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A Spatial Analytic Approach to Examining Property Tax Equity After Assessment Reform in Indiana

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Abstract. Scholars, public officials, and property owners have debated the administration of the property tax for decades. Scholars generally contend that the property tax is a good local revenue source while public officials and property owners loathe it. Much of the contention regarding the tax comes from equity issues related to assessment practices. This study examines an assessment process that was revamped from a decidedly unfair formula-based assessment to a market-value-in-use assessment. The objective of the study is to evaluate the new process through traditional measures and contemporary spatial analytic measures. The study contributes to the literature through its introduction of "spatial equity" measures.

1. Introduction

Decades of debate have surrounded the property tax as a local government revenue source (Fisher 1996, Oates 2000, Mikesell 2004). That debate ranges from theoretical deliberation over its incidence and efficiency to applied questions regarding equity and its administration. Generally, scholars regard the tax as a good local revenue source in principle while public officials and residents deplore it in practice (Mikesell 2004). The qualities that make the property tax a good tax in principle (e.g. ease of collection, difficulty of avoidance, and transparency) are reliant upon its administration.

Most problems regarding the property tax are a result of it being based on stock, not a flow of transactions. That is, the base of the tax is an estimated value. Additionally, those values are estimated by multiple assessors and certain characteristics of assessors and the assessment process (i.e. valuation) have been linked to assessment quality (Bowman & Mikesell 1990, Strauss & Sullivan 1998).

Since assessment is the foundation of the property tax system, valuation becomes the root from which all other components of the property tax can be accurately evaluated. If the assessment process is less than adequate, the positive evaluation of all other elements of the tax is threatened. Low quality assessment will directly jeopardize its fairness, diminish its ability to adequately raise revenue, and create economic distortions. All standards of equity, either constitutional or organizational (e.g. International Association of Assessing Officer standards [IAAO]), stipulate that comparable, equally valued properties must be taxed at the same rate (Bowman & Mikesell 1990, Smith 2000, Mikesell 2004).

In 1998, the Indiana Supreme Court answered a controversial question regarding Indiana property taxes when it declared that the method used to assess real property in that state was unconstitutional (*State Board of Tax Commissioners v. Town of St. John* [1998]). The Court's ruling set into motion comprehensive changes to how the property tax base is calculated in Indiana. It resulted in the State changing from an administrative formula-based assessment to a market-value-in-use assessment.

Assessment reform in Indiana brought a higher level of scrutiny to local property tax. As residents and assessors of Indiana adjust to the new system, the issue is whether or not there are systematic and administrative assessment inequities in the new valuation procedures. There are two primary objectives of this manuscript. The first is to evaluate an assessment process that was revamped in search of fairness and equity. Second, this study explores the use of contemporary local spatial measures to examine assessment equity at the neighborhood level rather than using ad hoc administrative boundaries (e.g. townships, counties, districts) like often used in similar studies. The neighborhood level analysis assists in describing spatial patterns of assessment inequity within and across assessment jurisdictions.

The following section provides background information regarding the catalyst for abandoning the old Indiana assessment system and explains the structure of the new system. Next, the analytic framework is discussed. Then, the equity effects of the new Indiana valuation process are evaluated and results are reported for both traditional and local spatial analytic measures. Finally, conclusions and implications are provided.

Generally, the analysis indicates that the revamped assessment in Indiana has fallen short of meeting its goal of an equitable assessment in some areas. The geographic distribution of high and low assessments is significantly, spatially concentrated. That means, households will bear lesser or greater property tax burden as a direct result of assessment practice and location of their property. Those clusters of high- and low-assessment span across and vary within administrative boundaries. The spatial approach used in this analysis assists in better identifying serious ramifications that should be addressed. Further analysis is necessary to identify the qualities of the new assessment procedures, property types, and neighborhood characteristics that potentially create inequities in the system. While this paper is a case study approach, it contributes to methods of identifying assessment problems that can be used in any locality.

2. Background

The old property valuation process in Indiana was deemed unconstitutional on grounds that it was unjust. The court found that the old system specifically violated Article 10, Section 1 of the Indiana Constitution, "the General Assembly shall provide, by law, for a uniform and equal rate of property assessment and taxation and shall prescribe regulations to secure a just valuation for all property, both real and personal." The Indiana Constitution also declares that the state must have, "a system of assessment and taxation characterized by uniformity, equality, and just valuation based on property wealth." The old valuation procedures made it extremely difficult for property owners to understand if their assessment was fair or equitable because there was no linkage between true tax value and another transparent value, like market value.

One goal of the new market-based assessment procedure in Indiana is to produce "objectively verifiable" assessment values. The "objectively verifiable" component of the true tax value allows for comparison between assessment values and real estate transactions. The true tax value under the new system equals assessed value. That is, the target for assessed value is 100 percent of the true tax value, not 33 percent of true tax value as with the old system.

Complexity is still present in Indiana's new definition of true tax value. As opposed to the IAAO's market value definition, which includes "the most probable price (in terms of money) which a property should bring in a competitive open market under all conditions requisite to a fair sale… not affected by undue stimulus," the State of Indiana uses market value-in-use (DLGF 2000, 8). Synonymous with true tax value in Indiana, market value-in-use is, "[the property's] current use, as reflected by the utility received by the owner or a similar user, from the property" (DLGF 2000, 8). The Indiana Department of Local Government Finance simplifies that definition as, "the ask price of property by its owner, because this value more clearly represents the utility obtained from the property, as the price represents how much utility must be replaced to induce the owner to abandon the property" (DLGF 2000, 8). Though the new valuation process is still somewhat convoluted, the true tax value can be, and should be, compared to the sales price as an "objectively verifiable" measure (DLGF 2000, 20). That is, market value-in-use should equal or approximate market value in single-family residential properties.

3. Analytic Framework

The property tax is a tax on wealth. Ideally, assessed value equals market value. If you divide the assessed value by a property's recent sale price (market value), then the result should be very close to or equal one (assessed value/market value=1). If a property is under-assessed, the calculated ratio between recent sale price and assessed value will be less than one. The ratio for over-assessed properties is greater than one. Most conclusions regarding factors that contribute to assessment performance are based on common measures associated with that ratio. The level of assessment (LOA), coefficient of dispersion (COD), and price-related differential (PRD) are the most common measures (Doering 1977, IAAO 1999).

3.1 Level of Assessment

Uniformity is frequently measured among different jurisdictions by calculating level of assessment ratio, or the median assessment-sales ratio. The median assessment-sales ratio is the result of sorting all assessment-sales ratios in a jurisdiction from the highest to lowest and reporting the data point that is exactly in the middle. It is the point value at which 50 percent of the properties' assessment-sales ratios in the sample are below and 50 percent of the properties' assessment-sales ratios are above. The median is used rather than the average (arithmetic mean) because it is less sensitive to extreme values. Confidence intervals also are reported, though the reliability of those intervals deteriorates as the number of observations decreases.

The industry standard set by the IAAO acknowledges the difficulty of perfect assessment. Therefore, IAAO standards allow 10 percent assessment error on either side of market value. IAAO standards also recognize the importance of sample selection. Therefore, the standards call for at least the upper or lower bound of the 95 percent confidence interval to be within the 10 percent standard (IAAO 1999).

3.2 Traditional Measures of Assessment Equity

The level of assessment matters at the broader scale of comparing jurisdictions for administrative and intergovernmental aid (Mikesell 2004). However, the tax rate is figured after the assessment. If all properties within a jurisdiction are under-assessed, then the statutory and effective property tax rate will be higher across all properties. If all properties are equally over-assessed, the statutory and effective property tax will be higher across all properties. Equity and fairness become a salient problem when property owners in the same jurisdiction receive the same services but have varying tax burdens as a result of inequities in valuation.

The fairness of the property tax is based on two concepts, horizontal equity and vertical equity (Mikesell 1995, Stiglitz 1999). Horizontal equity is a principle that requires like properties to share equal burden. That is, the level of assessment should be the same for similar properties in a given jurisdiction. For example, if a property has an assessment-sales ratio of 0.80, one would expect comparable properties' assessment-sales ratio to be near 0.80.

Vertical equity is another fairness concept to consider when evaluating property tax burden. Vertical equity calls for properties at different price levels to be assessed proportionally. The assessment ratio for higher priced properties should be the same as the assessment ratio for lower priced properties. For example, if the assessed value of a \$100,000 property is \$90,000 (0.90 ratio), then a \$180,000 assessed value is expected for a property with a market value of \$200,000 (0.90 ratio).

The standard measure for horizontal equity (fairness across comparable properties) is the coefficient of dispersion (COD). The COD is calculated by finding the average of all absolute deviations from the median in percentage terms. It is interpreted as the average percentage difference of all property assessment ratios from the median assessment ratio. A COD of zero indicates perfect horizontal equity with no disparities across properties. Any number above zero is the average percentage difference of all properties' assessment-sales ratios from the median ratio of the study area. As with measuring level of assessment, the IAAO recognizes the difficulty of perfect horizontal equity. The standard is a 15 percent range around the jurisdiction median assessment ratio in areas where housing type is diverse. In other words, the average percentage deviation from the mean in a jurisdiction should be 15 percent. The standard acceptable COD is 10 percent for areas where the housing type is similar in age and design (IAAO 1999).

$$COD = \frac{100}{Median_{A/S}} * \left(\frac{\sum_{i=1}^{n} |(A_i - Median_{A/S})}{n} \right) \quad (1)$$

where:

A_i=Assessed value of the i'th property

S_i=Sales price of the i'th property

$Median_{A/S}$=Median of jurisdiction sample A_i/S_i

The price-related differential (PRD) is a measure for vertical equity. It is an index that is centered on the number one. That is, if there is no vertical inequity, the index will be one. It is calculated by taking the overall mean assessment-sales ratio of a jurisdiction and dividing it by the sum of assessment divided by the sum of sale price (weighted average). Any number below one indicates that higher priced homes are generally over-assessed. Conversely, a number above one indicates that lower priced properties are generally over-assessed. Acceptable practices will produce a PRD index between 0.98 and 1.03 according IAAO standards for quality assessment (IAAO 1999).

$$PRD = \frac{\left. \sum_{i=1}^{n} A_i / S_i \right/ n}{\sum_{i=1}^{n} A_i \Big/ \sum_{i=1}^{n} S_i} \quad (2)$$

Governments commonly use the LOA, COD, and PRD standards developed by the IAAO to evaluate assessor performance and to perform equalization studies. Those measures are typically calculated at an administrative level (e.g. county, township, or school district). The academic literature continues to extend those measures by developing different statistical techniques to identify inequity (Paglin et.al. 1972, Cheng 1974, Reinmuth 1977, Bell 1984, Haurin 1988, Clapp 1990, Smith 2000, Mikesell 2004). Smith (2000) finds that the conclusions can differ between those measures. It is suggested here that using maps and performing analyses at the lowest geographic level possible can rectify many of those problems.

3.3 New Measures of Spatial Equity

It is justifiable for the scale of the assessment evaluation to be at a specified administrative unit (e.g. counties, townships, or school districts) if the reason for the study is to answer a policy question relevant to that spatial unit (e.g. intergovernmental aid formulas and debt limitation). However, the underlying problem in assessment error is fairness and equity to the tax payer. Therefore, it is important to identify the extent to which a problem truly occurs or does not occur at a given location. Performing analyses of assessment performance using a combination of spatial analytics and maps provides insight that is not apparent in typical studies that use measures summarized at an administrative spatial unit. Specifically, Anselin's Local Moran's I and the Getis-Ord GI* statistics can be used to identify property level geographic clusters of assessment error (Anselin 1995, Ord & Getis 1995, Getis & Ord 1992). Those statistics can assist in overcoming problems of geographic scale that are inherent in current studies on assessment performance and tax equity.

The Local Moran's I statistic is also referred to as a "similarity and dissimilarity index" or a "cluster and outlier analysis." A measure (e.g. assessment-sales ratio) is calculated for each property (*i*) and compared to surrounding properties (*j*) through a weight matrix (*w*) within a specified distance threshold (*d*). The significance of clustering is based on a calculated z-score from that statistic. Points with higher values are similar to their neighbors. Points with larger negative Z-scores (two or greater in this analysis) are considered dissimilar to their neighbors. For the purposes of this research, the Local Moran's I statistic is used to indicate if assessment inaccuracy is clustered across space. A local Moran statistic for each point "i" is defined as (Anselin 1995):

$$I_i = \frac{x_i - \bar{x}}{S^2} \sum_{j=1}^{N} w_{ij} (x_j - \bar{x}) \qquad (3)$$

where:

$$S^2 = \frac{\sum_{j=1, j \neq i}^{N} x_j^2}{N-1} - \bar{x}^2$$

For a randomization hypothesis, the expected value is:

$$E(I_i) = -\frac{\sum_{j=1}^{N} w_{ij}}{N-1}$$

The variance is:

$$Var(I_i) = \frac{(N-b_2)\sum_{j=1, j \neq i}^{N} w_{ij}^2}{N-1} + \frac{(2b_2 - N)\sum_{k=1, k \neq i}^{N}\sum_{h=1, h \neq i}^{N} w_{ik} w_{ih}}{(N-1)(N-2)} - [E(I_i)]^2$$

where:

$$b_2 = \frac{N\sum_{i=1}^{N}(x_i - \bar{x})^4}{\left(\sum_{i=1}^{N}(x_i - \bar{x})^2\right)^2}$$

The Getis-Ord Gi* statistic is the other neighborhood level measure of assessment equity explored in this analysis. It generates geographic "hot spots" of high and low values. Like the Local Moran's I statistic, it also produces a z-score for each property. The Getis-Ord Gi* statistic identifies clusters of properties within a specified distance threshold for which values (measures) of a point and its neighbors are significantly higher or lower.

Getis-Ord Gi for point "i" is defined as (Ord & Getis 1995):

$$G_i(d) = \frac{\sum_{j=1, j \neq i}^{N} w_{ij}(d) x_j - \bar{x}_i \sum_{j=1, j \neq i}^{N} w_{ij}(d)}{S(i)\sqrt{\left[(N-1)\sum_{j=1, j \neq i}^{N} w_{ij}^2(d) - \left(\sum_{j=1, j \neq i}^{N} w_{ij}(d)\right)^2\right] / (N-2)}} \qquad (4)$$

where:

$$\bar{x}_i = \frac{\sum_{j=1, j \neq i}^{N} x_j}{N-1} \qquad S(i) = \sqrt{\frac{\sum_{j=1, j \neq i}^{N} x_j^2}{N-1} - (\bar{x}_i)^2}$$

$$G_i^*(d) = \frac{\sum_{j=1}^{N} w_{ij}(d) x_j - \bar{x}\sum_{j=1}^{N} w_{ij}(d)}{S\sqrt{\left[N\sum_{j=1}^{N} w_{ij}^2(d) - \left(\sum_{j=1}^{N} w_{ij}(d)\right)^2\right] / (N-1)}}$$

and:

$$\bar{x} = \frac{\sum_{j=1}^{N} x_j}{N} \qquad S = \sqrt{\frac{\sum_{j=1}^{N} x_j^2}{N} - (\bar{x})^2}$$

Those statistics, accompanied with the use of maps, will allow for a better understanding of whether or not the problem is systematic across space or it is random. It also may identify clusters of inaccuracy that could be masked at some greater scale of analysis. Spatial clustering might indicate a more systematic problem with the application of assessment procedures (possibly specific to certain types of neighborhoods). More random inaccuracy might indicate less systematic and more "special case" related problems. This type of analysis sets the stage for exploring whether or not there are neighborhoods in which assessment is more likely to be inaccurate as a result of certain characteristics. Answering that question can assist in rectifying common inaccuracies in the assessment system and will be useful for analysts, assessors, and tax regulatory bodies.

3.4 The Data

The primary data sources for this analysis come from the Multiple Listing Service (MLS) database provided by the Metropolitan Indianapolis Board of REALTORS® (MIBOR) and parcel level data provided by local assessors. Parcel level assessment data from the assessors includes all residential parcels with fields for parcel identification, property type identification, gross assessed value, net assessed value, and tax district identification number in tax year 2003 pay 2004. The two primary data sources were merged by the parcel identification number. Only sales price data for properties that were sold during the same year as assessment were included. The resulting data set includes 17,367 records across eight counties after the data were appropriately cleansed. The number of observations ranges from 340 to over 9,800 by county. By township, the number of observations ranges from three to over 1,450.

4. Results

This study provides results to two types of analyses. First, the traditional measures of assessment equity are examined by county and township. Then, the non-traditional spatial approach using maps and spatial equity measures are analyzed.

4.1 Traditional Approach: Administrative (Cty) Level

The median assessment ratio (LOA) and the 95 percent confidence interval around that ratio are shown in Table 2. As shown, the median ratio for all counties in the study area was below one (under-assessed) after reassessment in 2003. Five of the eight counties (shown in bold) had median ratios within the 0.90 and 1.10 IAAO standards (10 percent above or below market value). Boone County's median assessment ratio was the lowest at 0.84. The median assessment ratio in Hancock County was closest to the target of one.

Table 2. Assessment Ratios in Eight Central Indiana Counties

	95% Confidence Interval for Median			
County	Median	Lower Bound	Upper Bound	Sample Size
Boone County	0.83	0.81	0.85	548
Shelby County	0.86	0.84	0.88	340
Hamilton County	0.88	0.87	0.88	3216
Morgan County	0.90	0.88	0.93	494
Marion County	0.92	0.91	0.92	9826
Johnson County	0.94	0.93	0.95	1281
Hendricks County	0.94	0.94	0.95	1102
Hancock County	0.96	0.95	0.97	560

Table 3. Proportion of Assessment Ratios Meeting IAAO Standard

County	Below Standard	(IAAO Standard) 0.90 to 1.10	Above Standard
Boone County	68%	25%	7%
Marion County	46%	29%	25%
Morgan County	49%	34%	16%
Shelby County	59%	35%	7%
Hamilton County	59%	36%	5%
Johnson County	37%	47%	16%
Hendricks County	33%	57%	10%
Hancock County	24%	67%	8%

The proportion of properties that were within the standard range 0.90 and 1.10 as well as the proportions above and below that standard are shown in Table 3. As indicated, Hancock County met the 10 percent standard on 67 percent of the properties in the sample. The only other county to meet the standard more than 50 percent of the time was Hendricks County. Boone County and Marion County met the standard on less than one-third of the properties. In all counties, the assessment ratio was more likely below the standard (under-assessed) than above the standard (over-assessed). Marion County had the highest proportion of over-assessed properties with one-quarter of properties above the IAAO standard.

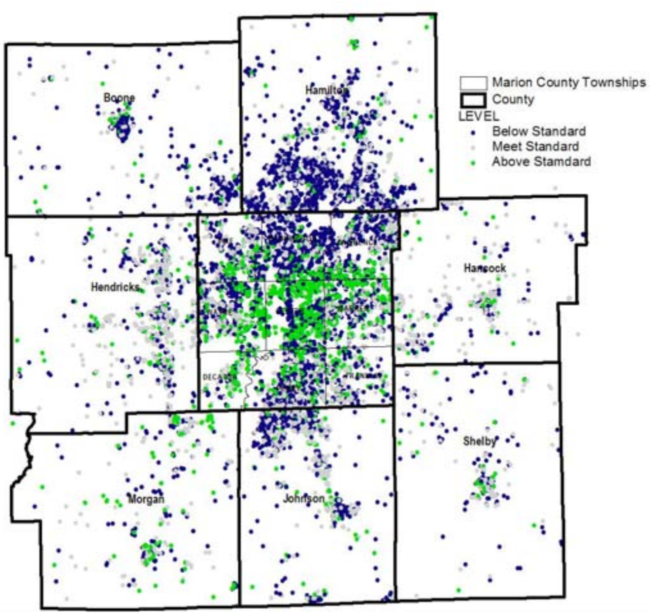

Figure 1. Distribution of Assessment Level

The spatial distribution of under- and over-assessment for all observations is shown in Figure 1. Figure 1 indicates that there are not only differences among counties, but differences between and within the counties. For instance, properties in Boone County townships are fairly consistently below the IAAO assessment standard. However, there are larger variances in Marion County.

Note from Figure 1 that under- and over-assessment are seemingly clustered within some smaller geographic areas that span across administrative boundaries. Marion County (the central, densest county and the only county where townships are shown), for example, has a pattern of under- and over-assessment that spreads across adjacent township boundaries. That is a pattern that is masked without using maps for visualization.

Table 4 shows the COD for each county and the proportion of properties in the sample that met the IAAO 10 percent and 15 percent standard. As shown, three (Hancock, Hamilton, Hendricks) of the eight counties studied met the overall county COD standard of 10 percent. Two additional counties (Johnson and Shelby) met the 15 percent COD standard. Marion County had the highest COD, indicating an average difference of 25 percent from the median assessment ratio. Other counties beyond the 15 percent COD standard were Morgan County (19 percent) and Boone County (17 percent).

Over half the properties in all counties were within 15 percent of the median assessment ratio. However, that proportion varied greatly. Eighty-five percent of properties in Hancock County were within 15 percent of the county median ratio, while only 52 percent of properties were within 15 percent of Marion County's median ratio.

Table 4. COD for Eight Counties and Proportion Meeting IAAO Standard

		Proportion within:	
	COD	10 percent of median	15 percent of median
Marion County	25%	39%	52%
Morgan County	19%	40%	57%
Boone County	17%	40%	56%
Shelby County	15%	41%	56%
Johnson County	14%	52%	68%
Hendricks County	10%	62%	78%
Hamilton County	10%	66%	81%
Hancock County	8%	71%	85%

The distribution of COD for all of the counties and whether or not they meet the IAAO standards is illustrated in Figure 2. Figure 2 indicates that there are not only differences among counties, but also differences within counties.

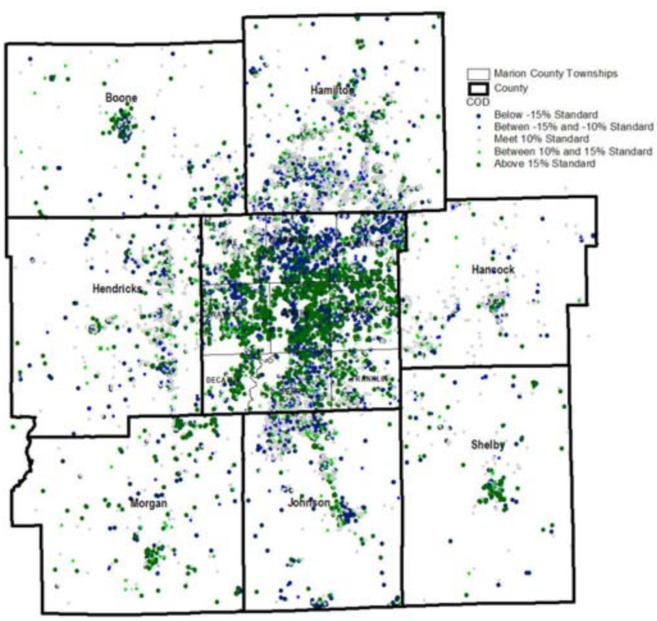

Figure 2. Distribution of Coefficient of Dispersion

Some counties fairly consistently met the standard across townships. For instance, townships in Hancock County fairly consistently met the standard, showing no apparent pattern of horizontal inequity. Marion County and Morgan County show a less consistent spatial pattern.

As mentioned previously, fairness in property tax administration is judged on a proportional basis. That is, residents should pay property taxes in proportion to their property wealth (referred to as vertical equity). There are several ways to measure vertical equity. The PRD statistic in Table 5 shows some evidence that higher priced properties are generally under-assessed relative to lower price properties. That places greater proportional burdens on residents in lower priced housing. However, seven of the eight counties meet the expected error (IAAO standard) for the PRD measure. There are much more inconsistent effects when the measure is detailed at a larger scale. This is more apparent in the following local spatial analysis.

Table 5. PRD Eight Counties

	PRD
Marion	1.12
Johnson	**1.03**
Boone	**1.05**
Hamilton	**1.02**
Morgan	**1.03**
Hendricks	**1.01**
Hancock	**1.06**
Shelby	**0.98**

4.2 Non-traditional Approach: Neighborhood Level

It is clear from the traditional measures of assessment quality that there are equity issues in property tax burden among single-family residential properties after assessment reform in the eight counties studied. An analysis using the Local Moran's I statistic and the Getis-Ord GI* statistic provides a more detailed neighborhood level aspect of how assessment discrepancies (Therefore, discrepancies in burden) are distributed spatially across administrative boundaries. Both of those local spatial statistics require judgment decisions made by the analyst. The primary judgment decision is determining parameter values for defining the "neighborhood."

For this study, a one-mile radius was chosen as the neighborhood extent around each observation after exploring various radii. Inverse distance weighting of neighbors from each point was used. The specification of inverse distance weighted follows Tobler's first law of geography; closer points in space are more likely to be similar to each other than are points farther away (Tobler 1970).

The analysis of neighborhoods is limited to select townships on the basis of data concentration. That is, only townships with an ample number of data points are studied (33 of 86 townships). The extent of the analysis for each neighborhood level calculation (centered on each point) is the township level, since that is the level at which assessment is administered. In other words, a neighborhood analysis was performed for each township. The townships studied are graphically shown in Figure 3.

As stated previously, the Local Moran's I statistic is essentially a "cluster and outlier analysis" of each neighborhood. A negative z-score indicates that an observation's assessment sales ratio is dissimilar to its neighbors. As the z-score becomes more negative, there is greater confidence that the dissimilarity is not expected by chance. For the purposes of this study, a z-score of two (confidence of 95.4%) was used as the standard for statistically significant detection of outliers. The distribution of outliers (those properties for which the assessment ratio is much different from its neighbors) across the study area is shown in Figure 4. The ramification of detecting these outliers is that there are some neighborhoods in which properties are experiencing different tax burdens due to inadequate calculation of the tax base alone.

The distribution across townships in Marion County is illustrated in Figure 5. It shows the proportion of outliers in the sample by township. As shown, that distribution varies quite dramatically. The proportion of properties with an assessment ratio that is significantly different than their neighbors' is nearly two times greater in Wayne Township (west central Marion County) and Center Township (central Marion County) than Pike Township (northwest Marion County), Decatur Township (southwest Marion County), and Franklin Township (southeast Marion County). Combined, Figures 4 and 5 show that the chance of one's property being assessed accurately is dependent upon which township and neighborhood it is located.

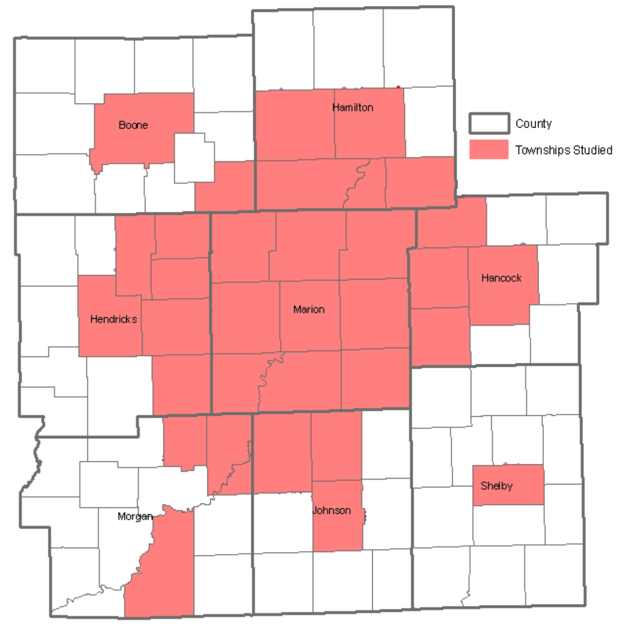

Figure 3. Townships in Neighborhood Analysis

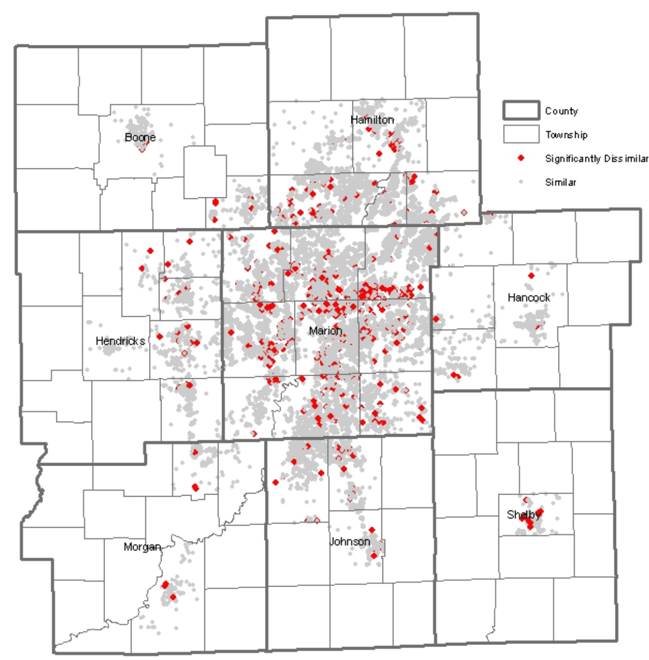

Figure 4. Distribution of Assessment Outliers

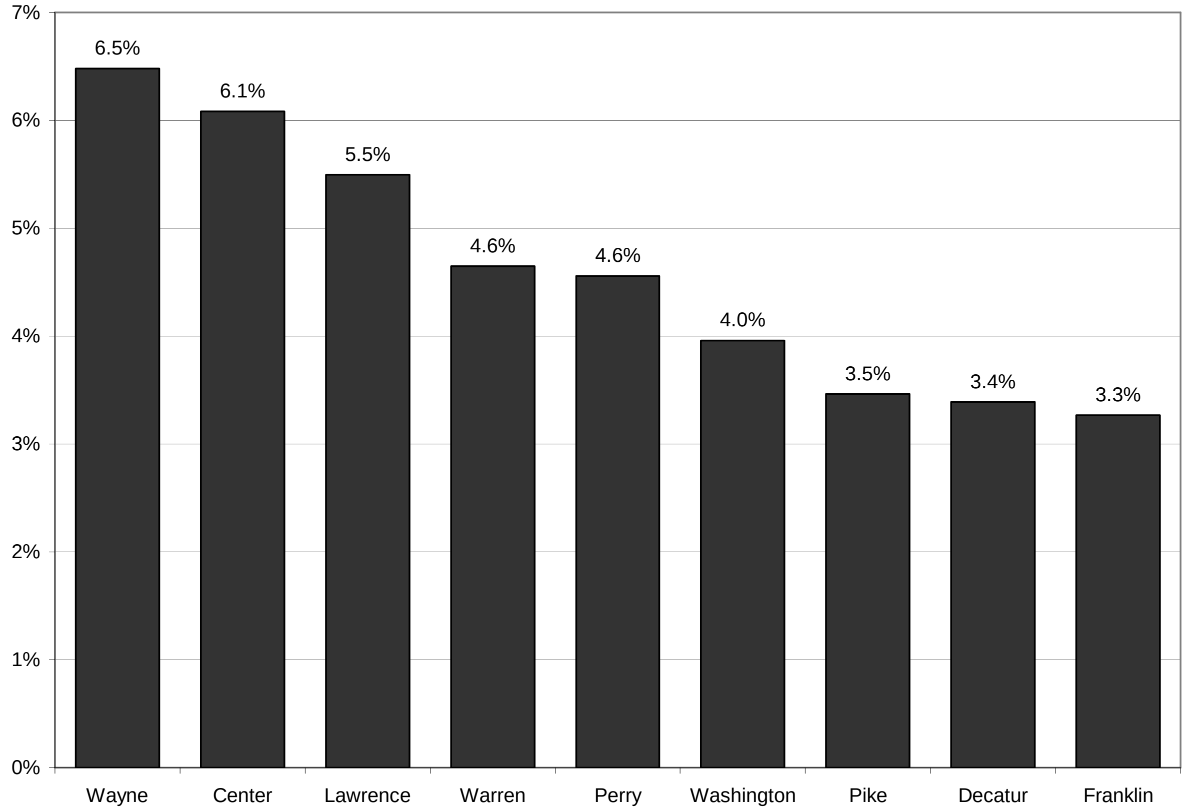

Figure 5. Percent Assessment Outliers by Township in Marion County

The Local Moran's I statistic shows where significant neighborhood discrepancies exist, but does not provide information to evaluate whether or not there are clusters of high and low assessments. The Getis-Ord Gi* statistic is used to detect over- or under-assessment clusters. A negative (positive) z-score indicates that an observation's assessment-sales ratio is located in a neighborhood cluster with low (high) assessment ratios. As the z-score becomes more negative (positive), there is greater confidence that the clustering is not a result of chance. As with the local Moran's I statistic, a z-score of two (confidence of 95.4%) was used as the standard for statically significant detection of spatial clustering. Figure 6 shows neighborhoods with significantly high and low assessment do exist in the townships studied.

Figure 7 illustrates how the distribution of under- and over-assessment across townships can differ by showing the proportion of properties in the sample that are located in high/low assessment clusters by township in Marion County. As shown, that distribution varies substantially. The proportion of properties within a cluster ranges from 47 percent (Lawrence Township) to 9 percent (Decatur Township). The proportion of properties located in significantly higher or lower assessment varies. Center Township (the central township) has the highest proportion of properties in over-assessed clusters, with very few properties in clusters of under-assessment. Other townships have a more mixed proportion of properties in both over- and under-assessment clusters. Jointly considering Figures 4 and 5 shows that the tax burdens can vary unambiguously depending on the neighborhood and township in which one is located.

It is an accomplishment to begin to understand the spatial context of the assessment inaccuracy. However, it does not determine its cause. To determine the cause of inaccuracy and inequities requires an understanding of the attributes of the properties that are located in poorly assessed neighborhoods. One example is identifying whether or not certain price points of housing are disproportionately distributed across under- or over-assessed clusters.

The results of this type of analysis for townships in Marion County is shown in Table 5. It shows the distribution of properties in high/low assessment ratio clusters by price quintile. Specifically, it shows that there are generally a higher proportion of properties in clusters of over-assessment in the lowest price quintile than in higher price quintiles. Conversely, there is generally a larger percentage of properties in the higher percentiles located in over-assessed clusters. This shows a tendency towards vertical inequities at the neighborhood level.

The fact that there are relatively large proportions of properties within some price points that are not located in significant geographic clusters of over- or under-assessment should not remain unnoticed. This indicates that there are likely other characteristics that contribute to clusters of inaccurate and inequitable assessment. Further analysis should focus on identifying those characteristics. That analysis should not only focus on the characteristics of the properties in the clusters, but also general characteristics of the neighborhoods in which those properties are seated. For example, further research may focus on whether or not the concentration of lower priced housing determines the extent to which a lower priced house is under- or over-assessed. Another extension would be to consider more explicitly the heterogeneity of neighborhood characteristics.

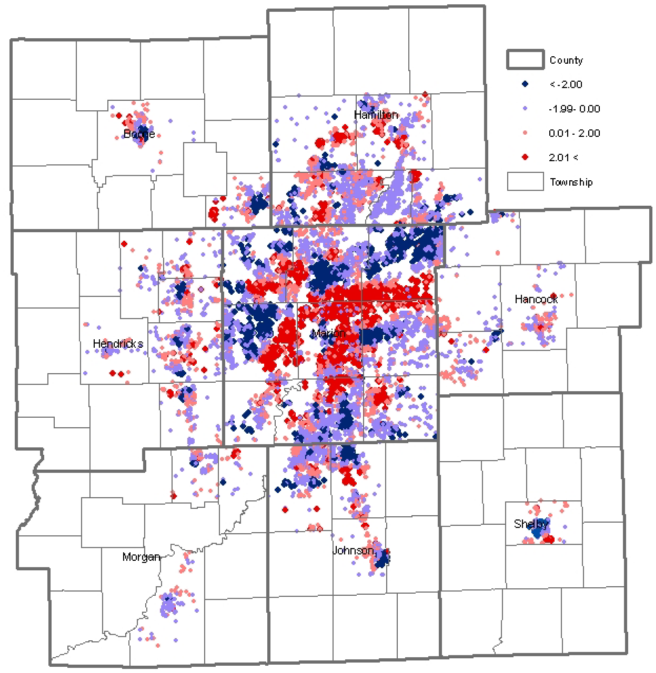

Figure 6. Distribution of High\Low Assessment Ratio Clusters

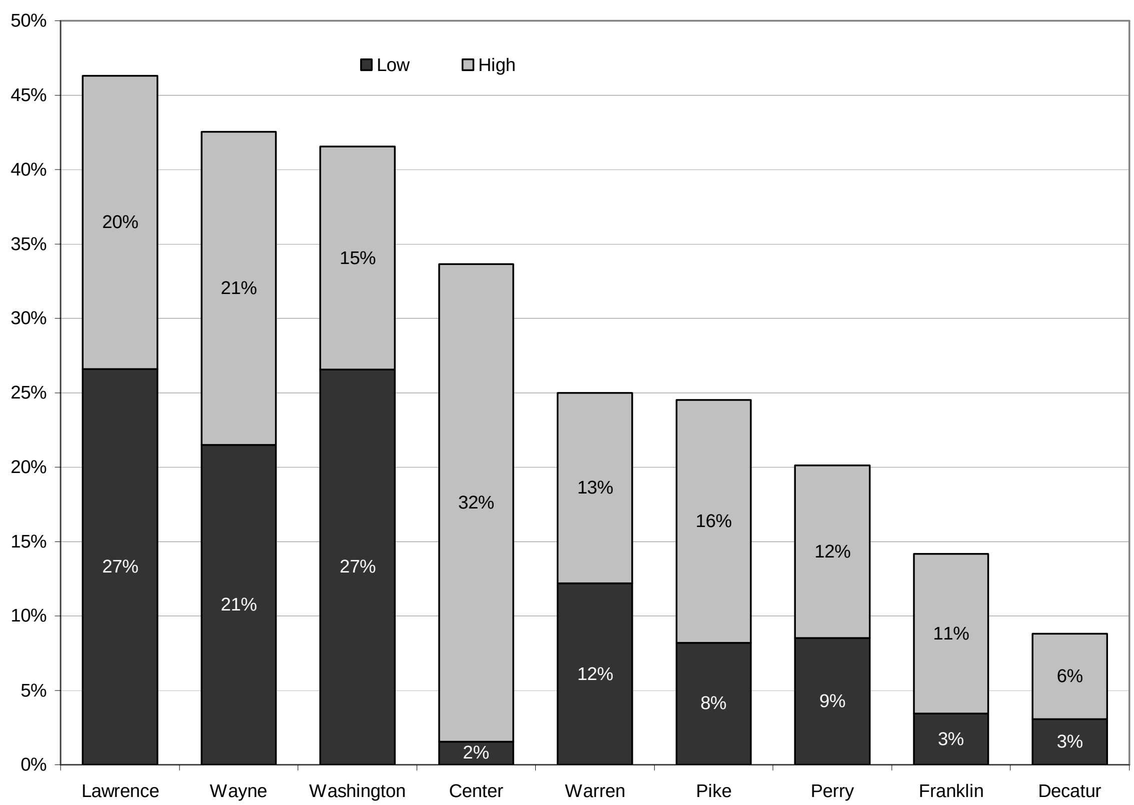

Figure 7. Proportion of Sample in Significantly High and Low Clusters

Table 5. Cluster by Price Quintile

	Price Quintile				
Area	**1**	**2**	**3**	**4**	**5**
	Significant Cluster of Under-Assessment				
Center Township	42%	0%	0%	0%	0%
Decatur Township	22%	3%	2%	0%	0%
Franklin Township	8%	13%	11%	10%	2%
Lawrence Township	79%	44%	6%	2%	1%
Perry Township	47%	13%	4%	0%	0%
Pike Township	31%	30%	12%	10%	3%
Warren Township	30%	10%	0%	1%	0%
Washington Township	34%	1%	0%	0%	0%
Wayne Township	49%	8%	1%	0%	6%
MARION COUNTY	**44%**	**14%**	**5%**	**3%**	**1%**
	Significant Cluster of Over-Assessment				
Center Township	0%	1%	9%	17%	17%
Decatur Township	2%	1%	9%	0%	67%
Franklin Township	4%	2%	3%	3%	11%
Lawrence Township	0%	4%	25%	37%	48%
Perry Township	4%	10%	7%	10%	8%
Pike Township	3%	3%	6%	11%	20%
Warren Township	5%	10%	20%	29%	15%
Washington Township	0%	1%	1%	1%	1%
Wayne Township	10%	25%	33%	29%	44%
MARION COUNTY	**3%**	**9%**	**14%**	**16%**	**21%**
	Not in Significant Cluster				
Center Township	58%	99%	91%	83%	83%
Decatur Township	76%	96%	90%	100%	33%
Franklin Township	88%	85%	85%	87%	87%
Lawrence Township	21%	52%	69%	61%	51%
Perry Township	49%	76%	89%	90%	92%
Pike Township	66%	67%	82%	79%	77%
Warren Township	65%	79%	80%	70%	85%
Washington Township	66%	98%	99%	99%	99%
Wayne Township	42%	67%	65%	71%	50%
MARION COUNTY	53%	77%	81%	82%	78%

5. Conclusions and Discussion

Assessment equity matters because property taxes affect the property owner's tax burden. If a parcel is under-assessed relative to like parcels, that property owner will pay *less* than his/her "fair share" in taxes. If a parcel is over-assessed relative to other properties, that property owner will pay *more* than his/her "fair share." This paper indicates that eight counties in Indiana, given a "new slate" with which to create a fairer property tax system, still operate under a system of inequitable property tax burden. It also shows that property tax inequities can be detected at the neighborhood level. It explores the identification of areas in which property taxes are inaccurately assessed simply as a result of location.

The ability to detect assessment problems at the neighborhood level can contribute to resolving them. This study makes a contribution by using spatial analytic methods for identifying neighborhoods in which problems exist and moves towards methods of identifying possible characteristics that contribute to the problem. Future research should focus more specifically on neighborhood assessment inequity to more formally detect which problems are the results of the state's system, the result of the neighborhood, or the result of the combination of the state system and the neighborhood.

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