

# Technological Change and the Inequality of Jobs: US Transport, 1750–1860

Benjamin Schneider, University of Oxford  
benjamin.schneider@history.ox.ac.uk

Supervisors: Prof. Jane Humphries and Prof. Stephen Broadberry

Innovation has been the main cause of improving living standards since the eighteenth century, but its effects on occupations have not been analyzed systematically.<sup>1</sup> Historical instances of transformative innovation can provide insights into the impacts of industrialisation on quality of life and the potential effects of automation on the availability of good jobs in the future.<sup>2</sup> The ‘Transportation Revolution’ in the United States demonstrates how new technology can change work and the available range of jobs. This paper uses the first index to measure the quality of historical occupations to analyze work in the maintenance of transport infrastructure and provision of transport services across the Northeastern American interior in the eighteenth and nineteenth centuries. The job quality measure combines data on income, hours, and scoring rubrics for qualitative aspects of jobs. Using this method, descriptions of work in the four key technologies, and more than 3000 new archival observations of working time and wages, the paper shows that macroinventions can produce new occupations and increase the differences between the best and worst jobs.<sup>3</sup>

Transport infrastructure in colonial America was rudimentary and transport services were limited. Long-distance journeys were unpleasant for travelers, and merchants avoided moving goods overland.<sup>4</sup> The principal thoroughfare was a narrow dirt road, and gravel-covered routes were designated ‘artificial’ surfaces.<sup>5</sup> Roads were rutted, included hazardous stumps, and drainage was poor, making many impassible in winter or wet weather.<sup>6</sup> To maintain these rough surfaces, states required residents to work on their local roads for several days each year, or pay the town surveyor fines that he would use to hire labourers.<sup>7</sup> As shown in Figure 1, town road maintenance included few occupations and required little management. The workers cleared trees, cut back overgrown bushes, and filled in ruts. Rather than spreading gravel to allow drainage, roads were patched with clay or saplings.<sup>8</sup> Road work was repetitive physical labour with some risk of stress injuries, modest remuneration, and infrequent opportunities for earning, although it was not as disciplined or intense as later transport work. This is the first paper to present information on tasks, wages, and working time in American road maintenance and stagecoach work, and the archival evidence underpins the data in Tables 1 and 2.

Post riders and, by the late eighteenth century, coach drivers, provided transport services. Drivers set off early and traveled for 14–18 hours a day to reach their destination.<sup>9</sup> They were constantly exposed to snow and freezing cold in winter or baking heat in summer.<sup>10</sup> It was an exhausting task, requiring focus over bumpy roads on a jarring unsprung carriage.<sup>11</sup> As shown in Figure 2, there were few workers employed in staging, and generally the drivers were the only direct employees.

---

<sup>1</sup> Transport contributions include Fogel, *Railroads and American Economic Growth* (1964) and David, “Transport Innovation and Economic Growth”, *Economic History Review* (1969).

<sup>2</sup> A recent work is Baldwin, *The Globotics Upheaval* (2019).

<sup>3</sup> The Historical Occupational Quality Index codebook and an explanatory working paper “Good Jobs and Bad Jobs in History” are available at [sites.google.com/view/benschneider/research](https://sites.google.com/view/benschneider/research).

<sup>4</sup> Mesick, *The English Traveller in America* (1922), 50.

<sup>5</sup> Holmes, “Levi Pease, Father of New England Stage-Coaching,” *Journal of Economic and Business History* (1931): 243.

<sup>6</sup> Taylor, *The Transportation Revolution* (1951), 15.

<sup>7</sup> DeLuca, *Post Roads & Iron Horses* (2011), 20–22.

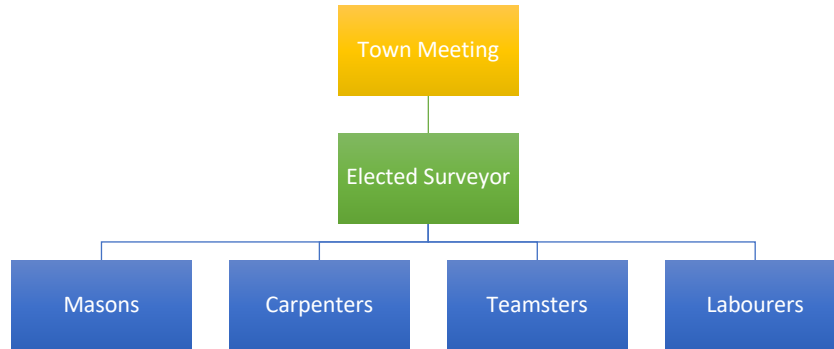
<sup>8</sup> Roach, “Colonial Highways in the Hudson Valley,” *New York History* (1959): 98.

<sup>9</sup> Holmes, “Stagecoach Travel and the Staging Business in New England,” *Massachusetts Historical Society Proceedings* (1973): 54.

<sup>10</sup> Bernard, *Retrospections of America* (1887): 34–37.

<sup>11</sup> Unsprung carriages were less likely to overturn. Holmes, “Levi Pease,” 250.

**Figure 1: Organisational Chart for Road Maintenance, c. 1750**



Sources for Figures 1–3: Elaboration from archival sources listed at the end of the paper.

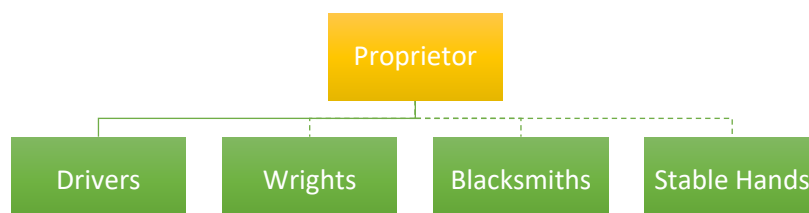
**Table 1: Occupational Quality in Road Transport, c. 1750**

Component	Labourer	Craftsman	Post Rider
Daily Wage (d)	18	30	18
Daily CPI Basket (d)	4.59	4.59	4.59
Welfare Ratio ( <i>w</i> )	2.38	4.04	2.94
Hours/Week	42.5	43.3	73.5
Time ( <i>t</i> )	3.95	3.88	2.29
Stability ( <i>s</i> )	2	2	3
Immediate Health Risks ( <i>a</i> )	4	4	3
Long-Term Health Risks ( <i>d</i> )	4	4	4
Control ( <i>c</i> )	3	4	3
Intensity ( <i>i</i> )	2	2	2
Repetitiveness ( <i>r</i> )	1	2	2
Qualitative Measures ( <i>q</i> )	2.40	2.83	2.75
HOQI	2.83	3.54	2.64

Sources for all Tables: See footnote 2, Allen et al. (2011), Allen (2015), UC-Davis Global Prices and Incomes Database, the archival sources at the end of the paper, and the text. Welfare ratios are calculated on a weekly basis using data on hours worked and a week of consumption needs.

The first technological change in transport infrastructure was the construction of the Philadelphia and Lancaster Turnpike in the 1790s; its success encouraged a spate of turnpike construction.<sup>12</sup> The turnpike was a modest development with substantial benefits for travelers. The right-of-way was cleared of stumps, graveled, and cambered. Toll-bars prevented free riding on the improved route. Maintenance included re-gravelling, cutting back bushes or trees, cleaning adjoining ditches, and occasionally placing paving stones along the surface. Turnpikes took more care over maintenance than municipalities, but seasonality still limited workers' earning potential.<sup>13</sup> The turnpike's superior construction improved speed, safety, and comfort.

**Figure 2: Organisational Chart of a Stagecoach Company, c. 1800**

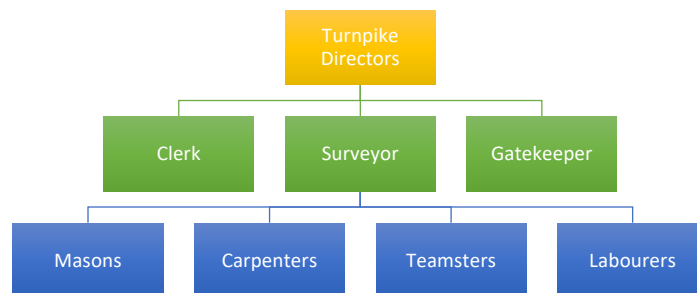


Note: Dashed lines indicate occasional employment; solid lines indicate consistent employees.

<sup>12</sup> Landis, "The Philadelphia and Lancaster Turnpike," *Pennsylvania Magazine of History and Biography* (1918): 131–32.

<sup>13</sup> Landis, "Philadelphia and Lancaster Turnpike," 241.

**Figure 3: Organisational Chart of a Turnpike, c. 1800**



Turnpikes added two new occupations: gatekeepers and clerks. Gatekeepers collected tolls, opened the toll bar, and undertook simple repairs.<sup>14</sup> It was a stable, tedious occupation with intermittent activity. Low pay was partly compensated by the low occupational risk and, frequently, accommodation in the tollhouse. Turnpikes also employed a clerk to account for revenues and expenditure on maintenance or dividend payments. This intermittent work was safer and better compensated than the blue-collar occupations. Unlike local surveyors, turnpike directors were paid for legal work and attending meetings. Table 2 and Figure 3 encapsulate the organisation and quality of work in turnpike construction and maintenance. Turnpikes incorporated bureaucratic functions, but most of the work was similar to municipal road maintenance.

**Table 2: Occupational Quality in Road Transport, c. 1800**

Component	Labourer	Craftsman	Gatekeeper	Coach Driver
Daily Wage (\$)	0.68	1.19	0.44	0.50
Daily CPI Basket (\$)	0.12	0.12	0.12	0.12
Welfare Ratio ( $w$ )	4.13	7.37	3.14	3.45
Hours/Week	51	52	60	81.2
Time ( $t$ )	3.29	3.23	2.33	2.07
Stability ( $s$ )	2	2	4	3
Immediate Health Risks ( $a$ )	4	4	5	3
Long-Term Health Risks ( $d$ )	4	4	5	4
Control ( $c$ )	3	4	4	4
Intensity ( $i$ )	2	2	4	2
Repetitiveness ( $r$ )	1	2	2	2
Qualitative Measures ( $q$ )	2.40	2.83	3.84	2.88
HOQI	3.20	4.07	3.04	2.74

Road travel was limited by rolling resistance from the surface. Water transport at low speeds required less power for the same weight, and Americans recognised the value of waterway improvements during the British canal-building era. Early projects improved or linked rivers in the Northeast.<sup>15</sup> The Erie Canal far surpassed these short routes: when completed in 1825, it connected the Atlantic coast to the Great Lakes by crossing more than 300 miles in central and western New York.<sup>16</sup>

For workers, the Erie extended a process that had begun on earlier canals with new managerial roles and greater differences between jobs. Canals employed more craftsmen to maintain locks and aqueducts, and they hired regional superintendents and foremen to organise maintenance.<sup>17</sup> Maintenance work included keeping the embankments in suitable condition and replacing lock components like doors and hinges. Lock maintenance was crucial as each one was a choke point for

<sup>14</sup> Klein and Majewski, "The Turnpike Movement in New York," *Law & Society Review* (1992): 481.

<sup>15</sup> Shaw, *Canals for a Nation* (1990), 3–9.

<sup>16</sup> Shaw, *Erie Water West* (1966), 101–03.

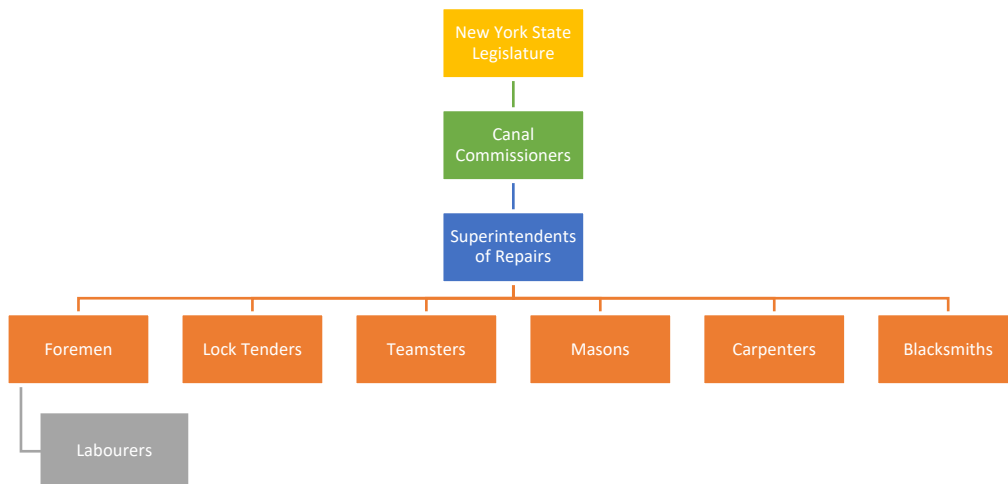
<sup>17</sup> *Erie Water West*, 182.

traffic.<sup>18</sup> Extra work was required to reopen the canal in the spring and following extreme weather. The lock tender was busier than the turnpike gatekeeper, opening and closing the lock doors six or seven days a week.

**Table 3: Occupational Quality on the Erie Canal, 1820s**

Component	Labourer	Craftsman	Lock Tender	Foreman	Superintendent
Daily Wage (\$)	0.75	1.50	0.77	1.00	1.92
Daily CPI Basket (\$)	0.14	0.14	0.14	0.14	0.14
Welfare Ratio ( $w$ )	4.44	8.72	5.11	6.12	11.76
Hours/Week	69.6	68.4	78	72	72
Time ( $t$ )	2.41	2.46	2.15	2.33	2.33
Stability ( $s$ )	3	3	4	4	5
Immediate Health Risks ( $a$ )	3	3	4	4	4
Long-Term Health Risks ( $d$ )	4	4	4	4	5
Control ( $c$ )	2	3	4	4	4
Intensity ( $i$ )	1	1	3	3	3
Repetitiveness ( $r$ )	1	2	2	3	3
Qualitative Measures ( $q$ )	2.04	2.45	3.40	3.63	3.91
HOQI	2.80	3.74	3.34	3.73	4.75

**Figure 4: Organisational Chart of the Erie Canal, 1820s**



Source: Elaboration from New York State Archives, Canal Expenditures.

Blue-collar canal work was exhausting labour, and workers were expected to toil for long hours. The greater complexity and scale of canals required more supervisory employees to oversee maintenance and operation (Figure 4). These workers enjoyed higher pay and safer, less strenuous conditions, as summarised in Table 3. Real wages were modestly higher than on turnpikes, but there were more health risks—canals were notorious vectors of disease—and higher levels of discipline.<sup>19</sup>

Canal boatmen (Figure 5) generally earned less than land-based workers, with only the captain making \$1 per day or more, and winter similarly curtailed their income.<sup>20</sup> By the time of the Erie, draught animals had largely replaced poling for propulsion, but canal boating remained a monotonous occupation. The driver monitored the animal team, the captain and bowsman watched for other boats and locks, and the helmsman directed the tiller to avoid collisions with banks or abutments. The most challenging maneuver was passing other boats, which occurred frequently on busy sections and was

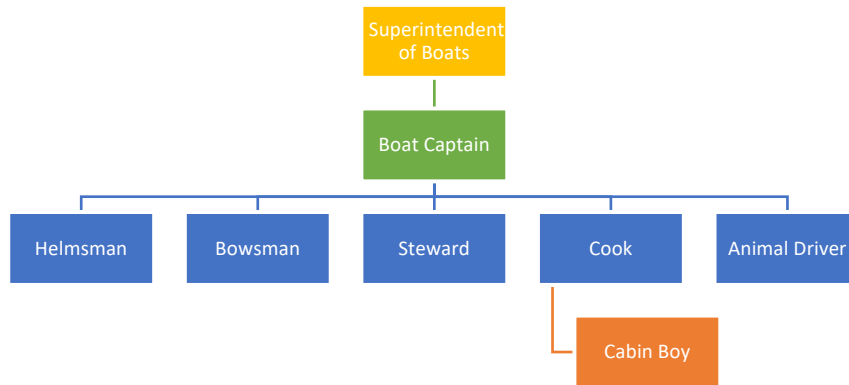
<sup>18</sup> Waggoner, *The Great Canal Era* (1958), 146.

<sup>19</sup> Shaw, *Canals for a Nation*, 178–80. See also Zimran, "Transportation and Health in the United States," *Journal of Economic History* (2020).

<sup>20</sup> Shaw, *Erie Water West*, 198.

imperative for passenger boats. Passing required boat captains and animal drivers (usually children) to coordinate by dropping their towlines or raising them above other boats.<sup>21</sup> Most crew, particularly on freight boats, were constantly exposed to the weather.

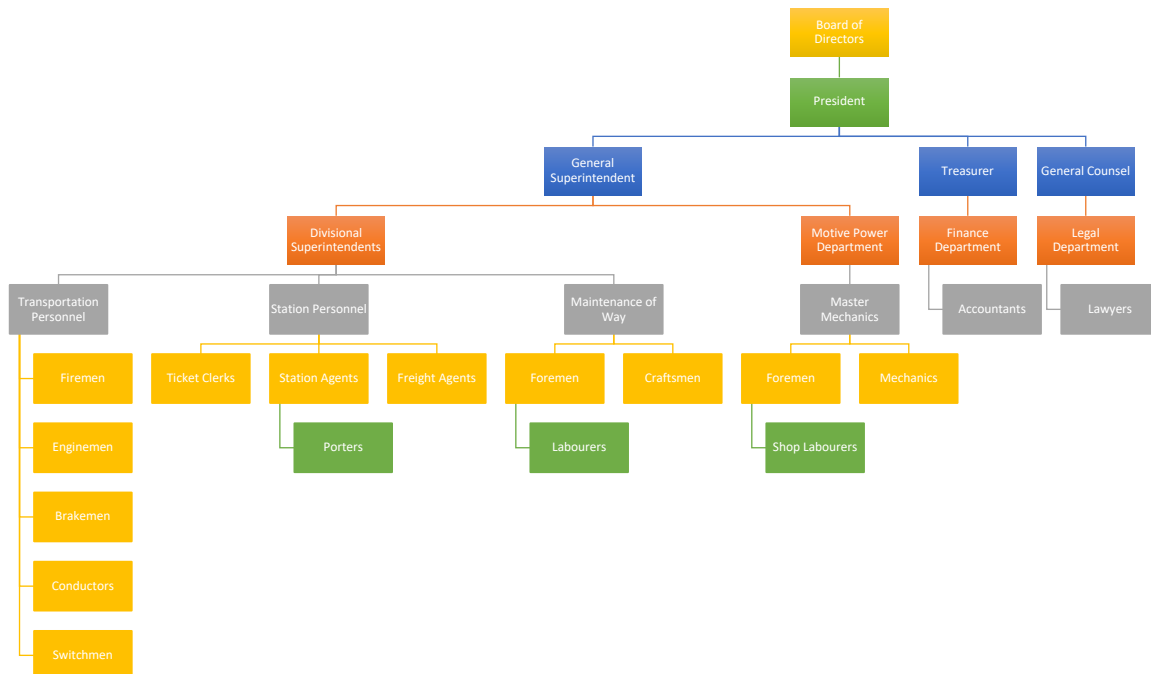
**Figure 5: Organisational Chart of the Erie Navigation Company, c. 1820**



Source: Elaboration from Cornell University Library, Simon Dexter Papers.

While canals allowed for higher through-put of goods and people, canal transport was slow and impossible during the winter. Railroads with steam traction enabled comparatively rapid movement and were less affected by seasonality. The first American experiments with railroads began in the late 1820s and by mid-century bands of iron linked cities across New England and the Mid-Atlantic.<sup>22</sup> Railroads combined infrastructure maintenance and service provision in the same firm. More importantly for workers, the logistical and technical requirements of railroads required more specialisation, with many new occupations and a greater division of labour.

**Figure 6: Organisational Chart of a Railroad, c. 1850**



Sources: Churella (2013) and archival sources.

Railroads continued to employ labourers and craftsmen but also hired station personnel to handle passengers, ticketing, and freight, an array of workers to operate the rolling stock, shop employees to maintain locomotives and cars, and office workers to oversee logistics, finances, and legal affairs. This increased division of labour is shown in Figure 6.

<sup>21</sup> Waggoner, *Long Haul West*, 132–42.

<sup>22</sup> Stover, *American Railroads* (1961), 3.

Specialisation came with growing differences in remuneration. Master mechanics earned between 250% and 400% of shop labourers' wages, and railroad presidents could earn more than six times a labourer's wage. Incorporating qualitative elements of work extends this analysis beyond research on income inequality.<sup>23</sup> The inequality of work rose on other dimensions: labourers still toiled for long hours trackside or in the shops; accidents that cost digits, hands, and lives were common for brakemen; switchmen were frequently dismissed for errors leading to accidents; and all trainmen risked their lives when operating engines with rarely-inspected steam boilers over cheaply-built infrastructure.<sup>24</sup> Employees at higher levels of the organisational chart had more control over their work and fewer occupational risks. The lone exception was the high-pressure job of the railroad president, several of whom suffered from stress-related ailments and died in office or shortly after retirement.<sup>25</sup>

**Table 4: Occupational Quality on Railroads, 1850s**

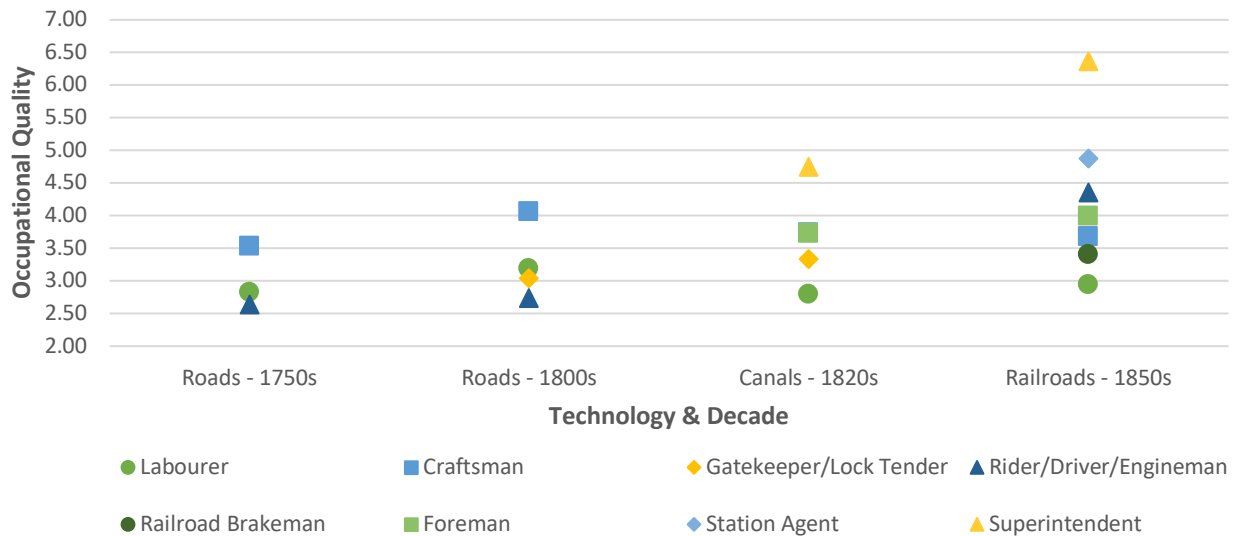
Component	Labourer	Craftsman	Brakeman	Engineman	Station Agent	Foreman	Superintendent
Daily Wage (\$)	0.85	1.38	1.09	1.78	1.98	1.31	5.61
Daily CPI Basket (\$)	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Welfare Ratio ( <i>w</i> )	3.20	6.44	4.63	5.11	10.32	6.31	30.64
Hours/Week	44.8	55.5	50.5	78	62	57.3	78
Time ( <i>t</i> )	3.75	3.03	3.33	2.15	2.71	2.93	2.15
Stability ( <i>s</i> )	4	4	4	4	4	4	5
Immediate Health Risks ( <i>a</i> )	3	3	2	4	4	3	5
Long-Term Health Risks ( <i>d</i> )	4	4	3	4	5	4	4
Control ( <i>c</i> )	2	3	2	4	4	4	4
Intensity ( <i>i</i> )	1	1	2	3	4	3	3
Repetitiveness ( <i>r</i> )	1	2	3	2	4	3	3
Qualitative Measures ( <i>q</i> )	2.14	2.57	2.57	3.40	4.15	3.46	3.91
HOQI	2.95	3.69	3.41	3.34	4.88	4.00	6.37

<sup>23</sup> Lindert and Williamson, *Unequal Gains* (2016).

<sup>24</sup> Licht, *Working for the Railroad* (1983); Aldrich, *Death Rode the Rails* (2006); Aldrich, "American Railroad Bridges," *Railroad History* (1999).

<sup>25</sup> Churella, *The Pennsylvania Railroad* (2013), ix.

**Figure 7: Occupational Quality in US Transport, 1750s–1850s**



Sources: See Tables 1–4

Canals and railroads increased the complexity of the transport sector. They demanded more specialised workers and job quality became more unequal (Figure 7). The unskilled labourers who maintained roads, turnpikes, canals, and railroads did not lose out in absolute terms from these changes. However, the differences between their work and that of clerks, master mechanics, and superintendents were substantial and grew over the colonial and early republic periods. On the other hand, the new jobs created by technological change produced a professional and managerial class in the transport sector. New technologies generated opportunity as well as inequality.

### Archival Sources

#### *Connecticut Historical Society*

E. Hubbard Account Book  
 Granby Toll-Gate Book  
 Granby Turnpike Records  
 Hartford & New Haven Turnpike Account Book  
 Joseph Pasco Account Book  
 New London Northern Railroad Records  
 Oxford Turnpike Account Book  
 Samuel Camp Account Book  
 Windham & Mansfield Turnpike Account Book  
 Windham Turnpike Accounts

#### *Connecticut State Archives*

Litchfield County Court Papers  
 New London County Court Papers  
 Pomfret Town Records

#### *Cornell University, Rare & Manuscript Collections*

Simon Dexter Papers

#### *Hagley Library*

Mount Carbon Railroad Papers  
 Reading Company Records

*Harvard Business School*

Baldwin Business Papers  
Boston and Albany Railroad Records  
Dennis Northrup Account Book  
James Brindley Diaries  
Josiah Chute Account Book  
Nathaniel Chamberlin Collection  
Plumer Business Records

*Massachusetts Historical Society*

Middlesex Canal Records  
Richard Frothingham Papers

*New Jersey State Archives*

Department of State Papers  
Joshua Wright Papers

*New-York Historical Society*

Bergen Turnpike Records  
Mohawk & Ballston Bridge Collection  
Mohawk Turnpike & Bridge Collection  
Ozias Brownson Collection  
Tolland County Collection  
Westchester Turnpike Records

*New York Public Library*

Conewago Canal Records  
Fairchild Collection  
Jesse Smith Account Books

*New York State Archives*

State Canal Expenditures  
State Local Records on Microfilm

*Princeton University Special Collections*

Gulick Family Papers  
Robert Anderson Papers  
Samuel Southard Papers

*University of Connecticut Special Collections*

Allyn Fuller Collection  
Providence & Worcester Railroad Records  
William McDermott Railroad Collection

*Yale Manuscripts and Archives*

Account Books Collection  
Farnam Family Papers  
Turnpikes Collection