

The Effects Of Fuel Prices & International Trade On Railroad Freight

As Diesel Prices Rise, Rail Market Share Rises

By Fred Norrell

The Association of American Railroads (AAR) recently posted an interesting article on its Web page, written by Frank Ahrens with the *Washington Post*. One theme is that railroad freight has recently benefited from increased fuel prices and from growing volumes of U.S. imports and exports. Higher diesel prices put trucks at a fuel cost disadvantage. Present market conditions beg the question: what if fuel prices increase even more? What will be the impact on rail freight? This article presents some freight data, explains analysis of that data, and simulates (projects) scenarios where fuel prices increase beyond present levels. Additionally, the impact of international transactions on rail freight is estimated.

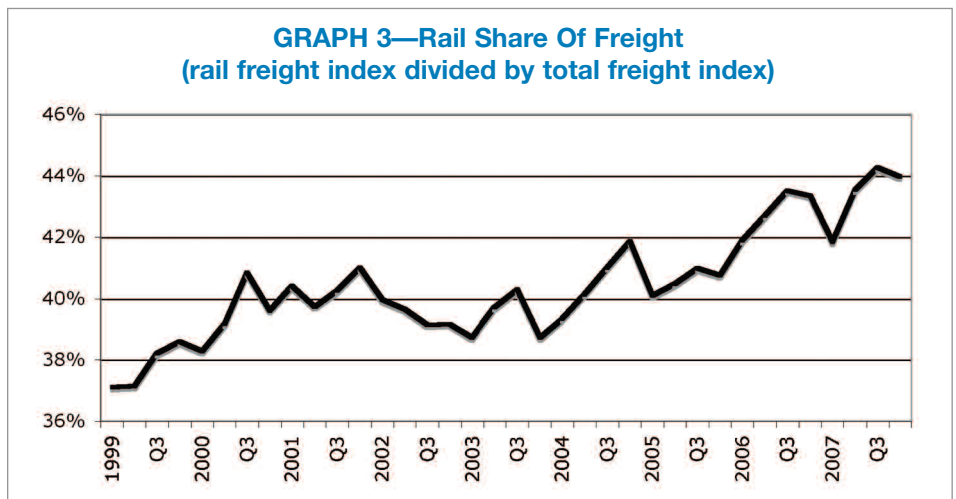
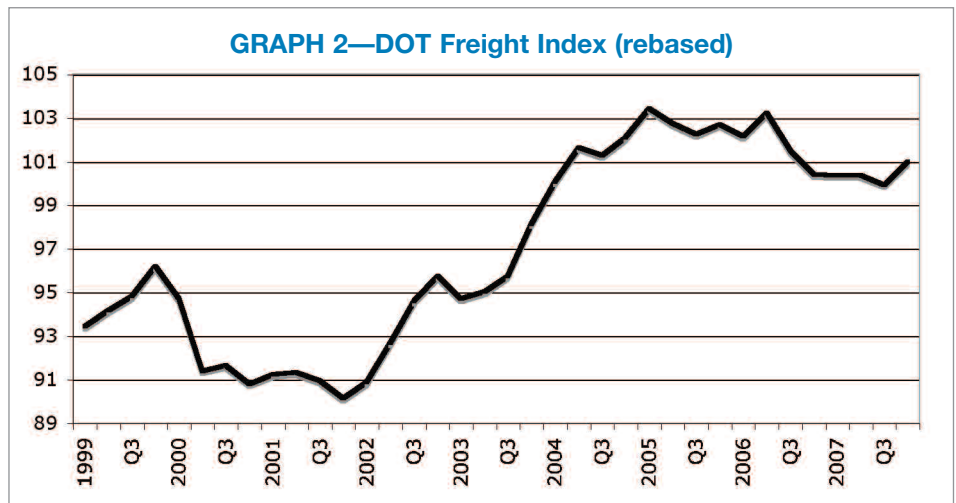
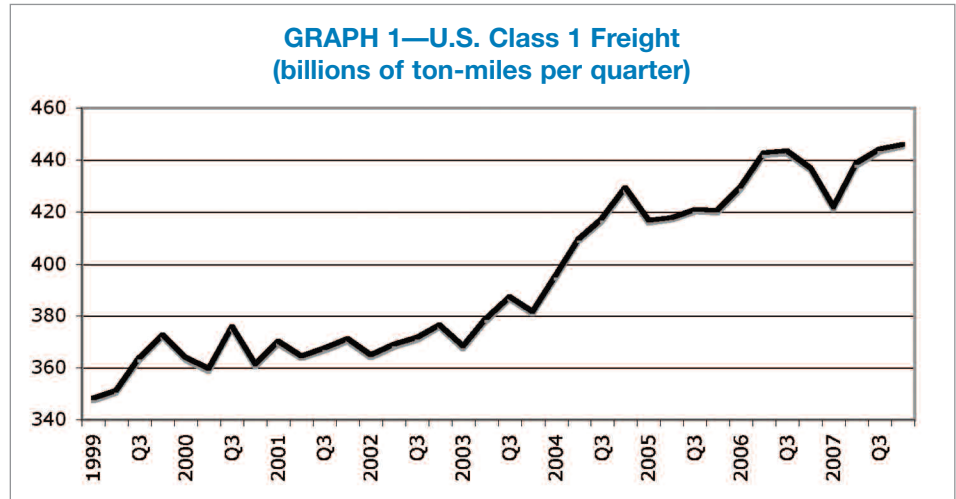
Data

AAR estimates ton-miles of freight on a weekly basis. These have been roughly summed to quarterly data (billions of ton-miles), reported to the Surface Transportation Board, and appear in *Graph 1*.

One can detect moderate growth in rail freight during 1999 through 2002, after which growth takes off at a faster pace.

The Department of Transportation collects U.S. freight movements from all modes and combines them into a Transportation Service Index. The components are physical measures of freight movement: ton-miles by air, ton-miles by water, truck tonnage, barrels by pipeline, and carloads and intermodal by rail. The index is published with a base year of 2000 (so that the index value is 100 in that year.) *Graph 2* shows the index rebased to the years 2003 through 2005.

Total freight demonstrates a distinct pattern, dipping in 2000 and 2001, expanding for three years, then stagnating. An interesting question then is rail's share of freight movement. AAR reports rail's share as about 40 percent in the years 2003 through 2005, therefore a share calculation (rail freight divided by total freight) takes that as a starting point in the data shown in *Graph 3*. ▶



Railroads have clearly gained market share, especially during the period 2004 to 2006. The challenge is to explain this increase in rail's market share.

Data on diesel fuel price and U.S. imports and exports was obtained from the website of the Federal Reserve Bank of St. Louis. Physical units, such as ton-miles of freight, are not affected by inflation; items measured in currency, such as dollars, are swept up along with general price increases. To adjust for the distorting effects of inflation, a time series of prices can be divided by a time series index of general prices to yield a time series of real prices. For example, the nominal prices of diesel fuel are divided by the GDP deflator values (from the same time period) to yield real prices of diesel. A similar calculation produces real U.S. imports and real U.S. exports. All subsequent reference to prices and trade volumes are in real, or constant dollar terms.

Analysis

The approach taken is representative of much economic research: the use of regression equations to estimate quantitative relationships between an item of interest (rail market share) and causal variables (variables that "explain" its increase.) The first equation estimated (1st quarter 1999 to 4th quarter 2007) states that rail market share depends on the price of diesel and the combined volume of imports and exports. The equation appears as:

$$\text{Rail share} = 0.32 + 0.017 (\text{price of diesel}) + 0.000025 (\text{imports} + \text{exports}).$$

t statistics: 20.0 3.45 3.08

The "t" statistics can be interpreted as signal divided by noise, or message divided by uncertainty. For hypothesis testing the rule of thumb is a "t" statistic should be 2.0 or higher. In this case they indicate the equation's constant is a good estimate, and diesel price and the trade variables are qualifying as a statistically valid causes of rail market share change.

Further analysis reveals that the equation's errors (fitted vs. actual rail share) are somewhat predictable...a potentially serious flaw. The Durbin Watson statistic is 1.21, which indicates the equation errors are (slightly) correlated over time. This suggests some causal variable(s) is missing from the equation.

The next equation includes a freight growth variable, denoted as "Fr," suggesting current (quarterly) rail market share is explained in part by the growth in the current and previous three quarters of total (all modes) freight growth. This variable plays a minor role, but eliminates the predictability of equation errors. The equation appears as:

$$\text{Rail share} = 0.315 + 0.0129 (\text{P diesel}) + 0.000030 (\text{imports} + \text{exports}) - 0.0015 (\text{Fr})$$

t statistics: 22.5 2.8 4.1 -3.4

The statistics show improvement: t statistics are all above 2.0, adjusted R square is 0.83, and Durbin Watson is 1.5—a good reading.

Interpretation of this equation is that rail market share increases when diesel price increases; this suggests some freight shifts from trucks or other modes to rail. Rail market share also increases with the volume of international trade. U.S. port activ-

ity has grown substantially in the past several years.

Rail market share decreases very slightly when total freight volume grows. In this instance, the quantities involved are so very small that no explanation is offered.

The above description is qualitative in nature; fortunately, the estimated equation provides quantitative results, from which one can calculate illustrative examples. Real diesel price has more than doubled since 2003; suppose it doubled again. Rail market share is thereby projected by the equation to increase from the current 43.7 percent to 46.7 percent. U.S. international trade has increased 30 percent in the last four years. Suppose it grew another 30 percent. Rail market share is thus projected by the equation to increase from the current 43.7 percent to 46.6 percent. If both diesel price and international trade increased in the amounts suggested above, rail market share is projected to increase to 49.5 percent.

According to RTA's forecasting models, an increase in railroads' market share of one percentage point (from the current 43.7 to 44.7 percent) would increase rail freight by 10.4 billion ton-miles per quarter and would add to crosstie demand by about 300,000 ties in the first year, and about 600,000 in the second year.

Conclusion

Of course, these examples are the product of estimates. Secondly, rail capacity would have to accommodate any such increases in railroads' market. Part of the motive for this paper was to test the hypothesis presented in Mr. Ahrens' article, and his hypothesis appears to be sound. Another purpose is to give RTA members a feel for the kind of changes the rail freight business might experience as fuel prices climb and as trade expands. Finally, the text of this article dwells more on the analysis than on how it relates to business application. The purpose is to provide some insight into the analytical methods being employed by RTA, as the association attempts to understand the factors that drive freight onto the nation's railroads and communicate that to members. §

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