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Railroads and Property Taxes*

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Nineteenth century state and local governments continued to invest in railroads and other internal improvement projects long after it was clear that these projects were financially very risky. This paper provides a motivation for public involvement in internal improvements by estimating the effect of railroad construction on property values from 1850 to 1910. Using Census data on true and assessed valuations, we find that the increase in property values associated with railroad construction, would, at typical levels of taxation, pay for a substantial share, if not all, of the construction costs solely on the basis of property tax revenues. The effect of construction on property values declined with mileage up to several thousand miles, which may explain why state governments typically were involved in construction of the initial systems. The effect, however, was nonlinear and increased at higher mileages, consistent with the persistent participation of county and municipal governments.

Economic historians have long been interested in the government's role in determining when, where, and how railroads were built. Public involvement was an integral part of most early railroads and continued to be important up to the end of the nineteenth century. Public participation varied from state or local construction and operation of railroads, ownership of stock in private corporations, guarantee of private bonds, swaps of government bonds for private bonds, to straightforward subsidies. Governments sometimes actively promoted projects, others were more passive participants, and still others were blackmailed or bribed

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into supporting projects that would otherwise go to other communities, counties, or states.

A great deal of attention has focused on the issue of building ahead of demand. Whether roads were built ahead of demand was the central question for scholars interested in determining if government involvement was a necessary ingredient in infrastructure investment and economic growth. Schumpeter stressed that many projects ''meant building ahead of demand in the boldest acceptance of that phrase . . .'' (Schumpeter, 1939, p. 328). Goodrich emphasized ''The purpose of public promotion was developmental . . .'' (1960, p. 279).[1] The work of Fishlow, Fogel, Mercer, and Fleisig naturally focused on the returns to private investors, since one of their counterfactual questions was: would the railroad have been built without public involvement? But what does this approach assume about the motivation of the government itself?

There were many possible incentives for government involvement: civic and state pride, external returns to land owners, the creation of a more vital economy, attracting new settlers, and municipal survival, or at least the survival of key mercantile groups. Were these enticements reason enough for taxpayers to invest substantial sums of money given the long record of public improvement failures in early nineteenth century America? Carter Goodrich viewed the continued willingness of state and local governments to loan their good faith and credit to railroads and other internal improvement projects long after it had become clear that these projects often failed as something of a mystery. ''Why, in the face of financial losses, and in the nation and century in which the primacy of the laissez-faire philosophy was most nearly unchallenged, was government action so long continued in the important economic field of internal improvements? The financial disappointments were well known.'' (1950, p. 165)

Although each railroad is unique, economic historians have generally found that while government and railroad promoters may have articulated the logic of building ahead of demand, railroads were usually not premature. Fishlow concludes ''that the preponderance of evidence denies such a phenomenon [building ahead of demand] before the Civil War.'' (1965, p. 204). Indeed, Fishlow claimed that settlement in the old northwest usually preceded railroad construction, because settlement was based on the anticipated rise in property values that would result from a railroad being built: ''The appreciation of land is central to all of this'' (p. 198). Fogel found that ''The Union Pacific was premature by mistake! . . . In actual fact the road was a highly profitable venture that should have been taken up by unaided private enterprise.'' (1960, p. 97). Mercer (1974, 1982) finds that most of the western railroads were profitable enough, ex post, to justify construction on the basis of private returns alone.[2]

[1] Goodrich published many articles on this theme, the most directly related was ''American Development Policy: The Case of Internal Improvements'' (1956).

[2] Mercer studies the western land grant railroads and finds several that were clearly built ahead of demand.

Fleisig (1975) finds that building and operating the Central Pacific provided enormous returns to investors.

This raises important issues about the motivation of the governments who supported railroads. If railroads typically were not built ahead of demand, so that private returns would have been sufficient to compensate private entrepreneurs for building the roads, and state and local governments, nonetheless, continued to assist in the construction of roads long after the ''financial disappointments were well known,'' then was assistance to railroads simply the result of graft and corruption? Goodrich answered that some projects were simply successful raids on the public treasury, but others were pursued for reasons other than financial returns (like local political issues), and still others may have produced indirect returns such as the increase in land values and property tax revenues associated with railroad construction (1950, p. 165).

It was clear that contemporaries thought that the benefits of railroads were large, large enough that ''. . . we can stand a pretty good 'steal' if we can get railroads in the state.''[3] In this paper we test the hypothesis that the financial returns to state and local governments from building railroads were large enough that they were willing to take the obvious risk of financial embarrassment (the ''steal'') if only they could obtain a railroad. We do not put forward or test any theory of the political economy of railroad investment. We test a simple and direct version of Goodrich's third hypothesis. Since both state and local governments relied heavily upon the property tax in the late nineteenth century, could building a railroad have raised the value of property in a state by a large enough amount that increased property tax collections could pay for the railroad?

I

Our focus is not on the economy or the railroad industry, but on state and local governments. We are particularly concerned with what state and local governments thought would happen if a railroad was built. The perspective is important since, in relation to the economy as a whole, state and local government revenues and expenditures were small, perhaps 5% of national income.[4] The public share of railroad investment was also relatively small and declined over time. Goodrich, referring to the work of Cranmer, Segal, and Heath, estimates that public investment accounts for roughly 70% of canal investment and between 25 and 30% of railroad investment before the Civil War, perhaps 15% of all railroad investment from 1861 to 1873, and a negligible portion thereafter (1960, pp. 270–71).

When Fishlow concluded that midwestern railroads were not built ahead of demand, the lack of government participation was one of three pieces of evidence

[3] A Goodrich epigram taken from the Fayette *Chronicle* of 1871 (1960, p. 205).

[4] Exactly how small is a matter of some conjecture, but certainly it was no larger than 8% of GNP, which was the size of the state and local sector in 1902.

on which he based his argument. He suggested that, after the disasters of the 1830s, state governments withdrew from railroad projects, and that

> Assistance was predominantly local, and relative to expenditures was not a major factor. The experience is in sharp contrast to the earlier episode of state aid in the 1830's. More governmental funds were spent to build the thousand-odd miles of western canals and two hundred miles of railroad in the 1830's and 1840's than was expended for nine thousand miles of railroad between 1850 and 1860.'' (1965, p. 195)

Was government involvement in railroad construction, particularly after 1840, too small to worry about?

Fishlow's statement is only accurate if we limit our focus to the Midwest. Indiana, Illinois, and Michigan plunged into programs of internal improvements in the 1830s and ended up financially prostrate. All three states defaulted on their bonded debt for a period in the 1840s, and Michigan ultimately repudiated part of its debt. Ohio narrowly averted default in the same period.[5] The results were constitutional restrictions on state debt in Wisconsin in 1848, Michigan in 1850, Indiana and Ohio in 1851, and Iowa in 1857, and stronger procedural safeguards on debt issues in Illinois in 1848 (Goodrich, 1950, p. 156).

Fishlow's conclusions do not extend to the rest of the country. Had he looked west he would have found Missouri granting over $21,000,000 in state bonds to six railroads between 1851 and 1857 (Million, 1895). Minnesota provided loans to four railroads totaling $5,000,000 in 1858. All but one of these 10 railroads defaulted. Missouri and Minnesota were not exceptions. Cleveland and Powell (1909, pp. 212–229) document capital stock subscriptions, loans, subsidies, and land grants to railroads after 1845 in Virginia, Georgia, Louisiana, North Carolina, South Carolina, Alabama, Mississippi, Arkansas, Massachusetts, Tennessee, Texas, Maine, Oregon, and California. Heath (1950, p. 41) shows the extent of public railroad investment in the South up to 1861, and places the total at $144 million. There was little public investment in railroads in the South before the 1840s. Southern investment in railroads continued at a rapid pace after the Civil War (Goodrich, 1956a). State support for railroads did not stop in the 1840s. Indeed, the point of Goodrich's article ''The Revulsion Against Internal Improvements'' is that many states embraced internal improvement programs after 1840 at the same time that other states were abandoning the field.

From the perspective of the states, the railroad projects of the 1850s, 1860s, and even 1870s were not small. Missouri issued $20,000,000 in bonds in the late 1850s when the state's annual budget ranged from $800,000 to $1,000,000. Florida issued $4,000,000 in bonds to the Jackson, Pensacola, and Mobile Railroad in 1869, a year when expenditures were $512,000. Florida issued another $3,597,000 in bonds to railroads after 1875, when expenditures were $368,000. Arkansas issued $5,350,000 in bonds to six railroads in 1868 when

[5] For Illinois see Pease (1918), Krenkel (1958), and Ford (1854/1947). For Ohio see Morris (1889). For a general description of state defaults see Ratchford (1941) and McGrane (1935).

annual revenues were roughly $900,000. Tennessee issued over $15,000,000 in bonds to railroads between 1852 and the beginning of the Civil War. In the late 1850s Tennessee's annual revenues ranged between $600,000 and $1,100,000.[6]

Local governments appear to have been just as active. Fishlow credits local governments with most of the promotional activity after the 1840s. But numbers on local government involvement are more difficult to obtain. Cleveland and Powell (1909, pp. 204–211) report over $120 million in local aid in a number of states up to 1890. Heath shows $37 million in municipal aid and $18 million in county aid in the South before 1861 (some of this is included in Cleveland and Powell's numbers). And while Goodrich does not provide a dollar estimate in his 1951 article, he documents over 2,200 special laws authorizing local governments to support, in any number of ways, railroad construction from 1830 to 1889. The bulk of the activity came between 1866 and 1873.

Both state and local governments committed large amounts of cash and credit to attract railroads into their communities well into the 1870s. Why did the politicians continue to invest in these projects, despite the obvious financial risks? Early projects were supposed to return a direct profit in tolls and dividends, like the Erie canal had. As ex-Governor Willie Blount of Tennessee articulated at the Constitutional Convention in 1834: ''a system of railroads, . . . afford[s] to the state, whenever disposed to take an interest in these improvements, a clear revenue sufficient to fill her treasury and support her civil list, as well as to provide extensively for the education of her youth; and all these without taxes on her people.'' (Folmsbee, 1939, p. 110, quoting from the Journal of the Tennessee Convention of 1834, pp. 152–54.) Tennessee went on to invest almost $15,000,000 in railroads before the Civil war, and another $15,000,000 after the war (Phelan, 1888, pp. 276–295).

Promoters and politicians soon began to couch their appeals for railroad assistance in terms of the ''indirect'' benefits that would flow to state treasuries from the construction of the railroads. There is some confusion in terminology, for what Goodrich (1950, p. 166) calls the indirect benefits of the railroad are what Fogel (1965, pp. 52–58) calls the direct benefits of the railroad.[7] In both cases they refer to the capitalized value of increases in land values consequent to the construction and operation of the railroads. The expectation that this ''property value'' effect would be large was captured by former Governor Thomas Ford in his history of Illinois (p. 290): ''it was believed . . . that the system would cause a great deal of land to be entered, and increase the land tax, a part of which would go to form a fund to pay interest.''

The Report of the Auditor of Public Accounts in Missouri for 1854, discussing

[6] Bond issues are taken from Cleveland and Powell, 1909, pp. 212–239. Government budgets are taken from Auditor and Treasurers Reports, and are available through ICPSR, Sylla, Legler, and Wallis ''Sources and Uses of Funds.''

[7] It would be more appropriate to say that Fogel measures the value of land brought into production by the railroad ''directly'' as part of the Social Savings, and then also estimates several other elements of ''indirect costs'' in the Social Savings total, 1965, chapter III, pp. 49–110.

in great detail the railway investments then underway, states ''In concluding this report, the Auditor of Public Accounts renews to the General Assembly his congratulations upon the happy and prosperous condition of the people, upon the unshakable confidence in our public credit, and upon the gratifying prospect of an overflowing Treasury.'' In the report the Auditor cites estimates from Major Walker, engineer of the North Missouri railroad, that completion of the railroad will increase property values in a strip of land 20 miles on either side of the road, by at least $100 million and he ''cannot avoid the conclusion that ultimately the advance in the value of property occasioned by the road, will be at least six times this enormous sum.''

Politicians emphasized the importance of fiscal considerations, but understandably placed a greater emphasis on the increase in property values that would flow directly to voters as the result of building the railroad. On balance, the ''general'' property effects were most prominent in the public debate.

> On what grounds, then, was economic justification found for these expenditures? In many cases, a part of the answer was the promise of indirect fiscal advantages. Since completion of the improvement would increase the value of property within the state or locality, the added revenue from this higher tax base would outweigh any loss on the immediate investment. The more important economic argument for public expenditures ran in terms of the general benefits to the community at large that could not be fully collected either by the enterprise itself in transportation charges or by the government in tax revenues. (Goodrich, 1960, p. 277).

State and local governments were acutely aware of the potential benefits of railroad construction.[8] Were these anticipated financial gains substantial enough to cover the state government's financial commitment to building a railroad?

II

The economic theory underlying our empirical approach is well developed. The value of agricultural land is a function of its inherent fertility, the population density, and the transportation costs required to move products to market. Urban land values are a function of density. Fogel (1965, pp. 66–73) develops a formal approach to land value in Chapter III of ''Railroads and American Economic Growth.'' We are interested in how railroad construction affects property values by opening up new land to settlement and reducing the transportation costs to market. We want to control for population size, population density, and degree of urbanization.

[8] While politicians could hope for fiscal returns on railroad construction, they had to be careful about confusing rising tax collections and rising tax rates. In 1840, two years before New York would raise tax rates to avoid default, Governor Seward declared that ''taxation for purposes of internal improvement deservedly finds no advocate among the people.'' Voters in many states were opposed to higher tax *rates* to finance internal improvements. Goodrich, 1950, p. 153.

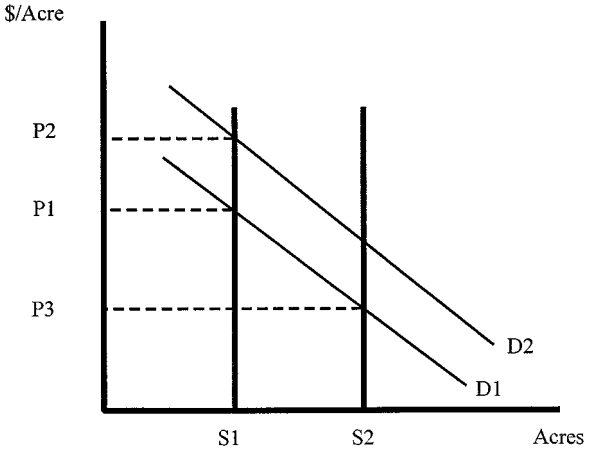

FIGURE 1

The market for land in a state is represented graphically in Fig. 1. The demand for land measures the benefits of owning land, controlling for population size, degree of urbanization, access to transportation services, quality of land, and the like. If we assume that the total land area is fixed at S1 and the existing demand for land is D1, the equilibrium price per acre is P1, and total value of land in the state is S1*P1. If a railroad is constructed, reducing transportation costs and increasing the benefits of owning land in the state, demand shifts to D2, the equilibrium price increases to P2, and total value of land rises to S1*P2. The benefits of the railroad are then S1*(P2-P1).

Although the amount of land in a state is fixed geographically, the amount of land in the the tax base may be a function of the current market price. For example, unsold or unclaimed public lands may be purchased as the market price of land rises. Suppose the effect of the railroad is not only to increase the demand for land, but also to draw more land into the market as the price rises. If the supply of land was not perfectly inelastic, as in Fig. 1, the shift in the demand for land caused by the railroads would result in two changes: a rise in the price and an increase in the quantity of land. Both effects would increase the total value of land, however. We do not attempt to distinguish whether the rise in total land values is due to increases in the value of an individual acre of land or an increase in the number of acres assessed. Clearly both forces were at work in the late nineteenth century.

III

State governments were interested in the total value of the property of the state and its relationship to the provision of rail services. A baseline model of that

relationship is

$$\text{Real Value} = \alpha + \beta_1 \text{RR Miles} + \beta_2 \text{Population} + \beta_3 \text{Urban Population} + \beta_4 \text{Population Density} + \beta_s \text{State Dummies} + \beta_t \text{Time Dummies} + \beta_{50} \text{South 1850} + \beta_{60} \text{South 1860} + \epsilon. \quad (1)$$

Real value is total land value, converted to constant 1913 dollars.[9] RR miles is the miles of railroad track in the state, population density is population per square mile, population and urban population are in persons, and ϵ is a random error term.

Railroad mileage is taken from Poor's Manual of Railroads (1868–1909) at decade intervals from 1850 to 1910.[10] Population, both total and urban, and population density are taken from *Historical Statistics.* The data on property values are taken from the 1902 and 1913 Census volumes *Wealth, Debt, and Taxation.*[11] The property values are reported as ''Estimated true value of all property'' and ''Assessed valuation of all property subject to ad valorem taxation.''[12] The census began with data on assessed valuations reported by the state and local governments. An estimate of the ratio of ''true'' property value to assessed value was obtained for each state individually, and the ratio was used to inflate the assessed values into true values.[13] The valuation measures are closely related to each other by construction. But the assessment ratios, i.e., the ratio of assessed to ''true'' value, range from 0.10 to 1.000. The two measures of value produce somewhat different results in the econometric estimates.

Of course, the original assessments made by the cities, counties, and states are themselves a source of concern. In most states, assessments were a joint

[9] All nominal values were converted to 1913 values using the Federal Reserve Board CPI indices from Historical Statistics, series E-183.

[10] The annual fluctuations in the Poor numbers that are so important for constructing capital stock numbers are not critical for us. See Wicker (1960) and Taylor (1960) for a discussion of the Poor data. The major problems with the data seem to be the year in which mileage comes on line. Different sources treat construction and completion differently. For our purposes these distinctions are not important.

[11] Although we refer to property values in the census years, census data often came from adjacent years. For example, values were collected in 1912 and 1902, which we use for 1910 and 1900. There are other minor discrepancies. Assessed values refer to 1902 and true values refer to 1900, for example. The data for early years reported in the 1902 and 1913 volumes, is the same as reported in the 1860, 1870, 1880, and 1890 census reports.

[12] The true value is taken from page 23 and the assessed valuation from page 747 of the 1913 volume. This was supplemented for 1850 with data from the 1902 *Wealth, Debt, and Taxation* volume.

[13] The ratio of assessed to true value in each state in 1912 is reported on page 16 of the volume; the discussion on pp. 15–23 of the volume gives more details. The true values were also converted into taxable values by the census. Taxable values are true values minus the value of tax exempt property. In 1912, tax exempt property was taken to be 12.5% of the value of all property, except for New York, New Jersey, and Ohio. In 1850, 1860, and 1870 the ratio of true to assessed values was estimated by the census officers gathering the data at the local level. After 1880, a more systematic attempt was made to estimate the true value. The procedure is explained in the 1880 *Report on Valuation, Taxation, and Public Indebtedness,* pp. 9–13.

responsibility of the three levels of government, but methods of equalization and adjudication varied widely from state to state.[14] In some states there was an incentive for local governments to under assess their property to avoid state taxes, and then make up local revenue by charging higher millages. Since ratios of assessed to true value are based on self-reported assessment ratios, the true numbers may be as tainted by political and strategic misrepresentation as the simple assessment. On the other hand, governments levied taxes on these values. For our purposes they may be closer to what governments expected to gain in their property tax base when railroads were built than a more objective measure of value would produce. After all, these are the property values actually measured by state and local governments, and increases in those values reflect true increases in the tax base.

There are property valuations for 1850, 1860, 1870, 1880, 1890, 1900, and 1912. The panel is an unbalanced sample of 297 observations, since many states entered the Union after 1850.[15] We use dummy variables to control for time and state specific effects. This allows us to control for the upward trend in property values, as well as differences in state assessment practices.[16] In every case the time and state effects are significant, but the coefficients are not reported in the tables. There also dummy variables for southern states in 1850 and 1860. Because of wartime destruction and emancipation, southern property values were much higher before the war than after, for reasons that have nothing to do with railroad construction or population density.

Tables 1 and 2 present basic information about the data set. Table 1 includes means and standard deviations for the entire sample, as well as for each of four regions. Table 2 contains a breakdown of railroad miles, population, and urban population for each of the seven decades.

IV

Coefficient estimates of Eq. (1) are given in the first column of Table 3. Additional specifications are presented in Tables 3 and 4, and are discussed below. In order to facilitate comparisons between regression specifications, the coefficients are converted into predicted changes in property value per mile of railroad construction in Table 5.[17] The increase in property value is converted into an

[14] There is an excellent discussion of the revenue systems and assessment methods of the various states in the 1902 *Wealth, Debt, and Taxation.*

[15] We have included several territories in the sample, but only if the borders of the territory were the same as the borders of the state. This affected Nebraska, New Mexico, Oregon, Utah, and Washington in 1850 and 1860 and Oklahoma in 1890 and 1900.

[16] This is not a perfect control for assessment practices, since assessment policies varied over time within states.

[17] With the exception of the increase in property value for the first mile of railroads built, the figures refer to the average change in property value for the preceding 50 miles. So the figure for 50 miles refers to the average increase in property value for building the 2nd through 50th mile of track, the figure for 1000 miles refers to the average increase in property value per mile for the 950th to 1000th mile of track.

TABLE 1
Regional Descriptive Statistics

	Mean	Standard deviation	Minimum	Maximum
Nation				
Railroad miles	2641	2795	0	14630
Total population	1248488	1327636	9000	9114000
Urban population	426407	818268	0	7188000
Percentage urban	0.25	0.20	0.00	0.91
Population density	47.6	70.0	0.1	508.5
True property value	1722	2810	4	26053
Assessed property value	727	1179	2	11596
Northeast				
Railroad miles	1873	2437	39	11537
Total population	1488590	1904253	92000	9114000
Urban population	791373	1293626	6000	7188000
Percentage urban	0.42	0.23	0.02	0.91
Population density	115	101	18	509
True property value	2415	4174	39	26053
Assessed property value	1177	1831	29	11596
Midwest				
Railroad miles	4214	3230	0	12111
Total population	1692756	1121113	107000	5639000
Urban population	500337	629275	10000	3480000
Percentage urban	0.22	0.13	0.02	0.62
Population density	34	25	1	117
True property value	2360	2558	44	16130
Assessed property value	852	941	37	6751
West				
Railroad miles	1647	1665	0	7373
Total population	298345	418025	9000	2378000
Urban population	120552	242630	1000	1468000
Percentage urban	0.24	0.16	0.00	0.62
Population density	2.7	3.4	0.1	17.1
True property value	759	1380	4	8817
Assessed property value	249	497	2	3043
South				
Railroad miles	2440	2577	0	14630
Total population	1205243	695122	87000	3897000
Urban population	156257	165581	1000	938000
Percentage urban	0.11	0.08	0.00	0.30
Population density	22.9	13.1	0.8	51.2
True property value	913	1000	42	7146
Assessed property value	434	385	36	2638

estimate of the increase in property tax revenues per mile of construction in Table 6, assuming a 40% assessment ratio and a property tax of 4 mills. The columns in Tables 3 and 4 carry through the rows of Tables 5 and 6.

As the tables show, real property values increased with rail construction. Property values in a state increase by $205,352 with each mile of railroad

TABLE 2
Annual Means for Nation

	Year	Mean	Standard deviation	Minimum	Maximum
Railroad miles	1850	288	357	0	1361
Total population		733774	670370	87000	3097000
Urban population		112226	191116	0	873000
Urban fraction		0.13	0.14	0.00	0.55
Population density		32.4	33.7	0.6	138.3
True property value		425	430	39	2001
Assessed property value		358	324	29	1325
Railroad miles	1860	890	841	0	2946
Total population		905000	810396	52000	3881000
Urban population		179735	306181	3000	1524000
Urban fraction		0.17	0.15	0.01	0.63
Population density		37.1	40.2	0.5	163.7
True property value		775	664	47	3022
Assessed property value		579	487	31	2279
Railroad miles	1870	1176	1202	0	4823
Total population		853622	935673	9000	4383000
Urban population		217356	400004	0	2189000
Urban fraction		0.19	0.16	0.00	0.75
Population density		34.0	46.0	0.1	203.7
True property value		731	1280	4	7144
Assessed property value		344	467	2	2162
Railroad miles	1880	2040	1877	106	7851
Total population		1107667	1103563	21000	5083000
Urban population		310133	536485	0	2869000
Urban fraction		0.23	0.19	0.00	0.82
Population density		42.2	56.3	0.2	259.2
True property value		1203	1611	36	7885
Assessed property value		473	664	8	3315
Railroad miles	1890	3520	2726	217	10116
Total population		1328872	1295114	47000	6003000
Urban population		464915	738698	0	3910000
Urban fraction		0.29	0.20	0.00	0.85
Population density		49.1	68.7	0.4	323.8
True property value		1759	2134	218	10996
Assessed property value		691	931	33	4854
Railroad miles	1900	4081	2966	209	11048
Total population		1594213	1556777	42000	7269000
Urban population		634362	1007108	7000	5298000
Urban fraction		0.32	0.21	0.06	0.88
Population density		59.2	85.4	0.4	401.6
True property value		2308	3024	238	15632
Assessed property value		932	1373	37	7462
Railroad miles	1910	5064	3312	212	14630
Total population		1909188	1838278	82000	9114000
Urban population		867708	1331981	13000	7188000
Urban fraction		0.37	0.21	0.11	0.91
Population density		70.2	105.9	0.7	508.5
True property value		4034	4813	321	26053
Assessed property value		1499	2063	75	11596

TABLE 3
Regression Estimates of Property Value (*t*-statistics)

	Total true property value (1)	Per capita true property value (2)	Total assessed property value (3)	Log total true property value (4)	Total true property value (5)
Intercept	404565884	3067.4573	221790200	17.165198	329172813
	(1.66)*	(13.06)**	(1.28)	(66.16)**	(1.05)
RR miles	205352	0.082443	14018	—	—
	(4.26)**	(2.55)**	(0.41)		
Log RR miles	—	—	—	0.302608	48706072
				(13.54)**	(1.80)*
Population	34.379964	−0.000133	−62.04	0.0000003	877.10610
	(0.13)	(−1.40)	(0.3)	(2.42)*	(5.53)**
Population density	−5036643	−2.216467	−650797	−0.00053	−6815190
	(−3.73)**	(−1.82)*	(0.6)	(−0.4)	(−5.22)**
Urban	3352.8965	1456.5401	1460.03	−0.000000	2835.5281
	(15.00)**	(2.68)**	(9.2)**	(−1.69)*	(15.41)**
South50	212694187	730.45874	124926652	1.178898	369682551
	(0.97)	(3.57)**	(0.8)	(6.4)**	(1.66)*
South60	525277675	914.95385	305331528	1.105232	651146187
	(2.47)**	(4.80)**	(2.0)**	(6.15)**	(3.00)**
R^2	0.98	0.82	0.93	0.93	0.97

* Significant at 10%.
** Significant at 1%.

constructed (Table 5). Since Eq. (1) is linear, the effect on property values is constant with additional construction. Property tax revenues increase by $329 per mile (Table 6).

The baseline estimate is a starting point for the consideration of three specification issues: measurement of the dependent variable, nonlinearities in the relationship between railroad construction and property values, and differential regional effects. Each modification will be discussed in turn. There is statistical support for modeling the relationship as nonlinear with regional interactions. The most basic result is that an increase railroad mileages increase property values is robust with respect to all the changes in specification.

The first issue is measurement of the dependent variable. The second and third columns of Table 3 replace total true land values with per capita true land values and total assessed values. In each case the coefficient on railroad miles is positive, but insignificant in the assessed value regression. When the dependent variable is per capita values, urban is measured as the percentage urban rather than the level of urban population.[18] The second and third rows of Tables 5 and 6 translate the coefficients into the change in land values and property tax revenues per mile. The

[18] The estimates are sensitive to the choice of the urban measure. We also used railroads and population per square mile of land area, which produced similar results.

TABLE 4
Regression Estimates of Property Value, Nonlinear and Regional Specifications (*T*-statistics)

	Nonlinear w/o regions (1)	Linear w/regions (2)	Nonlinear w/regions (3)
Intercept	434480450	300335403	320926437
	(1.62)*	(1.19)	(1.08)
RR miles	230816	81725	162453
	(2.03)*	(1.02)	(0.62)
RR Squared	−16.98169	—	−0.002763
	(−1.01)		(0.0)
RR Cubed	0.001514	—	0.0000819
	(1.76)*		(0.02)
West* RR miles	—	177071	289799
		(2.42)*	(0.9)
West* RR squared	—	—	−165.3152
			(−1.65)*
West* RR cubed	—	—	0.022499
			(2.38)**
Midwest* RR miles	—	96056	181974
		(1.72)*	(0.70)
Midwest* RR squared	—	—	−64.18946
			(−1.12)
Midwest* RR cubed	—	—	0.005214
			(1.5)
South* RR miles	—	71894	61711
		(1.04)	(0.22)
South* RR squared	—	—	−34.19222
			(−0.59)
South* RR cubed	—	—	0.002254
			(0.68)
Population	−83.59776	212.88736	190.71331
	(−0.31)	(0.75)	(0.59)
Population density	−5242997	−4938568	−4495293
	(−3.90)**	(−3.61)**	(−3.36)**
Urban	3416.8085	3321.6307	3092.6038
	(14.42)**	(13.14)**	(10.64)**
South50	247855435	167651010	128181279
	(1.14)	(0.3)	(0.4)
South60	544992203	483502557	448167143
	(2.6)**	(2.1)*	(1.9)*
R^2	0.98	0.98	0.98
F-Statistic	4.9**	0.68	3.1**
			2.9**

Note. *F*-statistic for comparison of residuals in unrestricted and restricted specifications.

Column (1): Restricted is Table 3, column (1).

Column (2): Restricted is Table 3, column (1).

Column (3): First test: Restricted is Table 3, column (1), second test: Restricted is Table 4, column (1).

* Significant at 10%.

** Significant at 1%.

TABLE 5
Effect of One Mile of Railroad Construction on Property Values (Constant 1913 Dollars)

	Miles of RR	1	50	100	500	1000	3000	5000	7500	10000
	Level estimates									
(1)	Total true value	205,352	205,352	205,352	205,352	205,352	205,352	205,352	205,352	205,352
(2)	Per capita true value	102,929	102,929	102,929	102,929	102,929	102,929	102,929	102,929	102,929
(3)	Total assessed value	35,045	35,045	35,045	35,045	35,045	35,045	35,045	35,045	35,045
(4)	Log/Log	17,306,612	1,188,821	427,883	115,486	69,911	32,108	22,433	16,887	13,810
(5)	Level/Log	16,880,213	3,266,220	675,209	102,634	49,966	16,372	9,790	6,516	4,883
	Nonlinear estimates									
(6)	Total true value	230,799	229,954	228,295	215,711	202,024	169,985	174,283	230,753	343,998
(7)	Per capita true value	264,580	257,764	259,961	236,020	208,135	119,280	66,718	52,054	94,100
(8)	Total asessed value	235,233	234,033	231,664	212,879	190,310	110,157	46,205	(10,955)	(42,801)
	Linear regional estimates									
(9)	East	81,725	81,725	81,725	81,725	81,725	81,725	81,725	81,725	81,725
(9)	West	258,796	258,796	258,796	258,796	258,796	258,796	258,796	258,796	258,796
(9)	Midwest	177,781	177,781	177,781	177,781	177,781	177,781	177,781	177,781	177,781
(9)	South	153,619	153,619	153,619	153,619	153,619	153,619	153,619	153,619	153,619
	Nonlinear regional estimates									
(10)	East	162,453	162,453	162,454	162,506	162,681	164,613	168,512	176,152	186,866
(10)	West	452,087	443,878	427,850	310,499	194,295	68,193	484,034	1,765,943	3,894,639
(10)	Midwest	344,363	341,167	334,891	287,033	234,360	103,107	98,958	272,511	644,662
(10)	South	224,130	222,426	219,076	193,261	164,147	82,730	57,376	104,522	239,267

Sources. (1) Table 3, column 1; (2) Table 3, column 2; (3) Table 3, column 3; (4) Table 3, column 4; (5) Table 3, column 5; (6) Table 4, column 1; (7) not reported; (8) not reported; (9) Table 4, column 2; (10) Table 4, column 3.

effect on land values and property tax revenues is lower for per capita true value than for total true value and markedly lower for assessed value. This is largely the result of the precision of the estimates. The assessed values series contains an element of measurement error that the true value series does not (the assessment ratios), and the true value coefficients are always more precisely estimated than the assessed value coefficients. Both the assessed value and per capita true value series are more sensitive to specification changes that the total true value series. In what follows we focus on the total true value results, but present the assessed value and per capita true value results for comparison.

The next issue is linearity. There is little reason to believe that the relationship between land values and railroad mileage in a state should be linear. One might expect that initial construction on a rail system has a much larger impact on property values than later construction when the system is filling in. One option is a log specification. Column (4) of Table 3 presents the results of a log–log specification and column (5) the results of a level–log specification, with property values in levels and railroad miles in logs. Both the log–log and level–log produce estimates of effects that are substantially higher than the linear estimates for the first 100 miles, but then the effects become smaller (rows 4 and 5 of Tables 5 and 6). The log results suggest that the effect of railroads on property values diminish sharply with size. This may be due, however, to the restrictive specification imposed by logs.

TABLE 6
Effect of One Mile of Railroad Construction on Property Tax Receipts (Constant 1913 Dollars)

	Miles of RR	1	50	100	500	1,000	3,000	5,000	7,500	10,000
	Level estimates									
(1)	Total true value	329	329	329	329	329	329	329	329	329
(2)	Per capita true value	165	165	165	165	165	165	165	165	165
(3)	Total assessed value	56	56	56	56	56	56	56	56	56
(4)	Log/Log	27691	1902	685	185	112	51	36	27	22
(5)	Level/Log	27008	5226	1080	164	80	26	16	10	8
	Nonlinear estimates									
(6)	Total true value	369	368	365	345	323	272	279	369	550
(7)	Per capita true value	423	412	416	378	333	191	107	83	151
(8)	Total assessed value	376	374	371	341	304	176	74	−18	−68
	Linear regional estimates									
(9)	East	131	131	131	131	131	131	131	131	131
(9)	West	414	414	414	414	414	414	414	414	414
(9)	Midwest	284	284	284	284	284	284	284	284	284
(9)	South	246	246	246	246	246	246	246	246	246
	Nonlinear regional estimates									
(10)	East	260	260	260	260	260	263	270	282	299
(10)	West	723	710	685	497	311	109	774	2826	6231
(10)	Midwest	551	546	536	459	375	165	158	436	1031
(10)	South	359	356	351	309	263	132	92	167	383

Sources. (1) Table 3, column 1; (2) Table 3, column 2; (3) Table 3, column 3; (4) Table 3, column 4; (5) Table 3, column 5; (6) Table 4, column 1; (7) not reported; (8) not reported; (9) Table 4, column 2; (10) Table 4, column 3.

A more general nonlinear specification is a cubic in railroad miles. Such a specification is provided in column (1) of Table 4. The results show a U-shaped relationship between property value and railroad mileage. As Tables 5 and 6 show, the marginal effects of railroad construction are to raise property values and property tax revenues by about $230,000 and $360, respectively, for the first 100 miles. The marginal effect reaches a minimum around 3000 miles of track, at $169,000 and $272, and rises thereafter. Tables 5 and 6 also report the nonlinear results using per capita values (row 7) and assessed values (row 8). Both the nonlinear per capita and assessed value estimates are quite different from the linear estimates and are imprecisely estimated. The assessed value estimated predict that railroad construction after 5000 miles actually reduces property values. For these reasons we pay closer attention to the true value results.

The third issue is regional differences. Railroad construction should have had a smaller impact on property values in seaboard states with access to adequate water transportation. We use regional dummies to capture differences in the timing and nature of railroad building: Midwest, West, South, and Northeast.[19]

[19] The Midwest includes Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota,

Midwestern states were better situated with regard to water transportation than states in the far west, but less well situated than states along the ocean in the Northeast and South. We interacted the dummies for the Midwest, West, and South with railroad miles. The regional dummies are included only in the interaction terms.

The regional interactions are entered linearly in column (2) of Table 4 and in a nonlinear cubic specification in column (3) of the table. In the linear specification, construction increases property values in all three regions relative to the Northeast, although the difference is significant only in the West and Midwest. Railroad mileage produced the largest increases in property values and tax revenues in the West, followed by the Midwest and the South, and the smallest in the Northeast. In the nonlinear results it appears that system construction produced high initial returns per mile that declined with further construction, then eventually rose again. Although returns began to rise in every region as rail systems reached a length of 5000 to 7500 miles, these results are based on a smaller number of observations and may be less the result of true increasing returns than fitting the regression to the more numerous observations at lower mileages.[20]

Which of the specifications should we prefer? The last row of Table 4 presents *F*-statistics for the inclusion of the nonlinear terms and the regional interactions. The tests reject the null that the coefficients on the nonlinear terms in column (1) are zero (when compared to the results in column (1) of Table 3), and that coefficients on the nonlinear regional interactions are zero in column (3) (when compared to either column (1) in Table 3 or column (1) in Table 4). But simply adding the regional interactions in the linear estimates, column (2) of Table 4 is not supported. There is, in summary, statistical support for using the regional nonlinear specification.

One puzzling result is the significantly negative coefficient on population density. Figure 1 is helpful in understanding this result. Increasing the population in a state shifts the demand curve upward as population density increases. In the regressions, however, where population is controlled for, the effect of raising population density is to lower land area. Suppose we take a state in equilibrium at P3, S2. If the land area decreases to S1, the price of land rises to P1. The effect on the total value of land is ambiguous, however. Whether the total value of land rises or falls depends on the elasticity of demand for land. If it is elastic, as it is reasonable to expect the land for an individual state to be, then the total value of land will fall. Increasing population density, controlling for the size of the population, will produce a negative effect on total land values. We cannot include land area directly in the regressions, since land area is fixed over time, and is

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Missouri, Nebraska, North Dakota, South Dakota, Kentucky, and Tennessee. The West includes: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, California, Oregon, and Washington. The South includes Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Virginia, and Texas.

[20] In other words, we are not prepared to argue on the basis of these results that every state should have built a 15,000 mile rail system.

therefore perfectly collinear with the state dummies. It is important to remember that we are estimating the relationship between the total value of land in a state and railroad miles, not the relationship between the average value of an acre of land in the state and railroad miles.

V

What do these results say about the fiscal effects of railroad construction? If we assume that railroads last for 50 years and that rates of time preference were between 5 and 10%, then the annual property tax revenues result in a net present value of roughly twenty (or ten) times the annual revenues. The present value of a $330 a year increase in property tax revenues, the basic linear estimate from column (1) of Table 3, would be between $3300 and $6600 per mile of railroad built. Construction costs ranged between $20,000 and $60,000 per mile.[21] The property tax increase alone would justify the state in providing between a tenth and a third of the costs of construction costs.

The regional nonlinear estimates suggest that the fiscal effects vary also with the size and location of the railroad. The first hundred miles of construction in the Midwest and West would bring in between $500 and $700 per mile built, somewhere between $5000 and $14,000 a mile in present value. Fiscal incentives for government participation, however, would begin to decrease after the first 500 or 1000 miles had been built. Fiscal returns were significantly lower in the Northeast, while the Southern states followed the western pattern of large then diminishing returns, but at a lower level as well. These fiscal returns are consistent with the early participation of state governments in construction projects and their eventual withdrawal as systems matured. They appear, however, to be too small to justify a state government undertaking railroad construction solely for fiscal purposes.

The estimates in Table 6, however, are too conservative by design. First, property tax rates were typically higher than 4 mils. Table 7 gives the average tax rates, expressed as millages, throughout the country for state, county, local, and total property taxes reported by the census, from 1860 to 1913. In no decade was the average state tax rate less than 2.4 mils, while local tax rates were always substantially higher. Governments would have anticipated much larger returns than the estimates in Table 6. Combined state, county, and local millages were typically around 20, which would have generated additional property tax revenues for all governments in the state that were five times higher than the estimates in Table 6. The baseline fiscal return would be $1645 per mile, or between $16,000 and $32,000 in present value terms.

Second, public assistance to railroads often involved only a partial subsidy.

[21] Million (p. 86) cites estimates from the *Eighth Census* on the cost of railroad construction in ten states between 1850 and 1860 that range from $20,000 to $56,000 per mile. He uses this figure to show that railroads in Missouri were uncommonly expensive, ranging from $30,000 to $62,000 per mile on different lines, and averaging exactly $50,000 per mile.

TABLE 7
Property Tax Millages and Assessment Ratios

	State	County	Local	Total	Assessment ratio
1912	3.5	4.7	11.3	19.4	37%
1902	2.4	18.1	—	20.5	—
1890	2.8	3.7	12.0	18.5	39%
1880	3.1	4.1	10.7	17.9	39%
1870	4.8	5.5	9.5	19.8	47%
1860	—	—	—	7.8	75%

After the Civil War, many southern states subsidized construction per mile of track completed. These subsidies ranged from $4000 to $20,000 a mile, never enough to finance construction completely (Goodrich, 1956). Few cities underwrote the entire cost of construction. Local governments more often offered a lump sum payment when the railroad reached the county line or the city limits (Goodrich, 1951 and Tingley, 1892). In these cases the subsidy was intended to attract the railroad to a particular location or route, and not to pay the entire cost of construction. Even at low millages the increase in property values could justify partial subsidies.

Third, our measure also excludes other, nonfiscal benefits. As Table 5 shows, regardless of the specification changes in the level of property values for the first 1000 miles of track far exceeded the costs of construction, even of the most expensive railroads.[22] In the Midwest region, construction of the 1000th mile of railroad raised property values by over $287,000 a mile, in the West region by $194,000, in the South by $164,000 and in the Northeast by $162,000. These are substantial effects on property values. State and local governments would have received higher taxes associated with increased economic activity of other types. Voters were undoubtedly delighted (as long as the railroad was actually built and operated), at least until the novelty wore off and they began asking their state governments to regulate the prices that railroads charged.

Fourth, state and local governments often issued bonds to railroads with the explicit understanding that the railroads would service the bonds. Only when the railroads went into default and bankruptcy were state and local governments required to assume the debt burden. Even if the probability that default would occur was as high as 50%, the expected present value of the cost of issuing $30,000 in state or local bonds to build a mile of railroad would be only $15,000. Even if, as Goodrich put it, ‘‘The financial disappointments were well known,’’ the probability of disappointment was less than one.

There are other biases of an unknown magnitude. Governments often subsidized railroads through land grants. We have not tried to value those grants or to estimate whether land grant states had a different experience with the railroads

[22] The only exception being the total assessed value linear estimates in row 3 of the table.

than states that offered financial inducements. Governments may have realized higher tax revenues because of the railroads, but they may also have incurred higher expenditures for road construction and other public works associated with the railroads. How these potential expenditures should be measured is not clear, but their magnitude was probably small.

Altogether, only under limited conditions would the fiscal returns to a state government pay for the entire cost of railroad construction. This could happen if construction costs were low, assessment ratios were high, and property tax millages were well above national averages. The combined fiscal returns to state and local governments, on the other hand, could approach construction costs. A Midwestern state with a 40% assessment ratio and combined state and local millages of 20 could expect $2259 a year in revenues for the 500th mile of railroad constructed.[23] If state and local bonds carried a 5% interest rate, tax revenues would cover the interest on $45,180 of government bonds, sufficient to cover construction costs of most railroads operating over relatively flat terrain. Even more modest millages would be sufficient to justify partial subsidies to railroad companies. This would be even more attractive to state and local governments when they hoped, perhaps against hope, that interest and principle on the bonds would be paid by the railroads, not the taxpayers.

VI

The empirical results support several conclusions. First, it was clearly in the interest of state and local governments to promote the construction of railroads in their communities. This was particularly true in the initial stages of construction, when relatively few miles of track had been built. The nonlinear estimates suggest that property values in the West rose over $400,000 for every mile of the first 100 miles railroad constructed, yielding increased property tax revenues of roughly $700 per mile of road. Returns in other regions were lower, but still substantial. Returns declined as systems matured, but remained positive and may have even increased as systems grew beyond 5000 miles. Whether it was in a specific state's interest to subsidize rail construction would depend critically on construction costs per mile and the combination of the assessment ratios and the millages used in that particular state.

Net social returns to railroad construction, as measured by the increase in land values, were large enough to justify construction costs in every region at virtually every level of mileage. Typically the increase in property value was several times construction costs on the most expensive railroads.

These conclusions provide a consistent quantitative answer to why state and local governments stayed involved in railroad construction long after it became apparent that these were risky ventures. Initial construction of a rail system would appear to be an attractive proposition to state governments. Even if state property tax revenues were not sufficient to cover construction costs, property values

[23] This is five times the fiscal return in Table 6.

would increase substantially and local government property taxes would increase. Additional construction would yield progressively smaller returns. Whether railroads would ''pay'' for themselves after the system reached a length of 500 to 1000 miles would vary substantially between states and regions. Railroads would continue to yield a substantial fiscal benefit even at higher mileages, which by itself could justify a partial subsidy from state or local governments. It is not surprising that city and county governments, whose property tax rates were on average four to five times the state rates, continued to encourage railroad construction as systems matured and state governments discontinued their assistance. These results do not prove that governments correctly anticipated these returns, but the fiscal returns were realized and perceptive politicians did use the anticipated returns as an incentive to encourage state and local participation, as we showed.

Why, then, did so many states get into financial difficulties when railroads defaulted on their obligation to service state bonds? There are two reasons. In some states the railroads were never completed or sometimes never even started. This was the case in Illinois and Indiana in the 1830s, and in several Southern states after the Civil War. There was no opportunity for fiscal effects to manifest themselves, and ample opportunity for voters to demand default and repudiation. The second type of problem was more common. It involved the timing of debt service and revenues flows. States that began ambitious construction programs shortly before the onset of major business cycle contractions, as in the early 1840s, mid 1850s, and mid 1870s found themselves in financial difficulties during the construction phase. Railroad companies that were supposed to pay interest on state bonds defaulted, throwing the interest burden back on the state at precisely the time when state resources and access to credit were strained. Default and repudiation became attractive alternatives for the states at that point.

Missouri provides a good example. Missouri began its railroad program in the early 1850s and suffered through the contraction of the mid 1850s. On the verge of default in 1860, it was saved by the Civil War. The state suspended interest payments during the war, and then resumed payments after the war. By that time property values along the completed section of the system, particularly along the Hannibal and St. Joseph, had risen. The state sold its ownership shares in the uncompleted roads in return for pledges to complete the system. Missouri was able to pay off its debts by the end of the century.

The geographical and chronological pattern of government involvement in railroad construction follows the quantitative results. There were two frontiers in nineteenth century America: a population frontier and a railroad frontier. From the 1830's, when railroads became technologically feasible, to the outbreak of the Civil War, the population frontier was to the west of the railroad frontier.[24] State governments in the east became heavily involved in canal and railroad improve-

[24] The railroad frontier did not just move west. It moved west, south, and north from the mid-Atlantic seaboard.

ments, particularly at the beginning of system building. As the railroad frontier moved west and south, more states became involved in promoting railroads in both areas.

At the same time, financial embarrassment during the 1840s caused a group of states to withdraw from the internal improvement field. As Goodrich (1950) points out, however, several of these states reentered the field later on. The railroad boom of the late 1840s and 1850s involved a whole new set of states in the internal improvement process, this time the states located in the West and South, rather than the Northeast and the old Northwest. These states, too, suffered financial embarrassment, although not on the scale of the 1840s.

While involvement of state governments followed the railroad frontier west, county and municipal governments in the Northeast (and later throughout the country) continued to bid for the local services of railroads. With some exceptions, such as Cincinnati, county and local governments rarely financed the total cost of construction, but offered bonuses for the completion of lines through or to their counties and towns.[25] In the settled regions, construction continued in areas passed by in the first waves of construction. The returns to the construction of the second and third thousand miles of track were, in all likelihood, more localized and redounded primarily to individual communities in a state. It is no surprise that local governments in communities without rail service continued to support rail construction well into the last decades of the nineteenth century, long after the states and federal governments had abandoned the field.[26] With their higher millages and propensity to offer partial subsidies for completed rail construction, local governments found public support of rail construction sound politics long after states had left the field.

In the 1860s the western part of the railroad frontier caught up to the population frontier. New and profitable construction would have to be undertaken in the territories, beyond the capacity of existing states. The federal government, anxious to sell land, moved into the vacuum and through land grants, loans, and subsidies, encouraged the construction of the pacific railroads. Again the pattern is consistent with the financial returns, only the federal government reaped its benefits in land sales rather than property tax revenues. After initial construction of the trunk line was completed, the federal government withdrew its support in favor of local promotion.

Goodrich noted this geographic pattern and suggested that ''Geography provides a partial clue to the explanation of persistence.'' (1950, p. 167) The pattern and timing of state involvement across the country is consistent with large initial fiscal returns that drop off with additional construction, as is the longer persistence of county and municipal involvement even in the face of substantial

[25] See Goodrich (1960), Chap. 7, pp. 230–264, and Goodrich (1951) for a discussion of local government involvement after the Civil War.

[26] The importance of local support for transportation services in communities passed by the railroad can be clearly seen in New York's boom in plank road construction in the late 1840s and early 1850s described in Majewski *et al.* (1993).

financial risk. The financial rewards to state and local governments, rewards that accrued primarily from the ''indirect benefits'' of the railroad, were substantial indeed.

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