

come increasingly more knowledgeable buyers of service.

To summarize, pricing freedom does not guarantee success; it provides an opportunity but success will depend on productivity improvements that will enable railroads to compete effectively and profitably for traffic. On balance, railroads appear to be as well off or better than they were before the Staggers Act, but there has been no improvement and some decline in market share. Based on ICC standards, they remain revenue inadequate. Sufficient data exist to show that railroads may be transporting a fairly substantial volume of traffic that does not contribute adequately to net revenues. Thus, although, as Levine points out, productivity measures are elusive, practical and consistent ways are needed to assess productivity from both an operating and marketing standpoint and specifically whether individual segments or even movements contribute to a railroad's financial success. In developing such tests,

the industry should reconcile itself to the need for adapting to a more knowledgeable shipping community that has, through its own productivity measurement, identified its transportation requirements and options and is doing more and more management of its opportunities.

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The Effects of Railroad Mergers on Industry Productivity and Performance

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ABSTRACT

In recent years a merger wave has swept the rail freight industry. An attempt to measure the effects of recent mergers on railroad productivity and performance is described. Specifically, financial performance [return on investment (ROI) and return on equity (ROE)], capacity, operating characteristics, and operating costs are compared for 1978 and 1983. Mergers appear to have produced some benefits, particularly in improved financial performance and reduced operating costs.

After several decades of poor financial performance, bankruptcies of numerous carriers, rapidly rising public subsidies, and a continuing decline of its market share, the U.S. rail freight industry is now emerging from a process of fundamental change in industry structure and public policy. Federal rail policy has moved steadily toward easing rail regulatory burdens and allowing market forces to operate in the industry.

In conjunction with and in response to these changes, a merger wave is sweeping the industry. Since the restructuring of the northeastern railroads into the Consolidated Rail Corporation (Conrail), five mergers of Class I carriers have been approved by the Interstate Commerce Commission (ICC):

1. 1979: Grand Trunk Western--Detroit Toledo and Ironton (GTW:DTI),
2. 1980: Burlington Northern--St. Louis-San Francisco Railroad (BN:SLSF),

3. 1980: CSX Corporation--Chessie System and Seaboard Coast Line (BOCO:SCL),

4. 1982: Union Pacific--Missouri Pacific and Western Pacific (UP:MP:WP), and

5. 1982: Norfolk Southern Corporation--Norfolk and Western and Southern Railroad (NW:SOUTSYS).

The merger wave continues. As of this writing, two railroads, the Soo Line and the Chicago and North Western, are vying for control of the Milwaukee Road and the ICC is conducting hearings on the proposed consolidation of Southern Pacific and Santa Fe. In addition, the U.S. Department of Transportation has recommended to Congress that Conrail be sold to the Norfolk Southern.

The merger wave was set off in part by several government reports advocating mergers, particularly end-to-end mergers, as a partial antidote to the many years of declining traffic volumes and low profitability for most railroads. Reports by the

Task Force on Railroad Productivity (1), the U.S. Department of Transportation (2), and the ICC (3) were among the promoter writings. This literature predicted that rail mergers would generate cost savings and increased productivity, thus improving the financial viability of the industry.

It is now appropriate to assess whether these optimistic projections were accurate. Moreover, with the prospect of additional rail mergers in the offing, a better understanding of the impacts of mergers on rail productivity and performance is essential for making rational policy decisions. This knowledge will aid rail managers in deciding which mergers to pursue and assist policymakers in deciding whether and which mergers ought to be allowed.

In this paper an attempt to measure and analyze the effects of recent mergers on railroad productivity and performance will be made. The methods and findings of prior rail merger studies will be reviewed first. Second, the specific methodology and data to be employed will be detailed. Finally, findings on the effects of mergers on carrier performance will be reported.

REVIEW OF PRIOR MERGER STUDIES

As discussed more fully by Grimm and Harris (4), there are three general approaches to measuring the impact of rail mergers. The first uses regression analysis of cross-section or time-series cost data, with each firm an observation, to gain insights on railroad cost structure. The main result from this voluminous literature is that substantial economies of density exist in the rail freight industry. Thus, to the extent that a merger produces higher traffic densities, all other things being equal, cost savings would be anticipated. A parallel merger may increase densities through consolidation of traffic; an end-to-end merger may do so by diverting traffic from other railroads or funneling traffic over fewer routes on the merged carriers' system.

A second approach to measuring rail merger impacts uses data from individual rail markets. For example, Harris and Winston (5) utilized service quality data in an econometric analysis of 130 major rail markets. The main results were that routings with fewer participating carriers were correlated with faster and more reliable service quality. Their work allows the inference that end-to-end mergers have the potential for significant improvements in both service quality and cost savings.

A third approach is to analyze in detail the consequences of a particular merger, either ex ante or ex post. The ICC conducts lengthy ex ante investigations of proposed mergers to determine whether they are consistent with the public interest. Testimony is received from both proponents and opponents of the merger, and witnesses are cross-examined. In all of the recent consolidation cases, the ICC has concluded that mergers would yield substantial traffic diversion and increased densities, cost savings from elimination of duplicative facilities and transaction costs, and service quality benefits.

The merging railroads also conduct ex ante investigations of the likely impacts of mergers. Assuming that railroads are profit maximizers (though other managerial motives may be important), the spate of recent merger proposals evinces managers' expectations that mergers will improve financial performance. Of course, increased profits could result from either cost savings or reduced competition, so that one cannot necessarily infer expectations of cost savings from private merger initiative.

Individual merger evaluations have also been conducted ex post or retrospectively. Many of these

studies have concluded that railroad mergers have not produced significant cost savings. Robert Gallamore's 1969 Ph.D. thesis (6), the most comprehensive merger retrospective, compared premerger and postmerger costs of nine merged railroads. Gallamore concluded that mergers have fallen short of expectations for cost savings.

Gallamore's findings were supported in the more recent merger retrospective study by Sloss et al. (7). The focus of their study was an analysis of the extent to which rationalization attempts--through mergers, abandonments, and rail-highway coordination--have been successful. Sloss et al. noted that (7,p.102) "voluntary merger applications submitted to the ICC have usually been motivated by projections of substantial cost reductions to be obtained through more efficient operations." However, they found that cost improvements were not so great or widespread as projections made in ICC hearings. Furthermore, their summary evaluation of seven mergers approved between 1957 and 1967 showed three successful, two unsuccessful, and two inconclusive, according to changes in the sum of selected performance measures.

Two detailed U.S. Department of Transportation studies of specific mergers further corroborated the earlier conclusions. A 1977 study of the N&W-Wabash-Nickel Plate merger (8) showed that the system had achieved approximately one-half of originally forecast cost savings and that the savings had taken longer than anticipated to achieve. A 1979 retrospective study of the Seaboard Air Line-Atlantic Coast Line merger (9) found that only modest cost savings had been achieved 12 years after merger consummation.

These retrospective merger analyses remain useful in providing methodological guidance. However, the studies are of limited use in predicting impacts of recent mergers because of subsequent changes in ICC merger policy. Historically, the ICC denied approval for the mergers that had the most potential benefits in an attempt to protect weak carriers from more efficient carriers. Before the recent merger wave, the ICC also imposed burdensome conditions as a requirement for approval, thereby saddling merged firms with costs that could offset benefits of a merger. In addition, previous regulatory policies prevented realization of potential merger economies. For example, firms could not fully realize economies of density if prevented from abandoning excess route miles.

It is therefore not surprising that earlier mergers often failed to deliver on their promises. However, ICC merger policy in the recent merger wave has been much more permissive, with few, if any, conditions attached to merger approval. Moreover, regulatory restrictions that earlier hampered realization of merger benefits have been largely removed. It should be noted that although increasing regulatory permissiveness would enable merged carriers to realize cost savings, it might also allow them to exercise market power vis-à-vis other carriers or shippers.

Thus, a review of the merger literature yields conflicting expectations regarding the impacts of recent mergers. The cost structure literature suggests that diverting traffic and increasing densities on the merged lines should result in operating efficiencies. The government-sponsored reports also suggest that mergers should reduce costs and improve performance and productivity. On the other hand, retrospective studies are less sanguine, although this may well be an artifact of restrictive regulatory policies no longer in force. The recent wave of mergers concurrent with regulatory reform necessi-

tates new retrospective analyses to assess the impacts of recent railroad mergers.

METHODOLOGY AND DATA

The methodology will follow that of Sloss et al. (7) whereby impacts across time are compared for merged carriers against a control group of nonmerging carriers. Sloss et al. used a different control railroad for each merger. This is no longer possible, because there are an insufficient number of large railroads not involved in mergers during the relevant period to match one with each merger of carriers. Instead the change in performance or productivity of each merged carrier is compared with the average change of all nonmerging railroads, with Conrail treated separately.

The rationale for breaking Conrail out of the control group is that, although the Conrail "merger" occurred somewhat before the mergers of greatest interest, Conrail experienced dramatic improvements in performance and productivity during the relevant time period. If, as seems likely, many of those improvements were made possible by the restructuring, including Conrail in the nonmerging control group would bias the comparison.

This analysis is intended to compare change in performance or productivity of carriers that merged and of those that did not. For several key indicators, the value for 1978 (the year before the merger wave) was compared with the value for 1983 (the most recent data available). By using carrier R-1 data as reported to the ICC, weighted ratios of each indicator were computed for each merged carrier. For example, in computing return on investment (ROI) for Carriers A and B, which later merged into Carrier AB, the weighted average ROI of the two carriers before the merger, the weighted average ROI of the carriers after the merger, and the percentage difference between the two ROIs were calculated. By comparing the direction and rate of change in those indicators with the average of all nonmerging carriers, inferences can be drawn as to whether merged carriers did better, worse, or no differently than the nonmerging carriers.

In line with the previous discussion of the expected or alleged benefits of rail mergers, four types of performance or productivity indicators were examined.

Financial Performance

In assessing the effects of mergers on profitability, ROI and return on equity (ROE) were used. It was expected that the financial performance of the merged carriers would be better than that of nonmerging carriers for three reasons:

1. If the merger produces cost savings, those should increase profit (either through improved profit margins or, if some or all of the cost savings are passed through in rates, by increased traffic);
2. If the merger produces service quality improvements, those should increase profits, either through higher rates or through increased traffic; and
3. If the merger increases the market power of the merged carrier (either with respect to shippers or connecting carriers), that would increase profitability by enabling the carrier to charge higher rates or obtain a larger share of joint revenues.

Capacity

Because numerous studies have found considerable excess capacity in the rail industry (10), relative changes in miles of road (MR) and switching track (ST) were assessed. Because horizontal mergers allow carriers to rationalize their systems, MR ought to decline through abandonments of redundant lines. Either horizontal or vertical mergers might enable carriers to reduce ST by eliminating redundant yards or by decreasing switching (e.g., by operating more run-through trains).

Operating Characteristics

Prior analysis of rail economics and previous merger studies have identified several major opportunities for achieving cost savings through operating efficiencies. An attempt to assess these claims has been made by examining the following indicators:

1. Line-haul capacity utilization as measured by car miles per mile of road (CM/MR). Horizontal mergers could increase traffic density by concentrating traffic on fewer lines as duplicate lines are abandoned. Vertical mergers could increase traffic density if improved service quality or market power results in traffic diversion to the lines of the merged carrier.
2. Length of train as measured by cars per train (C/TR). Given the well-known economies associated with train length (holding quality of service constant), a vertically merged carrier might be able to increase train length by consolidating traffic over fewer gateways or by assembling more run-through trains or both.
3. Net tons per gross ton as measured by net ton-miles per gross ton-mile (NTM/GTM). There are two main sources of improving the net-to-gross ratio: increasing cars per train (thereby reducing the ratio of locomotive tons to total tons) or reducing empty car miles (an empty 50-ton car moving 1 mi counts as 50 GTM, 0 NTM). Either horizontal or vertical mergers might achieve one or both types of operating efficiency.
4. Switching capacity utilization as measured by carloads originated or terminated per mile of switching track (CLOT/ST). Vertical mergers should improve utilization of switching capacity by reducing the number of switches per car handled, because carriers are able to use more or larger batches in train assembly.

Operating Costs

On the basis of econometric estimates of railroad cost structure and ex ante evaluations of individual mergers, mergers are expected to result in cost savings. Measures for three types of operating costs were used: maintenance-of-way and structure expense per 1,000 net ton-miles (MWS/NTM), maintenance expense per 1,000 net ton-miles (ME/NTM), and transportation expense per 1,000 net ton-miles (TE/NTM). In some cases, operating cost savings would simply reflect changes in operating characteristics (e.g., higher traffic density reduces transportation expenses). It is also possible, though, that mergers might enable carriers to use capital and labor resources more efficiently, even without changes in operating characteristics. Changes in operating costs could measure these efficiencies.

EMPIRICAL RESULTS AND IMPLICATIONS

Figures 1-11 display the changes in performance and productivity indicators for each of the five merged

TABLE 1 Summary Statistics for 1978-1983: Percentage Change in Financial Performance, Operating Costs, Operating Characteristics, and Capacity

Carrier	ROI	ROE	MR	ST	CM/MR	C/TR	NTM/GTM	CLOT/ST	MWS/NTM	ME/NTM	TE/NTM
All others	-62	-32	-12	-2	-5	1	4	-19	22	37	42
Conrail	109	- ^a	-15	-10	-19	3	2	-20	-4	-5	-6
GTW:DTI	-203	-313	-4	10	-11	13	-5	-33	22	19	40
BN:SLSF	139	109	-4	5	12	12	6	24	19	0	17
BOCO:SCL	-10	16	-4	-4	-7	8	0	-25	56	30	34
NW:SOUSYS	0	-29	2	-4	-16	19	0	12	17	9	13
UP:MP:WP	-45	-53	-4	1	-17	-2	15	-7	46	45	43

Note: ROI = return on investment; ROE = return on equity; MR = miles of road; ST = switching track; CM/MR = car miles per mile of road; C/TR = cars per train; NTM/GTM = net ton-miles per gross ton-mile; CLOT/ST = carloads originated or terminated per mile of switching track; MWS/NTM = maintenance-of-way and structure expense per 1,000 net ton-miles; ME/NTM = maintenance expense per 1,000 net ton-miles; TE/NTM = transportation expense per 1,000 net ton-miles.

^a No data applicable.

carriers under study, Conrail, and the weighted average of all other Class I carriers. These results are also presented in Table 1.

In reviewing the differences in financial performance in Figure 1 (ROI) and Figure 2 (ROE), it is evident that the carriers involved in recent mergers are not typical of the industry as a whole. For 1977-1979, the average ROI of nonmerging carriers was 2.5 percent, whereas the ROIs of merging carriers ranged from 3.1 to 7.8 percent. There are two implications of this marked contrast.

First, whereas regulatory policy had previously prevented mergers of strong carriers with other strong carriers, recent policy has not. Historically, merger policy was intended to protect weak carriers from mergers or force the merger of weak carriers into stronger carriers. Clearly, that policy has changed; if anything, current merger policy may have the effect--if not the intent--of eliminating weak carriers.

Second, the potential benefits of mergers may be related to the strength of the merging carriers. On the one hand, mergers of weak carriers might produce significant gains from reduction of excess capacity and redundant facilities (although the Milwaukee Road, through bankruptcy reorganization, had done that before its proposed merger). On the other hand, mergers of strong carriers may generate substantial increases in market power, with lesser potential for cost savings.

In a comparison of the change in ROI from 1978 to

1983, the merged carriers did considerably better than the nonmerging carriers. Although the latter experienced a 62 percent decline in ROI, four of the five merging carriers had a lesser decline or, in the case of BN, a substantial improvement in ROI. A somewhat more mixed picture emerges from the ROE indicator, because three of the five merging carriers did better than the control group. There are pronounced differences in financial performance across carriers, with BN:SLSF significantly improving in this time span whereas GTW:DTI greatly declined. The disparity can perhaps be best explained by differences in the two firms' traffic bases. BN:SLSF is the nation's largest coal railroad and benefited from increased demand for coal between 1978 and 1983. On the other hand, GTW:DTI, which depends heavily on automobile traffic, was greatly affected by the decline in U.S. automobile demand during this period. Overall, the evidence strongly suggests that recent consolidations have had a positive impact on financial performance.

As shown in Figure 3, changes in MR reflect the fact that the mergers involved strong carriers with less excess capacity and were, for the large part, vertical mergers. Accordingly, the nonmerging carriers have been abandoning route miles at a significantly faster rate than the merged carriers.

In the ST comparison (Figure 4), three of the merged carriers have actually increased trackage, whereas that of nonmerging carriers has declined slightly. It is possible that the vertical mergers

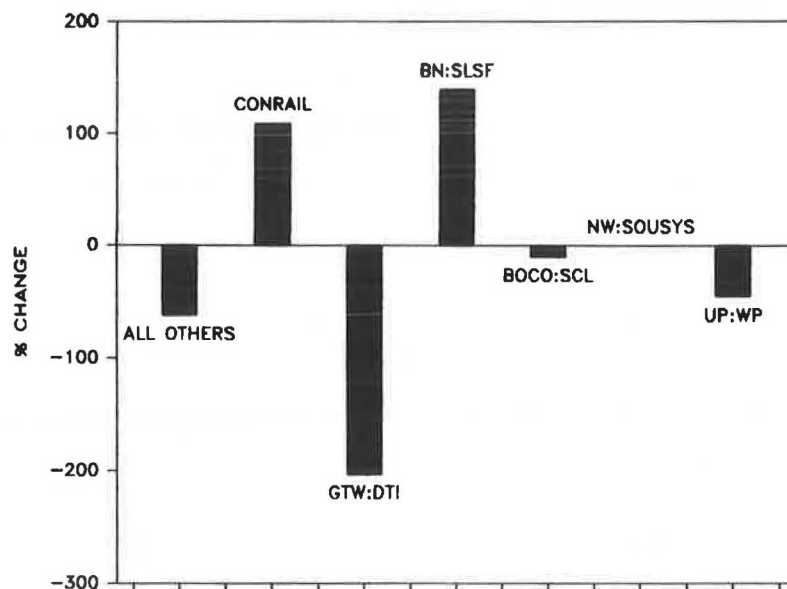


FIGURE 1 Return on investment: 1978-1983.

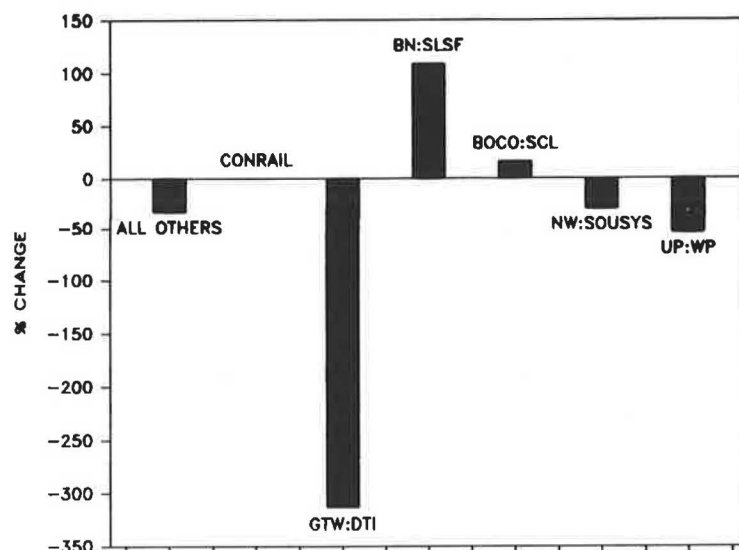


FIGURE 2 Return on equity: 1978-1983.

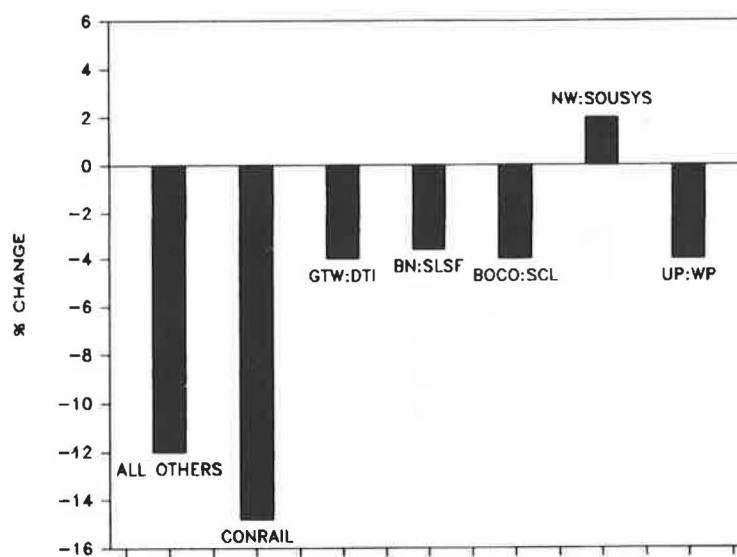


FIGURE 3 Miles of road: 1978-1983.

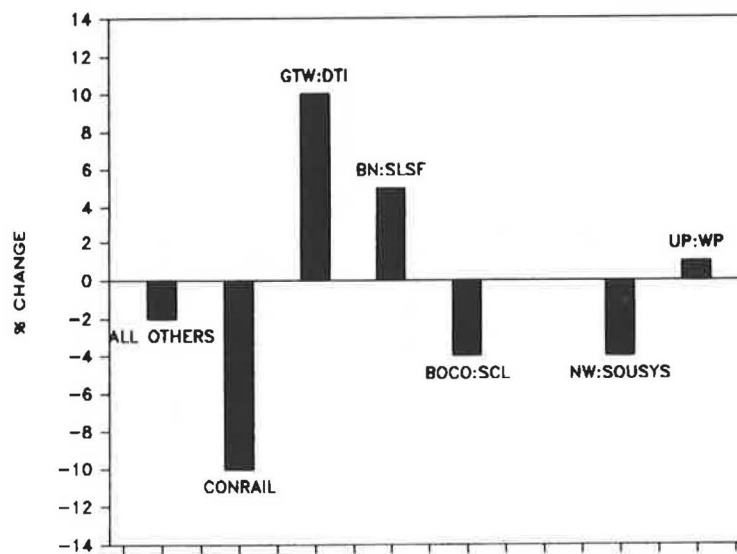


FIGURE 4 Switching track: 1978-1983.

have increased traffic sufficiently to offset any operating efficiencies, thereby necessitating an expansion of switching capacity. To test for that possibility, CLOT/ST utilization (Figure 5) was examined and it was found that, in fact, the merged carriers did relatively better on that score than did the nonmerging carriers. The NW:SOUSYS carriers, for example, increased ST by 2.2 percent, but their utilization declined by only 1.1 percent, versus an 11 percent decline in CLOT/ST for the control group.

The results in utilization of line-haul capacity (CM/MR, Figure 6) are also mixed but not inconsistent with expectations. Although the BN:SLSF and NW:SOUSYS did significantly better and the BOCO:SCL slightly better than the nonmerging carriers, UP:MP:WP and GTW:DTI did somewhat worse. As noted earlier, however, it would be expected that horizontal mergers would have a greater effect on traffic density than vertical mergers, so these results are not surprising.

One of the chief benefits of vertical mergers should be reflected in train length, and here (Figure 7) the results are unambiguous. Although non-

merging carriers experienced a slight decline from 1977-1979 to 1981-1983, all of the merging carriers except UP:MP:WP showed increases, from 5 to 19 percent. Presumably, these longer trains have reduced locomotive, crew, and fuel costs for the merged carriers.

Changes in net gross tons are shown in Figure 8. Two of the mergers (VP:MP:WP and BN:SLSF) have generated substantial gains, whereas the other three have not. The mergers do not appear to be beneficial on this count, though dramatic changes in car rules and supply practices may be influencing the results.

Finally, changes in operating costs are shown in Figures 9-11. Four of the five merged firms reduced their costs more than the control roads in at least two of the three categories, with the BN:SLSF and NW:SOUSYS consolidations experiencing the sharpest reductions. The UP:MP:WP was an outlier in this regard, with higher costs likely due to initial additional expenditure customary in the early period of merger consummation. Overall, the data provide some evidence that the recent mergers have resulted in operating cost savings. These differences are not

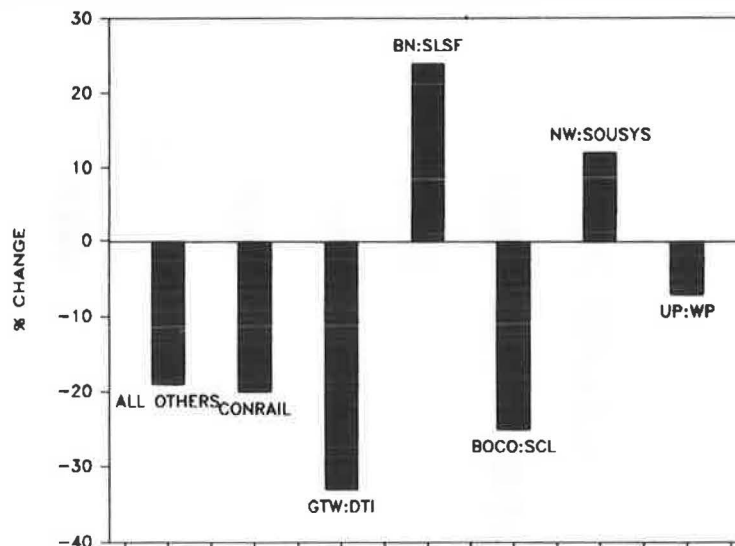


FIGURE 5 Carloads originated or terminated per mile of switching track: 1978-1983.

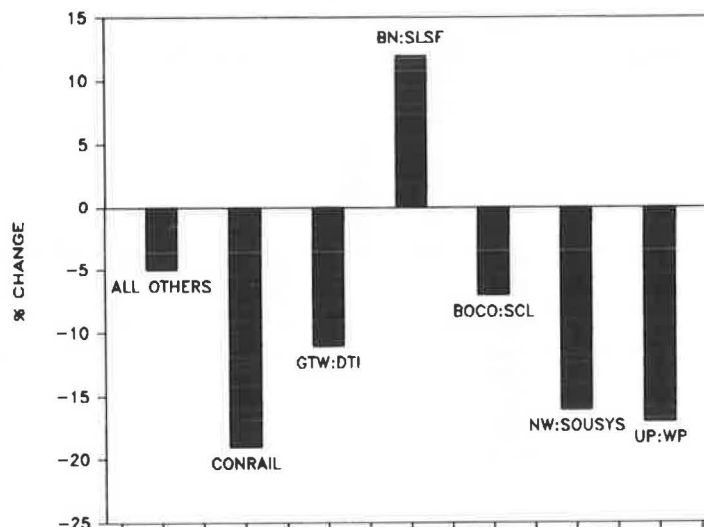


FIGURE 6 Car miles per mile of road: 1978-1983.

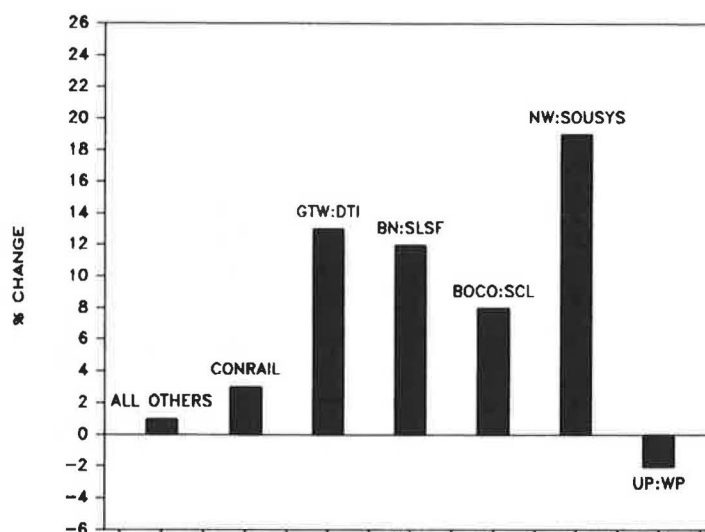


FIGURE 7 Cars per train: 1978-1983.

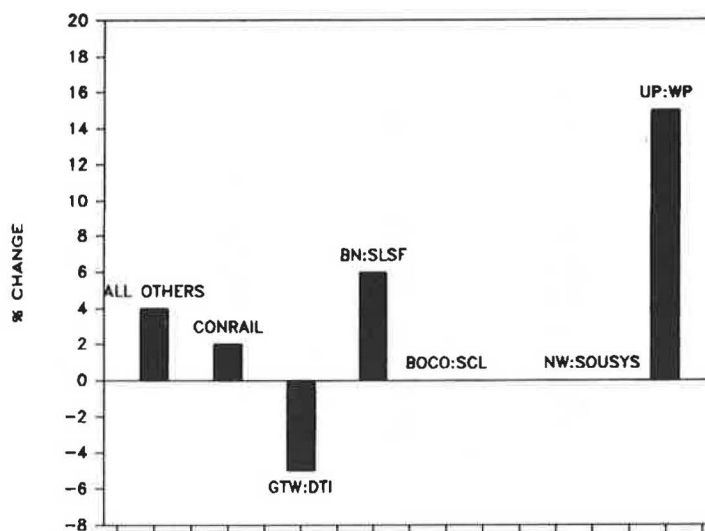


FIGURE 8 Net ton-miles per gross ton-mile: 1978-1983.

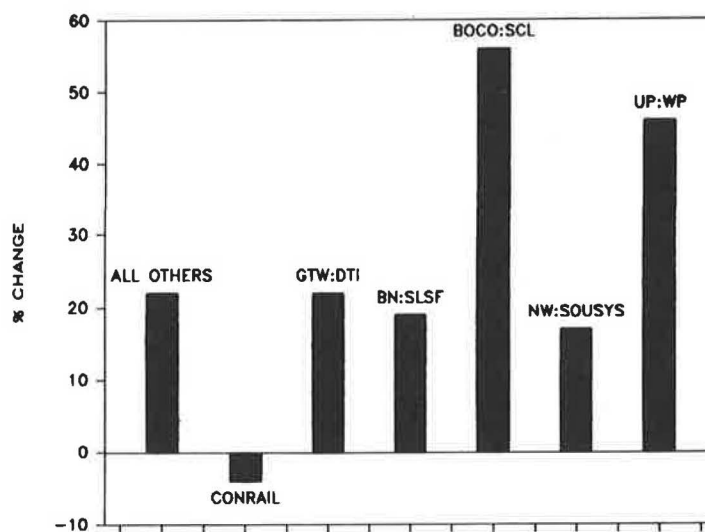


FIGURE 9 Maintenance-of-way and structure expense per 1,000 net ton-miles: 1978-1983.

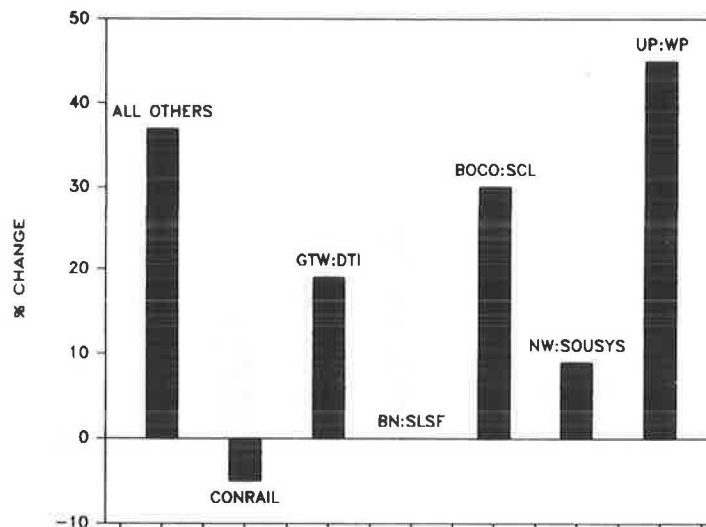


FIGURE 10 Maintenance expense per 1,000 net ton-miles: 1978-1983.

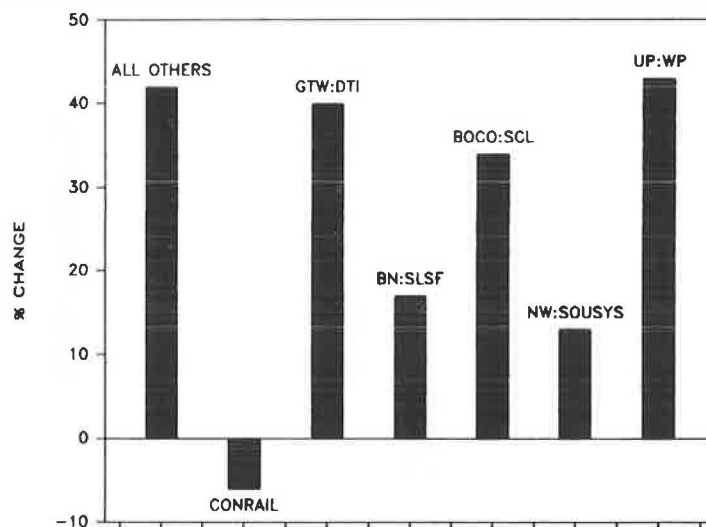


FIGURE 11 Transportation expense per 1,000 net ton-miles: 1978-1983.

TABLE 2 Difference-of-Means Test

	MWS	ME	TE
Nonmerged carriers			
Mean (%)	21	29	60
Standard deviation	0.003118	0.002653	0.007527
N	16	16	16
Merged carriers			
Mean (%)	15	19	43
Standard deviation	0.001285	0.000956	0.002032
N	11	11	11
t-Statistic	0.607742	1.125167	0.708393
t-Value ^a	1.7081	1.7081	1.7081
Rejection of hypothesis ^b	No	No	No

Note: MWS = maintenance of way and structure; ME = maintenance expense; TE = transportation expense.

^a Significance = 0.10; 25 degrees of freedom.

^b Rejection of hypothesis that means of nonmerged carriers equal means of merged carriers.

statistically significant, however, as shown in Table 2.

The recent mergers of major rail carriers have changed the structure of the industry rather dramatically. Although too little time has elapsed to draw

any firm conclusions, mergers appear to have produced some benefits, particularly in improved financial performance and reduced operating costs. Future research should extend this retrospective merger analysis as data from additional years become available. In particular, 1984 and 1985 data should allow a more accurate assessment of the GTW:DTI merger, because demand for U.S. automobiles has rebounded during this period. These data will also be crucial for evaluation of the UP:MP:WP merger when more time has elapsed since this relatively recent consolidation.

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Interface Between Passenger and Freight Operations

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ABSTRACT

The fundamental conflicts between trains with different speed profiles and stopping patterns are outlined. The operation of the Northeast Corridor of the National Rail Passenger Corporation (Amtrak) is presented as an extreme example, with 13 classes of service over the same tracks. Various methods of handling this problem are discussed with specific applications of the concepts cited. Additional track is the first concept reviewed; both addition of lines to existing routes and construction of new separate right-of-way are considered. Examples of the various methods of increasing the permissible speed of passenger trains on the existing infrastructure through the use of pendular suspension and of interactive systems are explored. The changing nature of freight service in North America is examined and the suggestion is made that the scheduling problems to be faced in operating this service will be very similar to the interface between passenger and freight service today. The role of timetable planning and careful scheduling of trains is explored. The relationship between schedules and track configuration, particularly at line stations, is discussed. The nature of the role of the train dispatcher and his capability is explored. The potential role of the modern computer to convert the time spent on clerical tasks to more useful time resolving transportation problems is outlined. The use of computers to handle actual routine decisions is explored. The development of computer simulation techniques from simple train performance calculators to a planning tool capable of handling extremely complex diagrams is discussed. These tools are now being developed to the point of being able to estimate arrival times, conflict points, and other situations on a real-time basis. Alternative courses of action can be tested quickly on the basis of accurate current information. These tools will be available soon and give the dispatchers the ability to handle increasingly complex traffic situations.

Although the title of this paper includes the word "passenger" and the questions and areas of concern are now most pronounced for passenger trains, the fundamental problems discussed are very much applicable to an increasing number of railroads that carry only freight. In fact, one of the most rapidly

changing areas, that of computer-aided dispatching (CAD), has been developed and is now in actual use on several railroads in this country that haul freight only.

The sound effects on the radio commercials for the National Rail Passenger Corporation (Amtrak)