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"Cost-of-Living" Index for Steam Railroads

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A "Cost-of-Living" Index for Steam Railroads

By J. C. Hooker

Introductory

In these high-cost "reconstruction" days following the unprecedented destruction due to the great world war, many progressive managers of forward-looking industrial enterprises are seeking new ways and means with which to readjust and rejuvenate their businesses on more economical bases. It would seem, therefore, that any prospective sidelights on lost motion, on the elimination of waste, on a larger production per unit-cost, on greater man-hour efficiency, or looking toward possible and substantial reductions in operating costs, should prove both timely and welcome.

Following this lead a majority of the going concerns operating today within our national boundaries have either adopted or evolved individual types of cost systems to measure their production expenses. Such schemes are planned to determine, at least with approximate accuracy, the relative values and degrees of importance attached to the elemental factors entering into successive stages of their finished products or salable materials. Some of these systems function remarkably well, while others fail dismally. But comparatively few American industries have yet utilized the helpful aid offered by our modern-day economists through the medium of index numbers. Boiled down to finite terms, this help indicates the use of special comparative numbers to measure certain relative prices, costs or quantities, through successive periods of time, with some fixed or selected base period. That is, if 100 be selected as the basic index price of a bale of cotton for any particular period, say the year 1903, and twenty years later the fluctuating price of the same quantity and grade of cotton has increased this index to 300, then we may assert that this important product sells for three times as much, comparing the second period to the first, and the value of a dollar in relation to this world commodity now holds merely one-third of its former purchasing power. Index numbers are thus commonly used to measure cost and price movements through intervals of time, but may be employed also to mark changes in elements, quantities and

groups subjected to analytical comparisons. To formulate a consecutive series of such numbers, for a definite period of months or years, concretely illustrates their usefulness in economic and statistical investigations.

As some interesting examples among the modern uses of practical index numbers, one may cite the series constructed and issued by the United States bureau of labor statistics covering farm products in the bulletin of *Wholesale Prices*, Dun's index of commodities and the less-known cost-of-living index covering food, shelter, clothing, fuel and light and sundries, as shown in the periodical research reports published by the National Industrial Conference Board. Adapted comparisons from some of these sources may be drawn upon in this prospective study of a railroad operating cost index.

The financial volume and vital importance of the railway industry as a whole, in the United States, take rank next after that of productive agriculture and often vie with those of mining for second place among the value-producing agencies of the nation. An impartial survey of public opinion admittedly indicates that farming is the most necessary industrial function of our country today; yet sufficient and efficient transportation is as necessary to the life and prosperity of the farmer as to the interdependent growth of the whole nation; hence it has seemed fitting thus to relate both industries in this brief paper. With this relative importance in mind, a little inquiry reveals the fact that, as yet, no comprehensive cost-index series has been constructed and issued for the transportation industry by either private or public authorities.

Investigation shows that approximately 178 steam railroads operating in the United States are included in the official designation of "Class 1 roads" (i. e., those operating steam roads showing annual revenues of over $1,000,000 each). Since the aggregate operating expenses of this class of roads constitute about 95 per cent of the total of all classes of United States steam carriers, by rail, and by reason of their major importance—coupled with the existence of more accurate and complete data, as returned by them annually to the interstate commerce commission—this prospective "cost of living" programme will here be confined to these first-class roads.

Two variables, costs and time, are herein treated to reflect changes in the operating cost-scale as affected by varying wage-

scales and prices of railway materials through a period of eight successive years.

Base for Railroad Cost Index

As index numbers are herein employed to picture operating cost movements, through successive years, a preliminary canvass of the available data and its varied presentation by the roads involved, from 1923 backward to 1912, suggests a low-cost period around the year 1915. A further examination of all adaptable records and cost figures recommends what has been selected by the United States railroad administration as a test period (i. e., a simple three-year average of the years 1915, 1916 and 1917) as a logical base period upon which to construct our index series. Careful reflection would suggest that, in lieu of a one-year cost-level for all component labor and material elements, the wider comparative range of item-costs through three full years would form a more ideal base year (T. P. average= 100) for relating all successive yearly costs down to and including 1922. The corrected figures for 1923 returns are not yet ready for assembling, but additional years can be added to this prospective series as the necessary data become successively available. On the other hand, this base selection is, or should be, largely influenced by the fact that many index numbers are rendered defective, and frequently distorted, by the use of a base too far distant from the periods for which comparisons are most desired. I shall therefore select, as the best index series for measuring the fluctuating costs of railroad material and labor, the average yearly costs of the items and classes involved, those items and classes being measured in dollar units in the base year (average T. P. year= 100)—in other terms, the ratios of the values of material and labor used, at actual costs, to the values of the same items if used at base costs. Of course both cost and quantity data must be used concurrently for each year so measured.

A practical method, then, for obtaining this cost series would seem to be "an aggregated fixed base formula weighted by base values." Translated into algebraic terms we would have an equation like this:

$$\text{Index number} = \frac{\Sigma\,(\text{Sum})\ C_r \times Q_b}{\Sigma\,(\text{Sum})\ C_b \times Q_b}, \text{ where}$$

C_r = Cost relatives;
C_b = Base costs (T. P. average year);
Q_b = Base period quantities.

Substituting, our formula gives us the sum-products of the several base-period quantities by their changing cost-relatives, divided by the sum-products of these same base-period quantities by their various base-year costs. This reflects the variation of yearly costs, successively, from the basic-period cost, and the principle has been sanctioned in usage by authorities like Australia's bureau of statistics, Dun's index, and United States bureau of labor statistics.

The tracks of these class I carriers traverse practically all United States continental territory, which is divided into three convenient geographical districts by the interstate commerce commission, viz., eastern, southern and western. The eastern district includes all states north of the Ohio and Potomac rivers and east of the Mississippi river, except a small portion of Illinois, the whole of the state of Wisconsin, plus the north half of Michigan; the southern comprises all south of the Ohio and Potomac rivers and east of the Mississippi river; and the western district includes all the remainder of the country, excepting Alaska and the island possessions. By grouping, within these separate districts, certain lines of inquiry can be narrowed down to sectional areas, with evidently beneficial results in the matter of technical comparisons. This would specifically apply in the proposed index with reference to the consumption of ties, lumber, ballast, coal and fuel oil.

Sources and Specific Character of Data

The interstate commerce commission collects all the labor data and some of the material data needed for such an index series as is here contemplated. For the basic test period (fiscal years 1915, 1916, 1917) certain data have been collected by the United States railroad administration, and these records constitute the best original source of information for most material items used by the steam roads within that three-year period. The administration records also show data for the federal control period (calendar years 1918, 1919 and first two months of 1920).

Other sources that can be drawn upon are the census bureau, United States geological survey, valuation bureau of the interstate commerce commission, federal trade commission, department of labor, and certain standard periodicals (in a corroborative way) like *Railway Age, Iron Age, Engineering News-Record, Coal Age,* and *American Lumberman. The American Metal Market*

figures could be utilized as a relative source of information, but the so-called market quotations will not always accurately measure the exact costs of large quantities of materials to the larger railway systems, which often purchase at contract prices far in advance of the specific periods in which the actual materials are applied to track and roadway or worked into car and locomotive equipment.

The total operating expenses for the average year of the test period approximate $2,261,558,700, and this test period is chosen as the only one in which the actual quantities of materials used for the maintenance of these steam roads can be secured readily. It was considered a normal pre-war period average, and so fixed by official ruling as the basis for adjustments with the roads, covering transactions under the federal control and guaranty periods. A sufficient number of material items was tabulated by the United States administration to form a fair basis for all fiscal settlements with the railroad companies, and will therefore furnish figures for a fairly accurate cost index.

The total list of forty-three material items and about sixty-eight classes or different grades of labor may be segregated, correlated, combined, grouped, districted and finally summarized under the following three general headings:

A. Maintenance of way and structures;
B. Maintenance of equipment;
C. Transportation—rail line.

Railway-maintenance cost keeping requires the summation of material and labor costs, and the aggregate method of comparison (as above formulated) is proposed for this measuring-stick series. In order to analyze why certain costs are high here and low there it is necessary to separate them carefully into their constituent factors and then calculate the relative ratio weights of each item under investigation. When a railroad superintendent, road-master, track foreman, car-repair foreman, section foreman or mechanical (shop) foreman needs material of any class he usually goes to the purchasing agent, storekeeper or material yard with a requisition order (for record). Thence desired issues of ties, rails, ballast, tie-plates, spikes, frogs, bolts, lumber, metals, cement, coal, fuel oil, machines, tools, etc., are made from stock and corresponding charge-outs are entered against the proper jobs or classes of service. From these accurate and detailed store records complete material costs are maintained and furnished to the ad-

ministrative and statistical units at the road's headquarters or general office. In like manner reports of all labor, from time-keepers and section foremen are sent in from all parts of the railway system. Then the statistical and accounting forces compute, tabulate and record the road's monthly and annual operating expenses—from charge-outs based on initial costs, not from current market prices—for transmittal to governmental authorities like the interstate commerce commission and the United States railroad administration.

Without specifying each class of material and labor, item by item, a comprehensive grasp of the outlined plan may be gathered from the following tentative tables. The quantities and aggregate money values covering so many primary items of material, combined with similar data for sixty-eight classes of basic-hour labor costs—all compiled from the varying returns of one hundred and seventy-eight separate railroads—would, of necessity, mount into huge volumes of figures, and several months' time might be consumed in constructing even an eight-year year index, as here projected.

As noted above, the requisite cost data may be grouped under three divisions, and a rough calculation from certain available figures, covering the entire United States, gives the following relative ratio weights for both material and labor:

ALL (I. C. C.) DISTRICTS

The relative-group percentages

	Average T. P. year	
Material—maintenance of way and structures	7.5%	
maintenance of equipment	8.6	
transportation—rail	13.5	
Total—all material		29.6%
Labor—maintenance of way and structures	14.1%	
maintenance of equipment	19.0	
Transportation—rail	37.3	
Total—all labor		70.4
Grand total—material and labor		100.0%

A glance at the above table reveals the rather surprising fact that the labor element constitutes about 70% (or more than two-thirds) of the entire operating outlay, while material items barely total 30%. The importance of fuel in the transportation group can be surmised when it is found to equal 13.5% of the grand aggregate, while all material costs of both maintenance sections total only 16.1%. It will be noted that the combined material

and labor costs for all transportation-rail for the test period amounts to 50.8% (or more than half) of the grand total for all districts. A circular pictogram chart would show the relative weights of these various groups and their constituent individual items in a very clear perspective.

However, a more definite impression of the relative importance of individual material items may be gleaned from the following:

COMPARISON OF MATERIAL ITEMS

(All districts)

	T. P. year to material aggregate	
Maintenance of way and structures:		
1. Ties—(all kinds)	11.3%	
2. Rails	2.7	
3. Track and roadway material	4.3	
4. Ballast (stone, sand, gravel, slag, etc.)	0.9	
5. All structures	3.6	
6. Machines, tools, etc.	2.7	
Group aggregate	25.5%	
Maintenance of equipment:		
a. Brass and bronze	5.4%	
b. Cast steel	1.6	
c. Wrought steel	2.3	
d. Wrought iron	0.8	
e. Cast iron	4.8	
All metals (sub-total)	14.9%	
f. Lumber	3.2	
g. Miscellaneous material	10.9	
Group aggregate	29.0%	
Transportation—rail line:		
A. Coal (segregated into anthracite bituminus and coke)	40.6%	
B. Fuel oil (used by about 80 roads)	4.8%	
C. Wood (segregated into hard & soft)	0.1	
Group aggregate	45.5%	
Grand total—all material		100.0

In similar fashion, by group totals, omitting long list of sixty-eight class titles:

COMPARISON OF LABOR ELEMENTS

(All districts)

	T. P. average year to aggregate labor costs	
1. Maintenance of way and structures (labor-hours)	20.1%	
2. " of equipment " "	26.9	
3. Transportation—rail line (labor-hours)	53.0	
Grand total—all labor		100.0

A fairly complete analysis of the test period maintenance-expense accounts for all first-class roads has been made by the United States railroad administration forces, and upon that basis the relative weights of all material elements and all labor factors can be calculated for the subsequent five years.

THE RAILROAD "COST OF LIVING" INDEX COMPARED WITH DEPARTMENT OF LABOR FOOD INDEX

While there may not appear to be any direct relation between the actual yearly budgets necessary to the maintenance of our major railway systems in good operating condition, and the annual food outlay for the average American family in normal peace times, yet the ever-present factor of labor in most economic inquiries seems to warrant the following tentative comparison of these two indexes:

COMPARISON OF INDEXES

(Test period year = 100)—(Approximate figures)

Year	*R. R. labor index (All districts) I. C. C. labor costs*	*Department of labor food index (All United States) Wholesale*	*Retail (costs)*
F. 1915	95	89	..
F. 1916	98	91	..
F. 1917	106	120	..
T. P. average	100	(*)	(*)
C. 1917	112	141	130
C. 1918	163	158	150
C. 1919	196	174	165
C. 1920	234	186	181
C. 1921	227	122	136
C. 1922	208	117	125
C. 1923	207		

From the above comparisons it will be seen that both index series here show a close agreement in their upward trend from 1915 to their common high-peak year of 1920, but that the rise in the railroad labor index is much more rapid from 1917 onward, due, no doubt, to the fact that federal control of railroads commenced with the first week in 1918. Another phase of the comparison is the marked lag of the retail food index behind its wholesale section, both ascending to and descending from the peak costs of 1920.

It is interesting to note that Great Britain alone has approximately three million laborers whose wages are reported as being regulated by an index of localized retail prices.

(*) Though all department of labor indexes are related to the normal base-year (1913 = 100), the food index ratios are here allocated to railroad base.

Conclusion

Resultant index numbers from this outlined plan can be used advantageously in the formulation of numerous complex rate decisions and with specific pertinence in the settlement of railway wage disputes, aside from the broader value of such comparative information to the public in general and economists in particular. Massed figures on production, consumption, costs and prices of any commodity or service are becoming increasingly attractive and useful to the live modern business administrator if presented in concise, clear, readable form.

A careful inspection of this tentative outline will indicate some informative and profitable facts that might be brought forth more clearly with the completed series, notable among them being the disproportionately large labor factor in all recent railway operating costs. This is strikingly apparent in the make-up of the figures for 1917 and all subsequent years under observation.

Certain obstacles will be encountered in the computation and assembling of the data for this full series, but such a study offers a fruitful field for research investigations.