This study offers a new approach to the problem of time-series studies and attempts to set up a model to account for the growth in demand for daily newspapers. Using U.S. data on a state-by-state basis for 1850 to 1970, we have used a marketing approach. What conditions were necessary for the survival of a daily newspaper? What conditions were conducive to consolidation? What conditions were a barrier to the adoption of social and technological innovation? The data were grouped into geographic and social regions for analysis, using a special case of generalized least squares. Independent variables included price as a proportion of per-capita income, percentage of the work force in nonagricultural labor, education, voting, and urbanization. Price proved the most powerful predictor. Corrected R^2s range from .22636 (in regions where newspaper growth took place very early or late in the period) to .67543 in the Midwest and Southwest. The model will be applied to data from the industrialized countries of Western Europe in later work.

DETERMINANTS OF NEWSPAPER CIRCULATION
A Pooled Cross-Sectional Time-Series Study in the United States, 1850-1970

ROBERT L. BISHOP
KATHERINE SHARMA
RICHARD J. BRAZEE
University of Michigan

For several years the first author of this study has been concerned with the historical development of communications, both in the United States and in other industrialized states. Existing models and typologies seem to offer little

---

AUTHORS' NOTE: *We wish to thank Professors Jan Kmenta and E. P. Howrey for their advice on econometrics and Mark Greene, computer counselor for the Department of Economics at the University of Michigan, for assistance with the computer and econometric techniques.*

COMMUNICATION RESEARCH, Vol 7 No 1, January 1980 3-22

more than labels, with practically no predictive or explanatory power.

Further investigation also began to impress us with the importance of the viewpoint of the investigator. Most inquiries into media development have proceeded from a psychological or sociological base. Though some of the same variables are involved in any approach, it seems much more fruitful to adopt an economic viewpoint when trying to explain or predict what is essentially an economic development.

Another shortcoming of most work in the area is its neglect of changes over time. Many studies have investigated the relationship between mass media consumption and factors such as urbanization, education, industrialization, and voting, but almost all have compared various nations at the same point in time. Therefore, we decided to study these factors, plus newspaper prices as a proportion of per-capita income, over an extended period of time. Availability of data dictated that we limit our study to the United States between 1850 and 1970.

The study has succeeded in generating a model which we hope to test in international studies. It has also demonstrated the overwhelming importance of economic variables.

DESIGN

We chose the period 1850-1970 for two reasons. First, observations before 1850 are incomplete—which is not to say that there are no data problems after that date. Second, the last half of the 19th century saw technological advances which increased the supply of newspapers. These technological advances included geometrically expanding press capacity, cheap newsprint, and the linotype. The first made it possible for a single firm to reach far more customers, since many more copies of a paper could be printed in a single day. The last two made it possible to offer more pages of printed material for the same or lower cost, greatly accelerating the growth of economies of scale.

The increasing use of advertising as a marketing tool and as a major source of newspaper revenue also contributed to changes in the economic realities facing publishers (Emery, 1962; Mott, 1962). We have not included advertising among our variables for several reasons. First, no reliable advertising figures were available until very late in the study period. Second, we are considering only the demand side of the equation, while advertising may be argued to contribute mainly to the supply. We are assuming that, at least within this period, supply was equal to or greater than demand.

If anything, advertising has been negatively associated with newspaper circulation per capita or per household. Circulation on a household basis has been declining in industrial states since about 1909, and in the country as a whole since about 1950. Advertising, on the other hand, has shown almost geometric increases in volume. Probably advertising has been more strongly associated with newspaper concentration than with increases in circulation. Taken together, these factors greatly increased potential profits, bringing hundreds of new firms into the market. But the same factors made possible the economies of scale which led to consolidation into larger, more efficient firms.

Our basic source of information is the decennial census; therefore our observations are taken at 10-year intervals. This wide interval dampens and even hides many fluctuations in all our variables, but better sources of information do not exist for the early period. We recognize that most of our indices are far from satisfactory. Nonagricultural employment, for example, is the lowest common denominator of the possible indices for industrial development. Urbanization probably should be defined differently during various periods, depending upon the market necessary to support various levels of capital investment, presses of varying capacity, distribution facilities, and so forth. But these indices have the advantage of being available in many countries and over extended periods.

In measuring circulation, we first converted aggregate circulation figures for English language dailies to a per-household basis, since the household is the natural unit of circulation in most of the United States. But, after determining that this would be impossible in other nations, we switched to a per-capita basis. The correlation between the two measures in the United States is high, and the change did not significantly alter our regression results. We excluded Sunday papers, but counted morning and evening editions by the same newspaper firm as separate newspapers.

Circulation figures for 1850-1880 are from the decennial Census of Population, supplemented where necessary by *Editor & Publisher* reports. Data for 1890-1940 are from the Census of Manufacturers and for 1950-1970 are from *Editor & Publisher.* Since these figures were not audited until relatively late in the period, we must acknowledge probable overstatements, but will limit ourselves to reported figures. Owen (1975) has concluded, on the basis of a comparison with Ayer, that the census included firms with very low circulation, but these would have little effect on our study.

We used observations from each of the 48 contiguous states for each time period for which data were complete. We then grouped the states into regions. (Each state is considered an "observation" from its particular region. This yields an amount of data that an aggregate regional approach or a state-by-state approach could not.) This was necessary due to the small number of observations per state and the amount of missing data.

We began with regions set up by the Bureau of the Census. However, the small number of states in some regions (three in one region, four in two, and five in another), plus some anomalies in placing dissimilar states together, led us to devise our own groupings. We have maintained contiguous geographical groupings but have attempted to group states which share a common political and economic history. The most notable failure is our combination of the Pacific coast states with their neighbors to the east, but no other contiguous groupings made sense.

We could also justify the use of regions on the basis of differences from region to region. We used binary variables to form regional intercepts and regional slopes from an equation that was determined from all observations. In all regions the F tests of the dummy variable and slope were significant at $p < .05$.

FACTORS INFLUENCING NEWSPAPER CIRCULATION

Possibly the most important factor affecting newspaper circulation is price. This is particularly true when price is a relatively high proportion of per-capita income. Price as a percentage of income fell from 1850 to 1910 and has remained relatively stable since. We used national rather than state percentages, since per-capita income is not available by state prior to 1930, except for 1860 and 1900 (Emery, 1962; Mott, 1962).

We devised a weighting scheme for our measure of urbanization. Using the decennial census, each state was assigned a weight of 1.[1] Each city within a given state was assigned a weight of 1 if its population was between 20,000 and 49,999; 1.5 if between 50,000 and 99,999; 2 if between 100,000 and 499,999; 3 if between 500,000 and 999,999; 4 if between 1 and 5 million; and 5 if greater than 5 million. The final urbanization value was the sum of these weights.

The percentage of nonagricultural workers in the labor force was computed from the decennial census by subtracting the number of agricultural workers from the total number employed and dividing by the total number employed.[2]

We measured political participation as the ratio of voters in the decennial presidential elections to the total population of the state. When elections fell on both sides, as in 1892 and 1888, we averaged the number of voters. These data are taken from the *Historical Statistics of the U.S.* They, too, present problems. No vote was cast by some southern states in 1868, and it has not been possible to correct for vote fraud.

The advantage of using voting as a proportion of state population is that such a measure will reflect the fact that over time, blacks, women, and young people have gained the right to vote. Considering only those eligible to vote would remove this trend and introduce immense uncertainties because there are no accurate figures on the number of eligible voters.

Another important explanatory factor of newspaper circulation is the educational level of potential readers. Probably the best measure would be the median number of school years completed by persons over 21. Since this is unavailable for much of the period, we have used the percentage of school-age children enrolled in public primary and secondary schools, lagged by 10 years.[3] Lagging the variable by 10 years implies that the percentage of children enrolled in 1850 is influential in 1860 circulation.

Per-capita income by state for each region would also be a desirable explanatory variable. Unfortunately, income measures by states are missing for the years before 1920.

MODEL SPECIFICATION

We began our investigations with a comparison of a linear model with multiplicative or log-linear model. The linear model was specified as:

$$Y_{it} = K_{it} + B_1X_{1it} + B_2X_{2it} + B_3X_{3it} + B_4X_{4it} + B_5X_{5it} + U_{it},$$

Y_{it} = circulation per capita

K_{it} = constant
X_{1it} = newspaper price as proportion of national per-capita income
X_{2it} = percent of total labor force in nonagricultural occupations
X_{3it} = percent of school-age children in public schools, lagged 10 years
X_{4it} = percent of voters in population based upon decennial presidential elections
X_{5it} = cities weighted by size
u_{it} = stochastic disturbance term satisfying all classical assumptions,

where the i subscript refers to the state which the observation is drawn from and the t subscript refers to the time period from which the observation is drawn. The multiplicative model was specified as:

$$Y_{it} = K_{it}B_1X_{1it}B_2X_{2it}B_3X_{3it}B_4X_{4it}B_5X_{5it}u_{it},$$

which we made log-linear by taking logarithms;

$$\log Y_{it} = \log K_{it} + B_1 \log X_{1it} + B_2 \log X_{2it} + B_3 \log X_{3it}$$
$$+ B_4 \log X_{4it} + B_5 X_{5it} + \log U_{it},$$

where all coefficients and variables are defined as above.

Regressions using the logged values had higher R^2 and corrected R^2 values,[4] and the signs of the regression coefficients estimated were more consistent and more often in the direction that would be theoretically correct. Examination of dependent-variable values plotted against independent variables support the use of logged data. Therefore, we used the log-linear model for the remainder of our model generation.

We estimated regression coefficients using ordinary least-squares technique for all U.S. regions. The following is a listing of the regions and states within each region:

(1) New England and Mid-Atlantic: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania

(2) Northeast and Central: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri
(3) Midwest and Southwest: North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas
(4) South Atlantic: Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida
(5) Mid-South: Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana
(6) West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California.

However, due to violations of the classical assumptions, the estimates of the regression coefficients are not efficient or asymptotically efficient but only unbiased and consistent. This would make our significance tests invalid because the size of the variance of the stochastic error term would be incorrectly estimated. In this particular case the size of the variance would be underestimated, thus making the confidence interval too small. It also increases the value of R^2 without justification.[5]

To correct for this we assumed a first-order autoregressive scheme of disturbances: $U_{it} = p\,(U_{it-1}) + V_{it}$, where p is greater than 0 and less than 1, u_{it-1} is the disturbance for the same state in the previous period and V_{it} is a disturbance term that meets all of the classical assumptions. To estimate p, we used the residuals from ordinary least-squares regression to form:

$$\hat{P}_r = \frac{\sum_{L=1}^{I} \sum_{t=2}^{13} U_{1t} U_{1t-1}}{\sum_{L=1}^{I} \sum_{t=2}^{13} U_{1t-1}}$$

where U_{it} is the residual for state i in time t and i runs from 1 up to the number of states in each region and hence P_r is computed separately for each region. Using this value of p we used the Cochrane-Orcutt transformation to form the next equation:

$$Y_{it} - \hat{p}Y_{it-1} = K_r(1 - \hat{p}) + B_1(X_{1it} - \hat{p}X_{1it-1}) + B_2(X_{2it} - \hat{p}X_{2it-1})$$
$$+ B_3(X_{3it} - \hat{p}X_{3it-1}) + B_4(X_{4it} - \hat{p}X_{4it-1})$$
$$+ B_5(X_{5it} - \hat{p}X_{5it-1}) + U_{it} - \hat{p}U_{it-1},$$

where all X and Y values are logged, K_r is the constant term estimated for the region over all time-periods, and $\hat{p}$ equals $\hat{P}_r$ for each separate region.

We performed ordinary least-squares regression on the transformed equations and used the residuals to form a second-round estimate of $\hat{p}$. We used this value of $\hat{p}$ to replace the first-round estimate and performed ordinary least-squares regression upon the new equation. This iterative procedure was used until the value of p converged. The stochastic disturbance term is now nonautoregressive. If no other classical assumptions concerning the stochastic disturbance term are violated, then our estimators have all desirable properties[6] and our significance tests are valid.

However, there was reason to suspect that another classical assumption concerning the disturbance term was violated. It is quite plausible to believe that there is heteroscedasticity[7] of the disturbance term. If the disturbance term is heteroscedastic, then, despite our corrections for autoregression, our estimates would still only be consistent and unbiased, but not efficient or asymptotically efficient and our significance tests would not be valid.

When heteroscedasticity is suspected, one often makes assumptions about how the size of the variance changes. We examined the scatter plots of the uncorrected residuals versus circulation and all of the explanatory variables and concluded that the size of the variance of the disturbance term varied directly with the size of the predicted circulation.[8] To correct for this we divided through all of the variables in the equation by the predicted values for circulation. Thus our transformed equation became:

$$\frac{Y_{it} - pY_{it-1}}{\hat{Y}_{it} - \hat{p}\hat{Y}_{i(t-1)}} = \frac{K_r\,(1 - \hat{p})}{\hat{Y}_{it} - \hat{p}\hat{Y}_{I(t-1)}} + B_1 \frac{[X_{1it} - \hat{p}X_{1i(t-1)}]}{[\hat{Y}_{it} - \hat{p}\hat{Y}_{i(t-1)}]}$$

$$+ B_2 \frac{[X_{2it} - \hat{p}X_{2i(t-1)}]}{[\hat{Y}_{1it} - \hat{p}\hat{Y}_{i(t-1)}]} + B_3 \frac{[X_{3it} - \hat{p}X_{3i(t-1)}]}{[\hat{Y}_{it} - \hat{p}\hat{Y}_{i(t-1)}]}$$

$$+ B_4 \frac{[X_{4it} - \hat{p}X_{4i(t-1)}]}{[\hat{Y}_{it} - \hat{p}\hat{Y}_{i(t-1)}]} + B_5 \frac{[X_{5it} - \hat{p}X_{5i(t-1)}}{\hat{Y}_{it} - \hat{p}\hat{Y}_{i(t-1)}}$$

$$+ \frac{U_{it} - \hat{p}U_{it-1}}{\hat{Y}_{it} - \hat{p}\hat{Y}_{it-1}}$$

where x, y, and $\hat{p}$ values are defined as above and $\hat{Y}_{it}$ is the predicted value.

Unfortunately, it is difficult to compare the results from the model transformed for autoregression to one transformed for autoregression and heteroscedasticity in this manner. It is difficult because the significance tests and R^2 measures are not valid when heteroscedasticity is corrected for in this manner.[9] We can, however, examine the coefficients of our explanatory variables to see if they exhibit the sign that theory would expect each to exhibit. When this criterion is applied to the model corrected for autoregression, there was only one sign in one region that was not what we would expect it to be—and its value was insignificant.

In the model that was transformed for autoregression and heteroscedasticity, one sign in three regions and two signs in one were not the direction that we would expect. It is impossible to determine whether the coefficients are significant because of the invalidity of significance tests. It was therefore quite difficult to choose between models.

We chose the model that was transformed only for autoregression because of the validity of test statistics, the more consistent coefficients, and the fact that the scatter plots might have been exhibiting the growth of the disturbances over time due autoregression rather than heteroscedasticity due to changes in circulation size.[10]

The remaining statistical problem of the population is the possibility that the disturbance term in one state may be correlated with the disturbance term in another state in a given time period. Two plausible assumptions are that the disturbance terms of states in one region are correlated (Pennsylvania's error term in 1950 would be correlated with New York's error term in 1950, indirectly correlated with New York's error term in 1940 due to autoregression, but not correlated with Idaho's error term in any year), or that contiguous states' disturbance terms are correlated. (Pennsylvania's error term in 1950 is correlated with New York's error term in 1950, indirectly correlated with New York's error term in 1940 due to autoregression, but not correlated with Massachusetts's error term in any year.) Although it is theoretically possible to estimate by the use of maximum likelihood estimators of generalized least squares a model that is autoregressive in disturbances, that are correlated by region or geography (and even heteroscedastic according to the predicted circulation), we found it not to be worth the difficulty. Therefore, we did not correct for correlation between the disturbances of different states. However, there is no reason to believe that this correlation is very high or that it significantly affected our results. Thus we returned to the model that was corrected only for autoregression.

The remaining problem is the high degree of multicollinearity between the explanatory variables in the sample. We determined that a high degree of multicollinearity exists on the basis of R^2 deletes.[11] The presence of a high degree of multicollinearity makes our standard errors larger than they would be if there was less multicollinearity. This makes our significance tests less sharp but the tests remain valid. We cannot correct for a high degree of multicollinearity, as it is a property of the sample and not of the population. The results for the model corrected only for autoregression are shown in Table 1.[12]

RESULTS

R^2, an estimate of the amount of variation due to the values being measured, is fairly high for cross-sectional data. We feel that lumping the various states together in regions created this cross-sectional bias, reducing the R^2 values. The expected downward bias is discussed in Note 5.

These values are lowest for New England and the Mid-Atlantic states, which were already well on the road to industrialization and such during the earliest years. Next lowest was the West, which remained sparsely populated and relatively undeveloped until late in the study period. The South Atlantic states also remained basically agricultural for many years.

Nonagricultural labor reaches a .05 significance level effect in two of the six regions and is just below the .05 level in a third. In the South, this could be due to the fact that nonagricultural employment fell from 45% to 29% during the Reconstruction era. Circulation also fell between 1870 and 1880, but only from 2 copies per 100 persons to 1.64 copies.

Education, lagged 10 years, is significant for four of the six regions.

The average regressional coefficient for voting is .22 and it reaches significance only for two regions.

Regression coefficients for urbanization differ greatly, from 0 to .65. They tend to be low for areas which were highly urbanized early in our history, such as New England, and for areas which remained low in urbanization until late in the study period.

Price is the most consistent explanatory variable, though this may be due in part to the limitations of data, which forced us to use a national average.

TABLE 1
Results (Logged) Corrected for Autoregression

	New England & Mid-Atlantic	North East & Central	Midwest & Southwest	South Atlantic	Mid-South	West
Nonagricultural Labor						
Coefficient	.80626	.20301	1.11780	.03884	.21245	.66827
Standard error	.42309	.39171	.27306	.22875	.19078	.41517
t statistic	1.90566*	.51826	4.09386*	.16980	1.11355	1.60962
Education-logged						
Coefficient	.81132	.02058	- .18385	.30343	.36657	.38091
Standard error	.31966	.11597	.21855	.08056	.19004	.13751
t statistic	2.5308*	.17746	- .84121	3.76637*	1.9288*	2.76999*
Voting						
Coefficient	.22689	.00412	.21426	.34967	.21680	.22752
Standard error	.12823	.18374	.18550	.19351	.17923	.19701
t statistic	1.76941*	.02243	1.15499	1.80701*	1.20961	1.15486
Urbanization						
Coefficient	.08106	.65338	.05425	.03766	.46737	.03637
Standard error	.15760	.11644	.08532	.14352	.24840	.08578
t statistic	.51431	5.61146*	.63587	.26239	1.88150*	.42400
Price						
Coefficient	- .34506	- .20329	-0.52929	- .60569	- .46317	.36050
Standard error	3.85245	.09560	0.10449	.13508	.12641	.10969
t statistic	-3.43145*	-2.13989*	-5.06557*	-4.48536*	-3.6608*	-3.8662*
Constant						
Coefficient	- .34506	-2.83977*	.19850	**.16954**	-1.28515	- .26144
Standard error	3.85245	.59264*	.42392	.68417	.96788	.45287
t statistic	- .08957	-4.79170*	.46823	.24780	-1.32780	- .63306
R^2	.26355	.57255	.64361	.37101	.6869	.3231
$\overline{R}^2$	.22636	.54853	.67543	.33266	.66243	.28591
D.W	1.83	1.90	2.13	2.21	2.14	2.16
Rho	.9995	.8862	.7565	.8472	.4903	.7815
NOB	105	95	57	88	70	97
f statistic	7.086	23.842	21.227	9.674	28.081	8.687

*p .05, one-tailed test (X70, except for price and constant). R^2 = corrected $R^2 = R^2 - (K - 1/n - K)(1 - R^2)$. D.W. = Durbin-Watson statistic. Rho = p. NOB = number of observations that do not have missing data.

All the coefficients are affected by the time period chosen. Variables which reach a plateau early in the study will not show much effect since they are not changing at the same rate as the independent variable. One could argue, however, that the level of the variable is quite as important. The results are due, in large part, to the statistical methods involved.

Much of our problem in dealing with media development stems from the use of a sociological or psychological rather than an economic viewpoint. If we started with the question "What are the necessary market conditions for the success of media organizations?" the answer would be much more apparent. The motive for media development may be political, religious, cultural, or economic. But each new venture must overcome the same set of barriers.

Barriers may be either economic or political. Economic barriers include the lack of markets, capital, skilled labor, and technology. Political barriers may be economic as well, such as restrictions on foreign exchange or the blockade and reconstruction of the South, or they may take the form of censorship, licensing, or direct and indirect ownership of the media.

If we adopt the entrepreneur's point of view (and entrepreneur may be stretched to include the state, a political party, businesses, or religious groups), we see that there are critical points in economic development which are closely linked to various types and scales of media development.

First, there must be an adequate market for the product. This implies literacy in the case of the print media and a certain degree of affluence for any medium. It implies that the market must be accessible—that enough people live in or near a given city to make distribution of either print or broadcast feasible.

On the question of literacy, one might contrast Mississippi and Massachusetts. In 1940, the median years of school completed for native white citizens of Mississippi above the age of 25 was 8.9 years. For Massachusetts, it was 10.7. But for blacks, the figures were 4.7 and 8.0, and blacks make up more than half of the Mississippi population. Therefore, it is safe to say that half of the potential newspaper audience in Mississippi was lost because of inadequate schooling.

As to affluence, not only was the South less well off, but what wealth she had was badly distributed. If one considers only totals—comparing whites and non-whites would accent the differences—41.5% of Southerners reported family incomes of less than $1,499 in 1949. This compares to 25.8% in the Northeast, 27.8% in the North Central, and 27.4% in the West. Median Southern income was $1,940

($995 for non-white), compared to $2,599 for the United States.

Market accessibility is another area of great contrast. In the southern region from coast to coast, there were only three cities of more than 100,000 population in 1890—San Francisco, 298,997; New Orleans, 242,039; and Louisville, 161,129. New England and the Mid-Atlantic states had 10, headed by New York with 2.5 million and Philadelphia with just over 1 million. Chicago was past the million mark, Baltimore and St. Louis were more than 400,000, and Cincinnati, Cleveland, Detroit, Indianapolis, Milwaukee, Washington, D.C., Denver, Kansas City, Missouri, Minneapolis, St. Paul, and Omaha were between 100,000 and 300,000.

New England and the Mid-Atlantic states had more than 100 people per square mile in 1890, whereas the mountain and Pacific states had about 2 persons and Mississippi had 27.8 persons per square mile. The problem would be further compounded by the fact that the average household contained 9.76 persons in the South in 1850, while new England averaged 5.35.

The entrepreneur who might have thought of starting a paper in Mississippi in 1850, therefore, would have faced some sobering statistics. The state reported a population of 606,000, but this represented only about 62,144 families. Half of these could not be considered potential subscribers because of income or education. Possibly another quarter would be inaccessible because of slow distribution, leaving a potential of around 15,500 families in the entire state.

A second economic barrier is a supply of capital. Certainly scarce Southern capital was unlikely to be attracted to newspapers. Another important barrier was the constant rise in capital requirements. A colonial printer could get started for a few hundred dollars, and the Scripps family began the Detroit *Evening News* with a capitalization of $50,000 as late as 1873. But capital requirements did interact with the growth of technology.

When presses could turn out no more than 20,000 copies a day, capital requirements were comparatively low. With an accelerating demand because of literacy, urbanization, and affluence coupled with falling prices of newsprint and such, swarms of new publishers were attracted. Owen (1975) indicates that there were 254 daily newspaper firms in 1850, but 2,600 in 1909. This is what would be expected in the classic economic cycle: above-average profit opportunities and low entry costs combine to attract more entrepreneurs than the market will accommodate. After 1909, the trend has been steadily downward.

The limits to press capacity in 1850 meant that the 14 papers which shared the New York City market could co-exist comfortably. If no one publisher could go beyond around 20,000 papers, the 154,000 subscribers could easily absorb all the product. By 1909, the number of papers rose to 85, with an average circulation of 52,000. But with the introduction of presses which could print more than one million copies per day, average circulation rose to 116,000 in 1929, with only 55 firms.

Market isolation is also important. As large regional papers developed, suburban papers lost their relative isolation and were forced into a single firm. Regional papers are restrained by rising costs of distribution and by relatively low penetration rates in outlying communities. They may drain off enough subscribers and advertising to force local consolidation, but cannot sell enough in most communities to warrant extensive editorial coverage of that community or to capture advertising directed only to the one area. Therefore, one tends to find small, independent papers in situations where the potential audience is small and isolated, either by geography or language. As the market becomes larger and more homogeneous, publishers and broadcasters tend to thrive in proportion to their ability to take advantage of economies of scale.

CONCLUSIONS

First, the proposed model results in a generally good fit when studying diverse regions of the United States with distinct patterns of development. It should, however, be linked with the idea of prerequisite levels of the market.

Second, newspapers are still essentially local affairs. They should be studied in as small units as possible. Actual local price indices and such should be used when available. Many national level studies wash out meaningful relations because of averaging out London and Wales or Milan and Naples.

Third, the decline in newspaper circulation on a per-household basis began in some states as early as 1910, and cannot therefore have been due to competition from radio or television. In states with much lower circulation rates, the decline did not occur until after 1950. These data do not contain more than a few suggestions as to the cause.

But one might well conclude that the very high levels attained by states like New York (3.21 daily papers per household in 1910) were artificial, stimulated by competition between an oversupply of firms, and that the market was sure to return to something like a normal state as publishers withdrew from competition.

In states such as Iowa, which reached a peak of 1.19 copies per household in 1950, competition may have been more restrained because of the lack of dominating urban centers. Since there were fewer potential mass markets, there may have been less introduction of equipment suited to huge circulations. Lower capital requirements would thus have allowed more small, independent papers than would have been the case in New York.

NOTES

1. If states are not assigned some value independent of city weights, then states that have no city of 20,000 or more have a value of 0. The log of 0 is minus infinity, and hence we lose the observation of that state in that period.

2. There are a few discrepancies. The 1850 figures include only free white males. Since most black slaves were used in agriculture, this is a serious defect. The 1860 census considered free white males and females in the work force. The 1870 census left out fishing, but this small figure would have no real effect. After 1870, all persons in the work force were included. From 1850 through 1930, only those 10 years of age or older were counted. For 1940 through 1960, the age limit was 14, and for 1960, 16. The 1940 figures exclude those doing "public emergency work," a large number in wartime.

3. The number of children between 5 and 17 was calculated from the Census of Population. The years 1850 and 1860, however, report the free population from 5-20. In some states, particularly in the South, more children attended private schools than public schools between 1850 and 1890.

4. R^2 is a measure of the proportion of variation between actual values of circulation and circulation mean that is explained by predicted values of circulation. $\bar{R}^2$ or corrected R^2 imposes a penalty for the inclusion of an additional explanatory variable. It is calculated as:

$$R^2 = R^2 - (K - 1/n - K)\,(1 - R^2),$$

where n is the number of observation, k is the number of regression coefficients, and R^2 is calculated as above. Our autoregressive disturbance scheme assumes that the disturbance in period t is a function of the disturbance in some t - 1 of an independent disturbance term.

5. The assumptions behind a classical regression model are:

(1) U_{it} is normally distributed

(2) $E(U_{it}) = 0$

(3) $E(U_{it}U_{is}) = 0 \ (t \neq s) \qquad E(U_{it}U_{jt}) = 0, \ (i \neq j)$

(4) $E(U_{it}) = G^2$

(5) number of observations is greater than number of regressors

(6) no exact linear relationship exists between any of the explanatory variables

(7) X_{ij1} is nonstochastic and $\sum_{l=1}^{n} \sum_{j=1}^{t} (X_{ije} - \bar{X}_e) < \infty. \qquad l = 1, 2 \ldots K.$

An estimator is efficient if it has the smallest variance of all estimators. An estimator is asymptotically efficient if it has the smallest variance of all estimators as the number of observations approaches infinity. An estimator is unbiased if its expected value is equal to the true value. An estimator is consistent if the limit of the bias squared and variance squared is equal to 0 as the number of observations approaches 0. It can be demonstrated for a variable that is positive and increasing, or negative and decreasing, that the intervals for significance tests are too small. All significance tests used in this article are one-tailed $p < .05$ in the direction that we would theoretically expect.

6. Desirable properties are unbiasedness, efficiency, best-linear unbiased estimator, asymptotically unbiased, consistent, and asymptotically efficient.

7. Heteroscedasticity of the disturbance term is present when the size of the variance of the disturbance is not constant.

8. Predicted circulation is the value for circulation that we predict using our regression coefficients and explanatory variables.

9. All regression statistics are invalid because of the lack of a constant in the equation. Without a constant the regression plane must pass through all the means of the variables and the origin, which implies that it is predetermined and thus not determined by the variation in the values of explanatory variables.

10. With values of p that are close to one, the size of the disturbance term grows quite rapidly as we travel in time. For example, after the Cochrane-Orcutt transformation to correct for autoregression, the disturbance term in period five for a given state is:

$$U_{i5} = V_{i5} + PV_{i4} + p2V_{i3} + p^{3}V_{i2} + p4V_{i1}.$$

If $V_{it} = V_{is}$ (s does not equal t) and P is close to one, then disturbances in later periods are larger than disturbances in earlier periods. It is difficult to determine whether the disturbances are growing over time due to this phenomenon or due to an increase in circulation.

11. R^2 deletes are the uncorrected R^2 for regressions that omit one of the explanatory variables. An explanatory variable is highly correlated with another explanatory variable in the sample if the R^2 delete for that explanatory variable is only slightly smaller than the R^2 for the regression that includes all explanatory variables.

12. It was impossible for us to use the same program to run a regression for observations in the United States, as we did for regions of the United States because the program could not accommodate over 300 observations. A search procedure for p indicated the most appropriate value to be .65. We present the results here:

Constant	
Coefficient	– .25212
Standard error	.07287
t statistic	3.4599*
Nonagricultural labor	
Coefficient	.48857
Standard error	.09653
t statistic	5.0615*
Education—logged	
Coefficient	.25847
Standard error	.05124
t statistic	5.0362*

Voting	
Coefficient	.29717
Standard error	.06732
t statistic	4.1470*
Urbanization	
Coefficient	.081327
Standard error	.042173
t statistic	1.9284*
Price	
Coefficient	– .13168
Standard error	.06554
t statistic	2.1647*
$\hat{f}$ statistic	27.03
Durbin Watson	2.08
# observation	454
Rho	.65
R^2	.23
$\bar{R}^2$	.23

These results are consistent with other results in that the more observations that were used, the larger the individual t statistics and the greater percentage of coefficients were significant (*$p < .05$, one-tailed; ×70, except for price and constant).

REFERENCES

EMERY, E. (1962) The Press and America. Englewood Cliffs, NJ: Prentice-Hall.

MOTT, F. L. (1962) American Journalism. New York: Macmillan.

OWEN, B. (1975) Economics and Freedom of Expression. Cambridge, MA: Ballinger.

Robert L. Bishop is Associate Professor of Communication at the University of Michigan with special interests in the economics of the mass media and in comparative media systems.

Katherine Sharma, a graduate student in journalism at the University of Michigan when this study was carried out, is now an editorial writer for the Detroit News.

Richard Brazee, then a graduate student in econometrics, is now studying at the University of Sydney, Australia, on an exchange fellowship.