Patterns of Productivity Growth for U.S. Class I Railroads:
An examination of pre- and post-deregulation determinants
Data Sources and Methods

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Introduction

This report provides a detailed description of the methods used to develop our estimates of U.S. railroad inputs, outputs, and productivity. This study relies primarily on financial and operating data filed by the Class I railroads with the Surface Transportation Board (STB) and, previously, with the Interstate Commerce Commission (ICC). Data for the years since 1996 are available on the STB web site. Since 2005, the STB has posted the Class I Railroad Annual Report (the R-1 Report) for each of the Class I railroads. Industry totals in those years are obtainable by summing the data for the Class I railroads. For the years 1996 through 2005, the STB posted summary data for the industry in the reports Statistics of Class I Freight Railroads in the United States. Data for earlier years came from a variety of reports, including Transport Statistics in the United States, Mergent (formerly Moody's) Transportation Manual, and Railroad Ten-Year Trends.

Inputs

Capital

Our approach to measuring the quantity of owned capital input is based on the following perpetual inventory equation:

$$K_t = (1-\delta)\cdot K_{t-1} + I_t$$

where K represents the quantity of capital stock, I the quantity of capital investment, and δ the rate of replacement. While the ICC and STB definitions of investment (booked

investment) are adequate for measuring equipment capital input, the use of betterment accounting in the early years of our study require us to make adjustments to book investment in way and structures. Investment expenditures, as defined by the ICC and STB, are found in reported expenditures for additions during the year (Schedule 330 in the R1 Reports) for road and equipment. Following Caves, Christensen, and Swanson (CCS) we add operating expenses associated with ties, rail and other track material, and ballast.[1] To convert the investment expenditures to investment quantities, we use the National Income and Product Accounts land transportation structures investment price index for way and structures investment and the National Income and Product Accounts railroad equipment investment price index for equipment investment.

The perpetual inventory equation requires a benchmark year and benchmark capital stock values in order for the equation to be computable. Our benchmark values for owned capital input are based on the CCS estimates of 1974 capital stock. Those estimates were $52,355 million for way and structures and $19,500 million for equipment. Following CCS, we used .03 as the replacement rate for way and structures and .06 as the replacement rate for equipment.

The formula used to calculate the price of owned capital is the same as that employed by CCS. This (implicit) rental price of capital formula has the following form:

$$P_i = \left[\frac{1-uz_i}{1-u}\right] \cdot \left[q_{i,t-1} r + q_i \delta_i - \left(q_i - q_{i,t-1}\right)\right] + q_i T$$

[1] These accounts are found in Schedule 410 of the R1 Reports. Prior to the reclassification of accounts in 1983, the expense categories were ties, rails, other track material, ballast, and labor engaged in track laying and surfacing.

where P_i is the annual cost per unit of capital stock for asset class i, q_i the investment price index, u the rate of corporate income taxation, z_i the present value of tax depreciation on a dollar of investment, r the opportunity cost of capital, δ_i the rate of economic depreciation (which equals the rate of replacement), and T the property tax rate.

For the opportunity cost of capital, we use the ICC and STB estimate of the railroad industry's cost of capital for the years 1978 forward, which we took from the Railroad Ten-Year Trends reports. We extrapolate this series for earlier years using the Moody's composite average yield on railroad bonds. We use the statutory federal income tax rate for u, while z is based on the allowable tax deduction formulas for each year. Finally, the property tax rate constructed by dividing the dollar value of property taxes and other taxes excluding income and payroll taxes by the value of capital stock at the end of the previous year.[2]

The values of rented way and structures and rented equipment are constructed by computing current dollar net rents from lease rental, joint facility rent, and other rent operating expenses.[3] The quantities of rented capital input are obtained by dividing the rented capital input values by the prices of owned capital input described above.

Labor

The quantity of labor input is based on employee hours worked, adjusted for changes in skill mix. Total hours worked are taken from the Railroad Ten-Year Trends reports. To compute an index of skill mix (the labor composition index) we use compensation and service hours reported for five employee categories: executive,

[2] Prior to 1978, these taxes were reported as Other Than U.S. Government Taxes.
[3] These accounts are found in Schedule 410 of the R1 Reports. Prior to 1978, net rents are not part of operating expenses, but are reported as components of net income.

professional and clerical, maintenance of way, maintenance of equipment, and transport. Since 1997, the number of service hours and compensation are available from the Wage Statistics of Class I Railroad in the United States (Statement A-300), posted on the STB web site. For earlier years, the number of service hours and compensation are available from the Mergent Transportation Manual. A Tornqvist index of service hours is computed, using compensation shares as weights. We then compute the ratio of this Tornqvist index to total service hours to obtain the labor composition index. Total hours worked is multiplied by the labor composition index to obtain the quantity index of labor input.

The value of labor input includes employee salaries and wages and fringe benefits reported in operating expenses (Schedule 410 in the R-1 Report).[4] An adjustment is made to exclude the compensation associated with the installation of ties, rails, other track material, and ballast.

Fuel

The value of fuel input is equal to locomotive fuel operating expense for train operations plus locomotive fuel operating expense for yard operations (Schedule 410 of the R-1 Report). The quantity of fuel input is based on the total quantity of diesel fuel consumed, which was taken from the Railroad Ten-Year Trends report.

Materials

The value of materials is computed residually from total operating expense by excluding expensed capital, net rents, labor-related expenses, fuel-related expenses, depreciation, and taxes (Schedule 410 of the R-1 Report). For the price of materials input

[4] Prior to 1978, fringe benefits were reported as employee health and welfare benefits, old age retirement payments, and unemployment insurance.

we used the Railroad Inflation Index for Materials and Supplies for the years 1980 through 2008, obtained from the Railroad Ten-Year Trends report. Since this index was unavailable for earlier years, we used the Producer Price Index for Industrial Commodities Less Fuel for the years 1974 through 1980.

Output

The study uses two measures of output: revenue ton-miles and average length of haul. Average length of haul is computed as the ratio of revenue ton-miles to freight tons originated. Revenue ton-miles and freight tons originated are taken from the Railroad Ten-Year Trends reports beginning in 1980. For earlier years they are taken from the Mergent Transportation Manual. The index of total output is constructed as a Tornqvist index of revenue ton-miles and average length of haul, using cost elasticity shares as weights. The cost elasticities for 1974 are taken from Caves, Christensen, and Swanson (CCS, 1980), while the cost elasticities for the years 1987 to 2008 are taken from Christensen Associates (2010). Cost elasticities for the years 1975 to 1986 were linearly interpolated from the 1974 and 1987 values. Cost elasticity shares are computed from the cost elasticities by normalizing them so that their sum equals one:

$$s_j = \frac{\varepsilon_j}{\varepsilon_{TM} + \varepsilon_{ALH}}; j = TM, ALH,$$

Where *TM* represents revenue ton-miles, *ALH* represents average length of haul, ε_j represents the cost elasticities for revenue ton-miles and average length of haul, and s_j the respective cost elasticity shares.

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