Does Phoenix Fit Wilson's Social Isolation Model?

Evidence From the Spatial Decomposition of Theil's T Statistic

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William Julius Wilson (1987) observed that complex patterns of growth in U.S. cities coupled with historic and existing racial discrimination created socially isolated places within these cities. These social islands, he argued, are increasingly areas of higher poverty concentrations, higher unemployment, lower educational attainment levels and lower labor force participation. Populations in these areas are also more likely to be both young and in a racial or ethnic minority (Wilson, 1987). Wilson (1987) contended that these socially isolated areas were mainly a product of societal and public policy mechanisms, and that antipoverty policies should be aimed at changing those mechanisms rather than addressing (and "correcting") the cultural features of the poor. Using data aggregated to Chicago Community Areas, he illustrated that the above variables defining the "social island" all changed in the expected direction from 1970 to 1980 for the impoverished enclaves in the city (Wilson, 1987).

It is important to note that Wilson's studies mainly focused on large cities in the Midwestern and Eastern U.S. like Chicago. Little is known about the applicability of Wilson's theories of social isolation outside of those regions. This paper will attempt to test several of Wilson's hypotheses for the greater Phoenix metropolitan area, a quintessentially Southwestern city with a vastly different history and growth pattern from the traditional Wilsonian cities. The research questions proposed here aim to quantify the extent to which Wilson's social isolation hypotheses are operative over time in Phoenix. These questions follow:

- To what extent has (1) the concentration of poverty changed; (2) unemployment changed; (3) the educational attainment level changed; and (4) labor force participation changed for poor areas within the greater Phoenix metropolitan area over time?
- To what extent are the racial and ethnic minorities in the greater Phoenix metropolitan region disproportionately represented in impoverished areas? Have these areas changed their minority representation over time?

In testing these hypotheses, one would typically choose a measure of poverty like the census-defined measure as the dependent variable. However, this absolute measure of

poverty has significant drawbacks for this study. The absolute nature of the poverty line disregards the income distribution outside of poverty essentially disregarding the cost of living in a given region. This problem compounds itself over time as regional cost of living either increases or decreases. In addition, this measure of poverty categorizes people as either poor or non-poor, which mischaracterizes the continuum of incomes. To combat these two drawbacks, this study uses a measure of income inequality (Theil's T statistic) as the dependent variable.

Theil's T statistic or the Theil index is a measure of income inequality ranging from 0 to infinity of the form:

$$T = \sum_{j=1}^{m} p_j R_j \ln R_j \qquad \text{Equation 1}$$

where m is the number of groups (census tracts), p_j is the proportion of total population in each group, and R_j is the ratio of average group income to overall average income (Conceicao and Galbraith, 1998). The interpretation of the minimum value of Theil's T is very similar to that of the Gini coefficient - when T=0 all persons in the evaluated area have equal income (Conceicao and Galbraith, 1998). However, since Theil's T has no upper bound, their interpretations diverge somewhat when T > 0. In completely unequal societies where one person earns all the income (and more than one person is in this society), the Gini coefficient equals one, but the Theil index increases in value as the society increases in size (Conceicao and Galbraith, 1998). Relative changes over time in the Theil index can show either income transfers (rich to poor or vice versa) or population movements. Other data are needed to discover the extent to which each process is occurring. One large shortcoming of the Theil index is the difficulty in interpreting the actual calculated value. The power of the index is in its relative changes over time.

One other feature of the Theil index that is only being utilized in a limited fashion in this study is its ability to be decomposed into additive parts. This is especially useful when looking at multiple geographic scales (country, state, and county scales, for example) when one would like to know the inequalities between and within similar geographies (Conceicao and Ferreira, 2000). For example, we could use the decompositional property of the Theil index to show both the inequalities between two countries and the inequalities within each county (at the state or province geographic level). Since the overall Theil index is a sum of the decomposed parts or Theil elements, we can characterize each part of the decomposition as that geographic area's contribution to the overall Theil index (Conceicao and Ferreira, 2000). Interpreting the Theil elements proves much easier than interpreting the overall Theil index (Conceicao and Ferreira, 2000). Theil elements whose value is zero contribute nothing to inequality. That is to say that the proportion of overall population within that geography receives their "fair share" of income ($R_j = 1$; $\ln R_j = 0$). Theil elements below zero contribute negatively to the Theil index ($R_j < 1$), while Theil elements above zero contribute positively to the Theil index ($R_j > 1$).

In addition, relative changes in Theil elements over time can demonstrate that an area is either becoming more or less equal relative to an overall "fair share" of income

(Conceicao and Ferreira, 2000). This interpretation is important for confirming the extent to which income inequality is increasing in impoverished areas. If Wilson's hypotheses hold, then one should see increasing income inequality coupled with the expected changes in the social isolation variables.

Data and Methodology

All data used in this study comes from the GeoLytics Census CD Neighborhood Change Database (NCDB), which was created jointly by GeoLytics Corp. and The Urban Institute. The NCDB was created wholly from the U.S. Census Bureau Decennial Census, SF3 (long form) data from the years 1970, 1980, 1990 and 2000. The important feature of the NCDB is that all data has been normalized to the 2000 census tract boundaries.[1] This allows for straightforward longitudinal comparisons at the census tract level, which is the unit of analysis in this study. The study area includes 656 census tracts in Maricopa County, Arizona, that include a slightly larger area than the census-defined Phoenix-Mesa, Arizona Metropolitan Statistical Area in 2000 (Figure 1).

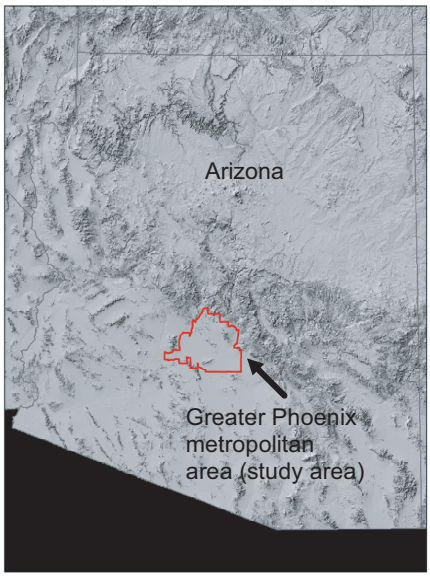

Figure 1. Overview map of the greater Phoenix metropolitan area.

This study uses relevant variables in the categories of race, poverty, education, unemployment and labor force participation. Age variables were not available throughout the NCDB in a useful format, so this category was not used.

I computed Theil's T statistic across the study area for the years 1970, 1980, 1990 and 2000. Due to unavailability of household income data, I used family income variables. These variables were the only total income variables that covered all time steps in the NCDB. Although this is an inferior income variable (I am likely missing quite a bit of income from unrelated individuals within a household), I contend that by using this variable this study most likely presents an overestimation of income inequality. I suspect (although I have no data to support this as of yet) that poor households benefit from income coming from unrelated individuals more so than wealthy households. Perhaps this is not the case, but in any event, future work in this area should use household income variables when the data become available.

ArcGIS maps were created to describe and analyze the spatial distribution of Theil elements over time. One purely descriptive map was made for each year in the study. In addition, four maps were created to illustrate the change in the value of Theil elements from

1 The U.S. Census Bureau draws cartographic boundaries between census tracts, which places between 4,000 and 10,000 people into each census tract. In a rapidly growing city like Phoenix, census tracts often become split into two or more parts during subsequent Censuses making longitudinal comparisons very difficult. The NCDB has the advantage of having the data from previous Censuses (1970, 1980 and 1990) disaggregated through a complicated algorithm into smaller units and re-aggregated to 2000 census tract boundaries based on their spatial location.

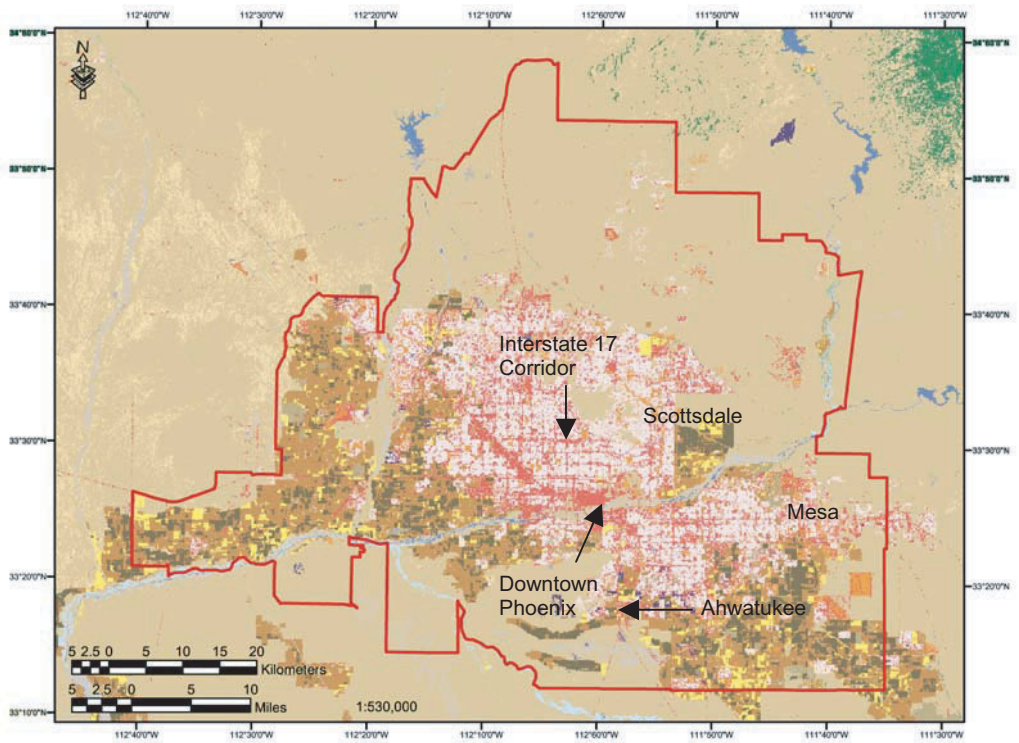

Figure 2. Overview map of locations within the greater Phoenix metropolitan area.

1970 to 1980, 1980 to 1990, 1990 to 2000 and finally 1970 to 2000.

Correlations were calculated between each independent variable and the dependent variable, Theil elements, to determine the extent to which changes in the independent variables reduce errors in predicting the changes in the Theil elements.

Findings and Discussion

The purely descriptive GIS maps showing the distribution of Theil elements in each year of the study show some very interesting trends in the growth of Phoenix (Appendix 1). By inspection, one can note the very solid blue centered on downtown Phoenix in 1970 indicating that this area contributed very negatively to the Theil index (Figure 3). That is to say that the ratio of average group income to overall average income was quite small. However, note that over time this solid area of blue breaks up and shifts to both the northwest and the east (Figure 6).

The GIS maps depicting change show essentially the same trends (Appendix 1). Figure 7 depicts the change in the Theil elements from 1970 to 1980. One can see from this map that the downtown Phoenix area (the solid blue area noted in Figure 3) shows very large increases in its Theil elements relative to other areas of the city. This change indicates that the downtown area is contributing less negatively to the overall Theil index by 1980. Ultimately, the means that average group incomes have increased relative to the overall average income across Phoenix. However, Figure 4 demonstrates that these increases in

average group income were not sufficient to raise this average to the overall average income across Phoenix (note the dark blue areas still present in 1980). Another interesting feature of Figure 6 is in the area north of downtown Phoenix. There we begin to see a relative decrease in the Theil elements as wealthier people begin to move to northern Phoenix and northern Scottsdale. Note that in Figure 10, some of the largest positive changes in Theil elements from 1970 to 2000 occur in these areas (north Phoenix and north Scottsdale). One can also see significant positive changes in Ahwatukee, parts of the southeast Valley (Chandler, Gilbert and Queen Creek) and downtown Phoenix.

Table 1
Population, Family Income and Theil index characteristics of the greater Phoenix metropolitan area in 1970, 1980, 1990 and 2000.

	1970	1980	1990	2000
Total Population	959,762	1,494,547	2,101,034	3,035,104
Aggregate Family Income (in 2000 dollars)	$13,183,238,126	$24,031,852,530	$34,201,568,246	$50,852,406,100
Overall Theil Index	0.072	0.079	0.130	0.147

Table 1 shows the overall characteristics of the greater Phoenix metropolitan area over time. Between 1970 and 2000, the population more than tripled, family income rose by nearly a factor of four and the overall Theil index doubled. Essentially, this means that as family income precipitously increased, the distribution of family income in 2000 was about twice as unequal as the distribution of family income in 1970. There are two factors that drive this increase in the overall Theil index: the wealthy become wealthier or the poor become poorer. Table 2 illustrates that while both of these forces are pushing the overall Theil index higher, the wealthy becoming wealthier has contributed much more to inequality than the poor becoming poorer.

Table 2
Temporal View of Contributions to the Overall Theil Index

	1970	1980	1990	2000
Sum of Theil Elements Contributing Negatively to the Overall Theil Index	-0.102	-0.109	-0.135	-0.146
Sum of Theil Elements Contributing Positively to the Overall Theil Index	0.174	0.188	0.265	0.293

Table 2 shows the sum of all Theil elements that contribute either positively or negatively to the overall Theil index in a given year. Note that for each year, the sum of these two calculated values (the negative contribution and the positive contribution) yields the overall Theil index found in Table 1. From 1970 to 2000, the elements that contribute negatively to the overall Theil index decrease from -0.102 to -0.146 showing that the poor are indeed getting poorer. Similarly, the sum of Theil elements that contribute positively to the overall Theil index increased from 0.174 to 0.293. This increase illustrates that the

wealthy elements' contribution to Theil inequality is increasing, and thus the wealthy are becoming wealthier. In addition, the magnitude of this increase is much greater than the magnitude of the temporal change amongst the elements contributing negatively to the overall Theil index. Simply put, this means that the increase in the overall Theil index over time has been largely driven by the wealthy becoming wealthier in the greater Phoenix metropolitan area.

Table 3
Percent of population with variable characteristics

Variable	Percent with characteristic, 1970	Percent with characteristic, 1980	Percent with characteristic, 1990	Percent with characteristic, 2000
Race				
White	94.9 %	87.6 %	84.9 %	78.4 %
African American	3.3	3.2	3.5	3.9
Hispanic[a]	14.5	13.2	16.0	24.9
American Indian	No Data	1.5	1.8	1.9
Asian	No Data	1.0	1.7	2.7
Pacific Islander	No Data	No Data	No Data	0.2
Other	No Data	No Data	8.1	11.9
People < Poverty Line	11.6	10.4	12.1	11.6
Education level[b]				
No High School	22.6	12.7	7.3	7.4
Some High School	17.2	12.1	11.1	10.0
High School or GED	32.3	34.9	25.4	23.0
Some College	15.1	21.9	34.0	33.6
Bachelor's Degree	12.9	18.4	22.2	26.0
Employment[c]				
Unemployed	3.9	5.4	6.0	4.7
In Labor Force	-------	-------	-------	-------
Unemployment Rate	-------	-------	-------	-------

[a] The variable Hispanic as defined by the census is not mutually exclusive from other race/ethnicity categories.
[b] For the population 25 years and older.
[c] For the population 16 years and older.

Table 3 exhibits the changes over time in the Wilsonian social isolation variables included in the statistical analysis (results of which are presented in Table 4). Three interesting features present themselves in Table 3. First, minority races and ethnicities shares of the population have increased from 1970 to 2000 with the exception of the African American and Native American populations, which have had relatively constant shares. Second, the overall poverty rate has stayed relatively consistent over time even though family income inequality had doubled in the same time period. One interpretation of this finding is that, again, those families in poverty are not experiencing the same level of an increase in income as wealthy families are experiencing. Finally, overall educational attainment has increased greatly over time.

Table 4 displays Pearson product moment correlations between the calculated Theil elements and the Wilsonian suite of social isolation variables presented in Table 3 for each tract in 1970, 1980, 1990 and 2000. Correlations below ±0.2 show essentially no relationship between the variables. Correlations between 0.2 and 0.4 show a weak correlation

Table 4
Pearson product moment correlation between Theil Elements and Social Isolation Variables

Variable	Theil's T, 1970	Theil's T, 1980	Theil's T, 1990	Theil's T, 2000
Race/Ethnicity				
White	0.191	0.212	0.234	0.388
African American	-0.213	-0.173	-0.169	-0.250
Hispanic[a]	-0.295	-0.329	-0.290	-0.390
American Indian	No Data	-0.130	-0.122	-0.180
Asian	No Data	0.003	-0.001	0.129
Pacific Islander	No Data	No Data	No Data	-0.226
Other	No Data	No Data	-0.281	-0.379
People < Poverty Line	-0.267	-0.297	-0.310	-0.369
Education level[b]				
No High School	-0.212	-0.279	-0.272	-0.371
Some High School	0.012	-0.185	-0.265	-0.395
High School or GED	0.254	0.070	-0.087	-0.156
Some College	0.468	0.295	0.109	0.195
Bachelor's Degree	0.659	0.592	0.546	0.703
Employment[c]				
Unemployed	-0.064	-0.191	-0.228	-0.284
In Labor Force	0.171	0.081	-0.022	0.102
Unemployment Rate	-0.197	-0.284	-0.241	-0.246

[a] The variable Hispanic as defined by the census is not mutually exclusive from other race/ethnicity categories.
[b] For the population 25 years and older.
[c] For the population 16 years and older.

between variables, while correlations from 0.4 to 0.6 show a moderate correlation between the variables. Correlations above 0.6 represent a strong association between variables. The important feature of these correlations, however, is the changes in them over time, and this is where I will focus my analysis.

First, note that over the entire time period, only the White and Asian race/ethnicity variables exhibited an increase in their correlations with Theil's T, meaning that as White and Asian populations increased, the value of census tract Theil elements also increased. For every other race/ethnicity category the opposite was true. Over time, African Americans, Hispanics, Native Americans and the category "Other" showed increasing negative correlations with Theil's T. As these minority populations increased, their negative contribution to the overall Theil index increased. In other words, these minority populations were over time more likely to reside in a census tract that on average had family incomes well below the overall average income. This finding lends strong support to Wilson's hypothesis that socially isolated areas are becoming increasingly minority.

Table 4 also shows the strengthening inverse relationship between the Theil elements and (1) the number of people in poverty; (2) level of educational attainment below the Bachelor's degree; and (3) the number of unemployed in each census tract. Each of these strengthening relationships (meaning that the correlations are becoming stronger over time) exhibits further support in Phoenix for Wilson's social isolation hypotheses. Only the labor force participation variable showed no correlation or discernable temporal change with Theil elements.

Conclusion

Taken together, the GIS and statistical analysis represent a change in thinking about social isolation, specifically in major Southwestern cities. The GIS work illustrates that areas contributing negatively to income inequality have shifted from downtown Phoenix to the Interstate-17 corridor, the University/Main St. corridor in Mesa, and areas directly to the west and north of downtown Phoenix. However, while the regions of lower average income shift place, their Wilsonian social isolation characteristics have continued to strengthen over time. This means that although the areas within town have shifted, these areas still are predominantly and increasingly below the poverty line, unemployed, poorly educated, and minority.

One major implication of these findings is that the Wilsonian model of social isolation has some merits outside of the large Midwestern and Eastern cities previously studied. While Phoenix is different in some ways, the public policy solutions that Wilson suggests are ultimately applicable here. Wilson (1987) argues that since social isolation is a condition with basically structural origins, public policy should address these structures rather than culture. It is clear that structure of various types (economic, family, class…) are the main drivers behind both the place shifts in inequality and the increase in social isolation variables over time, and that to undo those trends, these drivers must be addressed.

References

Allison, P.D. (1978). Measures of Inequality. *American Sociological Review*, 43, 865-880.

Bourguignon, F. (1979). Decomposable Income Inequality Measures. *Econometrica*, 47, 901-920.

Conceicao, P. & Galbraith, J.K. (1998). Constructing Long and Dense Time Series of Inequality Using the Theil Index. University of Texas Inequality Project Working Paper No. 1.

Conceicao, P. & Ferreira, P. (2000). The Young Person's Guide to the Theil Index. University of Texas Inequality Project Working Paper No. 14.

Cowell, F.A. (1980). On the Structure of Additive Inequality Measures. *The Review of Economic Studies*, 47, 521-531.

Shorrocks, A.F. (1984). Inequality Decomposition by Population Subgroups. *Econometrica*, 52, 1369-86.

Wilson, W.J. (1987). *The Truly Disadvantaged: The Inner City, the Underclass, and Public Policy*. Chicago: University of Chicago Press.

Appendix 1

Maps showing the distribution of Theil elements in 1970, 1980, 1990 and 2000 and the changes between years 1970-1980, 1980-1990, 1990-2000 and 1970-2000. Data are distributed into categories by "octiles," meaning that one-eighth of the distribution is represented in each category.

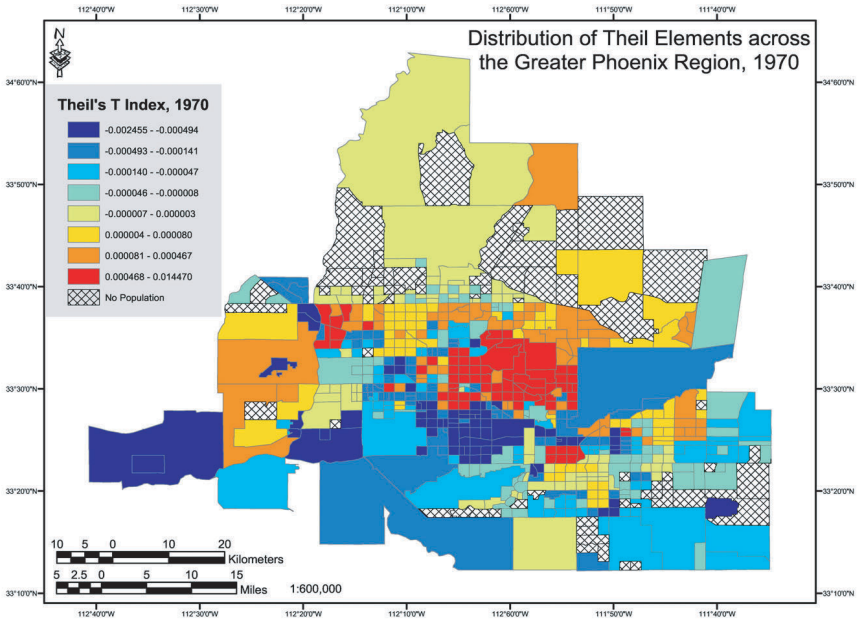

Figure 3. Distribution of Theil Elements across the Greater Phoenix Region, 1970. Note the cluster of dark blue centered on downtown Phoenix, which indicates that this area is contributing very negatively to the Theil Index.

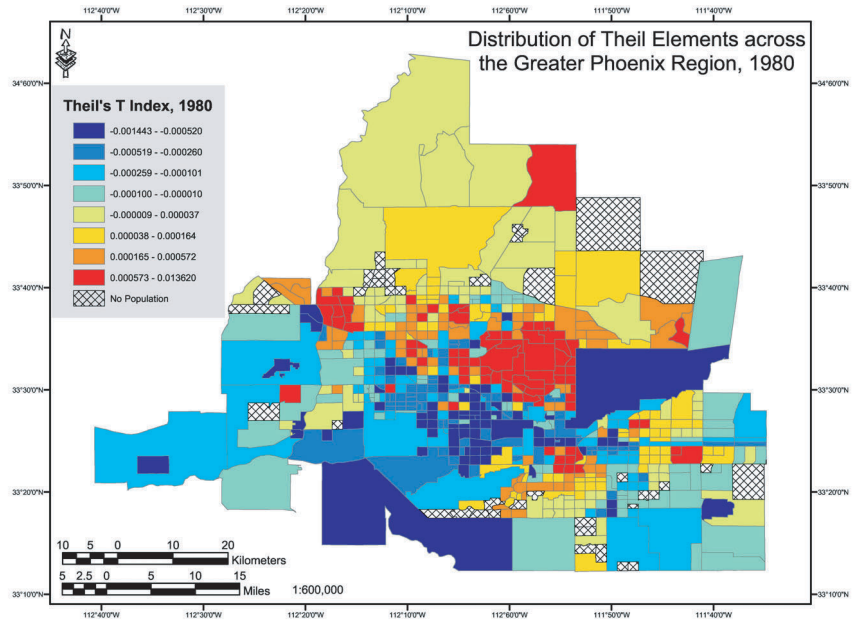

Figure 4. Distribution of Theil Elements across the Greater Phoenix Region, 1980.

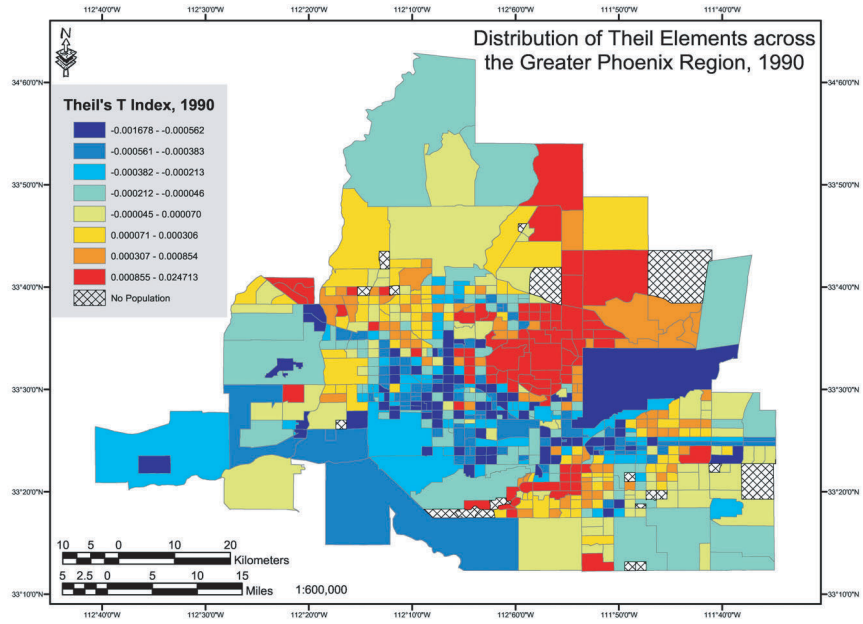

Figure 5. Distribution of Theil Elements across the Greater Phoenix Region, 1990.

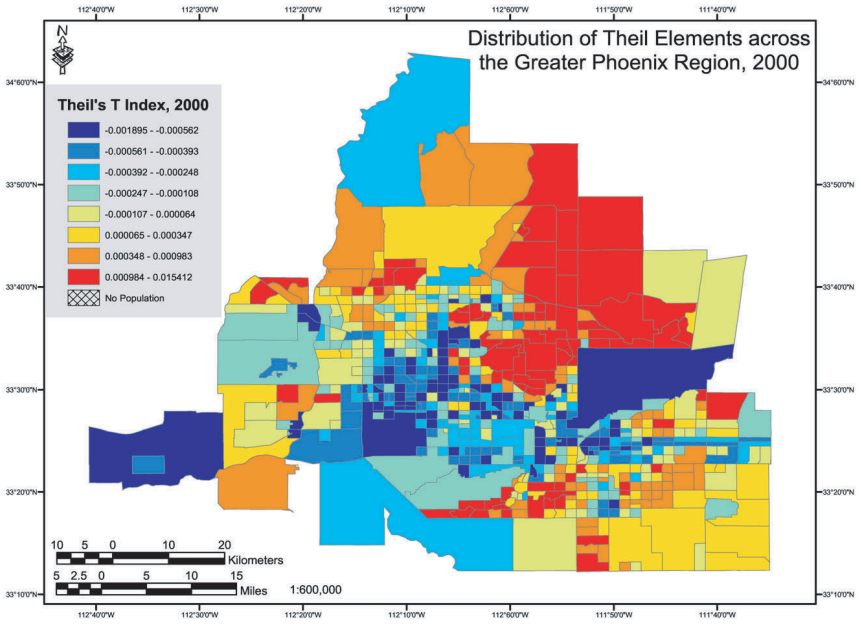

Figure 6. Distribution of Theil Elements across the Greater Phoenix Region, 2000. Note that the blue pattern seen in Figure 3 has dissipated and shifted to the east and northwest.

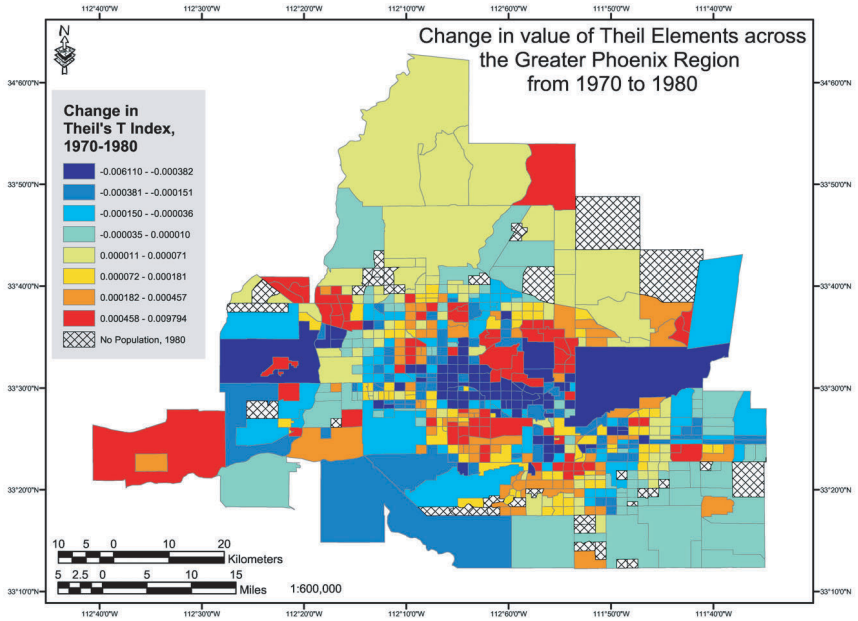

Figure 7. Change in the value of Theil Elements across the Greater Phoenix Region from 1970-1980.

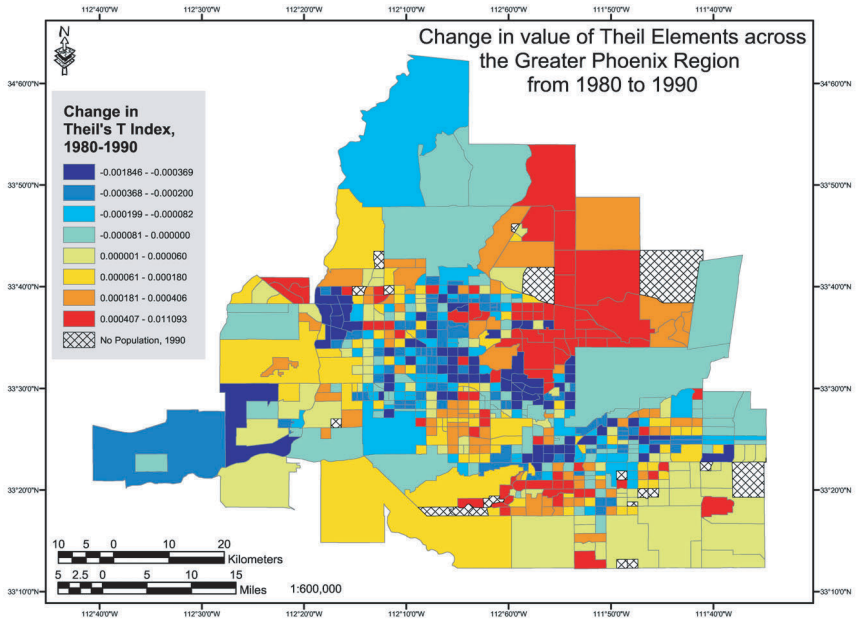

Figure 8. Change in the value of Theil Elements across the Greater Phoenix Region from 1980-1990.

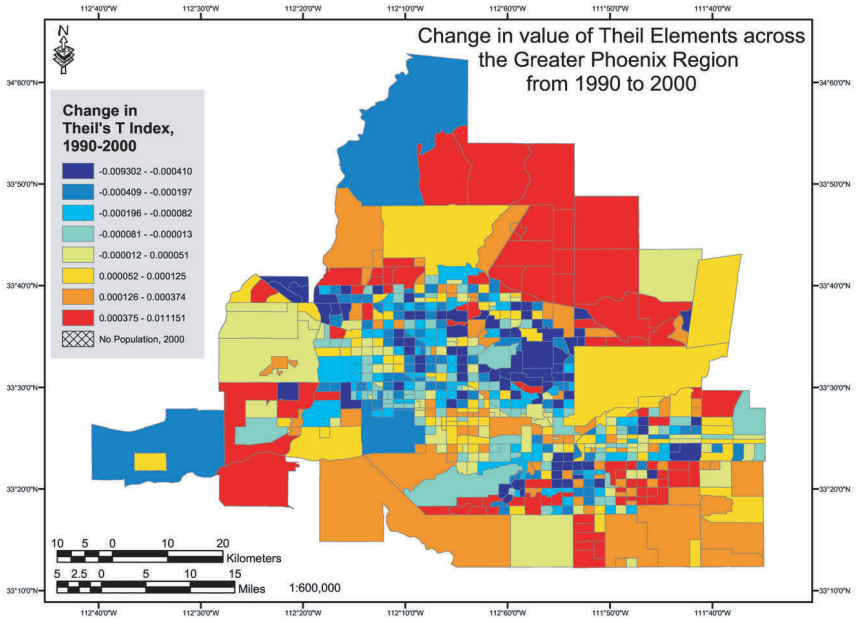

Figure 9. Change in the value of Theil Elements across the Greater Phoenix Region from 1990-2000.

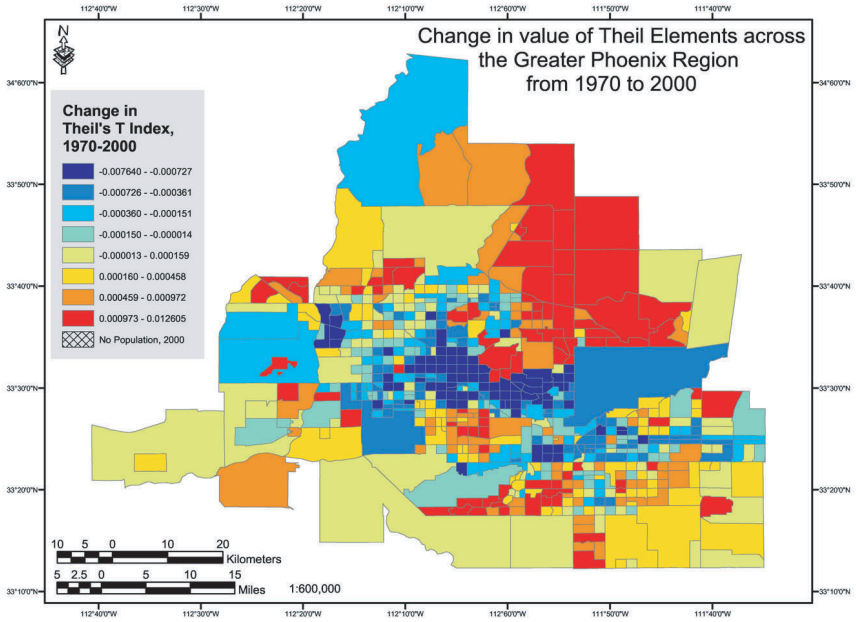

Figure 10. Change in the value of Theil Elements across the Greater Phoenix Region from 1970-2000.