, the (fitted) regression line, indicating that the error term is homoskedastic and the coefficient estimates are efficient. However, there is a gap between 2.5 and 4, which may be caused by the outlier tract in our analysis. The 2010 scatterplot of residuals, exhibited greater variation as the predicted values increased, starting around 1, which is indicative of some heteroskedasticity.

Assumption 4: *There is no perfect multicollinearity*
In examining the correlation matrices for the 2000 and 2010 regressions, there were no perfectly collinear variables, and overall the multicollinearity was very low.

Assumption 5: *The population error term is normally-distributed.*
In analyzing the histograms of residuals for both the 2000 and 2010 regressions, the measurement errors in the response variable have normal but steep and slightly skewed distributions. Because of this, we can conclude that the estimators are unbiased.

The statistical significance of the estimated regression coefficients for a two-tailed hypothesis test was checked by considering the p-value. If the p-value for a particular variable was greater than .025, it was indistinguishable from zero and hence not significant. For the 2010 model, 20 tracts' impacts on housing price were insignificant and for the 2000 model, 14 tracts' impacts were insignificant. Considering the absolute value of the Standardized coefficients (Beta) and holding all other variables constant, for the 2000 model, tract 6051.04 had the most impact on predicted home sales price (Standardized Beta = 0.244); and for the 2010 prices, single family homes had the greatest impact (Standardized Beta = 0.489).

<u>Difference in Predicted Home Sales Prices</u>
The 2000–2010 changes in predicted home sale prices were calculated by subtracting the 2000 prices from the 2010 prices. In order to standardize these results, we again calculated Z scores for each tract's price change using the following formula:

Z Score = (Change in sales price - Mean) / Standard Deviation

The results of these calculations are shown in the table below.

Table 7: Difference in Home Sales Prices from 2000–2010

Difference in Home Sales Prices from 2000–2010				
Census Tract	**2010 Sale Prices**	**2000 Sale Prices**	**2010-2000**	**2010-2000 Z Score**
Constant/6011.03	$520,357.64	$262,076.12	$258,281.52	0.092
6011.04	$580,072.28	$385,617.37	$194,454.92	-0.771
6011.05	$555,952.71	$253,807.48	$302,145.23	0.685
6011.07	$526,042.64	$216,493.04	$309,549.60	0.785
6011.08	$520,814.93	$203,086.03	$317,728.89	0.895
6012.01	$464,758.08	$213,937.44	$250,820.63	-0.009
6012.03	$416,484.64	$568,738.74	-$152,254.10	-5.456
6012.04	$482,171.62	$223,471.90	$258,699.71	0.097
6021.00	$610,745.21	$398,714.50	$212,030.71	-0.533
6022.01	$655,619.99	$501,863.95	$153,756.04	-1.321
6022.02	$553,751.86	$345,729.62	$208,022.24	-0.587
6023.02	$546,668.34	$283,265.68	$263,402.67	0.161
6023.03	$605,040.24	$430,718.72	$174,321.51	-1.043
6023.04	$591,698.14	$376,303.96	$215,394.18	-0.488
6023.05	$591,229.21	$322,711.11	$268,518.10	0.230
6023.06	$571,702.67	$290,859.56	$280,843.11	0.397
6026.00	$530,580.45	$303,487.06	$227,093.39	-0.330
6027.00	$575,651.31	$321,634.93	$254,016.38	0.034
6028.00	$560,161.26	$270,221.32	$289,939.95	0.520
6029.00	$596,979.01	$404,442.79	$192,536.22	-0.797
6030.01	$553,733.61	$340,109.93	$213,623.68	-0.512
6030.03	$750,902.82	$483,438.52	$267,464.29	0.216
6030.04	$810,657.64	$536,714.55	$273,943.09	0.303
6040.01	$569,727.69	$337,715.39	$232,012.30	-0.263
6040.02	$776,009.46	$526,944.52	$249,064.94	-0.033
6051.02	$690,726.79	$467,153.98	$223,572.81	-0.377
6051.03	$738,134.87	$481,506.92	$256,627.95	0.069
6051.04	$886,998.37	$711,617.79	$175,380.58	-1.029
6054.01	$571,279.81	$298,652.44	$272,627.37	0.286
6054.02	$504,601.83	$231,255.58	$273,346.25	0.295

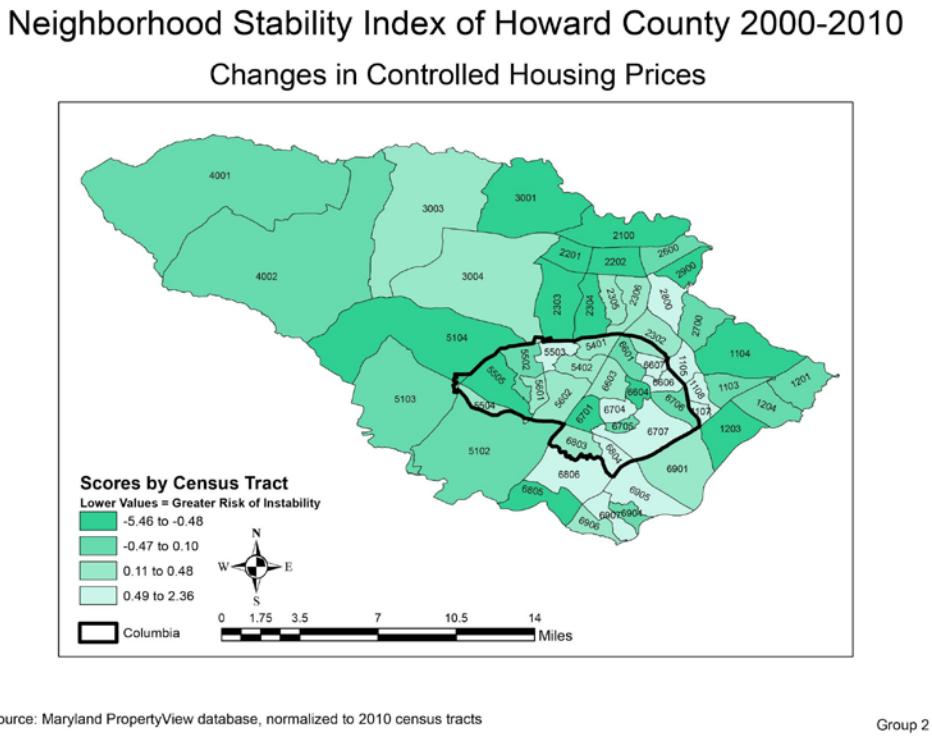
6055.02	$581,450.70	$342,866.02	$238,584.67	-0.174
6055.03	$516,902.97	$209,413.47	$307,489.50	0.757
6055.04	$698,176.64	$434,212.93	$263,963.70	0.169
6055.05	$644,112.96	$469,869.65	$174,243.30	-1.044
6056.01	$517,957.11	$230,819.56	$287,137.55	0.482
6056.02	$531,548.30	$257,239.60	$274,308.70	0.308
6066.01	$491,746.72	$244,577.06	$247,169.66	-0.058
6066.03	$462,182.58	$189,857.09	$272,325.49	0.282
6066.04	$465,989.94	$262,581.32	$203,408.62	-0.650
6066.06	$506,427.36	$196,728.78	$309,698.58	0.787
6066.07	$520,619.76	$218,858.89	$301,760.87	0.679
6067.01	$508,932.88	$293,324.95	$215,607.92	-0.485
6067.04	$515,348.04	$188,692.37	$326,655.67	1.016
6067.05	$452,547.22	$211,891.83	$240,655.39	-0.146
6067.06	$536,890.04	$283,334.84	$253,555.20	0.028
6067.07	$495,538.31	$163,199.08	$332,339.24	1.093
6068.03	$510,642.56	$227,120.96	$283,521.60	0.433
6068.04	$533,096.41	$227,821.59	$305,274.82	0.727
6068.05	$558,932.23	$358,571.78	$200,360.45	-0.691
6068.06	$577,889.24	$250,748.25	$327,140.99	1.022
6069.01	$451,002.92	$185,496.36	$265,506.56	0.189
6069.04	$462,152.64	$205,176.00	$256,976.64	0.074
6069.05	$636,145.43	$210,148.84	$425,996.58	2.358
6069.06	$462,004.69	$177,435.04	$284,569.66	0.447
6069.07	$514,044.62	$197,160.73	$316,883.89	0.884
not significant				

Converting the difference in sales prices to Z scores made it easier to compare the results of all three neighborhood stability indices developed thus far. A bivariate correlation was performed to compare the scores from the three reports to identify any association between the different approaches, which is discussed in greater detail later in this paper. Further, the Z Scores were divided into quartiles to categorize our results as shown in the table below.

Table 8: Quartiles

Quartile Number	Z Score
Lowest Quartile (1st-25th percentile) = Greatest risk of decline	-5.46 to -0.43
Lower Quartile (26th-50th percentile) = Stable, some risk of decline	-0.42 to 0.10
Higher Quartile (51st-75th percentile) = Stable, potential for upgrading	0.11 to 0.48
Highest Quartile (76th-100th percentile) = Strongest potential for upgrading	0.49 to 2.36

We then mapped these categories as shown below, to locate tracts that fall into each of these four categories. The census tracts are labeled with the last four digits of their respective numbers. The outline of the Columbia Planning area is identified with a thick black line. The darkest shade corresponds to tracts that fall into the lowest quartile, while the lightest shade corresponds to tracts that fall into the highest quartile.



To ensure consistency, this approach was also employed to categorize the results from previous interim reports, as shown in the table below.

Table 9: Regression Results and Comparison to Previous Reports' Results

Tract	Interim Report 4 Z-Score	Interim Report 3 T-Score	Interim Report 2 Overall/Average Z-Score
6011.03	0.09174274032	3.407914589	-0.1673315115
6011.04	-0.7707992583	10.89290365	-0.06224591425
6011.05	0.6845095807	10.89619691	-0.1862921413
6011.07	0.7845710528	3.821278087	0.62152532
6011.08	0.8951045871	18.130178	-0.272582391
6012.01	-0.009082429442	9.912743467	-0.1451673263
6012.03	-5.456166838	-1.682613206	0.372827052
6012.04	0.09739415104	-2.042796229	-0.223064332
6021.00	-0.5332830011	12.26943558	-0.1051521833
6022.01	-1.320797029	8.572400789	-0.6163132398
6022.02	-0.5874527185	9.232633274	-0.2271283723
6023.02	0.1609490867	4.103919102	0.156484314
6023.03	-1.042878724	3.438487025	-0.02300544025
6023.04	-0.4878295293	3.444477243	-0.153167655
6023.05	0.2300781755	7.051222582	-0.303234341
6023.06	0.3966363313	9.847394684	0.1380706943
6026.00	-0.3297284622	-3.30599802	-0.7367126085
6027.00	0.03410434949	6.118157449	-0.227154426
6028.00	0.5195694601	5.047614108	0.01054446225
6029.00	-0.7967281899	0.3022770029	-0.0734249225
6030.01	-0.5117557774	2.129478283	-0.2281802085
6030.03	0.2158372074	6.848171677	-0.465074514
6030.04	0.3033905145	5.478836501	-0.096918252
6040.01	-0.2632550859	5.194350594	-0.1721651908
6040.02	-0.03280858436	10.16506534	0.008378182
6051.02	-0.3773048797	2.178671017	-0.137650495
6051.03	0.06939670563	7.284965933	0.2636843148
6051.04	-1.028566669	3.740642773	0.1625912068
6054.01	0.2856101132	5.563484407	-0.1481240573
6054.02	0.2953250328	3.595841673	-0.1597821958
6055.02	-0.1744371533	4.839351577	-0.1783091448
6055.03	0.7567311055	7.134891382	-0.1067618948
6055.04	0.1685308144	11.03960183	0.1872404303
6055.05	-1.043935624	5.899409022	0.3860500178
6056.01	0.4816983304	7.449146539	-0.2282311793
6056.02	0.3083313336	7.418600813	0.1021490605
6066.01	-0.05842113105	11.15819483	0.5727825813
6066.03	0.2815306253	9.010115276	-0.1026185428
6066.04	-0.6498004688	2.065352489	0.493855206
6066.06	0.7865842849	0.3889715903	0.7471672103
6066.07	0.6793154624	8.153911893	-0.2755685625

6067.01	-0.4849411031	-0.7642899562	0.297981508
6067.04	1.015739562	9.044166817	0.757530638
6067.05	-0.1464538393	-0.4136657144	0.508761288
6067.06	0.02787201339	1.000466957	-0.2924330728
6067.07	1.092546312	-2.718541079	0.3126793588
6068.03	0.4328329568	5.115093599	0.6145243053
6068.04	0.7268023241	6.366974754	0.1323944023
6068.05	-0.6909929382	4.974838564	-0.1624340118
6068.06	1.022298127	11.35885183	0.1157032668
6069.01	0.189380693	-0.9739466705	-0.3829501395
6069.04	0.07410881329	13.28273771	0.227817824
6069.05	2.358216014	6.074579924	-0.1447002203
6069.06	0.4469962402	9.20384403	-0.4359857403
6069.07	0.8836853334	11.11733731	0.04912158275

Key	
Worst Score	
Greatest risk of decline Quartile	
Stable, some risk of decline Quartile	
Stable, potential for upgrading Quartile	
Strongest potential for upgrading Quartile	
Best Score	

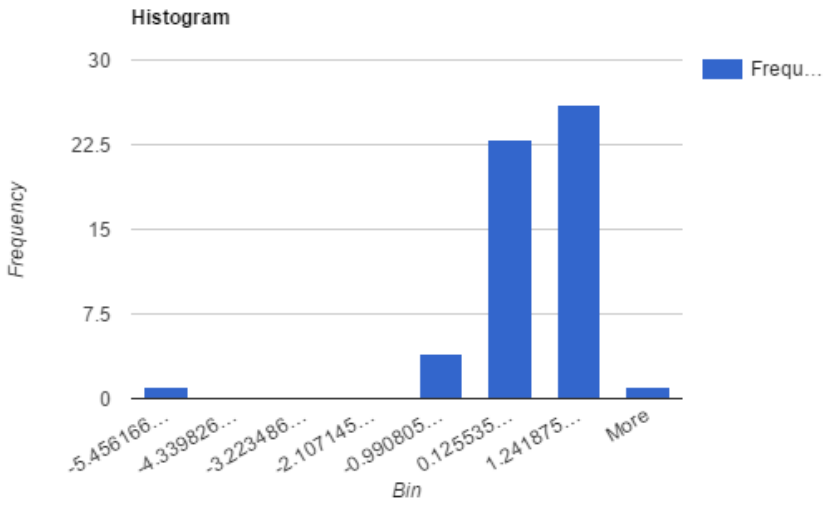
Findings and Interpretation

The general trends found in our *Interim Report 4* results were that the southwestern section of the County, including Columbia, had the greatest concentration of extreme results: both high and low performing tracts. The County's north and west sections were more uniform in their distribution, containing both stable and declining housing prices. There was one extreme outlier tract, 6012.03, with a Z score of -5.456, which fell far below the rest of the distribution, as shown in the Histogram and Frequency distribution below:

Frequency Distribution

Bin	*Frequency*
-5.456166838302355	1
-4.3398264308843615	0
-3.2234860234663674	0
-2.1071456160483732	0
-0.9908052086303791	4
0.125535198787615	23
1.241875606205609	26
More	1

Histogram



Interestingly, this tract, which is at the greatest risk of decline according to *Interim Report 4* results, also fell into the greatest risk of decline quartile in the overall scores for *Interim Report 2* (with a score of 0.373), and for the Education dimension it received the worst overall score (1.712). For *Interim Report 3*, this tract was in the greatest risk of decline quartile as well.

To investigate some potential explanations for this tract's poor performance, we researched conditions in the neighborhood. Tract 6012.03 is located in primarily in Jessup, Maryland, but also overlaps with a section of Hanover, Maryland. This area contains many warehouse delivery facilities, in addition to the Howard County Department of Corrections. The median household income of Jessup is $53,272 (in 2014 dollars), according to the ACS 2010–2014. These conditions could help to explain the area's low housing values.

The highest performing tract, 6069.05, is located in Savage and Annapolis Junction, Maryland. This area has generally a higher median income than Jessup ($82,242 in 2014 dollars). While it has some warehouse facilities, it also is home to historic landmarks, particularly the Historic Savage Mill, and has more residential neighborhoods than Jessup.

Tracts 6012.03 and 6069.05 are located close to one another, separated only by tract 6069.01 along the border with Anne Arundel County. Both tracts are adjacent to Interstate 95, and have MARC commuter rail stops.

CONCLUSION AND RECOMMENDATIONS

Comparison of Reports

Overall, each individual approach in *Interim Report 2, Interim Report 3, and Interim Report 4* had its strengths and weaknesses.

A strength of *Interim Report 2* was its holistic approach, measuring various indicators related to Education, Workforce, Housing and Demographics that can each influence overall stability. It also provided a relatively detailed approach that based the analysis on indicators cited in relevant literature. However, there were weaknesses with this approach worth noting. First, while a total of 16 indicators were analyzed, this list was not exhaustive and omitted home price-related data, which we concluded to be detrimental when comparing scores acquired in *Interim Report 3*. Second, relying on U.S. Census data meant that many of the variables that could have been useful were not comparable due to changes in the census questions between 2000 and 2010. Third, some potentially useful variables were not available for Howard County census tracts during the time periods analyzed. Lastly, all chosen indicators were weighted equally while in reality certain indicators could show either greater or lesser levels of potential instability. These factors could have affected overall accuracy.

Interim Report 3's strength was that it focused on home prices, which are often indicative of other variables that influence neighborhood stability. For example, according to Rohe et al. (1996), if a tract is experiencing rapidly increasing home prices, homeownership may be higher because people see an opportunity to make an investment, and homeownership is a subsequent indicator of stability.

However, there were also weaknesses to this approach; it did not consider housing unit characteristics such as age of the unit, unit type, number of bedrooms, location etc. These are all variables that could impact changing housing prices. Additionally, while declining housing prices are often linked to instability, they do not always tell the whole story. Some census tracts can still be considered stable even with a decline in housing prices. Issues of housing turnover and foreclosures may more specifically be attributed to instability.

We felt that the strengths of *Interim Report 4* were that it built on some of the strengths of *Interim Report 3* by controlling for housing unit type and age of the housing unit, which can increase the accuracy of the results compared to the previous method.

However, again, it is difficult to make conclusive statements on the stability of a neighborhood based solely on home sales price.

Conclusions and Recommendations

Our statistical analysis of the three reports, using bivariate correlation coefficients, showed that there is a small but statistically significant positive relationship between the approaches used in Reports 3 and 4, since $r(53)= 0.291$,$p= 0.031$ ($p<0.05$).

This finding supported our general feeling that none of the approaches can stand on their own in creating an appropriate Neighborhood Stability Index for Howard County. Some hybrid of the three approaches will likely yield the most useful results.

As discussed above, the approach in *Interim Report 2* was useful because it was comprehensive. Having analyzed home price changes in *Interim Report 3* and *Interim Report 4*, which presented a new set of

trends, one can assume that this is also a useful variable and could be added to the Housing dimension of the *Interim Report 2* index.

In addition, revising the *Interim Report 2* index to include home price changes in more detail will help to develop a more appropriate index. While more detail is useful, it can introduce factors that may affect the chosen variables. We see this in the methodology for the *Interim Report 3* index, which controls for both housing unit type and age.

Lastly, Maryland is growing quickly, and trends are changing quickly. This is especially true in Howard County. Our review of current news stories and County developments showed a healthy business climate, continued residential growth (including large new developments in parts of Columbia Village and Oakland Mills that our analysis identified as stable), an increasingly socially connected community (as evident through the popular HoCo Blogs website), and a strong public school system. All of that supports a need for additional time series data (on variables such as infrastructure decay and maintenance issues) that would strengthen our recommended hybrid approach.

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Appendix

Report 2 Indicators

Education

25+ years w/ only a middle/elementary school education

16–19 years neither enrolled in nor graduated from high school

25+ years who have completed 9–12 years of school but no diploma

25+ years old w/ only high school education

Demographics

Total persons below poverty level in the past 12 months

Households with public assistance income in past 12 months

Female-headed families with own children

Persons 65+ years old

Housing

Total renter occupied housing units

Total vacant housing units

Owner occupied housing units whose monthly owner costs are 50% or more of their income

Renter occupied housing units w/ more than 2 occupants per room

Employment & Workforce

16+ years old in the civilian labor force and unemployed

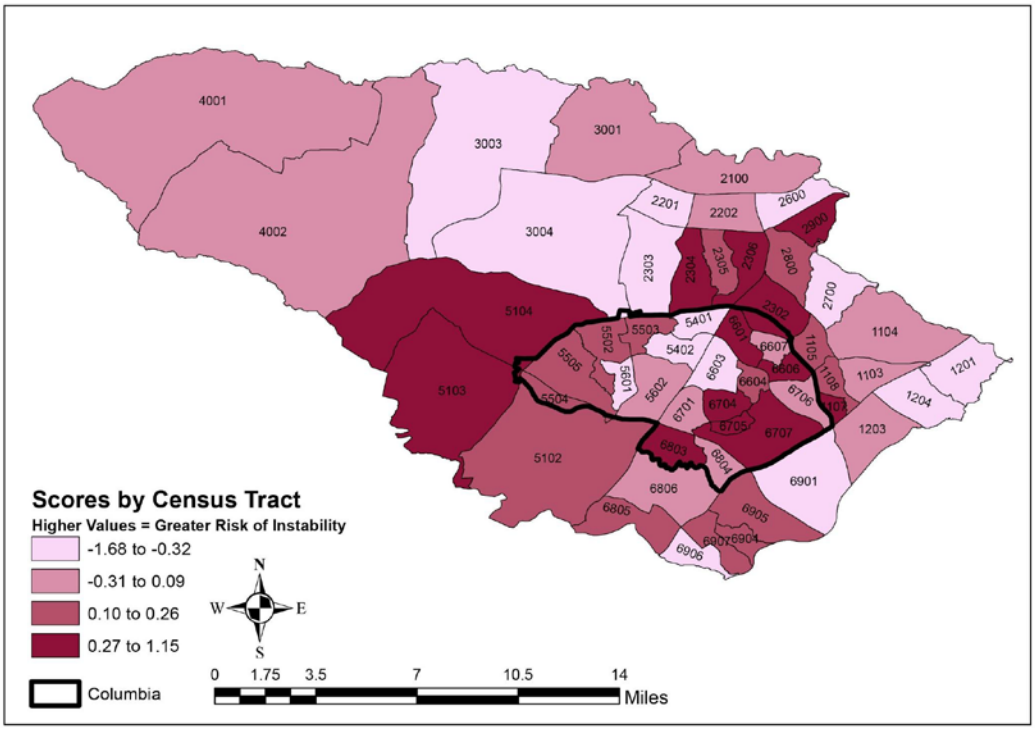
Civilians 16+ years old not employed in professional/ managerial/ technical post

Occupied housing units with no car available

16–64 years old who worked 0–26 weeks in past 12 months

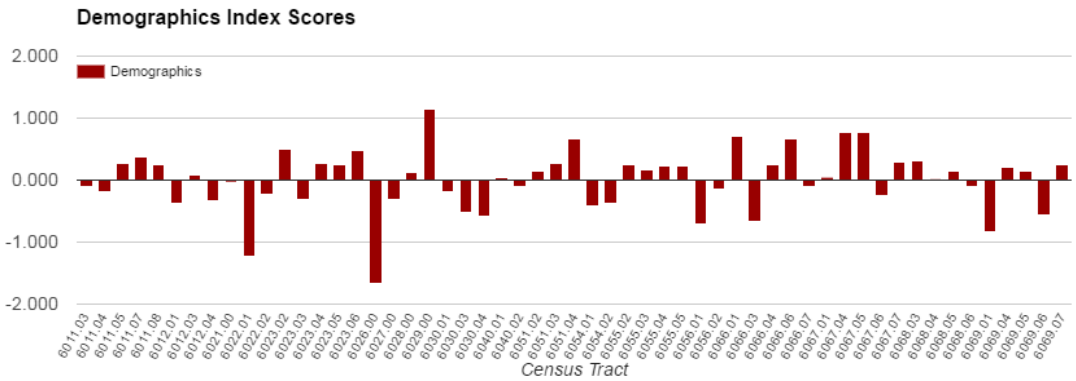
Neighborhood Stability Index of Howard County 2000-2010

Demographics Stability Score



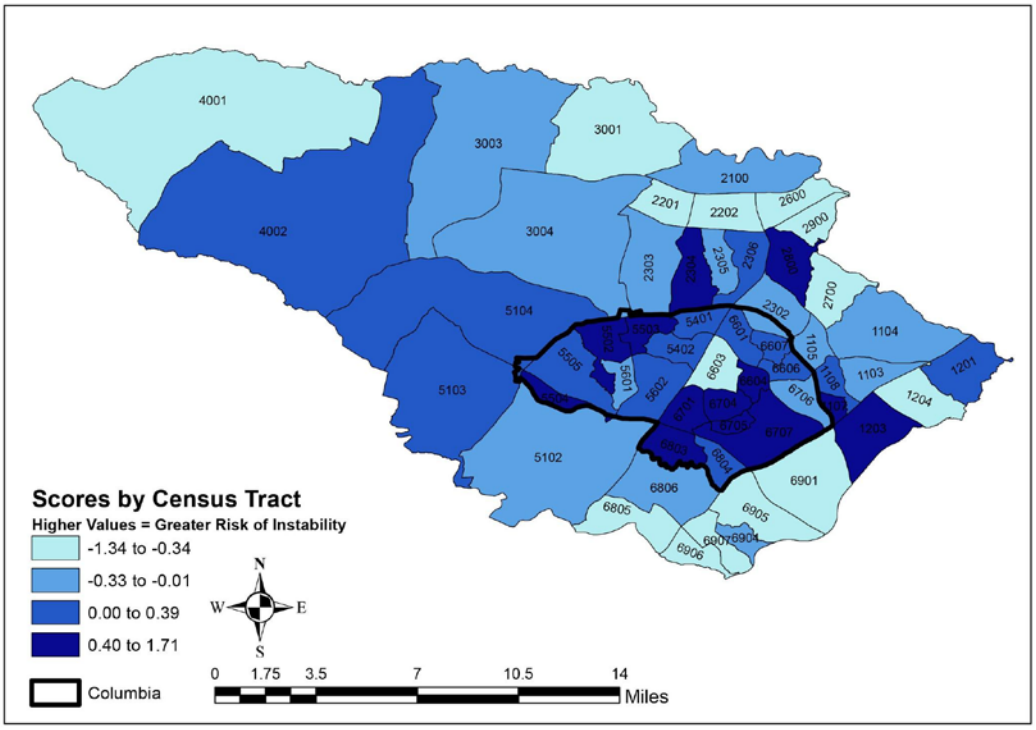
Source: Neighborhood Change Database: longitudinal U.S. Census data, normalized to 2010 census tracts

Group 2



Neighborhood Stability Index of Howard County 2000-2010

Education Stability Score



Source: Neighborhood Change Database: longitudinal U.S. Census data, normalized to 2010 census tracts

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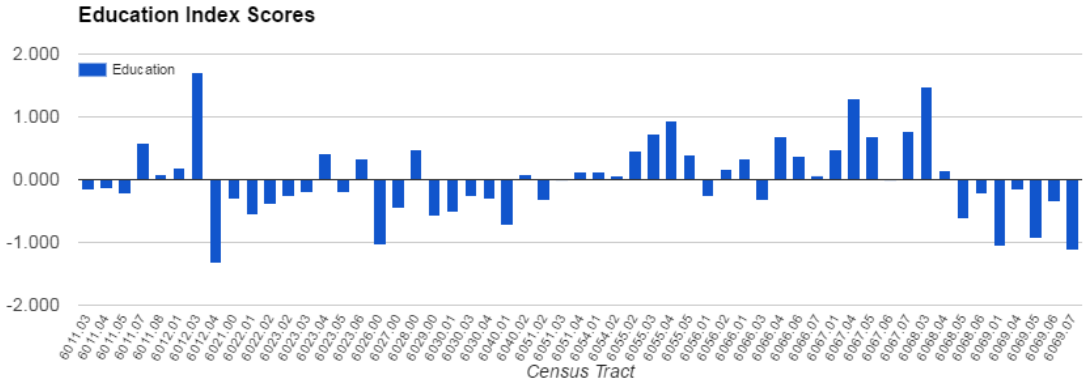
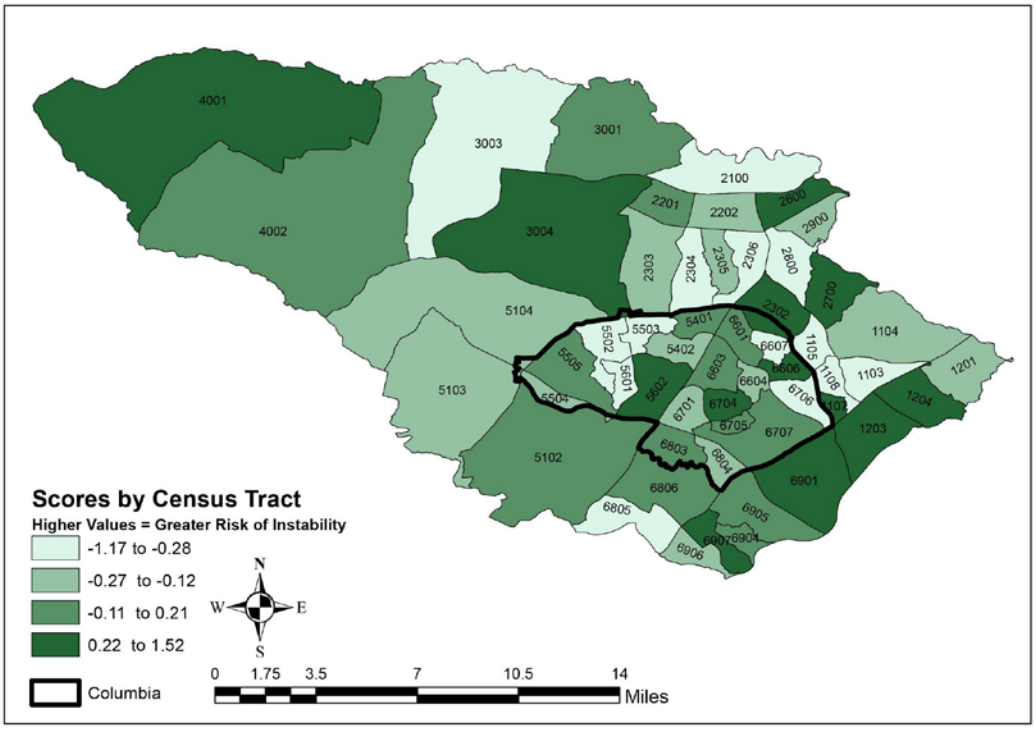


Neighborhood Stability Index of Howard County 2000-2010

Housing Stability Score



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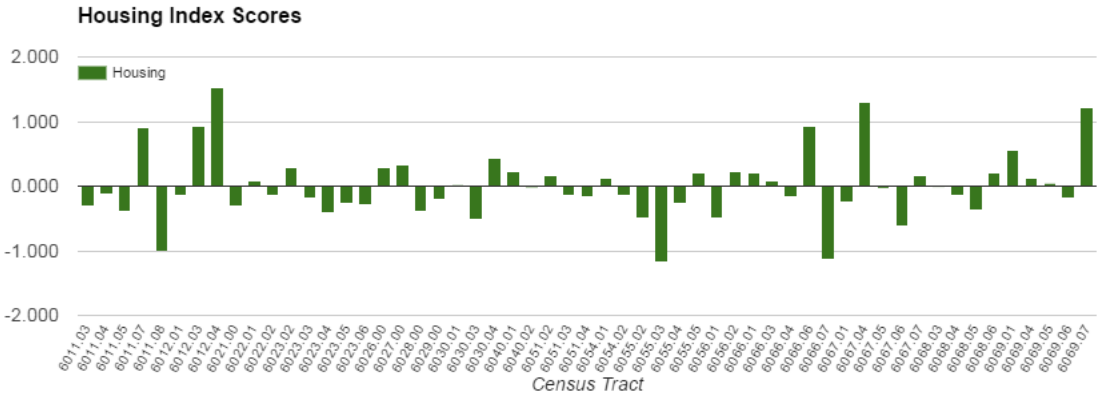
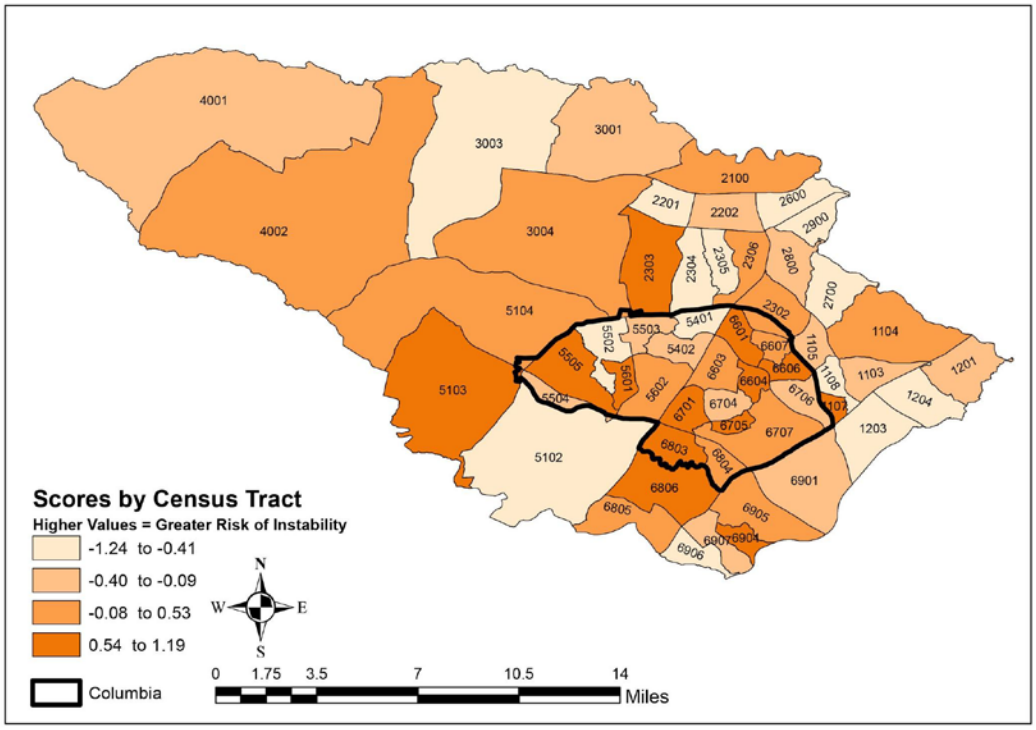


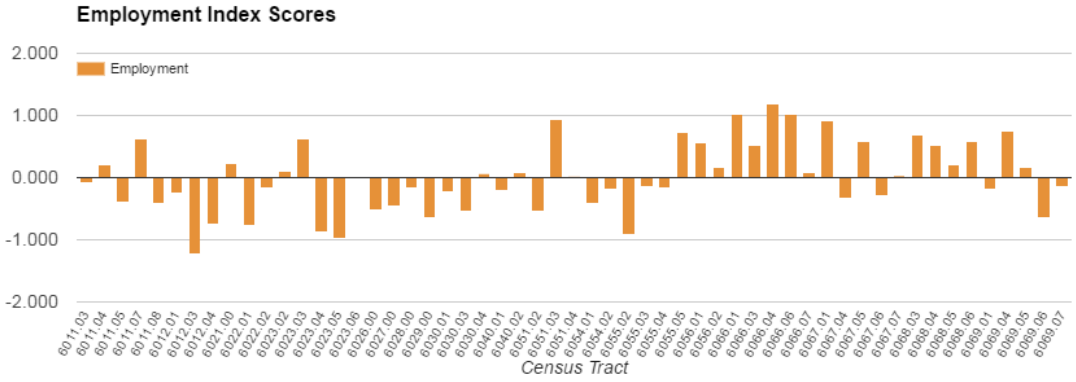
Neighborhood Stability Index of Howard County 2000-2010

Employment Stability Score



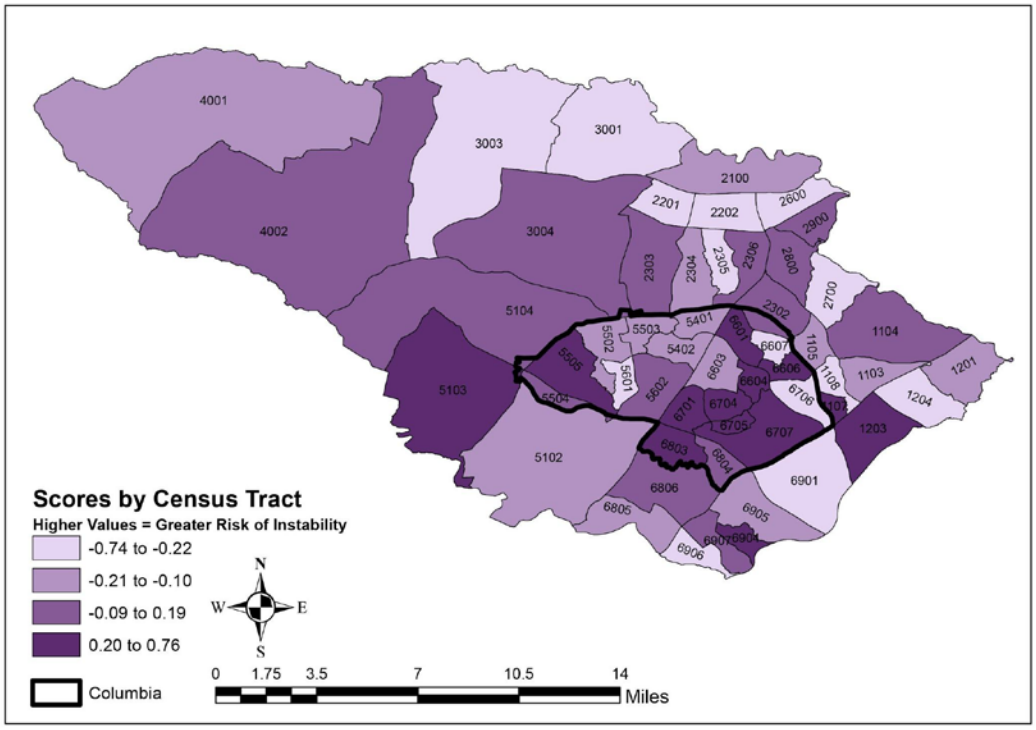
Source: Neighborhood Change Database: longitudinal U.S. Census data, normalized to 2010 census tracts

Group 2



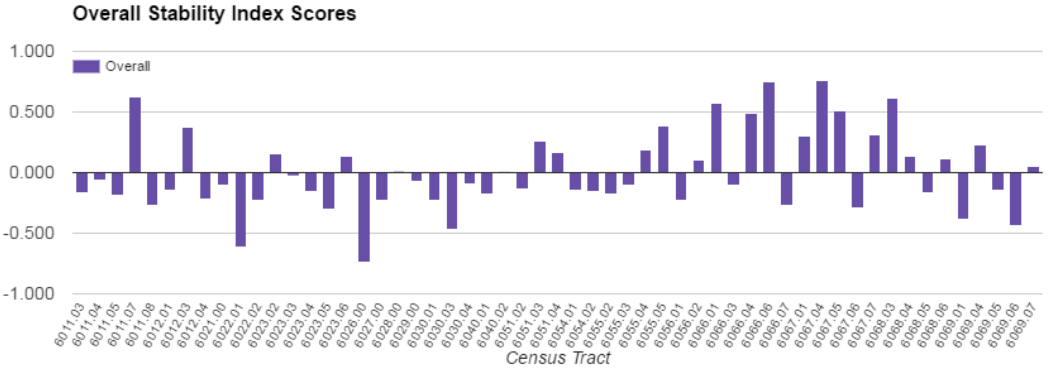
Neighborhood Stability Index of Howard County 2000-2010

Overall Stability Score



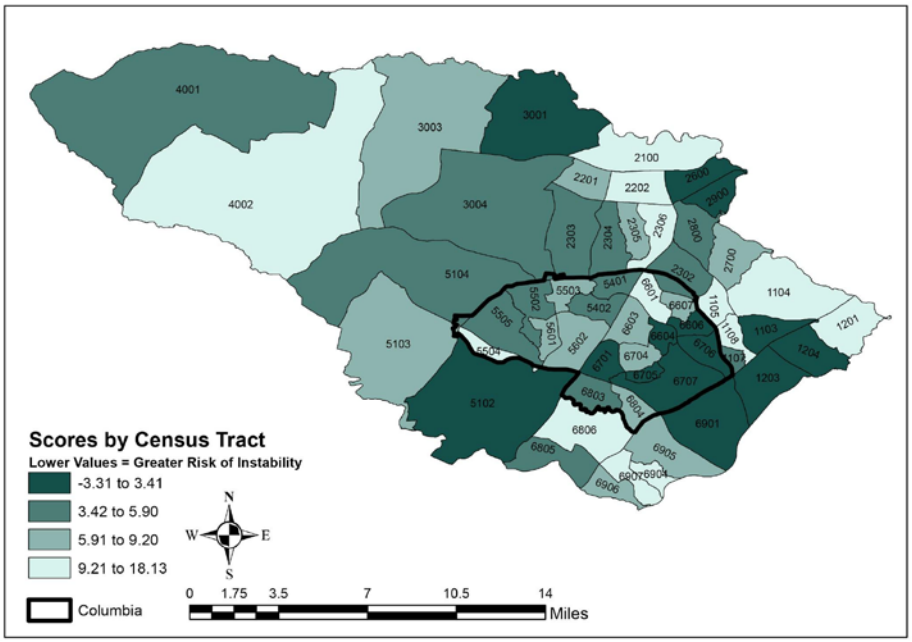
Source: Neighborhood Change Database: longitudinal U.S. Census data, normalized to 2010 census tracts

Group 2



Neighborhood Stability Index of Howard County 2000-2010

Changes in Housing Prices

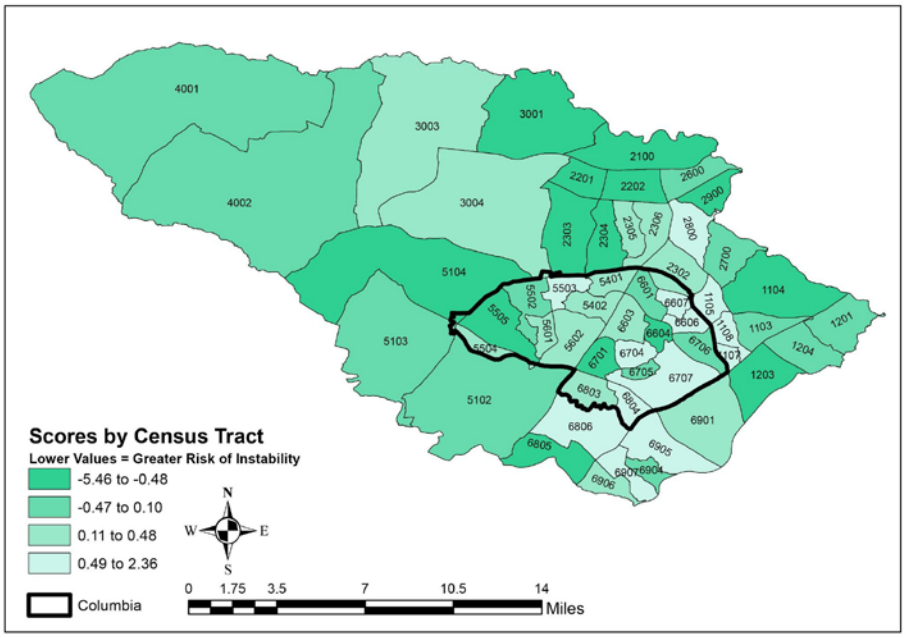


Source: Maryland PropertyView database, normalized to 2010 census tracts

Group 2

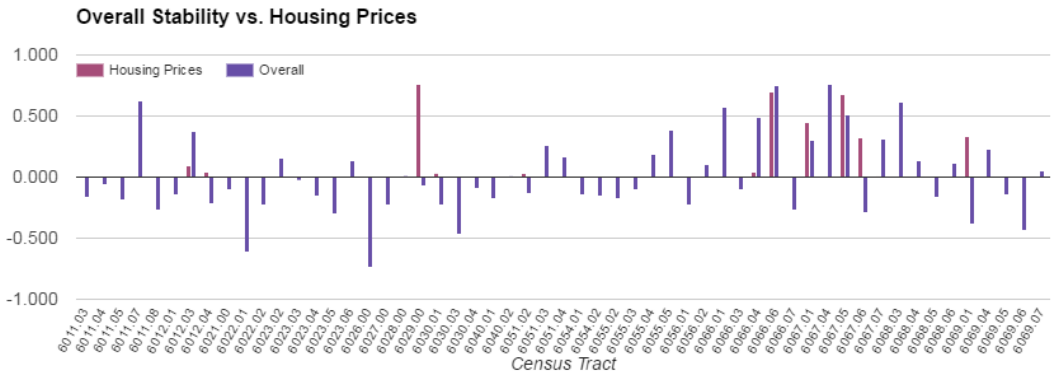
Neighborhood Stability Index of Howard County 2000-2010

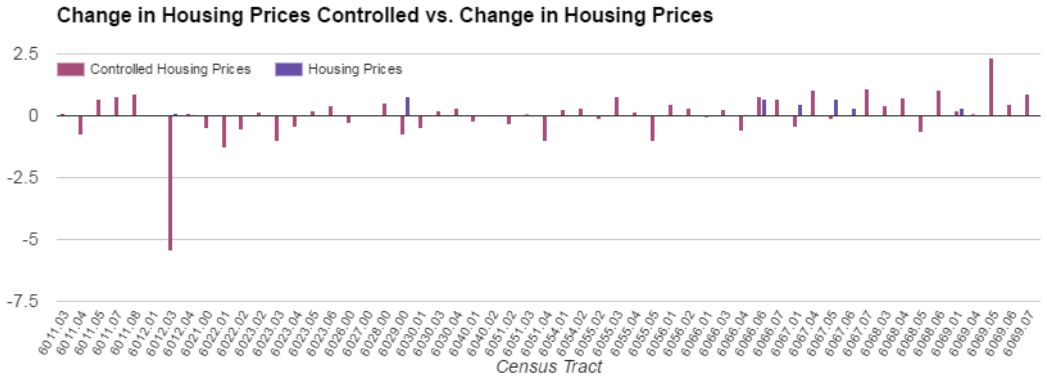
Changes in Controlled Housing Prices

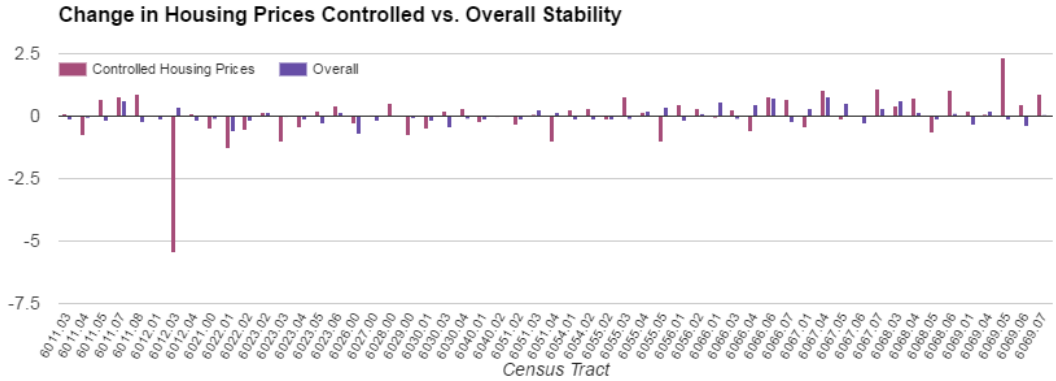


Source: Maryland PropertyView database, normalized to 2010 census tracts

Group 2


Overall Stability vs. Housing Prices
Housing Prices
Overall
1.000
0.500
0.000
-0.500
-1.000
Census Tract

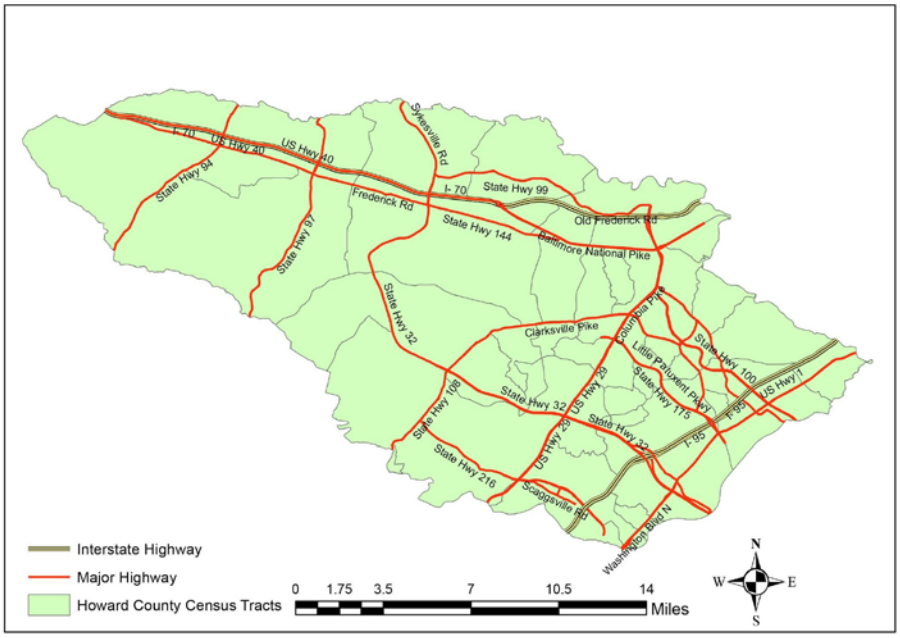

Change in Housing Prices Controlled vs. Change in Housing Prices
Controlled Housing Prices
Housing Prices
2.5
0
-2.5
-5
-7.5
Census Tract


Change in Housing Prices Controlled vs. Overall Stability
Controlled Housing Prices
Overall
2.5
0
-2.5
-5
-7.5
Census Tract

Supplementary Information

Howard County

Primary and Secondary Roads

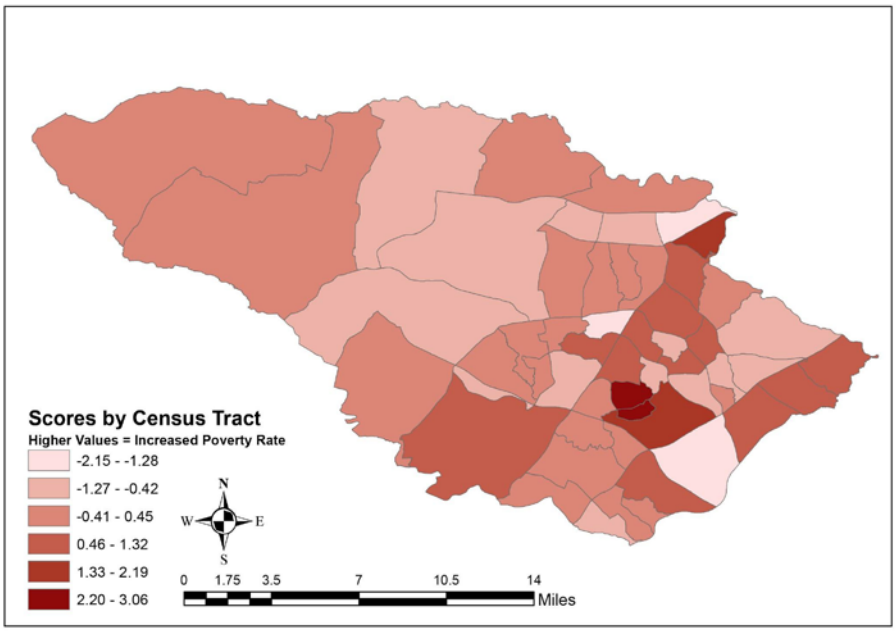


Source: TIGER/Line Shapefile, 2013, state, Maryland

Group 2

Neighborhood Stabilty Index of Howard County 2000-2010

Change in Poverty Rate Z Scores



Source: Neighborhood Change Database: longitudinal U.S. Census data, normalized to 2010 census tracts

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