

# Commission Briefing Paper 2D-01

## Conditions and Performance of the Freight-Rail System

Prepared by: Cambridge Systematics

Date: February 22, 2007

This paper is part of a series of briefing papers to be prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU. The papers are intended to synthesize the state-of-the-practice consensus on the issues that are relevant to the Commission's charge outlined in Section 1909, and will serve as background material in developing the analyses to be presented in the final report of the Commission.

This paper presents information on the conditions and performance of the nation's freight rail system. It covers the principal characteristics of the rail network, including the extent, intensity of use, current and forecast commodity flows, and levels of capital investment. The paper also identifies areas of possible future research to improve conditions and performance information.

### Background and Key Findings

The nation's freight railroads operated 140,810 miles of rail lines, employed 182,000 people, and reported \$47.88 billion in revenue in 2005. The nation's freight railroads contribute to the economy by providing long-distance, line-haul transportation for goods ranging from basic commodities such as coal and grain, to finished goods such as automobiles. The demand for freight rail service has grown steadily over the last decades and is projected to increase 69 percent by tonnage and 84 percent by ton-miles between 2005 and 2035. Intermodal traffic represents the fastest-growing portion of rail traffic. Both containerized freight and trailers-on-flatcar traffic are increasingly important to shippers operating fast-cycle, on-demand supply chains.

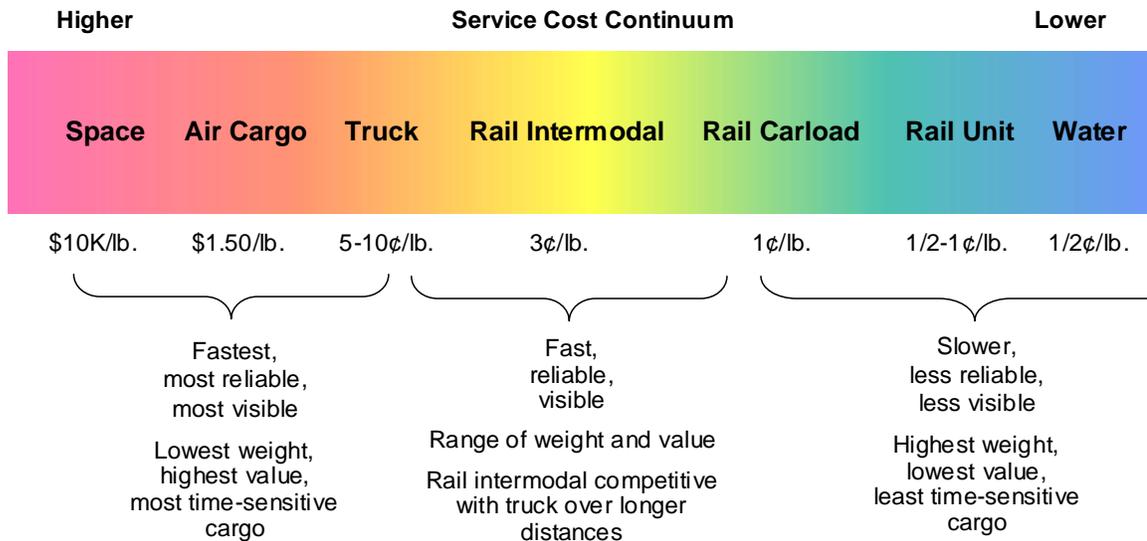
The rail industry today is stable, productive, and competitive with enough business and profit to operate. But despite the recent increase in rail prices and revenue, the industry is still not attracting capital fast enough to replenish its infrastructure quickly nor keep pace with demand and public expectations. Increasing demand has caught up with the downsized rail system, resulting in rail congestion and deteriorating service levels in many rail corridors and at interchange locations. This has prompted concern from lower-volumes shippers who may be priced out of rail service and from state and local highway agencies that may bear additional highway maintenance costs if the railroads shed freight to trucks.

### Role of Freight-Rail

Rail and the other modes used to transport freight are both competitive and cooperative. Each mode offers advantages and disadvantages in terms of cost, speed, reliability, visibility, security, and safety. When shippers design supply chains for their products, they try to use each mode to its greatest advantage. One way to visualize this is as a spectrum of freight transportation

services, as shown in Figure 1.

**Figure 1. Freight Transportation “Service Spectrum”**



The value and weight of the goods and commodities being shipped largely determines the mode of transportation, with lower-weight, higher-value shipments using faster, more expensive transportation. Rail falls toward the lower end of the spectrum, providing lower-cost transportation for long-distance shipments and bulk goods. But even within rail, there are different levels of service and price. Bulk unit trains, which move coal from mines to power plants and grain from farms to ports, represent the lower price end of rail service. Rail competes with water transport for these commodities. Premium rail service is targeted at international containers and domestic containers and trailers. This business, which is in direct competition with the trucking industry, represents the fastest growing segment of rail service. Carload service (e.g., boxcars, gondolas, tank cars, etc.) falls between the slower bulk unit trains and the faster intermodal services in terms of price and service levels.

### Freight-Rail System and Use

The nation’s freight railroads operated 140,000 miles of rail lines, employed 182,000 people, and reported \$48 billion in revenue in 2005. The U.S. freight-rail system has four tiers of freight railroads: Class I railroads are railroads having 2005 revenues at or greater than \$319.3 million. The Class II regional railroads operate at least 350 miles and have annual revenues greater than \$40 million, but less than the Class I threshold. Class III railroads are all railroads not qualifying as Class I or II railroads. They include short line railroads providing local line-haul services, and switching and terminal operations railroads. Table 1 shows the number of U.S. railroads in each class, the number of miles operated, employees, and their freight revenue.

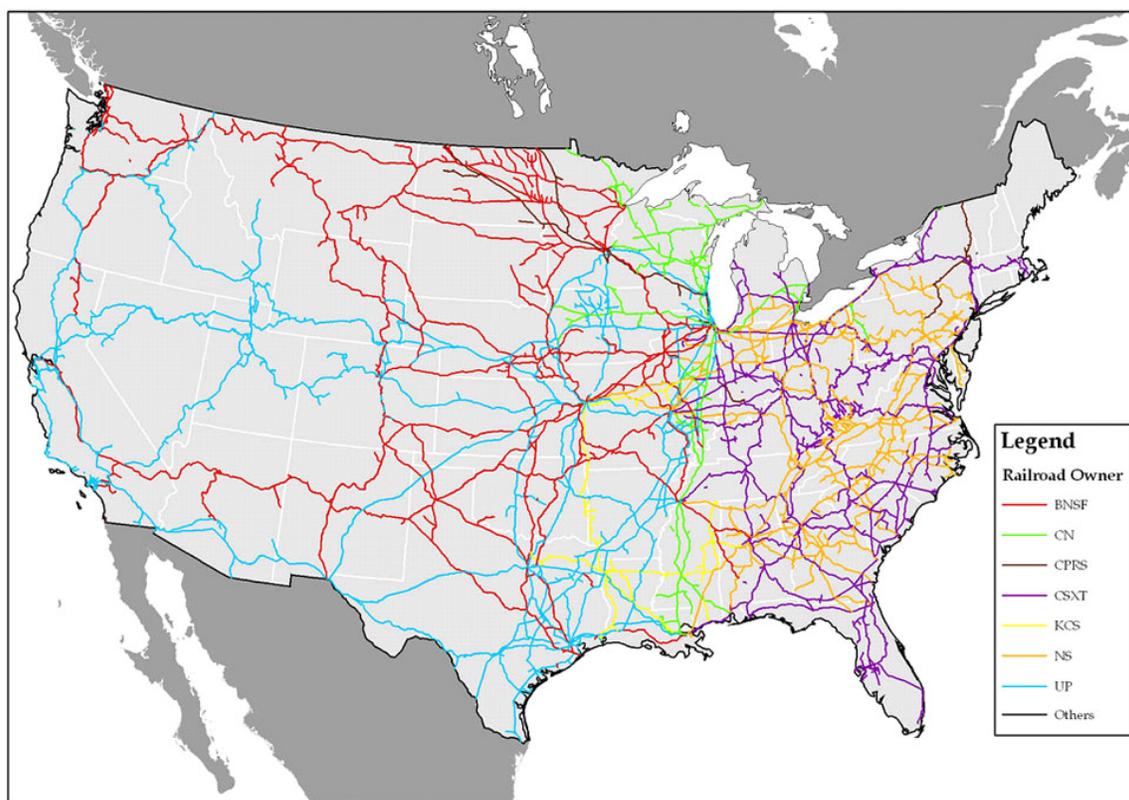
The Class I railroads form the backbone of the U.S. rail system, accounting for 68 percent of the system mileage, 89 percent of the employees, and 93 percent of the freight revenue. These railroads provide long-haul, interstate services throughout the United States with connections to Canadian and Mexican railroads for international traffic. Figure 2 maps the major rail lines of the seven Class I railroads operating in the United States.

**Table 1. United States Freight Railroads, 2005 Summary**

Type	Number	Miles Operated (Excl. Trackage Rights)	Employees	Freight Revenue (Billions of Dollars)
Class I	7	95,664	162,438	\$44.46
Class II Regional	30	15,388	7,322	\$1.48
Class III Short-Line	320	22,519	5,744	\$1.12
Class III Switching and Terminal	203	6,678	6,303	\$0.82
Totals	560	140,249	181,807	\$47.8888

Source: Association of American Railroads, *Overview of U.S. Freight Railroads*, December 2006.

**Figure 2. National Freight Rail System: Class I Railroads**



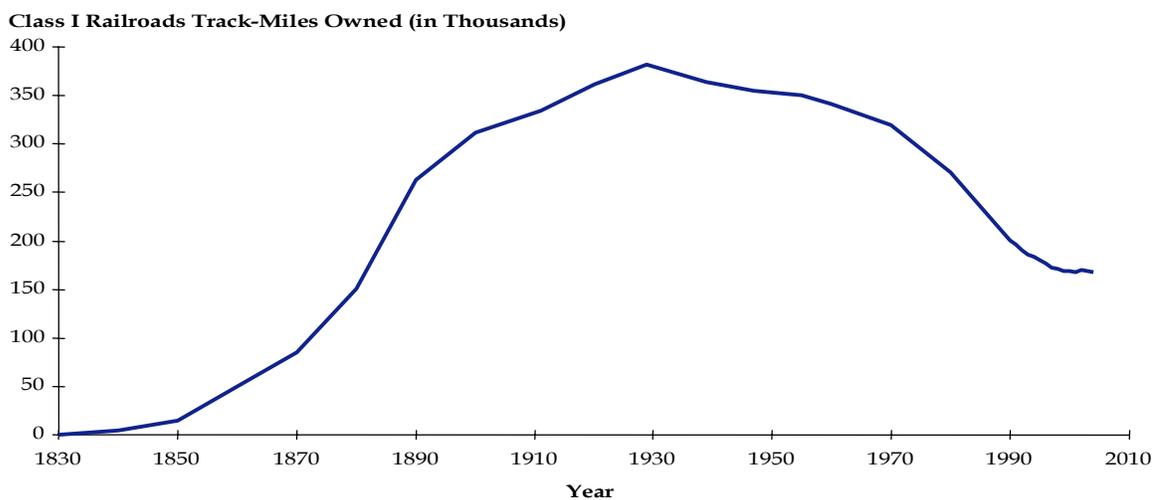
Source: Cambridge Systematics, Inc., AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007.

Each Class I railroad serves multiple geographic areas and commodity markets, but they can be grouped into:

- **Eastern Carriers** – With their joint acquisition and division of Conrail, the area east of the Mississippi River is dominated by Norfolk Southern (NS) and CSX Transportation (CSXT). Their major markets include intermodal shipments at East Coast ports, coal from the Appalachian Mountains, and autos and auto parts both in the Midwest and among automobile factories in the South.
- **Western Carriers** – In the 1990s, the four major western carriers were merged into the Union Pacific Railroad (UPRR), which includes the former Southern Pacific, and the Burlington Northern Santa Fe Railway (BNSF). Their major markets are Powder River Basin coal moving to the Midwest, intermodal service moving east from West coast ports, grain moving from the Midwest to Pacific Northwest and Gulf ports, and chemicals moving from the Gulf Coast to manufacturers across the U.S.
- **Spine and Canadian Carriers** – With its acquisition of Illinois Central, the Canadian National (CN) expanded its Canadian and upper Midwest network to the Gulf Coast. The Canadian Pacific (CPRS) reaches Chicago and has access to Kansas City through trackage rights. The Kansas City Southern (KCS) offers service in the south central United States, connecting several Midwest cities with Gulf Coast ports and central Mexico.

Today’s railroad system is about half the size of system that existed in the early 1900s. The Class I railroads have cut back the number of track-miles they operate—mostly through abandonment and spin-offs of low-volume and less profitable lines to short line railroads—to create a core system that can be maintained and operated cost-effectively and profitably. Much of the track mileage shed by the Class I railroads continues to serve as the collection-distribution system for the Class I railroads; however, the collection-distribution function is provided primarily by regional and short line railroads, and by trucks. Figure 3 charts the expansion and contraction of the track miles owned by the Class I railroads.

**Figure 3. Rail Network Today**



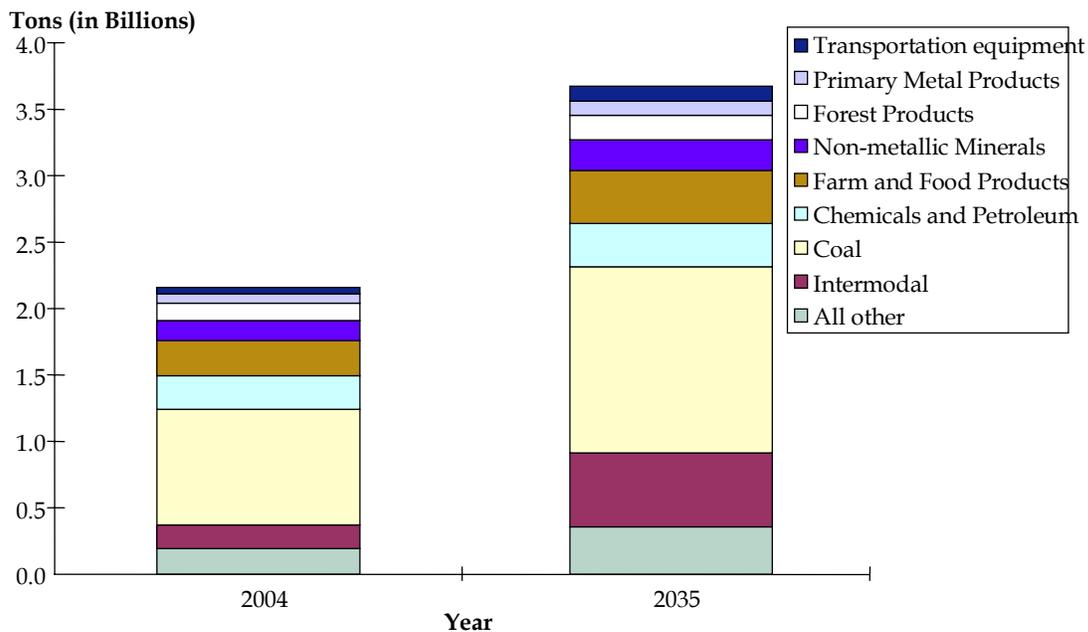
Sources: L. Thompson/World Bank, historic data; American Association of Railroads, recent data.

The two watershed events that accelerated the contraction of the system were the completion of the U.S. Interstate Highway System after World War II (which diverted freight from rail to more flexible truck service) and the economic deregulation of the rail industry by the Staggers Act of

1980 (which precipitated a massive restructuring of the rail industry and simplified the divestiture of unprofitable rail lines). Recently economic and trade growth have driven up the demand for rail transportation, straining the capacity of the core network. In response, the Class I railroads are adding track, lengthening sidings, improving signaling, and upgrading track to support more traffic and heavier loads.

Demand for rail transportation is driven by the commodity markets it serves, as well as by carrier performance. Almost three-quarters of the current rail tonnage and revenue come from four market groups: coal; farm and food products; chemicals and petroleum; and the intermodal business. Some 40 percent of the physical volume is in coal alone, but the revenue picture is different and more balanced: intermodal and coal each account for about 20 percent of the traffic (with intermodal somewhat the larger), while the farm and food group and the chemicals and petroleum group comprise about 15 percent each. Figure 4 charts the tonnage for the top commodity groups.<sup>1</sup>

**Figure 4. Major Rail Commodities by Tonnage, 2004 and 2035**



Source: Cambridge Systematics, Inc., AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007, based on Global Insight, Inc. 2004 TRANSEARCH data.

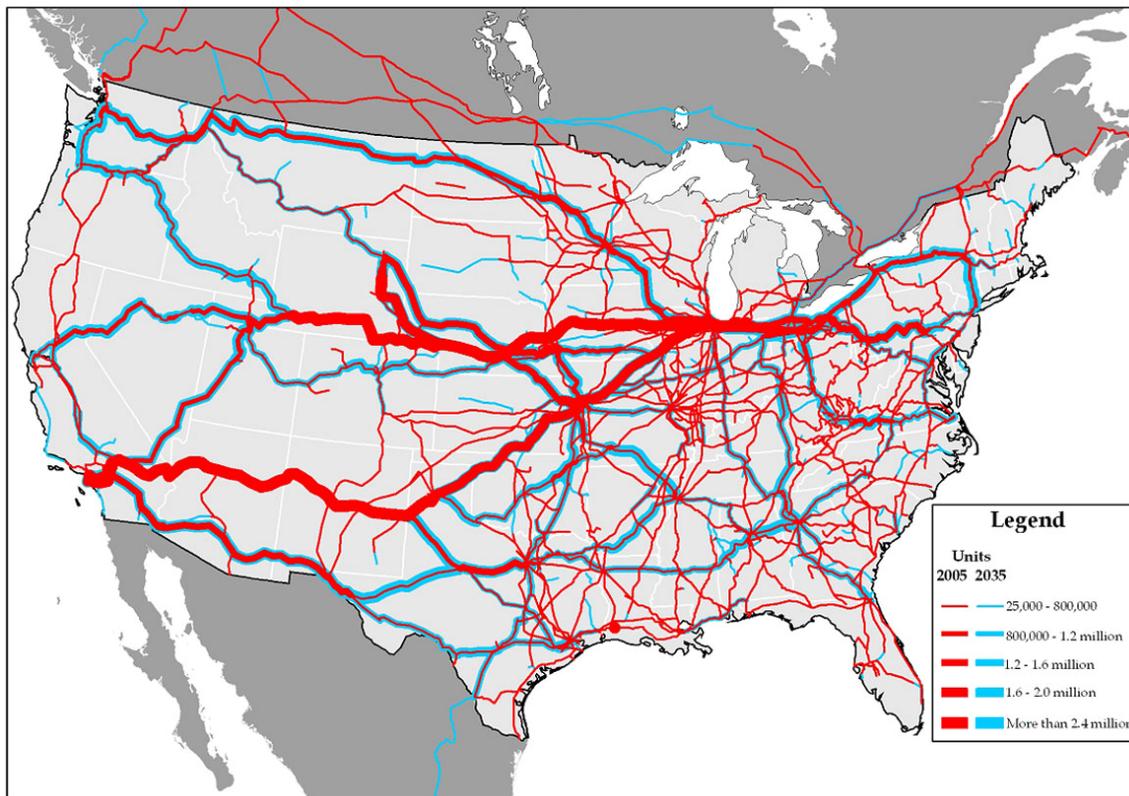
Figure 4 also shows the forecast tonnage for those commodities in 2035. The demand for rail transportation is expected to increase 69 percent by tonnage and 84 percent by ton-miles between 2005 and 2035. Roughly 60 percent of all new rail tonnage is attributable to coal and intermodal, and although the top four rail commodities remain the same, by 2035 intermodal is expected to vault to number two in terms of tonnage and will be the railroad industry’s largest source of revenue. The intermodal business is projected to maintain a 3.8 percent compound

<sup>1</sup> Cambridge Systematics, Inc., AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007, based on Global Insight, Inc. 2004 TRANSEARCH data and economic forecasts.

annual growth rate over the next three decades, causing it to more than triple in size, primarily because of its role in carrying containerized imports for the globalizing economy.

Figure 5 compares total rail volumes in 2005 with the anticipated rail volumes in 2035.<sup>2</sup> Traffic density is shown as railcars per year. The red lines indicate railcar volumes in 2005; the blue lines indicate railcar volumes in 2035. The wider the red and blue lines, the greater the number of railcars using the line.

**Figure 5. Comparison of Total Rail Flows in 2005 and 2035 – Railcars per Year**



Source: Cambridge Systematics, Inc., AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007, based on Global Insight, Inc. 2004 TRANSEARCH data and economic forecasts.

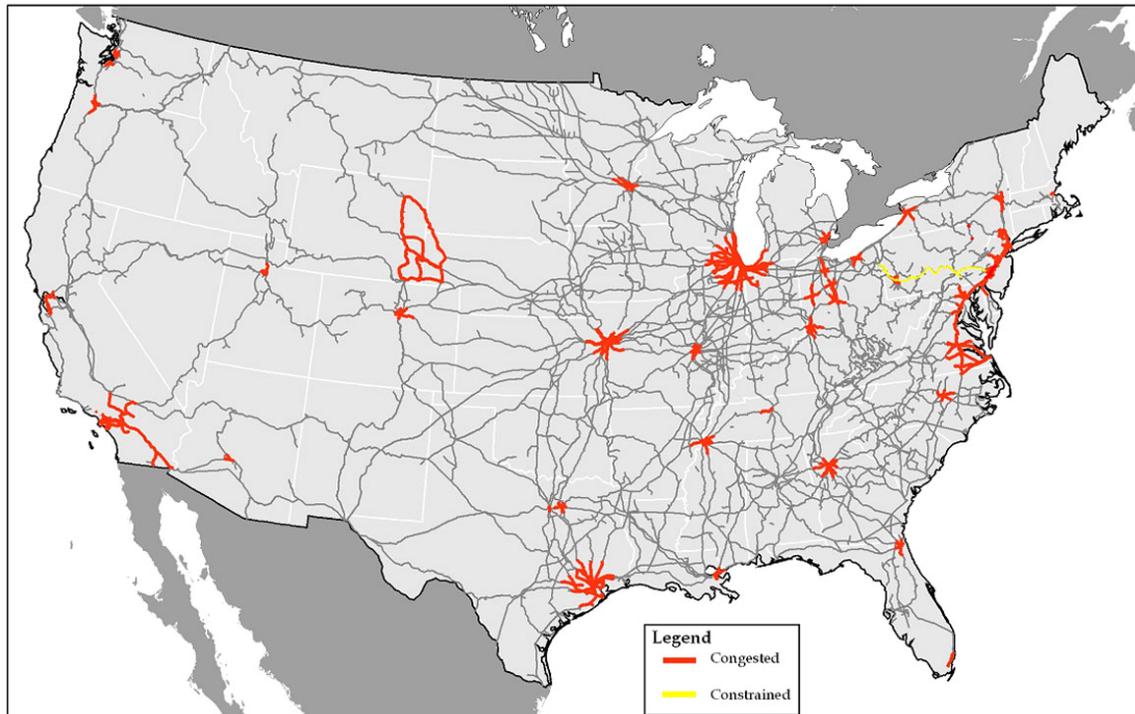
### Condition of the Freight-Rail System

There is no national rail-conditions database comparable to the FHWA's Highway Performance Monitoring System database, and therefore no uniform and comprehensive data for assessment of the physical condition and capacity of the national rail system. The general consensus of the industry is that the overall physical condition of the Class I rail system is good, but that the condition of Class II and Class III lines varies from good to poor. In particular, there is concern about the weight-bearing capacity of short line rail lines and bridges to handle collection and distribution traffic as the Class I railroads shift to heavier, more cost-efficient railcars.

<sup>2</sup> Cambridge Systematics, Inc., AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007, based on Global Insight, Inc. 2004 TRANSEARCH data and economic forecasts.

The primary concern today is about the capacity of the freight rail system. Increasing demand has caught up with the downsized rail system, resulting in rail congestion and deteriorating service levels in many rail corridors and at interchange locations. Railroad choke points – locations with regularly recurring congestion and delays – are increasing across the nation. Again, there is no uniform and comprehensive database on rail capacity; however, Figure 6 provides an approximate mapping of known major choke points and congested areas. The map is based on best professional judgment, not uniform empirical data.

**Figure 6. Approximate Freight-Rail Choke Points and Congested Areas**



Source: Cambridge Systematics, Inc., prepared for the AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007.

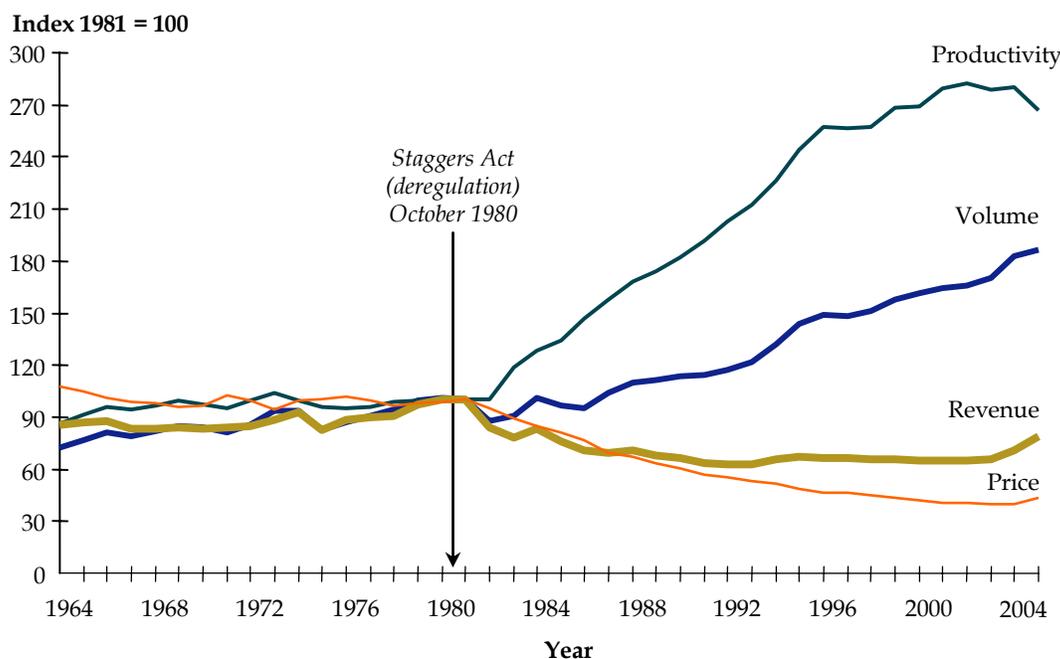
### **Performance of the Freight-Rail System**

The performance of the rail industry has improved steadily since the economic deregulation of the industry. Four indicators of Class I railroad performance are depicted in Figure 7: productivity, volume, revenue, and price. Each of the measures is indexed to 1981; the first year after the rail industry was deregulated under the Staggers Act.

- **Productivity** – Measured as system output per unit of system input, productivity has increased sharply since deregulation due to mergers and operating improvements. The rail mergers in the 1980s and 1990s allowed railroads to eliminate excess costs in labor, track, and rolling stock. During the same period, railcar loads became heavier and train lengths increased. However, productivity has started to decline recently due to inefficiencies introduced by increasing congestion. Productivity of general merchandise carload movements has declined the most, placing additional cost pressures on smaller-volume rail shippers as large carriers using pricing to ration capacity on the basis of economic return.

- **Volume** – The demand for rail service has shown a steady increase since 1980. Despite the erosion of rail market share by trucks, the rapid growth in demand for freight has allowed the rail industry to increase its total volume.
- **Revenue** – Demand for rail freight services has grown far faster than rail service capacity over the past four years, improving the pricing leverage held by rail carriers. Revenue, which was relative flat through the 1990s due to price reductions, is now rising due to rate hikes and continued growth in volume; and

**Figure 7. U.S. Class I Railroad Performance**  
1964 to 2005



Source: Association of American Railroads

- **Price** – The railroads reduced rates to retain and attract traffic after passage of the Staggers Act. Prices have now stabilized and started to increase, due to a combination of record volumes and limited capacity. In some markets, railroads have become more selective, accepting higher-margin traffic and pricing out shorter-haul, low-revenue shipments.

Despite the overall trend of improvement in performance, some erosion of performance has been seen in recent years. Class I freight line-haul speed, which measures over-the-road train speeds (not including dwell time and delay for local pickup and delivery) averaged 21.8 miles-per-hour in the first quarter of 2005, a decrease of 1.5 percent from the previous quarter. Between the first quarter of 2002 and the first quarter of 2005, average line-haul speeds decreased 15 per cent.<sup>3</sup> Terminal dwell time, the time a train spends in terminals, averaged 24.2 hours in the first quarter of 2005—an increase of 0.7 percent compared with the previous quarter. At the same time,

<sup>3</sup> US DOT, Research and Innovative Technology Administration, Bureau of Transportation Statistics, *Transportation Statistics Annual Report*, November 2005, p. 90

revenue ton-miles totaled 416.7 billion in the first quarter of 2005, an increase of 18 per cent during the same period in which average line-haul speeds were declining.

## **Financial Performance and Investment**

The rail industry today is stable, productive, and competitive with enough business and profit to operate. But despite the recent increase in prices and revenue, the industry is still not attracting capital fast enough to replenish its infrastructure quickly nor keep pace with demand and public expectations. The rail industry is straining to meet the growing demand for rail freight transportation today. This is because the railroad industry is unique among the nation's major industries in its extraordinary need for capital reinvestment. The rail industry spends three to five times as much on infrastructure as other major industries, much of this going to maintenance of existing track and facilities. From 1995 through 2004, the rail industry reinvested 17.8 percent of revenue into capital spending, compared to an average of 3.5 percent for all other United States industries. The rail industry announced that total Class I spending for laying new track, buying new equipment, and improving existing infrastructure would reach \$8.3 billion in 2006, an increase of 21 percent over 2005 levels. The rail industry also spends nearly \$500 million annually in property taxes for their privately owned right-of-way.<sup>4</sup>

In the highway freight system, the public sector constructs the roads and the trucking industry pays for the highways through fuel taxes as they use the highways. Railroads, conversely, must construct their own lines, incurring fixed costs that must be paid whether the lines, bridges, tunnels, and terminals are used or not. As a consequence, both lenders and railroads tend to be very cautious about over-investing in infrastructure, and the proportion of total capital that represents real increases in system capacity remains at fairly modest levels. Carriers earning record profits in recent years have authorized equity share buy-backs, revealing a lack of enthusiasm by their owners in wholesale "service capacity" enhancements. Most capacity-related investments are very carefully targeted to specific lanes and commodities.

In 2003, the AASHTO Freight-Rail Bottom Line Report estimated that at the level of investment the Class I railroads could afford from their revenue plus borrowing, the freight-rail system could handle around half of its 'fair share' of the forecast growth in freight-rail tonnage, but could not keep pace with the demand for freight movement.<sup>5</sup> The unmet half of new rail freight demand would likely shift to trucks and the highway system. The report estimated that to keep pace with economic growth and maintain its current share of freight tonnage, the rail system needed an investment of \$175 to \$195 billion over the next 20 years. The report anticipated that the railroads would be able to provide the majority of the funding needed (up to \$142 billion dollars) from revenue and borrowing, but the remainder (up to \$53 billion, or \$2.65 billion annually) would have to come from other sources, perhaps including loans, tax credits, and other forms of public-sector participation. No current reassessment of rail investment compared to need is available.

---

<sup>4</sup> Cambridge Systematics, Inc., AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007, based on Association of American Railroads and Class I railroad data.

<sup>5</sup> American Association of State Highway and Transportation Officials, Transportation: Invest in America: Freight-Rail Bottom Line Report, Washington, DC, 2003. See [http://freight.transportation.org/doc/rail/ex\\_railreport.pdf](http://freight.transportation.org/doc/rail/ex_railreport.pdf) and <http://freight.transportation.org/doc/FreightRailReport.pdf>.

## Research Needs

Areas for possible future research include programs that would improve information on the conditions and performance of the freight and passenger rail systems, such as information on rail, bridge, and tunnel conditions; information on choke points and congested areas; patterns of freight diversion; standardized performance measures, and development of regional and national rail capacity models. Among potential topics to be explored is the need for identification of a core system of freight railroads, similar to the National Highway System, that might be eligible for public funding or preferential treatment under public-private partnerships and tax incentives.

## CONSOLIDATED COMMENTS FROM MEMBERS OF THE BLUE RIBBON PANEL OF TRANSPORTATION EXPERTS - PAPER 2D-01

One reviewer commented as follows:

- Freight rail service has grown steadily in past few years, with 69% increase by ton and 84% increase by ton-miles forecasted between 2005 and 2035.
- Today, Class I railroad track miles owned is ½ the level in the early 1900s.
- 60% of new rail tonnage is attributable to coal and intermodal goods. Intermodal goods (mostly containers) forecasted to increase 3.8% annually between now and 2035.
- Rail system needs \$175 Billion-\$195 Billion over next 20 years, railroads anticipated to only be able to provide \$145 Billion.

Another reviewer commented as follows:

- This overview gives an accurate but not detailed perspective on the condition and performance of the rail system. The paper presents a useful summary view of rail demand by commodity now and in 2035. Yet it does not discuss how volatile future railroad service and economic performance may be; given its narrow commodity base (four commodities account for three-quarters of its tonnage and revenue). Changes in the general economy and in these specific commodity groups can have a big impact on an industry that is barely able to capitalize itself.
- How will accelerating global warming concerns effect the movements of coal, petroleum and chemicals? On the positive side growth of ethanol use and other alternative fuels might drive railroad demand. Are short-line and regional railroads doomed to the smaller share of the market since they so often serve a declining manufacturing base?
- Failure in port capacity or railroad service radiating out of West Coast may slow future railroad cargo growth and encourage new options originating in Canada or Mexico. This result might slow growth in US west-east intermodal freight so critical to railroad success. Since railroads have been slow to attack the difficult challenge of profitably

serving intermodal traffic of 400 miles or less – they are unable to compete with trucks in the market where most of future transportation growth will take place. Will this change?

- Finally, what performance requirements and measures should Congress apply if it decides to stimulate railroad capital investments with tax credits targeted to the creation of new capacity?

Another reviewer commented as follows:

This reviewer holds that it is generally not true that today's rail congestion is the result of past line abandonments and spin-offs. Lines that were spun off were typically not high density, well engineered, or through routes, and would generally not be helpful in relieving current congestion. Furthermore, the majority of the miles shed by Class I railroads have been taken over by more than 300 new Class II and Class III local and regional railroads. Most of these miles are still in service. Moreover, the spin-offs were necessary for the railroad industry to survive financially. In fact, railroads are spending more than ever before to alleviate chokepoints and increase the fluidity and capacity of their systems.