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Governance Structure, Managerial Characteristics, and Firm Performance in the Deregulated Rail Industry

THE PASSAGE OF the Staggers Act in 1980, which removed most federal economic regulations from the rail industry, provided the managers of U.S. railroads with a clear legislative sanction to earn a fair return on capital. To this end, they undertook a number of initiatives to rationalize their rate structure, input utilization, and scale of operations to increase returns to competitive levels.[1] The number of Class I railroads has been reduced from 37 to 14; railroad labor has been trimmed 52 percent, and route mileage 29 percent. Rates of return have risen substantially, although by 1990 no railroad had consistently earned its cost of capital. Railroad companies have shared the benefits of deregulation with shippers, in the form of improved service and moderate real rates, and with shareholders, in the form of higher returns. Thus, managers have not

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1. Friedlaender (1991) has discussed the issue of rail rates in a deregulated environment, while Friedlaender and others (1991) and Berndt and others (1991) have focused respectively on the questions of capital adjustments and productivity change in the rail industry. In addition, Vellturo and others (1992) have discussed the role of mergers upon rail costs.

only responded to the opportunities provided by the competitive market, but have also been increasingly subject to its discipline.

The inefficiencies of the regulated rate structure have been well understood, and the gains from its rationalization well documented, but the relationship among regulation, managerial effectiveness, and operating efficiency has not been as fully explored.[2] To be sure, it is widely recognized that regulation protected rail labor and prevented optimal adjustments in track utilization and in the way-and-structures capital embodied in the network.[3] Indeed, a major force behind many recent rail mergers was the expectation that they would create a dynamic that would permit greater labor and capital rationalization.[4]

Many economists believe that in addition to the inefficiencies associated with input utilization, the railroads were subject to basic managerial inefficiencies that arose from the highly regulated environment in which they operated. In this environment, the primary discipline came from the regulators or the trustees of the bankruptcy courts rather than from shareholders or from the market. Wyckoff, for example, has argued that regulation encouraged rail management to be risk averse and cautious and to concentrate on existing operating strategies at the expense of marketing innovations.[5] Harris and Grimm and Winston and his associates have argued that better incentive structures provided by a deregulated environment should attract new managers into the industry who are more innovative and willing to take risks.[6] In support of these hypotheses, Grimm and his associates present evidence of a move toward younger and better educated managers in the rail industry between 1977 and 1983.[7] None of these studies, however, has attempted to analyze the causal relationships among managerial characteristics, company performance, and company governance.

In a regulated environment under government protection, it is possible for an industry to be in a state of economic disequilibrium for a

2. On inefficiencies, see, for example, Winston (1985), Levin (1981), and Friedlaender (1969). On gains from rationalization of the rate structures, see, for example, Winston and others (1990), Boyer (1987), MacDonald (1987), and McFarland (1987).

3. See, for example, Meyer and Tye (1985); and Friedlaender and others (1991).

4. For a good discussion, see Vellturo (1989); and Vellturo and others (1992).

5. Wyckoff (1976).

6. Harris and Grimm (1985); and Winston and others (1990).

7. Grimm, Kling, and Smith (1987). In addition, Grimm and Smith (1986) analyze the impact of regulatory reform on managerial performance.

substantial period of time. Of course, one would expect that firms in such an industry might have trouble attracting new capital and that a substantial degradation of service would occur as infrastructure and equipment eroded. One might also expect bankruptcies as regulators miscalculated the relationship between revenues and costs. In fact, both of these events occurred frequently in the rail industry, particularly in the 1970s, and contributed to the passage of the Staggers Act. In addition, in a regulated environment one would expect to find cautious managers, who, largely protected from competitive pressures, value traditional operating strategies and are not prone to risk or innovation.

In a deregulated environment, however, a chronically low rate of return should not be sustainable. In addition to adjusting the rate structure to enhance revenues, management would be expected to reduce the work force and to rationalize capital to the point where its marginal returns were competitive with other industries. Furthermore, if firms consistently failed to receive an adequate return on rail operations, they would be expected to diversify into new, nonrail activities. Finally, one would expect to see new managers, with broader backgrounds and experience than their counterparts in the regulated era, enter the rail industry, attracted by opportunities provided by a free, market-oriented environment.

In fact, all of these events occurred in the 1980s, as more dynamic and innovative rail company managers diversified into energy, communications, real estate, and nonrail transportation. In recent years, however, virtually all of the railroads have undertaken substantial divestment, spinning off or selling the bulk of their nontransportation subsidiaries and returning to the core rail activities. It is this dialectic of diversification, disinvestment, and refocus—and the dynamic relationships it implies among railroad managers, company governance, and company performance—that constitutes the major focus of this study.

We hypothesize that the industry has steadily evolved over the last decade from a regime in which railroad managers balanced their own interests against the interests of shareholders, shippers, Congress, and rail labor to a regime in which rail managers are more directly subject to shareholder influence. The Burlington Northern Railroad is presented as an example of the way large railroad organizations have evolved and performed in the past decade. We then provide a regression analysis

that relates firm performance to the governance structures and managerial characteristics of the firm. The final section discusses our principal finding that the experience and background of the firm's chief executive officer (CEO) affects performance, with a background in rail and an internal promotion to CEO generally being associated with lower performance. The response of the industry to the market discipline exerted by the takeover activities of the latter half of the 1980s has been decidedly mixed, however, because the various restructuring activities undertaken by the railroads during this period failed to lead to unambiguous improvements in performance.

Evolution of the Rail Industry After Deregulation

To understand the evolution of the rail industry since the Staggers Act was implemented, it is useful to think of a simple principal-agent model in which the principals change.[8] Thus, we can consider a regulated period in which the key principals were Congress and the Interstate Commerce Commission (ICC), with shareholders and large shippers playing a marginal role, and a deregulated period in which the major principals are the stockholders, with the ICC and Congress playing a secondary but still significant role. Admittedly, this construct is something of a caricature. Nonetheless, because the major principals in each regime have very different goals, their behaviors are likely to differ.

The railroads have always been publicly held, but as regulated entities from 1887 to 1980, their behavior was directly controlled by the ICC, a federal agency with the power to regulate rates, entry, and financial structure. Although Congress never explicitly stated its goals for the railroads, the provision of service on a broad geographic basis at socially acceptable rates was certainly the key element.[9] This helps explain congressional and regulatory insistence on the continuation of a "value of service" rate structure, which favored agricultural constituencies over shareholders and reluctance to grant exit via abandonments. The

8. For a full discussion of this literature, see Grossman and Hart (1980, 1983); and Hölmstrom and Tirole (1987).

9. For a full discussion of this and related points, see Friedlaender (1969); and Keeler (1983).

price distortions and excess rail capital that resulted have been well documented.[10]

Stigler and others have argued that regulation creates a symbiotic relationship between the regulator and the regulatee in which the regulatee receives tangible benefits for carrying out the regulator's goals.[11] Just as there probably was not a single principal in the case of rail regulation, there also probably was not a single agent. To be sure, rail management was the primary agent and was responsible for railroad operations. But rail labor was also a key beneficiary of regulation and thus can be thought of as acting as an agent as well. Thus, under regulation, the potential economic rents did not go primarily to shareholders, but instead were shared with rail labor, which was both highly paid and subject to substantial protection via various legislative sanctions;[12] with rail management, which was largely insulated from competitive pressures and thus led the "quiet life of the monopolist";[13] and with politically favored shippers, who were cross-subsidized by the rate structure.[14]

With deregulation the environment changed, and railroad managers were subjected to many of the same pressures as managers in other markets. The initial focus was on profitability, and the corresponding response was to rationalize rates, reduce labor forces, and diversify into activities that complemented rail operations. In addition, holding companies were formed in an effort to separate rail from nonrail activities.

Table 1 shows the extent to which railroad managers adjusted rates in response to the Staggers Act. Although legislative restraints remained on commodities in which the railroads exercised market dominance, railroads were able initially to raise real rates on coal and manufactured

10. Friedlaender and Spady (1981), Winston (1985), and Winston and others (1990).

11. See Stigler (1971). For a recent review of the economic theory of regulation, see Peltzman (1989) and the citations therein.

12. Vellturo (1989) has an interesting analysis of the effect of deregulation on rail labor.

13. This protection was hardly complete because barges were substantially unregulated, and many elements of the trucking industry (including private carriers, carriers of agricultural commodities, and many owner-operators who operated in the truckload market) were not subject to regulation.

14. Historically, these have been primarily agricultural interests; see Friedlaender (1969) and the references cited therein.

Table 1. U.S. Railroad Revenue per Carload, 1978–90

Commodity	*1978*	*1980*	*1982*	*1984*	*1986*	*1988*	*1990*
				1982 dollars			
Grain	1,574	1,821	1,531	1,353	1,120	1,088	1,101
Coal	987	1,039	1,143	1,106	1,023	967	900
Stone gravel	668	809	889	722	596	516	503
Food products	2,189	2,358	2,280	2,033	1,797	1,596	1,454
Primary forest	457	545	579	571	526	530	547
Lumber, wood	2,932	3,086	3,215	3,040	2,553	2,465	2,187
Pulp, paper	1,982	2,101	2,326	2,289	2,133	2,015	1,863
Chemicals	2,488	2,572	2,722	2,465	2,370	2,157	1,955
Metal products	1,917	2,114	2,196	1,858	1,816	1,759	1,539
Motor vehicles	2,483	2,587	2,711	2,518	2,445	2,409	2,243
All carloads	1,417	1,470	1,477	1,372	1,266	1,156	1,064
				Index 1978 = 1.00			
Grain	1.00	1.16	0.97	0.86	0.71	0.69	0.70
Coal	1.00	1.05	1.16	1.12	1.04	0.98	0.91
Stone gravel	1.00	1.21	1.33	1.08	0.89	0.77	0.75
Food products	1.00	1.08	1.04	0.93	0.82	0.73	0.66
Primary forest	1.00	1.19	1.27	1.25	1.15	1.16	1.20
Lumber, wood	1.00	1.05	1.10	1.04	0.87	0.84	0.75
Pulp, paper	1.00	1.06	1.17	1.15	1.08	1.02	0.94
Chemicals	1.00	1.03	1.09	0.99	0.95	0.87	0.79
Metal products	1.00	1.10	1.15	0.97	0.95	0.92	0.80
Motor vehicles	1.00	1.04	1.09	1.01	0.98	0.97	0.90
All carloads	1.00	1.04	1.04	0.97	0.89	0.82	0.75

Source: AAR *Analysis of Class I Railroads.*

goods, particularly forest and wood products and pulp and paper.[15] Real grain rates actually fell. Since 1984, however, rates on virtually all commodities have been essentially constant or falling in real terms, indicating that the railroads had exploited the rate-setting advantages provided by the Staggers Act by that time.

As shown in table 2, adjustments were not limited to rates. Reductions in rail labor, equipment, and way-and-structures capital have also been substantial. In the first half of the 1980s, railroad managers concentrated on the large labor forces and car fleets that had been amassed during decades of regulated operations. More recently, they have been

15. See Friedlaender (1991) for a discussion of the behavior of rates since the passage of the Staggers Act.

Table 2. Utilization of Capital and Labor, Aggregate of U.S. Class I Railroads, 1978–90

Thousands unless otherwise specified

Year	*Miles of line owned*	*Locomotives in service*	*Freight cars in service*	*Total employment*	*Way-and-structures capital (billions of 1982 dollars)*
1978	175.9	27.3	1,170.9	471.5	110.7
1979	169.9	27.4	1,123.1	474.5	107.9
1980	164.8	28.3	1,106.2	458.3	104.7
1981	162.2	27.6	1,072.0	436.4	102.4
1982	159.1	27.0	1,006.2	378.9	101.6
1983	155.9	25.7	954.9	322.0	99.0
1984	152.0	24.3	886.6	323.0	94.5
1985	145.8	22.8	807.7	301.9	89.4
1986	140.1	21.0	717.3	275.8	82.6
1987	132.2	19.9	681.1	248.5	76.8
1988	127.5	19.6	646.3	235.9	70.9
1989	124.2	19.3	626.0	227.5	66.4
1990	119.7	19.2	600.7	216.4	62.3
			Index 1978 = 1.00		
1978	1.00	1.00	1.00	1.00	1.00
1979	0.97	1.00	0.96	1.01	0.97
1980	0.94	1.04	0.94	0.97	0.95
1981	0.92	1.01	0.92	0.93	0.93
1982	0.90	0.99	0.86	0.80	0.92
1983	0.89	0.94	0.82	0.68	0.89
1984	0.86	0.89	0.76	0.69	0.85
1985	0.83	0.84	0.69	0.64	0.81
1986	0.80	0.77	0.61	0.58	0.75
1987	0.75	0.73	0.58	0.53	0.69
1988	0.72	0.72	0.55	0.50	0.64
1989	0.71	0.71	0.53	0.48	0.60
1990	0.68	0.70	0.51	0.46	0.56

Source: AAR *Analysis of Class I Railroads*: miles of line (line 342), locomotives (line 388), freight cars (line 426), employment (line 14). Way-and-structures capital is an updated estimate of the reproduction value of way-and-structures capital based on Nelson's (1975) estimates.

Table 3. Financial Performance of U.S. Railroads, 1978–90

Year	*Net operating income (millions of dollars)*	*Average net investment*[a] *(millions of dollars)*	*Rate of return on net investment (percent)*	*ICC cost of capital (percent)*
1978	446	28,199	1.58	8.4
1979	861	29,344	2.93	9.0
1980	1,339	31,694	4.22	10.0
1981	1,361	34,201	3.98	13.7
1982	742	35,129	2.11	14.0
1983	1,838	42,851	4.29	11.7
1984	2,535	44,459	5.70	12.8
1985	1,746	45,530	3.83	11.1
1986	507	45,771	1.11	8.9
1987	1,756	45,516	3.86	9.3
1988	1,979	46,294	4.27	9.7
1989	1,894	47,211	4.01	11.5
1990	2,648	47,748	5.55	11.8

Source: AAR *Analysis of Class I Railroads*.

a. In 1983 railroads were required to change from betterment to depreciation accounting. This change required a one-time appreciation in the book value of assets in 1983.

able to rationalize the locomotive fleet and have begun to reduce the amount of capital embedded in way and structures.[16]

Although rates of return have risen somewhat, table 3 indicates that they have remained substantially below the cost of capital. The reason, as the analysis of adjustments in rail capital by Friedlaender and her associates indicates, is that railroads have been unable to disinvest to the point where their huge investment embodied in way-and-structures capital is profitable at the margin.[17] This suggests that Congress and the ICC have played a residual role as principals to whom rail management had to answer despite the legislative intent and language of the Staggers Act.[18] This residual implicit regulation has created a dilemma for rail managers, because it implied that if they focused exclusively on rail operations, they could fail to earn a competitive return

16. This has only been moderately successful, however, as Friedlaender and others (1991) point out.

17. Friedlaender and others (1991).

18. During 1991 several of the major railroads, including Union Pacific and Norfolk Southern, took major charges to write down track, suggesting that this constraint may be easing.

for shareholders. The result was a series of initiatives to increase financial returns outside of rail operations. Thus, the early 1980s were characterized by diversification and organizational restructuring, in which rail operations and property became independent of nonrail operations and properties.

In the late 1980s, however, the market imposed another form of discipline on railroad managers in the wave of takeover and acquisition activity that swept American industry. Railroad companies that had acquired valuable assets but that were still suffering low rates of return were especially vulnerable because of their potential value if they were broken up. Although shareholders of a target company typically benefit from takeovers, whether hostile or friendly, successful takeovers almost always result in the replacement of existing management (or at least bring about a substantial diminution of its power).[19] In response to this threat, rail companies undertook defensive actions, adopting shareholder rights plans, divesting nonrail assets to make their companies less attractive as breakup candidates, adopting share repurchase plans to increase earnings per share, and taking on increased debt.[20]

Thus, the threat of takeover appears to have brought the interests of shareholders and management together as management adopted measures to increase shareholder value. Whether motivated by self-interest or increased responsiveness to shareholder interests, rail management in recent years has also focused on the core railroad, which in all cases utilizes a smaller plant and less labor and typically carries fewer ton-miles than it did at the beginning of the decade. In addition, many railroads have recently undertaken large restructuring charges for track and labor force rationalization, introduced managerial innovations to make the individual firms more competitive, or both.[21] Finally, during

19. For a good discussion of these issues, see Jensen (1988); Jarrel, Brickley, and Netter (1988); and Coffee (1988).

20. In most cases, the railroads were not under specific attack. The takeover threats were real, however, for the Atchison Topeka and Santa Fe, the Chicago Northwest, and the Illinois Central Gulf. See Coffee (1988) and the references cited therein for a good discussion of the dynamics of the market for corporate control. In addition, see Scherer (1988) and Schleifer and Vishny (1988).

21. For example, during 1991 the Burlington Northern, Union Pacific, Norfolk Southern, CSX, and Conrail railroads each took charges in excess of $500 million to buy out labor to reduce their train crews and track. Charan (1991) has an interesting discussion of Conrail's efforts to increase its competitiveness by changing its managerial structure and approach.

the recent recession, most railroads have been able to maintain their profitability in the face of declining traffic and seem to be well poised to benefit from the traffic increases that recovery should bring. Thus, during the 1990s the railroads may finally be able to reach the elusive goal of achieving a fair rate of return while operating in the marketplace as competitive entities with the rest of American industry.

Effects of Managerial Change: Burlington Northern

During the past decade all of the major railroads exhibited most of the behavioral responses described above. A full description of their behavior is given in appendix A. Of these railroads, the Burlington Northern is particularly interesting because it has achieved the highest overall performance of the major railroads. Thus, a description of its experience during the past decade should be instructive.

Table 4 provides summary statistics for the Burlington Northern since 1982, the first full year after its merger with the St. Louis and San Francisco. The table provides data on its chief executive (who typically had the title of chairman, CEO, and president), indicating whether he had a railroad background and whether his appointment was the result of an internal promotion. The next column indicates whether the company was reacting proactively or defensively to market activities by undertaking share repurchase plans, shareholder rights plans, or major restructuring. The table then gives the percentage of the company's revenues that arose from its transportation activities and its debt-equity ratio. The table also provides data on the average number of employees, labor productivity (revenue ton-miles per worker), track miles, revenue ton-miles per track mile, operating ratio (variable costs divided by revenues), and an estimate of Tobin's q. The last five columns present various performance measures: gross economic rate of return, the ICC measure of the rate of return, the after-tax return on assets, the return on equity, and real earnings per share.[22]

The merger of the Burlington Northern Railroad with the St. Louis and San Francisco Railroad in May 1981 created a 29,300 mile rail

22. See appendix C for a discussion of the derivation of these variables and their data sources.

Table 4. Burlington Northern: Management and Operating Characteristics[a]

Year	Chairman, CEO	Railroad background	Internal promotion	Siege	% revenues from transport activities	Debt-equity ratio[b]	Average number of employees	Labor productivity	Track miles
1982	Bressler	no	no	no	91	0.489	46,015	3,427	40,170
1983	Bressler	no	no	no	90	0.732	40,911	4,213	39,487
1984	Bressler	no	no	no	49	0.565	39,793	5,041	38,745
1985	Bressler	no	no	no	47	0.666	38,294	4,807	37,603
1986	Bressler	no	no	yes	55	1.043	35,110	5,331	35,704
1987	Bressler	no	no	no	61	0.902	32,809	6,288	32,705
1988	Bressler	no	no	yes	96	3.041	32,402	6,899	32,491
1989	Grinstein	no	yes	no	100	2.183	32,896	7,069	32,477
1990	Grinstein	no	yes	no	100	1.702	32,905	7,120	32,082

Year	Revenue ton-miles per track mile	Operating ratio	Tobin's q	Gross economic rate of return	ICC rate of return	Return on assets	Return on equity	Real earnings per share (in dollars)
1982	3,926	0.9360	na	0.0219	0.0335	3.10	6.27	4.65
1983	4,365	0.8228	0.3009	0.0659	0.0731	4.95	11.55	5.20
1984	5,177	0.7867	0.2799	0.0880	0.0887	5.19	13.12	6.64
1985	4,896	0.8072	0.3871	0.0778	0.0648	5.29	13.10	7.24
1986	5,243	0.9719	0.3551	0.0684	0.0157	−4.57	−12.29	−10.61
1987	6,308	0.8509	0.4180	0.0864	0.0694	3.39	9.97	4.20
1988	6,880	0.8529	0.5013	0.1048	0.0838	2.40	8.76	2.28
1989	7,160	0.8545	0.4453	0.1081	0.0916	3.89	23.99	2.53
1990	7,303	0.8725	0.4238	0.1095	0.0805	3.63	18.92	2.20

Source: Compustat.

a. In 1988 Burlington Northern Inc. spun off Burlington Northern Resources and concentrated its attention on the railroad operations.

b. Debt-equity ratio based on Burlington Northern Inc.

system, which spread from the Pacific coast in Washington and Oregon through the timber, oil, and mining regions in the northern tier states and the grain areas of the Midwest to ports in Texas and Florida.

At the time of the merger, Burlington Northern, Inc., was established as a holding company with the merged railroads as its principal subsidiary, but also with ancillary interests in oil and gas properties and forest and lumber operations.[23] Richard A. Bressler, a former executive vice president of Atlantic Richfield with a strong financial and operations background, was named president and CEO of the holding company. He was the first executive to control the railroad who did not have a railroad background.[24]

Although railroaders with long experience with the two constituent railroads dominated the holding company's senior management, Bressler moved to bring new management into the railroad. Walter A. Drexel, also from Atlantic Richfield, was named president and CEO of the railroad. Darius Gaskins, an economist with broad academic and government experience, was named vice president for marketing. In 1985 Gaskins became president and chief operating officer of the railroad. He acquired the title of CEO the following year.

Until the mid-1980s the holding company's sources of revenue remained relatively constant, with approximately 90 percent derived from the railroad, 4 percent from oil and gas interests, and 6 percent from forest and lumber products. Then, in 1984, Bressler acquired El Paso, an energy company with interests in gas pipelines, oil and gas exploration, and production. In 1985 he acquired Southland Royalty, an oil and gas production company that was already a major supplier for the railroad's pipeline. Within two years, the share of rail revenues fell from 91 percent to 47 percent, with oil and gas activities becoming as important as rail operations.

23. In its proxy material to the shareholders, the company stated that it wanted to form a holding company because it was difficult to raise money as a railroad. Significantly, the unions tried to block formation of the holding company on the ground that it would divert assets from the railroad.

24. Shortly after his appointment, Bressler announced a managerial reorganization that led to the establishment of seven profit centers of the transportation and resource divisions: railroad, trucking, air freight forwarding, forest management, manufacturing of forest products, energy, and real estate. According to Bressler, the holding company wanted to allow "free-standing, self-sufficient lines of business [to] grow to their full potential" (Gus Welty, "The Era of the Giants," *Railway Age*, February 23, 1981, p. 21).

Similar transformations occurred at other railroad properties. Norfolk Southern Corporation, the holding company for the merged Norfolk and Western and Southern railroads, tentatively diversified into banking, fiber optics, and real estate and acquired North American Van Lines in 1985. Union Pacific, a company that had long been diversified into real estate and energy, acquired Overnite Transportation, a large trucking firm. CSX, the large railroad conglomerate on the eastern seaboard, acquired not only American Commercial Lines, a barge company, and SeaLand, an international shipping firm, but also substantial interests in energy, communications, and real estate.

The diversification of these and other railroad holding companies might have continued for some time were it not for the takeovers and acquisitions that characterized American industry in the mid-1980s. Although not under direct threat, Burlington Northern, Inc., undertook a number of initiatives to protect the company from takeover. In 1987 it adopted a shareholder rights plan and undertook a major write-down of assets to facilitate further cuts in track and work force. The most important change occurred with a major restructuring in 1988, under which the holding company spun off Burlington Northern Resources to operate as an independent company encompassing the natural resource, energy, and real estate holdings of the previous conglomerate. Before the restructuring, Burlington Northern, Inc., was estimated to have a breakup value of $8.2 billion, while its market value was only $4.5 billion.[25] As a result of the restructuring, Burlington Northern, Inc., returned its attention to the core railroad, which again accounted for 91 percent of the corporation's revenues. To make the railroad less attractive as an acquisition target, the holding company absorbed most of the outstanding debt, increasing its debt-equity ratio from 0.902 to 3.041.

In addition to affording takeover protection, this debt created an incentive to operate the railroad efficiently and to reduce investment in

25. In a recent interview, Bressler said that the primary motivation for spinning off Burlington Northern Resources was the undervaluation of the resource holdings. According to him, both management and security analysts insisted on treating the company as a railroad and valued it accordingly. At the time of the spinoff, the common stock of the holding company was worth $4.8 billion; two years later the combined value of the holding company and the resource company was $9 billion, with the bulk of the increment accruing to the latter. See University of Washington, School of Business (1991, p. 3).

way and structures. Since the restructuring, Burlington Northern has continued to reduce labor and track to rationalize its operations. In the first quarter of 1991, for example, the holding company took a $750 million restructuring charge, primarily to allow for substantial crew reductions in train operations and a concomitant reduction in the railroad's labor force. In 1990 its labor productivity was more than double that at the time of the 1982 merger, as was the ratio of revenue ton-miles to miles of track. Before the recession of 1990, the holding company's ratio had stabilized around 0.85, one of the best in the industry, and the firm had earned sufficient cash to reduce its debt-equity ratio substantially.[26] Since the spinoff of the resource company, Burlington Northern has increased its gross economic rate of return to levels just below 11 percent, a value that is almost competitive with much of American industry.[27]

Econometric Analysis

Although this case study of the Burlington Northern is suggestive, it does not enable us to isolate and summarize the key managerial and behavioral variables that affected the performance of U.S. railroads in the 1980s. To this end, we have undertaken a regression analysis relating overall firm performance to CEO characteristics, governance structure,

26. In 1989 Gerald Grinstein moved up from vice chairman to become CEO and president of the holding company and chairman, CEO, and president of the railroad. He had been appointed vice chairman of the holding company in 1987. A lawyer who had worked on the Senate Commerce Committee in the 1970s, Grinstein had served as CEO and president of Western Airlines, where he had played an active role in reducing labor costs and the size of the work force. Thus, he continued in Burlington Northern's recent tradition of bringing in top management with no rail experience. At the time of his appointment, Grinstein announced that a primary goal was the reduction of the outstanding debt. By the end of 1989, the debt-equity ratio had fallen to 76 percent; by the end of 1990, it had fallen to 68 percent. In a recent interview ("BN's Grinstein: Charting a Steady Course," *Railway Age*, vol. 192, January 1991, pp. 21–28), Grinstein stated that he hoped to reduce this further to 50 percent by 1994 by using cash from operations.

27. The ICC rate of return for the Burlington Northern is still well below its estimated cost of capital (as is true for all railroads). This suggests that ICC accounting procedures may systematically overstate the value of rail capital and thus understate the return to capital.

and the exogenous or predetermined operating environment facing railroads.[28]

Analytical Framework

In our analysis we distinguish three types of exogenous variables. The first are characteristics of the CEO (education, age, company tenure, and so forth), variables that we call X_1. Second, we have obtained data on a number of variables characterizing the corporate control and governance of the railroad (size of board, proportion of board members external to the firm, number of executives, and the like), which we call the X_2 variables. Finally, in their day-to-day operations, railroad managers face a number of predetermined variables, such as miles of track and way-and-structures capital stock, and exogenous environmental variables, such as GNP (gross national product) and aggregate energy prices; these are called X_3 variables.

The bottom-line performance of railroads could be measured in a number of ways. We have collected data on four alternative overall performance measures—a gross rate of return on capital, a rate-of-return measure computed by the ICC, Tobin's q, and real earnings per share.[29] Because these endogenous overall performance measures in some sense represent the final outcomes of managerial initiatives, we call them Y_F. This type of model formulation suggests a set of reduced form regressions, such as

$$Y_F = f(X_1, X_2, X_3). \tag{1}$$

Although such reduced form regressions are of interest, they would mask the effects of specific managerial initiatives and operating characteristics on the final overall performance variables. Hence, a more useful approach is first to specify a number of endogenous operating environment variables controlled by management, such as average length

28. Jarymiszyn, Clark, and Summers (1985) relate CEO characteristics and background to firm performance for a large sample of publicly traded firms. Abowd (1990) has recently performed a similar analysis focusing on the effect of CEO compensation on firm performance. Myerson (1992) has examined effects of ownership structure and executive team composition on a number of Swedish firms.

29. Because of the possibility of money illusion, we also utilized the nominal value of earnings per share. However, this variable performed less well than real earnings per share in terms of the usual statistical criteria, such as closeness of fit and coefficient significance.

of haul, operating ratio, utilization measures, and labor productivity. We call these variables Y_I because they are intermediate endogenous variables. These intermediate endogenous variables are related to the three sets of exogenous variables in structural equations of the form

$$Y_I = g(X_1, X_2, X_3). \tag{2}$$

Finally, the effects of these intermediate endogenous variables and the direct effects of the exogenous variables on the firms' overall performance measures can be modeled by specifying a set of recursive structural equations having the form

$$Y_F = h(Y_I, X_1, X_2, X_3).^{30} \tag{3}$$

Using equation 3, the total effect of the various exogenous variables upon the bottom-line performance measures can be separated into a direct effect that operates on the performance measure and an indirect effect that operates through the intermediate endogenous variables.[31]

This overall model formulation is shown schematically in figure 1. Notice that in this recursive formulation, we do not incorporate a complete simultaneity that would model, say, CEO characteristics as a function of overall firm performance. Although it is of considerable interest, such a complete framework of dynamic simultaneous equations is beyond the scope of this paper.

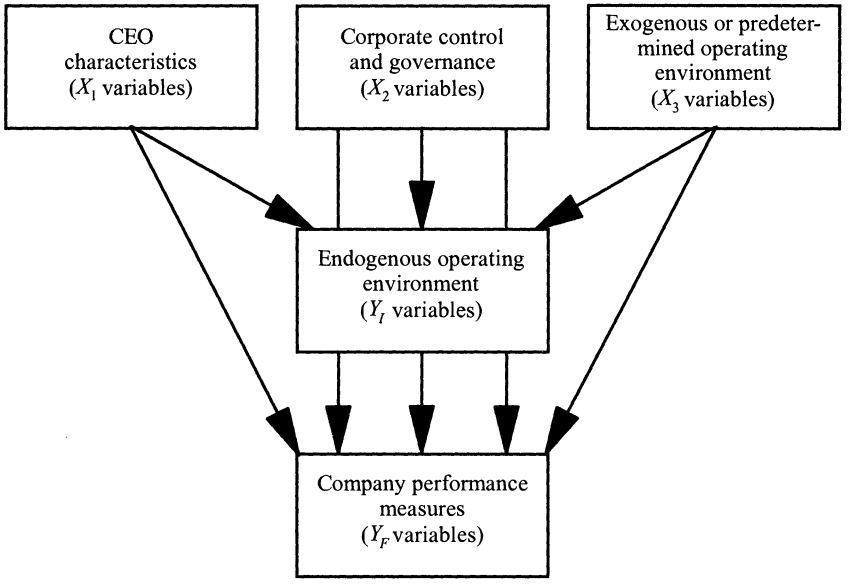
Data and Trends

The sample used in this analysis is a panel of the major railroads; for those railroads that experienced a merger between 1978 and 1990, both the merged firms and their constituent firms before merger are included. Altogether, we have 134 observations. The firms included in the analysis are Burlington Northern; Norfolk Southern; CSX; Chicago Northwest; Conrail; Illinois Central; Missouri Pacific; Norfolk and Western; Seaboard; Southern Pacific; Southern; Union Pacific; Atchison

30. To achieve identification, it is, of course, necessary to exclude from equation 3 a number of exogenous variables that are included in equation 2. In our most general formulation, each of the Y_F equations is just identified.

31. Note that $dY_F/dX = (\partial Y_F/\partial Y_I)(\partial Y_I/\partial X) + \partial Y_F/\partial X$. Thus the total effect of one of the exogenous variables upon the performance measures consists of two parts: the indirect effect expressed by $(\partial Y_F/\partial Y_I)(\partial Y_I/\partial X)$ and the direct effect expressed by $\partial Y_F/\partial X$.

Figure 1. Schematic Model Formulation



Source: Authors' calculations. Reduced form equations: $Y^F = f(X_1, X_2, X_3)$. Structural equations (recursive): $Y_I = g(X_1, X_2, X_3)$; $Y^F = h(Y_I, X_1, D_2, X_3)$.

Topeka and Santa Fe; and Western Pacific. Using these data, we first estimate by OLS the intermediate endogenous variable equations, and then, using two-stage least squares procedure, we estimate parameters in the overall performance equations.

The detailed definitions of variables used in this analysis are given in table 5. The means and standard deviations are given in appendix B, and full data sources are given in appendix C. Here, we briefly summarize the trends of these variables and then discuss the regression analysis in some detail.

The trends in the CEO characteristics indicate a substantial decline in the number of CEOs with backgrounds in operations and finance, and a concomitant increase in CEOs with backgrounds in law and marketing. The growing interest in CEOs with marketing backgrounds doubtless represents the perceived importance of pricing strategy and service quality in determining the profitability of the railroad. The growth of CEOs with legal backgrounds probably reflects an increase

Table 5. Definitions of Variables and Data Sources

Variable	*Definition*
Managerial characteristics (X_1) variables	
BA, BS, MA, MS, PHD, JD, MBA	Dummy variables taking on the value 1 if individual had earned this degree (holders of BBA degrees were classified as BAs). The omitted variable is a high school diploma. Source: Dun and Bradstreet, *Reference Guide to Corporate Management* (hereafter referred to as RGCM).
OPNS, LAW, FIN, MKT	Dummy variables taking on the value 1 if occupational background was primarily in railroad operations, law, finance and accounting, or marketing. The omitted variable is OTHER, such as government or a diverse business background. Source: RGCM.
AGE	Age of the individual. Source: RGCM.
COTEN	Years of tenure at this company (or its subsidiary). Source: RGCM.
EXECTEN	Years of tenure as an executive (president, CEO, CFO, COO, or chairman) at any major company. Source: RGCM.
RRBACK	Dummy variable taking on the value 1 if the executive had a background in the railroad industry before taking on this position. Source: RGCM.
INTERNAL	Dummy variable taking on the value 1 if the individual was promoted to current management position from within the company. Source: RGCM.
NONRRDUM	Dummy interaction variable taking on the value 1 if the individual did not have a railroad background and if the rail company he managed accounted for more than 75 percent of total holding company revenues. Source: RGCM and Moody's Transportation Manual, annual issues (hereafter referred to as MTM).
ED	Dummy variable taking on the value 1 if individual had earned graduate degree (degree beyond BA or BS). Source: RGCM.
Firm governance (X_2) variables	
CHRM, CEO, PRES	Dummy variables equal to 1 if the individual held the position of chairman, chief executive officer, and/or president. Note that often one individual held several of these positions simultaneously. Source: MTM.
EXECS	Number of other executives above the position of vice-president or senior vice-president. Source: MTM.
VPS	Number of vice-presidents and senior vice-presidents. Source: MTM.
HOLDING	Dummy variable equal to 1 if the railroad company was part of a holding company. Source: MTM.

Table 5 (continued)

Variable	*Definition*
ONBOARD	Number of company management officials serving on the company's board of directors. Source: MTM.
TOTALBD	Total number of members on the company's board of directors. Source: MTM.
BRDEXT	Proportion of total board of directors that do not serve as company management. Source: MTM.
Exogenous or predetermined environment (X_3) variables	
MERGEDUM	Dummy variable equal to 1 if company was involved in a merger that year. Source: MTM.
MERGEYR	Number of years since the company was last involved in a major merger or acquisition. Source: MTM.
SIEGE	Dummy variable equal to 1 if company was involved in a major corporate restructuring, was the subject of a merger takeover, or undertook shareholder rights plan in that year. Source: MTM, *Railway Age*, *Traffic World*, and *Wall Street Journal*.
POISON	Dummy variable equal to 1 if company adopted a shareholder rights plan in a given year and for each year that it continued in place. Source: MTM, *Railway Age*, *Traffic World*, and *Wall Street Journal*.
PCTCOAL	Percent of total freight tons involved in transporting coal. Source: Constructed from Association of American Railroads, *Analysis of Class I Railroads*, hereafter referred to as the AAR. See appendix C for a detailed description of the derivation of the AAR variables.
MLTRACK	Miles of track (including yards and double lines). Source: AAR.
MLROAD	Miles of road (route miles operated by railroad). Source: AAR.
KLLAG	Capital stock of the company at the end of the previous year (sum of way-and-structures capital and equipment capital in billions of 1982 dollars), divided by average number of employees at the company in the previous year. Source: AAR.
CAPLAG	Capital stock of the company at the end of the previous year (sum of way-and-structures capital and equipment capital, in billions of 1982 dollars). Source: AAR.
EMPLAG	Average number of employees at the company in the previous year. Source: AAR.
KQUAL	Capital stock of the company (as defined in CAPLAG) divided by miles of track in the previous year. Source: AAR.

Table 5 (continued)

Variable	*Definition*
PRT	Producer price index for rail freight divided by average truck revenue per truck ton, normalized to 1982 = 100. Source: U.S. Department of Commerce, *Survey of Current Business*.
PPIEN	Producer price index for finished energy goods (1982 = 100). Source: 1991 *Economic Report of the President*.
GDP	U.S. gross domestic product (billions of 1982 dollars). Source: 1991 *Economic Report of the President*.
SPLIT1, SPLIT2	Dummy variables that take on a value of 1 in the year of a stock split and thereafter. Because the number of shares only enters in the derivation of earnings per share, these variables are used only in the estimation of this final-stage equation. Source: MTM.
Endogenous operating environment (Y_I) variables	
ALOH	Average length of haul, in miles (freight ton-miles divided by freight tons). Source: AAR.
COMP	Average compensation of all employees, in 1982 dollars. Source: AAR.
XCOMP	Average compensation of all executives and staff assistants, in 1982 dollars. Source: AAR.
OPRATIO	Ratio of operating expenses to total revenue. Source: AAR.
RTMTRK	Revenue ton miles per mile of track. Source: AAR.
DERATIO	Ratio of company's debt (at par) to the sum of its equity (face value) plus retained earnings. Source: AAR and Compustat.
PCTTRANS	Proportion of company's revenues derived from transportation operations. Source: MTM.
MFP	Percent growth in aggregate multifactor productivity. Source: Constructed from AAR data.
LPROD	Average labor productivity (revenue ton-miles divided by total number of employees). Constructed from AAR data.
INVTOT	Current railroad expenditures for way-and-structures and equipment capital, deflated to billions of 1982 dollars. Source: Constructed from AAR data.
INVRATE	Current railroad expenditures in way and structures and equipment capital, divided by capital stock at end of previous period, all in billions of 1982 dollars. Source: Constructed from AAR data.
Endogenous aggregate performance (Y_F) indicators	
GROSSROR	Gross rate of return on nondepreciated assets (net railway operating income plus depreciation plus taxes, all divided by nondepreciated total assets, all in current dollars). Source: Constructed from AAR data.

Table 5 (continued)

Variable	*Definition*
ICCROR	Rate of return on capital computed using Interstate Commerce Commission procedures, but without adjustments for revenue adequacy. Source: AAR.
REPS	Real earnings per share (in hundreds of dollars). Gross income divided by shares outstanding at end of year. Source: AAR and Standard and Poors. Data deflated by consumer price index (1982–84 = 1.000).
TOBINQ	Market value of firm's debt plus equity, divided by replacement value of its equipment and way-and-structures capital stock. Source: Constructed from Compustat and AAR data.

in importance given to managers with experience in government and labor negotiations. The proportion of CEOs who were promoted from another position within the company fell initially but then rose somewhat. The rise, which probably reflects the internal promotion of executives who were brought into senior management positions from outside, is consistent with the fall in the proportion of CEOs with backgrounds in the rail industry.

Similar trends have occurred in firm structure and governance. The number of senior executives has fallen steadily, indicating a more centralized management structure, with more control in the hands of the chairman and CEO. Although the number of vice presidents rose somewhat after the passage of the Staggers Act, it has fallen since 1986, again indicating a desire to consolidate and simplify management. The growth and subsequent contraction of the number of vice presidents may also reflect the dialectic of diversification and retrenchment. Although the size of the board rose initially, it fell in the latter half of the decade, which again is consistent with smaller and leaner operations. The number of internal executives on the board also fell during this latter period, but the proportion of representatives from positions outside the railroad remained constant.

For the most part the exogenous operating environment has been constant throughout the sample period with the exception of variables that reflect some form of restructuring to enhance shareholder value (*SIEGE*) or the adoption of a shareholder rights plan (*POISON*). These variables only became operational in the latter part of the sample,

suggesting that the railroads were under considerable market pressure during the past several years.

While managerial control is not complete, the endogenous or intermediate operating characteristics (Y_I) represent those variables over which management has substantial control, although some of this authority is jointly held by the board and management. Productivity measures such as operating ratio, labor productivity, track utilization, and current investment in new equipment and way-and-structures capital are largely under direct control of management (although large labor reductions and investments may be subject to board approval). In contrast, variables that reflect the financial structure or the direction of the company, such as the debt-equity ratio or the degree of diversification, are more apt to be decisions that the board and management make jointly.[32]

Major changes occurred in the endogenous operating characteristics, especially in the last period of the sample, suggesting the importance of market and managerial influence. Miles of track in the larger, merged firms remained essentially the same, and employment did not drop until the last period, but dramatic gains were achieved in labor productivity, track utilization, and multifactor productivity. In addition, the average debt-equity ratio increased substantially. These results are consistent with the desire of management to streamline the railroad and cut costs.

The changes in the overall performance measures indicate general improvement in the management of the railroads. The gross economic return to capital has almost doubled, as has the "official" ICC rate of return. Tobin's q has also risen, suggesting that overall market valuation has responded to the efforts to enhance shareholder value. Real earnings per share have fallen throughout the sample period, however, indicating

32. The characterization of variables as being part of the endogenous or exogenous operating environment is admittedly discretionary. Although management, for example, can influence traffic levels through its rate structure or the average length of haul through its traffic mix, these variables are obviously affected by the general economic climate and the firm's geographic location. In addition, some causality is likely to exist between the endogenous operating characteristics and the management characteristics. Although a new, innovative outside management may generate a low operating ratio, for example, a high operating ratio may similarly cause the railroad to replace an existing CEO with one from outside the industry.

that management may not have acted as aggressively as it might have to increase shareholder value.[33]

First-Stage Regression Results

We now turn to the regression analysis and consider first the relationship between the intermediate endogenous variables (Y_I) and the different sets of exogenous variables.[34]

Table 6 gives the sign of the expected effect of the different exogenous variables upon each of the endogenous operating variables. The first three endogenous variables reflect various dimensions of productivity. Because the operating ratio (*OPRATIO*) reflects the ratio of variable costs to revenues, low operating ratios reflect operating efficiencies. In contrast, labor productivity (*LPROD*) and track utilization (*RTMTRK*) reflect output per input; thus, high values reflect operating efficiencies. The signs of the expected effects of the exogenous variables upon the operating ratio variable will therefore be opposite to those upon the other productivity measures.

The effect of variables reflecting CEO characteristics is somewhat difficult to predict. Because education reflects embodied human capital, we would expect a more educated CEO to enhance firm productivity. Thus, the expected sign of education (*ED*) on the operating ratio is negative, while those on labor productivity and track utilization are positive. The importance of human capital and experience would lead us to expect that CEO characteristics reflecting operating or marketing experience would also be associated with higher productivity, while the effect of a background in law or finance is unclear. Finally, the role of human capital and experience would also lead us to expect that higher productivity would be associated with age and variables that reflect railroad or broad managerial experience, such as tenure (*COTEN, EXECTEN*), railroad background (*RRBACK*), and promotion from within

33. Because of the apparent emphasis placed on shareholder value in recent years, it would be desirable to develop a series on total shareholder return, which is typically measured by dividend payout plus capital gains divided by the share price. We have been unable to develop a reliable series on shareholder return because of the large amount of financial restructuring that occurred in the 1980s.

34. We focus in the text and its equations on those variables associated with the endogenous operating environment that reflect productivity change and managerial control.

Table 6. Expected Signs, Endogenous Operating Characteristics

Exogenous variables	*Endogenous operating characteristics*				
	OPRATIO	*RTMTRK*	*LPROD*	*INVRATE*	*XCOMP*
ED	−	+	+	?	?
OPNS	−/+	+/−	+/−	+	?
LAW	?	?	?	?	?
FIN	?	?	?	−	?
MKT	−/+	+/−	+/−	−	?
AGE	−/+	+/−	+/−	?	?
COTEN	−/+	+/−	+/−	+	+
EXECTEN	−/+	+/−	+/−	?	+
RRBACK	−/+	+/−	+/−	+	+
INTERNAL	−/+	+/−	+/−	+	+
NONRRDUM	+/−	−/+	−/+	?	?
EXECS	+	−	−	?	+
VPS	+	−	−	?	+
HOLDING	+	−	−	−	+
TOTALBD	+	−	−	?	+
BRDEXT	−	+	+	?	?
MERGEDUM	−	+	+	?	+
MERGEYR	−	+	+	?	+
SIEGE	−	+	+	−	+
POISON	−	+	+	−	+
PCTCOAL	−	+	+	?	?
KLLAG	−	+	+	−	?
PRT	+	−	−	−	−
PPIEN	?	+	+	+	+
GDP	−	+	+	+	+

Source: Authors' calculations. Definitions of variables are given in table 5.

the company (*INTERNAL*). If, however, we accept the hypothesis of regulatory inefficiency, we would expect that the variables associated with a rail background would have a negative effect upon productivity. In these cases, we have assigned two values to the CEO characteristics. The first set would be expected if the effect of human capital were dominant, while the second set would be expected if the effect of regulatory inefficiency prevailed.

The next set of variables reflects company control and governance. In general, we would expect firms that had complicated management structures, with many executives and vice presidents under control of the holding company, to operate less efficiently than those with a simpler structure. To the extent that a large board reflects organizational com-

plexity, it too would be associated with inefficiencies. In contrast, a strong external board presence should be associated with efficiencies and enhanced productivity.

The third set of variables reflects the exogenous operating environment. To the extent that mergers lead to efficiencies, they should be associated with enhanced productivity. Similarly, because coal is relatively cheap to carry and is a high-volume commodity, high percentages of coal traffic should be associated with efficiencies, as should the lagged capital-labor ratio. To the extent that rail traffic is associated with general economic activity, gross domestic product (GDP) should have a positive effect on productivity. Conversely, a rise in rail rates relative to truck rates should have a negative effect. In contrast, the expected impact of a rise in energy prices (which largely reflect oil prices) upon productivity should be positive for two reasons: fuel plays a larger role in truck costs than in rail costs; and a rise in oil prices causes users to substitute coal. Both of these should enhance rail demand and hence output per unit of input. Finally, to the extent that market pressures exert discipline upon the companies, we would expect the presence of the *SIEGE* and *POISON* variables to enhance efficiency.

The investment rate reflects the ratio of new investment in equipment and way and structures to the existing capital stock and should therefore be connected to efforts to increase operating efficiency. Hence, we would expect it to be positively associated with a CEO background in operations or rail activities. The effect of the company governance or control variables on the investment ratio is unclear, however, although the existence of a holding company could indicate that, on balance, the firm would invest more in nonrail activities than in rail activities. Similarly, market discipline as evidenced through the presence of *SIEGE* or *POISON* could cause the firm to reduce investment in rail capital, as could the presence of a large amount of existing capital. Finally, an increase in GDP or the price of oil should be positively associated with rail investment to the extent that they enhance rail demand.

It is not clear whether the operating experience or education of the CEO should have a direct effect upon real average executive compensation (*XCOMP*). However, it is likely that a CEO with long company experience would want to reward his associates; thus, we would expect a positive association between company tenure and executive compensation. Similarly, we would expect a large complex organization (one

with a large number of executives or vice presidents, a holding company structure, or a large board) to be associated with relatively high executive compensation. Although a strong external board presence could serve to control executive compensation, it could also serve to reward managers who are performing well in the transitional environment that characterized the industry during the past decade. Hence, the sign of the impact of a strong external board presence is ambiguous. To the extent that market discipline, as shown by the presence of a *POISON* or *SIEGE* variable, is effective, executive compensation should rise in response to enhanced performance. If mergers yielded efficiencies, we would expect to see higher executive compensation. Similarly, increases in demand occasioned by increases in GDP or oil prices should be associated with higher executive compensation, while reductions in demand occasioned by a rise in relative rail rates should lead to reductions in executive compensation.

With this background, we now turn to the regression analysis. Although our analysis explicitly considers managerial characteristics and firm governance and control variables, there may be unobserved managerial characteristics and aspects of the operating environment that have not been taken into account. Hence, we add firm-specific fixed effects into our regression equations in the form of an additive dummy variable that takes on a zero–one value for each railroad in the sample.[35]

Table 7 reports on regressions relating the endogenous operating characteristics to the vectors of CEO characteristics, firm governance and control, the exogenous operating characteristics, and the fixed effects. The equation results in table 7 include the endogenous operating characteristics related to productivity (operating ratio, track utilization, labor productivity, and the investment rate) and executive compensation. Equations for the other intermediate endogenous variables are reported in appendix D.

Our final specification of these equations was derived through an

35. To test for the importance of these variables, we estimated the regression equations with and without the firm-specific dummy variables and performed a likelihood ratio test to evaluate their significance. With the exception of multifactor productivity and the debt-equity ratio, the χ^2 test statistic was well beyond the value of the test statistic at the 99 percent level of significance. The χ^2 test statistic for multifactor productivity was significant beyond the 90 percent level, while for the debt-equity ratio, it was significant at the 50 percent level.

iterative process, in which parameters with a *t*-statistic under 1.0 in absolute value were eliminated from the equations. Since theory does not indicate a priori which variables should be significant, this approach seemed acceptable and permitted us to focus on those variables that have a statistically significant impact upon railroad performance. We now discuss the results of the final specifications obtained from this iterative process.[36]

The operating ratio reflects the ratio of variable costs to revenues and is generally considered to be a key measure of efficiency. None of the CEO background variables is significant. However, executive tenure, internal experience, and education are associated with higher operating ratios, suggesting that embodied human capital may not lead to enhanced efficiencies. The negative sign associated with the nonrailroad dummy (reflecting the presence of the president of a rail subsidiary without a railroad background) implies that regulatory inefficiencies may offset any gains from embodied human capital in achieving low operating ratios. With respect to the exogenous operating environment, a high capital-labor ratio, GDP growth, and high energy prices are associated with low operating ratios, while a reduction in demand caused by an increase in relative rail rates causes the operating ratio to rise.

Track utilization and labor productivity are also indicative of operating efficiencies. Track utilization is positively affected if the CEO has a background in operations, law, finance, or marketing. Learning by doing also has a positive effect, as the positive coefficients on company tenure indicate. A rail background appears to have a strong negative impact, however, while a strong external board presence increases track utilization. External market pressure has a mixed effect. The adoption of a shareholder rights plan increases track utilization, while the presence of a more general *SIEGE* appears to reduce it. Finally, a high capital-labor ratio or growth in GDP has a positive effect on track utilization. CEO line experience does not appear to affect labor productivity, but an internal promotion to CEO appears to have a strong negative effect. In terms of company governance, the existence of a

36. To test for the joint validity of these restrictions, we performed a likelihood ratio test on the restricted and the unrestricted regressions that included all of the exogenous variables. In no case was the χ^2 test statistic significant at the usual levels of significance, indicating that the data supported the joint imposition of these restrictions.

Table 7. Final OLS Parameter Estimates of Selected First-Stage Regression Equations

	Dependent variable				
Regressor	*OPRATIO*[a]	*RTMTRK*[a]	*LPROD*[a]	*INVRATE*[a]	*XCOMP*[a]
Constant	−0.1805	0.8386	−4.5809	−33.6708	6.7963
	(0.24)	(0.78)	(3.59)	(6.89)	(11.51)
ED	0.0666	. . .	. . .	0.2813	−0.0583
	(3.40)			(2.45)	(4.34)
OPNS	. . .	0.1985	. . .	0.6237	. . .
		(3.99)		(3.19)	
LAW	. . .	0.2287	. . .	0.6414	0.0443
		(4.87)		(3.29)	(3.29)
FIN	. . .	0.1952	. . .	0.3952	. . .
		(4.22)		(2.04)	
MKT	. . .	0.2045	. . .	0.7851	. . .
		(3.39)		(3.21)	
AGE	. . .	. . .	0.0040	. . .	−0.0016
			(2.37)		(1.39)
COTEN	. . .	0.0023	. . .	. . .	. . .
		(1.77)			
EXECTEN	0.0044	. . .	. . .	0.0342	. . .
	(2.27)			(3.16)	
RRBACK	. . .	−0.1389	. . .	. . .	0.0228
		(3.52)			(1.25)
INTERNAL	0.0507	. . .	−0.0872	−0.2694	. . .
	(2.18)		(3.20)	(1.95)	
NONRRDUM	−0.0527	. . .	. . .	. . .	. . .
	(1.53)				
EXECS	. . .	. . .	. . .	. . .	0.0107
					(2.55)
VPS	. . .	−0.0038	−0.0018	. . .	0.0018
		(2.67)	(1.23)		(2.26)
HOLDING	. . .	. . .	0.0745	. . .	. . .
			(1.95)		
TOTALBD	. . .	−0.0074	−0.0043	. . .	−0.0025
		(3.25)	(2.01)		(1.88)
BRDEXT	. . .	0.0873	. . .	. . .	0.1380
		(1.62)			(4.63)
MERGEDUM	0.0641	. . .	. . .	0.3140	. . .
	(1.83)			(1.74)	
MERGEYR	. . .	. . .	0.0172	. . .	−0.0193
			(2.69)		(5.61)
SIEGE	0.0387	−0.0518	. . .	. . .	. . .
	(1.82)	(2.06)			

Table 7 (continued)

	Dependent variable				
Regressor	*OPRATIO*[a]	*RTMTRK*[a]	*LPROD*[a]	*INVRATE*[a]	*XCOMP*[a]
POISON	. . .	0.0468	0.0791	−0.2933	. . .
		(1.48)	(2.57)	(2.23)	
PCTCOAL	. . .	. . .	0.6264	. . .	. . .
			(3.57)		
KLLAG[a]	−0.1971	0.1246	0.3728	−0.5931	−0.0758
	(4.27)	(2.21)	(6.22)	(2.29)	(2.38)
PRT[a]	0.1884	. . .	. . .	−1.8647	. . .
	(1.72)			(4.36)	
PPIEN[a]	−0.0591	. . .	. . .	. . .	−0.0964
	(1.92)				(6.23)
GDP[a]	−0.1825	1.0994	1.9794	3.2491	0.5076
	(2.53)	(10.44)	(16.06)	(7.02)	(9.70)
Burlington Northern	−0.0107	0.2014	0.0778	−0.1865	−0.0911
	(0.35)	(3.93)	(0.81)	(1.07)	(3.55)
CSX	−0.0230	−0.1372	−0.4589	−0.3325	0.0262
	(0.75)	(3.23)	(5.55)	(1.80)	(0.95)
Chicago Northwest	0.0893	−0.4410	−0.1338	−0.7756	−0.1252
	(2.76)	(10.01)	(2.58)	(4.61)	(5.01)
Conrail	0.1983	−0.3184	−0.7823	−0.5786	−0.1726
	(4.72)	(6.02)	(10.27)	(2.70)	(6.78)
Illinois Central Gulf	0.1455	−0.3861	−0.3121	−0.8700	−0.1187
	(4.42)	(7.92)	(4.98)	(4.75)	(5.09)
Missouri Pacific	−0.0405	0.0747	0.1496	0.3545	−0.1274
	(0.99)	(1.56)	(2.13)	(1.59)	(5.22)
Norfolk Southern	−0.0591	−0.1667	−0.5693	−0.3759	−0.0273
	(1.65)	(3.40)	(5.81)	(1.84)	(0.92)
Norfolk and Western	−0.1260	−0.0663	−0.4505	−0.4539	−0.0981
	(2.83)	(1.13)	(3.45)	(1.86)	(2.98)
Seaboard Coast Line	−0.0315	−0.0530	−0.2569	−0.9805	−0.1884
	(0.68)	(0.88)	(2.09)	(3.89)	(5.54)
Southern Pacific	0.0735	0.1218	0.0595	−0.1030	−0.1945
	(2.54)	(3.60)	(1.50)	(0.67)	(10.67)
Southern	−0.0870	0.0015	0.0926	0.9543	−0.1249
	(2.05)	(0.03)	(1.21)	(4.36)	(4.67)
Union Pacific	−0.0476	0.3072	0.0745	0.0932	−0.0603
	(1.58)	(6.78)	(1.44)	(0.60)	(2.33)
Western Pacific	0.0753	−0.3256	−0.1390	−0.0344	−0.0243
	(1.98)	(5.87)	(2.48)	(0.17)	(0.89)
R^2	0.6528	0.9381	0.9638	0.7594	0.8173

Source: Authors' calculations. Definitions of variables are given in table 5. Numbers in parentheses are the absolute values of *t*-statistics. The Atchison Topeka and Santa Fe is used as the base-case railroad.

a. Natural logarithms.

holding company structure appears to increase productivity. As was true in the case of track utilization, external market forces in the form of the adoption of a shareholder rights plan also have a positive impact upon productivity, while the existence of a large capital-labor ratio has a very strong positive effect, as does GDP growth.

The investment rate (*INVRATE*), which measures the rate of investment in way-and-structures capital and equipment, is positively affected by line experience in operations, law, finance, or marketing, while an internal promotion appears to have a negative effect. Large amounts of existing capital relative to labor tend to reduce capital investment. The adoption of a shareholder rights plan also appears to reduce investment, suggesting that market discipline may encourage firms to divert their cash flow from capital investment in the railroad. To the extent that the railroads are overcapitalized, this diversion should serve to increase shareholder value.[37]

The first-stage regression also brings to light an interesting relationship between managerial characteristics and executive compensation. In the regression for real average executive compensation, none of the CEO characteristics is significant, with the exception of a law background, which has a positive effect on average executive compensation. Executive compensation is higher, however, if the CEO has a railroad background. Moreover, as the number of executives and vice presidents increases, so does average executive compensation, indicating that as its size increases, top management is able to exert some pressure on the board to increase executive compensation. Somewhat surprisingly, average executive compensation rises with the percentage of the board that is external (although it falls as the total board size increases).

The fixed effects are interesting and fail to indicate the existence of systematic differences among the railroads in our sample. The base railroad is the Atchison Topeka and Santa Fe (ATSF).[38] Thus, the fixed effects reflect deviations from the constant term of the ATSF for each of the dependent variables and as such can be interpreted as deviations from the average value of the dependent variable for the ATSF. The

37. Friedlaender and others (1991).

38. See appendix A for a full discussion of the behavior of the major railroads in our sample during the past decade. In this paper, we focus on the merged entities, rather than their constituent railroads.

Burlington Northern, the Norfolk Southern, and the Union Pacific have achieved the highest levels of overall performance during the past decade. In addition, although Conrail started from a very low base as the entity created out of the bankrupt railroads in the Northeast, its performance is generally viewed as being quite good. In contrast, the CSX has done less with its promise, as has the Chicago Northwest and Illinois Central Gulf. Finally, because of the difficulties created by their aborted merger attempt, the ATSF and the Southern Pacific are generally viewed as having performed rather poorly in the deregulated environment.

It is useful to evaluate the fixed effects in their context. Although the operating ratio is generally viewed as being the best measure of overall efficiency, only the Norfolk Southern and the Union Pacific have operating ratios that are, on average, lower (at the usual levels of statistical significance) than the ATSF, while those of Conrail, the Illinois Central Gulf, Southern Pacific, and the Chicago Northwest are higher. Moreover, relative to the ATSF, labor and capital productivity are lower for the CSX, Conrail, Illinois Central Gulf, Chicago Northwest, and Norfolk Southern. Only the Union Pacific has levels of labor and track productivity that are significantly higher than those of the ATSF, while the Burlington Northern has a higher level of track productivity. The investment rates of the other railroads are generally lower than those of the ATSF, as is the average level of executive compensation.

These results are somewhat surprising, since we would expect good performance to be associated with lower operating ratios, high levels of track and labor productivity, high investment rates, and high levels of executive compensation. Nevertheless, it is important to recognize that the fixed effects reflect average, rather than marginal, performance and, as such, do not capture changes in these variables, which are more likely to be related to overall performance than are the average values. Conrail is a particularly good example of this phenomenon since it was characterized by gross inefficiencies when it initially came into being. Thus, its high level of performance is related to its ability to shed these inefficiencies and improve its productivity and profitability, rather than its ability to be an industry leader in this regard. Indeed, despite the progress that the company has made, its performance with respect to operating efficiencies, productivity, and profitability is near the industry average. In contrast, the Norfolk Southern has consistently had

the lowest operating ratio in the industry despite relative low levels of labor productivity and track utilization.

Second-Stage Estimation Results

We now turn to the analysis of the final performance variables. Table 8 indicates the sign of the expected relationship between each of these final performance measures and the other variables. The first three performance measures—gross rate of return (*GROSSROR*), the rate of return computed using ICC procedures (*ICCROR*), and real earnings per share (*REPS*)—are largely driven by earnings or profits and thus can loosely be thought of as quasi-reduced form equations relating profits to the various regressor variables. Since profitability is related to productivity, cost efficiencies, and demand, variables that reflect these attributes (the operating ratio, GDP, and mergers, for example) should be positively related to these performance measures. As was true in the case of the intermediate operating characteristics (Y_I), the signs of the CEO experience variables are ambiguous. To the extent that they reflect embodied human capital, experience variables should be related to increased profitability, and we would expect positive relationships between these final performance measures and such variables as operations, marketing, a rail background, company tenure, and the like. To the extent, however, that regulatory inefficiencies dominated the managerial environment, the signs of these variables should be negative. Hence, we have included different signs in these cases, with the positive signs reflecting the importance of human capital and the negative signs reflecting the importance of regulatory inefficiencies. Finally, to the extent that market discipline (as shown by *SIEGE, POISON*, or the debt-equity ratio) causes management to undertake efforts to increase profitability, it should have a positive impact on these three profit-related variables.

Tobin's q is measured by the ratio of the market valuation to the replacement valuation of the firm. Thus, to the extent that market valuation reflects profitability, the expected signs of the relationship between Tobin's q and the various regressor variables should be the same as those of the other final performance variables. However, it is likely that this variable would be particularly sensitive to financial variables and those that reflect market discipline. Hence, we would expect To-

Table 8. Expected Signs, Aggregate Performance Indicators

	Aggregate performance indicators			
Variable	*GROSSROR*	*ICCROR*	*REPS*	*TOBINQ*
OPRATIO	−	−	−	−
LPROD	+	+	+	+
RTMTRK	+	+	+	+
INVRATE	+	+	+	+
XCOMP	?	?	?	?
COMP	?	?	?	?
ALOH	+	+	+	+
PCTTRANS	?	?	?	?
MFP	+	+	+	+
DERATIO	+	+	+	+
ED	+	+	+	+
OPNS	+/−	+/−	+/−	+/−
LAW	?	?	?	?
FIN	?	?	+	+
MKT	+/−	+/−	+/−	+/−
AGE	+/−	+/−	+/−	+/−
COTEN	+/−	+/−	+/−	+/−
EXECTEN	+/−	+/−	+/−	+/−
RRBACK	+/−	+/−	+/−	+/−
INTERNAL	+/−	+/−	+/−	+/−
NONRRDUM	−/+	−/+	+/−	+/−
EXECS	?	?	?	?
VPS	?	?	?	?
HOLDING	−	−	+	+
TOTALBD	?	?	?	?
BRDEXT	+	+	+	+
MERGEDUM	+	+	+	+
MERGEYR	+	+	+	+
POISON	+	+	+	?
SIEGE	+	+	+	+
PCTCOAL	+	+	+	+
KLLAG	+	+	+	+
PRT	−	−	−	−
GDP	+	+	+	+
PPIEN	+	+	+	+

Source: Authors' calculations. Definitions of variables are given in table 5.

bin's q to be positively affected if a CEO had a background in finance or if the company was taking defensive action in the presence of a *SIEGE*. Because shareholder rights plans have been shown to be associated with reductions in share prices and the returns to shareholders, the predicted sign of *POISON* is ambiguous.[39]

Table 9 presents the second-stage regressions that relate the final performance measures to the first-stage variables and the exogenous variables that reflect CEO characteristics, firm governance, and the exogenous operating environment.[40] With the exception of real earnings per share, the fixed effects did not add any explanatory power to the second-stage regressions and were consequently not incorporated into their final specification,[41] which was obtained by an iterative procedure in which we eliminated variables that were not statistically significant.[42]

Gross economic return is positively affected by high labor productivity, by operating efficiencies as exhibited by low operating ratios, and by high levels of new investment in track and equipment. It is negatively affected by high levels of executive compensation and by CEO line experience in operating, law, finance, or marketing. It is positively affected if the CEO was an internal appointment, suggesting some importance for the role of human capital. The importance of

39. For a discussion of these and related points, see Jarrell, Brickley, and Netter (1988); Ruback (1988); Analysis Group (1991); and Coffee (1988).

40. In the two-stage least squares regressions, we used as instruments the following variables: a constant, *OPNS, LAW, FIN, MKT, RRBACK, INTERNAL, NONRRDUM, HOLDING, TOTALBD, BRDEXT, SIEGE, AGE, COTEN, EXECTEN, EXECS, VPS, MERGEDUM, MERGEYR, EMPLAG* (ln), *CAPLAG* (ln), *PCTCOAL, KQUAL* (ln), *GDP* (ln), *PPIEN* (ln), *BA, BS, MS, MBA, PHD, JD, POISON, CEO, CHRM, PRES, YEAR,* and the firm-specific dummy variables. To check that the model was indeed simultaneous, we performed a Hausman specification test, with the null hypothesis that the Y_I variables were exogenous and the alternative hypothesis that the Y_I variables were endogenous and correlated with the equation disturbance term. In all cases (except the debt-equity ratio) the χ^2 statistic was well beyond the test statistic at the 99 percent confidence interval, implying that simultaneity was indeed present in these data.

41. To ensure that this assumption was acceptable, we estimated the equations with and without the fixed effects and performed a quasi-likelihood ratio test. In all of the regressions except the one for real earnings per share, the χ^2 statistic was well below the level that would cause us to reject the hypothesis that the omitted fixed effects had no explanatory power.

42. To ensure that this procedure was acceptable, we estimated the equations in their restricted and unrestricted forms and performed a quasi-likelihood ratio test. In no case was the χ^2 statistic at a level of significance to make us reject the hypothesis that the omitted variables had no explanatory power.

market discipline is shown by the positive relationship between the gross rate of return and a strong external board presence, *POISON*, and a high debt-equity ratio. However, a more general *SIEGE* appears to have a small negative impact.

The ICC rate of return exhibits similar behavior, being positively affected by labor productivity and operating efficiencies. It is also positively affected if the CEO has a railroad background, again lending some support to the importance of human capital. The presence of a shareholder rights plan appears to enhance the ICC rate of return, but a strong external board or a high debt-equity ratio has the opposite effect, indicating that the market may be more sensitive to economic rates of return than accounting rates of return as measured by the ICC rate of return.

Real earnings per share are negatively related to the operating ratio, indicating that operating efficiencies enhance earnings per share. However, CEO line experience in law or finance depresses earnings per share. This latter result is somewhat surprising, since one would expect a finance background to make a CEO sensitive to market value. The importance of demand is shown by the negative coefficient on the relative rail rates. A strong external board presence acts to enhance earnings per share, as does action taken to protect the company against takeovers, as shown by the existence of a *SIEGE*. Hence, earnings per share appear to respond to the discipline of the market.

Because Tobin's q measures the ratio of market valuation to replacement costs, it can be taken to reflect shareholder value. As expected, this is positively affected by labor productivity. CEO line experience in operations, law, marketing, and finance are all associated with low values of Tobin's q. This last effect is surprising, again because one would expect CEOs with a finance background to be sensitive to market valuation. The effect of external market pressures is strong, as shown by *SIEGE* and *POISON*. The large negative impact of a strong external board presence is unexpected since external board members should reflect shareholder interest.

Combined Estimation Results

We now consider the combined total and the indirect effects of the exogenously given CEO characteristics, the company governance and

Table 9. Final 2SLS Parameter Estimates of Second-Stage Regression Equations

	Dependent variable			
Regressor	*GROSSROR*	*ICCROR*	*REPS*	*TOBINQ*
Constant	0.6939	0.4325	1.2650	−8.2951
	(3.59)	(1.57)	(2.63)	(5.28)
COMP[a]	. . .	. . .	. . .	. . .
ALOH[a]	0.0100	. . .	. . .	. . .
	(1.93)			
XCOMP[a]	−0.0598	. . .	−0.1132	0.6052
	(3.75)		(2.53)	(4.61)
OPRATIO[a]	−0.1988	−0.4031	−0.2878	. . .
	(12.80)	(9.43)	(6.50)	
RTMTRK[a]	−0.0242	. . .	. . .	. . .
	(2.27)			
PCTTRANS[a]	. . .	. . .	. . .	. . .
LPROD[a]	0.0180	0.0790	. . .	0.1705
	(3.34)	(4.99)		(2.91)
DERATIO	0.0015	−0.0064	. . .	. . .
	(2.42)	(3.14)		
INVRATE[a]	0.0133	−0.0111	. . .	. . .
	(5.31)	(1.67)		
OPNS	−0.0194	. . .	. . .	−0.4214
	(3.98)			(10.18)
LAW	−0.0152	. . .	−0.0227	−0.4479
	(3.34)		(3.32)	(12.78)
FIN	−0.0162	. . .	−0.0128	−0.4895
	(3.67)		(1.54)	(13.44)
MKT	−0.0126	. . .	. . .	−0.6703
	(2.12)			(11.13)
RRBACK	. . .	0.0466	. . .	. . .
		(5.42)		
INTERNAL	0.0044	. . .	. . .	. . .
	(1.67)			
NONRRDUM	. . .	. . .	. . .	. . .
HOLDING	0.0051	. . .	. . .	. . .
	(1.94)			
PRT[a]	. . .	. . .	−0.0857	. . .
			(2.28)	
BRDEXT	0.0192	−0.0600	0.0350	−0.2384
	(2.69)	(2.90)	(2.19)	(3.58)
SIEGE	−0.0061	. . .	0.0101	0.1165
	(2.02)		(1.58)	(4.93)
POISON	0.0130	0.0240	. . .	0.0724
	(3.58)	(2.08)		(2.65)

Table 9 (continued)

	Dependent variable			
REGRESSOR	*GROSSROR*	*ICCROR*	*REPS*	*TOBINQ*
MERGEDUM	. . .	. . .	0.0232	. . .
			(2.29)	
MERGEYR	0.0019	. . .	. . .	0.0220
	(3.93)			(5.76)
GDP[a]	. . .	−0.1433	. . .	. . .
		(3.33)		
PPIEN[a]	. . .	. . .	. . .	0.2450
				(3.36)
SPLIT1	. . .	. . .	−0.0437	. . .
			(7.51)	
SPLIT2	. . .	. . .	0.0239	. . .
			(2.55)	
Burlington Northern	. . .	. . .	0.0284	. . .
			(2.25)	
CSX	. . .	. . .	0.0123	. . .
			(1.10)	
Chicago Northwest Transit	. . .	. . .	−0.0082	. . .
			(0.62)	
Conrail	. . .	. . .	−0.0235	. . .
			(1.66)	
Illinois Central Gulf	. . .	. . .	−0.0280	. . .
			(2.31)	
Missouri Pacific	. . .	. . .	0.0524	. . .
			(3.94)	
Norfolk Southern	. . .	. . .	−0.0029	. . .
			(0.25)	
Norfolk and Western	. . .	. . .	0.0055	. . .
			(0.37)	
Seaboard Coast Line	. . .	. . .	0.0658	. . .
			(3.95)	
Southern Pacific	. . .	. . .	−0.0128	. . .
			(0.91)	
Southern	. . .	. . .	0.1228	. . .
			(8.49)	
Union Pacific	. . .	. . .	−0.0283	. . .
			(2.69)	
Western Pacific	. . .	. . .	0.0000	. . .
			(0.00)	
R^2	0.9132	0.6911	0.9230	0.9571
N	134	134	107	44

Source: Authors' calculations. Definitions of variables are given in table 5. Numbers in parentheses are absolute values of *t*-statistics. The Atchison Topeka and Santa Fe is used as the "base-case" railroad.

a. Natural logarithms

control variables, and the variables denoting the exogenous operating environment upon the bottom-line performance measures. These are given in table 10, which shows the total effect of each of these variables, as well as the indirect effects.[43] The indirect effects come from a combination of the first-stage and second-stage regressions.[44]

The variables related to CEO experience and background (X_1) are considered first. Relative to a broad general background, specific line experience in operations, law, marketing, or finance has a negative impact upon all of the final performance indicators. With the exception of the ICC rate of return, the direct effect dominates the indirect effect, suggesting that the interactions between the endogenous operating environment and the exogenous variables are not very significant.

The effect of the variables that relate to aggregate experience and human capital is mixed. The quantitative effect of age, tenure in the company, or tenure as an executive is small in all cases. Education, however, has a negative effect upon all of the performance measures. A railroad background has a positive effect upon the rates of return and Tobin's q, but a negative effect upon real earnings per share. In contrast, an internal promotion has a negative effect in all cases (although quantitatively small in the case of Tobin's q), while a nonrail background on the part of the chief executive of a railroad that is within a larger holding company has a positive impact upon the performance of all the bottom-line variables. The indirect effects generally dominate the direct effects of the aggregate experience and human capital variables, indicating that these influence the endogenous operating environment rather than the bottom-line performance variables directly.

We now turn to the effect of the variables that reflect corporate control and governance (X_2). With the exception of the percentage of the board that is external, none of these variables has a numerically significant influence upon the final performance measures. Although a strong external board presence has a substantial positive effect upon real earnings per share, its impact upon the ICC rate of return and Tobin's q is

43. The direct effects and their standard errors are given in the equation estimates of table 9. Of course, the differences between the total effects and the indirect effects, given in table 10, are simply the estimated direct effects.

44. Note that for a given final performance index (Y_{Fi}), the direct effect of a given exogenous variable (X_j) is given by $\partial Y_{Fi}/\partial X_j$, while the indirect effect is given by $\Sigma_k (\partial Y_{Fi}/\partial Y_{Ik}) (\partial Y_{Ik}/\partial X_j)$. The total effects are the sum of the direct and indirect effects.

negative. This latter result is particularly puzzling since one would expect external board members to represent the fiduciary interest of the stockholders. In this connection, it is also noteworthy that the direct and indirect effects of a strong external board presence upon Tobin's q are negative. Although the direct effect of a strong external board upon the gross rate of return is large and positive, the indirect effect is large and negative, causing the total impact to be small and positive.

Several types of variables are included in the exogenous operating environment (X_3). *POISON* and *SIEGE* reflect the market for corporate control and take on a value of 1 when the company is either under pressure or perceives itself to be under pressure and takes defensive action to ward off unfriendly actions on the part of an acquiring firm. To the extent that these actions are aimed at increasing shareholder value and making the railroad (or its parent holding company) less attractive as an acquisition, these variables would be expected to have a positive influence upon Tobin's q and real earnings per share. To the extent that outside pressures exerted market discipline, they would be expected to have a positive effect upon the rate-of-return variables. However, this was not the case. The presence of a *SIEGE* appears to reduce both the gross economic and ICC rates of return and the real earnings per share, while having a modest positive effect on Tobin's q. The adoption of a specific shareholder rights plan has a positive effect upon the rates of return and Tobin's q, leaving real earnings per share unaffected.

The other exogenous variables either relate to the railroad's operating environment or reflect the general demand condition facing railroads. In all cases, a high capital-labor ratio (lagged) increases performance, as does an increase in the price of energy. An increase in aggregate demand, as shown through a percentage increase in GDP, increases rates of return and Tobin's q. Finally, an increase in the price of rail service relative to trucks has a strong negative impact upon all of the performance variables.

Because we are interested in the role of managerial and market pressures upon performance, we evaluated the combined effects of various managerial or market characteristics. Our base case is a CEO without previous rail experience and with a broad, general background. Table 11 shows the combined effects of a railroad background, an internal promotion, and specific line experience relative to this base case. These

Table 10. Indirect and Total Effects of Exogenous Variables on Endogenous Variables

Exogenous variable	*GROSSROR*		*ICCROR*		*REPS*		*TOBINQ*	
	Indirect	*Total*	*Indirect*	*Total*	*Indirect*	*Total*	*Indirect*	*Total*
OPNS	0.00413	−0.01528	−0.00597	−0.01982	0.00000	0.00000	0.00000	−0.42138
	(1.223)	(2.416)	(1.509)	(4.752)	(0.000)	(0.000)	(0.000)	(10.181)
LAW	0.00110	−0.01405	−0.00614	−0.02272	−0.00501	−0.02771	−0.02681	−0.42108
	(0.305)	(2.235)	(1.440)	(5.328)	(2.007)	(3.731)	(2.681)	(12.074)
FIN	0.00054	−0.01563	−0.00378	−0.01566	0.00000	−0.01282	0.00000	−0.48950
	(0.160)	(2.851)	(1.260)	(5.214)	(0.000)	(1.536)	(0.000)	(13.440)
MKT	0.00212	−0.01049	−0.15456	−0.15456	0.00000	0.00000	0.00000	−0.62030
	(0.426)	(1.344)	(1.551)	(1.551)	(0.000)	(0.000)	(0.000)	(11.132)
ED	−0.12704	−0.12704	−0.02820	−0.02820	−0.01257	−0.01257	−0.08072	−0.08072
	(27.890)	(27.890)	(3.416)	(3.416)	(1.761)	(1.761)	(3.875)	(3.875)
AGE	0.00017	0.00017	0.00036	0.00036	0.00018	0.00018	−0.00029	−0.00029
	(2.006)	(2.006)	(2.221)	(2.221)	(1.216)	(1.216)	(0.351)	(0.351)
COTEN	−0.00001	−0.00001	−0.00378	−0.00378	0.00000	0.00000	0.00000	0.00000
	(0.155)	(0.155)	(1.184)	(1.184)	(0.000)	(0.000)	(0.000)	(0.000)
EXECTEN	−0.00059	−0.00059	−0.01276	−0.01276	−0.00127	−0.00127	−0.00300	−0.00300
	(1.300)	(1.300)	(2.210)	(2.210)	(2.144)	(2.144)	(2.015)	(2.105)
RRBACK	0.00200	0.00200	0.00000	0.05419	−0.00258	−0.00258	0.01388	0.18991
	(0.998)	(0.988)	(0.000)	(4.852)	(1.118)	(1.118)	(1.203)	(4.527)
INTERNAL	−0.01523	−0.01082	−0.02451	−0.02451	−0.01459	−0.01459	−0.04943	−0.04943
	(2.961)	(1.964)	(2.566)	(2.566)	(2.017)	(2.071)	(2.651)	(2.651)
NONRRDUM	0.01047	0.01047	0.02017	0.02017	0.01516	0.01516	0.03593	0.03593
	(1.522)	(1.522)	(1.513)	(1.513)	(1.492)	(1.415)	(1.446)	(1.446)
EXECS	−0.00055	−0.00055	0.00000	0.00000	−0.00121	−0.00121	0.00646	0.00646
	(1.791)	(1.792)	(0.000)	(0.000)	(1.791)	(1.797)	(2.232)	(2.232)

VPS	−0.00015	−0.00015	−0.00452	−0.00452	−0.00020	−0.00020	−0.00077	−0.00077
	(1.302)	(1.302)	(1.340)	(1.340)	(1.687)	(1.687)	(1.280)	(1.280)
HOLDING	0.00248	0.00757	0.00657	0.00657	0.00000	0.00000	0.01271	0.01271
	(2.271)	(3.015)	(1.865)	(1.865)	(0.000)	(0.000)	(1.621)	(1.621)
TOTALBRD	0.00018	0.00018	−0.00038	−0.00038	0.00028	0.00028	−0.00224	−0.00224
	(1.415)	(1.415)	(1.919)	(1.919)	(1.511)	(1.511)	(2.341)	(2.341)
BRDEXT	−0.01720	0.00197	−0.29550	−0.31734	−0.01562	0.01938	−0.08352	−0.15484
	(4.220)	(0.357)	(2.256)	(2.395)	(2.221)	(1.251)	(3.268)	(2.166)
MERGEDUM	−0.00855	−0.00855	−0.02753	−0.02753	−0.01844	0.00473	−0.04369	−0.04369
	(1.143)	(1.143)	(1.975)	(1.975)	(1.757)	(0.330)	(1.684)	(1.684)
MERGEYR	0.00146	0.00337	0.00151	0.00151	0.00218	0.00218	−0.00874	0.01239
	(3.574)	(5.722)	(2.477)	(2.477)	(2.307)	(2.307)	(2.366)	(2.830)
SIEGE	−0.00674	−0.01287	−0.01481	−0.03059	−0.01113	−0.00105	−0.02637	0.09012
	(1.559)	(2.458)	(1.786)	(3.691)	(1.752)	(0.121)	(1.679)	(3.355)
POISON	−0.00079	0.01222	0.10326	0.12200	0.00000	0.00000	0.01349	0.08586
	(0.298)	(2.796)	(1.848)	(2.183)	(0.000)	(0.000)	(1.924)	(3.205)
KLLAG[a]	0.03952	0.03952	0.11400	0.11400	0.06532	0.06532	0.15210	0.15210
	(3.642)	(3.642)	(5.541)	(5.541)	(3.956)	(3.596)	(3.057)	(3.057)
PRT[a]	−0.06055	−0.06055	−0.05429	−0.05429	0.00000	0.00000	0.10684	0.10684
	(2.614)	(3.642)	(1.229)	(1.229)	(0.000)	(0.000)	(2.254)	(2.254)
PCTCOAL	0.01928	0.01928	0.40178	0.40178	−0.05432	−0.13996	−0.12848	−0.12848
	(2.039)	(2.039)	(1.218)	(1.218)	(2.662)	(2.863)	(1.600)	(1.600)
GDP[a]	0.05819	0.05819	0.21321	0.06583	−0.00493	−0.00493	0.76925	0.76925
	(2.902)	(2.902)	(5.250)	(1.560)	(0.150)	(0.150)	(8.017)	(8.017)
PPIEN[a]	0.01857	0.01857	0.02780	0.02780	0.02793	0.02793	0.23690	0.23690
	(2.834)	(2.834)	(2.255)	(2.255)	(2.720)	(2.720)	(3.058)	(3.058)

Source: Authors' calculations. For definitions of variables, see table 5. Numbers in parentheses are absolute values of *t*-statistics.
a. Natural logarithm.

Table 11. Combined Effects of Managerial and Governance Characteristics on Rail Performance

Characteristic	*GROSSROR*	*ICCROR*	*REPS*	*TOBINQ*
RRBACK INTERNAL OPNS	−0.0241	0.0099	−0.0172	−0.2809
RRBACK INTERNAL MKT	−0.0193	−0.1249	−0.0172	−0.3490
RRBACK INTERNAL FIN	−0.0244	0.0140	−0.0300	−0.4798
RRBACK INTERNAL OTHER	−0.0088	0.0297	−0.0172	0.1405
HOLDING BRDEXT	0.0096	−0.2889	−0.1056	−0.1421
SIEGE POISON	−0.0006	0.0089	−0.0011	0.1760

Source: Authors' calculations. For definitions of variables, see table 5.

attributes tend to increase the ICC rate of return for the base case, but reduce all of the others. Although hardly definitive, this finding suggests that CEOs with rail experience may focus on the ICC rate of return at the expense of other performance measures. It is also interesting to note that in the case of Tobin's q, a broad general background appears to outweigh the negative effects of a rail background or an internal promotion. Broad experience seems to matter.

We also consider the role of market discipline and evaluate the combined effect of a holding company structure and a strong external board presence and the combined effects of *SIEGE* and *POISON* activities. These effects are mixed and of opposite sign. A holding company in conjunction with a strong external board increases the gross economic rate of return by a modest amount but reduces all of the other performance indicators. However, market pressures, as evidenced by *SIEGE* and *POISON*, reduce the gross economic rate of return and real earnings per share, while increasing the ICC rate of return and Tobin's q. This latter result is to be expected, since takeover threats should encourage defensive action to increase shareholder return. A holding company with a strong external board, however, would also be expected to focus

upon shareholder value and thus to have a positive impact upon Tobin's q. The impact of market discipline upon the bottom-line performance measures appears to be decidedly mixed.

Summary and Conclusion

During the past decade, U.S. railroads have experienced significant change and evolution. They have moved from a highly protected, regulated environment to one subject to market discipline and heightened competitive pressures. Although each railroad has behaved differently, some common themes appear. Perhaps the most striking are the efforts to diversify in the mid-1980s, followed by divestiture and a return to the core rail business. In all cases these railroads today utilize smaller plants and less labor, and they typically carry fewer ton-miles than they did when they were first deregulated in the early 1980s. In addition, in the latter part of the decade, virtually all of the railroads undertook some form of financial restructuring that involved stock repurchase plans, substantial increases of debt relative to equity, or both. In most cases, this restructuring has had a positive effect on Tobin's q, although most firms still experience relatively low values of this variable.

The caliber of rail management clearly matters, but no clear pattern emerges about the characteristics of the effective CEO. Burlington Northern, Union Pacific, Norfolk Southern, and Conrail are generally viewed as the success stories of the past decade. The first two have been characterized by outside management with no previous rail experience, diversification followed by divestment, and large amounts of debt. Norfolk Southern has been characterized by inside rail management, a steady focus on rail activities, and very little debt. Conrail has been similar to Norfolk Southern in its management philosophy but has drawn its top management from outside of the company.

Table 12, which summarizes the performance and CEO backgrounds of the firms in our sample, is instructive. Of the successful firms, only Norfolk Southern has relied exclusively on its internal management. Norfolk Southern's experience is not readily transferable to other railroads, however. Before the merger, the Southern railroad had always been exceptionally well run, and as far back as the 1960s, its manage-

Table 12. Railroad Performance and CEO Background

CEO background	*Railroad performance*		
	Success	*Mixed*	*Failure*
Railroad, internal	Norfolk Southern	CSX, Chicago Northwest	ATSF/Southern Pacific
Railroad/ Nonrailroad, external	Burlington Northern, Union Pacific	ICG	. . .
Nonrailroad, external/ Railroad, external	Conrail	. . .	. . .

Source: Authors' calculations. See text for explanation of CEO background.

ment was noted for its penchant for innovation.[45] Although less innovative, the Norfolk and Western was characterized by particularly profitable traffic. Thus, the outstanding performance of the Norfolk Southern may be an anomaly rather than a behavioral pattern that can be utilized by other railroads.

If we omit the Norfolk Southern, the clustering of the successful railroads around management that is external to the railroad is striking, as is the clustering of the railroads with a mixed and poor performance around management that is characterized by an internal rail background. This is entirely consistent with the negative relationship between the performance measures and the dummy variable that represented an internal promotion to CEO. This evidence generally supports the hypothesis that regulatory inefficiencies were stronger than the benefits conferred by acquired human capital. On balance, internal rail management appears to have performed less well than external management. Moreover, while Conrail and Norfolk Southern are notable exceptions, CEOs with no previous rail background who are not encumbered by the regulatory culture of the industry have performed better than their rail counterparts.

The evidence with respect to market discipline is mixed. A strong external board presence has a substantial positive impact upon earnings

45. For example, in the so-called "Big John" case, the Southern railroad wanted to offer discount rates for multiple-car shipments using a new large hopper car that Southern had developed. Although these rates were initially disallowed, the ICC eventually permitted them but only several years after they were first introduced.

per share, but negative effects on Tobin's q and the ICC rate of return. Because earnings per share is a measure readily available to analysts and the market, one can argue that this is the variable upon which directors focus. The evidence in support of the hypothesis that external directors are acting on behalf of the shareholders is hardly overwhelming, however. Moreover, the evidence concerning the effect of market discipline as shown by the adoption of shareholder rights plans or actions taken to increase shareholder value (share repurchase plans or the acquisition of increased debt, for example) is not conclusive. Thus, even though all of the railroads in our sample undertook various activities to increase shareholder value in response to actual or perceived threats of takeover, the success of these actions, as shown in our final performance measures, is unclear.

Perhaps the strongest market effect has been in the divestment that all of the railroads have undertaken and the consequent refocus on the activities of the core railroad. Not only has the rate structure been rationalized, but in most cases, there has been a concomitant rationalization of the labor force, the capital stock, the management structure, and the financial structure.

Railroads have less labor, less capital, more debt, much greater productivity, higher rates of return, and increased market valuations relative to their asset base than they did in 1980. Nevertheless, rates of return and measures of Tobin's q are still low relative to other industries. It remains to be seen if rail managers will be successful in raising rates of return and enhancing shareholder value to levels competitive with other industries. It is reasonable to be relatively optimistic about the prospects of the rail industry in the 1990s, but if the industry is to be competitive with other activities, rail management will have to work harder to raise rates of return on capital and to shareholders. Otherwise, the industry could experience a slow erosion as it fails to attract sufficient capital to maintain itself.

Appendix A: Industry Experience After Deregulation

Following is a brief description of the experience of the major railroads, other than the Burlington Northern, after passage of the Staggers Act in 1980. We focus on (1) overall performance, as indicated by a

number of measures related to the financial and operating performance of the railroads; (2) diversification and governance history; (3) changes in the background and experience of rail management; (4) organizational changes both at the managerial and firm levels; and (5) financial restructuring and the adoption of antitakeover devices such as increased debt, stock repurchase activities, shareholder rights plans, and the sale of tangible assets (both rail and nonrail) to finance these activities.

We consider the major Class I U.S. railroads (Norfolk Southern, Union Pacific, CSX, Conrail, Atchison Topeka and Santa Fe, and Southern Pacific) and the Illinois Central Gulf, which has adopted a strategy of massive downsizing in response to a leveraged buyout.[46]

Norfolk Southern

Like the Burlington Northern, the Norfolk Southern is a well-managed company with a relatively high return to capital. It has the lowest operating ratio of all the major railroads. Unlike the Burlington Northern, however, it has focused on rail and related transportation activities throughout the post-Staggers period, and its management has been dominated by men with railroad experience who have come up through the ranks of the constituent railroads. The Norfolk Southern Corporation was established as a holding company upon the merger of the Norfolk and Western and the Southern railroads in 1982. Its first chairman and CEO was Robert Claytor, a lawyer who had been with the Norfolk and Western Railroad since 1951.[47]

An efficient and cash-rich company, the corporation undertook a number of financial investments in nonrailroad activities (banking, fiber optics, real estate), treating them as financial rather than operating investments.[48] Its one major operating acquisition was North American

46. Although the Chicago Northwest was also subject to a leveraged buyout, its experience does not appear to be sufficiently distinctive to warrant an explicit discussion.

47. Harold Hall, the president and chief operating officer of Norfolk Southern Corporation, had previously been president of the Southern Railroad, which he had joined as a member of the operations department in 1943. Although the two constituent railroads maintained separate identities as subsidiaries of the corporation, their operations were quite unified because Claytor served as chairman and CEO of each of the constituents. Like Claytor and Hall, the other executives of the holding company and its constituent railroads were men who had spent the bulk of their professional lives with these railroads.

48. The Norfolk Southern Corporation actively sought to control Piedmont Airlines for a number of years before finally selling its interest to USAir in 1987.

Van Lines in 1985, a large diversified trucking concern. As a result of this acquisition, about 80 percent of its revenues come from rail activities, the remaining 20 percent from trucking.

In 1987 Arnold McKinnon became chairman, CEO, and president of the holding company and its constituent railroads. Like Claytor, he was a lawyer and had worked his way up through the legal department of the Southern Railroad. With the change in management, the Norfolk Southern Corporation altered its investment focus and began a stock repurchase program. In 1987 it undertook a 20 million share ($600 million) repurchase program; in 1989 it undertook a larger one of 45 million shares ($1.7 billion). Although these repurchases were financed through debt and cash reserves, the corporation has maintained an extremely low debt-capitalization ratio of around 15 percent (that amount increased to 25 percent in 1990). The stock repurchase program was doubtless aimed at increasing shareholder value; however, the acquisition of debt as an antitakeover device did not appear to be a motivating factor.

Table A-1 provides a summary of Norfolk Southern management characteristics and performance since it was formed in 1982. Although it has steadily reduced its labor force and track miles and concomitantly increased productivity, in percentage terms these changes have been less than those experienced by the Burlington Northern. Nevertheless, Norfolk Southern has consistently had the best operating ratio of all of the railroads, typically experiencing values below 0.80. In recent years, its gross economic return has been about 11 percent, a high figure for the railroads. Table A-1 indicates that its stock repurchase plans appear to have had some effect. Since their inception in 1987, the return on equity and Tobin's q have increased somewhat. On balance, like the Burlington Northern, Norfolk Southern appears to have adapted well to the market discipline imposed in the post-Staggers world, although the responses of the two railroads to this new environment have been very different.

Union Pacific

Over the past decade, the experience of the Union Pacific has been similar to that of the Burlington Northern: it underwent a major merger, chose its top management from outside the industry, and subsequently

Table A-1. Norfolk Southern: Management and Operating Characteristics

Year	Chairman, CEO	Railroad background	Internal promotion	Siege	% revenues from transport activities	Debt-equity ratio[a]	Average number of employees	Labor productivity	Track miles
1982	Claytor	yes	yes	no	100	0.355	39,023	2,371	29,378
1983	Claytor	yes	yes	no	100	0.258	35,211	2,438	29,037
1984	Claytor	yes	yes	no	100	0.215	37,273	2,486	28,553
1985	Claytor	yes	yes	no	87	0.275	36,415	2,520	28,372
1986	Claytor	yes	yes	no	81	0.176	34,857	2,623	28,285
1987	McKinnon	yes	yes	yes	82	0.160	32,563	2,895	27,768
1988	McKinnon	yes	yes	no	81	0.152	30,330	3,323	27,222
1989	McKinnon	yes	yes	yes	81	0.153	29,667	3,374	25,703
1990	McKinnon	yes	yes	no	81	0.264	28,697	3,786	24,043

Year	Revenue ton-miles per track mile	Operating ratio	Tobin's q	Gross economic rate of return	ICC rate of return	Return on assets	Return on equity	Real earnings per share (in dollars)
1982	3,149	0.8389	0.2824	0.0483	0.0550	8.23	15.54	6.57
1983	2,956	0.8360	0.3535	0.0536	0.0461	4.76	9.31	5.46
1984	3,245	0.7957	0.3322	0.0705	0.0581	5.73	11.15	7.11
1985	3,234	0.7975	0.4684	0.0687	0.0477	5.43	10.83	7.17
1986	3,232	0.8011	0.4536	0.0703	0.0432	5.31	10.55	7.22
1987	3,395	0.9774	0.4230	0.0454	0.0000	1.76	3.43	0.78
1988	3,702	0.7410	0.5106	0.1100	0.0809	6.39	12.54	2.89
1989	3,895	0.7754	0.6307	0.1084	0.0702	5.97	11.75	2.76
1990	4,519	0.7843	0.6598	0.1140	0.0655	5.36	11.03	2.60

Source: Compustat. a. Debt-equity ratio based on holding company.

divested itself of many of its nonrail holdings and returned its focus to rail operations. Union Pacific has dramatically increased the productivity of its labor and its track, its operating ratio is among the lowest in the industry, and in recent years it has substantially increased its debt and its value of Tobin's q. Its gross economic rate of return has reached competitive levels (table A-2).

The Union Pacific Corporation, a holding company, has traditionally operated rail, energy, and real estate interests. Just before the merger of the Union Pacific Railroad with the Missouri Pacific and Western Pacific in 1982, rail operations accounted for only 36 percent of the holding company's total revenues. After the merger, these rose to approximately 50 percent. The share of transportation activities rose to 57 percent of total revenues with the acquisition of Overnite Transportation for approximately $1 billion in 1986. The purchase established a coast-to-coast trucking link in the absence of a direct rail link.

During the early and mid-1980s, James Evans and William Cook were the dominant managers of the holding company, with Evans as chairman and Cook as CEO and president. Each had come to the company in the late 1960s, with backgrounds and experience in finance. During their tenure as chairman and CEO, the railroad experienced relatively low rates of return and modest productivity gains.

In 1987 management and performance changed dramatically with the appointment of Drew Lewis as chairman, president, and CEO of the holding company and Michael Walsh with a similar position at the railroad. Lewis had broad industry and government background. The Secretary of Transportation from 1981 to 1983, he had served as president and CEO of Simplex Wire and Cable, Snelling and Snelling, and Warner American Cable Communications. Walsh, a partner in a large California law firm, had served as an attorney in the Southeastern District of California and, since 1986, had been with Cummins Engine.

Lewis and Walsh changed Union Pacific's focus and direction. Burdened with a large amount of debt through the purchase of Overnite Transportation, the holding company began a program of divestiture and restructuring that raised the percent of total revenues from its transportation activities to 83 percent by 1988, when the company purchased the Katy line. In 1989 the company undertook a stock repurchase plan of approximately $1.5 billion, financed by a combination of debt, asset sales, and cash flow. In addition, it acquired a waste management

Table A-2. Union Pacific: Management and Operating Characteristics

Year	Chairman, CEO	Railroad background	Internal promotion	Economic	% revenues from transport activities	Debt-equity ratio[a]	Average number of employees	Labor productivity	Track miles
1983	Kenefick	yes	yes	no	44	0.526	40,527	2,855	31,108
1984	Kenefick	yes	yes	no	50	0.475	40,450	3,099	30,778
1985	Kenefick	yes	yes	no	48	0.463	37,911	3,476	30,479
1986	Kenefick	yes	yes	yes	57	0.809	33,271	4,091	30,439
1987	Lewis	no	no	no	75	0.698	31,157	5,046	29,745
1988	Lewis	no	no	no	83	0.749	32,636	5,413	32,372
1989	Lewis	no	no	yes	83	1.032	32,658	5,605	31,596
1990	Lewis	no	no	no	83	0.955	31,850	5,953	30,188

Year	Revenue ton-miles per track mile	Operating ratio	Tobin's q	Gross economic rate of return	ICC rate of return	Return on assets	Return on equity	Real earnings per share (in dollars)
1983	3,719	0.9044	0.3723	0.0797	0.0363	4.36	10.15	2.31
1984	4,072	0.9055	0.3270	0.0458	0.0369	4.79	10.94	3.72
1985	4,323	0.9079	0.4160	0.0471	0.0379	4.75	10.73	3.79
1986	4,471	0.8190	0.5520	0.0251	0.0035	−3.84	−9.73	3.69
1987	5,286	0.8308	0.6726	0.1015	0.0654	5.14	14.15	4.34
1988	5,457	0.8139	0.8671	0.1282	0.0752	4.83	12.98	4.04
1989	5,793	0.8251	0.9467	0.1329	0.0677	4.82	14.18	4.45
1990	6,281	0.8218	0.7962	0.1489	0.0684	4.84	15.10	4.69

Source: Compustat.

a. Debt-equity ratio based on holding company.

company. In 1990 it purchased a stake in Chicago Northwest as a friendly partner to ensure its continued access to the coal fields in the Powder River Basin. Currently, Union Pacific Corporation primarily focuses on rail, with substantial trucking activities (Overnite Transportation). The remaining activities are in natural resources and minerals (15 percent) and waste management (2 percent).

Under Walsh's tenure, the Union Pacific Railroad has reduced its managerial structure from nine levels to five. It has taken substantial restructuring charges to rationalize its labor force and track levels. Since 1987 its gross economic rate of return has been above 12 percent, and labor productivity has increased substantially. Thus, like the Burlington Northern and Norfolk Southern, the Union Pacific appears to be operating from a strong core base.

CSX

The CSX Corporation was formed in 1981 with the merger of the Chessie System and the Seaboard (Family) Lines. Since then, CSX has gone through two distinct phases: the period between 1981 and 1987, in which the company diversified into many activities and experimented with several management structures; and the period since 1987, in which it has divested itself of most of its nontransportation activities, returned to a more centralized management structure, and undertaken stock repurchase plans in an effort to enhance shareholder value. Its overall performance has been considerably less impressive than that of the Burlington Northern or the Union Pacific, but its evolution in a deregulated environment has been somewhat similar to those two companies.

At the time of merger, Hayes Watkins was chairman of the CSX, a position he continued to hold. A certified public accountant with a master's degree in business, he began working for the C&O railroad in 1948 and worked his way through the system in administration and operations, becoming chairman and CEO of the Chessie in 1978. As chairman of the CSX, Watkins also served as chairman of its rail subsidiaries, although the position of president and CEO of the Chessie and Seaboard was held by different individuals, each of whom had extensive railroad background with the constituent railroads. At least initially, then, the management of CSX and its rail subsidiaries was

fairly centralized and dominated by men with strong rail and company ties.

Shortly after merger, CSX began to diversify in two distinct directions. Seeking to become a fully integrated transportation company, CSX made major acquisitions in barges (American Commercial Lines), containers (Sealand), and trucking. The second was to branch out into various activities that were believed to be complementary to rail operations: oil and gas, fiber optics, real estate development, and resorts. Between 1982 and 1984, CSX revenues derived from transportation activities fell from 95 percent to 68 percent, with the bulk of the nontransportation activities being in natural resources.

To manage this diverse enterprise, Watkins instituted a lateral management structure, which in 1986 had seven separate internal organizations reporting directly to him.[49] Significantly, three of these organizations were charged with managing specific aspects of the rail, trucking, and container operations, while information systems were under still another internal organization. During this time, Watkins and his senior management spent a good deal of time attempting to develop the appropriate internal transfer prices to allocate resources in this diverse and complicated enterprise.

Although most of the CSX management was dominated by men with strong rail backgrounds, John Snow was an exception. An economist and lawyer who had worked in government, Snow came to the Chessie in 1977. By 1986 he was president and CEO of CSX Transportation, and in 1987 he became chairman and CEO of the subsidiary that oversaw the diverse transportation activities of the enterprise.[50] Snow became president and CEO of CSX in 1989.

With Snow's emergence also came a change in company policy. In January 1986 Watkins stated that he was taking measures to increase

49. These were CSX Distribution, which focused on the sales and marketing of the rail enterprises; CSX Transportation, which focused on the operations and management of the rail enterprises; CSX Equipment, which focused on the car and equipment management of the railroads; American Commercial Lines, the barge subsidiary; CSX Energy, which focused on natural resources (oil, gas, and minerals); CSX Technology, which focused on information systems, telecommunications, and fiber optics; and CSX Properties, which focused on real estate development and resorts.

50. However, the tripartite management structure of distribution, transportation, and equipment was continued. Their consolidation under a single unified management was only recently announced.

shareholder value, and later in the year CSX adopted a shareholder rights program. CSX also began to divest itself of many of its non-transportation activities, and in 1988 it undertook a substantial stock repurchase plan, financed by debt and the sale of some of its energy, real estate, and resort properties. This activity continued in 1989, with the announcement of a $1.5 billion share repurchase plan (38 percent of its outstanding stock) and further divestiture of its properties in resorts, energy, and fiber optics.[51] By 1988 CSX had increased its share of revenues from transportation-related activities to 96 percent, primarily through reductions in its natural resource and energy activities (from 26 percent to less than 4 percent).

Table A-3 indicates that the performance of the CSX has been somewhat mixed over the last decade. Labor productivity has increased dramatically, but its operating ratio has remained relatively high, and its rates of return (as measured by its gross economic return on capital, the ICC rate of return, and the after-tax return on assets) have been relatively modest. Its stock repurchase efforts (which have been accompanied by substantial increases in its debt-equity ratios) appear to have been productive as measured by the return on equity. They do not appear to have had a substantial impact on Tobin's q, however. On balance, one would have to give the CSX a mixed rating. Although it now is focusing on making its rail and related transportation operations more efficient and competitive, it still appears to be suffering from its period of excessive diversification and managerial decentralization.

Conrail

The history of Conrail is different from that of the other railroads. Established by the government in 1976 as the successor to the bankrupt railroads in the Northeast, it received huge infusions of government investment in its track (in excess of $3 billion) as well as legislative relief that enabled it to shed substantial amounts of labor. By the mid-

51. The following quote from John Snow is instructive: "In recent years, management attention has wandered off to North Sea oil, Caribbean resorts, Washington Beltway real estate and 'multimodal links' with ships and trucks, all seemingly more attractive than locomotives and boxcars." He then expressed concern with the railroad's high operating margins, dwindling market share, and deteriorating equipment, and indicated that CSX planned to return to a focus on its rail operations. (Daniel Machalaba, "Back on Track," *The Wall Street Journal*, December 28, 1989, p. A-1.)

Table A-3. CSX: Management and Operating Characteristics

Year	*Chairman, CEO*	*Railroad background*	*Internal promotion*	*Siege*	*% revenues from transport activities*	*Debt-equity ratio*[a]	*Average number of employees*	*Labor productivity*	*Track miles*
1981	Watkins	yes	yes	no	95	0.691	69,508	1,875	41,623
1982	Watkins	yes	yes	no	95	0.595	63,525	1,824	41,322
1983	Watkins	yes	yes	no	81	0.565	57,180	2,178	40,957
1984	Watkins	yes	yes	no	68	0.660	55,806	2,498	39,652
1985	Watkins	yes	yes	no	69	1.043	52,011	2,578	39,133
1986	Watkins	yes	yes	yes	78	0.902	47,803	2,667	37,519
1987	Watkins	yes	yes	no	83	3.041	41,681	3,389	36,445
1988	Watkins	yes	yes	yes	96	2.133	38,872	3,683	34,428
1989	Snow	no	yes	yes	96	1.702	37,091	3,961	32,714
1990	Snow	no	yes	no	96	0.955	35,157	4,248	31,168

Year	*Revenue ton-miles per track mile*	*Operating ratio*	*Tobin's q*	*Gross economic rate of return*	*ICC rate of return*	*Return on assets*	*Return on equity*	*Real earnings per share (in dollars)*
1981	3,131	0.9159	. . .	0.0255	0.0330	4.72	12.21	9.49
1982	2,805	0.9645	. . .	0.0124	0.0167	4.18	10.31	8.10
1983	3,041	0.9090	0.2439	0.0317	0.0397	2.87	6.83	1.99
1984	3,516	0.8803	0.3244	0.0573	0.0525	4.14	9.83	2.93
1985	3,426	1.0400	0.4109	0.0283	−0.0013	−1.02	−2.48	−0.70
1986	3,398	0.8790	0.4916	0.0678	0.0435	3.46	8.81	2.32
1987	3,876	0.8794	0.4898	0.0707	0.0463	3.34	8.73	2.37
1988	4,158	1.0228	0.5365	0.0215	−0.0106	−0.29	−0.90	0.77
1989	4,491	0.8878	0.5011	0.0748	0.0396	3.37	12.57	2.87
1990	4,792	0.8814	0.5072	0.0837	0.0446	2.91	10.52	2.76

Source: Compustat.

a. Debt-equity ratio based on holding company.

1980s Conrail was on firm financial footing, and the government decided it was time to privatize the railroad. After Congress refused to sell it to Norfolk Southern, Conrail was sold to the public in a stock offering of approximately $1.5 billion in March 1987. At its inception as a private company, its asset value was thus substantially greater than its market value.

Conrail's management history is interesting, reflecting the diverse needs of the company during its relatively brief history. Its first chairman and CEO was Edward Jordan, who came from the U.S. Railway Administration but had no operating experience. With wide experience in Washington, Jordan was instrumental in obtaining congressional and rail support for the passage of the Staggers Act and in securing continuing infusions of capital from the government. During his tenure, however, Conrail continued to lose substantial amounts of money, typically running an annual operating deficit of $200 million to $300 million.

In 1981 Stanley Crane replaced Jordan. A former president of the Southern Railroad, Crane had broad operating experience and was also skilled in dealing with Congress. Upon becoming chairman of Conrail, he successfully lobbied Congress to enact legislation to slough off the existing commuter lines, which were a substantial drain on the company, and to undertake draconian measures to reduce the work force. In addition, he undertook active efforts to realign rates and abandon service under the provisions of the Staggers Act. As a result of these activities, Conrail began to earn an operating profit in 1983, and it has been profitable ever since.

Crane retired at the end of 1988, and Richard Sanborn became chairman, CEO, and president in January 1989. Like Crane, Sanborn had broad railroad experience; before coming to Conrail, he served as president of Seaboard. Unhappily, he died shortly after taking the helm of Conrail, and the board turned to one of its members, Stanley Hillman, who was appointed acting chairman, CEO, and president. Hillman, who had been a member of Conrail's board since 1980, had served as the president of Illinois Central Gulf for many years and had also been a trustee of the bankrupt Milwaukee Lines. Thus, like his predecessors, he came to Conrail with broad rail experience.

Conrail was protected from any takeover activity by several covenants of its privatization act. Nevertheless, these had a finite life, and

in view of the low value-to-capitalization ratio and the acquisition activities that were occurring throughout the economy at that time, Hillman was concerned about the possibility of a takeover. Thus, Conrail adopted a shareholder rights program in the summer of 1989, established an employee stock option plan for nonunion personnel, and undertook a major share repurchase plan in January 1990. The total cost of these latter activities exceeded $1.5 billion and led to a substantial increase in Conrail's debt, which nevertheless remained low relative to the other major railroads at that time. (Only Norfolk Southern enjoyed a lower debt-equity ratio during this period.)

James Hagen, who had led the marketing activities of CSX, became chairman, CEO, and president of Conrail in May 1989. Under his leadership, Conrail has continued to focus on its core rail activities, undertaken efforts to reduce costs and its work force, and engaged in more modest share repurchase activities.

Table A-4 provides a summary of Conrail's experience over the last decade. During this time it pared its labor force by two-thirds and increased its labor productivity concomitantly. Because of the density of its network, it has been less successful in reducing its track, but track utilization (as measured in revenue ton-miles per track mile) has increased substantially. Its operating ratio has continued to fall and is now comparable to industry norms. Because of its legacy from the Penn Central bankruptcy, Conrail has generally taken a cautious view toward debt and upon going public had one of the lowest debt-equity ratios in the industry. The share repurchase plan of 1990 raised this ratio substantially. Tobin's q, already low because of the large amounts of capital that the government infused into the company, actually fell when the amount of stock outstanding was reduced without a concomitant increase in share price. The share repurchase, combined with recent cost-cutting efforts and managerial initiatives, has since caused the stock price to rise substantially.[52] The share value at the beginning of 1992 was around $80 (almost double its value of a year earlier), and total shareholder return has risen accordingly. Thus, in terms of both op-

52. Among the managerial initiatives are a recently instituted committee consisting of 25 senior executives from all aspects of the company who meet regularly to review the company's operating and marketing strategies. Charan (1991) has an interesting review of these activities.

Table A-4. Conrail: Management and Operating Characteristics

Year	Chairman, CEO	Railroad background	Internal promotion	Siege	% revenues from transport activities	Debt-equity ratio[a]	Average number of employees	Labor productivity	Track miles
1979	Jordan	no	no	no	100	26.838	87,511	1,064	34,401
1980	Jordan	no	no	no	100	2.222	79,574	1,046	33,724
1981	Crane	yes	no	no	100	0.817	70,264	1,125	33,190
1982	Crane	yes	no	no	100	0.683	57,704	1,178	31,299
1983	Crane	yes	no	no	100	0.605	39,820	1,765	29,858
1984	Crane	yes	no	no	100	0.533	39,044	1,968	28,586
1985	Crane	yes	no	no	100	0.468	39,044	1,968	28,586
1986	Crane	yes	no	no	100	0.441	33,768	2,210	25,160
1987	Crane	yes	no	no	100	0.244	31,428	2,580	23,723
1988	Crane	yes	no	no	100	0.237	30,487	2,801	23,167
1989	Hagen	yes	no	yes	100	0.239	29,394	2,794	22,901
1990	Hagen	yes	no	yes	100	0.609	26,753	3,144	21,900

Year	Revenue ton-miles per track mile	Operating ratio	Tobin's q	Gross economic rate of return	ICC rate of return	Return on assets	Return on equity	Real earnings per share (in dollars)
1979	2,706	1.1294	. . .	−0.0149	−0.2458	. . .	. . .	. . .
1980	2,469	1.0924	. . .	−0.0073	−0.1303	. . .	. . .	. . .
1981	2,381	1.0216	. . .	0.0031	−0.0254	. . .	. . .	. . .
1982	2,173	1.0363	. . .	0.0022	−0.0381	. . .	. . .	. . .
1983	2,354	0.9059	. . .	0.0221	0.0580	. . .	. . .	. . .
1984	2,687	0.8647	. . .	0.0304	0.0872	. . .	. . .	. . .
1985	2,874	0.8764	. . .	0.0294	0.0608	. . .	. . .	. . .
1986	2,966	0.8721	. . .	0.0322	0.0525	. . .	. . .	. . .
1987	3,418	0.8718	. . .	0.0350	0.0423	. . .	. . .	. . .
1988	3,686	0.8632	0.1650	0.0424	0.0503	3.93	6.73	3.74
1989	3,586	0.9440	0.2180	0.0284	0.0197	4.37	7.78	1.78
1990	3,840	0.8739	0.1868	0.0467	0.0485	2.01	3.66	3.88

Source: Compustat.

erating and financial measures, Conrail appears to be well poised to operate effectively in the current decade.

Santa Fe Southern Pacific

Although the Atchison Topeka and Santa Fe (ATSF) and the Southern Pacific (SP) railroads entered and ended the period of analysis as independent companies, for a significant portion of it (1983–87) they were potential merger partners. They are consequently discussed together.

Santa Fe Industries is a holding company with interests in rail and trucking, forests and lumber, energy, and real estate. During the period, the share of revenues from its transportation activities remained relatively constant, ranging between 75 percent and 85 percent, and its management was dominated by men who had spent their professional life with the ATSF railroad. Thus, unlike many of the other major railroads, Santa Fe Industries maintained a relatively stable course.

In 1983 the company announced a potential merger between the Atchison Topeka and Santa Fe and the Southern Pacific railroads and formed a subsidiary, the Santa Fe/Southern Pacific Corporation (SFSP). Because the ICC had not yet ruled on the merger, the operations of the two railroad companies were kept separate, although John Schmidt served as chairman of the SFSP as well as its constituent railroads.

In 1986 the ICC disallowed the merger, ruling that it would create noncompetitive conditions in too many of the regions in which the proposed railroad would operate, and requiring the SFSP to divest itself of the Southern Pacific. At that time, Southern Pacific's financial condition was perilous, while that of the ATSF was only somewhat better.[53] Given the weak financial position of these railroads and their substantial breakup value, the SFSP adopted a shareholder rights plan in 1986. Nevertheless, the Henley Group attempted a takeover in 1987. In re-

53. Between 1982 and 1986, for example, the ICC had estimated that the rate of return for Southern Pacific was negative for all but one year. In addition, the railroad had the lowest measure of our estimate of the economic gross rate of return during this period. The ATSF experienced a somewhat higher return to capital during this period (as evidenced by the ICC rate of return and our measure of the economic gross rate of return), but its performance lagged considerably behind that of the other major railroads.

sponse, the SFSP initiated a major stock repurchase plan amounting to 60 million of its outstanding 157 million shares (estimated to be worth $3.4 billion), which it financed by selling its energy and related activities and acquiring substantial debt.

Olympia and York, a Toronto real estate development company, obtained a share in the SFSP, and a battle between Henley and Olympia and York ensued. In November 1987 Henley made a bid for the SFSP, followed by a counteroffer by Olympia and York. Although this offer was withdrawn in December, Olympia and York continued to maintain a substantial interest in the SFSP and had explicit representation on the company's board. Henley continued to attack the SFSP but finally sold its stake in July 1988.

Partly in response to the ICC's rejection of the proposed merger and partly in an effort to restore confidence and stability, the SFSP board replaced Schmidt with R. D. Krebs in 1987. A long-standing member of Southern Pacific's senior management, Krebs viewed his primary mission as finding a suitable buyer for that railroad and restoring financial stability to Santa Fe Industries. In 1988 Southern Pacific was sold to Rio Grande Industries, a privately held corporation controlled by P. F. Anshutz. The holding company, which was established to control the railroad, was in turn burdened with substantial debt.[54] In 1989 Anshutz took control of Southern Pacific, becoming the chairman and CEO. In early 1992 the railroad was generally viewed as being in a precarious position. It had a large amount of debt, few nonrail assets, a traffic base dependent on cyclical general freight with little coal traffic, and an aging capital stock.

With Southern Pacific sold, Santa Fe Industries has attempted to focus on its rail operations. The SFSP stock fell from $18 at the end of 1989 to $6.50 by the end of 1990. And SFSP announced that it planned to split into three independent units: the ATSF railroad, the Catella Development Corporation, and SF Energy Resources. The latter two operate the company's remaining real estate, energy, and natural resource holdings. These spinoffs were regarded as important defensive steps to increase shareholder value and prevent any potential takeover

54. In 1988 the holding company had a debt-equity ratio of 4.5; in 1989 this ratio rose to 8.2.

of the company, which had been considered to be vulnerable ever since the Henley Group first placed it under attack in 1987.[55] Krebs later announced plans to restructure and reorganize the railroad, involving changes in its track configuration, new operating and marketing strategies, and the sale or abandonment of a large amount of its line.

Table A-5 summarizes the experience of the ATSF during the past decade. Although ATSF has reduced its work force by half and increased its labor productivity concomitantly, it has been less successful in rationalizing its track. As a result, its operating ratio has remained relatively high, and its gross economic rate of return has been relatively modest, as have the other measures of its return to assets. With the divestiture of the Southern Pacific, Santa Fe Industries absorbed a large amount of debt, raising its debt-equity ratio from 0.359 to 7.760. This ratio has been reduced somewhat through asset sales and the generation of cash flow, but it is still one of the highest in the industry. The share repurchase plans and the acquisition of debt have not substantially affected Tobin's q, which has fallen in recent years. This decline is doubtless a reflection of the decline in the company's share price. The overall performance of the ATSF appears to be somewhat weak compared with the other major railroads, and its future strength and viability may well depend on its ability to reduce costs by further reducing its labor and track and making managerial changes to increase overall efficiency.

Table A-6 indicates that Southern Pacific's performance has been one of the weakest in the industry. Although its labor productivity has increased, its growth has been below industry norms. Unlike most railroads, its track utilization has remained relatively constant. This relative lack of efficiencies has caused its operating ratio to be the highest in the industry, generally exceeding 1. Its return to capital has also been low; its ICC rate of return has generally been negative, and other measures of return to capital have been similarly low. Given its traffic base and aging capital, the railroad appears to be particularly vulnerable. To date, it does not appear to have made a successful transition to the competitive, market-driven environment that characterizes the current rail industry.

55. "Santa Fe Pacific to Divide into Three Separate Units," *Traffic World*, 224: November 26, 1990.

Table A-5. ATSF: Management and Operating Characteristics

Year	Chairman, CEO	Railroad background	Internal promotion	Siege	% revenues from transport activities	Debt-equity ratio[a]	Average number of employees	Labor productivity	Track miles
1978	Reed	yes	yes	no	78	0.587	33,289	1,988	19,528
1979	Reed	yes	yes	no	78	0.753	33,975	2,139	19,561
1980	Reed	yes	yes	no	84	0.807	34,423	2,132	19,571
1981	Reed	yes	yes	no	83	0.711	33,605	2,254	19,818
1982	Reed	yes	yes	no	76	0.675	28,401	2,405	19,601
1983	Schmidt	yes	yes	no	79	0.310	26,037	2,602	18,827
1984	Schmidt	yes	yes	no	79	0.315	27,583	2,722	18,521
1985	Schmidt	yes	yes	no	82	0.311	26,020	2,655	18,436
1986	Schmidt	yes	yes	yes	85	0.381	23,965	2,802	18,201
1987	Krebs	yes	yes	yes	84	0.359	22,182	3,246	18,026
1988	Swartz	yes	yes	yes	73	7.760	20,460	3,777	18,697
1989	Krebs	yes	yes	yes	75	3.525	19,076	4,337	18,036
1990	Krebs	yes	yes	no	75	2.134	16,594	4,696	16,995

Year	Revenue ton-miles/ track miles	Operating ratio	Tobin's q	Gross economic rate of return	ICC rate of return	Return on assets	Return on equity	Real earnings/ share ($)
1978	3,389	0.9067	. . .	0.0215	0.0379	2.78	5.98	8.26
1979	3,714	0.9107	. . .	0.0236	0.0413	3.84	8.89	10.28
1980	3,751	0.8966	. . .	0.0305	0.0512	3.01	7.34	12.16
1981	3,822	0.9364	. . .	0.0243	0.0342	5.39	7.52	2.90
1982	3,484	0.9609	. . .	0.0197	0.0192	2.27	3.10	2.08
1983	3,598	0.9126	0.3077	0.0388	0.0321	3.95	8.24	1.70
1984	4,054	0.9036	0.3075	0.0449	0.0359	4.26	8.53	2.42
1985	3,748	0.9276	0.3742	0.0383	0.0243	4.00	8.14	2.41
1986	3,689	1.0683	0.3476	0.0227	−0.0163	−2.30	−4.98	−0.74
1987	3,995	0.9056	0.5064	0.0549	0.0304	2.96	6.75	2.02
1988	4,133	0.8979	0.6596	0.0663	0.0370	1.58	5.16	−0.46
1989	4,588	1.0972	0.5995	0.0040	−0.0305	−2.91	−29.28	−0.97
1990	4,585	0.9105	0.4487	0.0691	0.0720	−1.73	−11.48	−0.47

Source: Compustat. a. Debt-equity ratio based on holding company.

Table A-6. Southern Pacific: Management and Operating Characteristics

Year	Chairman, CEO	Railroad background	Internal promotion	Siege	% revenues from transport activities	Debt-equity ratio[a]	Average number of employees	Labor productivity	Track miles
1978	Biaggini	yes	yes	no	84	0.565	38,843	2,017	19,005
1979	Biaggini	yes	yes	no	85	0.659	40,126	2,022	18,877
1980	Biaggini	yes	yes	no	84	0.674	39,551	1,944	20,052
1981	Biaggini	yes	yes	no	82	0.564	38,561	2,034	19,963
1982	Biaggini	yes	yes	no	77	0.504	33,720	2,093	19,687
1983	Biaggini	yes	yes	no	85	0.382	30,733	2,450	19,720
1984	Schmidt	yes	yes	no	79	0.359	31,379	2,681	19,727
1985	Schmidt	yes	yes	no	82	0.336	29,557	2,604	19,446
1986	Schmidt	yes	yes	no	81	0.325	29,425	2,518	18,825
1987	Krebs	yes	yes	no	84	0.326	25,109	3,200	17,863
1988	Anschutz	no	no	yes	68	0.367	23,279	3,496	17,633
1989	Anschutz	no	no	no	68	0.553	22,019	3,924	17,626
1990	Anschutz	no	no	no	68	0.793	20,985	4,103	17,389

Year	Revenue ton-miles per track mile	Operating ratio	Tobin's q	Gross economic rate of return	ICC rate of return	Return on assets	Return on equity	Real earnings per share (in dollars)
1978	4,123	0.9601	. . .	0.0167	0.0253	1.37	3.22	8.26
1979	4,299	0.9583	. . .	0.0183	0.0204	1.26	3.19	8.49
1980	3,835	0.9641	. . .	0.0171	0.0206	1.62	4.26	6.74
1981	3,930	0.9736	. . .	0.0183	0.0078	1.88	4.87	6.57
1982	3,585	1.0224	. . .	0.0068	−0.0215	0.22	0.55	4.31
1983	3,818	0.9984	. . .	0.0199	−0.0003	0.47	1.10	2.31
1984	4,265	0.9780	. . .	0.0254	0.0137	2.60	5.80	. . .
1985	3,958	0.9929	. . .	0.0222	−0.0017	2.49	5.36	. . .
1986	3,936	1.2558	. . .	−0.0075	−0.0909	−5.38	−11.87	. . .
1987	4,498	0.9637	. . .	0.0391	0.0095	3.06	6.87	. . .
1988	4,616	1.0392	. . .	0.0198	−0.0326	1.88	4.41	. . .
1989	4,902	1.0261	. . .	0.0244	−0.0297	2.07	6.03	. . .
1990	4,951	1.0128	. . .	0.0301	−0.0103	0.62	2.10	. . .

Source: Compustat.

Illinois Central Gulf

The Illinois Central Gulf (ICG) is unique among the railroads under analysis here in that it was traditionally a relatively small component (approximately 25 percent) of a large conglomerate, IC Industries. Although its return to capital was extremely low in the early 1980s, its financial situation improved somewhat in 1983. Nevertheless, by 1987 IC Industries had decided to spin it off and began to look actively for a buyer. At that time the ICG began an active program of downsizing, reducing the plant by more than 50 percent between 1984 and 1988. In 1988 the Prospect Group acquired the ICG through a leveraged buyout that imposed a large amount of debt on the railroad, raising the ratio of debt to total capital from 28 percent to 98 percent. In response, the ICG has continued to reduce its investment in track and equipment and has instituted efforts to control costs to obtain sufficient income to reduce its debt.

Table A-7, which summarizes the experience of the ICG, indicates that these draconian actions appear to have paid dividends. Since the purchase of the ICG by the Prospect Group, labor and track have been slashed, the operating ratio has fallen dramatically, and rates of return have increased concomitantly. Thus, in the space of a few years, the ICG has been transformed from one of the weaker to one of the strongest performers in the industry. However, many analysts question whether it can sustain efficient operations on its debt-heavy, reduced-capital base.[56] It is still too early to determine whether the ICG can be viewed as a model for the rest of the industry.

56. For example, in a recent article in *Railway Age*, a question was raised about whether ICG was cannibalizing its assets to provide cash to reduce its debt or undertaking a rational program of downsizing its plant. (See Frank Malone, "Why ICG Is Single Tracking," *Railway Age*, February 1990, p. 32.)

Table A-7. ICG: Management and Operating Characteristics[a]

Year	Chairman, CEO	Railroad background	Internal promotion	Siege	% revenues from transport activities	Debt-equity ratio	Average number of employees	Labor productivity	Track miles
1978	Taylor	yes	yes	no	100	0.722	17,094	1,922	13,677
1979	Taylor	yes	yes	no	100	0.714	17,391	1,889	13,394
1980	Taylor	yes	yes	no	100	0.695	16,682	1,918	12,973
1981	Taylor	yes	yes	no	100	0.711	15,670	1,912	12,512
1982	Taylor	yes	yes	no	100	0.640	13,675	1,763	11,956
1983	Stewart	no	no	no	100	0.404	10,414	2,338	11,499
1984	Bruce	yes	yes	no	100	0.398	9,871	2,737	11,019
1985	Bruce	yes	yes	no	100	0.483	9,215	2,794	8,352
1986	Bruce	yes	yes	no	100	0.671	6,778	2,939	6,779
1987	Bruce	yes	yes	no	100	0.758	3,942	4,317	5,287
1988	Bruce	yes	yes	yes	100	0.448	3,942	4,317	5,287
1989	Moyers	yes	yes	yes	100	7.907	3,350	5,168	5,157
1990	Moyers	yes	yes	no	100	4.059	3,132	5,593	4,894

Year	Revenue ton-miles per track mile	Operating ratio	Tobin's q	Gross economic rate of return	ICC rate of return	Return on assets	Return on equity	Real earnings per share (in dollars)
1978	2,402	0.9966	. . .	0.0267	0.0027	1.75	3.48	7.24
1979	2,453	1.0350	. . .	0.0041	−0.0227	2.04	4.07	6.16
1980	2,466	1.0101	. . .	0.0177	−0.0047	2.41	4.60	7.03
1981	2,395	1.0179	. . .	0.0120	−0.0135	2.65	4.87	7.07
1982	2,016	1.0985	. . .	−0.0375	−0.0242	−0.60	−1.08	3.10
1983	2,118	0.9904	. . .	0.0375	0.0094	−0.38	−0.68	4.55
1984	2,452	0.9344	. . .	0.0658	0.0293	3.22	5.50	2.89
1985	3,083	0.9503	. . .	0.0576	0.0194	1.33	2.59	2.74
1986	2,939	1.5138	. . .	−0.1246	−0.1259	−10.25	−27.18	−1.09
1987	3,036	0.9350	. . .	0.0666	0.0274	0.10	0.33	1.90
1988	3,218	0.9678	. . .	0.0612	0.0161	−1.02	−2.68	. . .
1989	3,357	0.8442	. . .	0.0991	0.0766	0.75	2.62	. . .
1990	3,579	0.7540	. . .	0.1350	0.1226	3.99	43.87	. . .

Source: Compustat.

a. In 1988 IC Industries sold Illinois Central Gulf to the Prospect Group.

Appendix B

Table B-1. Means and Standard Deviations

Variable	*Entire sample*	*1978–90*	*1981–85*	*1986–90*
Managerial characteristics				
BA	0.403	0.462	0.240	0.533
	(0.492)	(0.505)	(0.431)	(0.505)
BS	0.575	0.538	0.740	0.422
	(0.496)	(0.505)	(0.443)	(0.499)
MASTER	0.015	0.000	0.000	0.044
	(0.122)	(0.000)	(0.000)	(0.208)
MS	0.045	0.026	0.040	0.067
	(0.208)	(0.160)	(0.198)	(0.252)
PHD	0.030	0.077	0.000	0.022
	(0.171)	(0.270)	(0.000)	(0.149)
JD	0.351	0.308	0.340	0.400
	(0.479)	(0.468)	(0.479)	(0.495)
MBA	0.209	0.282	0.140	0.222
	(0.408)	(0.456)	(0.331)	(0.420)
ED	0.642	0.692	0.520	0.733
	(0.481)	(0.468)	(0.505)	(0.447)
OPNS	0.425	0.513	0.500	0.267
	(0.496)	(0.506)	(0.505)	(0.447)
LAW	0.269	0.231	0.240	0.333
	(0.445)	(0.427)	(0.431)	(0.477)
FIN	0.194	0.256	0.200	0.133
	(0.397)	(0.442)	(0.404)	(0.344)
MKT	0.052	0.000	0.040	0.111
	(0.223)	(0.000)	(0.198)	(0.318)
AGE	58.022	57.897	59.120	56.911
	(5.889)	(5.707)	(5.185)	(6.643)
RRBACK	0.799	0.821	0.880	0.689
	(0.403)	(0.389)	(0.328)	(0.468)
COTEN	17.851	21.154	18.500	14.267
	(12.50)	(13.75)	(12.36)	(10.74)
EXECTEN	8.582	8.282	8.940	8.444
	(5.424)	(4.774)	(5.211)	(6.225)
INTERNAL	0.716	0.769	0.660	0.733
	(0.452)	(0.427)	(0.479)	(0.447)
NONRRDUM	.052	0.000	0.000	0.156
	(0.223)	(0.000)	(0.000)	(0.367)
Sample size	134	39	50	45
Firm governance				
CHRM	0.687	0.538	0.700	0.800
	(0.466)	(0.505)	(0.463)	(0.405)
CEO	0.866	0.821	0.800	0.978
	(0.343)	(0.389)	(0.404)	(0.149)

Table B-1 (continued)

Variable	*Entire sample*	*1978–90*	*1981–85*	*1986–90*
PRES	0.552	0.513	0.440	0.711
	(0.499)	(0.506)	(0.501)	(0.458)
EXECS	1.082	1.179	1.060	1.022
	(1.151)	(1.167)	(0.935)	(1.357)
VPS	12.209	12.333	13.100	11.111
	(7.096)	(6.127)	(7.098)	(7.843)
HOLDING	0.567	0.231	0.620	0.800
	(0.497)	(0.427)	(0.490)	(0.405)
ONBOARD	2.754	3.026	3.040	2.200
	(1.697)	(1.662)	(1.895)	(1.358)
TOTALBD	13.642	13.590	15.420	11.711
	(5.335)	(3.754)	(6.007)	(5.124)
BRDEXT	0.758	0.747	0.764	0.761
	(0.194)	(0.209)	(0.177)	(0.203)
Sample size	134	39	50	45
Exogenous, predetermined environmental characteristics				
MERGEDUM	0.037	0.026	0.080	0.000
	(0.190)	(0.160)	(0.274)	(0.000)
MERGEYR	1.507	0.487	0.860	3.111
	(2.700)	(1.636)	(1.400)	(3.676)
SIEGE	0.149	0.000	0.000	0.444
	(0.358)	(0.000)	(0.000)	(0.503)
POISON	0.164	0.000	0.000	0.489
	(0.372)	(0.000)	(0.000)	(0.506)
PCTCOAL	0.288	0.264	0.296	0.299
	(0.206)	(0.212)	(0.206)	(0.205)
MLTRACK	21,299	18,269	22,986	22,049
	(10,234)	(8,542)	(11,301)	(9,970)
MLROAD	12,795	11,065	13,835	13,140
	(6,323)	(5,088)	(6,964)	(6,361)
CAPLAG	9.699	9.594	8.025	8.754
	(5.729)	(6.126)	(3.105)	(4.490)
EMPLAG	30,675	32,063	33,284	26,574
	(17,759)	(21,794)	(18,172)	(12,194)
KQUAL	0.457	0.499	0.466	0.412
	(0.135)	(0.126)	(0.130)	(0.137)
KLLAG	0.00033	0.00031	0.00033	0.00035
	(0.00008)	(0.00005)	(0.00008)	(0.00011)
PRT	1.012	0.962	1.060	1.002
	(0.077)	(0.063)	(0.080)	(0.051)
PPIEN	75.452	61.533	95.680	65.040
	(18.973)	(18.025)	(5.311)	(5.347)
GDP82	2,032	1,812	1,920	2,346
	(248)	(212)	(126)	(101)
Sample size	134	39	50	45

Table B-1 (continued)

Variable	*Entire sample*	*1978–90*	*1981–85*	*1986–90*
Endogenous operating characteristics				
ALOH	468.1	430.0	466.0	503.6
	(175.5)	(154.7)	(168.2)	(195.9)
COMP	31,866	30,996	31,663	32,846
	(2,218)	(1,776)	(2,270)	(2,169)
XCOMP	46,302	45,027	44,955	48,903
	(4,349)	(3,653)	(3,609)	(4,551)
OPRATIO	0.927	0.934	0.927	0.921
	(0.102)	(0.089)	(0.080)	(0.133)
RTMTRK	3,635	3,298	3,301	4,299
	(1,058)	(812)	(853)	(1,151)
DERATIO	1.478	2.069	0.815	1.704
	(3.217)	(5.251)	(0.788)	(2.433)
PCTTRANS	85.76	86.23	84.40	86.87
	(17.09)	(17.90)	(19.49)	(13.38)
MFP	0.045	0.037	0.033	0.062
	(0.089)	(0.076)	(0.069)	(0.015)
LPROD	2,881	2,072	2,488	4,019
	(1,228)	(479)	(748)	(1,287)
INVTOT	0.278	0.238	0.270	0.320
	(0.176)	(0.150)	(0.192)	(0.173)
INVRATE	0.030	0.029	0.026	0.036
	(0.016)	(0.018)	(0.015)	(0.014)
Sample size	134	39	50	45
Endogenous aggregate performance indicators				
GROSSROR	0.035	0.024	0.030	0.050
	(0.029)	(0.022)	(0.022)	(0.036)
ICCROR	0.025	0.014	0.027	0.033
	(0.060)	(0.088)	(0.040)	(0.047)
Sample size	134	39	50	45
REPS	0.080	0.117	0.069	0.059
	(0.061)	(0.065)	(0.060)	(0.038)
Sample size	107	33	40	34
TOBINQ	0.450	. . .	0.343	0.512
	(0.169)		(0.059)	(0.182)
Sample size	44	. . .	16	28

Source: Authors' calculations. Definitions of variables are given in table 5.

Appendix C: Railroad Performance Data

The purpose of this appendix is to explain the sources of the data used in the regression analyses of railroad performance. The variables describing managerial characteristics and firm governance were presented in detail in table 5. The sources used for these data were the Dun and Bradstreet *Reference Guide to Corporate Management* and Moody's *Transportation Manual*. Sources for operating data were the annual *Analysis of Class I Railroads* published by the Association of American Railroads (AAR). These present the annual accounting and other data that Class I railroads provide to the ICC. Before 1978 these data were publicly available in the *ICC Transport Statistics of the U.S.* We present line references to the *Analysis of Class I Railroads* and, where necessary, Transport Statistics. Other financial data are from Standard and Poor's Compustat, and from the U.S. Department of Commerce Bureau of Economic Analysis (BEA). All monetary variables are converted to 1982 dollars.

Railroad Operating Variables

Nonlabor operating variables that came directly from the *Analysis of Class I Railroads* (hereafter referred to as Analysis) were revenue ton-miles (line 709) and miles of track (line 343). Length of haul is the ratio of ton-miles (line 711) to tons (line 708). Percent coal tonnage is the ratio of coal tons (line 557) to total tons (line 708). New investment is new capital for road and equipment (line 383). Care was taken to merge data for constituent firms of merged companies if they reported separately. (For example, the C&O and B&O reported separately through 1985 although they became part of CSX in 1981.)

Lagged employment is from line 308 of the Analysis. Executive compensation is at line 327. Average compensation is at line 334. These are deflated by the consumer price index (CPI) (1982 = 100). Labor productivity is the ratio of revenue ton-miles (line 709) to average employment (line 308). The operating ratio is total operating expenses (line 2) divided by total operating revenue (line 1). For railroad operating firms, the debt-equity ratio is the sum of short-term debt (line 76) and long-term debt items (lines 78–82) divided by net shareholder

equity (line 97). For holding companies, the debt-equity ratio is the ratio reported by Compustat.

Measures of Economic Return

Gross economic return is a measure of the ratio of cash flow (gross of depreciation and taxes) to replacement value of the firm. The numerator is the sum of net railway operating income (line 5 of the Analysis) plus depreciation (line 3) and total taxes (line 4). The denominator is working capital (line 99) plus replacement value of structures and equipment (calculated by the authors and described in the section on capital). The ICC return is the ratio of net railway operating income (line 5) to the book value of net investment (line 113). Net railway operating income is an ICC accounting measure that adjusts net income to exclude nonrail income and fixed charges.

Real Earnings per Share

The numerator is the net cash measure used in the gross economic rate of return and is given by the sum of the net rail operating income (line 5), depreciation (line 3), and total taxes (line 4) from the Analysis. The denominator is given by the end-of-year shares outstanding from Standard and Poor's *Daily Stock Price Record for the New York Stock Exchange and the Over the Counter Exchange*. The nominal values are deflated by the CPI (1982 = 100) to obtain real earnings per share.

Berndt-Fuss Measure of Multifactor Productivity

To measure the growth of multifactor productivity in railroads, we utilize an approach that takes into account nonoptimal use of firms' quasi-fixed inputs in the short run.[57] The rate of growth of technical progress is defined as a difference between measured output growth and weighted growth of inputs. Output growth is measured by revenue ton-miles (line 709). Variable inputs are fuel, labor, materials, and equipment services. Way-and-structures capital is quasi-fixed. The first three variable inputs are weighted by budget shares derived from their contribution to freight service expenses (lines 250–60). Prices for these

57. See Berndt and Fuss (1986) for a full discussion.

inputs are from the *Railroad Cost Recovery Indexes*, submitted by the AAR to the ICC. Stocks of equipment and way-and-structures capital are estimates we assembled; they are described below. The factor price for equipment includes both depreciation and its opportunity cost. Depreciation on equipment is described below. The opportunity cost is the ex ante yield on bonds in the firm's debt category for a given year. The factor price for way and structures includes separate depreciation (see below) and an ex post return on way-and-structures capital. This is derived by dividing railway operating income (line 5) by our estimate of way-and-structures capital.

Estimates of Tobin's q

The estimates of Tobin's q require the use of market data for railroad holding companies whose stocks were traded publicly in 1978–90. Tobin's q is strictly defined as the ratio of the market value of a firm's capital assets to their replacement value. The Compustat tapes list the closing price of stock shares and the book value of long-term debt and short-term debt. We assume that book value of debt equals the market value. Replacement costs of capital are Nelson's estimates of railroad capital stocks that we updated using a perpetual inventory method described below.[58] Since only rail assets are used in the denominator, a portion of the market value in the numerator must be assigned to rail assets. We do this with a "Segment Report" from Compustat, which gives the portion of a company's assets involved in rail transportation. This limits the estimates of Tobin's q to the 1983–90 period when the "Segment Report" is available.

Railroad Capital Estimates (Reproduction Value)

Railroads maintain large stocks of long-lived track and equipment assets, which not only are heterogeneous but also embed large amounts of current expenditure. Maintenance and improvement of track structure, for example, are complex procedures that involve draining, cleaning, and replenishing ballast, repairing and replacing ties, and relaying and refinishing rail. In 1989 expenditures by Class I railroads for way-and-structures maintenance and improvement were 18 percent of total

58. Nelson (1975).

freight service expenditures. Of the $4.4 billion that railroads spent on way and structures in 1989, $1.7 billion was for labor. It is not obvious what (if any) portion of this expenditure should be considered maintenance and what portion investment. Railroad equipment assets also embed a large amount of current expenditure. A railroad normally spends half of the original purchase price "rebuilding" a locomotive or freight car that has been in service 8 to 10 years. It also is common for a railroad to "remodel," from the underframe up, a locomotive unit designated for retirement after 20 to 25 years of service. Expenditures by Class I railroads on equipment (including lease rentals) were 24.7 percent of total freight service expenditures in 1989. Of the total $6.1 billion that railroads spent for equipment, $1.4 billion was for labor.

To deal with the complexities of railroad investment, we develop a series that starts from an authoritative estimate of the reproduction costs of railroad track and equipment and then adds annual net investment in each year to obtain annual measures of the real capital stock.[59] Specifically, the initial estimates of the reproduction value of way and structures and equipment are brought forward to the present by deflating, depreciating, and capitalizing railroad investment expenditures for the two categories of assets. Investment expenditures are from annual financial statements filed by the railroads with the ICC. These statements for 1973 through 1977 are summarized in the ICC's annual Transport Statistics. The statements for 1978 to the present are contained in the AAR's Analysis.

To update the Nelson equipment estimate, we convert it to real terms (1982 dollars) using an implicit price deflator for railroad equipment investment, made available by the Bureau of Economic Affairs. We then calculate the difference between the undepreciated nominal value of the equipment stock in year t-1 (initially 1973) and the undepreciated

59. This method was first utilized by Swanson (1968) and adopted by Caves, Christensen, and Swanson (1980), Friedlaender and Spady (1981), Caves and others (1985), and Vellturo (1989). The technique begins with authoritative estimates of reproduction costs of railroad track and equipment stocks, which are taken as "acceptable" for a given year. The point of departure for Swanson (1968) and Caves, Christensen, and Swanson (1980) was a working paper compiled by ICC staff for the base year 1951 entitled "Elements of Value of Class I Railroads." The point of departure for Friedlaender and Spady (1981), Caves and others (1985), and Vellturo (1989) was an AAR Staff Studies Report by Nelson in 1973 entitled "Values of Class I Railroads." We use an updated 1975 Nelson report.

value of the equipment stock in year t. (The undepreciated equipment stock figure is at line 68 in the Analysis and line 28 in the Transport Statistics.) The first difference is the nominal value of equipment investment in year t. This value is converted to real value using the BEA deflator, and the real investment is added to the year t-1 base figure. The result is then depreciated to arrive at an end-of-year t reproduction value. The process is iterated to bring the series to 1990.

Economic depreciation is derived by solving an equation that allows railroad equipment to depreciate exponentially over 25 years to a salvage value of 10 percent. The 25-year assumption is based on the age distribution of railroad locomotive and freight car fleets reported in Moody's *Transportation Manual*.

The investment component for way and structures cannot be measured in a straightforward manner. Before 1982 railroads used "betterment" accounting in which a portion of the work on railroad way and structures was listed as investment and a portion as expense. This means that the full increment of economic investment in way and structures involves both a first difference between undepreciated book values and a component of direct maintenance expenditures.

After 1982 the railroad industry adopted a conventional depreciation accounting system in which all work on way and structures was added to the investment base. This makes the calculation of way-and-structures investment straightforward but creates a transition problem, because the railroads added somewhat arbitrarily to their undepreciated book values in 1983 to capitalize previous years of way-and-structures maintenance expenditures. To deal with this problem, we obtained ICC railroad filings from the AAR that listed beginning-of-year and end-of-year 1983 assets in depreciation format and betterment format.

The general technique for updating way-and-structures capital is essentially the same as the technique for updating equipment stocks. The Nelson estimate is converted into real terms using a BEA price deflator for way-and-structures capital. Investment for the years 1974 to 1982 is calculated using a first difference and a summation of maintenance expenses. (The undepreciated way-and-structures stock is at line 68 in the Analysis for 1978–90 and at line 27 in the Transport Statistics. Freight service expenditures for way and structures are at line 174 in the Analysis and at line 316 in the Transport Statistics. Depreciation is at line 172 in the Analysis and line 298 in the Transport Statistics.)

Nominal investment is converted to real investment using the BEA way-and-structures deflator for year t and real investment is added to year t-1 base stock. The result is then depreciated to produce an end of year t way-and-structures stock. The process is iterated to 1982. Deflated nominal investment for 1983 was added directly. From 1983 to 1990 a simple first difference was used to calculate investment.

Appendix D

Table D-1. Final OLS Parameter Estimates of Remaining First-Stage Regression Equations

	Dependent variable				
Regressor	*COMP*[a]	*PCTTRANS*[a]	*ALOH*[a]	*DERATIO*	*MFP*
Constant	9.4876	1.8726	6.4836	4.1327	−3.5979
	(19.43)	(2.96)	(96.77)	(1.83)	(3.60)
OPNS	. . .	−0.1418	0.0627	. . .	. . .
		(2.01)	(2.41)		
LAW	0.0035	−0.2624	0.0744	. . .	. . .
	(1.30)	(3.97)	(2.86)		
FIN	0.0252	−0.3033	. . .	. . .	. . .
	(1.88)	(5.21)			
MKT	0.0208	−0.2193	. . .	−2.2177	. . .
	(1.11)	(2.66)		(1.49)	
AGE	. . .	0.0159	. . .	. . .	0.0033
		(4.58)			(1.25)
COTEN	. . .	0.0057	−0.0047	0.0561	. . .
		(2.67)	(3.85)	(1.16)	
EXECTEN	. . .	−0.0160	0.0080	−0.1711	−0.0058
		(3.66)	(3.33)	(2.01)	(2.06)
RRBACK	. . .	−0.1968	. . .	. . .	−0.0769
		(3.09)			(1.87)
INTERNAL	. . .	−0.1113	. . .	. . .	. . .
		(2.48)			
NONRRDUM	0.0531	. . .	. . .	. . .	. . .
	(2.96)				
EXECS	−0.0060	. . .	0.0086	. . .	. . .
	(1.80)		(1.22)		
VPS	0.0020	−0.0050	. . .	−0.0528	. . .
	(3.29)	(2.73)		(1.04)	

Table D-1 (continued)

	Dependent variable				
Regressor	*COMP*[a]	*PCTTRANS*[a]	*ALOH*[a]	*DERATIO*	*MFP*
HOLDING			0.1134		
	. . .	. . .	(3.83)	. . .	. . .
TOTALBD	0.0015	0.0171	−0.0070	. . .	0.0030
	(1.39)	(5.81)	(3.46)		(1.26)
BRDEXT	−0.0461	. . .	. . .	−4.4232	. . .
	(1.92)			(2.33)	
MERGEDUM	−0.0196	0.1679	. . .	. . .	. . .
	(1.05)	(2.97)			
MERGYR	. . .	0.0290	. . .	. . .	−0.0085
		(3.65)			(1.32)
SIEGE	. . .	0.0957	−0.0312	. . .	−0.0316
		(3.30)	(1.36)		(1.17)
KLLAG[a]	0.0306	−0.2094	. . .	. . .	. . .
	(1.20)	(2.87)			
PRT[a]	. . .	. . .	0.1718	. . .	−0.2671
			(1.89)		(2.01)
PCTCOAL	0.3446	. . .	. . .	5.6749	−0.1991
	(5.00)			(1.14)	(1.15)
POISON	−0.0399	. . .	0.0660	1.2104	. . .
	(2.84)		(2.47)	(1.46)	
ED	. . .	0.1617	0.0592	. . .	−0.0584
		(4.69)	(2.37)		(2.29)
GDP[a]	0.1866	. . .	0.0592	. . .	0.3649
	(3.94)		(2.37)		(3.35)
PPIEN[a]	−0.0692	. . .	. . .	. . .	0.0816
	(5.06)				(2.02)
Burlington Northern	−0.2006	0.0195	−0.0561	−1.4515	0.0691
	(5.94)	(0.25)	(1.20)	(0.55)	(0.80)
CSX	−0.1939	−0.0628	−0.8152	−1.5977	0.1392
	(7.07)	(0.75)	(23.00)	(0.81)	(1.71)
Chicago Northwest	0.0471	0.4607	−0.8235	2.7913	0.0427
	(2.44)	(8.08)	(18.71)	(1.91)	(1.09)
Conrail	−0.1647	0.3100	−0.5460	1.4998	−0.0296
	(7.18)	(3.73)	(10.26)	(0.77)	(0.57)
Illinois Central Gulf	−0.0532	0.4451	−0.9202	−0.5421	0.0557
	(1.97)	(7.28)	(23.77)	(0.27)	(0.95)
Missouri Pacific	−0.0365	0.0412	−0.4546	1.5172	0.0151
	(1.68)	(0.50)	(8.18)	(0.78)	(0.28)
Norfolk Southern	−0.2607	−0.0772	−0.7116	−2.5475	0.0732
	(7.15)	(0.98)	(18.31)	(0.95)	(0.80)

Table D-1 (continued)

	Dependent variable				
Regressor	*COMP*[a]	*PCTTRANS*[a]	*ALOH*[a]	*DERATIO*	*MFP*
Norfolk and Western	−0.3017 (6.03)	0.2988 (3.91)	−0.6490 (11.20)	−4.1203 (1.23)	0.1660 (1.41)
Seaboard Coast Line	−0.2700 (5.81)	0.1315 (1.61)	−0.8705 (13.83)	−2.3003 (0.70)	0.2016 (1.83)
Southern Pacific	−0.0075 (0.44)	0.0821 (1.75)	−0.0862 (2.34)	1.0844 (0.71)	−0.0402 (0.95)
Southern	−0.2043 (7.63)	0.1090 (1.36)	−0.4708 (8.78)	−2.5911 (1.11)	−0.0700 (1.02)
Union Pacific	−0.0568 (3.18)	−0.6367 (9.48)	−0.1228 (2.70)	1.1133 (0.63)	0.0119 (0.25)
Western Pacific	−0.0324 (1.47)	0.2573 (3.63)	−0.4007 (7.28)	3.5537 (1.82)	−0.0156 (0.31)
R^2	0.7951	0.8621	0.9680	0.2516	0.2587

Source: Authors' calculations. Numbers in parentheses are the absolute values of *t*-statistics. Definitions of variables are given in table 5. The Atchison Topeka and Santa Fe is used as the base-case railroad.

a. Natural logarithms.

Comments and Discussion

Comment by John R. Meyer: The Friedlaender, Berndt, and McCullough paper is a highly inventive and insightful investigation of a much too neglected topic: the impact of the characteristics and selection of corporate management on economic performance. The paper also pioneers, quite constructively, I believe, in using diverse sources and data to analyze particular phenomena; specifically, case studies are used to enrich and suggest hypotheses, while econometrics structure and quantify the testing. The paper contains a wealth of data and measures, more than enough to keep those of us with "Lionel complexes" busy for quite a spell. Given the complexities of the subject, moreover, it takes quite a bit of "intellectual heroism" to even undertake their task. I'm sure, in fact, that these daunting complexities have much to do with why these relationships between corporate governance and management performance have been so underexplored. The criticisms and comments made hereinafter must be accordingly scaled: to the extent they are unfavorable, this reflects more the very complexity and difficulty of the subject than any deficiencies or omissions by Friedlaender et al.

To start, there are some technical econometric problems. For example, what is exogenous and what is endogenous? For several of the variables included in the analysis, this is really a very difficult and borderline call, as the authors well recognize and attempt to handle by using various techniques. Furthermore, what is endogenous in one context may not be in another. As an illustration, the percentage of total freight tons involved in transporting coal almost surely was deemed to

Editors' note: This comment is based on the version of the paper presented at the conference.

be an endogenous variable by the Chicago Northwestern and the Union Pacific during these years (undertaking, as they were, Project Yellow to open up an alternative rail access to the Powder River Basin), while the Norfolk Southern probably considered it exogenous. At any rate, the percentage of coal carried by any railroad after deregulation would be at least somewhat subject to the competitive actions adopted by the railroad, especially in designing competitive unit train contracts.

These problems of specifying exogeneity and endogeneity also lead into difficulties of determining cause and effect. For example, the authors report that "executive tenure, internal experience, and education are associated with higher operating ratios, suggesting that embodied human capital may not lead to enhanced efficiencies." An equally plausible interpretation of at least part of this relationship might be that companies experiencing high operating ratios feel more need to recruit experienced and educated people from outside the organization, reversing the causality.

In general, there are many difficulties in sorting out not only what is exogenous and endogenous, but also the causality and various leads and lags in the various relationships. Econometrics imposes a discipline that, while helpful, may be almost too restrictive. Here, once again, the case studies are useful, providing a safety valve or alternative source of information and evaluation.

In many ways the most difficult of all the results to interpret are those associated with the so-called *POISON* variable. The authors apparently interpret the presence of a poison pill as similar to that of the *SEIGE* variable, reflecting pressures on management exerted through the market for corporate control. They therefore expect the presence of a poison pill to improve managerial performance. Some other researchers have, of course, taken a rather dimmer view of poison pill adoption, considering such an act to be a defensive measure reducing managerial accountability and sensitivity to stockholder interests. Still others have suggested that evaluating the effect of poison pill adoption depends on the larger corporate context, such as whether the company is under "seige," has an inbred management, is in a regulated industry, and so forth.

The findings of generally positive poison-pill results are therefore quite intriguing, especially since it is the railroad industry that is under investigation. The usual arguments that can be made in favor of poison

pills are that they choke off attempts at greenmail and can "buy" extra time (beyond the 20 days or so normally allowed under the Williams Act) for boards of directors in a takeover situation to negotiate better terms, find higher bids or white knights, and so on. In the railroad industry, of course, mergers are seldom consummated in less than two years, and greenmail is really not a very practical possibility, except possibly for extremely patient takeover practitioners (an oxymoron?). Accordingly, one would expect that adoption of a poison pill would be construed as a very negative signal in the railroad industry. An investor might plausibly ask why such a defense is needed in such circumstances. If a negative effect from adoption of poison pills cannot be found in the railroad industry, it is difficult to imagine where it might be found.

So what can we make of all this? Are there any generalizations that would seem permissible about the impact of corporate governance and management on performance in the deregulated rail industry? The honest answer is that we really cannot narrow the range of possibilities much. Specifically, what we have, and what the authors have splendidly documented, is a sample of eight or so companies, four of which were more or less success stories (Burlington Northern, Union Pacific, Norfolk Southern, and Conrail), two for whom the jury should still be out (Illinois Central and CSX), and two that were failures during the 1980s (the Santa Fe and the Southern Pacific).

Unfortunately, the four success stories apparently do not have too much in common with regard to the management variables central to the authors' concerns and hypotheses: as the authors note, the Norfolk Southern is a classic case of success achieved under a railroad management internally developed and promoted, the Conrail case is a mixture of outside and inside management, while the Union Pacific and the Burlington Northern both went outside, recruiting management from outside the industry (although very recently Union Pacific promoted from within a "young" railroad man who has risen up through the organization).

The two indeterminate cases (jury still out) of the Illinois Central and the CSX are also somewhat mixed: the CSX shows signs of revival under management promoted from within, which while originally recruited from outside the industry was reasonably well seasoned by industry standards at the time of its ascendancy in the late 1980s; by contrast, the Illinois Central's revival in the late 1980s was overseen

by management that was clearly recruited from outside. The two failures, the intertwined cases of the Santa Fe and the Southern Pacific, were both dominated by experienced railroad people throughout most of the period under review (the only partial exception possibly being the Southern Pacific at the very end of the 1980s). But the difficulties of these two railroads might be largely ascribed to one ill-fated decision, that of attempting to merge the two railroads, which led not only to a rejection by the ICC but to several external takeover attempts. It can be plausibly argued that at least the Santa Fe might have prospered if it had not attempted the merger with the Southern Pacific. The unresolved question is whether that ill-fated decision to merge owes any particular allegiance or derivation to having experienced rail people at the helm at the time the decision was made.

In short, as the authors suggest, no clear pattern emerges about the characteristics of the effective CEO. My own guess, considerably reinforced by reading this paper and reviewing its highly interesting data, would be that a mixed strategy is probably best. That is, the well-run railroad today needs both experienced operating people, well-versed in railroad practices, and people from outside the industry, particularly those with general management and marketing skills. The Conrail experience is perhaps a particularly apt illustration of the point. The first chief executive, Edward Jordan, from outside the industry brought to Conrail some of the best marketing, financial, and government relations skills to be found in the industry. After Jordan left in the early 1980s, he was replaced by an extremely experienced and able rail operating man, Stanley Crane, who brought badly needed operating discipline and skills, which in turn resulted in a sharp upward turn toward profitability. Similarly, in the case of both the Burlington Northern and the Union Pacific, outsiders were "superimposed" on an already solid base of good operating skills and capabilities. The emerging and potential success stories in the case of the Illinois Central and the CSX could also be interpreted as bringing outside skills to bear in situations where reasonably strong operating capabilities are already in place.

The remaining success story, that of the Norfolk Southern, on the other hand, has never been "tainted" by substantial infusions of outside talent. The explanation of success in this case, however, may reside in the intrinsic strength of the two railroads that originally merged to create the Norfolk Southern. The Southern Railway was generally regarded

as the best managed, most innovative, and customer- or market-oriented of all U.S. railroads throughout much of the 1940s, 1950s, and 1960s; by contrast, it was once observed of the Norfolk and Western (the "other half" of the Norfolk Southern) that "anybody should be able to make money rolling coal downhill to Tidewater."

Any problem, then, with the Santa Fe and the Southern Pacific may be attributable not so much to a negative contribution from the available railroad skills but rather to a failure to leaven those basic railroad skills with more external inputs, particularly in marketing and government relations. Neither railroad, moreover, was lucky enough to be built on a mountain of coal only a short downhill ride to Tidewater. So, if a road can't be lucky, then the search should be for outside help, but not to the neglect of core operating skills.

The need for a broader mix of management skills after deregulation is easily explained. The most important single reform embodied in the Staggers Act was that of granting railroads the right to enter into negotiated contracts for rendering their services. This meant that all kinds of trade-offs between rates and volumes, timeliness and speed of delivery, backhaul guarantees, shipment seasonality, equipment specialization and availability could be explored for the first time. (The only important prior exploration was by the Southern Railway in the infamous Big John case of the 1960s.)

In broad terms American railroads made a transition in the 1980s from operating under what have been called "exit" contracts to "voice" contracts; actually, the change was even more pronounced than this since conventional exit contracts were not presumably available to railroads because of the regulation-enforced "common carrier" obligations. This ability to negotiate contracts meant that the railroad managements confronted entirely new, or at least unexplored, production possibilities (which, incidentally, greatly complicates the interpretation of traditional production function and productivity analyses in the industry before and after regulatory reform). Properly exploring these new possibilities required (and still requires) managers with both good marketing and production skills, working collaboratively with one another and with customers. Under regulation, by contrast, production and marketing possibilities were "frozen" and severely delimited by the regulatory contract, a contract generally more stultifying than the most rigid take-it-or-leave-it exit contract. In short, with deregulation,

railroads can productively use a broader range of managerial skills, and the survivors are (will be) those recruiting these new skills while at the same time maintaining or extending fundamental operating capabilities.

Comment by Ronald R. Braeutigam: The paper by Friedlaender, Berndt, and McCullough has set its sights on a difficult target. Although many articles and books have attempted to assess how the domestic railroad industry has fared under regulatory reform, few quantitative studies have focused on the effects of managerial characteristics and the structure of corporate governance on firm performance. This paper takes a first, significant step in that direction.

The first part of the paper paints a dynamic picture of an industry moving quickly to respond to the opportunities and competitive pressures brought on by regulatory reform. These signs of evolution include, among other things, the abandonment of unprofitable lines; a general reduction in the number of miles of track, locomotives, and freight cars in service; decreases in the size of the labor force; a general lowering of real transport tariffs; and the rationalization of rates, routes, and service offerings to meet intermodal and intramodal competition. Many of these structural changes have been documented elsewhere.

The authors then describe activities that have received less attention in the literature on the effects of regulatory reform. There was a wave of diversification of railroad firms into nonrail activities in the early 1980s, as management attempted to provide investors with a rate of return on investment above the subnormal levels earned for so many decades in rail operations. The authors also point out that this widespread diversification was followed by a wave of spin-offs in the latter part of the decade as the industry was able to improve profitability in rail operations following regulatory reform. Finally, during this period railroad management often responded to threats of takeovers by introducing shareholder rights plans and by restructuring to enhance shareholder value.

In short, the first part of the paper summarizes rather nicely how the industry was being transformed physically, financially, managerially, and structurally. It also provides perspective on the nature of the difficulties the authors encounter in trying to develop a methodology that,

Editors' note: This comment is based on the version of the paper presented at the conference.

amid all of this turmoil, isolates the effects of the structures of management and corporate governance on firm performance.

One of the nice features of this paper is that it contains a brief case history of each of the railroads in the study. These histories provide perspective on the nature of the empirical factors that might be most relevant to an investigation of the effects of managerial efficiency and corporate control on railroad performance.

Against this backdrop, the authors prepare for their econometric journey. They have armed themselves with a panel data set, comprised of annual data on nine (as I counted them) major railroad firms (including constituent firms for those that experienced merger over the period) during the time period from 1978 to 1990. The data include four categories of variables: (1) various measures of performance, (2) characteristics of chief executive officers, (3) variables representing the nature of control and governance of the firm, and (4) selected exogenous operating characteristics.

Their analysis of the panel data set leads to three major findings, briefly summarized here. First, "CEO experience and background affect performance, with a railroad background generally being associated with a lower performance." Second, "firm governance and the external environment are also important determinants of performance, with a strong external board generally having positive influence." Finally, "the takeover activity of the latter half of the 1980s influenced rail performance, with the adoption of shareholder rights plans generally having a negative effect and the restructuring activities and/or share repurchase plans generally having a positive effect."

They also conclude that the "caliber of rail management clearly matters, but no clear pattern emerges about the characteristics of the effective CEO." The successful example of the Burlington Northern, with its management from a nonrail background, its history of diversification followed by divestment, and large amount of debt, contrasts sharply with the Norfolk Southern, with its inside rail management, low debt, and focus on rail operations.

The Empirical Analysis

For the balance of this comment, I will focus on the empirical analysis. The authors have been quite clear about the empirical methodology

used in the analysis and have motivated the approach well. The basic form of the empirical work is summarized in footnote 29 of the article. It is comprised of a two-stage least squares analysis.

(1) First stage: $y_1 = f(x_1, x_2, x_3)$

(2) Second stage: $y_2 = g(y_1, x_1, x_2, x_3)$,

where

y_1 = variables representing the endogenous operating environment of the firm, e.g., average length of haul, average compensation of employees, average compensation of executives and staff assistants, operating ratio, revenue ton-miles per mile of track, debt-to-equity ratio, percent of revenues from rail operations, average labor productivity, current investment, current investment as ratio to capital, annual revenue growth in ton miles.

y_2 = performance measures of the firm, gross rate of return on nondepreciated assets, the rate of return calculated based on Interstate Commerce Commission procedures (without adjustments for revenue adequacy), growth rate of multifactor productivity, Tobin's q.

x_1 = vector of characteristics of the chairman and CEO, such as education, occupational background, age, rail experience, tenure as CEO.

x_2 = vector of variables representing the control and governance of the firm, such as number and composition of board and senior management, number of management on board.

x_3 = vector of variables representing the exogenous operating environment of the firm, such as occurrence and timing of merger, lagged number of employees, lagged value of way and structure, percent coal, miles of track, miles of road, presence of a shareholder rights plan, restructuring to enhance shareholder value.

Thus, in the first stage they regress endogenous operating measures on CEO characteristics, control and governance variables, and exogenous operating characteristics. In the second stage they regress the overall performance measures against the endogenous operating characteristics and all of the exogenous variables.

As equations 1 and 2 suggest, the effect of any particular exogenous

variable (x), such as a characteristic of a CEO, on performance (y_1) can be analyzed by looking at the sum of two effects:

$$dy_2/dx = (\partial y_2/\partial y_1)dy_1/dx + \partial y_2/\partial x. \tag{3}$$

The authors refer to the first term on the righthand side of equation 3 as the indirect effect of a change in x on y_1. The second term is called the direct effect. Point estimates corresponding to the sum of the indirect and direct effects for 4 performance measures and 25 exogenous variables are presented in table 10 of the text.

IMPLICIT STRUCTURAL MODEL. The two-stage econometric process represented by equations 1 and 2 are in principle related to some underlying structural model of the railroad industry. In general, a structural model might describe whether economic performance is generated by an equilibrium model or a model of disequilibrium, or through some optimizing process not involving equilibrium at all. It will further specify whether the relevant time frame is the long run or the short run, and whether there are important dynamic elements that must be captured in any empirical attempt to estimate or test the model. Finally, it will help to identify which variables are exogenous and which are endogenous. Equations 1 and 2 are in effect quasi-reduced forms associated with some structural model or models.[1] The justification for the empirical procedure actually used might be further clarified if the nature of the implicit structural model (not necessarily the full specification of a formal model itself) were discussed in the paper.

To be more concrete, let me suggest some possible concerns in more detail. Factors that influence the costs and demand schedules facing a given railroad potentially influence the economic performance ultimately observed for the firm. The authors have clearly included some of these factors in their analysis. For example, average employee compensation, both for the firm as a whole (*COMP*) and for executives and staff assistants (*XCOMP*), attempts to measure wage rates for the firm. The inclusion of levels of physical capital (for example, LN*MLTRAK*) instead of factor price for capital suggests that the implicit structural

1. I use the term "quasi-reduced" here to distinguish equations 1 and 2 from a standard reduced form model in which all variables on the right side are exogenous, since equation 2 contains endogenous variables on the right.

model is for the short run, again an assumption that would seem to be appropriate for this industry using annual data.

At the same time, some variables that would normally be found in cost and demand relationships seem to be omitted. For example, fuel prices vary across railroads and time and would affect economic performance. Yet they are not included in the analysis. Similarly, demand might be affected by income, which may vary by regions served by various railroads, and certainly would vary across time as well. Yet no measure of income appears in the analysis.

To take the structural issues to another level, one might also well ask about the nature of the equilibrium or disequilibrium setting within which the observations on performance are generated. One would normally believe that the economic performance of the railroad industry depends rather crucially on the nature of intermodal competition with motor carriers, pipelines, and water carriers in an increasingly economic environment. Yet no variables reflecting the existence of intermodal or intramodal competition are included in the empirical work. The intensity of intermodal competition may well differ across railroads and across time.

This leads one to ask whether, for example, transport rates for competitors shouldn't be included in the empirical work. Further, if the environment takes place in an equilibrium setting, should the transport rates themselves be modeled as endogenous? If they are not included because they are in some way "enveloped out" of the system, it would be helpful to know just what assumptions affect the interpretation of the empirical findings.

DISTINCTION BETWEEN Y_1 AND Y_2 VARIABLES. In the paper the authors have properly observed that in some cases it is difficult to know whether some variables (the percentage of traffic that is coal, for example) are endogenous or exogenous. Perhaps some specifications tests, such as a Hausman test, could be carried out to assist in this determination.

In addition, many of the y_1 variables, labeled as variables representing the endogenous operating environment of the firm, would seem to be equally well characterized as y_2 variables, that is, as measures of economic performance. Examples include revenue ton-miles per mile of track, average labor productivity, annual revenue growth in ton miles, and, perhaps most obviously, the operating ratio. The authors note that the operating ratio "reflects the ratio of variable costs to revenues and

is generally considered to be a key measure of efficiency.'' But it is also arguably a measure of performance.

This leads to a set of potential questions that might helpfully be answered in the paper. Why were these designated as y_1 variables instead of y_2 variables? Were specification tests run to assist in this formulation? What difference would it make if these variables were designated as y_2 variables?

MIDDLE MANAGEMENT. The study focuses on the effects of CEO and, to some extent, other senior management on rail performance. But a more complete characterization of the managerial technology would recognize the great change that has taken place at middle level of management. Over the past 10 years railroads and other formerly heavily regulated industries undergoing reform beat a path to the doors of the better business schools and actively recruited candidates trained in marketing, strategy, and finance. It would be interesting to see how economic performance has been affected by the composition of middle management (as measured in part, for example, by the percentage of middle management with an MBA or equivalent degree).

SOME FINAL QUERIES. The results of table 10 represent the heart of the empirical findings. As noted earlier, table 10 contains point estimates corresponding to the sum of the indirect and direct effects for 4 performance measures and 25 exogenous variables. The point estimates do conform to the authors' main conclusions from the work, namely, that (1) CEO experience and background affect performance, with a railroad background generally being associated with a lower performance, (2) a strong external board generally has a positive influence on performance, and (3) the takeover activity of the latter half of the 1980s influenced rail performance, with the adoption of shareholder rights plans generally having a negative effect and the restructuring activities and/or share repurchase plans generally having a positive effect.

However, these results are somewhat difficult to interpret in their present form since the table contains only point estimates and no standard errors or indications of levels of significance. It would be helpful if the authors would include levels of statistical significance along with the point estimates, since it is not presently easy to see what is statistically significant and what is not.

I would also like to see discussion of some other aspects of the

findings in table 10. First, although Tobin's q is certainly not purported to be the same measure of performance as rate of return, one might normally expect the comparative statics effects on most of the performance measures to have the same sign, absent a theoretically generated hypothesis to the contrary. It is somewhat curious that the comparative statics effects for Tobin's q are often opposite of the effects on other performance variables, at least at the point estimates in table 10. The percentage of coal and the number of miles of track both affect Tobin's q negatively and all of the other performance variables positively. Parenthetically, one might remark that it is difficult to believe that the presence of coal should lead railroads to have lower measures of profit, so the negative effect of coal traffic on Tobin's q in particular deserves some attention. Lagged employment and both merger variables also have opposite effects for Tobin's q relative to the other performance variables. Some elaboration on these findings might clarify the picture for the reader. Of course, it may well be the case that some of the results just cited are statistically insignificant, and that may help to resolve the puzzle.

Conclusion

I found the article by Friedlaender, Berndt, and McCullough to be most interesting and thought-provoking. The brief case histories of the railroads, as well as the general discussion of developments in the industry over the past decade, are informative and show an appropriate appreciation of rapid evolution in the industry following regulatory reform. The empirical effort has attempted a most difficult task in trying to isolate the effects of managerial characteristics and the structure of corporate governance on firm performance in a time of great turmoil. The authors have identified a set of primary findings that are plausible but could not have been regarded previously as forgone conclusions. Thus, we have learned something from their work, and this first step must be regarded as successful and worthwhile.

General Discussion: Several participants commented on the managerial characteristics that the authors evaluated against railway performance. In regard to the authors' finding that the previous railroad industry experience of a CEO had a negative effect on firm performance during

the deregulation period, Sam Peltzman argued that railroad background was really a proxy for a set of skills that had become obsolete with deregulation. Along the same lines, George Borts noted that because many of the problems of regulation were well known, a person with a traditional railroad background would be able to deal with some of the issues of the deregulation period—such as the need for divestiture of excess capacity and for smaller crew sizes—but might lack skills to deal with new postderegulation issues—such as marketing and pricing.

Frank Wolak tried to explain the authors' finding by reversing cause and effect: he wondered if it were not bad times—as evidenced by low rates of return—that would cause a firm to bring in a CEO with industry experience. He also observed that the authors' data showed a large turnover of CEOs for these railroad firms. He suspected that mandatory retirement might have been playing some role here.

Peter Reiss found the overall examination of managerial characteristics to be disturbing since it failed to pin down exactly what characteristics made a good CEO. He said that an attempt should be made to link information about CEO compensation to CEO and railway characteristics. He wondered if unobservable CEO characteristics might drive CEO compensation in the industry.

Geoffrey Rothwell suggested that characteristics of individual managers are less important for firm performance than structural relations between various levels of management, such as the span of control at each level of management.

Paul Joskow noted that the railway capital stock measure used for calculating Tobin's q might not be very meaningful because it would include stock difficult to value, such as 100-year-old tracks. Borts added that this capital stock measure is really just "an inflation-corrected valuation of a bunch of assets that are not worth anything with the railroads broken up, except for land and rolling stock." Joskow said it might make more sense to use an operating margin or operating ratio in place of Tobin's q. Bronwyn Hall suggested using shareholder rate of return because it reflects the stock market valuation of the firm and represents more than just current year rate of return. Borts disagreed with Hall, saying that both stock market valuation and Tobin's q capital stock value presented the same problem: they were both heavily influenced by merger possibilities. He argued in favor of looking at a real rate of return.

Richard Schmalensee was disturbed by the mismatch between the econometrics and the case studies used in the paper. According to Schmalensee, the authors' regressions basically show that putting a CEO with the right managerial characteristics in charge will lead to an increase in the operating rate of return the following year. Schmalensee noted, however, that the case studies tell stories of radical organizational transformations of large enterprises with substantial bureaucratic inertia.

Frank Lichtenberg suggested that the authors were failing to exploit the longitudinal character of their data. Noting that the paper was primarily concerned with contemporaneous correlations, he suggested that it would be interesting to examine leads and lags as well. According to Lichtenberg, this would allow an examination of the dynamics surrounding events such as a merger, where one could then see the trajectory of productivity and profitability leading up to and following such an event.

Robert McGuckin wanted to know why the authors had excluded from their study the five railroads that had not been involved in mergers and chose to keep the nine that had been.

References

Abowd, John M. 1990. "Does Performance-Based Managerial Compensation Affect Corporate Performance?" *Industrial and Labor Relations Review* 43 (February):52-S–73-S.

Analysis Group. 1991. "Corporate Governance and Corporate Performance." Los Angeles: Analysis Group, Inc.

Berndt, Ernst R., and others. 1991. "Mergers, Deregulation, and Cost Saving in the U.S. Rail Industry." NBER Working Paper 3749. Cambridge, Mass.: National Bureau of Economic Research (June).

Berndt, Ernst R., and Melvyn A. Fuss. 1986. "Productivity Measurement with Adjustments for Variations in Capacity Utilization and Other Forms of Temporary Disequilibrium." *Journal of Econometrics* 33 (October-November):7–29.

Boyer, Kenneth D. 1987. "The Costs of Price Regulation: Lessons from Railroad Deregulation." *RAND Journal of Economics* 18 (Autumn):408–16

Caves, Douglas W., and others. 1985. "Network Effects and the Measurement of Returns to Scale and Density for U.S. Railroads." In *Analytical Studies in Transportation Economics*, edited by Andrew Daughety. Cambridge, Eng.: Cambridge University Press.

Caves, Douglas W., Lauritis R. Christensen, and Joseph A. Swanson. 1980. "Productivity in U.S. Railroads, 1951–1974." *Bell Journal of Economics* 11 (Spring):166–81.

Charan, Ram. 1991. "How Networks Reshape Organizations—For Results." *Harvard Business Review* (September-October):104–15.

Coffee, John C., Jr. 1988. "Shareholders versus Managers: The Strain in the Corporate Web." In *Knights, Raiders, and Targets*, edited by John C. Coffee, Jr., Louis Lowenstein, and Susan Rose-Ackerman. New York: Oxford University Press.

Friedlaender, Ann F. 1969. *The Dilemma of Freight Transport Regulation.* Brookings.

———. 1991. "Fair Rates and Rates of Return in a Deregulated Rail Industry." MIT Department of Economics Working Paper 576. Cambridge, Mass.: Massachusetts Institute of Technology (March).

Friedlaender, Ann F., and others. 1991. "Rail Costs and Capital Adjustments in a Quasi-Regulated Environment." NBER Working Paper 3841. Cambridge, Mass.: National Bureau of Economic Research (September).

Friedlaender, Ann F., and Richard H. Spady. 1981. *Freight Transport Regulation: Equity, Efficiency, and Competition in the Rail and Trucking Industries.* Cambridge, Mass.: MIT Press.

Grimm, Curtis M., and Ken G. Smith. 1986. "The Impact of Rail Regulatory

Reform on Rates, Service Quality, and Management Performance," *Logistics and Transportation Review* 22 (March):57–66.

Grimm, Curtis M., James A. Kling, and Ken G. Smith. 1987. "The Impact of U.S. Rail Regulatory Reform on Railroad Management and Organizational Structure." *Transportation Research* 21A (March):87–94.

Grossman, Sanford J., and Oliver D. Hart. 1980. "Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation." *Bell Journal of Economics* 11 (Spring):42–64.

———. 1983. "An Analysis of the Principal-Agent Problem." *Econometrica* 51 (January):7–46.

Harris, Robert G., and Curtis M. Grimm. 1985. "Revitalization of the U.S. Rail Industry: An Organizational Perspective." In *International Railway Economics: Studies in Management Efficiency*, edited by K. J. Button and D. E. Pittfield. Aldershot, Eng.: Gower Publishing Co.

Hölmstrom, Bengt R., and Jean Tirole. 1987. "The Theory of the Firm." In *Handbook of Industrial Organization*, vol. 1, edited by Richard Schmalensee and Robert D. Willig. Amsterdam: North-Holland.

Jarrell, Gregg A., James A. Brickley, and Jeffrey M. Netter. 1988. "The Market for Corporate Control: The Empirical Evidence Since 1980." *Journal of Economic Perspectives* 2 (Winter):49–68.

Jarymiszyn, Philip, Kim B. Clark, and Lawrence Summers. 1985. "Chief Executive Background and Firm Performance." In *The Uneasy Alliance: Managing the Productivity-Technology Dilemma*, edited by Kim B. Clark, Robert H. Hayes, and Christopher Lorenz. Boston: Harvard Business School Press.

Jensen, Michael C. 1988. "Takeovers: Their Causes and Consequences." *Journal of Economic Perspectives* 2 (Winter):21–48.

Jensen, Michael C., and Richard S. Ruback. 1983. "The Market for Corporate Control: The Scientific Evidence." *Journal of Financial Economics* 11 (April):5–50.

Keeler, Theodore E. 1983. *Railroads, Freight, and Public Policy*. Brookings.

Levin, Richard C. 1981. "Railroad Rates, Profitability, and Welfare under Deregulation." *Bell Journal of Economics* 12 (Spring):1–26.

MacDonald, James M. 1987. "Competition and Rail Rates for the Shipment of Corn, Soybeans, and Wheat." *RAND Journal of Economics* 18 (Spring):151–63.

McFarland, Henry. 1987. "Did Railroad Deregulation Lead to Monopoly Pricing?" *Journal of Business* 60 (July):385–400.

Meyer, John R., and William B. Tye. 1985. "The Regulatory Transition." *American Economic Review* 75 (*Papers and Proceedings, 1984*):46–51.

Myerson, Eva M. 1992. "The Impact of Ownership Structure and Executive

Composition on Firm Performance." Ph. D. diss. Stockholm University, Department of Sociology, January.

Nelson, R. A. 1975. *Values of U.S. Class I Railroads*. AAR Staff Studies Group, Consultant Report 75-1. Washington, D.C.: Association of American Railroads.

Peltzman, Sam. 1989. "The Economic Theory of Regulation After a Decade of Deregulation." *Brookings Papers on Economic Activity: Microeconomics, 1989*: 1–60.

Ruback, Richard. 1988. "An Overview of Takeover Defenses." In *Mergers and Acquisitions*, edited by Alan J. Auerbach. Chicago: University of Chicago Press.

Scherer, F. M. 1988. "Corporate Takeovers: The Efficiency Arguments." *Journal of Economic Perspectives* 2 (Winter):69–82.

Schleifer, Andrei, and Robert W. Vishny. 1988. "Value Maximization and the Acquisition Process." *Journal of Economic Perspectives* 2 (Winter):7–20.

Stigler, George J. 1971. "The Theory of Economic Regulation." *Bell Journal of Economics and Management Science* 2 (Spring):3–21.

Swanson, Joseph A. 1968. "Railroad Investment Demand, 1948–1965: A Neoclassical Model." Ph. D. diss. University of Wisconsin.

University of Washington, Center for the Study of Financial Management. 1991. *Digest* 8 (Fall):2–3.

Vellturo, Christopher A. 1989. "Achieving Cost Efficiencies Through Merger: Evidence from the U.S. Rail Industry." Ph. D. diss. Massachusetts Institute of Technology (September).

Vellturo, Christopher A., and others. 1992. "The Cost Effects of Mergers and Deregulation in the U.S. Rail Industry." MIT–Sloan School of Management Working Paper 3415EFA (March).

Winston, Clifford. 1985. "Conceptual Developments in the Economics of Transportation: An Interpretive Essay." *Journal of Economic Literature* 23 (March):59–94.

Winston, Clifford, Thomas M. Corsi, Curtis M. Grimm, and Carol A. Evans. 1990. *The Economic Effects of Surface Freight Deregulation*. Brookings.

Wyckoff, Daryl D. 1976. *Railroad Management*. Boston: Lexington Books.