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Chapter Author: John R. Meyer, Alexander L. Morton

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JOHN R. MEYER
National Bureau of Economic
Research and Harvard University

ALEXANDER L. MORTON
National Bureau of Economic
Research and Harvard University

The U.S. Railroad Industry in the Post-World War II Period: A Profile

ABSTRACT: Railroading has been a troubled industry for half a century. The troubles have approached the crisis stage once again during the past few years. Much of the railroad system in the industrial heartland of the nation—east of Chicago and north of the Potomac and Ohio rivers—is in bankruptcy. These bankruptcies, furthermore, are not yielding to the traditional solution of financial reorganizations. The rate of return on the investment of Class I railroads even in the "prosperous" south and west has averaged only about 3.6 percent per year during the past six years. The recent surge in railroad traffic, causing ton-miles to attain all-time peaks, has not generated a corresponding improvement in profits, thus causing railroad managements and analysts to speak of their "profitless boom"! This gives rise to fears

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NOTE: This study draws on research performed for the Task Force on Railroad Productivity, of which the authors were members. The Task Force was co-sponsored by the National Commission on Productivity, the Council of Economic Advisers, and the Office of Science and Technology. Other members of the Task Force included Robert E. Gallamore, Lawrence Goldmuntz, George Hilton, John W. Ingram, A. Scheffer Lang, Alan K. McAdams, Thomas G. Moore, John Morrissey, James R. Nelson, and Robert D. Tollison. The final report of the Task Force, *Improving Railroad Productivity*, was released by the National Commission on Productivity in November 1973.

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that another economic recession may send more railroads into bankruptcy. ¶ The origins of the railroad problem reside in the simple fact that the economy is expanding in areas that do not typically produce much new traffic of a type suited to conventional rail transport. Competition from trucking, other specialized modes of transport, and transport alternatives (such as high voltage transmission of electricity, synthetic materials, and recycling of waste materials) are further circumscribing the demand for rail freight service. ¶ The railroads have also suffered productivity problems, caused in part by these shifts in the freight market. Employment in the industry has declined by nearly two thirds during the postwar period, enabling the industry to record gains in labor productivity as great or greater than the average for private industry. However, to achieve this reduction in labor inputs, the industry has had to maintain or slightly increase its employment of capital; as a result, railroad capital productivity, the ratio of output to capital inputs, has shown no growth or has even declined slightly. Total or multiple factor productivity measures that combine labor and capital inputs suggest that railroads' overall productivity gains have been no higher and perhaps lower than the average for private industry.

[1] INTRODUCTION: BASIC FINANCIAL TRENDS

Railroading in the United States has been a troubled industry for half a century. In this paper an attempt is made to document what those troubles have been and why they may have occurred. To the degree possible, the emphasis throughout is on the quantitative facts of the United States rail industry's situation during the post-World War II years. These facts are supplemented as necessary by qualitative considerations and basic historical trends within the industry and the surrounding economic environment.

Since railroads in the United States are still private firms in a market economy, it seems sensible to start with the profitability or earnings record of the enterprises involved. Table 1 shows the earnings of Class I railroad companies from railroad operations and from other sources for the last four decades.[1] A distinct long-run decline in net railway operating income has occurred and been partially offset by an upward trend in income from other sources. The gradual upward trend in "other income" reflects the accelerated development of the extensive real estate and mineral rights of railroads and the diversification of railroad companies into other industries.

The profitability of rail operations alone (exclusive of other income) can be measured by what is called net railway operating income (NROI), shown in column 2 of Table 1.[2] In addition to the rather sharp downward course of net

TABLE 1 Income (After Taxes) and Rate of Return on Net Investment in Transportation Property of Class I Railroads, 1929–1972

(1) Year	(2) Net Railway Operating Income[a]	(3) Other Income[a]	(4) Total Income[a]	(5) Net Investment in Transportation Property (billions)	(6) Crude Rate of Return on Net Investment col. 1–col. 2 (%)
1929	1252	360	1512	23,868	5.30
1939	589	161	750	23,017	2.56
1946	620	210	830	22,549	2.75
1947	781	229	1010	22,891	3.44
1948	1002	235	1237	23,624	4.31
1949	686	254	941	24,028	2.88
1950	1040	266	1305	24,592	4.28
1951	943	273	1216	25,519	3.76
1952	1078	289	1367	26,263	4.16
1953	1109	309	1419	26,670	4.19
1954	874	277	1151	26,670	3.28
1955	1128	271	1399	26,851	4.22
1956	1068	276	1344	27,234	3.95
1957	922	289	1212	27,688	3.36
1958	762	333	1095	27,538	2.76
1959	748	315	1062	27,431	2.72
1960	584	346	930	27,474	2.13
1961	538	322	860	27,181	1.97

TABLE 1 (concluded)

(1) Year	(2) Net Railway Operating Income[a]	(3) Other Income[a]	(4) Total Income[a]	(5) Net Investment in Transportion Property (billions)	(6) Crude Rate of Return on Net Investment col. 1–col. 2 (%)
1962	726	326	1051	25,858	2.74
1963	806	330	1136	25,773	3.12
1964	818	369	1187	25,989	3.16
1965	962	365	1327	26,319	3.69
1966	1046	399	1445	27,322	3.90
1967	676	458	1134	27,733	2.46
1968	678	500	1177	27,668	2.44
1969	655	505	1160	27,892	2.36
1970	486	482	968	28,186	1.73
1971	696	422	1118	28,100	2.47
1972	835	395	1230	28,280	2.95

[a]All figures are after taxes (including federal income taxes) but before fixed charges. All figures in current dollars.

railway operating income over the postwar period, there is a strong in-phase cyclical component. Most significantly, operating income hit successively lower levels during the recessions of 1954, 1958, 1961, and 1970. Net investment in transportation property, including cash and materials inventories,[3] is shown in column 5 of Table 1 and the rate of return on this investment (column 2 ÷ column 5) is shown in column 6.[4]

Compared to more recent years, 1972 was a "good year" for the railroad industry. Yet the return of 2.95 percent puts railroads next to the last among 62 industries ranked according to rate of return on net worth in 1972; their return on equity of 3 percent is less than one-third that for all private industry (10.5 percent).[5] In only five of the years since 1947 has rail rate of return exceeded 4 percent, and the most recent of those years is 1955. Since 1955 the rate of return has exceeded 3 percent in only six out of 16 years, and the most recent of those years is 1966. Because net investment in transportation property displays a modest growth over the postwar period, the rate of return exhibits an even sharper downward trend than net railway operating income.[6]

The earnings performance of the railroad industry portrayed in the foregoing statistics is, of course, considerably influenced by the low profits or actual losses of the northeast railroads. For example, the losses of six deficit eastern carriers reduced net income of the rail industry by $386 million in 1970 and by $321 million in 1971. Table 2, showing the rate of return by district, reveals that it is primarily the mounting problems of ailing railroads in the northeast that have caused the rate of return for the entire industry to decline over the postwar period. However, a low rate of return on investment is not unique to eastern district roads. The railroads of the southern district have maintained a rate of return in the range of only 4–5 percent and 1972 was the first year since 1956 that a 5 percent return was achieved. Western district roads have maintained a return in the 2.5–4 percent range, with a 4 percent return exceeded since 1952 only in 1966 and 1972.

The low earnings of the industry also can be attributed partially to deficit-producing passenger operations, only recently relieved by the transfer of these services to AMTRAK. The passenger-service deficit, as calculated by the ICC yearly since 1963, is shown in the fourth and fifth columns of Table 3. The addition of these amounts to the net railway operating income figures in Table 2 would attenuate, but by no means reverse, the profit decline. In fact, in terms of total deficit (column 5), the passenger loss has been static or slightly declining since the late 1960s.

Net railway operating income, moreover, may actually overstate the earning power of the rail industry. In computing net railway operating income, the consumption of capital is measured by depreciation and amortization computed according to service lives specified by the ICC.

TABLE 2 Rate of Return by District

Year	United States	Eastern District[a]	Southern District	Western District
1929	5.30	6.03	4.27	4.85
1939	2.56	3.14	2.77	1.85
1944	4.70	4.37	5.45	4.82
1947	3.44	3.02	3.52	3.84
1950	4.28	3.63	5.31	4.63
1951	3.76	3.47	4.74	3.76
1952	4.16	3.86	5.27	4.13
1953	4.19	4.01	5.45	3.98
1954	3.28	2.89	4.48	3.29
1955	4.22	4.19	5.45	3.86
1956	3.95	4.05	5.00	3.54
1957	3.36	3.29	4.14	3.18
1958	2.76	2.00	3.68	3.20
1959	2.72	2.27	3.63	2.87
1960	2.13	1.55	2.97	2.40
1961	1.97	0.89	3.19	2.58
1962	2.74	1.80	4.17	3.15
1963	3.12	2.28	4.04	3.60
1964	3.16	2.56	4.01	3.43
1965	3.69	3.32	4.16	3.87
1966	3.90	3.55	4.45	4.03
1967	2.46	1.58	3.86	2.75
1968	2.44	1.27	3.79	3.01
1969	2.36	1.10	4.17	2.81
1970	1.73	def.	4.50	3.02
1971	2.47	def.	4.93	3.90
1972 est.	2.95	0.44	5.17	4.19

[a]Includes Pocohontas region.

These accruals, in the view of many experts, understate the actual loss of value of the railroad plant. For one thing, the service lives accorded roadway and equipment are rather long, and much of rail investment has become economically obsolete before it has been fully depreciated in the accounts. In addition, because of the typically long service lives of rail assets and the continuing inflation in the U.S. economy, cost of replacement often substantially exceeds original cost. As in other industries, inclusion at replacement costs would increase depreciation accruals appreciably; in the railroad industry, with its exceptionally long accounting periods for depreciation, however, the effective understatement based on historical costs may be considerably larger than for most other industries.

TABLE 3 Passenger Service Deficit, 1963–1971 (in millions)

Year	Passenger Service Revenues	Passenger Service Expenses, Taxes, and Rents: Solely Related[a]	Passenger Service Expenses, Taxes, and Rents: Total	Passenger Service Deficit: Solely Related[a]	Passenger Service Deficit: Total
1963	$1,107	$1,116	$1,506	$ 9	$399
1964	1,085	1,103	1,496	18	410
1965	1,042	1,086	1,463	44	421
1966	1,018	1,048	1,417	31	400
1967	878	1,016	1,363	138	485
1968	686	884	1,172	198	486
1969	638	863	1,102	225	464
1970	586	837	1,062	252	477
1971	407	522	692	115	285

[a]Under accounting rules prescribed by the ICC, railroad operating revenues and expenses are divided into freight and passenger services so as to develop a net railway operating income for each service. "Solely related passenger service expenses" are expenses incurred directly in the provision of passenger service and which could be avoided if passenger service were discontinued. "Total passenger expenses" also include common and joint expenses that have been apportioned statistically between freight and passenger service and which could not *necessarily* be avoided if passenger service alone were discontinued, but which in all likelihood would be largely avoided if it were.

[2] THE CHANGING MARKET FOR RAIL FREIGHT TRANSPORT

Obviously, there can be little doubt that the U.S. railroad industry has not been highly profitable in recent decades. Of the many reasons advanced to explain this condition, unquestionably one of the most important is simply the changing character of the intercity freight market. Changing markets characterize the American economy, and the success of an industry depends in no small way on its ability to adapt the product it offers to changing demands. The freight market, like other markets, is subject to change and the problems of the railroad industry owe in large measure to its not being able to adapt to changing market conditions, in terms of both the types of services it provides and the manner in which it produces those services.

As an economy matures, the evolution of consumption patterns and industrial activity causes the overall importance of materials to decline and the relative importance of various commodities to change. The volume of freight, particularly freight of a type suited to rail transport, normally fails to grow in proportion to the rate of economic growth. In gross terms, aggregate intercity freight tonnage has been growing only about 60 percent as fast as real GNP during the postwar period. The geographic distribution of economic activity also changes over time, partially in response to the changing composition of economic activity and partially in response to the changing character of the transport system. This relocation of industry and markets transforms the spatial pattern of freight flows, sometimes in ways that deprive the railroads of traffic and alter the densities of remaining rail traffic. The railroads participate, therefore, in what is inherently a slow-growth market and often an increasingly less profitable one as well.

Bulk-Commodity Traffic

It is useful to divide freight traffic into two categories: bulk commodities and manufactures. Bulk commodities are raw materials or "intermediate" (or "producers") goods in transit from raw-material origin to factory or between factories. Bulk commodities tend to be handled in flows rather than in discrete, packaged units, and they tend to move in large volumes. The commodities themselves are usually dense or "heavy" and of relatively low value per unit weight. They are typically not fragile, perishable, nor particularly subject to depreciation in market value with time. The railroads' arch competitors for bulk-commodity traffic, on a cost basis, are the water carrier and the pipeline, though the relatively high-cost truck has made surprising inroads into even this traffic in certain special cases.

The economic consumption of bulk commodities has not kept pace with the growth of national product. The postwar growth in total consumption of raw materials other than primary construction materials (sand, gravel, and stone for direct use in construction), and air and water, has grown at an average rate of only 1.9 percent per year during the postwar period, half or so the growth rate of about 4.0 percent in real GNP. Furthermore, the long-run trend is for the growth rate of raw material consumption to decline relative to the growth rate of real GNP.[7]

The explanation of this trend seems to lie in evolving consumption patterns and in advancing industrial technology. For consumption, increments to per capita income are increasingly devoted to the purchase of services, such as health care, personal services, education, entertainment, travel, communication, etc., rather than goods. Services typically require a lesser weight of physical materials per unit of output than manufacturing and construction. Specifically, the total share of real GNP allocated to goods as opposed to services fell from 60.8 percent in 1945 to 48.1 percent in 1970.

Even among manufactured goods, incremental personal income is devoted increasingly to goods relatively more labor- and capital-intensive than material-intensive. As personal incomes rise, consumers typically spend smaller fractions of their incomes on such basic commodities as food, clothing, furniture, shelter, and fuel and larger fractions on such highly-fabricated products as televisions, stereo sets, cameras, watches, jewelry, toiletries, and cosmetics, for which weight is much lower in relation to value. The 50 manufacturing industries among the 417 four-digit SIC manufacturing industries exhibiting the highest rates of growth from 1958 to 1966 have freight input coefficients (as taken from the Department of Commerce's 1963 Input-Output table) averaging only one-half the weighted average freight input coefficient (0.02204) of all 417 manufacturing industries. In fact, as Table 4 reveals, only four among the 50 fastest-growing industries have freight input coefficients equal to or exceeding the 0.02204 average for all manufacturing.

Another change in consumer expenditure patterns inhibiting material consumption is the tendency of consumers to substitute more expensive brands, models, and styles of individual products as their personal incomes rise. The weight of materials used in producing more expensive brands, models, and styles of commodities such as food, clothing, cars, furniture, appliances, and housewares rarely rises in proportion to the value of these products; in some products, weight does not rise with value at all.[8]

Progress in industrial technology also retards the growth of material usage. Economies in material usage are achieved in diverse ways, among them the substitution of lighter materials, development of synthetics, creation of more durable materials, miniaturization, improved product design, improved process design, new uses for by-products, waste and scrap, and improved inventory and distribution systems that reduce inventory "shrinkage." Even innovations less directly motivated by a desire to economize on materials and their transport nevertheless may have had such an effect. For example, nuclear energy replaces heavier fuels; radio, television, telephones, and computers are substitutes for "paper" forms of communication; airplanes and communication satellites require fewer ground structures and construction and utilize lighter equipment than their predecessors.

The extent to which material-economizing innovations as well as the shifts to more highly fabricated products and to more expensive brands and styles have retarded the growth of material usage within individual industries is summarized in Table 5. The table contrasts the average annual growth of primary raw material inputs (in units of weight) for each of 16 major industries with the growth of each industry's output (as measured by the respective F.R.B. index of industrial production or some other index of industry output). In every case but one, output has grown more rapidly than the physical weight of inputs and, by implication, the physical weight of outputs.

Of course, volume and composition are not the only dimensions relevant to defining a traffic market. The spatial pattern also is important. Indeed, total ton-miles of traffic could increase even if volume declines, if miles traveled per physical unit rose by more than enough to offset the

TABLE 4 Low Freight Intensities of the Fifty Fastest-growing Manufacturing Industries

SIC Code	Industry	Growth Ratio (value of 1966 shipments ÷ value of 1958 shipments)	Direct Freight Input Coefficient, 1963
1929	Ammunition, N.E.C.	5.80	0.00611
3672	Cathode ray picture tubes	5.10	0.00764
3674	Semiconductors	4.49	0.00739
3571	Computing and related mach.	4.38	0.00383
1914	Guns, mortars, ordnance N.E.C.	4.15	0.00551
2272	Tufted carpets & rugs	3.80	0.01256
1951	Small arms	3.46	0.01802
3679	Electronic components	3.35	0.00814
3339	Primary non-ferrous metals, N.E.C.	3.33	0.00861
3831	Optical instruments & lenses	3.23	0.00630
3392	Non-ferrous forgings	3.16	0.01055
3742	Railroad & street cars	3.02	0.01842
3537	Industrial trucks and tractors	2.94	0.01481
3399	Primary metal industries, N.E.C.	2.83	0.00777
1961	Small arms ammunition	2.79	0.01274
3841	Surgical and medical instruments	2.76	0.01143
3861	Photographic equipment	2.73	0.01005
3953	Marketing devices	2.71	0.01317
3541	Metal-cutting machine tools	2.69	0.00787
3663	Radio, TV, communications equipment	2.65	0.00373
3651	Radio and TV receiving sets	2.64	0.01177
2262	Textile finishing plants, synthetic	2.61	0.01558
2519	Household furniture, N.E.C.	2.55	0.02669
3622	Industrial controls	2.54	0.00740
3357	Non-ferrous wire drawing	2.53	0.01393
3693	X-ray & therapeutic apparatus	2.53	0.00616
2282	Throwing and winding mills	2.51	0.01875
3799	Transportation, equip., N.E.C.	2.50	0.02679
3499	Fabricated metal prod., N.E.C.	2.50	0.00945
3079	Plastic products, N.E.C.	2.49	0.01368
2295	Coated fabric, not rubberized	2.41	0.01035
3545	Machine tool accessories	2.41	0.00598
3479	Metal coating, engraving, etc.	2.39	0.01071
3715	Truck trailers	2.38	0.01641
3565	Industrial patterns	2.37	0.00359
3536	Hoists, cranes & monorails	2.37	0.01127
3791	Trailer coaches	2.36	0.01865

TABLE 4 (concluded)

SIC Code	Industry	Growth Ratio (value of 1966 shipments ÷ value of 1958 shipments)	Direct Freight Input Coefficient, 1963
3341	Secondary non-ferrous metals	2.36	0.05940
3351	Copper rolling and drawing	2.35	0.02630
2256	Knit fabric mills	2.35	0.00919
3713	Truck and bus bodies	2.33	0.01420
358X	Service industry machines, N.E.C.	2.33	0.01302
2327	Separate trousers	2.30	0.00511
2844	Toilet preparations	2.29	0.01295
3542	Metal-forming machine tools	2.29	0.00894
3559	Special industry machinery, N.E.C.	2.27	0.00927
3572	Typewriters	2.24	0.00821
3569	General industry machinery, N.E.C.	2.23	0.00684
3451	Screw machine products	2.23	0.01246
3694	Engine electrical equipment	2.21	0.01068
	All manufacturing	1.65	0.02204

SOURCE: U.S. Department of Commerce, *Industry Profiles, 1958–1966* (U.S. Government Printing Office, 1968); and U.S. Department of Commerce, *Input-Output Structure of the U.S. Economy, 1963* (U.S. Government Printing Office, 1963).

tonnage drop. The geographic organization of economic activity does, of course, adapt itself to changes in the economy. To start, manufacturing is becoming more market-oriented,[9] for many reasons. For example, manufacturers usually ship bulk commodities rather than finished goods because of the lower freight rates for bulk commodities.[10] Similarly, the shift in competitive emphasis from price to style and service encourages producers to locate as close to markets as possible. The concentration of people, and therefore of demand, in large metropolitan areas makes it easier to achieve economies of scale in manufacturing in more and more regions, thus making decentralization and a market-oriented location increasingly feasible.

Another factor tending to lengthen hauls of bulk commodities is increasing geographic specialization in the production of materials. The various regions of the nation are not uniformly endowed with natural resources. As freight rates decline, it becomes economical for a market to draw on ever more distant raw material sources. In particular, the decline in freight rates with distance has encouraged the use of more distant, low-cost raw material sources. The United States has thereby progressed from an economy in which local areas were nearly self-sufficient in producing their own raw material needs to one of regional self-sufficiency (in which there was

TABLE 5 Growth of Primary Raw Material Inputs (in tons) Compared with Growth of Output (as measured by F.R.B. indexes of industrial production), 1947–1967, by Industry

Sector or Industry (in order of declining weight of primary raw material inputs)	Average Annual Growth in Weight of Primary Raw Material Inputs, 1947–1967 (%)	Average Annual Growth in Output, 1947–1967 (F.R.B. Industrial Prod. Index) (%)
New construction	2.2[a]	3.6
Energy	1.9	2.8
Manufacturing	2.2	4.5
Petroleum refining	3.3	3.8
Clay, glass, & stone products	2.9	3.7
Food products	2.1	2.5
Chemicals & products	4.1	8.3
Primary ferrous metals	1.0	1.5
Primary non-ferrous metals	2.8	3.4
Fabricated metal products, machinery, transportation equipment, & instruments & related products	2.1	5.5[b]
Lumber & products	0.7	1.4
Paper & products	2.7	4.6
Rubber & plastics products	7.6	6.4
Textiles	1.7	2.6
Apparel	1.9	3.5
Leather	−1.6	0.7

SOURCE: Alexander L. Morton, "Freight Demand," Ph.D. dissertation, Harvard University (unpublished), Chapter 5.

[a]The index used is the Composite Index of (Ten) Construction Materials, published by the Construction and Building Materials Divison of the Department of Commerce. The ten materials are weighted in relation to value, so that the rapid growth of sand, gravel, and stone consumption affects the index less sharply than otherwise.

[b]Simple average of the F.R.B. production indexes of the four categories.

considerable trade within regions, but regions themselves tended to be self-sufficient) and presently to one of considerable regional interdependence (in which many raw materials are produced in whichever areas of the country have a comparative advantage). Indeed, many important commodities, including citrus and other fresh fruits, and vegetables, grain, meat, lumber, iron ore, coal, and petroleum are supplied throughout the nation from the one or two regions in which they are produced most cheaply.

The exhaustion of natural resources close to historical population centers also causes markets to turn to more distant sources of supply, thereby lengthening hauls of bulk commodities. This process of exhaustion and discovery of new sources at more remote locations is or has been at work in the case of coal, petroleum, iron ore, lumber, and soil fertility. Increasing geographic specialization and the exhaustion of older sources of supply have generally pushed production of raw materials into the west and the south. Most of the traffic growth arising from the lengthening of hauls has, therefore, occurred in these regions.

For those commodities already produced in but one or two areas of the U.S., regional specialization already is well developed, implying that additional lengthening of domestic hauls of these commodities is improbable. Further geographic specialization, if it occurs, is more likely to be on an international scale. Although the effect of expanding international trade on the demand for domestic intercity freight will depend on the types of goods and services exchanged, it may be generally negative. Exports of bulk commodities have only to reach the nearest port. As for imports, to the extent that the population is increasingly concentrated in metropolitan belts extending along the Atlantic, Pacific, and Gulf coasts, and around the Great Lakes, all accessible by ship, imports of bulk commodities and manufactured goods received in trade can be delivered to an increasing proportion of American markets without a long domestic intercity overland haul.

Although intercity hauls of commodities generally seem to be longer, intercity movements of some commodities can become shorter, or even be eliminated altogether, for various reasons. For example, in some industrial sectors certain materials can be substituted for others and these substituted materials may have very different accessibility characteristics—some may originate at great distances whereas others may be available nearby. Thus, the construction industry can choose among concrete, metals, lumber, and synthetics as structural materials, as insulating materials, and as facing or surfacing materials, and these substitutions can be sensitive to differential freight costs, just as they are sensitive to cost differentials in general. Similarly, electric utilities may switch fuels, so that differences in cost, including freight charges, may alter the choice among, say, nuclear, oil, pipelined natural gas, rail transported coal, or hydroelectric or mine mouth generation (with subsequent high voltage transmission). Obviously, not only the total distance and volume of transport involved, but the modal choice will be sensitive to which of these alternatives is selected.

Recycling of used materials presents industry with another opportunity for shortening or even eliminating some intercity freight hauls, for recycled materials substitute for virgin materials that typically must be brought to the market over long distances. Recycling is presently limited to minor amounts of metals, paper, rubber, and industrial chemicals, although it appears probable that the proportions of materials recycled will increase and that recycling will be extended to other commodities, such as heat energy, as the technology is developed. Rising prices of virgin materials as resources are depleted and increasing concern over the environmental impact of waste disposal also can be expected to encourage recycling.

Good estimates of the net effect of all these conflicting influences on the length of haul for bulk commodities during the postwar years are difficult to ascertain. The average length of haul for *all* rail traffic apparently has grown from approximately 411 miles in 1947 to 488 miles in 1967, or at an annual rate of 0.9 percent per year.[11] This average, of course, represents both movements of bulk and manufactured commodities. For water carriers and pipelines, which are more heavily specialized in the movement of bulk commodities than railroads, annual growth rates in average length of haul in postwar years have been 0.2 percent and 0.9 percent, respectively.[12] It is difficult to believe that the length of haul of rail bulk commodities has increased at a rate any more rapid than that for pipelines during these postwar years. This would suggest that the overall rate of growth in length of rail haul of 0.9 percent per year, which is essentially identical with that for pipelines, would be a reasonable estimate of the actual rate of increase in bulk-commodity trip lengths over the postwar period. Assuming this to be the case, this 0.9 percent growth per year in length of haul would constitute almost one-half of the remaining gap between real U.S. GNP growth, approximately 4.0 percent per year during the postwar years, and the average 1.9 percent per year growth in total physical tonnage volume. In short, lengthening of hauls has probably increased the actual rate of growth in total rail bulk ton-miles of traffic during the postwar years by approximately 50 percent, but this is still not enough to bring the rate of increase in this market up to parity with the rate of increase in real GNP.

Traffic in Manufactures

The other major category of freight traffic, manufactures, consists primarily of finished goods, or parts, moving from factory to assembly plant, warehouse, or store. Manufactures typically move in packages or discrete units; shipments tend to be of lower volume, smaller and less regular, than bulk-commodity flows. The goods themselves tend to be of lower density (i.e., lighter) and of higher value per unit of weight. They frequently are fragile or perishable and subject to loss of market value as a function of time. This traffic accounts for 25–40 percent of railroad ton-miles (depending on definition) and a still larger proportion of revenues and profits.

Obviously, the weight of manufactured goods must bear some reasonably constant relation to the weight of raw material inputs. Accordingly, the weight of traffic in manufactures almost certainly has been growing more slowly than real GNP. However, it is significant that aggregate intercity freight tonnage in *both* bulk commodities and manufactures has been growing at a rate about 60 percent as fast as real GNP during the postwar period whereas, as already mentioned, the rate of increase in bulk commodities alone has been growing only about 50 percent as quickly as real GNP. The discrepancy of 10 percent in growth rates between bulk commodity and total commodity tonnage suggests some increased activity in manufactured goods traffic.

The primary cause of this relatively faster growth in manufactured goods traffic tonnage would appear to be an increase in the number of shipments. For example, as per capita incomes rise, there is a shift in consumer expenditures toward products that pass through a greater number of stages of fabrication.[13] Increasing specialization or "division of labor" in manufacturing industry also contributes to a rising number of interplant shipments. Hence, the total tonnage of manufactured goods shipped may rise more rapidly than bulk commodity tonnage. The proliferation of distinct brands, models, and styles of manufactures may also reduce the size of individual shipments and require a more elaborate system of distribution.

It is not so much in tons or ton-miles, however, as in freight revenues that the faster growth of traffic in manufactures than in bulk can be discerned (i.e., in greater revenue per ton-mile). Aggregate intercity freight revenues have been growing about 86 percent as fast as current dollar GNP and the relationship would not seem to be significantly altered if one uses price deflated or real values (since the deflators for freight revenues and GNP are not too dissimilar). Freight revenues from bulk commodities have apparently grown roughly in proportion to bulk-commodity tonnages, economies in bulk handling apparently offsetting the cost of slightly longer hauls.[14] Accordingly, the greater growth in total revenues than in total tonnage has derived chiefly from traffic in manufactures.

An increase in the quality of freight service used is the major explanation of these differential growth rates between tonnage and revenues. A fundamental change in the postwar freight market is the increasingly higher standards of service that shipments of manufactures require. This change parallels—and, in large part, derives from—a shift in most markets toward higher-quality products and services. As the economy shifts to production of more highly fabricated goods and more expensive brands, models, and styles, the value of manufactures per unit of weight tends to rise because of the relatively greater inputs of labor and capital. As the amount and cost of working capital tied up in goods rises, there is a tendency to opt for speedier, more reliable deliveries as a way of controlling logistical costs. Growing sophistication among shippers concerning the trade-offs between transport and other components of the total distribution bill also is partly responsible for the gradual shift to higher-quality freight service.[15]

Highly fabricated and expensive goods are inclined to be fragile, perishable, or otherwise damage-prone, prompting the use of premium transport service. Greater stress on styling erodes rapidly the market value of many products, which also stimulates demand for speedy, reliable delivery. Increasingly, products compete in the market on the basis of quality and service as well as price. The reliability, speed, and convenience of deliveries is part of the quality of service for which a buyer or shipper looks.

Unfortunately for the railroads, they have not been well equipped to meet this demand for higher service standards. The easiest way of documenting this point is to look at the trends in intercity freight shares by the different carriers, shown in Table 6. The most important statistics in Table 6 for evaluating trends in manufactured-goods traffic are the relative performance of rail and truck shares, since the truck is unquestionably the major competitor of rail for this traffic. Since the end of World War II, truck ton-miles have increased fivefold and the truck share of the total market has more than tripled; railroad ton-miles, on the other hand, have increased only slightly, if at all, and the rail share of the total market has declined from roughly two-thirds to a little less than 40 percent. Without much question, the superior growth performance of the trucking industry is in large part attributable to that industry's better performance in meeting the increasingly higher service requirements for manufactured-goods traffic.

Changes in the spatial patterns of traffic and manufacturing also may have handicapped the railroads in competing with trucks. Probably the most important change is the urbanization of the American population. The rural population of the U.S. has declined as a percentage of the total population from 85 percent in 1850 to 60 percent in 1900, 36 percent in 1950, and 25 percent at present. A rural population, geographically disbursed about its manufacturing and distribution centers, requires intercity hauls for distribution of its consumer goods. Much of the rural rail network was constructed to provide both freight and passenger transportation to rural communities that, at the time, had no suitable alternative means of transport. The delivery of consumer goods to a rural population supplied the railroads with traffic that was doubly valuable (1) because manufactures tend to be relatively high-rated (i.e., profitable) traffic; and (2) because manufactures can be back-hauled into rural communities while bulk commodities are being moved out. As the rural population has migrated to cities, this flow of manufactures has diminished relatively, causing much of the rural rail network to become superfluous. In essence, urbanization has eliminated any semblance of balance between bulk commodity flows out of rural areas and manufactured goods back, a two-way traffic for which the all-purpose rail boxcar was uniquely well suited.

The growth of large urban markets also encourages the decentralization and market orientation of manufacturing, a factor that tends to shorten or do away entirely with some intercity hauls of manufactures. Indeed, given the strength of these demographic trends, it is somewhat surprising that total manufactured-goods traffic has continued to grow as much as it has. At any rate, the minimum efficient scale of production for many manufacturing processes has not grown so rapidly as the size of the market in most metropolitan areas.[16] Hence, an increasing proportion of the total market for products is concentrated in cities of a size sufficient to support their own factories in an increasing portion of the manufacturing spectrum. That is, metropolitan areas are becoming increasingly self-sufficient in their local manufacturing capacities.[17] There is, accordingly, a tendency toward a diminished flow of manufactured goods among cities, ceteris paribus. The traffic growth lost as a result of such "import substitution" is again relatively high-rated traffic. The flows also tend to be of relatively high-density, and therefore are less costly to move on a unit basis, since the traffic is concentrated among a limited number of urban origins and destinations.[18] Finally, to the extent that each metropolitan area must produce something in trade, these intercity flows tend to be somewhat balanced as to back-haul.

This decentralization or regionalization (or megapolitization) of manufacturing, in concert with the migration of population to the west and the south, also is having an effect on the interregional balance of traffic in manufactures. Even after the discovery and development of abundant natural resources in the west and during the early westward migration of markets, manufacturing remained highly concentrated in the "industrialized northeast." This generated long hauls of raw materials into the northeast and long hauls of manufactures back to the west and the south. It could only be a matter of time until some manufacturing capacity migrated in order to abbreviate this roundabout traffic. The dispersion of manufacturing away from the northeast thus contributes to lower traffic volumes and the redundance of fixed rail plant in the northeast.

Concurrent with the migration from rural to urban areas has been a migration of population and industry from the central cities to the suburbs. The population residing in the "outside-central-city" areas of the Standard Metropolitan Statistical Areas (SMSAs) grew at a rate half again as great as the growth rate of the central cities between 1930 and 1950, three times as great between 1950 and 1960 and, it is estimated, will grow six times as rapidly between 1965 and 1975.[19] Commerce and industry are suburbanizing at about the same rate as the population.[20]

Suburbanization seems to be generally adverse to the fortunes of the rail industry. Railroads were built at about the same time as cities were expanding or forming, and cities in most cases either grew up around rail facilities or else rail terminals were built near the industrial cores of the

TABLE 6 Intercity Freight by Carriers (billions of ton-miles)

Year	Rail Amount	%	Truck Amount	%	Oil Pipe-line Amount	%	Great Lakes Amount	%	Rivers and Canals Amount	%	Air Amount	%	Total
1939	339	62.3	53	9.7	56	10.3	76	14.0	20	3.7	0.01	0.00	544
1940	379	61.3	62	10.0	59	9.5	96	15.5	22	3.6	0.02	0.00	618
1941	482	62.4	81	10.5	68	8.8	114	14.8	27	3.5	0.02	0.00	772
1942	645	69.5	60	6.5	75	8.1	122	13.1	26	2.8	0.04	0.00	928
1943	735	71.3	57	5.5	98	9.5	115	11.2	26	2.5	0.05	0.00	1,031
1944	747	68.7	58	5.3	133	12.2	119	10.9	31	2.8	0.07	0.01	1,088
1945	691	67.2	67	6.5	127	12.4	113	11.0	30	2.9	0.09	0.01	1,028
1946	602	66.6	82	9.1	96	10.6	96	10.6	28	3.1	0.08	0.01	904
1947	665	65.3	102	10.0	105	10.3	112	11.0	35	3.4	0.11	0.01	1,019
1948	647	61.9	116	11.1	120	11.5	119	11.4	43	4.1	0.15	0.01	1,045
1949	535	58.3	127	13.8	115	12.5	98	10.7	42	4.6	0.20	0.02	917
1950	597	56.2	173	16.3	129	12.1	112	10.5	52	4.9	0.30	0.03	1,063
1951	655	55.6	188	16.0	152	12.9	120	10.2	62	5.3	0.34	0.03	1,177
1952	623	54.4	195	17.0	158	13.8	105	9.2	64	5.6	0.34	0.03	1,145
1953	614	51.0	217	18.0	170	14.1	127	10.6	75	6.2	0.37	0.03	1,203
1954	557	49.6	213	19.0	179	15.9	91	8.1	83	7.4	0.38	0.03	1,123
1955	631	49.5	223	17.5	203	15.9	119	9.3	98	7.7	0.49	0.04	1,274
1956	656	48.4	249	18.4	230	17.0	111	8.2	109	8.0	0.58	0.04	1,356
1957	626	46.9	254	19.0	223	16.7	117	8.8	115	8.6	0.68	0.05	1,336

1958	559	46.0	256	21.1	211	17.4	80	6.6	109	9.0	0.70	0.05	1,216
1959	582	45.3	279	21.7	227	17.7	80	6.2	117	9.1	0.80	0.06	1,286
1960	579	44.1	285	21.8	229	17.4	99	7.5	121	9.2	0.89	0.07	1,314
1961	570	43.5	296	22.7	233	17.8	87(67)	6.6	123(84)	9.4	1.01	0.08	1,310
1962	600	43.8	309	22.5	238	17.3	90(66)	6.6	133(90)	9.7	1.30	0.09	1,371
1963	629	43.3	336	23.1	253	17.4	95(68)	6.5	139(94)	9.6	1.30	0.09	1,453
1964	666	43.2	356	23.1	269	17.4	106(73)	6.9	144(102)	9.3	1.50	0.10	1,543
1965	709	43.3	359	21.9	306	18.7	110(76)	6.7	152(110)	9.3	1.91	0.12	1,638
1966	751	43.0	381	21.8	333	19.1	116(81)	6.6	164(117)	9.4	2.25	0.13	1,747
1967	731	41.4	389	22.0	361	20.5	107(75)	6.1	174(128)	9.9	2.59	0.15	1,765
1968	757	41.2	396	21.5	391	21.3	112(75)	6.1	179(139)	9.7	2.90	0.16	1,838
1969	774[a]	40.8	404	21.3	411	21.7	115(83)	6.1	188(144)	9.9	3.20	0.17	1,895
1970	768	39.7	412	21.3	431	22.3	114(79)	6.0	205(156)	10.6	3.40	0.18	1,933
1971(p)	744	38.7	422	21.9	444	23.1	104	5.4	205	10.7	3.50	0.18	1,923

SOURCE: *Transportation Facts and Trends*, July 1972.
NOTE: Intercity freight by carriers includes both for-hire and private carriers; (p) indicates TAA preliminary estimate.
[a]Effective 1969; no longer includes mail and express.

newly-forming cities. As long as cities remained dense and compact, clustered around the rail facilities on which they were so dependent, traffic readily moved by rail.[21] Rail lines have not been extended in most cities to serve emerging suburban areas as completely and efficiently as they serve the central business district and, indeed, probably could not be for technological reasons. Suburbanization, therefore, tends to carry consumers, warehouses, and factories away from rail service.[22] Furthermore, in choosing among possible suburban locations, factories, warehouses, and shopping centers are sometimes more concerned today with locating along highways for ease of access by employees and customers than they are with locating along rail lines.

Not only does suburbanization reduce the proportion of shipments with origins and destinations having ready or efficient access to rail, it also transforms the pattern of movements to a pattern for which the rail network and conventional train operations are not well suited. Formerly, the distribution pattern for manufactured goods tended to be radial, outward from urban manufacturing cities to satellite cities and towns, thus paralleling the rail network. The present trend is toward movements of manufactured goods that originate at one suburban point and terminate at other suburban points scattered about the metropolitan area. This emerging distribution pattern is less radial, more dispersed and "random," with an increasing number of shipments moving over trans-suburban routes not paralleled by rail lines and lacking the density for conventional train operations.

In sum, the basic trends in manufactured-goods traffic have not been so adverse as those for bulk commodities. Certainly, the revenues realized in aggregate from manufactures traffic have almost kept pace with the growth in GNP. However, from the standpoint of the railroads, this relatively favorable performance of the total market for manufactured goods has not been particularly beneficial, as most of this traffic growth has gone to other carriers, and especially to trucks. Trucks apparently were better adapted to rendering the higher-quality service increasingly required by manufactured goods, and the spatial distribution of activity has trended away from situations and sites (i.e., origins and destinations) that once were well served by the railroad route structure.

[3] RAIL PRODUCTIVITY GROWTH

Traditional Measures of Rail Productivity

Productivity growth measures the improvement over the years in the efficiency with which an industry converts its factors of production into a salable service or product. In an environment in which competing industries are achieving significant productivity gains, an industry whose productivity lags normally finds it difficult to simultaneously match wage increases in other industries, keep its prices stable to fend off competition from other products and services, and maintain a satisfactory rate of profit. For example, when productivity lags, market-enforced wage increases must be translated into higher prices, which gradually cause demand to cease growing and perhaps eventually to taper off. At the same time, lagging productivity and falling output put pressure on profits and the ability of any industry to raise capital for renewal and modernization. Accordingly, industry growth in output and productivity generally are positively correlated.

It is at least somewhat surprising, therefore, given the static character of output growth in the railroad industry, that published studies of industry productivity growth rates suggest that the railroad industry has done quite well by usual measures of productivity gain. Specifically, "net ton-miles and passenger-miles per man-hour," the index (attributable to the U.S. Department of Labor's Bureau of Labor Statistics, or BLS) frequently used to measure productivity in the transportation industries, has grown at an average rate of 5.2 percent per year in the rail industry during the period 1947–1970 (and 6.0 percent per year between 1957 and 1970). During the same period, the productivity of the private economy as a whole, measured as real net output per man-hour of labor, has grown at an average rate of only 3 percent. According to these studies, then, the railroad industry has generated productivity gains at a rate 70 percent greater than the rest of the economy.[23] In addition, for the railroads' major competitors, output per unit of labor input rose only 3.1 percent per year in intercity motor trucking and 0.7 percent per year in water transportation vs. 5.8 percent a year in railroading during the period 1948–1966.[24] The question thus arises, how have the railroads seemingly violated the usual rule relating good productivity performance to general industry growth and prosperity?

At least one explanation may be that net ton-miles per man-hour is an incomplete measure of overall rail productivity, at least for some purposes. To begin, rail labor inputs have declined much more rapidly than capital inputs. In most industries capital has been substituted for labor over the last few decades but this substitution has been especially pronounced in the rail industry. The capital-labor ratio increased at an average rate of 2.6 percent per year in the private domestic economy during the period 1948–1966.[25] In the rail industry the capital-labor ratio has increased at an average annual rate of about 4.7 percent during the same period.

Like capital inputs, inputs of materials and services (or so-called "intermediate" inputs) have tended to decline less rapidly than labor inputs in the rail industry. Specialization is an important means of improving productivity, and the railroad industry has used this device extensively. Not only has it increasingly employed relatively more outside labor services, but it also has turned increasingly to purchasing the services of capital assets owned by others as an alternative to owning the assets itself. This is particularly evident in rolling stock. Although the number of railroad-owned freight cars has been decreasing throughout the postwar years, the number of cars leased by the railroads and the number of cars owned by car companies and shippers have been increasing, until in 1971 the latter accounted for roughly 18 percent of all freight cars.[26] In 1955 railroads built over half as many freight cars as the car-building industry, but by 1971 they built only 15 percent as many.

Recorded man-hours may also understate the growth of inputs needed to produce current output while maintaining rail plant at given standards.[27] Financial stringencies have prompted some rail companies to economize on labor and other inputs by deferring maintenance of their properties and by allowing the average quality of the rail plant to deteriorate. This "reduced-level" of maintenance may be wise and proper in cases in which there is an excess of rail plant that will never need to be replaced; more generally, deferring maintenance may simply postpone expenses associated with producing present output, thereby causing present inputs to be understated and productivity gains to be overstated.[28]

Ton-mileage might also overstate the output growth of the rail industry. This could occur because, among other reasons, there has been a shift in the composition of traffic toward that which is inherently less costly to produce and less valuable in the market place. The most important instance of this is the decline of passenger service. Since passenger-miles are several times more costly to produce than revenue freight ton-miles, the precipitous decline of passenger traffic relative to freight traffic has caused a reduction in average cost per unit of the composite output used by the BLS and others. In addition, virtually all the growth in aggregate freight ton-mileage has come from the growing length of freight hauls. As pointed out previously, average distance per ton increased in recent years—indeed, by approximately 24 percent between 1947 and 1971. The marginal factor input requirement of longer hauls is comparatively light, so that growth of ton-mileage stemming from longer hauls is a less costly increment to output than one stemming from added shipments. Thus, if output were measured as revenue tonnage rather than ton-mileage, measured productivity growth between 1947 and 1971 would be roughly 24 percent less.

As a measure of output, ton-mileage also does not reflect any deterioration in quality of service that may be overtaking some railroads. To the extent that a lower quality of service is less costly to perform, the inputs needed to produce a given ton-mileage are reduced, causing conventional productivity measures to rise. Standards of rail service may have fallen in a number of ways. Shippers, it is alleged, must wait longer for empty cars for loading, and more often the cars on arrival are dirty or otherwise unsuitable for loading. Speed of delivery has shown little if any improvement during the postwar period and may even have declined; the average freight-car cycle time (the time elapsed between successive loadings of a single car) has increased from 16.6 days in 1947 to 25.5 days in 1971, an increase substantially in excess of the 24 percent rise in length of haul. The incidence of loss and damage, another aggravation to shippers, has shown a fairly steady upward trend. As a rough indicator, loss and damage claims paid have risen from $98 million, or 1.1 percent of freight revenues, in 1955 to $235 million, or 2.0 percent of revenues, in 1971.

Sensitivity Tests of Productivity Measures

The standard measures of rail productivity can be modified or tested for sensitivity to the various factors cited above. The first or most obvious of these would be to adjust for the changing character of rail output. The unit of rail output used by the BLS is a combined total of ton-miles and passenger-miles in which a passenger-mile is said to be the equivalent of roughly two freight ton-miles, corresponding to the fact that average rail passenger revenue per passenger-mile is approximately twice the average rail freight revenue per ton-mile. However, as stated in section 1, throughout the postwar period passenger service has been a cross-subsidized and deficit-producing operation, so the relative revenues of passenger and freight operations fail to reflect their relative costs. Using standard ICC formulas for apportioning operating expenses between freight service and passenger service, passenger operating expenses per passenger-mile have been estimated to be from five to nine times as great as freight operating expenses per ton-mile.[29] Counting passenger-miles as the equivalent of five rather than two ton-miles, total rail traffic measured in ton-miles would be found to have declined at an average of 0.3 percent a year between 1947 and 1970 rather than rising at an average rate of 0.2 percent as the BLS statistics indicate. This, in turn, would reduce the measured labor productivity gain by one-half of one percentage point per year from the 5.2 percent per year calculated by the BLS to 4.7 percent per year. Of course, if one were to count a passenger-mile as equivalent to seven or eight freight ton-miles, the simple labor productivity gain using the BLS index would be further reduced.

As noted, the use of ton-miles as the unit of freight output may also overstate the growth of rail output, for the shifts toward lower-value, bulk commodities, toward larger shipments and longer hauls, all are shifts toward ton-miles that are inherently less costly to produce. Assuming that the relative costs of different types of freight shipments are roughly proportional to their respective revenues (i.e., applying the BLS rule for weighting passenger and freight service to weighting different types of freight traffic which would seem more defensible for freight service since freight mark-ups are probably more uniform), an estimate of the actual increase in freight output may be obtained by deflating total freight revenues by an index of freight rates (say the RI-1 freight rate index computed by the ICC); by so doing, one can at least partially abstract from systematic changes in the composition of freight traffic with respect to commodity, size of individual shipments, and length of hauls. Freight output measured in this manner would have risen only 0.2 percent per year between 1947 and 1970, one-half a percentage point less than the 0.7 percent per year increase in revenue ton-miles.[30] If translated into an adjustment of the BLS productivity statistics, this would reduce the measured productivity growth in the rail industry by another ½ of 1 percent per year. Together, these two changes in the output index—one to weight passenger service more nearly in accord with its contribution to operating expenses, the other to account for the changing character of freight traffic—would reduce the measured rate of growth in labor productivity by a full percentage point.

To the extent that the rail industry, like most other industries, has substituted capital for labor in the production process, productivity may also be better measured for many purposes by endeavoring to construct combined or multiple factor productivity indices. Specifically, Kendrick, in a study of productivity trends in the American economy, defines what he calls "total factor productivity" which takes into account increases in capital as well as labor inputs.[31]

Indexes of labor and capital are weighted together in the Kendrick study "on the basis of the labor and property shares of national income originating in the railroads as estimated by the Office of Business Economics."[32] The property share of capital in national income, however, corresponds to profits, and inasmuch as the rate of profit in the highly regulated railroad industry is relatively low, the proportionate level of capital inputs could be understated by the Kendrick procedure. As pointed out in Section 1, the rate of return on net investment (original cost less depreciation) in rail transportation property has averaged only about 3 percent during the postwar period. This is only half the 6 percent return that the ICC has traditionally taken as a desirable standard for the rail industry and only one-third the 9 percent to 10 percent or more after-tax return that is perhaps more "normal" throughout non-regulated private industry.

It could be argued, therefore, that productivity measures for the rail industry might be more nearly comparable with unregulated sectors if capital inputs were accorded two to five times the weight that is accorded them in the Kendrick study. (On the other hand, of course, Kendrick can argue that all of his indices are constructed using the same definitions in all industries so that inter-industry comparability is thereby improved.) Kendrick affords capital inputs a weighting of roughly 10 percent and labor inputs a weighting of 90 percent during the period 1950 to 1966. The effect of a heavier weighting of capital inputs on the measured growth of Kendrick's total factor productivity would be to reduce it by three-tenths of a percentage point for each doubling of measured capital inputs; thus, with a 75–25 weighting instead of Kendrick's 90–10, total productivity growth from 1948 to 1966 would drop from Kendrick's estimate of 5.2 percent to 4.7 percent.[33]

Alternative Measures of Rail Productivity

Total rail output, for purposes of calculating the growth of factor productivity, has been, as we have seen, traditionally a weighted combination of revenue freight ton-miles and revenue passenger-miles. However, the growth of freight traffic might be better represented not as the growth of physical ton-mileage, for reasons advanced earlier, but as the growth of rail freight revenues measured in constant or deflated dollars. There is also the question of how to combine passenger traffic with freight traffic in order to arrive at a measure of total rail output. Using the convention that a passenger-mile is equivalent to five revenue freight ton-miles (to reflect the relative cost of producing passenger-miles vs. ton-miles), railroad output for the years 1947 and 1970 could be measured as follows:[34]

	1947	1970
Freight service—in ton-miles (billions) measured in constant rail freight dollars	655	689
Passenger service in equivalent ton-miles—passenger-miles (billions) × 5	230	54
Total output in ton-mile equivalents (billions)	885	743
Total output index (1947 = 100)	100	84.0

Total inputs to the rail industry consist of labor, capital, and purchased materials and supplies. For productivity measures, each input, like each output, should be measured in real or constant dollar terms or physical units or as close thereto as possible. Accordingly, labor input might be measured as customary by man-hours worked, including straight time and overtime.[35]

For capital inputs the measurement problem is considerably more complex. Fortunately, the Bureau of Accounts of the ICC in 1937 reevaluated all the transportation property (other than land and landrights) of the railroads; they concluded that the cost of reproducing the rail system (except for land and landrights) less depreciation would be $19,491 million as of January 1, 1937. Over the years, investments by the railroad industry have added to the cost of reproducing the rail plant while depreciation and retirements have reduced that cost.

The annual investments in rail plant and equipment normally used for updating the 1937 ICC valuation are the gross capital expenditures of the railroad industry as reported by the U.S. Department of Commerce.[36, 37] Annual depreciation can be roughly estimated to be at the rate of 2.5 percent of the present value of the capital stock, which is approximately the average ratio of annual depreciation actually charged to the book value (*original* cost less accrued depreciation) of rail plant and equipment. The 40-year average life of rail assets implied by the 2.5 percent annual charge represents a compromise between the 20–30 year lives for rolling stock and the 50–60 year lives for structures allowed by the Internal Revenue Service.

A correction for change in the cost of railroad construction is necessary so that the existing capital stock, current investments, and depreciation all are combined at the same price level. The Bureau of Accounts of the ICC computes a railroad construction cost index that measures the annual change in the cost of constructing railroad track, structures, and equipment. This index can be used to maintain the valuation of all assets in the same year's prices. Table 7 shows the reproduction cost less depreciation of the capital stock owned by the railroad industry and employed to produce rail output in both constant 1957–1959 dollars and in current dollars for the years 1947–1970. In the constant dollars series, each year's gross capital expenditures are deflated to 1957–1959 dollars before addition to the capital stock. In the current dollar series, the capital stock is inflated year-by-year (before capital expenditures are added) in order to reflect the rising cost of reproducing that stock in each year.

The capital stock series in constant dollars seems like a reasonable basis for determining capital inputs to the rail industry. To a reasonable first approximation, capital inputs can be taken to be proportional to the size of the capital stock. The constant dollar series in Table 7 indicates that the capital stock owned and employed by the rail industry has changed negligibly during the postwar period in real terms. This fact roughly corresponds to other observations about rail fixed plant. Rail route miles and freight cars both number roughly the same today as they did at the end of World War II. Various signaling and yard improvements should roughly offset the marginal decline in the number of route-miles during the postwar period; similarly, increases in the capacity and motive power of freight cars and locomotives tend to offset the decline in their numbers. The steadiness of the capital stock implies that in real terms, gross capital expenditures in the rail industry have just offset depreciation and retirements. That is, the

TABLE 7 Capital Stock, Owned by Railroads and Employed in Producing Rail Output, Reproduction Cost Less Depreciation

Year	Constant 1957–1959 Dollars	Current Dollars
1947	51.7	34.0
1948	51.7	37.6
1949	52.3	38.1
1950	52.5	38.8
1951	53.1	41.7
1952	53.5	43.3
1953	53.7	45.0
1954	53.4	45.2
1955	53.2	45.8
1956	53.2	49.4
1957	53.3	52.1
1958	52.8	52.9
1959	52.4	53.5
1960	52.1	53.4
1961	51.5	52.5
1962	51.0	52.0
1963	50.8	51.6
1964	50.9	52.2
1965	51.3	52.9
1966	52.0	54.5
1967	52.1	55.9
1968	51.9	58.8
1969	51.9	61.8
1970	51.8	65.3

SOURCES: Kendrick, *Productivity Trends in U.S. Transportation Industries*, (prepared for the Office of the Under-Secretary of Transportation, U.S. Department of Commerce, January 1966), pp. 8, 31–32; and U.S. Department of Commerce, *Survey of Current Business*, June 1956 and March issue of 1958 and subsequent years.

excess of gross capital expenditures above depreciation in the financial accounts of the railroads may not reflect net physical additions to the capital stock so much as the rise in the cost of replacing assets over their original cost.[38]

The preceding estimates of the rail-owned capital stock exclude land and landrights. It is estimated that railroads occupy roughly 3 million acres of rural land and 300,000 acres of urban land, only slightly changed between 1947 and 1970.[39] Assigning value to these lands at the rate of $100 per rural acre and $10,000 per urban acre, roughly corresponding to the average value of rural and urban acreage in 1957–1959, the total value of the railroad investment in land would be estimated at $3.3 billion in 1957–1959 prices.

Finally, as mentioned, considerable growth has occurred in capital inputs from plant and equipment that are employed in producing rail output but not owned by the railroad companies and therefore excluded from the preceding capital inputs. During recent years, outlays on private freight cars by other than railroad operating companies have been running $300 to $500 million per year, or roughly one-quarter to one-third the total gross capital expenditures of the operating companies themselves. A lack of historical data on such outlays prevents arriving at an estimate of the total stock by cumulation, so instead that value must be estimated by capitalizing the annual rental charges, as is done to a rough approximation in Table 8.

The ICC reports annual rental charges for equipment and jointly operated facilities. Of equipment rental charges, ICC figures suggest that roughly 30 percent represent maintenance, leaving the balance to pay for interest and depreciation. As the bulk of these rental charges are for equipment, a 4 percent rate of annual depreciation (25-year life) can be assumed. The average yield on equipment obligations, about 3 percent in 1947 and 6 percent in 1970, is used as the appropriate rate of interest. These estimates imply that the capital stock that yielded $131 million in

TABLE 8 Estimate of Total Value of Capital Stock Employed in Producing Rail Output but Owned Externally (millions)

Item	1947	1971
1. Hire of equipment	$ 134	$ 736
2. Reimbursement for maintenance (30% of above)	40	221
3. Hire of equipment net of maintenance (1) − (2)	94	515
4. Joint facility rents	37	42
5. Total rental charges for externally owned rail plant (3) + (4)	131	557
6. Annual depreciation rate	4%	4%
7. Annual interest rate	3%	6%
8. Capital recovery factor (6) + (7)	7%	10%
9. Estimated capital value of rented plant & equipment in current dollars (5)/(8)	1 870	5 570
10. Railroad construction cost index (1957–1959 = 100)	66.2	122.2
11. Estimated capital value of rented plant & equipment in 1957–1959 dollars (9)/(10)	2 830	4 560

rental charges (net of maintenance) in 1947 had a value of approximately $1.9 billion, whereas the capital stock that yielded $557 million in rental charges in 1970 had a value of approximately $5.6 billion.[40] Converting these estimates to constant 1957–1959 dollars by the ICC's railroad construction cost index, the constant-dollar capital stock of externally owned rail plant and equipment can be estimated as growing from $2.83 billion 1957–1959 dollars in 1947 to $4.56 billion in 1970. When inputs of both railroad-owned and externally owned plant and equipment are taken together, the striking aspect is the overall stability of the total capital stock used in the U.S. rail industry in the postwar years. Moreover, whatever increase has occurred, apparently has consisted largely of externally owned assets.

In Table 9, the rate of growth of rail inputs and outputs, as calculated from the statistics just presented, are summarized. Crude estimates of the rates of growth of rail labor productivity and rail capital productivity can be determined by subtracting the rate of input growth from the rate of output growth. Labor productivity in the rail industry, by this measure (using the figures of Table 9), grew at an average rate of 3.7 percent per year. Although this figure is substantially lower than the 5 to 6 percent rate of growth in labor productivity estimated by the BLS and Kendrick in their studies, it still is above the reported rate of growth in labor productivity in the entire private domestic economy, which has averaged 3.0 to 3.1 percent per year during these same years. This is a surprising record of accomplishment for an industry that has suffered declining output, with the result that increases in labor productivity have necessitated a rather rapid contraction of the labor force.[41]

An important factor in this comparatively rapid growth of rail labor productivity is almost certainly the substitution that has occurred of capital

TABLE 9 Rate of Growth of Rail Inputs and Outputs

Item	Index 1947	Index 1970	Percent Annual Rate of Growth 1947–1970
Output	100	84.0	−0.7
Inputs			
Labor	100	36.2	−4.4
Materials and supplies	100	45.7	−3.4
Capital—rail-owned	100	100.2	0.0
Capital—external	100	172.4	2.4
Capital—rail-owned plus external	100	104.3	0.2

TABLE 10 Weightings for Aggregating Labor, Capital, and Intermediate Inputs Based on Contribution of Each to Total Rail Operating Costs, 1947 and 1970[a]
(all figures in millions of *current* dollars)

Item	1947 Amount	1947 % of Total Costs	1970 Amount	1970 % of Total Costs
Labor (including payroll taxes & welfare benefits)	$4,986	55	$6,400	44
Materials & supplies	1,909	21	1,636	11
External capital	171	2	777	5
Rail-owned capital (excluding land) see Table 8	(34,000)		(65,300)	
Depreciation	850	10	1,633	11
Interest	1,020	11	3,918	27
Land	(2,000)		(3,500)	
Interest	60	1	210	1
Total operating costs[a]	$8,996	100	$14,574	100

[a] In the case of labor, purchased materials and supplies, and external capital, the contribution to total costs is equated to actual outlays. The cost of rail-owned capital inputs, however, is taken as depreciation equal to 2.5 percent of reproduction cost less accrued depreciation (in current dollars) plus interest charge equal to 3 percent in 1947 and 6 percent in 1970 of reproduction cost less depreciation (in current dollars).

for labor, as depicted strikingly in Table 10. Although output has declined, total capital inputs have actually increased slightly, implying in simplistic terms a negative rate of capital productivity growth.[42]

Rather than calculating either labor productivity or capital productivity, the change in productivity for all factors could be measured. In order to calculate the growth of multiple factor productivity, it is first necessary to determine with what weights labor, capital, and any other inputs should be combined. It is clear that the more heavily labor inputs (which have declined) are weighted relative to capital inputs (which have been stable or increased slightly), the greater will be the measured rate of productivity gain, and vice versa. The theoretically most defensible weighting procedure is probably to weight each class of input according to its contribution to total costs; that is, the larger, more costly a certain class of input, the more heavily it should be weighted. The problem with this strategy is that as the proportion in which the various inputs are combined has changed over the years, the proportion in which each input contributes to total costs has presumably changed also. Thus, the actual weights depend on the year of observation. Fortunately, input proportions measured in physical units usually change in the opposite direction to their relative prices (due to factor substitution), with the result that their proportions in total cost change less sharply than their proportions in physical units.

The contributions of labor, capital, and intermediate inputs to total operating costs in the years 1947 and 1970 are shown in Table 11. Whereas the substitution among capital and intermediate inputs as against labor has moved steadily in one direction between those years, it may be assumed that the weightings developed using those two extremes are the extremes of the various weightings that would result from using intermediate years. Using the weighting scheme based on the input costs analysis for 1947, in which year labor and intermediate inputs were used rather intensively, multiple factor productivity in the rail industry grew at an average rate of 2.4 percent per year from 1947 to 1970; using the 1970 weights, in which year capital inputs were used rather heavily, overall rail productivity grew at an average rate of only 1.5 percent per year. These estimates compare with a 2.5 percent rate for combined labor and capital productivity in the entire private domestic economy during this same period.[43]

In sum, the railroad industry may not be achieving the high rates of productivity growth often claimed for it. Much of the statistical gain in rail labor productivity owes simply to the decline of passenger traffic, of less-than-carload traffic, or traffic in manufactures, and of short-haul traffic, with the resulting shift in the composition of rail traffic toward heavy-loading, bulk commodities, and longer hauls, which are inherently less labor-intensive. Compensating for the changing character of traffic reduces the growth rate of labor productivity to a level that is close to the average throughout industry.

This growth of labor productivity has also been accompanied by some replacement of labor inputs by capital and other inputs. Annual productivity growth for all factors in the rail industry has perhaps averaged only 1.5 percent to 2.5 percent during the postwar period. This record is approximately the same or somewhat lower than the comparable productivity gain in most other industries, though not adverse compared to what might be expected in a declining industry such as railroading.[44]

[4] THE RAILROAD FINANCIAL SITUATION REVISITED

For a number of reasons, the standard reports on net railway operating income often are regarded by financial and other observers of the industry as being potentially misleading. They are, of course, prepared to ICC specifications and in many respects conform to accounting procedures found elsewhere in industry. However, some ICC procedures predate the

TABLE 11 Railway Earnings Computed with Cash Flows Charged with Gross Capital Expenditures Rather than with Depreciation as the Cost of Maintaining Capital Intact

Year	Net Railway Operating Income	Depreciation Accruals	Cash Flow	Gross Capital Expenditures	Adjusted Net Railway Operating Income ÷ (Cash Flow − Gross Capital Expenditures)	Adjusted Rate of Return[a]
1950	1040	430	1470	1066	404	1.64
1951	943	445	1388	1414	−26	def.
1952	1078	486	1564	1341	223	0.91
1953	1109	505	1614	1260	354	1.44
1954	874	527	1401	820	581	2.36
1955	1128	539e	1667	910	757	3.08
1956	1068	553	1621	1228	393	1.60
1957	922	582	1504	1395	109	0.44
1958	762	602	1364	738	626	2.55
1959	748	614	1362	818	544	2.21
1960	584	629	1213	919	294	1.20
1961	528	641	1179	646	533	2.17
1962	726	655	1381	833	548	2.23
1963	806	699	1475	1044	431	1.75
1964	818	686	1504	1417	87	0.35
1965	962	707	1669	1631	38	0.15
1966	1046	732	1778	1953	−175	def.
1967	676	756	1432	1522	−90	def.
1968	678	773	1451	1187	264	1.07
1969	655	766	1421	1509	−88	def.
1970	486	790	1276	1351	−75	def.
1971	696	800e	1496	1178	318	1.29
1972	835	812e	1647	1244	403	1.64

emergence of modern accounting practices and are therefore at some variance with current accounting conventions.

Unquestionably, the largest number of questions about railroad accounting pertain to the handling of depreciation expenses or the capital asset accounts. For example, many suspect that the depreciation accruals, computed by standard ICC methods, underestimate the true degree of capital consumption in the industry. Other reservations about railroad depreciation figures originate in the fact that railroad equipment is assumed to have an uncommonly long average physical life by the standards of modern industry (usually in the range of twenty to sixty years). When coupled with the obvious fact of considerable inflation in costs in the U.S. economy over the last few decades, these long lives for depreciation could under certain assumptions (and particularly in a slow-growing industry)[45] result in cash flows from depreciation that are inadequate to finance current replacement needs.

The rail industry, as explained in section 1, has for some time experienced a stable volume of traffic and seems to have limited prospects for future growth. In such an environment, it is difficult to believe that current gross capital expenditures would consistently run above a level needed to do more than maintain current output. In fact, the capital committed to the industry, as developed in the calculations reported in section 2, does indeed seem to have been more or less constant over the last couple of decades. More precisely, if one concentrates only on that capital owned by the industry itself and therefore subject to depreciation on the books of the industry, the total committed capital has actually declined somewhat in recent years.

This suggests that a somewhat truer picture of the earnings situation in the rail industry might be achieved by substituting gross capital expenditures for depreciation accruals in computing net railway operating income. The standard objections to such a procedure, applicable in almost any other industry, that gross capital expenditures not only provide for the replacement of depreciating assets but also for additional assets necessary for the expansion of the business (and therefore cannot realistically be charged off as costs of business in the year incurred), would not necessarily be as applicable in an industry as stable (or even declining) as the railroad industry. Moreover, though gross capital expenditures in the U.S. railroad industry have run substantially above depreciation charges, there is some evidence that the quality of the equipment and property committed to railroading may actually have deteriorated somewhat in recent years; for example, there is much comment on a continuing so-called shortage of freight cars and an undeniable increase in the instances of derailment.[46] Consequently, gross capital expenditures, as much in excess of depreciation charges as they are, may themselves be a conservative estimate of the cost of capital maintenance in the railroad industry. On the other hand, a plausible argument against charging gross capital expenditures (instead of depreciation) against current revenues in calculating a more realistic estimate of net railway operating income is that, as pointed out in the preceding section, some of the capital expenditures represent a substitution of capital inputs for labor inputs and thus are a legitimate charge against future revenues. On balance, though, gross capital expenditures are probably a somewhat more accurate estimate of capital consumption in the U.S. rail industry than the historically based depreciation figures. The "true" figure—to the extent that it can ever be determined in matters such as these—is probably somewhere in between.

The effect on measured railroad earnings of substituting gross capital expenditures for depreciation is dramatic, as Table 11 shows. The rate of return on net investment in 1950 computed in this way has not exceeded 3 percent since 1955 and has exceeded 2 percent in only six years since 1950, the most recent of which is 1962.[47] Thus, if gross capital expenditures are regarded as expenses necessary merely to keep the rail system intact and functioning, the system has been operating without return on

TABLE 12 Net Income and Its Uses (millions)

Year	Net Income: Before Extraordinary & Prior-Period Items	Net Income: After Extraordinary & Prior-Period Items[a]	Total Cash Dividends	Payout Ratio: Dividends to Net Income Before Extraordinary Items
1960	445	N.A.	385	86.5
1961	382	N.A.	358	93.7
1962	571	N.A.	368	67.5
1963	652	N.A.	379	58.1
1964	698	N.A.	457	65.5
1965	815	N.A.	471	57.8
1966	904	N.A.	499	55.2
1967	554	322	503	90.8
1968	569	565	516	90.7
1969	514	464	487	94.8
1970	227	76	421	185.5
1971	347	−336	387	111.2
1972	500		408	81.6

NOTE: All data are on Class I railroads.

[a]The large extraordinary charge in 1971 was related to the beginning of Amtrak operation.

investment in all but three years since 1964, even before fixed charges are paid.

The financial viability of the industry depends ultimately, of course, on its ability to meet these fixed charges. The fixed charges of the railroad industry have increased markedly over the past decade, from $367 million as recently as 1963 to $601 million in 1971.[48] The upward march of fixed charges owes to a combination of advancing interest rates in the capital market plus the increased debt of the railroad industry. Despite the stable volume of rail traffic, gross capital expenditures have exceeded internal cash flows (depreciation plus net income) less cash dividends in every year since 1960, thus requiring an addition to borrowed capital and greater fixed charges.

Net income, the residuum of total income left after paying fixed charges and miscellaneous deductions from income, is the amount of income remaining for distribution to equity holders as dividends or for reinvestment in the business. The gradual decline of total income and the rising level of fixed charges imply that net income has trended downward, as Table 13 indeed shows. Although net income has been falling, the total cash dividends paid out by Class I railroads have been increasing during the last decade, to the extent that dividends paid during 1970 and 1971 exceeded net income for the system as a whole.[49] However, if the deficits in net income of the six northeastern railroads are added back into the net income of all Class I railroads, the dividend payout ratios for 1970 and 1971 are reduced to 68.7 percent and 57.8 percent for those years.

Clearly, the financial condition of the railroad system as an entity is less than robust. The cash flows of the industry (net railway operating income plus depreciation) are barely sufficient to provide for capital maintenance if that is measured by gross capital expenditure rather than depreciation, let alone to provide a competitive rate of return on invested capital. Furthermore, cash flows have been stable or trending slightly downward, whereas the amount of money invested, and therefore the costs of amortization and interest, have been rising.

An intriguing question is why monetary investment has continued at such a high or even expanding level in a declining or stagnant industry, earning such low rates of return. A high rate of reinvestment in an industry with a low average rate of return is understandable, of course, if the new investment is expected to earn a high marginal rate of return. Unfortunately, continuing increases in the dollar value of railroad assets have been accompanied thus far by a fairly stable level of cash flows (railway operating income plus depreciation) and by a continuing low level or even decline in the average rate of return. The claim of high marginal returns can only be supported, then, by maintaining that although new investments earn a high return, the returns to old assets are falling so fast as to

TABLE 13 Flows of Capital Funds—Class I Railroad Companies, 1956–1970 (thousands)

Year	Funds Generated by Internal Sources—Railroad Operations: Net Railway Operating Income (1)	Depreciation: Road and Structure (2)	Depreciation: Equipment (3)	Funds Generated by External Sources: Equipment Debt (4)	Funded Debt (5)	Sales of Equity (6)	Funds Generated by Unidentifiable Sources, Including Other Income[a] (7)	Other Income (8)
1970	485.9	170.3	628.8	676.1	333.0	66.7	850.8	482.4
1969	654.7	165.4	609.5	630.4	512.6	40.1	736.0	505.3
1968	677.6	165.1	607.6	554.8	369.8	107.4	587.4	520.6
1967	676.4	163.4	601.2	755.2	100.4	49.9	809.8	457.5
1966	1,045.9	161.4	570.9	1,136.3	50.4	36.9	553.2	399.4
1965	961.5	159.5	547.1	799.1	151.4	75.9	490.7	365.4
1964	818.2	160.4	525.2	749.8	184.5	39.9	614.0	368.9
1963	805.7	161.1	507.8	448.8	166.8	18.2	307.6	330.1
1962	725.7	159.7	495.6	313.1	59.8	8.8	285.2	325.6
1961	537.8	159.6	481.2	224.2	126.3	30.4	430.8	322.3
1960	584.0	157.6	470.9	312.6	137.3	8.1	732.8	346.3
1959	747.7	155.6	458.3	196.5	153.1	9.5	535.4	314.6
1958	762.3	153.8	448.5	286.7	214.8	13.3	179.0	333.1
1957	922.2	150.8	430.7	627.1	45.6	11.3	513.5	289.3
1956	1,068.2	147.1	405.4	439.1	159.9	12.2	434.2	275.6
Totals:	11,473.2	2,390.8	7,788.7	8,149.8	2,765.7	528.6	8,060.4	5,636.4
Averages:								
1966–1970	708.1	165.1	603.6	750.5	273.2	60.2	707.4	473.0
1961–1965	769.1	160.0	511.3	507.0	137.7	34.6	425.6	342.5
1956–1960	816.8	152.9	442.7	372.4	142.1	10.8	478.9	311.8

TABLE 13 (continued)

Year	Funds Paid to External Sources: Interest and Guaranteed Rents (9)	Dividends (10)	Funded Debt Repayment (11)	Equipment Debt Repayment (12)	Total Internally Generated Funds[b] (13)	Total Externally Generated Funds[c] (14)	Capital Expenditures[d]: Road and Structure (15)	Equipment (16)
1970	557.0	422.4	340.9	541.2	1,285.0	−785.7	357.0	993.1
1969	545.3	438.8	324.8	530.3	1,429.6	−656.2	420.7	1,088.7
1968	505.5	470.4	570.7	335.9	1,450.3	−850.7	368.3	818.7
1967	487.4	498.6	155.0	492.8	1,441.0	−728.3	374.1	1,148.4
1966	455.1	467.1	230.4	449.5	1,778.2	−378.6	398.6	1,554.2
1965	433.1	440.2	258.7	422.8	1,668.1	−528.1	327.1	1,303.6
1964	412.3	419.3	326.7	516.4	1,503.8	−700.5	277.6	1,139.7
1963	401.4	346.6	222.2	402.0	1,474.6	−738.4	258.9	784.9
1962	398.7	333.8	108.7	373.7	1,381.0	−833.2	239.6	593.4
1961	406.0	322.6	262.6	352.7	1,178.6	−963.0	219.3	427.1
1960	415.8	344.7	331.9	391.7	1,212.5	−1,026.1	285.7	633.5
1959	419.7	346.5	303.8	368.0	1,361.6	−1,079.0	250.5	567.5
1958	424.5	380.9	135.5	379.3	1,364.6	−805.5	258.4	479.7
1957	410.6	395.6	144.9	355.3	1,503.7	−622.5	387.0	1,007.7
1956	402.6	418.8	273.8	342.9	1,620.7	−827.0	406.5	821.4
Totals:	6,675.1	6,046.3	3,990.6	6,254.5	21,653.3	−11,522.8	4,829.3	13,361.6

TABLE 13 (concluded)

Year	Funds Paid to External Sources: Interest and Guaranteed Rents (9)	Dividends (10)	Funded Debt Repayment (11)	Equipment Debt Repayment (12)	Total Internally Generated Funds[b] (13)	Total Externally Generated Funds[c] (14)	Capital Expenditures[d]: Road and Structure (15)	Equipment (16)
Averages:								
1966–1970	510.1	459.5	324.4	469.9	1,476.8	−679.9	383.7	1,120.6
1961–1965	410.3	372.5	235.8	413.5	1,441.2	−752.6	264.5	849.7
1956–1960	414.6	377.3	238.0	367.4	1,412.6	−872.0	317.6	702.0

SOURCE: Interstate Commerce Commission, *Transport Statistics in the United States*. Table reproduced from verified statement of Dr. R. A. Nelson before the ICC in hearings on Ex parte No. 271, pp. 54 and 55.

[a]Column 7 comprises sources of funds that cannot be identified in ICC summary data. It probably includes proceeds from sale of railroad property, short-term borrowing, and income from non-rail sources.

[b]The sum of columns 1, 2, and 3 equals column 13.

[c]The sum of columns 4, 5, and 6 less the sum of columns 9, 10, 11, and 12 equals column 14.

[d]The sum of columns 7, 13, and 14 equals the sum of columns 15 and 16.

offset the impact of the new investments on the average rate of return.[50] But beyond some point, the erosion of the return on aging assets can no longer be ignored in claiming a high marginal return on new investments. It is therefore significant that even if all the earnings of all the capital employed in the rail industry (i.e., net railway operating income) were attributed to the gross capital expenditures of the preceding ten years alone, the rate of return in 1970 would have been only 3.7 percent, in 1971, 5.2 percent, and in 1972, 5.9 percent. These rates, although higher than overall rates for the rail industry, still are low compared to industry in general.

Continuing reinvestment in railroad property also may reflect the absence of alternative uses for the funds available to the railroads. Regulation, in particular, has impeded withdrawal of funds or diversification "out" of railroading. The common-carrier obligation of railroads enforced by the ICC and the specific prohibition of line abandonment and related forms of disinvestment may sometimes have caused the railroads to reinvest despite low anticipated returns.[51] Given that railroad management is committed (whether by choice or by regulatory compulsion) to remaining in the traditional railroad business, simply doing so necessitates a continuing high level of investment.[52] If rail service is to be provided, new cars must be purchased as old cars wear out and as traffic grows, and so on. The rising monetary cost of replacements in an inflationary economy contributes to the growing dollar investment in railroad property. Furthermore, railroad equipment is depreciated on its original cost rather than its cost of reproduction, and the service lives of railroad assets are comparatively long, so the cost of replacing them is usually considerably in excess of depreciation based on historical costs. This may be offset to some extent by technological innovations, but it is doubtful if this offset is total or complete for the railroad industry.

Of course, if the sum of gross capital expenditures plus cash dividends exceeds cash flows (net income plus depreciation), an industry must rely on external funds. Table 13 shows the volume of external funds that the rail industry has succeeded in attracting in recent years.[53] In view of the chronically low average rate of return on capital invested in railroad property and of the apparent withdrawal of equity capital through dividends, this ability to raise outside debt is rather remarkable.

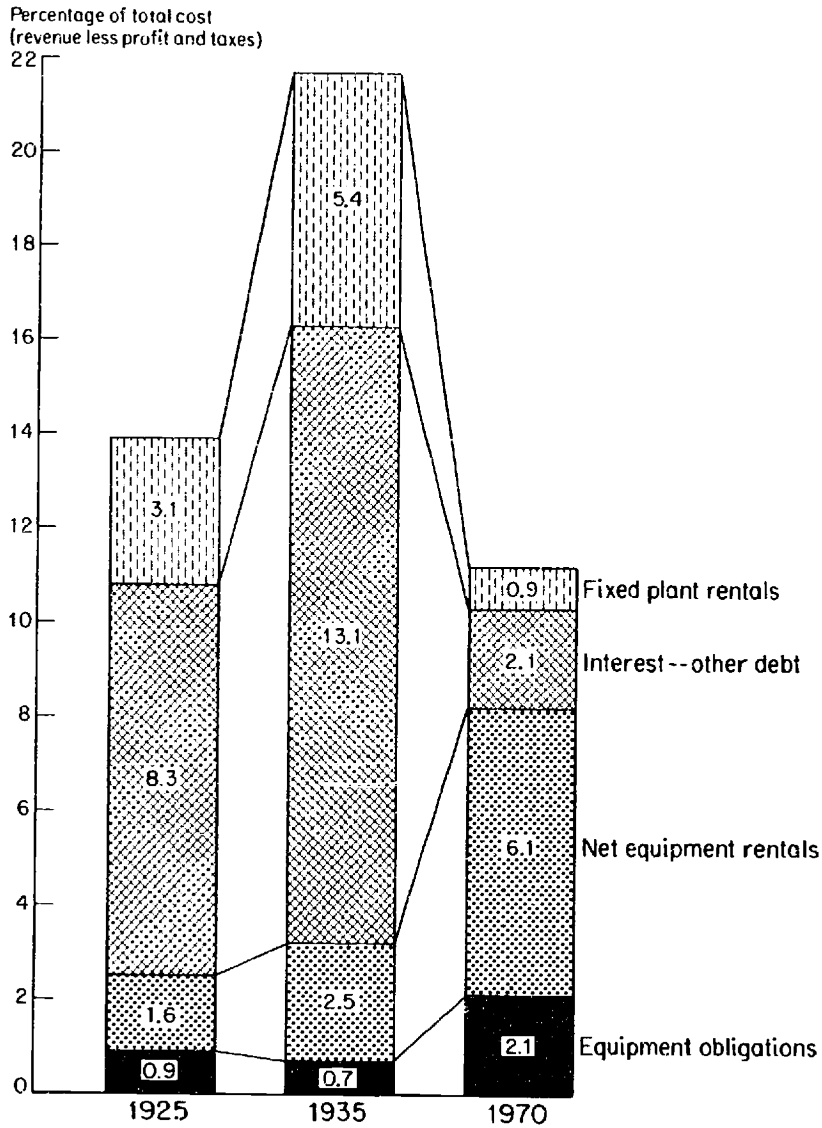
One apparent explanation for the relative ease with which external funds have been raised is to be found in their form. The largest category of external funds shown in Table 13 is "equipment debt." Equipment debt comes in two primary categories, equipment trusts and conditional sale contracts (or deferred payment contracts).[54] In cases in which neither equipment trusts nor conditional sale contracts are feasible, the long-term lease provides a third method of raising external funds for rolling stock.

Equipment debt has been made available to the railroad industry because of the near perfect security or collateral that the equipment provides to the creditor. "A history of equipment trusts," in the words of one expert, "indicates practically zero risk to holders. The security is readily repossessed and, if necessary, resold. Considering that the car life is more likely 30 years than 15, the market value from date of issue is greater than the indebtedness generally. Thus there is no risk premium.[55] Another attractive feature of equipment debt is the seniority of the claims on earnings of the creditors compared to the claims of bondholders and stockholders. The power of repossession puts the claims of those underwriting equipment trusts and conditional sale contracts ahead of those holding the funded debt.[56] Together, the seniority of claims and the liquidity and mobility of the collateral have provided the railroads with a large source of external funds in equipment debt; these funds, moreover, have been made available to the railroad industry at very favorable interest rates. Interest rates on rail equipment obligations have tended to be equal or slightly lower than yields on AAA corporate bonds and rates on conditional sale agreements have been only slightly less than half a point higher.[57,58]

One not totally incidental consequence of the substitution of equipment debt for funded debt and equity capital is that it has already substantially complicated the problem of reorganizing railroads in bankruptcy. Capital costs as a proportion of total railway operating "expenses" in the years 1925, 1935, and 1970 are shown in Figure 1.[59] Traditionally, reorganizations have succeeded by changing the capital structure to reduce debt service costs to a point at which operating revenues can reasonably be expected to cover them. Equipment debt cannot necessarily be written down in this way, if the creditors prefer to exercise their option to repossess. Thus it is only the claims of holders of funded debt and of lessors of fixed plant that can be reduced in this manner. Figure 1 shows that, as a result of the substitution of equipment debt for funded debt and equity, the proportion of capital costs that might be easily voided by bankruptcy has declined greatly. Compared to 11.4 percent of total operating costs in 1925 and 18.5 percent in 1935, readily voidable capital costs for the industry in 1970 comprised only 3.0 percent of total operating expenses. Hence, the bankruptcy courts presently have a much narrower margin within which to work than during earlier rounds of railroad bankruptcies.

In short, the railroad industry has continued to maintain its investment in railroad property and has managed to attract new external debt to fund these capital expenditures, despite a low rate of return on invested capital. In essence, the industry has to some extent substituted debt for equity and leases and conditional sales agreements for debt in its financial structure. In the long run, obviously, some limit must exist to the extent to which an industry can attract relatively cheap capital by using more senior forms of financing, thereby subordinating older debt.

FIGURE 1 Capital "Rents" (Excluding Equity Capital)



SOURCE: Association of American Railroads

[5] SUMMARY

The evolution of the freight market has created serious problems for the railroad industry. Aggregate intercity freight traffic (of all carriers) has grown less than two-thirds as fast as real GNP during the postwar period, and traffic of a type suited to conventional rail transport has grown still more slowly. The emergence of new carriers, particularly trucking and pipeline transport, have narrowed the number of freight markets in which rail service holds a cost and service advantage, further circumscribing rail growth.

Conventional and widely used measures of railroad productivity, such as "ton-miles per man-hour," indicate that rail productivity has grown at a rate of 5–6 percent a year during recent decades, considerably above the average 3.0 percent growth of labor productivity in the private economy during these same decades. However, using alternative assumptions and measures (e.g., allowing for changes in the composition of rail traffic), it can be argued that the growth in rail-labor productivity has been only about 3.7 percent. Capital inputs to the railroad industry have not declined nearly so rapidly as labor inputs, so that the indicated crude productivity growth rate for rail capital is near zero. When labor, capital, and other inputs are weighted together, productivity in the industry may have grown only about 1.5 to 2.5 percent per year during recent decades, a productivity growth rate at or slightly below the 2.5 percent per year rate for the private economy as a whole.

The financial condition of the railroad industry reflects the sluggish growth of traffic and productivity. On many grounds, in fact, the 3 percent or so overall average rate of return on transportation operations reported by U.S. Class I railroads, using conventional ICC accounting techniques, may be an overstatement. Trends in railroad operating income and capital expenditures also point toward a possible further deterioration in the railroads' financial condition.

In short, the U.S. railroad industry suffers severe problems. This does not necessarily mean, though, that the industry can never be restored as an efficient, competitive, profitable industry.[60] Indeed, even today, there are important segments of the industry that are progressing and have every reason to expect continued prosperity. Nevertheless, attainment of a reasonable level of prosperity for the industry as a whole probably will require quite dramatic changes, either in current economic trends or the structure of the industry, or both.

APPENDIX TABLE A Income Statement, Class I Railroads, 1960–1970 (dollar amounts in thousands; index, 1960 = 100)

Item	1960		1961		1962		1963	
	Amount	Index	Amount	Index	Amount	Index	Amount	Index
Total operating revenue	$9,514,294	100.0	$9,189,138	96.6	$9,439,895	99.2	$9,559,522	100.5
Freight revenue	8,025,423	100.0	7,739,044	96.6	7,991,146	99.6	8,146,131	101.5
Passenger revenue	640,268	100.0	624,688	97.6	619,056	95.1	588,104	91.9
Mail revenue	331,378	100.0	341,697	103.1	343,588	103.7	338,684	102.2
Total operating expenses	7,565,336	100.0	7,274,260	96.2	7,418,562	98.1	7,451,648	98.5
Maintenance: way and structure	1,191,690	100.0	1,117,680	93.8	1,154,802	96.9	1,182,507	99.3
Maintenance: equipment	1,759,828	100.0	1,683,363	95.7	1,743,639	99.1	1,731,735	98.4
Transportation	3,832,882	100.0	3,710,832	96.8	3,755,092	98.0	3,771,254	98.4
Operating ratio (percent)	79.52	100.0	79.16	99.5	78.59	98.8	77.95	98.0
Net operating revenue	1,948,958	100.0	1,914,878	98.3	2,021,333	103.7	2,107,874	108.2
Railway tax accruals	998,799	100.0	991,083	99.2	905,044	90.6	886,387	88.7
Railway operating income	950,159	100.0	923,794	97.2	116,289	117.5	1,221,487	128.5
Equipment and facility rents	366,143	100.0	386,023	105.4	390,610	106.7	415,828	113.6
Net railway operating income	584,016	100.0	537,771	92.1	725,679	124.3	805,659	138.0
Other income	346,328	100.0	322,281	93.1	325,575	94.0	330,074	95.3
Total income	930,344	100.0	860,052	92.4	1,051,254	113.0	1,135,733	122.1
Total fixed charges	372,751	100.0	369,111	99.0	366,817	98.4	367,970	98.7
Income after fixed charges	494,799	100.0	428,976	86.7	612,705	123.8	694,065	140.3
Ordinary income[a]	444,640	100.0	382,444	86.0	571,017	128.4	651,637	146.6
Cash flow	1,191,693	100.0	1,073,155	90.1	1,023,229	85.9	1,226,326	102.9
Net income								
Net railway operating income before federal income taxes	786,919	100.0	780,227	99.2	882,483	112.1	969,768	123.2
Ordinary income before federal income taxes	647,543	100.0	624,900	96.5	727,803	112.4	815,746	126.0
Total cash dividends	385,493	100.0	357,561	92.8	368,164	95.5	378,549	98.2

APPENDIX TABLE A (continued)

Item	1964 Amount	1964 Index	1965 Amount	1965 Index	1966 Amount	1966 Index	1967 Amount	1967 Index
Total operating revenue	$9,856,527	103.6	$10,207,850	107.3	$10,654,666	112.0	$10,366,041	109.0
Freight revenue	8,455,457	105.4	8,835,958	110.1	9,280,613	115.6	9,130,233	113.8
Passenger revenue	577,910	90.3	553,056	86.4	543,632	84.9	485,369	75.8
Mail revenue	329,169	99.4	311,341	94.0	303,999	91.7	263,633	69.6
Total operating expenses	7,737,847	102.3	7,849,841	103.8	8,117,657	107.3	8,204,492	108.4
Maintenance: way and structure	1,225,759	102.8	1,235,801	103.7	1,303,739	109.4	1,287,834	108.1
Maintenance: equipment	1,763,786	100.2	1,774,878	100.8	1,843,089	104.7	1,867,789	106.1
Transportation	3,920,622	102.3	4,020,161	104.9	4,139,268	108.0	4,186,049	109.2
Operating ratio (percent)	78.50	98.7	76.90	96.7	76.19	95.8	79.15	99.6
Net operating revenue	2,118,679	108.7	2,358,009	121.0	2,537,010	130.2	2,161,549	110.9
Railway tax accruals	870,581	87.2	916,494	91.8	968,372	97.0	910 178	91.1
Railway operating income	1,248,098	131.4	1,441,515	151.7	1,568,638	165.1	1,251 371	131.7
Equipment and facility rents	429,886	117.4	479,999	131.1	522,775	142.8	574,936	157.0
Net railway operating income	818,213	140.1	961,516	164.6	1,045,863	179.1	676,434	115.8
Other income	368,891	106.5	365,389	105.5	399,492	115.4	457,545	132.1
Total income	1,187,103	127.6	1,326,905	142.6	1,445,355	155.4	1,133,980	121.9
Total fixed charges	380,420	102.1	400,665	107.5	425,804	114.2	460,923	123.6
Income after fixed charges	739,106	149.4	855,607	172.9	941,489	190.3	588,774	119.0
Ordinary income[a]	698,184	157.0	814,629	183.2	903,783	203.3	553,789	124.5
Cash flow	1,383,824	116.1	1,521,210	127.6	1,634,349	137.1	1,310,092	109.9
Net income							321,541	
Net railway operating income before federal income taxes	956,131	121.5	1,125,172	143.0	1,232,188	156.6	742,752	94.4
Ordinary income before federal income taxes	836,103	129.1	978,285	151.1	1,090,108	168.3	620,106	95.8
Total cash dividends	457,188	118.6	470,800	122.1	499,364	129.5	502,872	130.4

APPENDIX TABLE A (concluded)

APPENDIX TABLE A (concluded)

Item	1968 Amount	1968 Index	1969 Amount	1969 Index	1970 Amount	1970 Index
Total operating revenue	$10,854,678	114.1	$11,450,325	120.3	$11,991,658	126.0
Freight revenue	9,749,788	121.5	10,346,258	128.9	10,921,813	136.1
Passenger revenue	444,334	69.4	438,667	68.5	420,452	65.7
Mail revenue	195,418	59.0	177,284	53.5	161,457	48.7
Total operating expenses	8,580,961	113.4	9,066,529	119.8	9,659,982	127.7
Maintenance: way and structure	1,405,132	117.9	1,502,958	126.1	1,612,585	135.3
Maintenance: equipment	1,914,265	108.8	2,002,316	113.8	2,165,254	123.0
Transportation	4,354,705	113.6	4,595,574	119.9	4,873,299	127.1
Operating ratio (percent)	79.05	99.4	79.18	99.6	80.56	101.3
Net operating revenue	2,273,718	116.7	2,383,796	122.3	2,331,676	119.6
Railway tax accruals	946,334	94.7	1,029,067	103.0	1,068,518	107.0
Railway operating income	1,327,384	139.7	1,354,729	142.5	1,263,158	132.9
Equipment and facility rents	649,760	177.5	700,059	191.2	777,304	212.3
Net railway operating income	677,624	116.0	654,670	112.1	485,854	83.2
Other income	499,639	144.3	505,267	145.9	482,433	139.3
Total income	1,177,263	126.5	1,159,937	124.6	968,787	104.1
Total fixed charges	483,815	129.8	521,346	139.9	589,148	158.1
Income after fixed charges	602,779	121.8	545,054	110.1	256,851	51.9
Ordinary income[a]	569,402	128.1	514,238	115.7	226,583	51.0
Cash flow	1,363,132	114.4	1,280,043	107.4	1,016,177	85.3
Net income	564,505		463,565		76,179	
Net railway operating income before federal income taxes	743,702	94.5	760,861	96.7	574,204	73.0
Ordinary income before federal income taxes	635,480	98.1	620,429	95.8	314,933	48.7
Total cash dividends	515,590	133.7	487,440	126.4	421,226	109.3

SOURCE: ICC, AAR, Moody's transportation manual.
[a]Prior to 1967 reported as net income.

NOTES

1. The income statements of Class I railroads combined for the years 1960 to 1970 are given in Appendix Table A.
2. Operating income is computed net of payments for hired equipment and joint facilities. Payments for hired equipment have risen rapidly during the past decade, from $321 million in 1960 to $816 million in 1971 (cf. section 4).
3. Net investment represents original cost, less depreciation and amortization, accrued under the accounting regulations of the ICC. The return on investment is consistent with respect to hired equipment (e.g., private cars) in that payments for hired equipment are charged off as expenses before net operating income is computed, while the value of this equipment is not included in the net investment accounts. The effect of this partial exclusion of capital is to leverage the rate of return shown in Table 1 more highly.
4. The charge is frequently leveled that the net investment figures shown in Table 1 are inappropriate as a rate base because they include economically obsolete assets and much over-valued real estate. In defense of the net investment figure, it should be noted (1) that the most blatant cases of historical over-valuation have been removed by write-downs in a series of bankruptcy proceedings that swept the railroad industry in the thirties; (2) that in 1963 the commission (ICC) issued an order which required all railroads to adjust their corporate books and substitute the adequately supported cost of property figures shown in the valuation records in place of the rejected historical costs; and (3) that gross capital expenditures on roadway structures and equipment between 1947 and 1972 alone have totaled $30.8 billion, or more than 85 percent of the gross investment in transportation property recorded on the general balance sheet for 1972. See 339 ICC 164, in which the commission defends the existing valuation of assets as a rate base.
5. First National City Bank of New York, *Monthly Letter*, April 1973.
6. Both net railway operating income and net investment in transportation property (and, a *fortiori*, rate of return on investment) are affected by the fact that most railroads use retirement accounting rather than depreciation accounting to write off certain categories of investments in road and structure, such as grading, tunnels, rails, ties, and ballast. With retirement accounting, these assets are carried on the books at full value (original cost) and written off only when they are retired. Replacements of rail, ties, ballast, and other assets subject to retirement accounting are charged to operating expenses; i.e., written off in the year in which the expenses are incurred.

   Without detailed analysis, it is not possible to say whether the use of retirement accounting results in net railway operating income and net investment being higher or lower in the long run than they would be if conventional depreciation accounting were used. It is probable, whichever is the case, that the level of net operating income and the level of net investment would be changed in the same direction, so that their quotient (rate of return on investment) would not be much affected in the long run by the choice of accounting technique. One railroad, the Chicago and Northwestern, recently converted from retirement accounting to depreciation accounting: reported net income during the first eight months under depreciation accounting was about $5 million higher than it would have been under retirement accounting. That is, the increase in depreciation accruals was more than offset by the decline in expenses as outlays on track ceased to be recorded as current expenses. However, there was a major write-down in asset value at the time of conversion from retirement accounting to depreciation accounting so that depreciation accruals increased less than they would have otherwise.

   One effect of retirement accounting is to give management greater control over the level of profits reported in any particular year. Unlike depreciation costs, which accrue automatically each year based on historical investments, the recorded "cost" of wear-and-tear to assets subject to retirement accounting in any particular year is essentially the replacement expenditures in that particular year. So management can control or vary the annual cost of assets subject to retirement accounting in the short run by varying the level of replacement expenses.

A large number of assets do not require periodic replacement and are carried on the railroads' books at original cost. One financial analyst estimates that the rail industry carries about $3.5 billion worth of gradings and tunnels on its books in this way and that railroad cash flows would increase by $65 to $75 million annually were Congress to permit the railroads to amortize these investments and, thereby, reduce their income tax liabilities. See Pierre S. Bretey, *Railroad Industry Review* (New York: Reynolds Securities, Inc., 1972), p. 29. Of course, for railroads operating at a loss or having no tax liability for other reasons, amortization of presently nondepreciable assets would have no material value.

7. See Alexander L. Morton, "Freight Demand," Ph.D. dissertation, Harvard University, 1973 (unpublished), Chapter 5. "Sand, gravel, and stone" is actually the largest category of raw material consumption in terms of weight, as Table 1 indicates, and has also been the fastest growing during the postwar period, owing to the acceleration of highway construction, which uses these materials intensively. However, sand, gravel, and stone for direct use in construction tend to move very short distances in large volumes and to rely on specialized private carriage, thereby making disproportionately small demands on the general transport system.
8. The case of food illustrates this point. Although per capita expenditures on food rose from $405 in 1950 to $491 in 1970 (in constant 1967 dollars), the weight of food consumed per capita, as measured by the U.S. Department of Agriculture, fell from 1,506 pounds in 1950 to 1,449 pounds in 1970.
9. This increasing decentralization and market orientation of production is documented in studies by B. Chinitz and V. Fuchs. See B. Chinitz, *Freight and the Metropolis* (Cambridge: Harvard University Press, 1960), pp. 114–115; and V. Fuchs, *Changes in the Location of Manufacturing in the United States Since 1929* (New Haven: Yale University Press, 1962), pp. 292–293. In many instances some form of processing of the raw material occurs at or near the raw material source, but the resulting intermediate good to be transported is usually still in bulk commodity form.
10. Freight rates on bulk commodities have declined more rapidly than (or not increased so much as) those on manufactures (see Chinitz, 1960 (Note 9), pp. 119–120). This owes in part to the lower labor intensity of transporting bulk commodities, and in part to the practice of value-of-service pricing, which encourages a greater mark-up over costs on the higher valued manufactures.
11. Morton, 1973 (see note 7), Table X, p. 91.
12. Morton, 1973 (see note 7), Table X, p. 91.
13. For example, in producing automobiles, machinery, instruments, and other metal products, metals may be transported as many as three or four times in one form or another (ore, sheet metal, stamping, subassembly) before leaving the final factory as a finished product.
14. Morton, 1973 (see Note 7), Chapter 3.
15. The mechanization, computerization, and "routinization" of industrial production and distribution raise the allowable premium for reliable deliveries. In food distribution, for example, handling the routine shipment has become almost costless to the consignee compared to the lost, delayed, damaged, or otherwise exceptional shipment.
16. See L. W. Weiss, "The Survival Technique and the Extent of Suboptimal Capacity," *Journal of Political Economy*, June 1964, pp. 246–261, especially Table 1, p. 249.
17. This tendency for regional economies to acquire their own production capacity in a

wider variety of manufacture as the size of the market expands is known in international trade as "import substitution."

18. Not only are individual cities becoming larger, but urban growth seems to be concentrated in a limited number of metropolitan belts, such as those extending from Boston to Norfolk, from San Francisco to San Diego, from Miami to Jacksonville, and around the Great Lakes. These four "megalopoli" alone have absorbed almost all the nation's net population growth during recent decades; in 1970 they included 41.1 percent of the population and it is estimated they will include 60.1 percent by 2000. (See Jerome P. Pickard, *Dimensions of Metropolitanism*, Urban Land Institute Research Monograph 14, Washington, D.C., 1967.) As this type of agglomeration continues, even a limited number of plants producing any one item will be able to supply a majority of consumers without resorting to long hauls to distant markets.
19. Advisory Commission on Intergovernmental Relations, *Urban and Rural America: Policies for Future Growth*, Washington, D.C., April 1968, p. 3.
20. See J. R. Meyer, J. F. Kain, and M. Wohl, *The Urban Transportation Problem* (Cambridge: Harvard University Press, 1965), Chapter 2; J. F. Kain, "The Distribution and Movement of Jobs and Industry," *The Metropolitan Enigma: Inquiries into the Nature and Dimensions of America's "Urban Crisis,"* James Q. Wilson, ed. (Cambridge: Harvard University Press, 1968); and Edwin Mills, *Studies of the Structure of the Urban Economy* (Baltimore: Johns Hopkins Press, 1972), p. 35.
21. Raw materials and semi-processed goods were brought into cities by rail to factories clustered around the railhead. The products of these factories were loaded directly back onto railcars for distribution to consumers in other cities and rural markets. Manufactured goods arriving by rail in cities and towns were easily distributed to consumers who generally resided relatively close to the business core and railhead.
22. The rate of suburbanization is not uniform among manufacturing industries. Light manufacturing has suburbanized the most rapidly since it is least concerned with high-volume throughputs of commodities (other than fuel and electricity), hence least dependent on rail service for delivery of inputs and least likely to employ rail service for delivery of outputs. But it is also light industry that is growing fastest among manufacturing industries and producing the greatest growth of freight traffic (in terms of revenue). Thus, suburbanization handicaps the railroads in participating in the faster-growing sectors of the freight market.
23. The growth rate of rail labor productivity calculated in this fashion is, in fact, the eighth highest among the growth rates for 35 individual industries calculated by the BLS for the period 1957–1970. See *Indexes of Output Per Man-Hour, Selected Industries, 1939 and 1947–1970*, BLS Bulletin 1692, p. 7.
24. John W. Kendrick, *Postwar Productivity Trends in the United States, 1948–1969* (New York: National Bureau of Economic Research, 1971), Chapter 5. Output per man-hour rose 8.2 percent a year in air transportation and 9.1 percent a year in pipeline transport, however, during this same period.
25. Kendrick, 1971 (see Note 24), pp. 5–8.
26. Non-railroad freight cars account for an even greater proportion of total investment in rail freight cars, as private ownership tends to be concentrated among higher-priced tank cars, refrigerator cars, and cars of special design.
27. One other consideration that would reinforce this bias would be that the quality of each man-hour has probably improved over the years because of rising educational levels, etc., though in the case of railroading this may have been less than in industry in general because of the relative aging of the rail labor force.
28. Deferring one expense may cause another category of expense to rise, thereby partially offsetting the reduction in total costs that can be achieved by deferral. For example,

deferred replacement of equipment causes higher equipment maintenance expenses; deferral of track maintenance necessitates "slow orders" that escalate train-crew hours, etc.

29. The ICC first assigns expenses that are "solely related" to either freight or passenger service to their respective service; then common expenses are apportioned statistically. "Solely related" passenger service expenses include, therefore, only those expenses that could be directly avoided if passenger operations were ceased; it does not include elements of track maintenance, signal system operations, etc., that would be incurred anyway, though almost surely in lesser amounts if passenger service were discontinued. Assigning only solely related passenger expenses to passenger service and all remaining operating expenses to freight service, the average cost of passenger service per passenger-mile was 6.0 times as great as the average cost of freight service per ton-mile in 1963, and 6.75 times as great in 1970. On a "fully-allocated" basis, on the other hand, passenger service was 8.5 times as expensive as freight service in 1963 and 8.8 times as costly in 1970.

30. The index of railroad carload freight rates prepared by the ICC (RI-1) indicates that carload rates rose 47.5 percent between 1947 and 1970. Yet average revenue per ton-mile for all freight rose only 32.7 percent during this same period. The difference between these two figures is a rough indication of the extent to which the composition of rail freight traffic is shifting toward movements whose rates are lower, presumably because they are less costly to produce. Although this presumption is clearly more accurate for different classes of freight service than for passenger vs. freight weightings, it is still of limited validity because of value-of-service rate structures.

31. Kendrick, 1971 (see Note 24), Chapter 5.

32. John W. Kendrick, *Productivity Trends in U.S. Transportation Industries*, prepared for the Office of the Under-Secretary for Transportation, U.S. Department of Commerce, January 1966, p. 22.

33. In general, as the Kendrick calculations illustrate, many factors influence productivity and complicate its measurement. At best, productivity measures incorporate an element of art as well as of science. For an excellent summation of the "state of this art" see S. Fabricant, "Perspectives on Productivity Research," prepared for the Conference on an *Agenda for Economic Research on Productivity*, Washington, D.C., April 6, 1973. Sponsored by the National Commission on Productivity.

34. Rail ton-mileage fluctuates with the business cycle, and these cyclical variations are large compared to the secular growth in ton-mileage. Consequently, the measured growth of rail output varies with the choice of terminal years. Cyclical fluctuations during the forties were sizable. The 658 billion ton-miles of 1948 represents something of a compromise between the wartime high of 741 billion ton-miles in 1944 and a postwar low of 529 billion ton-miles in the 1949 recession. Were 1949 used as an initial year rather than 1947, rail output (freight and passenger) would have grown by 0.4 percent per year (1949–1970) rather than declining by 0.7 percent per year (1947–1970). But this is to measure freight growth from a rather deep recessionary low to a near all-time peak.

At 765 billion, ton-mileage in 1970 was off 3 billion from its former record of 768 billion in 1969, but well above the 740 billion ton-miles of the 1971 recession. If the new record of 778 billion ton-miles in 1972 were used, measured rail output (passenger and freight) would decline by 0.6 percent per year (1947–1972) rather than by 0.7 percent per year (1947–1970).

35. Man-hours paid for have declined at a rate about one-tenth of a percentage point less than the annual rate at which man-hours worked has declined during the postwar period. Also, it should again be noted, as in Note 27 above, that the quality of

man-hours may well have improved over time so that even "man-hours worked" is not so unambiguous a term as it might at first seem.

36. See U.S. Department of Commerce, *Survey of Current Business*, June 1956 and March issue for 1958 and all subsequent years. This series closely parallels the gross capital expenditures reported by Class I railroads through 1967. Beginning with 1968, the Department of Commerce figures appear to include capital expenditures on railroad equipment by other than railroad companies, so in these latter years the gross capital expenditures reported by Class I railroads have been used instead in order to keep the series consistent.

37. The series of gross capital expenditures may understate actual investment in rail plant and equipment. Because of the use of retirement accounting rather than depreciation accounting, replacement and renewal of rail, ties, ballast, etc., are charged to current expenses and so do not appear in gross capital expenditures.

38. This possibility will be invoked in the next section where it will be suggested that gross capital expenditures may be a more accurate measure of the actual depreciation than the figures shown in the railroads' depreciation accounts, which reflect original acquisition values.

39. Jack Fawcett Associations, Inc., *Capital Stock Measures for Transportation*, prepared for the Office of the Secretary, U.S. Department of Transportation, June 1972, Vol. I, p. 3-49.

40. These estimates are at some variance with the value of freight cars owned by shippers and private car lines, which make up most of the external capital. The net investment (purchase price less accrued depreciation) in private cars was only $3.2 billion in 1971 and $0.3 billion in 1947, according to ICC accounts. See ICC, *Transport Statistics in the United States*, Part 9, 1971; and ICC, *Selected Statistics from the Annual Reports of Owners of Private Cars*, 1947.

41. Another recent study of employment and labor productivity in the rail industry proceeds by a different method of analysis to conclusions similar to those reported here. (Paul H. Banner, *The Measurement of Productivity in Rail Transportation*, a paper for presentation at the 1973 annual meeting of the American Society of Mechanical Engineers.) That study begins by questioning whether the ton-mile is the relevant measure of output with regard to railway labor. For example, does one wish to assert that because the movement of a freight car loaded with 100 tons of coal rather than 25 tons of computer equipment generates four times as many net ton-miles for each mile it travels, it represents four times the productivity? In terms of the work effort involved, carloads, car-miles, and train-miles are the most appropriate units in which to measure work output in the rail industry. Man-hours of work are disaggregated by employment category, and each category of labor output is assigned to that unit of output that is most relevant to its task. Thus, for example, "freight station foremen, laborers on platforms, yardmasters are associated with carloads. . . . Road maintenance, train dispatchers, freight engineers are assigned to train-miles. . . . Claim agents are assumed to vary with car-miles on the assumption that loss and damage is correlated with distance." (Banner (see above), pp. 8–9.) Professional, supervisory, executive, and similar activities are assigned to "overhead labor," which is in turn associated with a weighted composite index of car-miles, train-miles, and carloads. The growth in labor productivity is then calculated as the growth in carloads, car-miles, and train-miles per man-hour of associated labor. This procedure states, in effect, that increases in ton-miles that are the result of increases in the average capacity of individual cars, the average number of cars per train, the average length of haul per car, etc., do not reflect an increase in the output of numerous categories of railway labor and should not be attributed to those categories in computing their productivity. The average annual rate of growth in labor productivity during the period 1946–1971 in each of the four output dimensions is as follows:

Rail labor associated with carloads	2.5%
Rail labor associated with car-miles	2.7%
Rail labor associated with train-miles	4.1%
Overhead labor associated with a composite index	1.5%

If the four divisions of the rail labor force are combined according to their respective shares in total labor compensation, the average annual rate of labor productivity growth for all railway labor during the twenty-five year period is 2.7 percent per year (Banner (see above), p. 10).

42. The low rate of gain in capital productivity may be seen by comparing output to the principal forms of capital inputs: freight cars, locomotives, road, and yards. Revenue freight ton-miles per ton of freight-car capacity increased from 6,280 in 1947 to 6,400 in 1970, an average gain of only 0.1 percent per year. Revenue tonnage originated per ton of freight-car capacity actually declined 16 percent from 14.7 tons in 1947 to 12.4 tons in 1970. Ton-miles per locomotive in service rose at an average rate of 2.6 percent per year during this period. Taking miles of road as a proxy for capital investment in railroad lines other than yards, ton-miles per mile of road grew at an average rate of 0.8 percent per year. Taking miles of track in yards and sidings as a proxy for investment in yard plant, freight ton-miles per mile of yard track and siding rose 1.0 percent per year. In short, it is apparent that capital inputs have not contracted so freely as labor inputs so as to produce productivity gains.
43. The choice of terminal years for calculating productivity growth affects the results somewhat, but not severely. For example, using the record-high year for freight, 1972, rather than 1970, the growth of total rail output is increased by 0.1 percent per year, and so total productivity growth is also increased by 0.1 percent per year. The most favorable comparison possible is to measure growth from the rather deep recessionary low of 1949 to the all-time high of 1972. Over this interval, measured rail output growth is 1.0 percent higher, so measured productivity would be almost 1.0 percent higher (i.e., reduced somewhat by a rather sharp year-to-year drop in employment in 1949).
44. A recent study of differential productivity gains among industries concludes that there is a significant positive correlation between productivity gains and output growth. Cf. Kendrick, 1971 (see Note 24), Chapter 6. "The relationship is reciprocal: relative advances in output affect productivity through differential scale economies; and relative changes in productivity, mirrored in relative changes in prices of the outputs of the various industries, in turn affect relative changes in sales and output."
45. For discussions of some of the issues involved see E. D. Domar, "Depreciation, Replacement and Growth, and Fluctuations," *Economic Journal*, December 1957, pp. 655–658; E. D. Domar, "Accelerated Depreciation: A Rejoinder," *Quarterly Journal of Economics*, May 1955, pp. 299–304; and R. Eisner, "Accelerated Depreciation: Some Further Thoughts," *Quarterly Journal of Economics*, May 1955, pp. 285–296.
46. To illustrate deferred maintenance, the total number of train derailments reported to the FRA Bureau of Railway Safety rose 110 percent between 1961 and 1970, whereas the number of those derailments attributed to defects or failures or roadway alone rose to 315 percent during the same nine-year period.
47. If gross capital expenditures are said to equal actual depreciation, then actual net investment in transportation property is, by definition, unchanged. The net investment in 1950, $24,592 million, is used in calculating the adjusted rate of return in the last column of Table 12.
48. These fixed charges are in addition to and subordinated to payments for hired equipment, which have more than doubled from $376 million to $816 million over the same period.

49. Payment of dividends in excess of net income draws down shareholders' equity. Shareholders' equity declined from a high of $18.2 billion in 1966 to $16.6 billion in 1971.
50. In which case, of course, the old assets should be depreciated or written off more rapidly in the accounts.
51. The tone of the Conglomerate Merger Studies conducted by the ICC in 1969 suggests that the ICC will scrutinize closely any diversion of funds generated in railroad operations to non-rail activities. The Conglomerate Merger Studies of the ICC are reprinted in *Failing Railroads,* Hearings Before the Senate Commerce Committee, November 1970, Part 3, pp. 795 *et seq.*
52. As an industry, railroading is characterized by strong feelings of pride and tradition, an unusual degree of attachment to the physical property, and by a rather unique historical involvement with the regions they serve, all of which contribute to a reluctance to disinvest or diversify out of railroading. This reluctance is likely to be amplified in railroad managements that have ascended to their positions through the operating divisions of the railroad and have therefore been close to the traditions of the railroad.
53. The amounts in this table do not include external capital in the form of freight cars supplied by private-car lines. The net investment in railroad cars by private-car owners has risen from $300 million in 1947 to $3.2 billion in 1971. (See ICC, 1971 and ICC, 1947 in Note 40.)
54. "The equipment trust generally requires a 20 percent downpayment and a 15-year payout. It is sold on competitive bid and approval of issuance is required of the ICC. The conditional sale contract is used not only for new equipment but for financing the rebuilding of equipment, where no downpayments are involved, or where more than the customary 15 years is desired. Conditional sale contracts are placed privately and involve no placement cost. ICC approval is not required." (Paul H. Banner, "Capital and Output in the Railroad Industry," *Papers of the Transportation Research Forum,* 1968, pp. 137–138.)
55. Banner, 1968 (See Note 54), pp. 137–138. It is believed that only one railroad equipment mortgage has been defaulted on. In that case, involving the Florida East Coast line, the equipment was readily placed elsewhere, confirming the liquidity of the collateral. Of course, if defaults on equipment trusts, conditional sale contracts, and leases should become more widespread in the rail industry, the liquidity of this collateral could be considerably lessened.
56. On the other hand, "the obligations of the industry for other forms of investment funded debt and equity rest upon the earning power of the firm since very little can be repossessed and courts have not looked with favor upon the dismemberment of a railroad and public sale of its parts to satisfy debt. Rather, the company in bankruptcy continues in operation with bondholders receiving no return. Ultimately reorganization and recapitalization occurs with possible loss to the bondholders." (Banner, 1968 (see Note 54), p. 138.)
57. The real cost of funds provided through equipment debt or leasing is not so cheap to bond holders and equity holders as the nominal rate implies. Each time one of these forms of financing is employed, the claims of bond holders and stock holders are further subordinated. This may be a very real price that these junior creditors are paying, particularly if the marginal rate of return on the equipment so financed is below the cost of this capital, as the decline in interest coverage ratios suggests to have been the case.
58. There is an interesting debate whether the ready availability of external funds for equipment but the relatively unavailability of external funds for investment in road and structures (for lack of collateral) biases the type of investments made in the rail industry. (See Banner, 1968 (see Note 54), pp. 137 ff.)

59. For purposes of Figure 1, operating "expenses" are defined as railway operating revenues minus profits and federal income taxes. Capital costs or rents do not include any cost for equity capital.
60. For suggestions and policy recommendations on how this might be achieved, see *Improving Railroad Productivity*, Final Report of the Task Force on Railroad Productivity, Washington, D.C.: National Commission on Productivity, November 1973.