Transportation Productivity

What is Productivity?

In the general sense, "productivity" refers to the rate at which workers produce goods or complete work. *Economic productivity*, however, has a more precise definition: it is the ratio of total output to the inputs used in the production process. Inputs can include labor, capital, land, and entrepreneurship. If productivity increases, a business can produce the same output using fewer inputs. The business may then choose to produce more output, lower prices, invest in the business, or return income to shareholders.

Productivity for an industry can increase for a number of reasons. For example, new technology or training classes can allow workers to produce more goods in the same amount of time or with the same amount of resources. Likewise, policy changes can allow firms to operate more efficiently, such as when Congress deregulated railroads by passing the Staggers Rail Act of 1980, allowing railroads to abandon unprofitable routes and adopt labor-saving technologies.

Productivity growth is beneficial because increases in productivity improve economic wealth and the standard of living. One classic example is the Ford Motor Company's Model T automobile, produced in the early 1900s. Ford greatly increased productivity by using interchangeable parts and a moving assembly line. Ford chose to use the increased productivity to sell the Model T for a lower price than competing vehicles. As a result, more people could afford an automobile. Similarly, if a freight delivery company optimizes its routing and delivery schedules, it can offer lower prices to shippers.

As the freight delivery example suggests, transportation itself is an input for other industries. If the cost of providing transportation decreases, other industries become more productive as well, which reduces business costs and brings savings to consumers.

At the same time, however, many other factors besides productivity affect the performance of a firm or industry. For example, demand for a firm's products may decline even as the firm becomes more productive. In other words, productivity is necessary but not sufficient for economic well-being. Employment may also decrease in an industry as it becomes more productive. Automating certain processes may make a firm more productive, but may also lead to worker layoffs.

Productivity Measurements

Productivity measures provide answers to important questions about the transportation sector—for example, how efficiently transportation providers move people and goods, and whether the value of their services has grown more rapidly than the costs of the inputs they use. There are two main measures of transportation productivity: *labor (single-factor) productivity* and *multifactor productivity*. Labor productivity measures the output per unit of labor input, while multifactor productivity measures the output per unit as a weighted average of multiple factors, including fuel, equipment, and materials. While multifactor productivity is a more comprehensive measure of economic performance, labor productivity is easier to measure and continues to have a broad appeal.

In the United States, the Bureau of Labor Statistics (BLS) produces labor and multifactor productivity measures for industries as defined by the North American Industry Classification

System (NAICS).[1] These measures show industry changes in inputs, outputs, and productivity.

Labor Productivity

To measure *labor productivity*, BLS measures outputs by industry and divides the output by paid labor hours. When an industry has multiple products or services, the outputs are weighted by value. BLS indexes the ratios to a common base year to allow for comparisons over time. BLS measures allow comparisons among industries to analyze industry responses to regulations and policies, changes in labor costs, and competitive pressures.

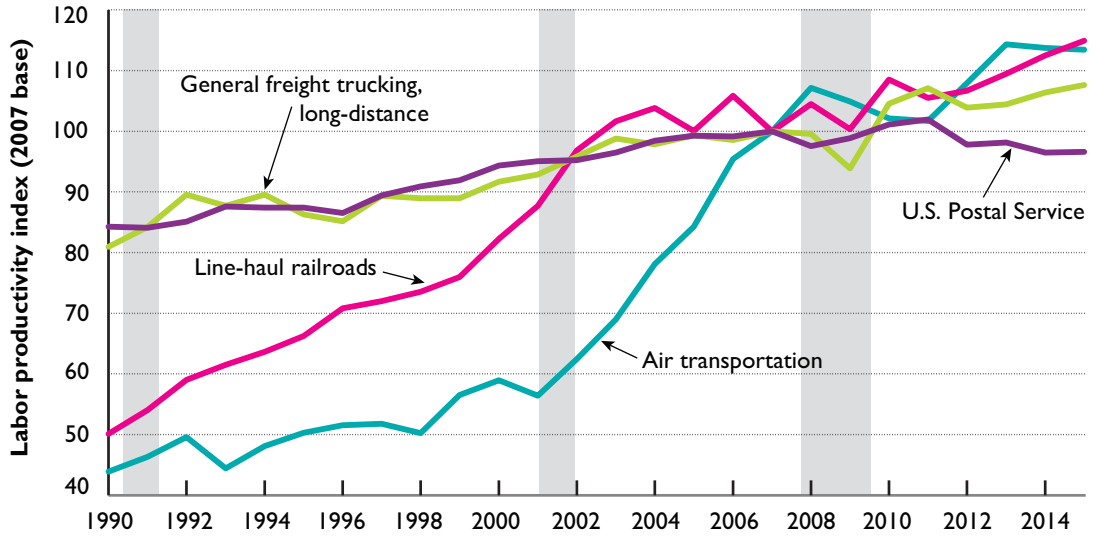
Figure 5-1 illustrates changes in labor productivity for selected transportation industries from 1990 to 2015. Air transportation had the least productive labor force in 1990, but became the second most productive mode by 2015 after productivity increased by 158 percent. Railroads had the second least productive labor force in 1990, but became the most productive mode after productivity increased by 129 percent from 1990 to 2015. These large changes in air and rail labor productivity were spurred by deregulation, allowing for changes in labor requirements (e.g., reduced crew sizes) and changes in market competition. The labor force in long-distance freight trucking and the U.S. Postal Service (USPS) had smaller productivity increases of 33 and 15 percent, respectively. Moreover, the USPS moved from having the highest labor productivity in 1990 to having the lowest labor productivity in 2015.

[1] The Bureau of Economic Analysis also releases productivity measures. The BEA measures differ from the BLS measures because BEA calculates productivity using a gross-output approach, while the BLS uses a sectoral approach. Since 2002 the agencies have met to ensure that their estimates are compatible.

Multifactor Productivity

To measure *multifactor productivity (MFP)*, BLS divides output by a weighted set of inputs, including labor hours, fuel, equipment, and materials. Changes in multifactor productivity reflect the combined effects of factors such as new technologies, new regulations, or organizational changes.

Figure 5-1 Labor Productivity Indices for Selected Transportation Industries, 1990 to 2015



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Industry Productivity and Costs*, available at http://www.bls.gov/data/ as of May 2016.

From 1990 through 2013, air transportation and water transportation had the largest increases in MPF: 116 and 62 percent, respectively (Figure 5-2). MFP in air transportation was the lowest in 1990, but became the second highest by 2013. MFP in pipeline transportation had a smaller increase of 32 percent over the same period and showed considerably more year-to-year variation, but it remained the most productive industry in 2013 because of its relatively high productivity at the start of the period. Finally, MFP in the railroad industry increased 44 percent during the same period.

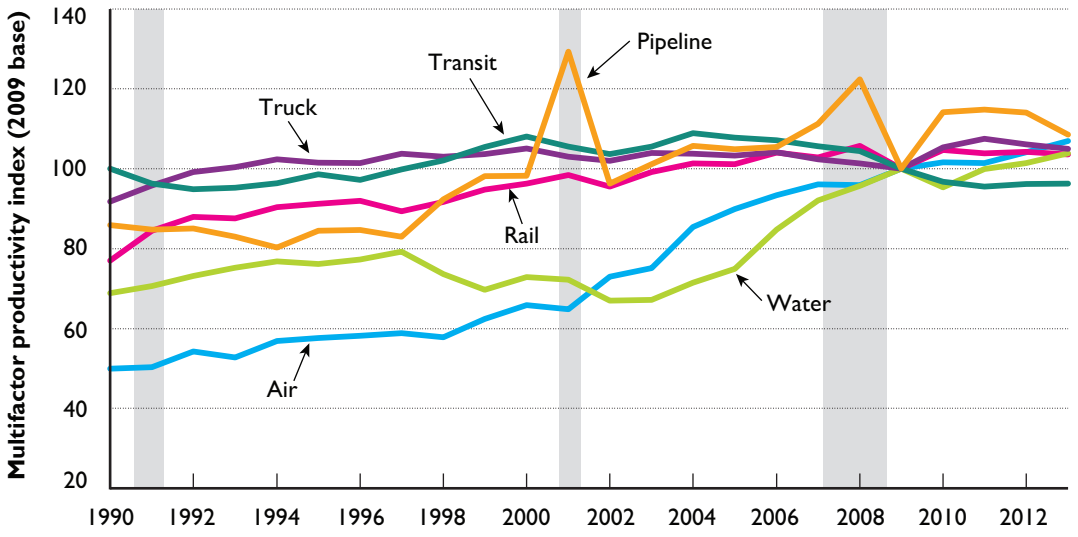
Per-Mile Revenue Measures

Another way to look at transportation productivity is to examine what users pay for transportation. This can be seen as an economic measure of the value of transportation. For passenger transportation, the unit of output is passenger-miles, and average revenue per passenger-mile is the measure of what travelers pay. For freight transportation, the unit of output is ton-miles, and average freight revenue per ton-mile is the measure of what freight shippers pay. For modes where users do not typically pay per use, like driving, complete data are difficult to obtain.

Revenue per Passenger-Mile

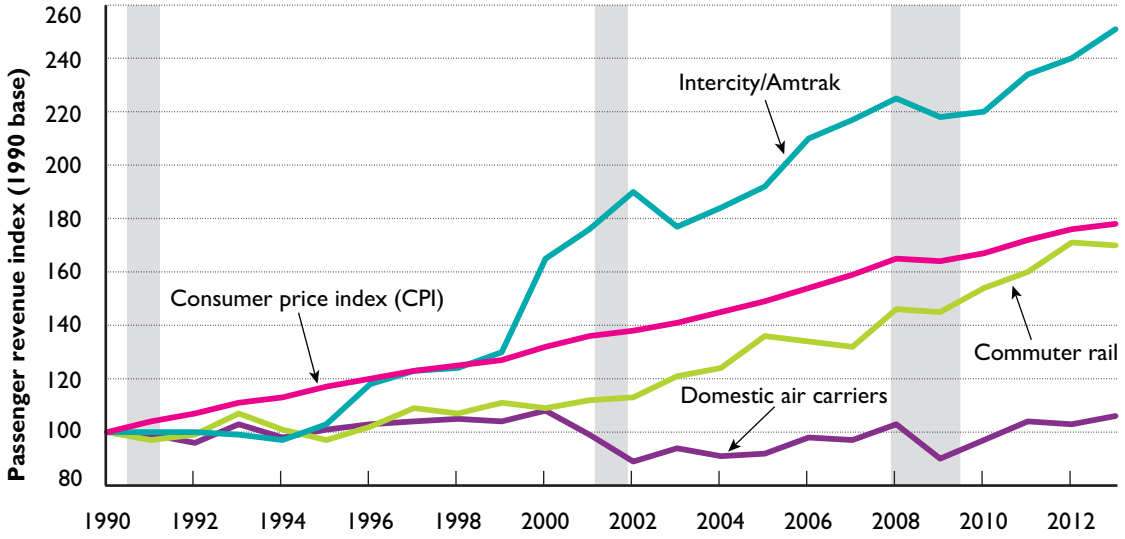
While nominal revenue per passenger-mile increased from 1990 to 2012, only Amtrak/intercity rail experienced real (inflation-adjusted) passenger revenue growth. Figure 5-3 shows nominal changes in revenue per passenger-mile from 1990 to 2012 relative to the index for all consumer expenditures (CPI) for three industries: domestic air carriers, commuter rail, and Amtrak/intercity rail. Intercity rail and Amtrak experienced the largest growth in revenue per passenger-mile, increasing 140 percent between 1990 and 2012, and commuter rail increased 70 percent. However, domestic air carrier revenue per passenger-mile remained almost unchanged, increasing 3 percent.

Figure 5-2 Multifactor Productivity Indices for Selected Transportation Industries, 1990 to 2013



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Multifactor Productivity (MFP) and Related KLEMS (Capital, Labor, Energy, Management, Services) Measures from the NIPA Industry Database, 1987 to 2013, available at www.bls.gov/mfp as of May 2016.

Figure 5-3 Average Passenger Revenue per Passenger-Mile Indices, 1990 to 2013



NOTE: Domestic air carrier revenue includes baggage fees and reservation change fees.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-20, available at www.bts.gov as of May 2016.

The increases in revenue per passenger-mile are partly due to an increase in the overall price of goods and services. The Consumer Price Index (CPI), which measures overall changes in prices, increased by almost 80 percent from 1990 to 2013, indicating that Amtrak/intercity rail was the only industry with real increasing revenue per passenger-mile during the period. Domestic air carriers, meanwhile, suffered a decrease in real revenue per passenger-mile, most likely because of competitive pressures among air carriers.

Domestic Air Carrier Revenues

Two developments have affected domestic air carrier revenues from 1990 to the present.[2] First, domestic air fares declined 18.2 percent between the fourth quarter of 1995 and the fourth quarter of 2015. As a result, fares have accounted for a lower percentage of operating revenues. In the 1990s, domestic air carriers received just below 90 percent of their revenues from passenger fares. In the 2000s, however, the percentage declined from 88.8 percent in 2000 to 73.7 percent in 2009, and has remained around 74 percent. Second, airlines began increasing baggage fees and reservation change fees in 2008. In 2015, passenger airlines collected $3.8 billion from baggage fees and $3.0 billion from reservation change fees; these fees accounted for 2.3 and 1.8 percent of total operating revenue, respectively.

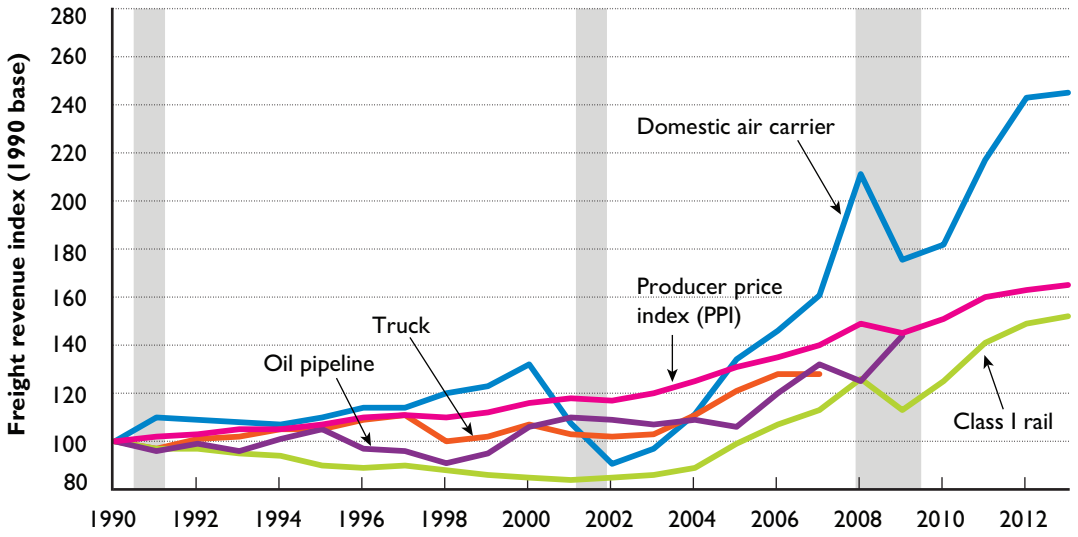
Freight Revenue per Ton-Mile

Figure 5-4 shows the average freight revenue per ton-mile for air, truck, rail, and pipeline compared to the Producer Price Index (PPI). The PPI measures overall changes in the selling prices received by transportation service providers for their services.

Nominal freight revenue per ton-mile increased for all freight modes; however, revenue increases exceeded producer price increases only for domestic air. Domestic air carriers experienced the largest increase in revenue per ton-mile,

[2] For more information on domestic air carrier revenues, please see the BTS airline financial data press releases at http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/press_releases/airline_financial_data.html.

Figure 5-4 Average Freight Revenue per Ton-Mile Indices, 1990 to 2013



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-21, available at www.bts.gov as of May 2016.

increasing 143 percent from 1990 to 2012. Class I railroads, defined as line-haul freight railroads with annual operating revenues of $475.75 million or more as of 2014, experienced a smaller increase in revenue per ton-mile of 48 percent in the same period. Oil pipelines experienced an increase of 44 percent from 1990 to 2009, and trucks experienced the smallest increase of 28 percent from 1990 to 2007. (Data for trucks after 2007 and data for pipelines after 2009 are currently unavailable.) In addition, the value per ton of freight shipments increased by 17.5 percent between 1997 and 2013, from $763 to $896 per ton in 2007 dollars (table 5-1). At the same time, the PPI increased by 63 percent from 1990 to 2012. As a result, real freight revenue per ton-mile increased only for domestic air carriers during that period.

Table 5-1 Shipment Value Statistics from the Freight Analysis Framework, 1997, 2002, 2007, and 2013

	Shipment value (billions of 2007 dollars)	Freight volume (millions of tons)	Value per ton
1997	12,501	16,390	$763
2002	14,196	17,215	$825
2007	16,651	18,879	$882
2013	17,983	20,063	$896

SOURCE: U.S. Department of Transportation, Federal Highway Administration, Freight Analysis Framework, http://ops.fhwa.dot.gov/FREIGHT/freight_analysis/faf/index.htm