PRODUCTIVITY AND PRICES IN THE U.S. RAIL INDUSTRY: EXPERIENCE FROM 1965 TO 1995 AND PROSPECTS FOR THE FUTURE

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ABSTRACT

This paper documents the major changes in rail freight service productivity and the overall changes in rail prices over the period 1965 to 1995. Over this period, productivity improvements produced annual savings approaching $25 billion by 1995, with most of the savings achieved after 1983. Despite these dramatic improvements, the profitability of the industry never returned to the peak level of 1966, as the great majority of the savings were passed on to customers in the form of lower rates. A major concern is that the recent rate of productivity improvement will be very difficult to sustain into the 21st century, while the pricing pressures unleashed by deregulation will only grow stronger. The industry may therefore face significant financial problems in the not too distant future.

BACKGROUND

A combination of structural, technological, regulatory, and environment changes propelled the U.S. rail industry from the brink of bankruptcy in the late-1960s and 1970s to apparent financial prosperity in the 1990s. This transformation was especially remarkable since most of the dramatic productivity savings were passed on to customers in the form of lower rates. However, the industry did not survive intact, as railroads exited many markets, rationalized their networks, and focussed on high density, heavy haul operations. The rail industry in the mid-1990s was therefore smaller than it was in the mid-1960s, and it was a much smaller piece of the growing freight transportation marketplace. The shrinkage of the rail industry has been masked by inflation, the continued growth in bulk traffic and the surge in intermodal traffic following the introduction of doublestack trains. While ton-miles and tonnage continued to set records, revenue and profitability in the mid-1990s were nowhere near their highs. When NROI (net railway operating income) is expressed in real terms, 1966 emerges as the most profitable year of the last three decades, as shown in Figure 1. While there are other ways of looking at financial performance[1] and there are accounting intricacies that could alter the shape of the figure,[2] Figure 1 certainly challenges some of the accepted mythology of the rail industry. The collapse of the Penn Central in 1970, which triggered the Northeast Rail Crisis, clouds our perspective and obscures the bright prospects that were actually then apparent for a time. The "wreck of the Penn Central" just 871 days after the merger was as spectacular as it was unexpected:

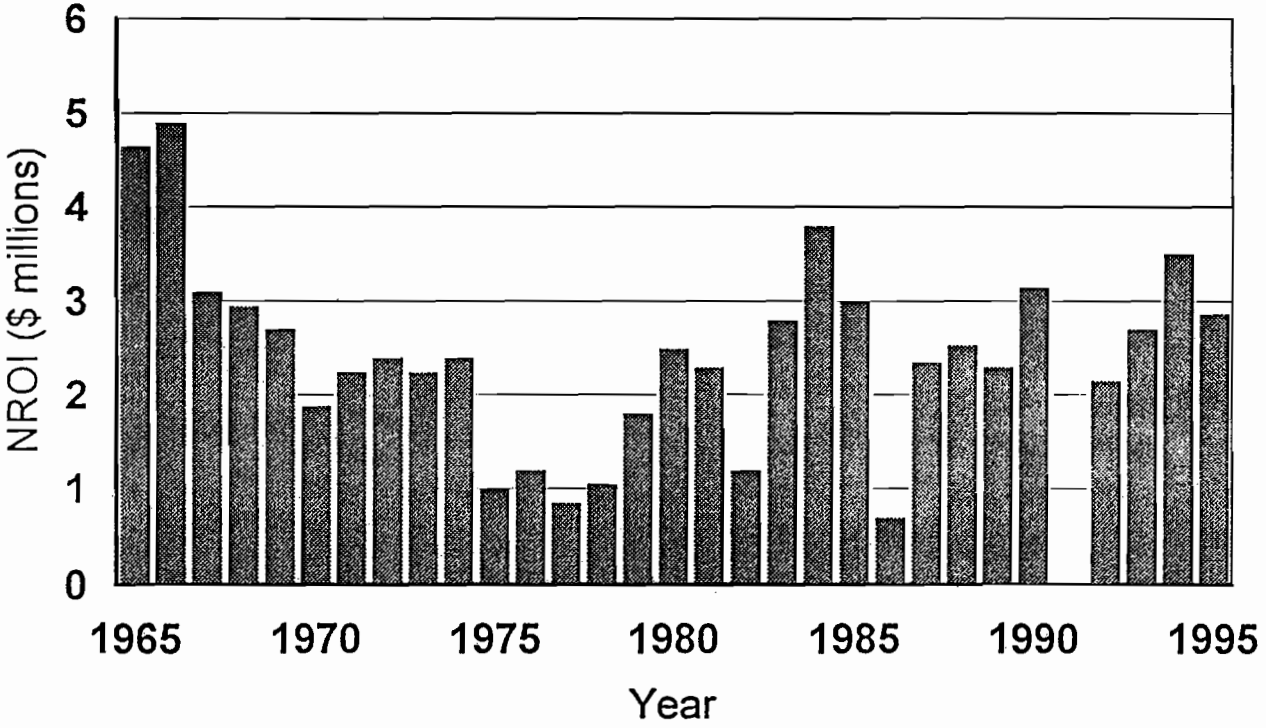
> "Problems that nobody foresaw or bothered about on opening day swelled to unmanageable proportions. On June 21, 1970, with a sickening crash that frightened Wall Street, jarred both the United States economy and its government, and scared off foreign investors, the nation's largest railroad went broke. The history of American Railroading is marked by wildly cyclical ups and downs, but never before had there been a cataclysm as stunning as this." [Daughen and Binzen, 1971, p. 12]

In February 1968, when the Penn Central was formed, however, it was not apparent that it would fail. Indeed, it was viewed as "the most ambitious merger in railroad history, ... a truly awesome monument to the free enterprise system" [Daughen and Binzen, 1971, p. 206]. To understand why this was the case, let's begin by looking more closely at that peak year of 1966, a point of time when the rail industry earned NROI that, in real terms, would not be matched in the next 30 years. Yet, as we now know, the industry at that time was perched on the brink of disaster.

THE RAIL INDUSTRY IN 1966

The industry as a whole in 1966 had revenues of $10.6 billion and net railway operating income (NROI) of $1.05 billion, enough for a return on investment of 3.9% during a period of low

Figure 1: U.S. Class I Railroad Net Railway Operating Income
CPI-Adjusted Constant 1995 Dollars
(Adapted from Chapman & Martland, 1996)



inflation and low interest rates.[3] Furthermore, 1966 was not an outlier, but the culmination of a 5-year period during which both NROI and ROI doubled. Nor were the railroads in the northeast excluded: for the Eastern District, which included the roads that would merge to form the Penn Central, the NROI was nearly $400 million. Using constant dollars will put these numbers into sharper perspective. The $10.6 billion operating revenues of 1966 would amount to $45 to $50 billion in 1995, i.e. 50% to 60% greater than the 1995 operating revenues of $32 billion. And we have already seen in Figure 1 that the average NROI in 1965 and 1966, when expressed in real terms, was roughly twice the average NROI from 1990 to 1995.

Of course, the outlook for the industry in 1966 was not entirely rosy. Inflation, competition for merchandise traffic, passenger service deficits, light density operations, and many of the other problems that would dominate the public policy debates in the 1970s were beginning to be evident at that time:

Inflation: while railroad material prices and wage rates rose only about 2% per year from 1961 to 1964, they rose 5% in from 1965 to 1966 (and would rise more than 8% per year for the next 7 years).

Merchandise Traffic and Light Density Lines: the depression and the travel restrictions during World War II masked the competitive advantage of trucking for many years, but trucking's market share of intercity freight rose from about 5% during the war to about 22% by 1966. The obvious targets were the general merchandise customers on light density lines who received costly and unreliable service; as traffic dried up, rail losses on these lines grew. In many locations, railroads introduced intermodal operations to keep customers affected by line abandonments and service cutbacks. From 1957 to 1966, piggyback loadings increased at 18% per year, from 0.25 million to 1.2 million. (However, by 1966 the rate of growth was slowing, and the number of piggyback carloadings would actually drop back to 1.2 million in the recession of 1971).

Passenger Deficits: The passenger service deficit was $400 million in 1966, which was a 5% improvement from 1965 and typical of the early 1960s; of this total, only $31 million was considered to be solely related to passenger operations, as the $1.02 billion in passenger revenues nearly covered the direct expenses of these operations. As airlines and the interstate highway system were continuing to grow, the rail passenger market was clearly in decline in the late 1960s. (The solely related deficit would grow rapidly to $252 million in 1970, eventually forcing the creation of Amtrak as a way to retain passenger service while alleviating the freight railroads of the rising deficits.)

Labor Productivity: labor strife was common in the 1960s as the railroads pushed hard to reduce crew consists, to eliminate restrictive work rules, and to modify the basis of pay. The unions resisted strenuously, and it was clear by 1966 that it would be very difficult to achieve any rapid breakthroughs in labor productivity.

The importance of these problems was abruptly brought into the public eye with the collapse of the Penn Central in 1970. For 10 years thereafter, the industry, labor unions, congress, DOT, the ICC, USRA, state governments, shipper organizations grappled with these and other problems. The formation of Amtrak and Conrail, the continuation of the merger movement, establishment of procedures for and alternatives to rail line abandonment, and significant regulatory reform were some of the fruits of these efforts.[4] In a strategic sense, however, the fact that the industry had so many problems was an advantage, because it was possible to identify opportunities for overcoming the problems and improving performance. Even though much of the rail industry was still on the verge of bankruptcy for much of the 1970s, major efforts were underway to rationalize the network, improve equipment management, increased labor productivity, upgrade the track structure, improve the regulatory environment and to focus marketing activities on profitable traffic (e.g. Task Force on Railroad Productivity, 1973; Secretary of Transportation, 1978). These efforts led to remarkable productivity improvements in many areas, as discussed in the next section.

PRODUCTIVITY IMPROVEMENT AND COST SAVINGS, 1965 TO 1995

Changes in Traffic Mix

Four trends in rail traffic mix tended to eliminate high cost shipments and encourage low cost shipments. First, boxcar traffic declined dramatically, with some traffic shifting to intermodal and more shifting to truck. Second, bulk traffic rose dramatically, to the extent that coal and farm

products accounted for 50% of the tons hauled in 1995. Third, bulk traffic shifted away from single- and multi-car shipments to unit trains. Fourth, the average length of haul5 increased from 500 miles in the mid-1960s to 615 miles in 1980 and to 843 miles in 1995.

From 1965 to 1973, the trends toward larger cars and an increasing percentage of bulk traffic were just beginning. From 1973 to 1985, many dramatic institutional changes took place - the formation of Conrail, the Railroad Revitalization and Regulatory Reform Act in 1976, and the Staggers Act in 1980 - but the productivity was roughly the same in 1983 as it was in 1973 [Martland, 1989]. The greatest underlying factor during this period was the shift away from boxcar traffic toward bulk traffic, which resulted in lower prices for transporting heavier cars. After 1983, the dominant trend was no longer the elimination of light density box car traffic, but the achievement of even further productivity gains for bulk unit-train traffic.

Exhibit 1a shows some of the key service units for 1965, 1978, 1983, and 1995. Exhibit 1b restates the service units as percentages of the base year. The output index (freight service revenue deflated by a price index[6]) was roughly constant over the first half of the period, rising from 96.3 in 1965 to 100 in 1978. Output fell to 76.5 in 1983, but then rose substantially, reaching 147.2 in 1995.

If there were no changes in productivity and no changes in traffic mix, then we would expect to find service units changing in proportion to output. In fact, revenue ton-miles (at 146% of the base year) and gross-ton-miles (152.2%) did grow as fast as the output index. However, road train-miles, car-miles, and revenue carloads all increased less than 10%, while yard switching hours continued to decline, indicating dramatic changes in productivity. With fewer service units per unit of output, substantial cost savings were achieved, as shown in Exhibit 1c.[7] From 1978 to 1983, when traffic was in decline, service units declined, but not as fast as traffic, so that the service unit effect was negative. However, before and after that period, the service unit effect was very strong leading to annual savings of approximately $7.5 billion overall in 1995 compared to 1965.

Maintenance of Way

A recent study [Chapman and Martland, 1996] estimated that improvements in track productivity save the industry on the order of $7 billion annually (in 1995 dollars). Annual maintenance of way (MOW) expenditures[8] increased only 6% in constant dollars from the mid-1960s to the mid-1990s, despite a 73% increase in revenue ton-miles and an increase of 31% in average axle loads. The MOW expense per 1000 GTM declined 28% in real terms over this period, with all of the decline coming after 1986. The productivity savings were attributed to economies of density ($2.6 billion), track technology ($1.8 billion), network rationalization ($1.5 billion), and equipment productivity ($1.3 billion).

Train Crew Costs

During the 1980s, the railroads finally achieved a breakthrough with the United Transportation Union (UTU) concerning crew consist. Rather than arguing the effects of reduced crews on workload or safety, management offered financial incentives and the unions agreed to allow crews with a conductor and an engineer on most line and many yard jobs. Exhibit 2 shows that the annual impact is approximately $4 billion. Exhibit 2a shows the basic factors related to wages and crew productivity. Train-miles were fairly constant over the entire period shown, but the train and enginemen (T&E employees) dropped 60%. As a result, T&E employees per 10,000 train miles dropped from 3.8 in 1965 to 1.39 in 1995, with the largest drop occurring after 1983. Some of this reduction in train T&E undoubtedly reflects the shift from slow local freights to faster through freights, but the dominant factors are believed to be smaller crew consists and longer crew districts.

The total compensation for train T&E employees rose from $2.6 billion in 1965 to $3.6 billion in 1983, then stayed at that level in 1995 despite the increase in train-miles. The total T&E wages per 10,000 train-miles was the same in 1995 as it was in 1978, despite the fact that the average wage rose from $24 to $57 thousand. The 136% increase in the average wage reflects in part an increase in wage rates, but also the addition of incentive payments for working on reduced crews as well as the shift from brakemen to higher paid conductors and engineers.[9]

Exhibit 2b translates the productivity gains into cost savings. Total crew costs were estimated under two sets of assumptions. First, the current employees per train-mile were used with the 1978 T&E wages. In this calculation, crew costs are directly proportional to train miles and vary very little over the entire period. The next portion of the table calculates crew costs based upon the current year wage rates and the base year employees per train mile. With this calculation, crew costs would have been $8.5 billion in 1995.

Exhibit 1
Reductions in Service Units per Unit of Output

a. Total Quantity of S.U. (millions, except where indicated)

	1965	1978	1983	1995
Road train-miles	421	433	346	458
Yard switching hours (note 6)	34	27	15	11
Total car-miles (billions)	29	29	21	30
Gross ton-miles (billions)	1680	1836	1698	2680
Revenue ton-miles (billions)	698	858	828	1306
Revenue carloads	28	23	19	24

b. Index (1978 = 100)

	1965	1978	1983	1995
Road train-miles	97%	100%	80%	106%
Yard switching hours	126%	100%	54%	41%
Total car-miles	101%	100%	73%	105%
Gross ton-miles	92%	100%	93%	146%
Revenue ton-miles	81%	100%	97%	152%
Revenue carloads	121%	100%	80%	102%
Output index	96%	100%	77%	147%

c. Savings from Reduction in S.U. per Unit of Output (1995 $)

		1965 to 1978	1978 to 1983	1983 to 1995	Total
Road train-miles	@ $5	$22	($97)	$1,036	$961
Yard switching hours	@ $10	$839	$473	$1,692	$3,004
Total car-miles	@ $0.0	$89	$86	$623	$798
1000 Gross ton-miles	@ $2.5	($226)	($1,157)	$1,467	$84
Revenue carloads	@ $15	$913	($175)	$1,866	$2,604
Total		$1,637	($869)	$6,684	$7,452

Exhibit 2
Changes in Train & Enginemen Expense, 1965 to 1995

	1965	1978	1983	1995
a. T&E Wages and Productivity				
Train-miles (millions)	421	433	346	458
T&E, Train Employees	160,180	141,220	95,168	63,831
Total compensation (millions)	$2,611	$3,393	$3,634	$3,611
Average wage	$16,300	$24,026	$38,185	$56,571
Employees/10,000 train-miles	3.80	3.26	2.75	1.39
Actual T&E Wages/10,000 train-miles	$62,019	$78,378	$105,059	$78,791
b. Labor Costs Under Various Assumptions:				
Current employees per train-mile and 1978 T&E wages per train-mile	$3,300	$3,393	$2,711	$3,592
1978 employees per train-mile and current wages per train-mile	$2,239	$3,393	$4,309	$8,458
c. Estimated Savings:				
Reduction based upon 1978 employees per train-mile and current wages per train-mile	($372)	$0	$675	$4,847
Productivity savings attributable to reduction in crew consist and longer crew districts (estimated as 80% of the total savings)	($298)	$0	$540	$3,877

The estimated savings are shown in Exhibit 2c. The first row shows the difference between the actual crew cost and the crew cost projected with current wages and the base year crew consist. In 1995, the savings amount to $4.8 billion relative to 1978. Given that some of this may relate to the shift away from local switching services rather than productivity improvements on through trains, the savings are estimated to be 80% of this, or $3.9 billion over all. Relative to 1965, the savings are estimated to be $4.2 billion.

Computers and the Elimination of Clerks and Managers

Railroads have clearly benefited along with the rest of the economy from the technological improvements in communications and office automation. By 1995, most of the clerical, car management, and customer service functions were automated and centralized. As a result, the category of employees called "Professional, clerical, and general" declined from over 130 thousand in 1965 to 108 thousand in 1978, 68 thousand in 1983, and 27 thousand in 1995. The average annual compensation for this category of employees was $43,893 in 1995, so that the benefits of just the reductions from 1983 totaled $1.8 billion, even without taking into account the 25% increase in carloads over that period. For the entire period, the savings are estimated to be $4.7 billion.

Fuel Efficiency

Fuel consumption is proportional to the work that is done in moving trains, which is commonly expressed in terms of gross ton-miles. Given total GTM, total fuel cost depends upon fuel efficiency and the price of fuel. Over the period in question, fuel efficiency measured as GTM per gallon of fuel improved, especially after 1983, with an annual benefit of $1.33 billion in 1995 prices (Exhibit 3).

Summary -- Total Productivity Savings

If we add up the productivity savings discussed in this section, we quickly come to a very impressive number, nearly $25 billion annually, most of which have been achieved just since 1983 (Exhibit 4). It is beyond the scope of this paper to try to provide a complete discussion of the sources of productivity benefits, and there surely could be differences of opinion as to the best way for calculating each area of benefits. However, it is absolutely clear that the net effect of productivity improvements has been dramatic. If the 1995 traffic were moved on the 1966 network with 1966 performance capabilities, the actual 1995 expenses of $31.4 billion would have increased more than 75% to $55 billion!

Exhibit 5 summarizes the productivity changes over this period. Productivity is measured as the ratio of an index of railroad freight volume to an index of the inputs used in rail freight transportation. From 1965 to 1978, the output index was relatively stable (rising from 96 to 100), while the input index declined steadily from 130 to 100. As a result, productivity rose by a third, from 0.74 to 1.00, or just over 2% annually. Productivity held steady through 1983, as both outputs and inputs fell. After 1983, productivity rose rapidly, from 1.02 to 2.43, which is equivalent to productivity improvement of nearly 8% annually. This extremely rapid rate of productivity improvement might well be dismissed as way out of line for a major industry over a 12-year period were it not for the specific improvements already documented in this section.

PRICES AND PROFITABILITY

Unfortunately for the rail industry, the revenue side of the picture is as dismal as the productivity side is bright. For whatever reason, essentially none of the multibillion dollar annual cost savings have survived. A decade of cost-cutting has had little or no effect on NROI. In fact, three tumultuous decades have simply reduced the size of the industry. As shown above in Figure 1, the constant dollar NROI was essentially the same in 1995 as it was in 1983, when it was barely half the NROI in 1966. What happened to the savings? To answer this question, we need to look at trends in prices and costs. Improvements in productivity lead to greater profits only if prices at least keep pace with costs. As shown in Exhibit 5, that did not happen. The price index rose steadily from 1965 through 1978, increasing by 220%, but the cost index rose by just over 300% The one third improvement in productivity offset some of the cost increases, but much of the industry still fell into bankruptcy over this period. From 1978 to 1983, a period of rapid inflation in the country and a period of great public concern about the rail industry, prices actually rose faster than costs. This is evident in the column that shows the ratio of the price index to the cost index, which rose from 0.89 to 0.94 during this period of highly focussed attention on the rail industry. It is no coincidence that this was the period when the industry's NROI rebounded. After 1983, costs continued to rise, albeit less rapidly, but

Exhibit 3
Effects of Changes in Fuel Efficiency and the Price of Fuel, 1965 to 1995

	1965	1978	1983	1995
GTM (billions)	1680	1836	1698	2680
Gallons (millions)	3592	3898	3112	3480
Cost/gallon ($/gallon)	$0.09	$0.38	$0.83	$0.60
Total fuel cost ($ billion)	$0.33	$1.48	$2.57	$2.09
1000 GTM/gallon	0.47	0.47	0.55	0.77
Index, 1978 = 100	0.99	1.00	1.16	1.64
Gallons, at 1978 consumption rate	3568	3898	3606	5691
Efficiency savings (million gallons)	-24	0	494	2211
Efficiency savings ($ billion):				
At current prices	($0.00)	$0.00	$0.41	$1.33

Exhibit 4
Summary of Annual Cost Reductions Resulting From Productivity Improvements, US Class I Railroads
(Billions of 1995 $)

Area of Savings	1965 to 1978	1978 to 1983	1983 to 1995	Overall
Reductions in Service Units per unit of Output (Heavy Haul)	$1.6	($0.9)	$6.7	$7.5
MOW Productivity (a) and Network Rationalization	$1.0	$1.0	$5.0	$7.0
Office Technology	$1.7	$1.1	$1.8	$4.7
T&E Employees	$0.3	$0.5	$3.3	$4.2
Fuel Efficiency	$0.0	$0.4	$0.9	$1.3
Total	$4.6	$2.2	$17.7	$24.6

(a) The MOW savings were predominantly achieved during the last 12 years, and the entire benefits were distributed as shown to approximate this assessment

Exhibit 5
Productivity, Price and Cost Changes, and Net Freight Revenues

	Freight Revenues	Price Index	Output Index	Freight Service Cost	Cost Index	Input Index	Produc-tivity	Ratio of Price to Cost	Revenue/ Ton-mile
Est. 196	$8.8	77	96	$8.6	62	130	0.74	1.24	1.27
Est. 196	$10.6	79	111	$10.1	77	123	0.90	1.03	1.35
1972	$12.6	100	105	$12.0	100	113	0.93	1.00	1.62
1978	$20.2	169	100	$20.2	190	100	1.00	0.89	2.36
1983	$25.8	282	77	$23.9	300	75	1.02	0.94	3.12
1995	$31.4	178	147	$27.9	433	61	2.43	0.41	2.40

Notes: The BLS Price Index for Railroad Freight was used for 1972 to 1983; the Surface Transportation Board's Price Index for Class I Railroads was used to compare 1983 to 1995.

The RR Cost Recovery Index extends back only to 1976; prior to that, the Index of charge-out prices and wage rates was used (where the wage rate includes supplements)

The freight service costs for 1965 and 1969 were estimated as total operating expense minus passenger revenues minus the solely related passenger deficit.

Revenues, costs, net freight revenues, and revenue/ton-mile are current dollars.

prices began to fall and the ratio of prices to costs declined precipitously.

In short, a serious pricing problem emerged after 1983, presumably in response to the pricing freedoms and competitive pressures resulting from deregulation of the rail and trucking industries. Using the Surface Transportation Board's Index of Class I Railroad Prices, real prices fell (from 100 in 1982) to 92.7 in 1983 to 58.5 in 1995 [Office of Economics, 1998]. If the prices had remained at the 1983 level, the revenue would have been $50 billion rather than $31 billion. If real prices had remained at the 1965 level, total 1995 revenues would have been $53 billion. The $19 billion in price cuts from 1983 to 1995 and the $22 billion for the entire period are equivalent to the cost savings summarized in Exhibit 4, i.e. the cost savings were almost entirely passed on to the customers. Despite the very impressive gains in productivity, especially over the 1983 to 1995 period, the net effect for the rail industry was simply to reduce the size of the industry by 50%, without any increase at all in profitability. The industry was unable to retain the savings that it worked so hard to gain through productivity improvements.[10]

THE RAIL INDUSTRY IN 1996

Stable Finances

By 1996, the RR industry was in its best financial shape since 1966, with NROI in the range of $2-3 billion annually and return on shareholders equity in the range of 8-10%. Despite all of the very significant achievements, the industry was still not quite revenue adequate.

Diminishing Opportunities for Productivity Improvement

By 1995, the industry had addressed its serious structural problems. It had upgraded its track and equipment; it had resolved the crew consist dispute and made headway on other major labor issues; and it had taken advantage of significant technological advances in track and equipment. Opportunities for further improvement still remained, of course, but the industry would suffer from declining returns. Future increases in car capacity will not be as dramatic as the 43% increase from the 200,000 pound car of the 1960s to the 286,000 pound car of the 1990s. Going from a 2-person crew to even a no-person crew provide lower savings, in absolute terms, than going from the 5-man crew of the 1950s to the 2-person crew of the 1990s. Doubling the life of rail components has decreasing returns because of the time value of money. Eliminating branchlines and consolidating duplicate facilities, long a major source of productivity improvements, offers fewer opportunities for the future and the industry is now in the position of adding rather than eliminating capacity. Sustaining productivity improvements for another decade at the 8% annual rate achieved from 1983 to 1995 would seem to be a very difficult feat given the emergence of severe capacity and service problems.

Increasing Pressures on Pricing

In the old regulated environment, a common complaint was that the ICC was slow to allow rate increases that would allow revenue to keep pace with inflation. Nevertheless, from 1969 to 1983, a period of high inflation, rail prices did in fact keep pace with inflation. In the deregulated environment, there is no longer an ICC, there is no longer a floor for rail prices, and prices can be raised only in the context of a highly competitive freight transportation market. With nearly two decades experience of pricing under deregulation, it is evident that it is now very difficult to raise prices. In general, customers did gain the advertised benefits of deregulation, while the railroads barely managed to retain enough profit to approach revenue adequacy. It is also worthwhile to recall that railroads fared quite well under deregulation relative to their motor carrier competitors. The motor carriers were plagued by bankruptcies and enormous operating deficits for most of the years following deregulation of their industries. The main problem was that intense competition resulted in a level of price discounting that "clearly exceeded even the fondest dreams of deregulators and has reflected the worst fears of the proregulators" [Glaskowsky, 1990, p. 12].

The motor carrier industry differs from the rail industry in that entry of new firms is relatively easy, since firms only have to worry about equipment and operations, not about the right-of-way. Even in the highly capitalized LTL industry, where entry is more difficult, all of the carriers have access to all of the customers over the same highway system, which heightens the competitive atmosphere. Railroads thus far have retained control over most of their network, and they have not been subjected to cutthroat competition from aggressive, new, non-union carriers. However, the experience of these other transportation industries should serve as a reminder that the effects of deregulation could, eventually, become much worse for the rail carriers.

Strategic Problems

Today, the rail industry faces a variety of strategic problems, some of which are new and some of which are very old:

Capacity: as a result of continued traffic growth during an era of network rationalization, line and terminal capacity are again becoming concerns.[11]

Bridges: the industry is aware that bridges could be a major annual expense of $500 million or more at some time in the not-too-distant future, when it finally becomes necessary to upgrade or replace thousands of 80-100 year old bridges [Sweeney et al., 1996].

Service: for the most part, service capabilities for general merchandise, single-car shipments are still as slow and unreliable or inefficient as they were 20 years ago [Kwon et al, 1995]. Equipment utilization and terminal performance remain major problems; in fact, the benchmarks for hump yard performance date back to the 1970s or to hump yards in other countries [Martland et al., 1994].

Competition: deregulation has certainly promoted competition. Railroads face stronger interroad competition for bulk traffic, continued competition for merchandise traffic from efficient truckload carriers, and increasing competition for intermodal traffic. With competition among rival partnerships, intermodal prices will tend to drop to the marginal costs of a service involving double-stack container trains. As Glaskowsky [1990, p.96] noted in his study of the effects of deregulation on LTL carriers, "larger shippers will never lose all of their rate advantage unless re-regulation of interstate LTL rates occurs". Unlike motor carriers, who serve all types of customers, the rail industry deals almost exclusively with "larger shippers", perhaps explaining why prices have fallen so much.

Trucking productivity: continued productivity improvements in trucking are possible in the areas of fuel consumption, size and weight restrictions, and especially in the use of information technology. Information technology will provide some efficiency at tolls, borders, weigh stations, as well as offering a better customer interface and possibilities for improved utilization of equipment and drivers.

Pressure for open access: as the number of carriers decline, shippers and state agencies are likely to push for some sort of open access to promote price competition.[12]

Pressure for passenger service: as highways and airports become more congested, and as population and travel continue to grow, pressure will continue to mount for better commuter, traditional inter-city, and high-speed rail service. These pressures will become stronger, and increased passenger operations will contribute to concerns regarding capacity.

Deregulation of the electric utilities: deregulation of the electric power utilities may put serious pressure on unit coal train rates and on the use of coal for generating electricity. At the very least, utilities will be pressing much harder for lower rates.

None of these problems are insurmountable, but they will require innovative and informed responses over the next ten to twenty years.

Outlook

Projecting the general pattern of the past 30 years out for another decade or two points to a declining traffic base, greater focus on bulk traffic and very large customers, and falling prices. With fewer obvious opportunities for productivity improvement today, the prospects for productivity improvement are much diminished. Therefore, we can envisage a scenario where price pressures prove more powerful than productivity improvements, forcing the rail industry once again into serious financial problems. But this time around, there will be fewer, more difficult options for recovery. The future is of course not entirely dismal, and there are opportunities for railroads to prosper. Railroads could do more for merchandise customers in terms of equipment and service and they could do more for bulk customers in terms of heavy haul technology. All customers could benefit from precision train control systems, efficient terminal operations, and better use of information technology. All of these possibilities will require innovation, planning, technological development, and leadership on the part of the railroads.

It will also be important for railroads to avoid strategic marketing mistakes as the industry introduces new services and more efficient equipment. Senior management must pay special attention to the implications of its marketing and pricing strategies in the light of projected operating

conditions and technological opportunities. As capacity problems become evident on many routes, a more aggressive pricing strategy and a deeper consideration of technological options would both seem to be appropriate.

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ENDNOTES

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1. Figure 1 would be little changed if another price index were used. With the GDP price index, for example, prices increase by a factor of 4.3 from 1965 to 1995, compared to a factor of 4.8 using the CPI index. The shape of the chart would be basically the same using either index.
2. Figure 1 does not take into account all of the accounting changes that took place over this period, nor does it show the effect of special charges and adjustments. During the late 1980s, for example, the industry incurred significant special charges related to the implementation of new crew consist agreements. These charges were included in current expenses, having the effect of depressing NROI. For example, the special charges in 1986 were $1.8 billion, which explains the dip in NROI in that year. If NROI before special charges were graphed, then the recovery of the 1980s would look better, but the stabilization in the 1990s would be little changed.
3. Except where otherwise noted, the financial information, service units and operating statistics used in the Exhibits and cited in the text are taken from *Railroad Facts*, published annually by the Association of American Railroads.
4. The Northeast Rail Crisis, the creation of Amtrak, the formation of Conrail and the other elements of the "Northeast Rail

Crisis" are all well-documented [Secretary of Transportation, 1978].

5. The figures on average carload used here are based upon the ratio of ton-miles/car mile, rather than "tons originated/carload" as published in *Railroad Facts* [AAR, various years].

6. The level of output is dependent upon the price index that is used. For the 1983 to 1995 period, an index published by the Surface Transportation Board was used [Office of Economics, 1998]. The BLS Price Index was based upon the 1% waybill sample and went back as far as 1969. The prices for 1965 were estimated by extrapolating changes in proportion to changes in revenue per ton-mile. During this time period, inflation was relatively low and general price increases were allowed by the ICC, so that revenue per ton-mile did reflect inflation to some extent.

7. The unit costs were assumed to be the same in 1995 as in 1978, as dramatic changes in productivity have offset equally dramatic changes in the underlying wage rates. The service unit cost for train-miles, for example, is basically the cost of the crew. In 1978, the average crew had more than 4 people; today it is down close to 2. Likewise, the breakthroughs in maintenance have extended the life of track components and reduced the costs of materials. As a result, there was no need to update these unit costs, as they remain approximately valid today.

8. Chapman combined capital and operating expenditures in his study in order to overcome the problems caused by the shift from betterment to depreciation accounting in 1983. The assumption was that the same total amount of work was being done, with only the accounting changed.

9 These other factors are believed to be much smaller than the increase in wages, as the increase in wages for other transportation employees was 133% over the same period and the increase for all railroad employees was 137%. There is also the matter of how to deal with the substantial payments to UTU members who agreed to take buyouts. Since those payments were concentrated in the period 1984 to 1991 or so, those payments do not affect the years examined in this table.

10. As a final note on profitability, consider the effect of Conrail on the industry's performance. Conrail's NROI was $0.34 billion in 1995, whereas Conrail suffered losses of $0.5 billion or more in the late 1970s. Hence, Conrail's NROI increased by roughly $1 billion per year over this period, accounting for well over a quarter of the industry's overall gain in NROI. Since Conrail only accounted for 12% of the industry's revenue in 1995, it had achieved far more than its share of the NROI improvements.

11. This was written in May 1997, somewhat before the UP capacity crisis became front page news. A "capacity crisis" is a logical end result of 15 years of downsizing and price-cutting; downsizing eliminates the excess capacity, while price cutting attracts more business.

12. Pressure has mounted dramatically for re-regulation and open access as a result of UP's capacity problems and concerns about high prices and poor service: "Another key complaint was the National Industrial Traffic League's view that the Surface Transportation Board accepted flawed arguments by the railroads that real rates had fallen precipitously in the past two decades" [Watson, 1998]. Given the evidence for dramatic productivity improvements as presented in this paper, it would appear that the STB is much closer to the truth than the NIT League.