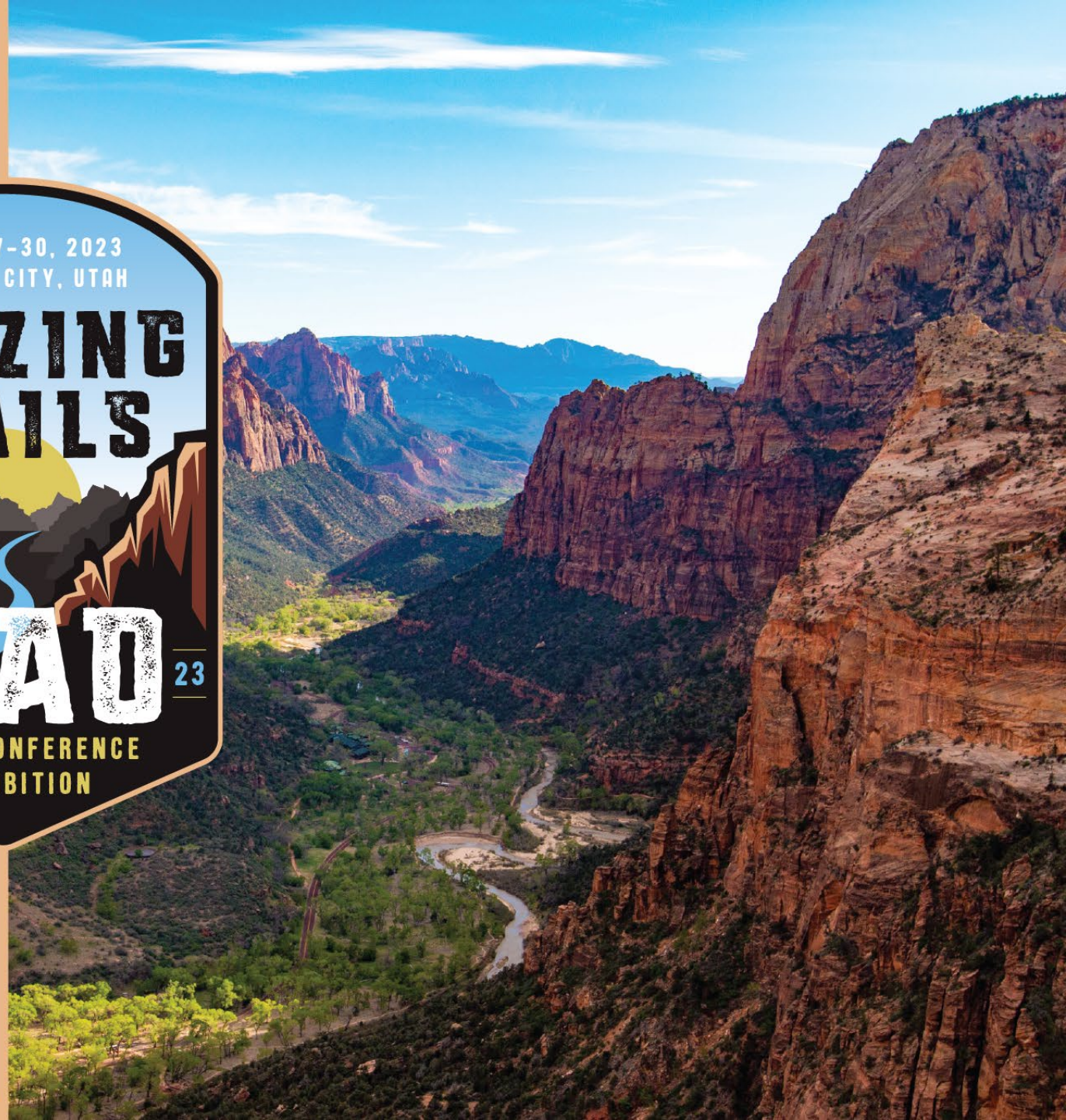
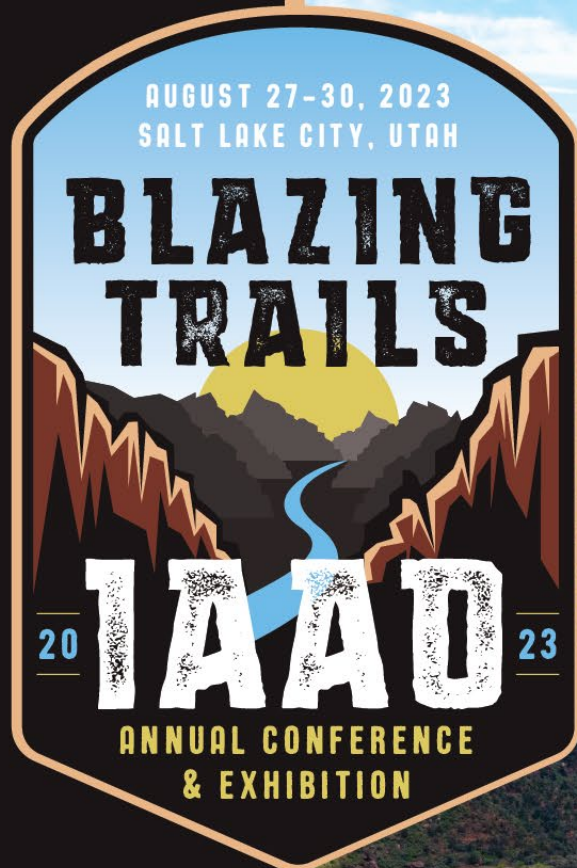


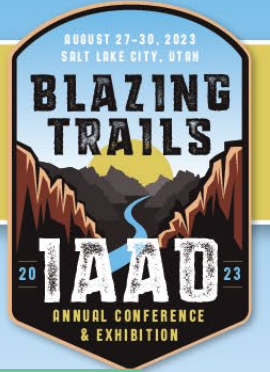
Demonstration of the Lincoln Institute of Land Policy Vertical Equity App

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and Technology



Renewed Focus on Vertical Equity in the Academia.....



✓ *Reassessing the Property Tax*, Christopher Berry, The University of Chicago Harris School of Public Policy and the College. 2021

✓ *The Assessment Gap: Racial Inequalities in Property Taxation*. Carlos Avenancio-León, Indiana University and Troup Howard, University of California, Berkeley. 2020

✓ *Why are Residential Property Tax Rates Regressive?* Natee Amornsiripanitch, Federal Reserve Bank of Philadelphia. 2020

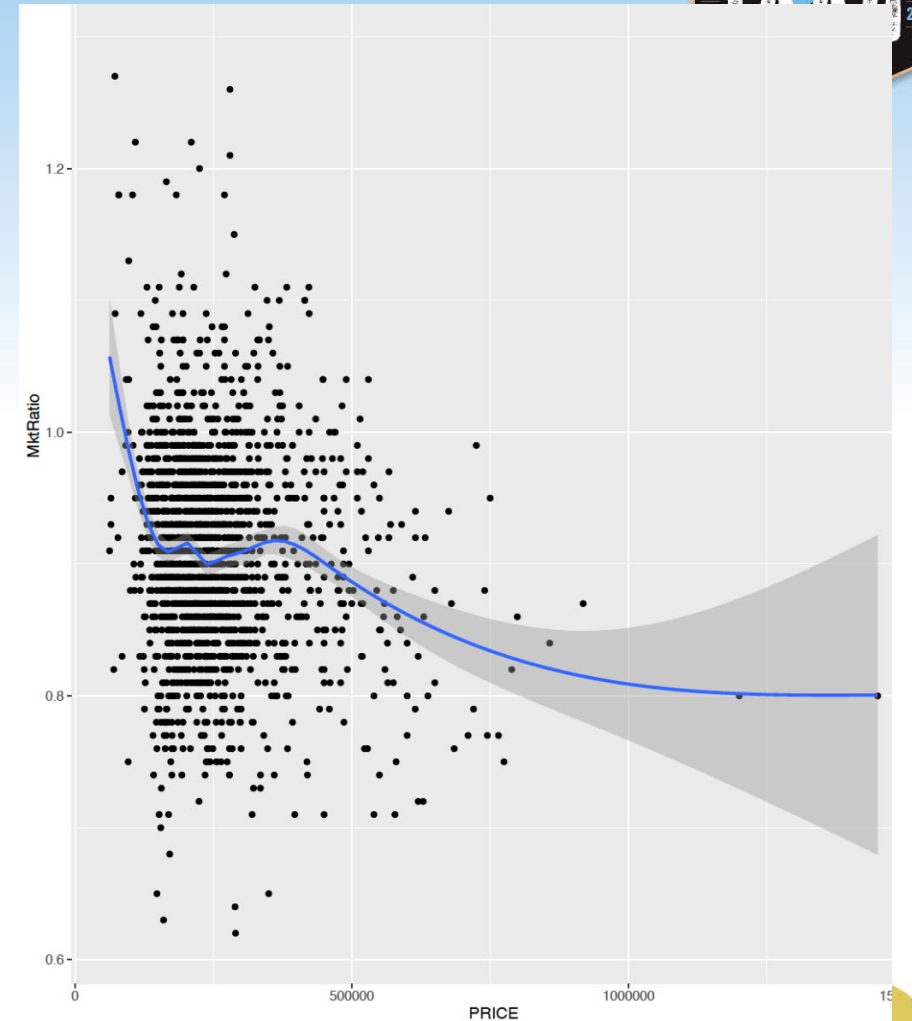


*All find significant levels of **regressivity** in assessments using national datasets*

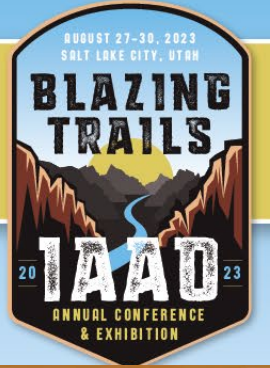


What is Vertical Equity

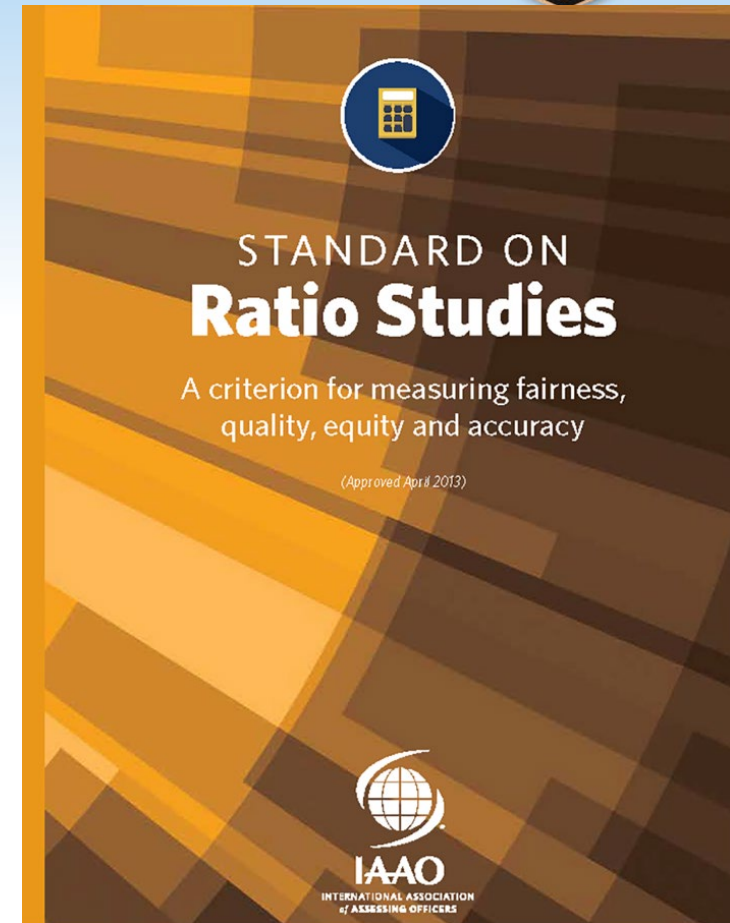
- Vertical equity exists when sales ratios are consistent between lower, middle, and upper-priced properties.
- Sale ratios should be uniform, regardless of price.
- If ratios do fluctuate across prices, vertical inequity is suggested to exist.
- Two types of vertical inequity:
 - **Regressivity:** ratios are lower among higher-priced properties
 - **Progressivity:** ratios are lower among lower-priced properties



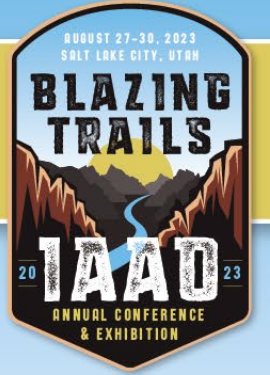
Measuring Vertical Equity



- **Measuring vertical equity in assessments is challenging since the market value of any given property is unknown.**
- **Detailed guidance is provided by IAAO Standard on Sales Ratio Studies**
- **IAAO Vertical Equity Measures**
 - **Price Related Differential – PRD**
 - **Coefficient of Price Related Bias - PRB**

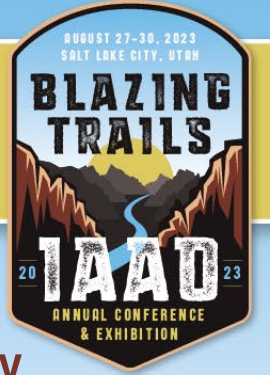


Price Related Differential (PRD)



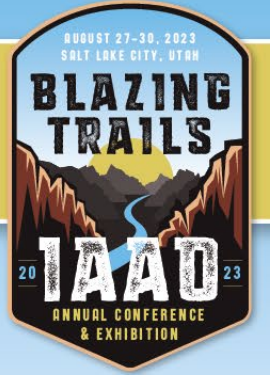
- The PRD is calculated by dividing the mean sale ratio by the weighted mean sale ratio
 - If vertical equity exists, this ratio should be close to 1.00.
 - A PRD above 1.00 suggests a regressive distribution.
 - A PRD below 1.00 suggests a progressive distribution.
- The PRD as a vertical equity measure is useful but somewhat flawed.
 - The PRD's strength is its simplicity and ease of calculation.
 - A disadvantage of the PRD is that it can be distorted by a small number of very high-priced properties that can lead to a false indication of regressivity.
- The PRD can be a useful indicator that more analysis is necessary, but by itself it is not necessarily conclusive that vertical inequity exists.

Coefficient of Price Related Bias - PRB

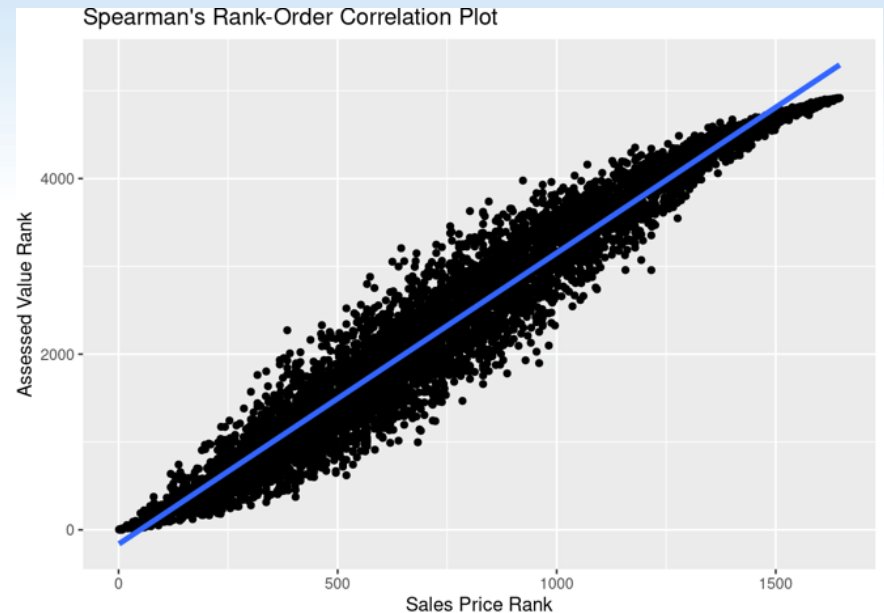


- The Coefficient of Price Related Bias, or PRB, measures vertical equity with an index calculated by regression that quantifies the relationship between sales ratios and value in percentage terms.
 - If vertical equity exists, the PRB value should be close to zero.
 - A PRB below zero suggests a regressive distribution where lower-valued properties are assessed at a higher level than higher-valued properties.
 - A PRB above zero suggests a progressive distribution, where the reverse is true.
- The PRB is a more robust measure that is not as susceptible to the influence of outliers as the PRD.
- The PRB is more difficult to calculate than the PRD.
- Some academic research has found that regression based vertical equity measures like the PRB may be prone to indicating a regressive distribution even if there is no bias present

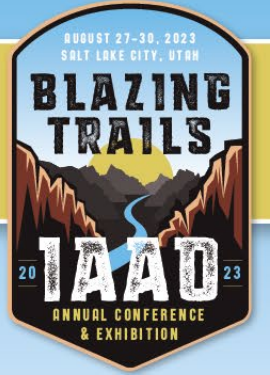
Spearman's Rank-Order Correlation



- Spearman's Rank is also recommended in the IAAO Standard for evaluating whether low and high priced properties are appraised at equal percentages of market value i.e., whether vertical equity exists.
- The Spearman's Rank measures the strength and direction of association between two ranked variables.
 - Ranks are determined for each property in the analysis, one rank for sale price, the other for assessment.
 - A correlation analysis of the two ranks is performed - Spearman's rho.
- While the Spearman analysis provides useful information, since its a simple correlation it lacks other important information on the distribution.



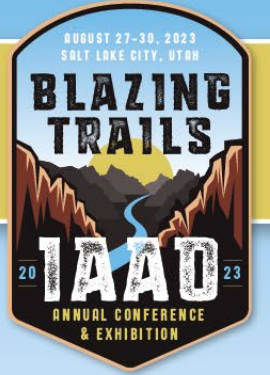
Gini Measures



- Gini measures also use rankings of sales and assessments in their calculation.
- However, Ginis go beyond Spearman's simple measure of co-movement quantifying how the distribution of assessments behave relative to the distribution of sales at given price levels.
- Gini measures have been a common measure of inequity in economic analysis for decades but have only recently been considered as a measure of vertical equity for assessments.
- The Kakwani Index (KI) provides a measure that summarize the relationship of the sales and assessment distributions.
 - KI less than zero indicates regressivity
 - KI above zero indicates progressivity
- Gini measures provide more information on the vertical equity of the entire distribution.



Vertical Equity App



- The notion of a single or best measure of vertical equity may be illusive.
- Instead, the best approach may be to calculate and evaluate all the measures in the Standard - with the addition of Gini's measures - to develop a more complete picture of the level of vertical equity for a given distribution.
- The Lincoln Institute developed the Vertical Equity App with the Center for Appraisal Research and Technology to provide assessors with a tool to assist them in to measure and evaluate vertical equity in assessments



Lincoln Institute of Land Policy Vertical Equity App

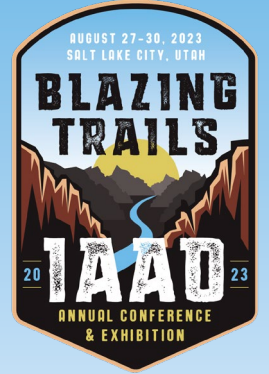
[Introduction](#) [Data](#) [ASR](#) [COD](#) [PRD](#) [PRB](#) [Spearman](#) [Gini Measures](#) [Summary](#)

Introduction

Vertical equity in property tax assessment requires that assessment levels remain consistent over the range of real estate values, with high-value and low-value properties exhibiting the same ratio of assessment to market value.

Recent studies utilizing national datasets have found widespread vertical inequity in property tax assessments, with low-priced properties assessed at a higher percentage of market value than high-priced properties. These findings challenge assessment offices across the country to measure and evaluate the level of vertical equity in their assessment rolls. To do this requires that assessment offices have the capacity to undertake this statistical study and the ability to communicate the results effectively.

This application is designed to help meet that need, by allowing assessors to analyze vertical equity using six different approaches: the Assessment to Sale Ratio (ASR), the Coefficient of Dispersion (COD), the Price Related Differential (PRD), the Price Related Bias (PRB), the Spearman's Rank Order Correlation, and Gini measures. Graphic displays and an overall Summary allow these results to be shared and communicated more easily than would be possible with computational data alone.




Demonstration of App


Questions:

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