A Note on the Relationships Between Circulation Size and Newspaper Advertising Rates

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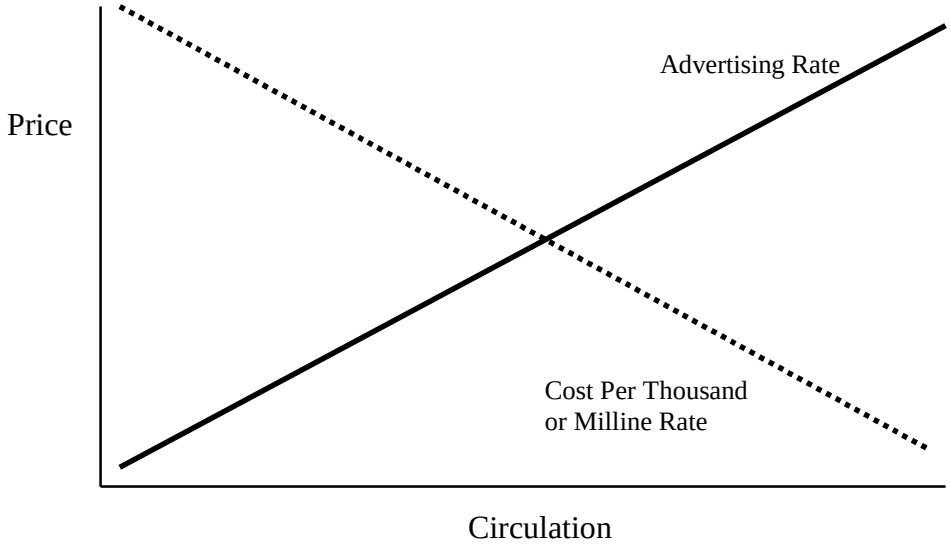
It is generally understood that there is a relationship between size of circulation and advertising rates because advertisers are willing to pay more to reach larger groups of people. Although other factors influence demand, the amount of circulation is generally seen as the primary factor in the pricing of advertising space.

This relationship has been stated as: “The advertiser demand for space...is derived demand stemming from a demand for audience” (Ferguson, 1983, p. 637) and “Both the desirability and cost of advertising space depend on the size...of the newspaper audience, that is, the circulation” (Thorn, 1987, p. 24). Because of this demand, advertising prices rise as circulations rise.

Another relationship linked to price and audience size involves the cost per unit of circulation, which tends to decline as circulation increases. That is, “the relationship with circulation allows a newspaper to increase advertising rates when circulation increases and still maintain an attractive milline [cost per line per circulation] rate” (Lacy & Simon, 199 p. 42).

There is a tendency among scholars and educators to think of this relationship as linear and to assume that the linear relationship applies across all circulation sizes. As a result, the relationship is often illustrated with a graph similar to that shown in Figure 1.

Figure 1
Typical Illustration of Relationships Between
Advertising Price and Newspaper Circulation



That linearity should be used for such an explanation is not surprising, given the emphasis on linearity in simple regression analysis and even multiple regression analysis in major statistics and research texts (Ferguson & Takane, 1989; Kerlinger, 1986; and Mendenhall & Beaver, 1994). Expressing linearity in the illustration of advertising price and newspaper circulation, however, would appear problematic because it is implicitly based on the assumptions that value of and demand for advertising remains constant across all circulation categories and that rates and costs do not differ significantly across newspaper markets.

To explore the extent of these problems and seek clearer understanding of the relationships, a regression analysis to explore the trends in newspaper advertising price and circulation was created. A random sample of 160 daily newspapers (representing approximately 11 percent of daily newspapers in the U.S.) was drawn from *Editor & Publisher Yearbook*, along

with the corresponding data on daily circulation and open line rate.[1] Using that data, the cost per thousand was calculated using the standard formula (Hall, 1988, p. 55). Regression trends were then sought for the price and cost data.

To determine the extent to which linear representation is a problem, three types of regressions and trendlines were utilized in this analysis: Linear (using the equation $y = mx+b$, where m is the slope and b is the intercept), logarithmic (using the equation $y = c\ 1n\ x+b$, where c and b are constants, and $1n$ is the natural logarithm function), and polynomial (using the equation $y = b+c_1x+c_2x^2+...$, where b and c_1, c_2...are constants). The three regression models for trends calculate least squares fits through the points.

The linear model seeks a single straight line explanation assuming that a straight line is best for prediction. The logarithmic model uses logarithmic transformations to bring variances closer together by adjusting for statistical problems with the assumption of a constant rate of change. The logarithmic model is useful if the assumptions of homogeneity in variance, normality, and additivity used in linear regression are not met (Ferguson & Takane, 1989). The polynomial model seeks a curvilinear relationship recognizing that close relations between variables may not be shown by linear or logarithmic regression if increases in the x variables are not consistently accompanied by similar changes in the y variable (Mendenhall & Beaver, 1994).

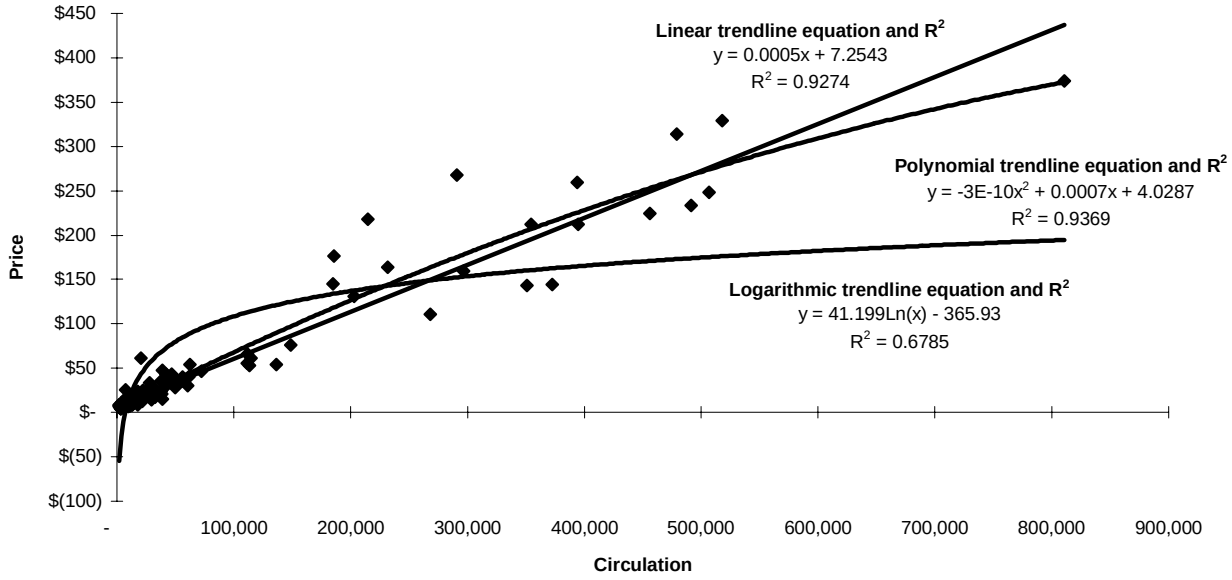
[1] Open rates represent the generally available rate paid by advertisers, which can then be discounted for volume of space and frequency for insertion. Advertising rate sources such as *Editor & Publisher Yearbook* quote the open rate because it is the most comparative rate among papers and thus appropriate for use in this analysis.

Traditional Plotting and Trend Seeking

When the data set is plotted, the advertising rate and circulation plots reveal the general relationship shown in the typical illustration used by educators (Figure 2). This relationship is also borne out with both the linear and polynomial trendlines. The polynomial trendline provides the best explanation, with a R^2 of .9369.

The logarithmic trendline achieves a R^2 of only .6785 and shows a rapid and steep rise followed by a slow but steady rise beginning between 100,000 and 200,000 circulation. It also plots open line rates in negative amounts at the low end of the circulation scale, which would occur only if newspapers paid advertisers, so its use as an explanatory trendline must be discarded.

Figure 2
Open Line Rate and Newspaper Circulation



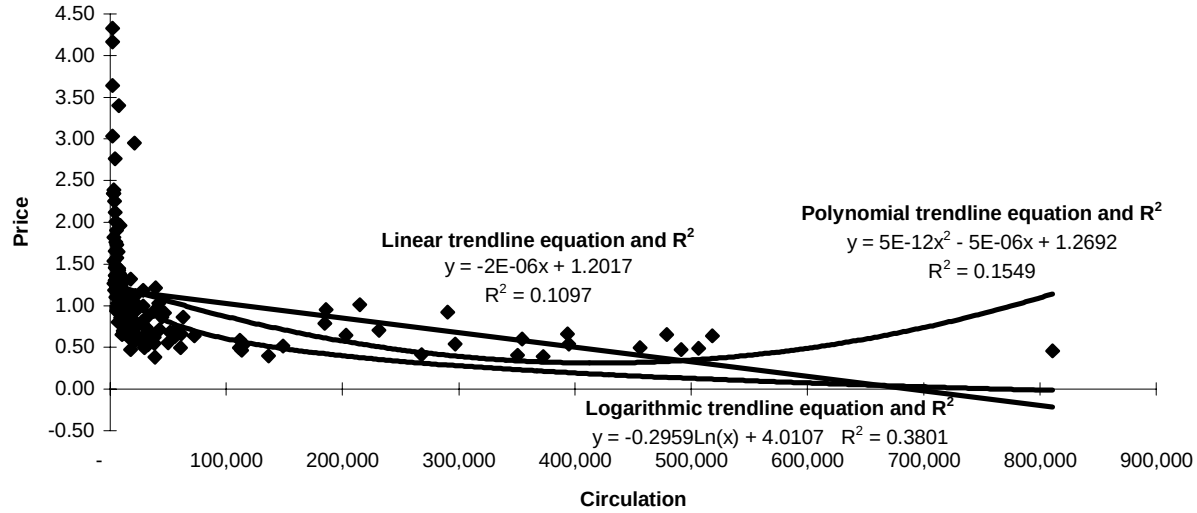
When cost per thousand and newspaper circulation are plotted (Figure 3), the relationship shown is very different than that typically used as an illustration. Prices differ widely at the low

end of the circulation scale but then stabilize downward. None of the three trendlines achieve R^2 results that provide strong forecastablity.

Both the linear and logarithmic trendlines move downward into negative cost per thousand at about 800,000. This move into negative cost per thousand is erroneous and is not found in the newspaper industry. It would occur only if the advertising space were provided free or if the newspaper paid the advertiser for the right to carry the ad. Those trendlines, then, do not provide reasonable forecastability. The polynomial trendline sweeps downward but then moves upward near the half million circulation mark.

Of the three trends, the polynomial regression provides the most realistic explanation of behavior involving cost per thousand and circulation because it stays in the positive cost per thousand range and concurs with anecdotal evidence and intuitive understanding that the largest papers are able to charge higher prices and costs per thousand.

Figure 3
Cost Per Thousand and Newspaper Circulation



Both these traditionally displayed plots and trendlines of advertising rates and cost per thousand present a highly distorted view, however, because the statistical display gives equal

attention to all sizes of newspapers. In Figures 2 and 3, the greatest distance in the *x* axis display (circulation) is given for newspapers between 100,000 and 900,000 circulation.

The newspaper industry in the United States, however, is dominated by papers with far smaller circulations. The mean circulation of a newspaper is about 38,000. One-half of all papers are below 25,000 circulation, two-thirds are below 50,000 circulation, and 93 percent are below 100,000 circulation. Only five percent exceed 500,000 circulation (Picard & Brody, 1997)

Thus, when traditional display is used, more than 90 percent of the papers fall within about 10 percent of the display area, distorting the display of the activity that takes place regarding those papers by pushing them together and minimizing their effects on the displayed curves. To compensate for this problem, an adjustment to the display is necessary.

Adjusted Display

To correct for the data and trendline display problem, one can adjust the circulation display by showing it in logarithmic scale, thus increasing the impact of the larger number of papers at the lower end of the scale.

When the data set is plotted using logarithmic scale, the price and cost data do not reveal readily apparent strong linear relationships but rather somewhat curvilinear relationships (Figures 4 and 5).

Figure 4
Open Inch Rate and Newspaper Circulation

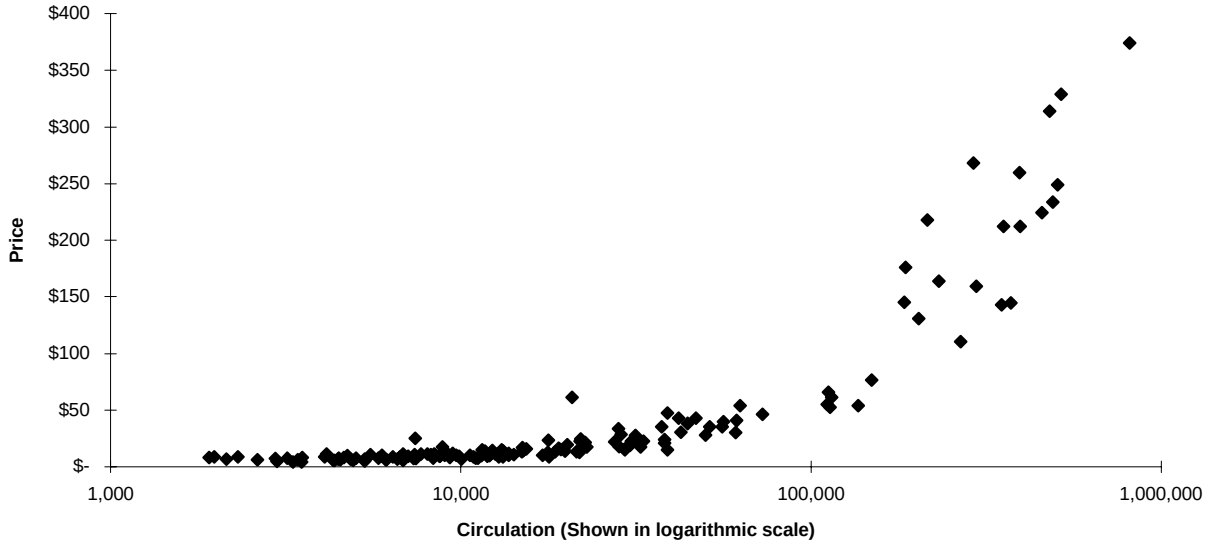
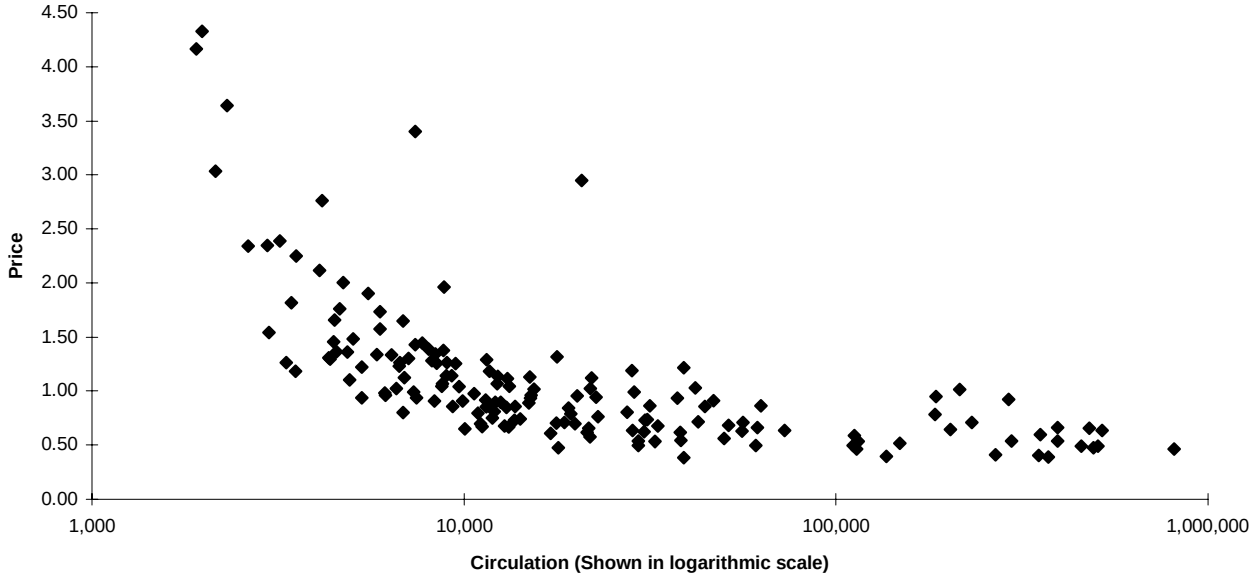


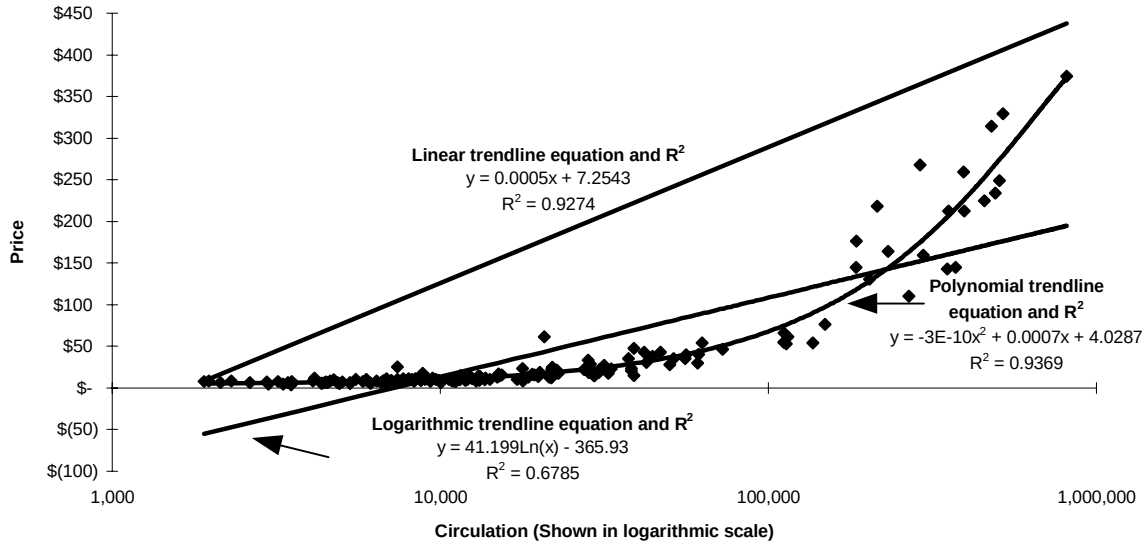
Figure 5
Cost Per Thousand and Newspaper Circulation



When plotted with trendlines produced through the regression analyses, as seen in Figure 6, a linear relationship is shown across the lower and higher circulation points with regard to the open inch rate, but the line does not pass through the data because circulation is displayed in logarithmic scale. The trend is heightened by the linear method because it increases the effect of larger papers and diminishes the impact of the small- and mid-sized papers that account for two-thirds of all dailies.

The logarithmic regression trendline somewhat adjusts for this problem and diminishes the slope of the trend, but it loses forecastability at the lower and upper ends of the trendline because it drops into negative open line rates and drops well below the prices of the larger papers. The line does not contain a curve, as in traditional display, because of the logarithmic scale on the circulation axis.

Figure 6
Trendlines for Open Inch Rate and Newspaper Circulation



The polynomial regression trendline provides a better explanation of the relationship between circulation and advertising price and produces the highest R^2 of the three regression trendlines (.9369). This curvilinear explanation clearly shows that advertising rates hold relatively steady among smaller newspapers, begin rising steadily after 10,000 circulation, and then take a steep rise after 100,000 circulation.

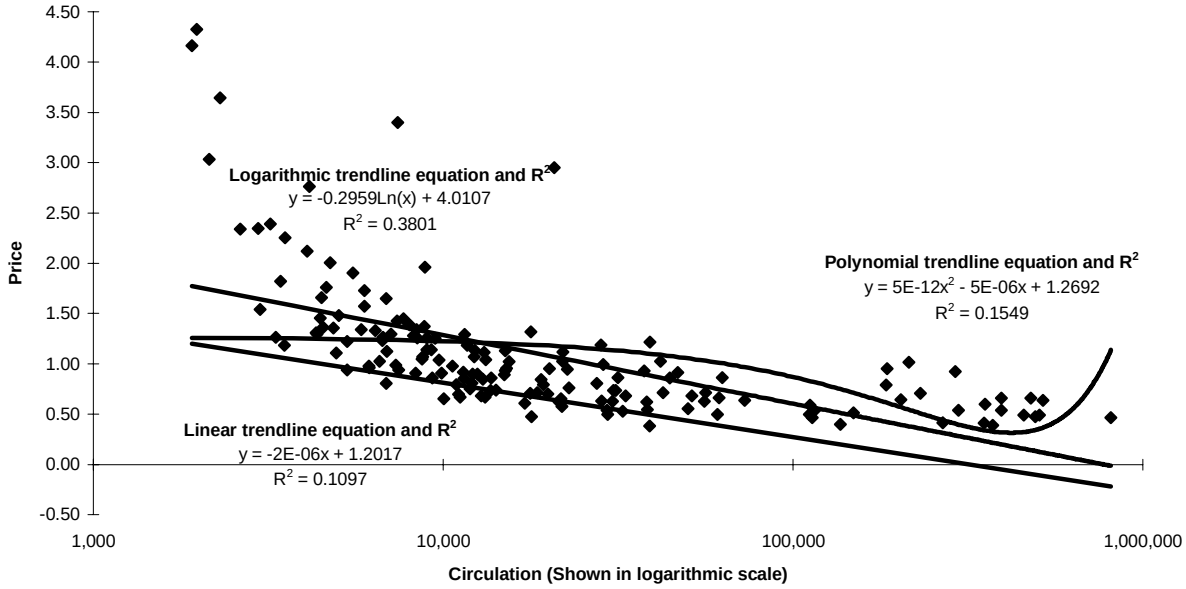
When cost per thousand is considered, both the linear and logarithmic regression trendlines are problematic because they produce trend forecasts that drop to zero and then into negative cost per thousand (Figure 7). As noted earlier, negative cost per thousand would appear only if the ad space were provided free or the newspaper paid the advertiser. The problem with both the linear and logarithmic trendlines occurs because the equations emphasize and de-emphasize higher cost per thousand papers at the lower and higher circulation ends, although the logarithmic regression does so to a lesser degree than the linear regression. The logarithmic trendline does not contain a curve, as in traditional display, because of the logarithmic scale on the circulation axis.

The polynomial regression trendline de-emphasizes higher priced cost per thousand papers at the lower end, but appears to better account for papers of higher circulation. The trend indicates that cost per thousand holds relatively steady among smaller newspapers and then begins dropping in mid-sized papers, reaching its lowest point at about 500,000 circulation and then moving up significantly and rapidly.

Although the curvilinear relationship shown by the polynomial regression may be useful in providing an explanatory overview of what happens to cost in relationship to size, neither it nor the logarithmic and linear regressions provide strong predictability that can be used in

forecasting because the regressions returned relatively low R^2 values (logarithmic R^2 = .3801; polynomial R^2 = .1549; linear R^2 = .1097), although the R^2 for the curvilinear trend is not untypical for a polynomial regression.

Figure 7
Trendlines for Cost Per Thousand and Newspaper Circulation



Conclusions

The regression analyses in this note reveal that the relationships between advertising rates and newspaper circulation are best explained as curvilinear rather than linear relationships and that polynomial regression provides the best forecasting method for price and circulation. Forecasting cost per thousand was found to be more problematic because cost differences occur at several circulation points. Nevertheless a curvilinear explanation of cost is useful for illustration and discussion, although it is far less useful for forecasting.

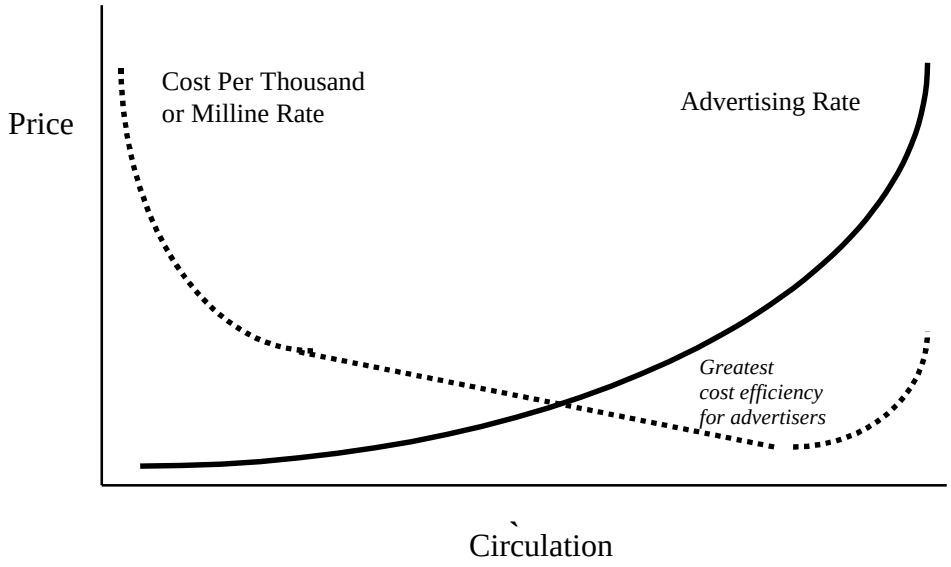
The regressions and their display revealed problems with both linear and logarithmic regression trends, leading to the acceptance of the polynomial trendlines.

In traditional display of the data, for example, the linear trendline dropped into negative cost per thousand at the upper end of circulation and the logarithmic regression trendline shows negative open line rates at the lower end of circulation and negative cost per thousand at the upper end of circulation. Thus, the polynomial trends provide a better explanation in the traditional display.

Problems with linear and logarithmic regression trendlines are continued in the adjusted display, which adjusts for the sizes of newspapers by displaying circulation (the *x* axis) in logarithmic scale. The linear regression trendline for open line rate does not run through the data, drops into negative for very small circulation, and produces a trendline for cost per thousand that drops into the negative range at the upper end of circulation. The logarithmic trendline produced a negative rate at the lower end of circulation and its display of a constant rate of change hides the upward movement of rates at the upper end of circulation. In addition, the logarithmic trendline moved into negative cost per thousand at the upper end of circulation. Thus, the polynomial trendlines once again provide a better explanation of the trends in the data.

Given the findings in this note, the author suggests a substitute illustration of the relationships between advertising prices and newspaper circulation (see Figure 8) for that shown at the beginning of the note that has traditionally been used. The illustration accounts for the curvilinear relationships and clearly reveals that advertisers' ability to achieve the greatest cost efficiency occurs in a relatively small area to the right of the point at which advertising rates and cost per thousand cross and before cost per thousand rises.

Figure 8
Realistic Illustration of Relationships Between Advertising Price and Newspaper Circulation



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