NEBRASKA
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DEPARTMENT OF REVENUE

Memorandum

To: Tax Equalization and Review Commission

CC:

From: Ruth Sorensen, Property Tax Administrator

Date: April 19, 2022

Re: Price Related Differential

The Price Related Differential (PRD) is used by the Department of Revenue, Property Assessment Division (Division) to measure vertical equity, which is the assessment level of lower-priced properties relative to the assessment level of higher-priced properties. Although the PRD is commonly used by assessing officials to measure vertical equity, its reliability has been subject to debate since its inception.

Examining the history of the PRD provides some insight as to how the measures use has changed over time. It was developed by the U.S. Census Bureau in 1957 to determine if there was any relationship between levels of assessed value and property price ranges. In 1980, the measure became popular in assessment ratio studies after being included in the definitions section of the first IAAO Standard on Ratio Studies (Standard). That reference briefly explained that the PRD itself contains a bias and that a PRD within the range of 90 to 110% was considered to be an inconclusive indicator of regressivity. (Gloudemans, 2011). More recent versions of the Standards have not contained this language yet continue to offer a number of cautions regarding the PRD. Some of the references in the IAAO Standard on Ratio Studies include the following.

The weighted mean and price-related differential (PRD) are sensitive to sales with high prices even if the ratios on higher priced sales do not appear unusual relative to other sales. (IAAO 2013, 12)

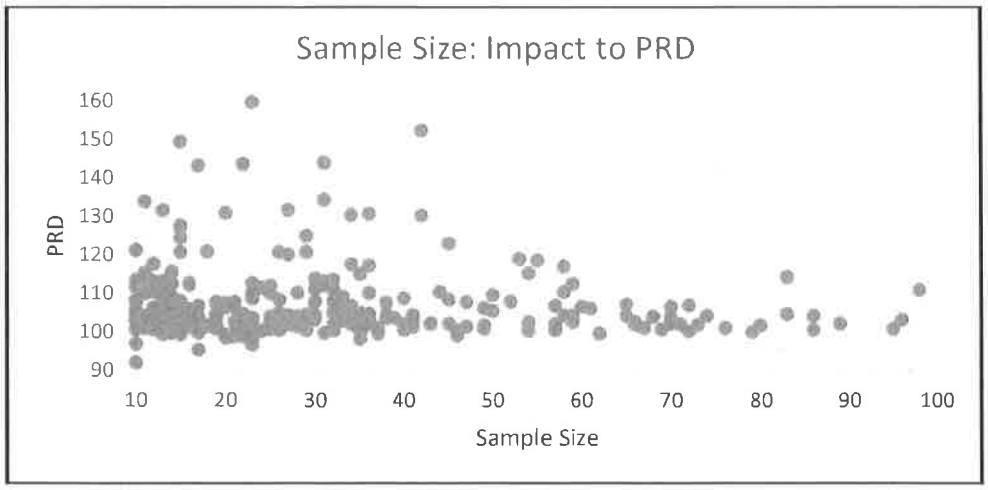
When samples are small, have high dispersion, or include properties with extreme values, the PRD may not provide an accurate indication of assessment regressivity or progressivity. (IAAO 2013,19)

The PRD is easily computed in that it uses two different averages, the mean of assessment to sale ratios, and the weighted mean, which divides the total assessed value, by the total sales price of properties. However, the mathematical calculation itself has a bias in that it produces more ratios above 100% than below. The Standard explains this as an inherent upward bias in that the mean is subject to outliers more than the weighted mean is; the Standard also introduced the Coefficient Price Related Bias (PRB) as a measure of price-related bias that is more meaningful than the PRD. (IAAO 2013, 19) All of these cautions indicate that while the PRD may be helpful in examining vertical equity, it cannot be used as a stand-alone determinant of assessment quality.

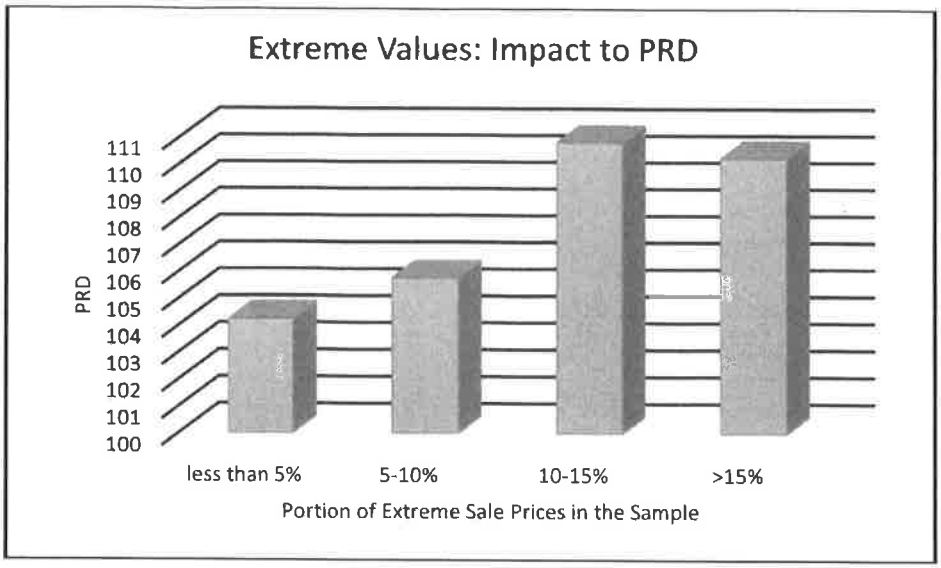
Analysis of statistics used in the 2022 Reports & Opinions of the Property Tax Administrator offer a practical demonstration of the factors that influence the PRD. Examining the nearly 350 residential valuation groupings used by Nebraska county assessors it is evident that PRDs decrease as the sample size increases. The smallest samples were twice as likely to have PRDs above the standard range as large samples were.

Sample Size		Total # Samples	Average PRD	% of samples with PRDs >103%
	10	14	105.59	64%
11	25	121	107.55	58%
26	50	100	107.76	56%
51	100	47	105.23	53%
101	500	47	103.58	45%
501	50000	20.00	103.21	30%

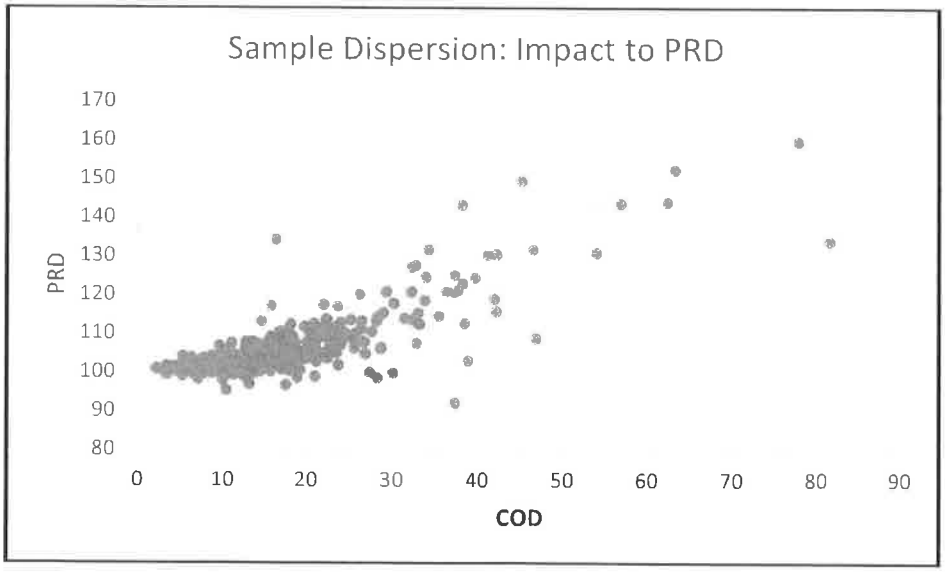
Graphically examining the smaller samples of less than 100 sales, the same trend is observed. As sale prices increase, the PRDs decrease and approach 100%. This trend demonstrates the warnings given in the IAAO standards that the PRD calculation contains an upward bias as the mean calculation is impacted by outlier sales.



The professional literature also suggests that extreme sales prices skew PRDs. To examine this, samples of sales were stratified by average selling price, and examined for the number of extreme transactions, relative to the average selling price. A sale price was considered to be extreme if it was at least half of the average selling price, or greater than twice the average selling price. Extreme selling prices on the low end were capped at $30,000. While extreme selling prices on the upper end reach into the $500,000 to $999,999 range. The number of transactions that met the prescribed parameters were counted and compared to the total number of sales in the sample to arrive at a percentage of the sample that consisted of extreme sale prices. When less than 5% of the sample consisted of extreme sale prices, the PRD was generally near the standard range, but the PRD exceeded 110% when 10% or more of the sample was comprised of extreme sales prices.



Finally, PRDs are impacted by dispersion in the sample. The Coefficient of Dispersion (COD) quantifies the amount of dispersion in a ratio study, when CODs are plotted against PRDs a nearly linear pattern emerges indicating that PRDs increase with dispersion in the sample. Since CODs are also a measure used to analyze assessment quality, this analysis does not contradict that PRDs are necessarily false indicators of vertical inequity, but it does demonstrate that sample dispersion should be examined before placing any reliance on a PRD. Sample dispersion can exist for a number of reasons. Some of the causes of sample dispersion may be reflective of assessment models that do not accurately capture market characteristics, while others are caused by economic influences such as rapidly increasing or decreasing markets or unrepresentative samples.



In conclusion, the PRD is a measure of vertical equity that is highly influenced by several different factors. The PRD was developed to identify whether there was any correlation between assessed value and selling price. The calculation contains an inherent upward bias that can make the result unreliable when samples are small, contain extreme selling prices, or too much dispersion. Although the PRD is a useful calculation for analyzing assessment performance, additional

analysis must be conducted to examine the factors influencing the PRD. For that reason, the Division will continue to evaluate sample PRDs, but will base opinions regarding assessment quality on a correlation of statistical analysis and the verified assessment practices of each county.

References

Gloudemans, Robert J. 2011. The Coefficient of Price-Related Bias: A Measure of Vertical Equity. Fair & Equitable August 2011:3-8.

IAAO. 2013. *Standard on ratio studies*. Chicago: IAAO.

Data Source

Nebraska Department of Revenue, Property Assessment Division, State Sales File, Residential Sales 10/1/2019 To 9/30/2021.