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CHAPTER TEN

# **Transportation**

# 10.1. Introduction

This chapter details the estimation of the current-price and constantprice (1860) capital stock on a decadal basis from 1840 to 1900 for the transportation sector. It covers, in turn, shipping, canals and river improvements, steam railroads, street railroads, Pullman and express cars, and pipelines.

# 10.2. Shipping

#### 10.2.1. Current Value of Vessels

The censuses of 1880 and 1890 include statements of the value of vessels that seem reliable. The 1880 value of sailing vessels was established by an insurance expert; steam valuations were apparently obtained from steamboat owners (US Census Office 1883b, 718–19). In 1890 all valuations were "commercial valuations" estimated by owners (US Census Office 1895b, xii, 5). The fact that both steam and sailing values per ton show small increases between 1880 and 1890 is encouraging. All the appraisals appear to be in current market values.

We used the census data for 1880 and 1890 without modification. Our 1900 estimate is from Kuznets, who interpolated between 1890 and 1906 on the basis of tonnage figures (see table 10.1 and accompanying notes for details).

Gallman wrote the substance of this chapter. "We" and "our" refers to Gallman and Howle.

For 1870 and earlier, only official tonnage data are available. We first modified them to exclude ghost tonnage (US Bureau of the Census 1960, series Q-155, Q-161, Q-162, Q-178, Q-179). Then we extrapolated the 1880 valuations per ton, for each kind of vessel, back to 1840 on the basis of the adjusted Brady price index of ships and boats. Finally, we multiplied the tonnage figures by valuations per ton for each kind of vessel (steam, sail, and other) to yield total valuations (see table 10.1 and accompanying notes for details).<sup>1</sup>

Since the Brady index relates to the prices of vessels of constant size and quality, since price per ton was positively associated with size of vessel, and since the size of vessels was increasing, the current price series we computed is almost certainly biased upward, although probably only modestly—the bias being greater the earlier the date of the estimate.

# 10.2.2. Constant Value of Vessels

The current value of vessels was deflated by the Brady index.

# 10.2.3. Real Estate in Shipping

We were unable to develop an accurate estimate of the value of real estate in shipping. Rather than omit this component of capital entirely, we used a rough estimating procedure developed by Kuznets. We divided real estate between land and improvements according to our ratio for trade and nonfarm residential real estate. The improvement estimate was then deflated by Brady's adjusted price index for factories and stores (see table 10.1 for details).

# 10.3. Canals and River Improvements

# 10.3.1. Coverage

All canals and all river improvements, whether part of a canal system or not, are included. For convenience, we will henceforth use the term "canals" to include river improvements.

# 10.3.2. Derivation of Cost Estimates

We first estimated the cost of canal construction by decades. For the period 1815 through 1860, the most reliable source is an annual construction

	1840	1850	1860	1870	1880	1890	1900
Ghost tonnage deduction Steam vessels	12%	10%	2.50%				
Tons (in thousands)	202	526	868	1.075			
Adjusted tonnage	178	473	846	1,075			I
Value per ton (in dollars)	148	601	87	73	99		I
Value, at current prices (in millions of dollars)	26.3	51.6	73.6	78.5			
Sailing vessels							
Tons (in thousands)	1,582	2,408	3,589	2,363	I		
Adjusted tonnage	1,392	2,167	3,499	2,363			
Value per ton (in dollars)	56	41	33	28	25		I
Value, at current prices (in millions of dollars)	78	88.8	115.5	66.2	1		
Other vessels							
Tons (in thousands)	1,189	1,956	2,971	2,292			
Adjusted tonnage	1,046	1,760	2,897	2,292			
Value per ton (in dollars)	12.8	9.5	7.5	6.3	5.7		
Value, at current prices (in millions of dollars)	13.4	16.7	21.7	14.4			
All vessels							
Tons (in thousands)	2,973	4,890	7,428	5,730			
Adjusted tonnage	2,616	4,401	7,242	5,730			
Value per ton (in dollars)	44.9	36	29	27.6			
Value, at current prices (in millions of dollars)	117.5	158.4	210	158.1	156	221	343
Price index	170	126	100	84	76	57	51
Value, at 1860 prices (in millions of dollars)	1.69	125.7	210	188.2	205	388	673
Real estate							
Improvements, at current prices (in millions of dollars)	20.4	27.6	36.5	27.5	27.1	38.5	59.7
Price index	107	108	100	90	114	16	89
Real estate							
Improvements, at 1860 prices (in millions of dollars)	1.9.1	25.6	36.5	30.6	23.8	42.3	67.1
Land, at current prices (in millions of dollars)	26.6	35.8	47.5	35.7	35.3	49.9	77-5

TABLE 10.1 Value of vessels and real estate in shipping, measured in current and 1860 prices, 1840-1900

Sources:
Line 1: For all years, US Bureau of the Census 1960, 439, indicates that in 1841 official tonnage figures were reduced by about 12 percent to eliminate ghost tonnage. We accordingly reduced the 1840
unadjusted data by 12 percent. The next adjustment for ghost tonnage was made in 1855-58 and resulted in an 18 percent reduction of official tonnage figures. We prorated this by years, deducting to percent
from the 1850 tonnage data. We also reduced our 1860 estimate on the assumption that undeducted ship losses accumulated at the same rate per year after 1858 as they did from 1841 to 1858. It was not
necessary to adjust the tonnage figures for 1870 and later, since ghost tonnage represented a much smaller part of the total (1-3 percent).
Line 2: For all years, US Bureau of the Census 1960, series Q-155. Lines 3, 7, 11, and 15, for all years, lines 2, 6, 10, and 14 respectively, reduced by the percentage in line 1.
Lines 4, 8, and 12: For all years, the 1880 values were computed from US Census Office 1883b, 718-19). The price index in line 18 was used as an extrapolator to estimate values in 1840-70 from values in
1880.
Lines 5, 9, 13: For all years, adjusted tonnage multiplied by value per ton.
Line 6: For 1870, US Bureau of the Census 1960, series Q-161, hereafter <i>Historical Statistics</i> .
For 1840-60, certain vessels were included in the data that were not included in our 1880 value-per-ton figure. We reduced the Historical Statistics figure by 20 percent to account for this. The 20 percent
estimate is somewhat arbitrary, since we know the tonnage of these vessels only after they were excluded from the sailing category. In the years from 1868 to 1875, the sailing category was smaller than it
would have been if the pre-1869 classification had been used, by the following percentages:
1868 1869 1870 1871 1872 1873 1874 1875
20% 21% 25% 28% 30% 33% 32% 30%
US Bureau of the Census 1960, series Q-161 and Q-162. After 1875, the information for a comparison is not available. It can be seen that the data we have are insufficient to indicate a definite trend.
Therefore, we reduced the 1840. 1850, and 1860 figures by 20 percent, the ratio computed from the 1868 data.
Line 10: Unfortunately, the 1960 Historical Statistics figures included only documented vessels. Many internal, non-passenger-carrying vessels were excluded. The "other ships" (canal boats and barge,
series Q162) category in the 1960 Historical Statistics is therefore not nearly so broad as the ones in the 1880 or 1890 census. This miscellaneous category in 1880 made up 44 percent of total tonnage, and
in 1890 it made up 57 percent. We assumed that this category made up 40 percent of total tonnage prior to 1880. Even though the tonnage is quite significant, the value is not, since this category has a low
pre-ton value. See US Bureau of the Census 1960.
Line 14: For all years, line 2 + line 6 + line 10.
Line 16: For all years, line 17 + line 15 (expressed in millions).
Line 17: For 1840-70, line 5 + line 9 + line 13: For 1880, US Census Office 1883b, 718-19. For 1890, US Census Office 1895b, xii, 5. For 1900, we accepted Kuznets's interpolation between 1890 and 1906,
derived as follows: "The value of vessels is estimated as the product of the tonnage and the value per ton. Tonnage is interpolated between 1890 and 1906 (for 1890 given in [US Census Office 1897] and for
1906 in [US Bureau of the Census 1906] by tonnage of the total merchant marine [US Bureau of Navigation 1923]. Value per ton, computed for 1890 and 1906, is interpolated along a straight line. Value
figures for 1890 and 1906 are from the sources cited for tonnage" (Kuznets 1946, 215).
Line 18: Brady 1966, 110–11, adjusted as follows. The Brady index numbers refer to the wrong years (see chapter 7, above). However, the evidence on lumber prices and the wage rates paid by
shipbuilding firms suggest that the Brady indexes require no adjustment on this account, except for 1880 (1879). The Brady index of 1879 had to be raised by 5 percent to approximate a vessel's price index
for 1880, an adjustment we made. See the Aldrich Report (US Senate 1893, 228 [white oak boards], 222 [yellow pine boards], 229 [white pine boards], and 238 [spruce boards]); Henry Hall 1884, 245-46;
Joseph D. Weeks 1886, 499–500; US Bureau of the Census 1949, series L-9 and L-10. Brady reported price index numbers for census years 1834, 1844, and 1854, but not for 1839 or 1849. The 1834, 1844, and
1854 index numbers were found to be good proxies for index numbers for calendar years 1855, 1845, and 1855 (see above). We then interpolated between these values on data from the Weeks Report (Weeks
1886, 499), to obtain index numbers for 1840 and 1850 (calendar years).
Line 19: 100 $\times$ line 17 - line 18.
Line 20: For all years, very little information is available on which to construct an estimate of real estate in shipping. Kuznets (1946, 211), used 1880 steamship figures to compute a ratio of the value
of real estate to the value of vessels, a ratio he then used to estimate the value of real estate in shipping. We accepted Kuznets's ratio (0.40). We divided real estate between land (0.565) and improvements
(0.435) according to ratios developed in Chapter 9.2, above.
Line 21: For all years, table 8.9, Line 5.
Line 22: For all years, 100 × line 20.
Line 23: For all years, same method as for line 20.

cost series done by H. Jerome Cranmer (1960, 547–64) and modified by Harvey Segal (1961, 169–215). An alternate source for the period is US Census Office (1883b), where cost and dates of construction are given for each canal. The census estimates are slightly higher than the Cranmer-Segal series, apparently because they include some maintenance costs and noncanal assets. We therefore used the Cranmer-Segal estimates, with minor modifications (as indicated in table 10.2 and table 10.3) to include river improvements and pre-1815 canal construction.

All of our cost figures for the 1860–1900 period are from the US Census Office (1883b, 753) and US Bureau of the Census (1929, 72–73). The 1860–80 census data omitted river improvements that were not part of a canal system and canals constructed by the federal government. We modified the census data to include estimates of these items, as indicated in tables 10.2 and 10.3.

Having determined the cost of canal construction by decades, we then adjusted the data to exclude obsolete canals. When properly maintained, canals do not wear out, but the development of the railroads made obsolescence an important factor. We deducted the cost of abandoned canals from our decade cost totals from US Census Office 1883b and US Bureau of the Census 1929. (The former source lists individual abandoned canals and dates of abandonment.) In addition, the value of an abandoned canal can be considered to have been greatly impaired for a number of years prior to abandonment, due to reduced traffic and inadequate maintenance. To compensate for this factor, we assumed that any canal abandoned during the ten years following a valuation date was of no value on that date. For example, our 1870 canal estimate excludes the cost of all canals abandoned before *1880*. This adjustment is the equivalent of our depreciation adjustments of other wealth categories.

#### 10.3.3. Division of Cost into Improvements, Equipment, and Land

We assumed that all construction costs were for improvements; land could hardly have accounted for I percent of the total cost of canals. The principal component of equipment—and the only one we took into account was canal boats, which form part of our shipping series.

# 10.3.4. Derivation of Constant Cost Estimates

The cost basis estimates were deflated by decade of construction, as shown in table 10.4. To obtain the construction dates of canals in operation at

TABLE IO.2	Book value o	f canals, June 30	, 1840, to June	30, 1900, in	millions of dollars
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Operating canals, 1840	II2
Less those abandoned, 1840–50 <sup>a</sup>	<u>-2</u>
Value of canals, 1840	110
Add construction, 1840-50	<u>+44</u>
Operating canals, 1850	154
Less those abandoned, 1850–60	<u>-3</u>
Value of canals, 1850	151
Add construction, 1850–60	<u>+39</u>
Operating canals, 1860	190
Less those abandoned, 1860–70	<u>–6</u>
Value of canals, 1860	184
Add construction, 1860–70	<u>+9</u>
Operating canals, 1870	193
Less those abandoned, 1870–80	<u>-25</u>
Value of canals, 1870	168
Add construction, 1870–80	+12
Operating canals, 1880	180
Less those abandoned, 1880–90	<u>-7</u>
Value of canals, 1880	173
Add construction, 1880–90	$\pm II$
Operating canals, 1890	184
Less those abandoned, 1890–1900	<u>-13</u>
Value of canals, 1890	171
Add construction, 1890–1900	+59
Operating canals, 1900	230
Less those abandoned, 1900–10	-19
Value of canals, 1900	211

<sup>a</sup>i.e. From June 30, 1840 through June 30, 1850

Sources:

Line 1: According to Cranmer's estimate, as modified by Segal (1961, 208-9), \$107 million was invested in canal construction between 1815 and 1840. (We interpolated the June 31, 1840, figure from year-end figures for 1839 and 1840.) We added \$5 million to this, as a rough allowance for canals constructed before 1815. The abandonment of canals prior to 1840 was negligible, so no adjustment on this account was necessary. See Goodrich's introduction to Segal 1961, 7, for a comment on abandonment. Lines 2, 6, 10, and 14: Estimated from data in US Census Office 1883b, we adjusted the census data upward by 5 percent to account for those abandoned canals with no valuation listed. Lines 18, 22, and 26: US Bureau of the Census 1929, 72-73. The 1890-1900 and 1900-1910 estimates were interpolated between 1889, 1906, and 1916. Lines 4 and 8: Segal 1961, 209, interpolated between year-end figures. To the Segal estimate we added the estimated cost of river improvements. See notes to lines 12 and 14. Lines 12 and 16: US Census Office 1883b listed the cost of construction of operating canals, and the dates of construction. From these data we estimated the decade totals. We added the cost of construction of US government-built canals and of river improvements that were not a part of canal systems, since neither was included in the census estimate. The costs of these categories were extrapolated from 1880, 1889, and 1906 on data found in U.S. Bureau of the Census 1908, 40. See table 10.3. Lines 20 and 24: US Bureau of the Census 1929, 72-73. The census lists the total cost of operating canals in 1880, 1889, and 1906. The cost of abandoned canals was also given for 1880-89, and 1889-1906. By subtracting the cost of operating canals in 1880 from the cost in 1889 and adding to the difference the cost of canals abandoned, we obtained the cost of canals constructed between 1880 and 1889. The same procedure was used for 1889-1906. The 1900 estimate was then interpolated between 1889 and 1906. We assumed that one-half of the total construction between 1889 and 1906 was carried out prior to 1900. We used only the incremental changes given in the census, not the census total cost figures, because we believe that the earlier canal cost totals are not accurate; see text. Lines 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, and 27: Obtained from the other columns in this table by addition and subtraction as indicated.

	1840	1850	1860	1870	1880	1889	1906
US government canals	_	_	_	4	8	21	27
River improvements	_	I	2	4	9	17	43
Total		Ι	2	8	17	38	70

TABLE 10.3 Categories excluded from the Cranmer-Segal and tenth census estimates, 1840–1900, in millions of dollars

Source: US Bureau of the Census 1908, 40.

each valuation date, we assumed that the canals abandoned earliest were the first to be constructed. Common labor is the major portion of construction cost. We therefore used Lebergott's common labor wage index as our price index. Since the wage index extends back only to 1832, we made a rough extrapolation to 1815, based on a comment by Segal regarding changes in canal construction costs during the 1815–44 period; see notes to table 10.2 for details.

# 10.4. Steam Railroads

#### 10.4.1. Introduction

Two methods were available to us to make railroads asset estimates. The first, used by Kuznets (1946, 201-19), was to develop total capital estimates, break them down into their components using asset ratios (available for 1858 and 1880), and then apply appropriate price indexes to convert them to constant dollars. Instead, we used a procedure developed by Albert Fishlow (1965). The procedure allowed us to exploit more reliable evidence: evidence of the count of physical components of the capital stock. Indexes were developed that were adjusted for changes in resource content per unit of component. For example, a mile of track in 1850 might be considered to be the equivalent of 0.9 miles of track in 1900. Fishlow followed this procedure for track, locomotives, freight cars, and passenger cars. He then combined the indexes into an index of improvements and one of equipment, and used 1909 prices to convert them to constant dollars. Because we wanted our series in 1860 prices, we applied 1860 valuations to Fishlow's improvement and equipment series.<sup>2</sup> See table 10.5. The 1860 valuations were based on census data, but were modified because the census valuations did not represent the true value of the assets.

# 10.4.2. Value of 1860 Fixed Capital

The 1860 census lists \$1,151.6 million as the cumulative cost of construction of railroads to that date (US Census Office 1866, 331). From what we know of railroad accounting methods of the period, we can be confident that no depreciation had been deducted. In addition, railroads typically paid for construction materials with stock; the result was that assets were set up on the books at valuations considerably above their cash prices. Fishlow's adjustment of the census cost of construction figure to exclude overvaluations, land purchases and non-railroad assets, and to include omitted railroads, reduced the census return from \$1,151.6 to \$990.7 million.<sup>3</sup> This figure is net of retirements, but gross of depreciation. It is also on a cost basis, which may represent a deviation from 1860 market prices. But before addressing these problems, we will show how we divided the total between improvements and equipment.

#### 10.4.3. Value of Improvements and Equipment in 1860

Based on a sample of railroad balance sheets in 1858, we estimated that improvements made up 89.2 percent and equipment 10.8 percent of the total value of improvements and equipment. The sample from which we derived this estimate was weighted for size of railroad, to parallel the size distribution of the total population.<sup>4</sup> On this basis we divided Fishlow's total between its two major components (see table 10.6, panel A.)

Fishlow's (1965, 389) price indexes for railroad equipment and improvements indicate that there is no need to adjust the 1860 valuation from book to current value. Assuming a twenty-year life-span of equipment, and interpolating our equipment growth rate along the change in mileage (table 10.7), shows that the prices at which equipment was entered on the books averaged about 98 percent of average 1860 prices. The deviation of the book value of improvements from the 1860 price level was even smaller. We therefore used the estimates in table 10.6, panel A, as if they were in 1860 dollars—that is, as if they represented gross reproduction cost estimates.

Next, our equipment and improvements estimates had to be depreciated. Fishlow's equipment series is already properly depreciated, using a twenty- to twenty-five-year life, but we had to depreciate our 1860 value of equipment before we applied it to his series. Conveniently, we could use the ratio of undepreciated values to depreciated values for 1860 that

TABLE IO.4 Value O	f canals and riv	er improvemen	its, measured in	current and 18	60 prices, 1840-	-1900, in millior	is of dollars			
	Date of con	ıstruction <sup>a</sup>								
	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)	(6)	(10)
Date of valuation	Pre-1815	1815-35	1835-40	1840-50	1850-60	1860-70	1870–80	1880–90	1890-1900	All
Price index (1860 = 100)	73	73	16	16	16	131	126	127	136	
1840 Cost valuation Constant value	0 N	61 84	47 52							110 139
1850 Cost valuation Constant value		60 82	47 52	44 84						151 182
1860 Cost valuation Constant value		54 74	47 52	44 84	39 43					184 217
1870 Cost valuation Constant value		29 40	47 52	44 84	39 43	6				168 190

in millions of dollars TOOD T840and TS60 nrices. ł 1 d in Ē nto 4 Value of canals and river imp L O

1880 Cost valuation	22	47	4	39	6	12			173
Constant value	30	52	48	43	7	10			190
1890									
Cost valuation	6	47	4	39	6	12	II		171
Constant value	12	52	48	43	7	10	6		181
1900									
Cost valuation		37	44	39	6	12	II	59	211
Constant value		41	48	43	7	10	6	43	201
<sup>a</sup> The dates refer to intervals extendin	ng firom June 30 of	the first date to Ju	ne 30 of the secor	ıd.					
Sources: Line 1: The price index is a common	labor wage index	for all years after 1	834. For 1834–90,	, it is based on Leb	ergott's (1964, 298	, 541) common lat	oor daily earnings	index. We shifted	the
Lebergott index to an 1860 base. Th	e decade averages	for 1850-60 and 18	380–90 were obtai	ined by averaging t	he wage index for	the beginning and	d end of the decad	le, since annual da	ita are not
available. At least we know that this 1	procedure is fairly	reliable for 1880-	po, since other wa	ge indexes show a	relatively constant	increase from ye	ar to year during	this period. Annua	al figures
are available (Lebergott 1964, 298) fo	or 1860–80, and th	e index numbers ir	this period are a	verages of the year	ly indexes.				
For 1800 1000 the I abarantt in:	dev was extranola	ted on the index of	lower skilled lab.	or from US Burea	of the Cancus to	60 carias D 602	Annual data ware	to a parage	ina tha

The pre-1835 index values are based on a statement by Segal (1961, 186): "We believe ... that average construction cost rose sharply between the first (1815-34) and second (1834-44) canal averaged to produce un ILLE LEUGI BUIL nhi-nhoi in. decade indexes.

Lines 2, 4, 6, 8, 10, 12, and 14; table 10.2. The pre-1840 values were broken down by construction cycle according to the Segal (1961, 208-9) annual construction index. Canals abandoned in cycles—perhaps by as much as thirty-three percent." David and Solar's (1977, 59) data suggest that the figure may have been more like 17 or 18 percent. We assumed a 25 percent increase. the decade following each census date were treated as obsolete and of no value on the census date. See text.

Lines 3, 5, 7, 8, 11, 13, and 15: Lines 2, 4, 6, 8, 10, 12, and 14 respectively, divided by the price index and multiplied by 100.

	Equipment	Improvement
1840	79.3	99.8
1841	78.9	92.3
1842	76.2	90.2
1843	73.8	101.7
1844	75.5	99.0
1845	78.2	99.2
1846	83.3	110.9
1847	88.0	106.9
1848	86.5	99.3
1849	86.0	94.0
1850	84.3	88.2
1851	85.1	88.3
1852	87.1	89.0
1853	91.4	98.3
1854	96.7	108.0
1855	100.0	97.5
1856	100.1	106.5
1857	103.1	109.0
1858	106.3	104.0
1859	102.7	100.4
1860	100.0	100.0

TABLE 10.5 Fishlow's railroad price indexes

Source: Correspondence with Albert Fishlow

is implicit in the Fishlow figures. We simply recomputed the 1860 value in Fishlow's series, but this time left out all adjustment for depreciation and retirements. In this way we determined that the depreciated value of equipment in 1858 was 65.3 percent of the new value, and we therefore multiplied the total cost of equipment, including retired equipment, by 0.653 to obtain the approximate depreciated value of equipment in 1860 (see table 10.6, panel B).

We could not follow the same procedure for depreciating improvements, because a useable estimate of depreciation is not implied in Fishlow's improvements index. Fishlow (1966c, 600) depreciated the long-lived railroad improvements (road bed), but assumed that the ratio of depreciated value to new value would remain about the same throughout the period for rails and ties. This assumption is reasonable as far as the index is concerned, but to apply our 1860 values to the index we had to depreciate all assets.<sup>5</sup> Fishlow (1966c, 596) estimated the accumulated depreciation on long-lived improvements at 8.9 percent of the value of *all* improvements in 1858, and 13.8 percent in 1869. An interpolation yields 9.8 for

fable 10.6	Value of	f railroad	assets,	1860,	in	millions	of	doll	ars
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Panel A. Gross book value of railroad assets, 1860

I	Improvements	883.70
2	Equipment	107
3	Improvements and equipment	990.70

Panel B. Depreciated value of railroad equipment (net reproduction cost), 1860

107.00
8.90
115.9
0.653
75.7
73.7

Panel C. Depreciated value of railroad improvements (net reproduction cost), 1860

I	Book value of improvements, December 1860	883.7
2	Less depreciation	199.7
3	Depreciated value of improvements	684
4	Line 3 extrapolated from December to June	666.2

Sources: Panel A. See text.

Panel B. Line 1: panel A, line 2. Line 2: communication from Albert Fishlow. Line 3: line 1 + line 2. Line 4: See text. Line 5: line  $3 \times \text{line 4}$ . Line 6: Line 5: was extrapolated for six months according to the interpolated change in railroad mileage in US Bureau of the Census 1960, series Q-43.

Panel C. Line 1: panel A, line 1. Line 2: The depreciation adjustment of  $0.226 \times \text{line 1}$ ; see text. Line 3; line 1 – line 2. Line 4: Line 3 was extrapolated for six months according to the interpolated change in railroad mileage in US Bureau of the Census 1960, series Q-43.

1860. For all practical purposes, retirements of these assets were nil as of that date. To the cumulated depreciation of long-lived improvements we added the depreciation of rails and ties to obtain an estimate of the total accumulated depreciation of improvements still in use in 1860. (Since this total excludes retired assets, there was no need to add retired improvements to our book value of improvements, as we did with equipment.)

If we assume a ten-year life of rails and ties and interpolate Fishlow's improvements index along the change in railroad mileage, we find the depreciated value of rails and ties in use in 1860 amounting to about 62 percent of their new value.<sup>6</sup> This is probably too high, since rerolled rails were extensively used for replacement purposes (Fishlow 1965, 130). We have not been able to determine how much this affected the total value of all rails, but we lowered our estimate of the ratio of depreciated to

	(1)	(2)	(3)	(4)	(5)	(9)	$(\mathcal{L})$	(8)	(6)	(01)
	Value, at 1909 prices, in millions of dollars	Decade increase	Track mileage	Track mileage	Track mileage	Ratio of mileage increase	Equipment increases to census date	Value, at 1909 prices, in millions of dollars	Equipment index (1860 = 100).	Value, at 1860 prices, in millions of dollars
Dec. 1838	2.9		1,879							
June 1840			2,510		631	0.144	1.2	4.1	0.062	4.57
Dec. 1848	11.4	8.5	6,262		4,383					
June 1850			7,941		1,679	0.0863	4.1	15.5	0.233	17.2
Dec. 1858	59.2	47.8	25,713		19,451					
June 1860			28,170		2,457	0.138	7.2	66.4	1.00	73.7
Dec. 1869	L.111	52.5	43,512	46,844	17,799					
June 1870			49,883		3,039	0.0765	13.3	125	1.883	138.8
Dec. 1879	286.1	174.4	86,556		39,712					
June 1880			89,909		3,353	0.0449	14.4	300.5	4.526	333.6
Dec. 1889	606.8	320.7	160,884	161,276	74,720					
June 1890			163,597		2,713	0.0891	12.7	619.5	9.33	687.6
Dec. 1899	749.6	142.8	191,321		30,437					
June 1900			193,346		2,025	0.0429	39	788.6	11.877	875.3
Dec. 1909	1658.2	908.6	238,564		47,243					
Courses Col	mn r. Eichlow roffio	fof: con taxt Co	amileo io amili	nulce ett sool r	T actimate to	acilace acount	i untro 0,01 otto ti	0 of the state of the root	1 x mullos ni mine 0.	metro 2000 anter
in column 1.	Columns 3 and 4: Thr	ee different mile	age series (miles	t tess une cotun built, miles ope	rrated, miles ov	u years canner ( vned) were piec	ded together. See US	Bureau of the Censu	us 1960, series Q-15, C	ess ure 1030 enury 2-43, Q-47. The
June estimate	es were obtained by ir	iterpolation, dow	vn to 1890; the D	ecember estimation in the intervention in the intervention is the intervence in the intervence is the intervence in the intervence is the intervence is the intervence in the intervence is the	ates were obtai	ned thereafter. (	Column 5: the increa	se in columns 3 or 4	between the index da	te and the census
Column 6: Th	ween two index dates he increase in mileage	from December	1838 to June 18.	ts the increase 1 40 is this portio	n of the increase	n 1030 to 1040, se from Decemb	while the 1646 entry ser 1838 to Decembe	rr 1840. The same pro	ocedure was used for	other vears.
Column 7: Co	olumn 6 × column 2 ei	ntry for the corre	sponding period	1 (i.e., the 1840	entry in colum	a 6 was multiplie	ed by the 1848 entry	in column 2 to yield	the 1840 column 7 fig	ure). Column 8:
To the colum	n 1 index was added t	he interpolated i	increase indicate	d in column 7.	Column 9: Colu	ımn 8 was divide	ed by its own 1860 er	try so that 1860 = 10	00. Column 10: The 18	60 figure is from
table 10.6 in j	oanel B above. For oth	her years, the 18t	50 entry was mul	ltiplied by the c	olumn 9 entry 1	for each respecti	ive year (i.e., for the	1870 estimate, 73.7 >	$\times$ 1.883 = 125.4).	

undepreciated value from 62 to 60 percent, as a rough allowance. This meant lowering the value of rails and ties by 40 percent, or, since rails and ties made up about 32 percent of all improvements, lowering the value of the latter by 40 percent  $\times$  32 percent = 12.8 percent. Adding this to Fishlow's 9.8 percent depreciation of long-lived improvements gives a total depreciation allowance of 22.6 percent.

# 10.4.4. Equipment and Improvements: Constant Value Series

The Fishlow equipment and improvements indexes could now be used to determine the 1860 dollar value of these assets in all other years. As already mentioned, the indexes represent weighted physical counts of assets that have been adjusted for changes in resource content (over time) per unit of asset. The application of 1860 valuations to the Fishlow indexes is shown in table 10.7 for equipment, and in table 10.8 for improvements. (The indexes had first to be interpolated along rail mileage to coincide with census years.) Table 10.9 summarizes the results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Value, at 1909 prices, in millions of dollars	Decade increase	Ratio of mileage increase	Improvements increases to census date	Value, at 1909 prices, in millions of dollars	Improvement index 1860 = 100	Value, at 1860 prices, in millions of dollars
Dec. 1838	1,986						
June 1840			0.144	500	2,486	0.092	61.3
Dec. 1848	5,458	3,472					
June 1850			0.0863	1,676	7,134	0.264	175.9
Dec. 1858	24,877	19,419					
June 1860			0.138	2,159	27,036	1.000	666.2
Dec. 1869	40,533	15,656					
June 1870			0.0765	2,630	43,163	1.597	1063.9
Dec. 1879	74,906	34,373					
June 1880			0.0449	3,190	78,096	2.889	1924.7
Dec. 1889	145,949	71,043					
June 1890			0.0891	2,092	148,041	5.476	3648.1
Dec. 1899	169,429	23,480					
June 1900			0.0429	2,122	171,551	6.345	4227
Dec. 1909	218,897	49,468					

#### TABLE 10.8 Value of railroad improvements, measured in 1860 prices, 1840-1900

Sources: Column 1: Fishlow 1966c, 596; see text. Column 2: See notes to table 10.7, column 2. Column 3: table 10.7, column 6. Columns 4, 5, 6 and 7: derived in the same manner as columns 7, 8, 9 and 10, respectively, in table 10.7. The 1860 figure in column 7 is from table 10.6, panel C.

		1840	1850	1860	1870	1880	1890	1900
Eq	uipment							
Ι	Value, at 1860 prices	4.57	17.2	73.7	138.8	333.6	687.6	875.3
2	Price index	79.3	84.3	100	62	61	49	43
3	Value, at current prices	3.62	14.5	73.7	86.1	203.5	336.9	376.4
Im	provement							
4	Value, at 1860 prices	61.3	175.9	666.2	1,063.9	1,924.7	3,648.1	4,227.0
5	Price index	99.8	88.2	100	151.3	117.1	107.6	109
6	Value, at current prices	61.2	155.1	666.2	1,609.7	2,253.8	3,925.4	4,607.4
La	nd							
7	Value, at current prices	4.3	10.9	46.6	112.7	157.8	274.8	322.5

TABLE 10.9 Value of railroad capital and land, measured in current and 1860 prices, 1840–1900, in millions of dollars

Sources:

Line 1: Table 10.7, column 10.

Lines 2 and 5: 1840–60: Fishlow 1965, 389. 1870–1900: The equipment index is from Brady 1966, 111, adjusted per the notes to table 8.0. The improvements index was constructed following the procedures of Fishlow 1965, 387–90. We used the same wage rate series (weight of 6) as Fishlow (Lebergott 1960, 462). Unfortunately, Lebergott has no wage data for 1890 and 1900; we were obliged to substitute data for 1889 and 1890. For the building materials price index (weight 1) Fishlow used US Senate 1893; we substituted the Warren-Pearson index, which seems to have a slightly better structure and also covers the full period we required, which the Aldrich Report index does not. (See Fishlow's discussion of the Aldrich Report index, p. 390.) For the weights of the Warren-Pearson index, see Warren and Pearson 1922, 128. We constructed a chained rail price index (weight 3) from data in American Iron and Steel Association 1912, 86–89. The link between 1860 and 1870 was established on the basis of domestic iron rail prices (American Iron and Steel Association 1912, 87); the link between 1870 and subsequent years, on the basis of domestic steel rail prices (American Iron and Steel Association 1912, 89). Fishlow used imported rail prices in the antebellum period, since imports composed a large part of the rails used by American railroads. After the Civil War, domestic supply dominated the market.

Line 3: line  $1 \times \text{line } 2 \div 100$ . Line 5: table 10.8, column 7. Line 6: line  $4 \times \text{line } 5 \div 100$ . Line 7: A sample of railroad balance sheets taken from US Census Office 1883b, 60-131, indicates that land values amounted to percent of the value of improvements. Fishlow's (1965, 119) study shows that the percentage was about the same in the prewar period. Line 7 is therefore 7 percent of line 6.

# 10.5. Street Railways

#### 10.5.1. Introduction

The value of street railways (gross book value) is listed in the censuses of 1860, 1890, and 1900 (Ulmer 1960, 159, 163). In addition, some data are available for 1870 and 1880 from US and state sources. Using these sources we developed undepreciated book value estimates, then depreciated and deflated to obtain our current and constant price series.

#### 10.5.2. Undepreciated Book Values

**1880–90.** We used Kuznets's (1946, 201–2, 208–9, 213, 215) gross current price series, the estimates for 1890 and 1900, taken from the census, and the estimate for 1880, extrapolated on miles of track.

**1850–70.** Ulmer computed the total value of street railways for 1870, using the reports of the railroad commissions, but his sample covered only three states. He assumed that these three states contained the same portion of the total US street railways in 1870 as they did in 1890 (Ulmer 1946, 403, 413). We accepted Ulmer's estimate *for these three states*, but followed a different procedure in the construction of a national estimate.

The 1860 census gives the major city passenger railways and lists the cost of "roads, equipment, etc." as \$14,862,840 (US Census Office 1866, 332). We do not know how reliable or complete the 1860 data are, how they were obtained, or even the concept of value involved, although we have assumed that it is gross book value. The implied growth rates of individual state roads after 1860 are plausible, however, and we therefore decided to accept the data in the absence of better evidence. Presumably the data were collected in the same way as other railroad data returned by the census.

The three states for which Ulmer has data (New York, Massachusetts, Pennsylvania) accounted for 93.2 percent of the total value of street railways in 1860, according to the census. Ulmer shows that in 1890 they contributed 48.7 percent of the total. We interpolated between 1860 and 1890, obtaining a value of 78.3 percent for 1870. We then divided Ulmer's data for the three states by 0.783 to get a figure of \$45.57 million as the value of capital in 1870.

No primary data are available on which to base an estimate for 1850, but Willford King (1915, 257) published a figure of \$4 million for that year. How King arrived at this result is unclear, but an exponential

		1850	1860	1870	1880	1890	1900
I	Land	0.5	1.8	5.4	15	41	157
2	Improvements	2.8	10.4	31.9	104	288	1,131
3	Equipment and animals	0.7	2.7	8.3	19	60	288
4	Total durable capital	4	14.9	45.6	138	389	1,576

TABLE 10.10 Gross book value of capital of street railways, 1850-1900, in millions of dollars

Sources:

1850: The total capital estimate is by Willford King (1915, 257). It agrees with the extrapolated growth rate indicated by our later figures. The total was divided among land, equipment, and improvements by the same procedure as that used for 1860.

1880, 1890, 1900: Kuznets's (1946) tables IV.1, line 9; IV.2, line 9; and IV.3, line 8.

<sup>1860:</sup> Total durable capital is from US Census Office 1866, 332. The value of equipment was obtained by using an 1890 ratio of equipment to total durable capital from US Census Office (1895a, 697) data on animal-drawn street railways. The remaining fixed capital was divided between land and improvements in accordance with Ulmer's (1960, 415) estimate that land made up 11.9 percent of total durable capital for animal-drawn roads. 1870: Total durable capital was estimated as described in the text, above. The total was divided among land, improvements, and equipment by the same procedure as that used for 1860.

			(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)
			1840-50	1850–60	1860-70	1870-80	1880–90	1890–1900	Improvements	depreciated
									Cost basis	1860 prices
I	Book value of improvements		2.8	10.4	31.9	104	288	1,131		
0	increase		2.8	7.6	21.5	72	184	843		
б	retirements					2.8	7.6	21.5		
4	Gross capital formation		2.8	7.6	21.5	75	192	865		
2	Depreciated value	1850	2:4						2.4	2.9
9	I I	1860	1.5	6.6					8.1	8.6
~	I	1870	0.6	4.1	18.6				23.3	8.61
8	I	0881		1.5	11.5	65			78	59.2
6	I	0681			4.3	40.1	166		210.3	180.9
10	I	0061				15	102	750	867	794
II	Price index 1	Decade	94	94.4	125.7	134.2	112.4	108.3		
Sou Coli Line	rces: umns 1–6. Line 1: table 10.10, book vi se = 10. The more consided formation f	alue at the er	nd of the decade de	signated. Line 2:	line 1, less line 1	entry for previou	us date. Line 3: A	30-year life span w	as assumed. Line 4:	line 2 + line 3.
of th	re decade. This assumption is approx	imately corr	ect for the growth r	ate indicated. Lit	ne 11: table 10.9,	column 6, means	of terminal-year v	alues, approximat	ing decade average	נוס מו נווט כוונו

Column 8: Columns 1-6 were each divided by the relevant price index (line 11) and then multiplied by 100; the lines were then totaled for each valuation date.

Column 7: for all years, the totals of Cols. 1-6.

TABLE 10.11 Net book values of street railway improvements, measured in current and 1860 prices, 1840–1900, in millions of dollars

			(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)
			1840-50	1850-60	1860-70	1870-80	1880-90	1890-1900	Equipment, d	epreciated
									Cost basis	1860 prices
<sub>1</sub>	Book value of equipment		0.7	2.7	8.3	19	60	288		
7	increase		0.7	2.0	5.6	11	41	228		
б	retirements				0.7	2	6.3	13		
4	Gross capital formation		0.7	2.0	6.3	13	47	241		
5	Depreciated value	1850	0.6						0.6	0.7
9	on evaluation date	1860	0.5	1.6					0.8	2
7		1870		0.6	5.0				5.6	6.8
8		1880			0.1	10			6.11	18.6
6		1890				4	38		42	76
10		1900					14	193	207	445
II	Price index	Decade	81.8	92.2	81	61.5	55	46		
Source index i	s: See notes to table 10.11. Here the strong strong them and of them	te life of equi	pment was assum	annroximating de	years, and the averages	erage age of capi	ital formed during	g each decade was a	ssumed as four year	rs. The price

TABLE 10.12 Net book value of street railway equipment, measured in current and 1860 prices, 1840-1900, in millions of dollars

extrapolation of our later estimates yields a value of slightly less than \$5 million for 1850, so we accepted the King estimate.

The total asset figures for 1850, 1860, and 1870 were divided among land, improvements, and equipment according to 1870 and 1890 ratios. The notes to table 10.10 give further details.

# 10.5.3. Depreciation and Deflation

Depreciation and deflation of the book values are shown in tables 10.11 and 10.12; their derivation is explained in the notes.

#### 10.6. Pullman and Express Cars

The value of equipment in this category is available for 1900 and 1904, but not for earlier years. We adjusted the 1900 figure and extrapolated it according to our general railway equipment category. US Bureau of the Census (1907, 22) gives a value of \$98.8 million for Pullman and private cars in 1900. We assumed that the 1900 value given by the census is similar to the railroad valuation, since "the value of Pullman and Private cars was ascertained in connection with the estimates of the value of railroads" (US Bureau of the Census 1907, 23). In order to obtain an approximation to net reproduction cost, we reduced the stated valuation by the same proportion that our railroad estimate lies below the census returns for railroads (US Bureau of the Census 1907, 36). The adjusted 1900 Pullman and express valuation was then extrapolated along our current value general railroad equipment series. This seems to be appropriate because the ratio of Pullman

		1870	1880	1890	1900
I	Value, at current prices	13.3	31	52	58
2	Price index	62	61	49	43
3	Value, at 1860 prices	21.5	551	106	135

TABLE IO.13	Value of Pullman and	l express cars, net	t reproduction c	ost, measured
in current and	1860 prices, 1870-190	oo, in millions of (	dollars	

Sources: Line 1, 1870–90, extrapolated from 1900 by the change in the current value of railroad equipment, table 10.9, line 4, 1900: The census estimate was \$98.8 million. We reduced this by the ratio of our railroad asset valuation to the census valuation.  $98.8 \times 5307 \div 9036 = 58.0$ . See text and lines 4, 7, and 8 of table 10.9.

Line 2: see line 3 of table 10.9. Line 3: 100 × line 1 ÷ line 2.

		Investme	nt flows		Capita	l stocks	
		1870–79	1880–89	1890–99	1880	1890	1900
I	Net investment in improvements, book value	10	32	99	10	42	141
2	Price index $(1860 = 100)$	126	127	136			
3	Net investment in improvements, 1860 prices	7.9	25	73	7.9	33	106
4	Net investment in equipment, book value	Ι	Ι	7	Ι	2	8
5	Price index (1860 = 100)	90.5	54	30			
6	Net investment in equipment, 1860 prices	I.I	1.9	23.3	1.1	3	25.2
7	Value of land, at current prices				0.5	2	8

TABLE IO.14	Value of capital and land in pipelines, measured in current and 1860 prices,
1880–1900, in	millions of dollars

Sources: Line 1: Kuznets 1946, table IV, 2, line 17. We assumed that no improvements had been retired before 1900. Line 2: Table 10.3, line 1. Each index number represents an average price level for the indicated decade. Line 3: In columns 1–3, 100 × line 1 ÷ line 2. In columns 4–6, these are stock estimates, derived by cumulating the flows in columns 1–3. Line 4: Kuznets 1946, table IV, 3, line 16. We assumed that the equipment acquired in the period 1870 through 1879 was retired in the period 1890 through 1899. Line 5: Table 8.9, line 2, the means of the indexes for 1870 and 1880, 1880 and 1890, 1890 and 1900, respectively. These means were taken to represent the average price levels during the decades of the 1870s, 1880s, and 1890s respectively. Line 6: In columns 1–3, 100 × line 4 ÷ line 5. In columns 4–6, these are stock estimates, derived by cumulating the flows in columns 1–3. We assumed that the equipment acquired in the period 1870 through 1879 was retired in the period 1890. Line 7: Kuznets 1946, table IV, 1, line 17.

and private car values to railroad asset values (census figures) remained constant from 1900 to 1904. Table 10.13 presents the summary estimates.

# 10.7. Pipelines

We adopted Kuznets's (1946) current price estimates (tables IV-1 and IV-2), which are in book values, presumably net, and deflated them, using price indexes assembled for the deflation of manufacturing and canal aggregates (described above). See the notes to table 10.14 for details.

# 10.8. Conclusion

This chapter details the estimation of the capital stock in the transportation sector (exclusive of the value of roads).