economical (see Figure 5). The cross arms used direct registration of the contact wire, thereby omitting the short registration arms customary on lines catering to higher speeds.

PROSPECTS

Because of the expectation of increased activity in railroad electrification, it is the turn of the manufacturers and the contractors to economize their supply and installation costs. Because the current range of catenary fittings manufactured in the United States has remained basically unchanged for the past 50 years, considerable opportunity exists to develop new designs by using new techniques and new materials. Similarly, the demonstration of custom-built rail-mounted equipment for track renewal is the springboard for catenary installers to develop sophisticated construction equipment for operation either on-track or off-track. Reduced pole counts, light poles, small foundations, improved component designs, and specialized equipment will not only lower construction cost, but they will reduce the total work content, thereby freeing the track for traffic more quickly. As a result, earlier completion of projects will be possible, and the prime benefits of electrification--faster trains and more economical operation--will be available to the operators at an earlier date and at a lower cost.

REFERENCE

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Discretionary Spending of Class II Railroads

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ABSTRACT

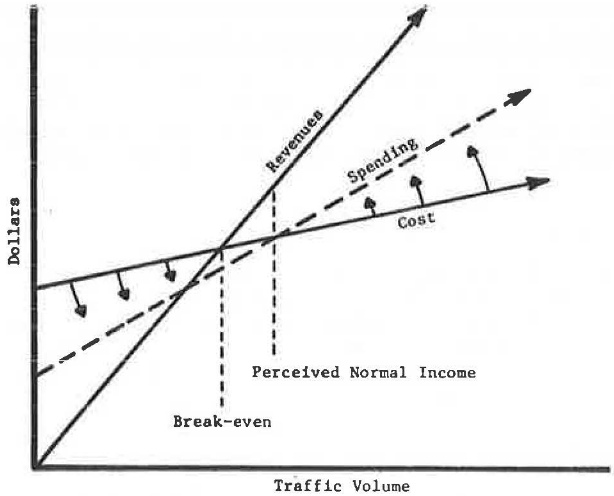
In this paper a statistical analysis of differences in expense levels of 30 Class II railroads for the period 1968 to 1977 is described. After controlling for the physical activity level with a regression model, the spending variations associated with revenue level were attributed to management strategy. A pattern of spending between years and between railroads is revealed in this study that supports the hypothesis that managers attempt to smooth income and cash flow.

Railroad cost functions have been analyzed quite successfully over the years. Costs of operation are viewed as functional to specifics of the plant, equipment, and traffic of a railroad. In this study the differences in spending attributable not to engineering or operating efficiency but to economic strategy of management are reviewed. The increasingly competitive environment of the 1980s places a premium on measuring hypotheses about how managers behave. Better understanding of how railroad operators use their discretion may help in anticipating their reactions to future changes in regulation, competition, or market opportunities. Theoretically, expenses are described as functional to volume (variable) or not functional to volume (fixed); in reality the level and timing of an expenditure is part of an economic strategy.

STUDY HYPOTHESIS

Although certain costs are economically unrelated to volume, cash expenditures are subject to management discretion. During lean years managers are more adamant about the need to cut spending, whereas they are more liberal in spending when funds are available for investments as well as profits. Likewise, managers with comparatively high revenue traffic will invest more in improvements and maintenance, whereas managers on tight budgets will curtail spending wherever they believe they can afford to. As shown in Figure 1, spending tends to be greater than economic cost when revenues are sufficient and less than cost when revenues are not sufficient for the normal level of income.

The discretionary spending behavior of railroad managers has two dimensions. As the business cycle progresses, firms adjust their spending to keep periodic income and cash flow near the level perceived as normal. This kind of spending variation is commonly referred to as income smoothing, and basically means spending extra revenues and economizing during revenue shortfalls. The other dimension of discretionary spending represents differences in spending between firms according to what funds are available. This latter variation describes the reaction of management to the revenue level their firms' traffic mix and location allow. Analysis of between-year and between-firm spending differences allows a fuller understanding of income smoothing and rate level accommodation by railroad managers.



Revenue = f (Traffic Volume, Rate Level)
Cost = f (Traffic Volume, Efficiency, Input Prices)
Spending = f (Cost, Revenues Available to Spend)

FIGURE 1 Actual spending versus economic cost.

PROCEDURE OF INVESTIGATION

The study of discretionary spending involves two major tasks. Variations in spending must be separated into those explained by cost influences and those still unexplained. Unexplained variations are then examined for evidences of discretionary spending. The first task involves creating a state-of-the-art statistical costing model. The second task involves advancing that model to include the influence of discretionary spending. The hypothesis is that the best cost model is improved by introducing the selected independent variable. The analysis is performed on a sample of operating and financial data from short-line (Class II) railroads.

For this study cost of operating is the value of resources that must be used to provide some level of service. Conversely, expense is the amount actually used toward generating revenues of the period. Because the cost definition precludes direct measurement, a surrogate is required. In this case the expected spending generated by the cost model is taken to represent the economic cost of producing a particular service. This model provides average spending figures rather than minimums because lower figures may include short-run economic practices or may not recognize the use of certain resources. Discretionary spending is the difference between reported expense and the average or expected expense for any given traffic volume mix.

STUDY POPULATION

Independent short-line railroads provide an appropriate study population. Class II railroads are quite small (revenues less than $10 million annually) by definition. They function essentially as substitutes for branch line service, connecting shippers with the main line of a Class I railroad. However, because each short line is a separate company, reported expenses cover only the costs of local operation. This allows association of differences in operating policy, traffic mix, or scale to costs (1). Many of these lines have remained essentially stable, serving the same few customers over the same section of track for many years (2). In contrast, few Class I railroads could provide comparable data over a long term because most have been involved in mergers or abandonments in recent years. Thus it is possible to select a sample of sufficient size from Class II railroads to test multivariate relationships.

Because of the required annual reports to the Interstate Commerce Commission (ICC), short-line railroad information is available to the public. These data were summarized and published through 1968, but have been merely collected and filed since then (1). The same ICC report form was used for each year from 1968 through 1977 (a new form with less detail was introduced in 1978); these 10 years of comparable figures are a source of information with the detail, consistency, and variation required for an internally valid statistical investigation. The study population is all 30 Class II railroads for whom complete reports for each of the 10 years were on file with the ICC.

MODEL DEVELOPMENT

Investigation of discretionary spending demands a model to control for the economic influences on railroad costs. Previous research has established several such cost predictors and has suggested others. Generally, these spending determinants belong to one of three types. The primary spending determinant is the output activity level of the transportation firm. The second type of spending determinant relates to economies of scale and utilization, whereas the last type includes moderating the influences of prices and efficiency. Costing analyses on both Class I and Class II railroad data are examined for conceptual identification and operational definitions for the spending determinants of each type.

Volume of Traffic

The most important influence on cost is the level of output. Certain expenses are less functional to output level and are referred to as fixed or semivariable. Others can be explained satisfactorily by the volume measure. In the long run all operating expenses are variable, but in the short run several are expected to be fixed. These fixed expenses are usually discretionary in the short run and thus are more subject to spending manipulation by management. Past research allows hypotheses to be stated about which expense categories are substantially variable and which are more often fixed. The order of variability and lack of discretion for Class II railroad operating expenses are as follows: transportation, traffic, general and miscellaneous, maintenance of equipment, and maintenance of way and structures. Volume of traffic should be the primary cost predictor for each category, with accuracy decreasing in the hypothesized sequence.

The ideal instrument for volume of traffic includes a representation for the two dimensions: amount and distance of shipments. Because a variety of commodities are hauled by railroads, an artificial unit is suggested. The most popular unit is ton miles, although several alternatives are available.

Economies of Utilization

At the same volume of traffic, costs vary between operations of different efficiency. Efficiencies due to the firm being larger are known as economies of scale. The consensus of researchers is that railroad economies of scale are exhausted at relatively small firm size (3). Economies of utilization, on the other hand, refer to technical advantages of matching traffic volume to plant and equipment capabilities. These economies reflect differences in the cost of ton miles carried as the engines, tracks, and labor are used more efficiently. Economies of utilization are hypothesized for intense traffic, long hauls, and dense loads. Each hypothesis merits discussion and operational definition.

Traffic density traditionally has been regarded as the chief influence on average cost. Meyer and Kraft (4) evaluated statistical costing methods over 40 years, principally discussing models that estimated average cost as a function of traffic density. Traffic density represents intense utilization of roadbed and tracks, and until congestion or lack of maintenance interferes, it is expected that costs will be related inversely to such utilization. Dense traffic uses the plant more efficiently.

Of the various instruments for traffic density, the Harris (5) model is the most appropriate. In his average cost specification, he defines traffic density as ton miles per mile of track (5). Harris found significant density of traffic economies for trunk lines in 1973. Sidhu et al. (1) applied the Harris model to 1968 and 1973 cross sections of Class II railroads with similar results. They also discovered traffic density economies for 8 of 10 short-line railroads on a time series from 1963 through 1973 by using the same instrument (6). Beyond the precedent of these works, choosing ton miles per mile to measure density allows consistency with a ton mile volume of traffic measure.

It is accepted that rail transportation is more appropriate for long distances than for local delivery. One justification for this is the lower average cost of ton miles produced when multiple carloads are pulled at high speeds compared with shorter movements involved in switching and delivery. One expects efficiency to improve with length of haul, at least until the distance to a reclassification point is reached. Borts (7) attributed the trunkline cost differences he discovered between regions to congestion in the East and to the longer hauls of the West and South. Class II lengths of haul vary from less than a mile to more than 100 miles, and cost per ton mile is hypothesized to decrease across that range. Further, such efficiency should be predominantly reflected in transportation expenses but also may be reflected in maintenance, traffic, and administration expenses to the extent that longer haul reflects higher operating speeds and allows less sales effort per ton mile.

The Harris (5) model provides a simple and effective operational definition of length of haul. The ratio of ton miles per ton provides a weighted average length of haul (5). Sidhu et al. (1) likewise found distance efficiencies for short lines operating in 1968 and 1973, but they were unable to recognize length-of-haul economies in their time-series sample of Class II railroads (6). On any given line length of haul is nearly constant and is approximately the same as the track mileage for most shortline railroads. A cross-section model to estimate operating cost should include ton miles per ton to measure the economy of trip length.

An important cost predictor beyond traffic volume would be some reflection of traffic mix. It is expected that commodity differences will vary railroad needs for switching and maintenance. Borts (7) mentioned that minerals are often shipped in multiple car lots, which require less switching. On the other hand, unit train coal service appears to increase track maintenance requirements. Harmatuck (8) found costs inversely proportional to the "proportion of metallic ore, coal, crushed stone, gravel, and sand cars loaded to total cars loaded." Conversely, Harris (5) sought to differentiate the influence of load density from traffic density and concluded that commodity mix does not change cost per ton mile significantly. Thus the hypothesized existence of dense load economies are questionable but worthy of examination.

Separating the cost differences of commodities by density depends on the operational definition of the influence. Harmatuck's (8) measure of proportion of traffic by carload in certain commodity types limits application to the selected commodities. Density of the commodity does not determine the maintenance and transportation costs; instead it is the mass loaded in a railcar that in turn determines the axle weight on the rail and the amount of switching and delivery per ton mile. Thus the influences of car size and content density may be contradictory. An appropriate and simple measure of load density was suggested in ATE Management's (9) report to the United States Railway Association in that the average ton miles per car mile should detect the economy of larger shipments generated by either dense commodities or larger rail cars. This is similar to the Harris (5) technique of repeating his cost per ton mile analysis on cost per car mile. Inclusion of the load density instrument is preferable to mere sensitivity analysis and is justified by the incongruence of the Harris (5) and Harmatuck (8) conclusions about load density.

Three economies of utilization have been suggested in railroad cost analysis. Dense traffic patterns should correspond to lower operating costs as resources are used more fully. Longer and larger shipments may provide economies measured with long hauls and dense loads. These variables are expected to affect the cost of transportation per volume in ton miles.

Price Differences

The cost of production of transportation service is also a function of input prices. Firms operate at lower costs when they pay less for labor, fuel, or materials, and costs to railroads increase as the costs of the resources involved increase. Differences between years reflect a change in measurement unit as dollars represent different amounts of purchasing power. Conversely, differences in prices paid by railroads for equipment and supplies in any one year reflect their effectiveness at purchasing resources. The two effects are dealt with separately.

The decline in purchasing power of U.S. currency has continued over a length of time sufficient to warrant recognition in railroad costing studies. Restatement of dollar values into a common unit is accomplished with deflation indices selected to standardize costs over a time series. Cross-section studies only require deflation when their predictions are applied to future periods. However, a comparison between cross sections is facilitated by application of a consistent and appropriate price index across the periods.

Although the bulk of railroad cost studies have been cross-sectional, a number of deflation indices for railroading have been developed. The Association of American Railroads (AAR) publishes cost indices developed for various combinations of wages, fuels, and materials purchased by railroads (10). The most general of these reflects the prices paid by Class I railroads in the United States for the input combinations they actually purchased. Although Class II railroads use a different input mix and face divergent local markets, the Class I index is closer to their circumstances than any other readily available index.

Differences between prices paid by individual railroads for labor, fuel, or materials will be reflected in costs per ton mile. Major railroads purchase materials and fuel in national markets and usually hire labor at union rates; thus there is only minor variation between carriers in cost of these inputs. Class II lines, however, hire labor at divergent wages that reflect local markets and range from minimum legal rates to Class I union wages. A complete cost analysis on short-line railroads includes a measure of differences between firms in labor cost.

Past studies of railroad costs have included variables that have failed to account for all wage level variations. Langley and Patton (11) include dummy variables to differentiate regions partly to account for wage differences. Borts (7) and other researchers include regional variables but attribute their effects to geographic differences in terrain, congestion, and traffic mix. A better measure of cost of labor variation between firms is simply the average wage paid. Inclusion of such a spending predictor should reduce the need for price level deflation because wage rates are a surrogate for other input prices. Thus explicit consideration of wages allows both between-year and between-firm input price differences to be reflected in one convenient variable.

The cost model includes five independent variables and has as dependent variables the categories of railroad operating expense: maintenance of way, maintenance of equipment, transportation, traffic, and general and administrative. A number of alternative structures are available, and selection should reflect economic theory and goodness-of-fit criteria.

The hypothesized cross-section model is given in the following equations:

$$\text{Expenditure} = f\,(\text{control variables, funds available}) \quad (1)$$

$$\text{Expenditure} = f\,(\text{volume of traffic, traffic density, length of haul, load density, wage rate, funds available}) \quad (2)$$

$$\text{Expense} = I(\text{TNMI})^V \cdot (\text{TDEN})^T \cdot (\text{HAUL})^H \cdot (\text{LDEN})^L \times (\text{WAGE})^W \cdot (\text{OREV})^S \cdot E \quad (3)$$

where

I = intercept,
TNMI = volume (ton miles),
TDEN = traffic density (ton miles per mile),
HAUL = length of haul (ton miles per ton),
LDEN = load density (ton miles per car mile),
WAGE = wage rate (dollars per hour),
OREV = operating revenues (dollars), and
E = error.

Also, V, T, H, L, W, and S are coefficients for volume of traffic, traffic density, length of haul, load density, wage rate, and smoothing, respectively. Although there are precedents of simple additive functions (11) and complex multiplicative forms (8), the selected model is simple, accurate, and homoscedastistic. It follows Griliches' (3) suggestion that volume raised to a power provides satisfactory fit for expenses of both small and large railroads. This form measures average elasticity of regressors and is estimated as linear in logarithms.

Discretionary spending has two dimensions. To separate these dimensions of the phenomenon, both cross-section and time-series analyses are needed. Estimation of separate regressions for each of 10 years allows consideration of the spending differences between firms, which reflect their traffic mix. In addition, the cross sections estimate the spending of various firms under substantially similar economic circumstances.

Time-series analysis, however, is affected by the stability of certain aspects of the short-line railroad. Should mileage not change, the efficiency instruments of length of haul and traffic density become linear functions of traffic volume. That is, without variation in miles of track, ton miles per mile is correlated perfectly with ton miles. Thus time-series estimation relies on a simplified form because length of haul or the effects of traffic density (through multicollinearity) are included with the volume coefficient.

MODEL EVALUATION

When estimated on the pooled sample of 300 Class II railroads, both the cross-section and time-series forms of the control model perform well when compared with the Harris model. Harris (5) estimated average costs as functional to the inverse of traffic density and the inverse of length of haul. Charney et al. (6) used that formulation to estimate long-run cost functions from a cross section of Class II railroads, and the same researchers (1) estimated Class II short-run costs by using the Harris model on a time series. However, the proposed control model provides better fit over the study period, as evidenced by the R-square values given in Table 1 and in the following equations (from pooled estimation):

TABLE 1 Comparison with Harris Model (from pooled estimation)

	R^2 Values		
Expense	Harris	C-Model	T-Model
Total operating	0.7309	0.8976	0.7309
Maintenance of way	0.6288	0.8077	0.6872
Maintenance of equipment	0.5556	0.8465	0.7157
Traffic	0.4885	0.5713	0.4442
Transportation	0.7058	0.7736	0.5525
General and miscellaneous	0.6920	0.7337	0.5392
Homoscedastic	–[a]	–[b]	–[b]

[a]No. [b]Yes.

$$\text{Harris: Expense/ton miles} = a + b\,(\text{miles/ton miles}) + c\,(\text{tons/ton miles}) \quad (4)$$

$$\text{C-model: Expense} = a\,(\text{ton miles})^b\,(\text{ton miles/miles})^c\,(\text{ton miles/tons})^d \times (\text{ton miles/car miles})^e\,(\text{dollars/hour})^f \quad (5)$$

$$\text{T-model: Deflated expense} = a\,(\text{ton miles})^b \quad (6)$$

Furthermore, the Harris model suffers from severe heteroscedasticity, which decreases efficiency and biases efficiency estimates. Thus, when applied to cross-section estimation, the R-square figures for the Harris model are overstated. Figures 2 and 3 show residual plots for pooled regressions of both models on the same sample. It appears that the control model selected is more appropriate than the Harris model for both cross-section and time-series estimation.

Two forms of the control model have been devised. The form developed for use with cross sections includes parameters for volume of traffic and for dif-

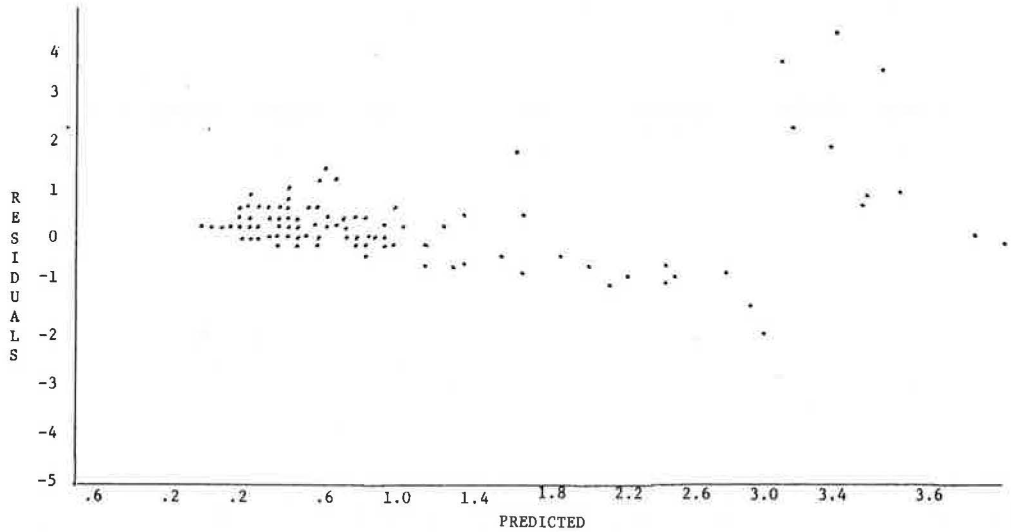


FIGURE 2 Harris model residuals.

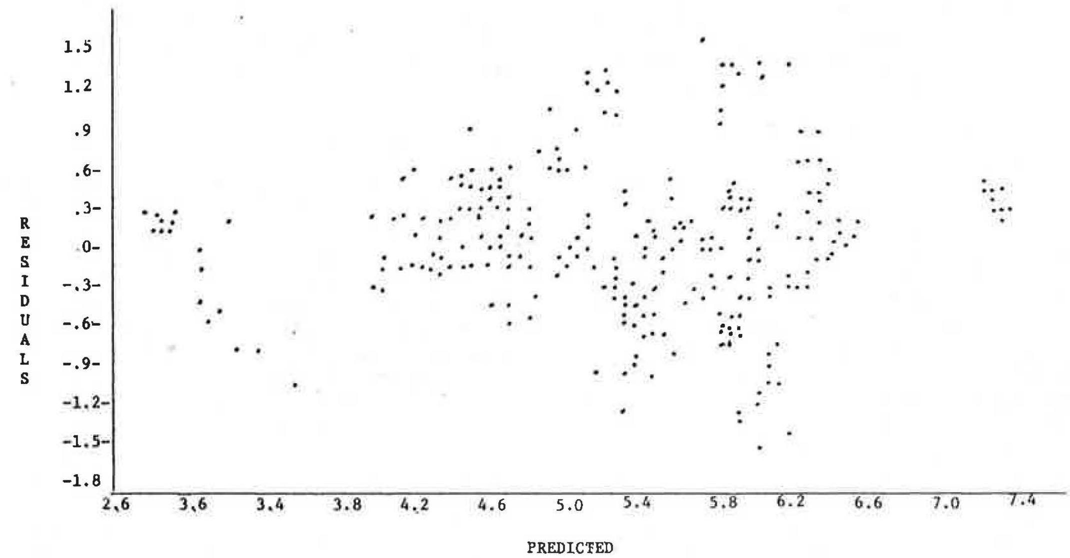


FIGURE 3 Wood model residuals.

ferences between firms in efficiency and input prices. The model developed for time-series analysis relies on traffic volume to estimate price-deflated figures. Both models are unbiased, relatively efficient, and appropriate for the purposes for which they were developed. Separating the between-firm and between-year aspects of spending behavior requires further analysis. This is accomplished with separate cross sections and time-series measurements of spending explanation model improvements attributable to the smoothing instruments.

MODEL APPLICATION

The model provides estimates of economic cost. To measure discretionary spending, the model must include an independent variable for the hypothesized influence of discretionary spending. If inclusion of this variable improves prediction of actual expenditures, it may be inferred that the managers are using their discretion in the hypothesized manner.

The instrument for management discretion is operating revenues. The important consideration is that this instrument can be one that the manager could accurately anticipate and react to. Operating revenue was selected because it is so closely related to cash flow (freight is paid for soon after shipment) and because managers would already be forecasting revenue levels when they estimated traffic.

Cross-Section Estimation

To separate interfirm spending differences, individual analyses were completed on cross sections of 30 carriers in each of the study years. In each year and for each expense, regressions were run with the control model before and after including operating revenues. A significant improvement between models indicates that the marginal variable predicts spending beyond the influence of those previously considered.

The F-ratios given in Table 2 allow evaluation of the value of adding operating revenues to the control model. The expense equations with F-statistics

TABLE 2 Cross-Section F-Ratios for Operating Revenues

Year	Total	Maintenance of Way	Maintenance of Equipment	Traffic	Transportation	General and Miscellaneous
1968	66.09[a]	13.35[a]	1.458	7.463[b]	38.19[a]	8.521[a]
1969	50.79[a]	8.723[a]	3.374	3.515	25.18[a]	5.509[b]
1970	74.49[a]	6.894[b]	3.744	8.012[a]	31.38[a]	7.587[b]
1971	62.46[a]	6.007[b]	6.209[b]	16.88[a]	37.06[a]	6.635[b]
1972	37.10[a]	1.106	1.975	14.19[a]	24.59[a]	1.722
1973	45.94[a]	3.958	2.844	11.60[a]	31.92[a]	1.711
1974	28.72[a]	5.089[b]	8.614[a]	13.14[a]	24.77[a]	0.7738
1975	19.38[a]	8.089[a]	2.229	5.371[b]	25.22[a]	0.0142
1976	11.31[a]	5.180[b]	0.6428	7.642[b]	18.91[a]	0.0643
1977	9.396[a]	0.1725	2.825	7.693[b]	23.59[a]	0.1376
Simple avg	40.56[a]	5.856[b]	3.391	9.55[a]	28.01[a]	3.260

Notes: $F = (R^2 \text{ with} - R^2 \text{ without})/(1 - R^2 \text{ with}/25)$. Critical value $F_{1,25}$.
[a]Statistically significant at 0.01.
[b]Statistically significant at 0.05.

higher than the critical values 4.24 and 7.77 realize improvements that, if attributable to chance, occur only 1 time in 20 and 1 time in 100. Most of the figures in the table surpass these standards. However, the extent to which the statistics vary between years and between expense categories provides additional information. The F-statistic represents the proportional improvement in model accuracy caused by the inclusion of the smoothing instrument; thus high ratios indicate which spending differences are highly functional to revenues, and low ratios indicate which spending differences are less functional to revenues. The data in Table 2 not only report the hypothesis test, but they facilitate further analysis.

The discretionary spending in a cross-section model is not periodic income smoothing but differences between firms in spending at a given level of traffic. It is concluded from the data in Table 2 that significant improvement in expense prediction is provided by adding operating revenues to the control model. Furthermore, it appears that the greatest improvements occur in the categories of transportation and traffic, although in some years significant ratios appear in the other columns. Also, it appears that these differences in spending between carriers are becoming less functional to revenues as time passes. The reasons for the noted differences in smoothing between expenses and over time are not clear, but each warrants some discussion.

Improvement in estimating transportation and traffic expenses may be caused by differences in rates between commodities and shipment patterns. Rail rates reflect cost influences as well as demand influences. Examples of cost factors not explicitly represented in the control model include switching complexity, operating terrain, multiple- or single-car shipments, and inclement weather. Each of these may be reflected in rates, so that discretionary spending, as measured by cross-section analysis, may not be truly discretionary. Higher expenditures on selling and providing frequent service may be associated with attempts to compete for traffic with motor carriers or other railroads, and such competition is often for higher-rated traffic. Conversely, high-income traffic allows carriers to incur the expenditures that better track maintenance, transportation service, and selling efforts require.

The noted decrease in the relative improvement of the expenditure predictions implies that spending differences between firms are functional to influences other than funds available. These influences, whatever they may be, appear to have grown in importance in the latter years of the study. One possible reason is that resistance to cost inflation varies from firm to firm, whereas general rate increases during the 1970s were tied to either fuel price or to growth in general price levels. An alternative explanation is that differences in general and miscellaneous expenses became less predictable because the category often contains what might be called extraordinary items. Further research would be required to identify with confidence the underlying cause of the noted trend.

Time-Series Estimation

Time-series regressions were run for each of the six operating expenses with the control model and with the smoothing instrument added to the model. The behavior to be detected is spending variation between years attributable to income smoothing. As with the cross-section estimation, a ratio of improvement in model accuracy was computed between each pair of regressions. The F-statistics given in Table 3 measure the significance and extent of the improvement attributable to operating revenues.

The smoothing influence appears less pervasive when estimated across the time series. Two weaknesses of the time-series estimation could be responsible for the lack of detected smoothing. First, a 10-point time series has limited degrees of freedom; thus the test of statistical significance requires a high value of F. Second, the shortness of the time series and number of regressions make autocorrelation difficult to detect. In almost every case the Durbin-Watson statistics were in the indeterminant range--not clearly autocorrelated but not uncorrelated either. It is suspected that more accurately budgeted expenses such as maintenance and administration are autocorrelated, regardless of an inconclusive test. An addition to the two difficulties in detecting an existing smoothing effect is the possibility that the phenomenon does not exist.

Traditionally, the term smoothing has been applied to the intrafirm or time-series relationship between income and expenses. When estimated across time, the phenomenon appears strongest for the expenses of transportation and maintenance of equipment. To some extent, that result was unanticipated, as transportation spending is usually not thought of as discretionary. However, a comparison of time-series and cross-section results offers a better interpretation of each.

Comparative Analysis

Under both time-series and cross-section estimation, the highest F-ratios for the smoothing instrument

TABLE 3 Time Series F-Ratios for Operating Revenues

ID Number	Total	Maintenance of Way	Maintenance of Equipment	Traffic	Transpor-tation	General and Miscellaneous
1	23.73[a]	0.4980	6.545[b]	25.28[a]	43.27[a]	0.8742
3	18.16[a]	4.228	4.736	2.669	4.328	6.880[b]
8	284.8[a]	6.078[b]	10.13[b]	5.021	4.292	0.0426
9	12.80[a]	2.863	2.354	2.676	6.841[b]	10.93[b]
12	3.648	4.265	0.0820	0.0059	10.71[b]	0.0907
13	14.71[a]	4.853	4.218	0.8608	19.90[a]	4.559
21	12.37[a]	2.391	6.130[b]	3.246	33.93[a]	7.370[b]
22	2.593	3.163	0.0764	2.244	0.8811	1.041
24	47.38[a]	17.84[a]	22.65[a]	29.66[a]	26.50[a]	9.330[b]
25	1.435	0.2177	0.0122	20.32[a]	10.88	0.7990
26	25.91[a]	3.292	7.377[b]	0.3080	15.14[a]	0.2978
29	3.607	0.5367	5.301	0.4134	2.901	0.3350
30	8.837[b]	3.955	11.33[b]	15.88[a]	7.267[b]	12.47[a]
31	5.791[b]	0.2620	12.25[a]	0.2583	3.566	4.549
32	283.6[a]	17.31[a]	7.006[b]	0.0005	95.92[a]	32.12[a]
34	68.25[a]	8.773[b]	12.92[a]	16.73[a]	110.4[a]	11.11[b]
35	2.005	1.045	6.560[b]	1.489	0.5307	2.310
36	1.321	3.136	0.2321	0.1967	1.962	0.1223
37	41.98[a]	5.578	17.19[a]	82.69[a]	60.95[a]	16.57[a]
40	1.208	1.977	3.070	0.8742	11.02[b]	0.8073
41	6.133[b]	0.2579	8.148[b]	4.146	1.841	2.900
42	42.04[a]	12.822[a]	0.2817	14.29[a]	8.669[b]	7.925[b]
43	11.72[b]	1.769	3.452	0.1191	0.2243	0.0128
44	0.2963	0.2366	0.2849	5.456	1.056	0.3861
46	0.1576	0.2027	0.3577	0.1845	0.3426	0.7530
47	16.41[a]	0.9639	19.28[a]	1.167	7.279[b]	1.807
49	4.946	1.287	0.0512	5.785[b]	58.09[a]	2.989
50	0.1083	0.1589	1.603	0.0326	0.898	4.969
51	2.100	2.505	1.620	0.2594	0.1447	0.0272
53	0.0015	3.939	32.29[a]	0.2681	0.3055	0.0002

Notes: $F = (R^2 \text{ with} - R^2 \text{ without})/(1 - R^2 \text{ with}/7)$. Critical value $F_{1,7}$.
[a]Statistically significant at 0.01.
[b]Statistically significant at 0.05.

occurred for transportation expense. On short lines transportation expense is adjusted by changing schedules, and thus fuel and labor costs, but train length and service frequency are also affected. This discretion is less extensive for Class I railroads, as labor and customer relations are adversely affected by schedule changes. There may be some question, then, as to whether the noted effect should be anticipated on larger railroads.

However, the statistical measurement of the smoothing does bring to light some interesting observations on the other expenses. Revenue differences between firms account for a substantial portion of maintenance-of-way variation, whereas revenue differences between years account for an important portion of the variation in maintenance-of-equipment spending. General expense and traffic expense appear to experience moderate amounts of both interfirm and intrafirm smoothing effects. These generalizations lend some support to speculations about management behavior typical to the short-line railroads studied.

The scenario most easily imagined from observations about the average firm's behavior is as follows. Maintenance of way, traffic, and general expenses vary between firms according to what their traffic mix affords, so that high-revenue lines spend more per traffic volume than those earning less. In years of higher-than-normal sales, the extra funds beyond those spent on transportation go to selling, administration, track maintenance, and (especially) equipment maintenance. Likewise, when traffic volume is down, some economizing occurs in office expenses (traffic and general) and in maintenance of way; but equipment maintenance is deferred most of all. When an unusual need for maintenance of way arises, spending varies according to funds available. Companies with available funds do extra work, and companies without such funds evidently operate with less than might be ideal. These suppositions about the operation of the average Class II railroad fit the image of the industry.

The firms in the study were small operations for which the hypothesized behaviors make economic sense. The average net income was $107,000 during the study period, with revenues averaging $736,000 yearly [these figures are in 1967 dollars from AAR (10) deflation indices]. Few of these railroads could be considered profitable even compared with the railroad industry as a whole. Class II railroad owners and managers often are motivated to perform needed maintenance rather than to display and distribute profits. It is possible to imagine that a good year inspires some fixing up of equipment, almost as an investment for the next year when the railroad might not be able to afford such work. In contrast, track maintenance probably is performed yearly at a minimum tolerable level, whereas repairs to equipment are made when they can be afforded.

CONCLUSIONS

The evidence indicates that the firms studied tend to manage income by varying expenses both between carriers and between years. Thus one application of the research findings is to expect carriers to increase spending when rates go up rather than to generate profits. Suppliers might understand the cyclicality of sales, and users may recognize more clearly the consequence of low rates. Promoters should revise estimates of subsidies required to eliminate deficits, and regulators could assess the spending consequences of rate changes. Most of these applications are only moderately feasible because no entity previously mentioned deals specifically with the set of carriers in this study. Suppliers, customers, and government agencies are not concerned only with independent short-line railroads that reported to the ICC during the years 1968 to 1977; instead, they are concerned with railroads with various ownership, or different sizes, and often in specific regions.

Extension of Study

There are some indications that these research findings apply to carriers not studied, but for certain situations generalization is not merited. For instance, carriers owned by their users may not smooth income but rather may allow the parent companies to absorb profits and losses. Likewise, in the case of a carrier owned by a Class I railroad, funds available for spending may be functional to the entire enterprise's success instead of the short-line railroad's own traffic. There is reason to believe that Class I railroads behave in the same manner as do the Class II railroads that were studied. On the other hand, the analysis would not be appropriate to differentiate between branch lines of a Class I railroad because funds available for spending on any one branch line are related to systemwide resources and allocations thereof. A branch line thus receives budgeted amounts only indirectly related to those it would have access to if it were operated as an independent line. There is reason to believe that railroads smooth income with discretionary spending, but there is no reason to suspect that specific segments of a railroad behave similarly.

Remaining Questions

The completed research provided evidence of an expense-revenue correlation after controlling for known expense predictors. Thus discretionary spending, as defined in the study, was detected in the sample of short-line railroads over a 10-year time span. The fact that operating income was smoothed justifies further consideration of the hypothesized spending manipulation behavior. Specifically, do these firms exhibit that behavior, and what are the consequences? Questions of motivations and results of income smoothing may be less suited for statistical study. Perhaps interviews with railroad managers would reveal their thought processes and would help decide the merits of spending discretion. Such a project could lead to relaxation or enforcement of accounting, tax, and budgeting policies for the railroad industry. Because firms are subject to economic regulations and often are considered for promotion and subsidy, the questions of why, how, and should they smooth are within the realm of the public interest. An in-depth investigation of discretionary spending by railroads perhaps should precede and facilitate decisions about rates, subsidies, or even nationalization of railroads.

In this paper an alternative to an experiment in the field has been documented. Known influences on cost were controlled to separate the hypothesized influence identified as management discretion. The procedure succeeded in that the statistical control model compares favorably with published costing models, and that the hypothesized behavior was detected on both cross-section and time-series samples. The research was conducted on 30 independently owned Class II railroads over the 10-year period (1968 to 1977). It appears likely that similar results may be expected for different populations and in different time periods. Income management is not a newly hypothesized behavior, but this study represents a pioneering effort to substantiate its existence and to measure its importance. As such, this study is a valuable precedent for future studies of discretionary spending and of railroad costing.

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