Volume Title: American Transportation in Prosperity and Depression

Volume Author/Editor: Thor Hultgren

Volume Publisher: NBER

Volume ISBN: 0-870-14086-8

Volume URL: http://www.nber.org/books/hult48-1

Publication Date: 1948

Chapter Title: The Movement of Goods

Chapter Author: Thor Hultgren

Chapter URL: http://www.nber.org/chapters/c4610

Chapter pages in book: (p. 1 - 42)

CHAPTER 1

The Movement of Goods

RAILWAY TONNAGE REFLECTED CYCLES IN FLOW OF COMMODITIES

Cycles in total flow

The farmers, lumbermen, and fishermen, the miners and manufacturers of the United States send forth a great stream of commodities into the commerce of the nation. Their contributions are supplemented by those of importers, who bring in additional goods over our land and water borders. Such are the sources from which the railroads of the country, and its other means of transport, derive their freight traffic. The total flow of goods is variable. Although it has increased mightily over the decades, there have been frequent periods, each lasting months or years, during which it has diminished. These contractions, and the intervening expansions, necessarily affected the volume of traffic offered the transportation companies. Each disturbance in traffic affected their earnings and many other aspects of their operations.

This web of events can be explored rather thoroughly as far as the steam railroads are concerned, for in this branch of the transport industry the size of enterprises and the growth of governmental regulation have produced a wealth of statistics. Until recently no comparable record was kept for any other kind of transportation. An exploration must therefore concern itself chiefly with railways.

We can roughly distinguish the periods of expanding from those of contracting commodity flow with the aid of the reference chronology established by Arthur F. Burns and Wesley C. Mitchell.[1] After surveying the annals and statistics of American business, they designated certain dates as 'reference peaks', and other dates, alternating in time with the peaks, as 'reference troughs'. In their judgment the dates represent high and low points in economic activity at large. They call the period from a trough to the following peak a reference expansion, and that from

[1] *Measuring Business Cycles* (NBER, 1946), Ch. 4; reference dates are shown on p. 78. In that volume, other statistical tools used in this book are fully described and carefully examined.

a peak to a trough a reference contraction. The chronology takes three forms: in one, months, in another, quarters of years, and in the third, whole years are designated as high and low points. Either an expansion or a contraction is a 'reference phase', and two successive phases make a 'reference cycle'. We shall make extensive use of these terms and concepts.

The reference chronology is not intended to mark off cycles in any one aspect of economic life. When the figures on a single economic activity, such as employment in factories or production of steel ingots, are charted and inspected, however, it is usually possible to observe peaks and troughs, and consequently expansions, contractions, and cycles in that activity. Burns and Mitchell call them 'specific' peaks, troughs, expansions, contractions, and cycles to distinguish them from 'reference' turns, phases, and cycles. The dates of specific turns in one activity often differ from those in another activity and from those in the reference system. On many of the charts in this book the specific turns are indicated by asterisks.

Although the reference scheme was not designed to reflect commodity flow, it is reasonably safe to assume that the aggregate flow of commodities was increasing during most of each 'reference' expansion and diminishing during most of each contraction. The annual reference dates, however, may not indicate correctly the direction of change in flow from one whole year to the next whole year in the contractions before 1893–94. Those dates were intended to supplement the monthly scheme. A survey of annual business statistics alone might have suggested fewer contractions.[2] It is quite possible that aggregate flow increased from year to year in some of the early contractions, although at a slower rate, perhaps, than in the expansions. With this reservation in mind, we may form a rough impression of the relation between total flow and railway tonnage by observing the changes in traffic against the background of the reference chronology.

Corresponding cycles in tonnage

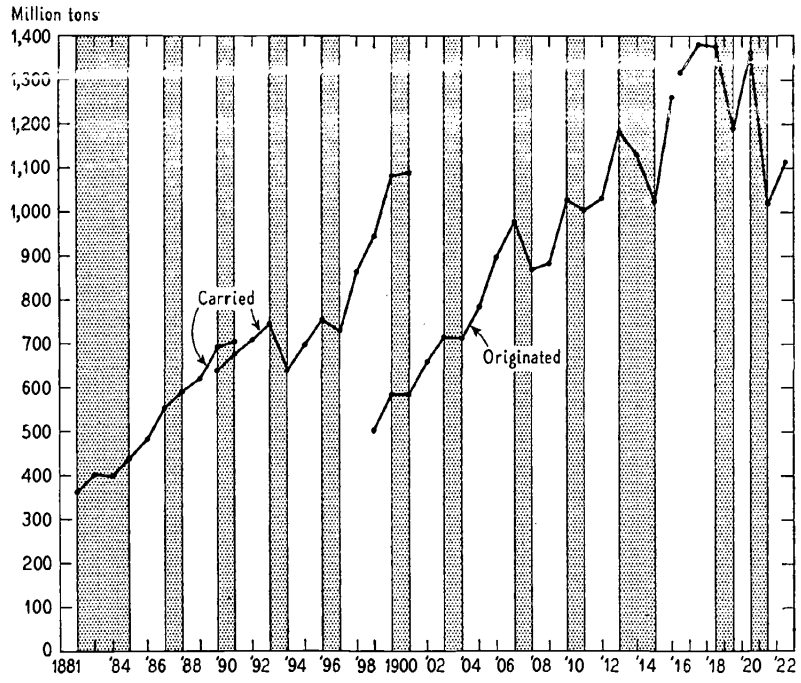
Burns and Mitchell recognize cycles in business beginning as long ago as 1834. A few small railroads were operating even before that. But the continuous statistical record of tonnage handled by all

[2] For a fuller discussion, see *Measuring Business Cycles*, pp. 80–1, 261–2.

roads does not begin until 1882. We must therefore start our comparisons in that year.

CHART 1

Tons Carried, Annually, 1882–1901; Tons Originated, Annually, 1899–1922



Shaded periods are reference contractions.

Our study was undertaken, and many parts of it were completed, during the business expansion that began in 1938. That expansion could not be included in our analysis, since its dimensions could not be taken until it ended. Our narrative in this and other chapters must stop with the contraction of 1937–38; we shall therefore seldom have occasion to present more recent data.

During the period for which we have figures, railway tonnage, as might be expected, rose in every expansion, fell in most of the contractions (Charts 1 and 2.[3] The data in the latter, like all

[3] A shipment often travels over the lines of several railroads in succession. In the computation of 'tons originated' the weight of each shipment is counted only when the initial road receives it from the shipper; in computing 'tons carried' it is

quarterly or monthly data charted or cited throughout this book, except as specifically noted, have been seasonally adjusted; i.e., the original figures for normally high months have been reduced, and those for normally low months increased). In some phases of declining general business, however—1882–85, 1887–88, 1890–91, 1900–01—it increased. Even these cases are not as exceptional as they look. Although tonnage did grow in the 1882–85 contraction as a whole, it diminished very slightly in the middle. Furthermore, it grew less rapidly, on the average, than in the following phase. (We do not know anything about the one preceding 1882–85.) In 1887–88 and 1900–01 the increase was less rapid than in either the preceding or the following expansion. From 1890 to 1891 the rise, according to Poor's *Manual*, was only 13 million tons, but from 1888 to 1890 it averaged 50 million tons per year. All these comparisons between phases of opposite character, therefore, indicate that the growth of traffic, although not halted in contraction, was decelerated. On the other hand, ICC figures, which begin in 1890, show a rise of 39 million tons to 1891, which is slightly greater than the annual average rise in the expansion from 1891 to 1893. With this one exception, tonnage either fell in reference contractions or grew less rapidly than in the adjacent phases.

Although there are no consecutive national totals for years before 1882, we do have figures for thirteen railroads. They were large and geographically fairly well diversified. Seven operated in

---

counted again each time it passes into the custody of another railroad. We prefer the 'originated' figures because they eliminate duplication, and are not influenced by mergers of railways; but they are available only from 1899 onward.

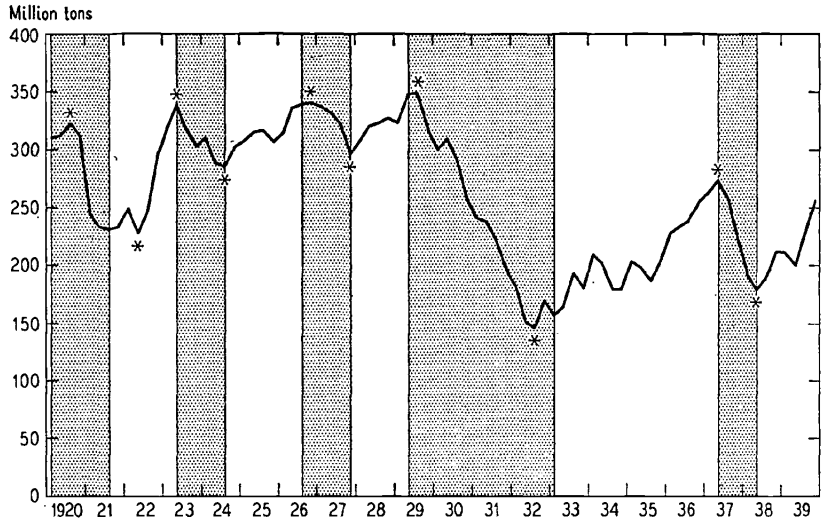
The scale-marks along the bottom of charts in which we present annual data mark off calendar years. Our practice is to plot data in the middle of the period to which they pertain. Consequently, a figure for the year ended June 30, 1906, for example, would be plotted at Jan. 1, 1906, i.e., over the scale-mark for the end of calendar year 1905 (beginning of calendar 1906). For a reference system we use the Burns-Mitchell fiscal-year chronology before 1916, their calendar-year chronology afterwards. Consequently the World War I expansion has a fractional length—3.5 years.

The curve on a chart of annual data is likely to be broken into three segments. A segment ending near 1891 represents Poor's *Manual* data. The transition from fiscal to calendar figures (the latter plotted halfway between calendar year-ends) in 1916 is indicated by another break. See Note on Sources, at the end of this book. In Chart 1 the shift from carried to originated requires another break near 1900.

the East;[4] six were western roads approaching Chicago from different directions.[5] Little if any movement in the South or the Far West can be covered by the figures, but the movement on the thirteen roads of interterritorial traffic originating or terminating in those areas must be included. Aggregate tonnage on all roads must have conformed to business in much the same way as that on the thirteen. Traffic on the latter, except for a slight dip from 1876 to 1877, increased year by year from 1865 to 1883. But it grew more rapidly during the reference expansions than during the contractions (Table 1).

CHART 2

Tons Originated, First Quarter 1920—Fourth Quarter 1939



Shaded periods are reference contractions.

Expansions and contractions in traffic that corresponded in a general way to those in the business chronology did not always begin and end at exactly the same time as the reference phases. We have just noted an instance—the minute 1882–83 contraction in tons carried. The annual data present only one other: traffic

[4] Pennsylvania; Pittsburgh, Fort Wayne and Chicago; New York Central; Lake Shore; Michigan Central; Boston and Albany; New York, Lake Erie and Western.
[5] Illinois Central; Chicago and Alton; Chicago and Rock Island; Chicago, Burlington and Quincy; Chicago and Northwestern; Chicago, Milwaukee and St. Paul.

was slightly higher in 1917 than in the reference peak year 1918. Departures are more frequent in the quarterly figures, as the asterisks in Chart 2, which mark the peaks and troughs in traffic itself, indicate.

Table 1
Tons Carried, Thirteen Railroads
Change per Year during Reference Phases, 1868–1885

(1) Initial year of reference phase	1868	1869	1871	1873	1878	1882
(2) Terminal year of reference phase	1869	1871	1873	1878	1882	1885
(3) State of business (expansion or contraction)	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.
(4) Length of phase in years, (2) − (1)	1	2	2	5	4	3
	(millions)					
(5) Tons carried, initial year	24.5	28.6	34.5	44.8	54.8	94.8
(6) Tons carried, terminal year	28.6	34.5	44.8	54.8	94.8	100.9
(7) Change in tons carried, (6) − (5)	4.1	5.9	10.3	10.0	40.0	6.1
(8) Change per year in tons carried, (7) ÷ (4)						
In expansion	4.1	...	5.2	...	10.0	...
In contraction	...	3.0	...	2.0	...	2.0

One road reported figures for the year ending March 31; others May 31, Sept. 30, or Dec. 31. Above we assume June 30 to be a fair average and apply the fiscal year reference chronology. If we assume Dec. 31 fair, and use the calendar-year chronology, we have the following dates and changes per year: 1867–69 expansion, 3.4; 1869–70 contraction, 1.4; 1870–73 expansion, 4.9; others as above. The conclusion in the text is unaffected.

There was a notable difference between pre-1919 cycles and later cycles. Almost every expansion in the flow of goods before that year carried traffic to a level never previously attained. In the four cases in which tonnage grew during the contraction itself, it was already above its level at the previous reference peak, of course, when business at large began to prosper again. But even when the railroads lost traffic in a contraction, the subsequent increase greatly exceeded the loss on several occasions. It is true that the tonnage carried in the peak year 1896 was only 1 per cent larger than in the preceding peak year 1893, and the tonnage originated in 1910 only 5 per cent above 1907. But 1907 overtopped 1903 by 37 per cent, 1913 overtopped 1910 by 15 per cent, and 1917 was 17 per cent above 1913. In the postwar peak years—1920, 1923, 1929, 1937—there was no comparable transcending of previous records. Tons originated were 1 per cent fewer in 1920

than in 1917. In 1923 they exceeded their 1920 level by 6 per cent. Traffic in 1926 was practically the same as in 1923. In 1929 it was only 2 per cent above 1926. A substantial part of the loss in the great 1929–32 contraction was not recovered in the following expansion: 1937 tonnage was 21 per cent below 1929.[6]

BUSINESS CONDITIONS INFLUENCED COMPETITION AMONG MEANS OF TRANSPORT

Background factors after World War I

Perhaps the aggregate production and importation of commodities did not increase as rapidly from peak to peak after World War I as before. If so, it would help account for the failure of traffic to exceed materially or even to approach previous records. Whether it was true we cannot tell, for no appropriately weighted index of total flow to market, by rail and other means, is available. But it cannot be the whole explanation, because even partial or not quite suitable data make it clear that after 1920 rail traffic did not grow as fast as total supply.

From 1920 to 1926 we must base this conclusion on the indirect evidence of general indexes of production (Table 2). They are not very satisfactory for our purpose, since in each index the output of different kinds of commodities is added together on the basis of average dollar values at constant prices. Such an index might diverge somewhat from one in which the same commodities were added on the basis of their importance as railway traffic. We have included a measure of the total flow of commodities. From its name one might infer that it is just what we want. But it too suffers from the limitation just mentioned. Furthermore, it pertains to the flow of goods into the hands of final users, or near that point. A measure of the flow from points of production and import, including materials and fuels used up in production, might change in a somewhat different manner. In view of these characteristics all the indexes and the flow measure might rise somewhat more than tonnage originated, and we still could not be certain that the latter had increased less than the aggregate flow from points of origin, appropriately weighted for comparison with traf-

[6] The last four percentages are computed from data for peak quarters.

fic. But when a preponderance of the various measures of supply increased by an appreciably greater percentage than traffic, we can be fairly sure that changes in railway tonnage were not proportionate to those in total flow from origin. In this connection it should be noted that 'industrial' tonnage—minerals and manufactures—is about four times as large as agricultural traffic. From 1917 or 1918 to 1920 the change in most of the indexes was not greatly different from that in traffic, while manufactures declined. In this instance traffic and the aggregate flow probably changed in about the same degree. From 1920 to 1923, however, and again from 1923 to 1926, total supply apparently increased more than railway tonnage.

Table 2
Production Indexes, Commodity Flow, and Tons Originated
Peak Years in Business or Traffic, 1917–1926

	Indexes or amounts for					Ratio of			
	1917	1918	1920	1923	1926	1920 to 1917	1920 to 1918	1923 to 1920	1926 to 1923
Agriculture[a]	124	130	130	132	146	1.05	1.00	1.02	1.11
Agriculture[b]	86	90	92	94	100	1.07	1.02	1.02	1.06
Mining[a]	268	270	271	329	348	1.01	1.00	1.21	1.06
Manufacturing[a]	257	254	242	280	316	.94	.95	1.16	1.13
Industry[c]	[d]	[d]	75	88	96	...	...	1.17	1.09
Commodity flow[e]	18.5	18.7	19.8	24.9	28.8	1.07	1.06	1.26	1.16
Tons originated[f]	1382	1377	1363	1388	1440	.99	.99	1.02	1.04

[a] 1899: 100. These indexes, on that base, are conveniently assembled in Barger and Schurr, *The Mining Industries, 1899–1939* (NBER, 1944), p. 14. They are available on a 1929 base also. For further information see Barger and Landsberg, *American Agriculture, 1899–1939* (NBER, 1942), and Solomon Fabricant, *The Output of Manufacturing Industries, 1899–1937* (NBER, 1940).

[b] 1935–39: 100. U. S. Department of Agriculture, *Agricultural Statistics, 1942*, p. 659.

[c] 1935–39: 100. Board of Governors of the Federal Reserve System, *Federal Reserve Index of Industrial Production*, 1943, p. 45. Includes mining and manufacturing.

[d] Not available.

[e] Absolute amounts, value in billions of dollars at 1913 prices of finished commodities plus construction materials. William H. Shaw, *Commodity Output since 1869* (NBER, 1947).

[f] Absolute amounts, millions of tons, all line-haul railways (ICC).

Beginning with 1926 there are estimates of the total flow of commodities from points of origin, weighted by their importance as sources of traffic. The ICC Bureau of Statistics ascertained or es-

timated the production of each of the 70 classes of commodities into which traffic was statistically divided before 1928, and made allowances for imports and changes in stocks at points of origin. It computed the tonnage of each commodity the railroads would have received each year if traffic had remained the same percentage of adjusted production as in 1923–25. By adding the results for all commodities it determined the traffic that would have resulted if the relation to supply had remained constant for all articles. It then expressed the aggregate tonnage actually transported in later years as a percentage of the hypothetical tonnage. In later studies similar computations were made, using the ratios of tonnage to production in 1928 instead of the ratios in 1923–25. This procedure permitted a more exact study based on the 157 classes into which traffic was divided in 1928 and later years. The percentage of total supply transported by railroad was lower in 1929 than in 1926, and much lower in 1937 than in 1929 (Chart 3).[7]

As these figures emphasize, not all goods produced or imported are or ever have been forwarded by rail. Some receive no transportation at all comparable with rail movement, but are disposed of locally. For example, some of the food grown on farms is eaten by the families who raise it. Much of the pig iron produced is converted into steel in the plant in which the blast furnaces are located. Some of the clothing manufactured in New York is sold to consumers in that city. Another part of the flow of goods is shipped from its place of production or port of importation, but moves entirely by other means of transport—in pipe lines, motor trucks, ships, or airplanes.

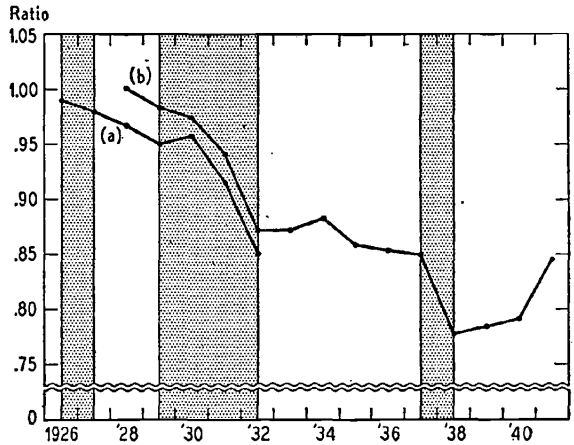
Presumably the largest portion of the share lost by the railways after 1920 went to motor trucks. In this period the mileage of paved highways was greatly extended and improved. The economy and reliability of motor trucks increased.[8] Although changes occurred in the cost to shippers and in the serviceability

[7] In the study based on 1923–25, tonnage means tonnage originated, except that a correction was made to eliminate reshipments of anthracite coal from breakers. In the study based on 1928, it means tonnage originated or tonnage terminated, whichever was higher; the special correction for anthracite was continued. The data for the chart are from E. S. Hobbs, *Fluctuations in Railway Freight Traffic Compared with Production, 1926–1936*, and *1928–1941* (ICC Bureau of Statistics, Statement 3744, mimeographed, 1937, and 4257, 1942).

[8] For a discussion, see Athel F. Denham, *20 Years' Progress in Commercial Motor Vehicles* (Military Vehicles Division, Automotive Council for War Production, Detroit and Washington).

CHART 3

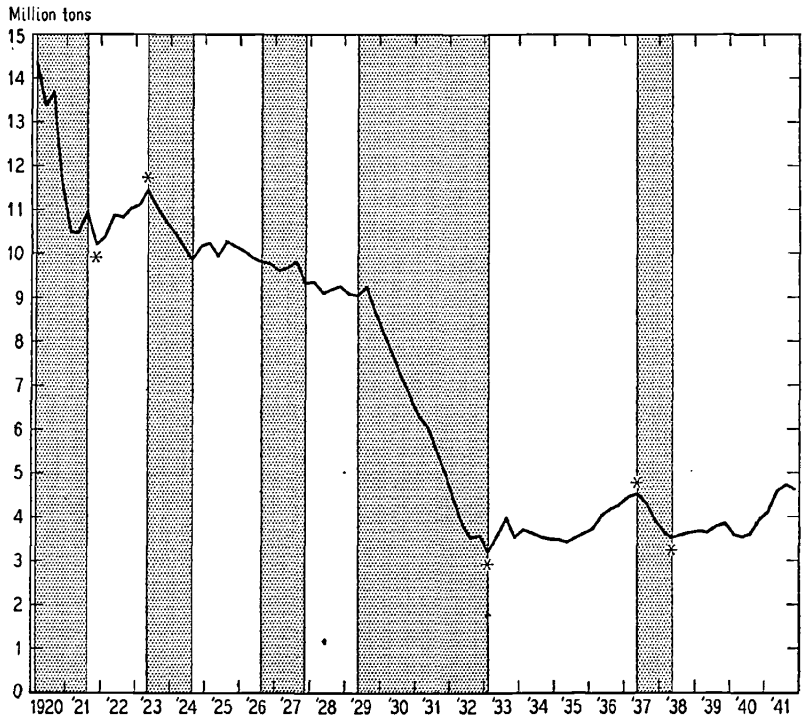
Ratio of Actual Railway Tonnage to Tonnage that would have been Transported if Traffic had Maintained (a) its 1923–25 or (b) its 1928 Relation to Supply of Commodities



Shaded periods are reference contractions.

CHART 4

Less-than-carload Freight: Tons Originated, First Quarter 1920—Fourth Quarter 1941



Shaded periods are reference contractions.

both of railroad and of highway transport, the balance shifted in favor of the latter, which came to be regarded as preferable for an increasing percentage of all shipments, sometimes because of better service, even at higher cost. It should not be supposed, however, that all the business diverted to the highways went to the commercial motor transport industry. Much of it was handled in trucks belonging to the shippers themselves. In effect the railroads compete not only with other transport enterprises but with the integration of transport into the operations of producing and trading enterprises, as well as with the system of local disposal.

The effect of highway competition on the aggregate amount of shipments in less than carload quantities was especially marked. Railway rates on such traffic are usually higher than on consignments in carloads. But a partial carload often makes a full truckload. A commercial trucker has little incentive to discriminate on grounds of cost against shipments in full truckloads, even though they would not make full carloads. The rail rate on L.C.L. is therefore more likely to exceed the trucking charge than on carload traffic. Shippers who are considering the cost of carrying goods in their own trucks are likewise more likely to find the comparison favorable to motor movement in the case of L.C.L. Highway service is often faster, too. A carload usually goes through to the consignee without rehandling of the goods. The railroad company usually loads L.C.L. traffic from station platform to car at the beginning, and unloads it from car to platform at the end of the movement. Sometimes, in an effort to economize car space, the goods are transferred from one car to another once or more en route. A truck frequently goes through from consignor's to consignee's door without reloading. This kind of traffic therefore proved highly vulnerable. Although L.C.L. tonnage recovered somewhat after the 1920–21 depression, it was still 20 per cent below the first quarter of 1920 at its peak in 1923 (Chart 4). Thereafter it declined fairly continuously until 1933, not only in contraction but also in the expansions of 1924–26 and 1927–29. A slight recovery in 1933–37 left the tonnage 50 per cent below the second quarter of 1929. Even in the case of these small shipments, however, the influence of improving business was not wiped out. The tonnage did rise somewhat in two of the reference expansions, and declined less rapidly in the other two than in their neighboring contractions.

During most of the cycles before 1919 it is likely that the railroads drew traffic from competing outlets instead of losing it. As the network of rails was extended, people came to rely more and more on areas outside their own locality both for markets and for supplies. During part of the period the railroads also displaced water carriers. After the 1870's the trend of traffic on the New York State canals, including the Erie, was downward (Chart 132). Similar losses occurred on the Mississippi River.[9]

Shift from railroads to motor trucks more rapid in contraction

Although the increasing competitive attraction of highways and perhaps of other forms of disposal has more recently prevented the railroads from recovering, in expansion, their former share in the flow of goods, that attraction is apparently itself related to the state of business. The share of the railroads diminished much less rapidly in the expansion of 1932–37 than in the preceding or following contraction (Chart 3). After 1937–38 it began to rise. It is true that the ICC computations show a somewhat less rapid drop in 1926–27 than in 1927–29. But the 1926–27 contraction was mild, and the data, as previously noted, are not as good as for later years.

During 1929–32 and 1937–38 rail freight rates, on the whole, declined little or rose. The rates operators of trucks for hire charged for their services probably declined sharply. Many unemployed persons apparently went into the business of trucking for hire, buying vehicles and driving them for whatever they could get out of it. Truck transport, unlike rail transport, was easy to enter. The government provided the highways, collecting only a current charge for their use; no heavy initial investment was required on this account. Trucks, often second-hand, could be purchased on credit. Truck operators could probably hire drivers for lower wages than in prosperity, because so many people were unemployed and almost anybody could either drive a motor vehicle or quickly learn. The cost to business men of having their goods carried in their own vehicles must likewise have declined.

These factors, we surmise, induced manufacturing and trading enterprises to patronize commercial truck operators, and also have

[9] See the charts in Harold G. Moulton, *Waterways Versus Railways* (Houghton Mifflin, 1926), pp. 71–3.

goods carried in vehicles of their own. Many small business men, particularly farmers, began not only to use their own trucks but to do the driving themselves. If a farmer shipped his produce to market by rail, he received the market price minus rail freight charges. If he took it to market himself, he received the market price minus something for gasoline, oil, and wear and tear. Going to and from market of course took some time. But he could make up for it either by apportioning less time to the production of crops and livestock than in prosperity or by working more hours. Farm prices had fallen sharply and the returns from effort devoted to production must often have seemed less attractive than the savings from effort devoted to marketing. The great diminution of their total income put pressure on farmers to take on the job of driving, even as an additional chore.[10]

Diversion of traffic from the railroads may not be as marked a feature of future contractions as it was of the two that have most recently run their course. Legislation has tended to make truck rates more rigid. It is true that divergence between rail traffic and the supply of commodities was accelerated in the 1937–38 contraction, although the Motor Carrier Act, which regulates truck rates in interstate commerce, was passed as early as 1935. But administration of the Act has become progressively more effective and will be tighter in the future.

Keeping up the rates of carriers for hire, however, will not necessarily lead business enterprises to choose rail in preference to truck transport; they may choose to carry goods in their own trucks, avoiding the fixed rates for commercial haulage whether by truck or by rail. Unionization of truck drivers, of course, might prevent costs from falling; but such a development would not affect small business men and farmers able to do their own driving. Some cyclical divergence is therefore likely to recur.

Motor transport will probably eventually find a place in the economy that will be stable except for cyclical fluctuations. When it does, decline in the rail share of supply during contraction may be followed by a compensating recovery during expansion.

[10] Available statistics on total truck registrations (Table 138) and estimates of the number of trucks on farms and miles per truck (Bureau of Agricultural Economics, *Income Parity for Agriculture*, Part II, Section 4, mimeographed, Oct. 1940, p. 27) may seem to disprove our hypothesis; but they do not enable us to distinguish between local trucking, which no doubt declined, at least in industry, and trucking competitive with rail movement.

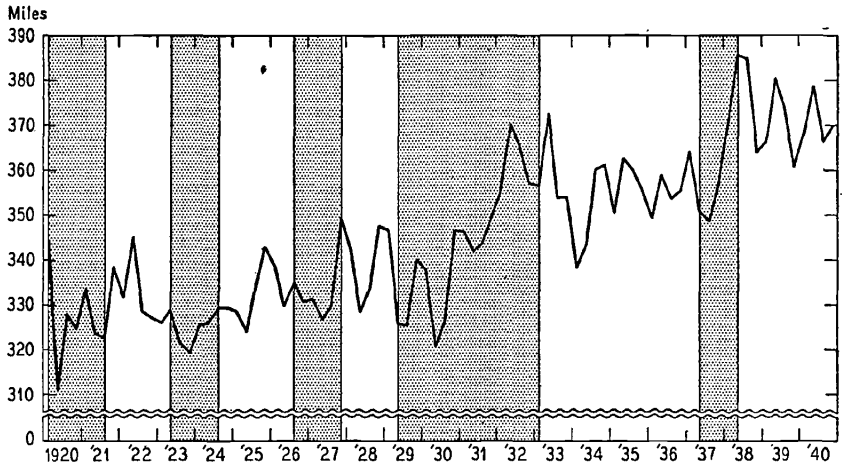
LONGER HAULS IN DEPRESSION

Average haul inversely related to cycles in flow

Tonnage originated indicates the quantity of goods the industries of the country dispose of in ways involving rail movement. It measures the importance of the railroads in the distribution of commodities. But in view of the work they must do and the compensation they receive, distance also is important. A railroad company must burn more coal and hire more workers to haul 1 million tons 1,000 miles than it would need to move an equal tonnage of the same commodities 100 miles, and it usually receives more revenue from the longer movements.

CHART 5

Average Haul, First Quarter 1920—Fourth Quarter 1940 (ton-miles per ton originated)



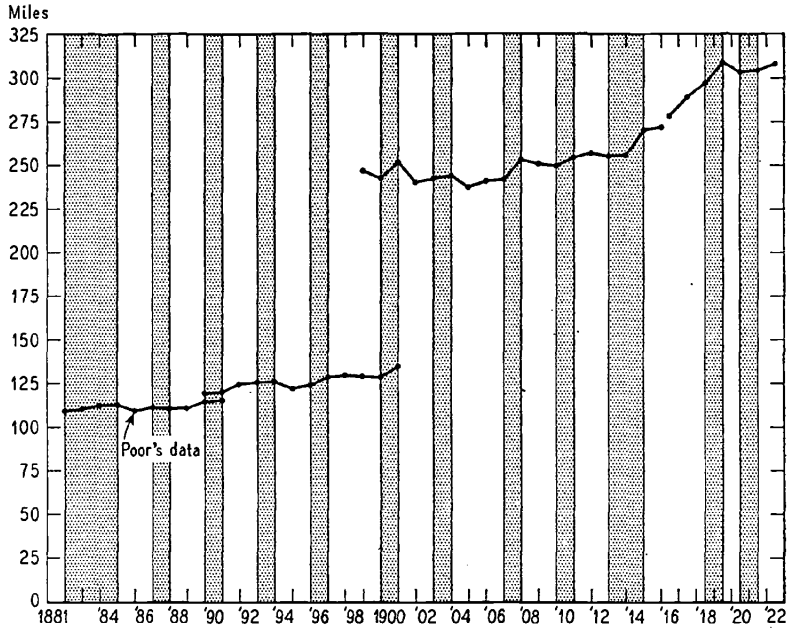
Shaded periods are reference contractions.

Variations in the average haul during a phase of business have been pretty uneven. This is especially obvious when quarterly data, available from 1920 onward, are examined (Chart 5). The contraction of 1920–21, for example, or the expansion of 1927–29, does not present a picture of even roughly continuous growth, or continuous decline. Annual figures for earlier phases necessarily make a somewhat smoother curve; but within a phase lasting more than one year even they sometimes display considerable irregularity, e.g., in 1904–07 (Chart 6).

Some distinction with respect to distance of movement, however, can be drawn between the two kinds of phase. In 14 of 16 reference contractions, the average haul was longer at the end than at the beginning, whatever the intermediate distances. On the other hand, it was shorter at the end than at the beginning in 8 of 15 expansions.

CHART 6

Average Haul, 1882–1922 (ton-miles per ton carried 1882–1901, per ton originated 1899–1922)



Shaded periods are reference contractions.

When a set of figures commonly shows a net fall during reference expansions and a net rise during contractions, we say that it conforms inversely to business. But a net rise during expansion, together with a greater net rise, in proportion to time elapsed, during an adjoining contraction, is analogous to a net decline followed by a net increase. And a net fall in expansion, together with a less rapid net fall in contraction, is likewise analogous to decline followed by increase. We regard sequences of either kind as additional cases of an inverse relation. In this more comprehensive

Table 3

Average Haul: Rate of Change in Phase Preceding Compared with Rate in Phase Following Each Reference Date

Reference date (year or quarter)	Phase preceding date		Phase following date		Description of change in		Conformity suggested by comparison
	State of business	Change per year[a] (miles)	State of business	Change per year[a] (miles)	Exp.	Contraction	
1885[b]	Contraction	1.15	Expansion	−0.48	Fall	Rise	Inverse
1887	Expansion	−0.48	Contraction	−0.79	Fall	Faster fall	Positive
1888	Contraction	−0.79	Expansion	1.92	Rise	Fall	Positive
1890	Expansion	1.92	Contraction	0.74	Rise	Slower rise	Positive
1891	Contraction	0.28	Expansion	2.80	Rise	Slower rise	Positive
1893	Expansion	2.80	Contraction	0.28	Rise	Slower rise	Positive
1894	Contraction	0.28	Expansion	−0.71	Fall	Rise	Inverse
1896	Expansion	−0.71	Contraction	3.80	Fall	Rise	Inverse
1897	Contraction	3.80	Expansion	0.09	Rise	Faster rise	Inverse
1900	Expansion	0.09	Contraction	6.50	Rise	Faster rise	Inverse
1901	Contraction	9.25	Expansion	−4.82	Fall	Rise	Inverse
1903	Expansion	−4.82	Contraction	1.95	Fall	Rise	Inverse
1904	Contraction	1.95	Expansion	−0.75	Fall	Rise	Inverse
1907	Expansion	−0.75	Contraction	11.89	Fall	Rise	Inverse
1908	Contraction	11.89	Expansion	−2.13	Fall	Rise	Inverse
1910	Expansion	−2.13	Contraction	4.42	Fall	Rise	Inverse
1911	Contraction	4.42	Expansion	0.52	Rise	Faster rise	Inverse
1913	Expansion	0.52	Contraction	7.77	Rise	Faster rise	Inverse
1915	Contraction	7.77	Expansion	7.49	Rise	Faster rise	Inverse
1918	Expansion	7.49	Contraction	11.71	Rise	Faster rise	Inverse
1919	Contraction	11.71	Expansion	−5.08	Fall	Rise	Inverse
1920[c]	Expansion	−5.08	Contraction	0.59	Fall	Rise	Inverse
III 1921[d]	Contraction	−3.57	Expansion	0.89	Rise	Fall	Positive
II 1923	Expansion	0.89	Contraction	0.10	Rise	Slower rise	Positive
III 1924	Contraction	0.10	Expansion	0.69	Rise	Slower rise	Positive
III 1926	Expansion	0.69	Contraction	2.88	Rise	Faster rise	Inverse
IV 1927	Contraction	2.88	Expansion	−3.91	Fall	Rise	Inverse
II 1929	Expansion	−3.91	Contraction	2.06	Fall	Rise	Inverse
I 1933	Contraction	2.06	Expansion	−0.34	Fall	Rise	Inverse
II 1937[e]	Expansion	−0.34	Contraction	8.68	Fall	Rise	Inverse

From 1882 to 1900 data pertain to ton-miles per ton carried ('individual railway' average haul); from 1901 onward to ton-miles per ton originated ('United States railways as a system' average). Figures opposite reference dates 1885–90 are computed from data in Poor's *Manual*.

[a] The method of computation may be illustrated as follows: In 1882, a peak year in business, the average haul was 109.02 miles. In the trough year 1885 it was 112.46 miles, an increase of 3.44 miles in 3 years, or 1.15 miles per year during the contraction phase ending in 1885. Rates of change for 1921 and after are per quarter instead of per year.

Note that although the average haul rose from the year 1920 to the year 1921 it fell from the first quarter of 1920 to the third quarter of 1921.

[b] Preceding reference year, 1882.

[c] Following reference year, 1921.

[d] Preceding reference quarter, I 1920.

[e] Following reference quarter, II 1938.

sense, 22 comparisons, each involving a pair of neighboring phases, indicate inverse, only 8 positive conformity (Table 3).

On the whole, therefore, if one is to form any judgment about the relation of distance to the state of business, it would be that the average haul tends to shorten in expansion and to lengthen in contraction.

Changing composition of traffic a likely reason

These cyclical changes may mean that the average haul of many articles, considered individually, lengthens as a decline in business deepens and becomes shorter as prosperity cumulates. Or they may mean that traffic in articles that have short hauls falls off more during contractions and recovers more during expansions than traffic in articles that have long hauls. Apparently they result in part at least from cyclical changes in the composition of traffic. Analysis of data for the only year within our period for which there are figures on ton-miles of individual commodities creates this impression.[11] As will be shown presently, the part of the traffic composed of durable goods expands and contracts more violently than the rest. And durable goods do not travel as far as other commodities. We have totaled the ton-miles of all durables in 1932 and divided them by the total tons originated. The quotient is 236 miles. For all other commodities a similar computation indicates an average distance of 373 miles. So wide a spread suggests that an appreciable difference must exist in years of prosperity also. As the percentage of nondurables rises during contraction, the average haul for all traffic (ton-miles of all commodities divided by their tonnage) lengthens; as the percentage falls with returning prosperity the average haul becomes shorter.

A more detailed statistical experiment will illustrate more precisely the possible effects of cyclical changes in composition. Suppose the average haul of each commodity had been exactly the same in 1929 as in 1932. How closely would the change in composition account for the actual change in the over-all distance? To answer this question we multiplied the 1929 tonnage of each article by its 1932 average haul, and divided the sum of the resulting products by the aggregate 1929 tonnage. The outcome is a hypo-

[11] The data appear in *Freight Traffic Report, Appendix I* (Federal Coordinator of Transportation, mimeographed, 1935), p. 74.

thetical haul of 323 miles for 1929. The actual average for 1932 was 353 miles, 30 miles longer. The regular ICC figures on average haul show a rise of 28 miles.[12] The lengthening that would have resulted from changing composition alone is almost the same as that which actually occurred.

We made a similar experiment for 1932 and the following peak year, 1937. The 1932 hauls, multiplied by 1937 tonnage originated, commodity by commodity, yield an average haul of 330 miles. In other words, if each article had moved the same average distance in 1937 as in 1932, the average haul on all traffic would have declined 23 miles (353 − 330), solely because of changes in the composition of the traffic. The actual decline was only 10 miles (from 347 to 337 miles). Since the actual change in composition would, of itself, have caused a greater decline in the average haul than actually occurred, other forces must have opposed it.

Cumulative lengthening over many cycles

Increases in distance have preponderated over decreases. The lengthening in most contractions, abetted by that in some expansions, has more than offset the fall in other expansions and in two contractions. In 1890, according to Poor's *Manual* data, the average individual-railroad haul was 6 miles longer than in 1882, another peak year in business. The ICC figure for 1890 differs appreciably from Poor's, so we cannot accurately compare the length before that year with the length in later years. But the ICC data themselves show a rise of 9 miles from 1890 to 1900, both peak years. When figures on the average distance from origin to destination become available, a rise from 243 miles in 1900 to 304 in 1920 is indicated. Finally, the average haul in the 1920 peak quarter was 344 miles; at the peak in 1937 it was 351 miles.

There were numerous reasons, at one time or another, for this cumulative elongation. Many of the ways in which the economic geography of the country has been changing have lengthened the distance between producers and consumers. A great fruit and vegetable industry grew up in Florida, Texas, California, and other

[12] For Class I roads 334 miles in the earlier and 362 miles in the later year. These are somewhat higher than the figures cited above. The difference may be due to the fact that the ICC data include less than carload traffic, the Coordinator data do not.

states remote from the major consuming areas. The coal fields in the Southern Appalachians were developed more rapidly than those farther north. The Pacific Northwest came to supply a large proportion of the nation's lumber. Enormously productive oil fields were developed in the Southwest. A new industry, the production of automobiles, grew up in a relatively small area and shipped its products to all parts of the country. Toward the end of the period motor competition drew off more of the short-haul than of the long-haul traffic of the railroads. Changes like these reflected a progressive appreciation by business enterprises of the possibilities of new areas, new products, and a new mode of transport. They persisted cycle after cycle and did not necessarily slacken during contractions. Though both new and old producing areas might reduce output, the newer areas might reduce theirs less. Perhaps if these more or less enduring influences had not existed, the average haul would actually have shortened more frequently in expansions. But then, without such dynamic sources of disturbance there might be no business cycles.

AGGREGATE RAIL MOVEMENT, LIKE TONNAGE, REFLECTED COMMODITY FLOW

Fluctuations in ton-miles conformed to cycles in business

Since distance of movement as well as the aggregate weight of shipments is important, figures that reflect both are in many respects preferable in the study of freight traffic. Such figures we have in the statistics of ton-miles. This quantity can be computed for any shipment by multiplying its weight by the miles between its origin and destination. National totals are in effect the sum of the products of such computations for all shipments. They are equal to the product of the national tonnage and the national average haul. Consequently, they are influenced both by the circumstances that give positive conformity to the former and those which give inverse conformity to the latter. But variations in the length of haul between reference dates are far less important. The percentage change in the average distance was almost always less than that in tonnage (Table 4). The first approached the second only in 1896–97, 1903–04, and 1910–11.

Table 4
Railway Tonnage and Average Haul: Percentage Change between Reference Years, 1882–1920, Reference Quarters, 1920–1938

Reference date (year or quarter)	Level of business	Tonnage[a]		Average haul[b]	
		Millions	% change from preceding date	Miles	% change from preceding date
1882	Peak	360	...	109.02	...
1885	Trough	437	21	112.46	3
1887	Peak	552	26	111.51	−1
1888	Trough	591	7	110.72	−1
1890	Peak	691	17	114.55	3
1890	Peak	637	...	119.72	...
1891	Trough	676	6	120.00	0[c]
1893	Peak	745	10	125.60	5
1894	Trough	638	−14	125.88	0[c]
1896	Peak	754	18	124.47	−1
1897	Trough	729	−3	128.27	3
1900	Peak	1082	48	128.53	0[c]
1900	Peak	583	...	242.73	...
1901	Trough	584	0[c]	251.98	4
1903	Peak	715	22	242.35	−4
1904	Trough	714	0[c]	244.30	1
1907	Peak	977	37	242.05	0[c]
1908	Trough	870	−11	253.94	5
1910	Peak	1026	18	249.68	−2
1911	Trough	1003	−2	254.10	2
1913	Peak	1183	18	255.15	0[c]
1915	Trough	1024	−13	270.69	6
1918	Peak	1377	34	296.89	10
1919	Trough	1190	−14	308.60	4
1920	Peak	1363	15	303.52	−2
I 1920	Peak	310.3	...	344.1	...
III 1921	Trough	231.0	−26	322.7	−6
II 1923	Peak	339.9	47	328.9	2
III 1924	Trough	285.8	−16	329.4	0[c]
III 1926	Peak	339.9	19	334.9	2
IV 1927	Trough	295.6	−13	349.3	4
II 1929	Peak	348.5	18	325.8	−7
I 1933	Trough	156.2	−55	356.7	9
II 1937	Peak	273.9	75	350.9	−2
II 1938	Trough	178.0	−35	385.6	10

[a] Carried 1882–1900, originated 1900–38. This change in divisor accounts for the much higher level of the average haul in the last two segments. The level of the tonnage figures in the fourth segment is much lower than in the third because they are quarterly, not annual.

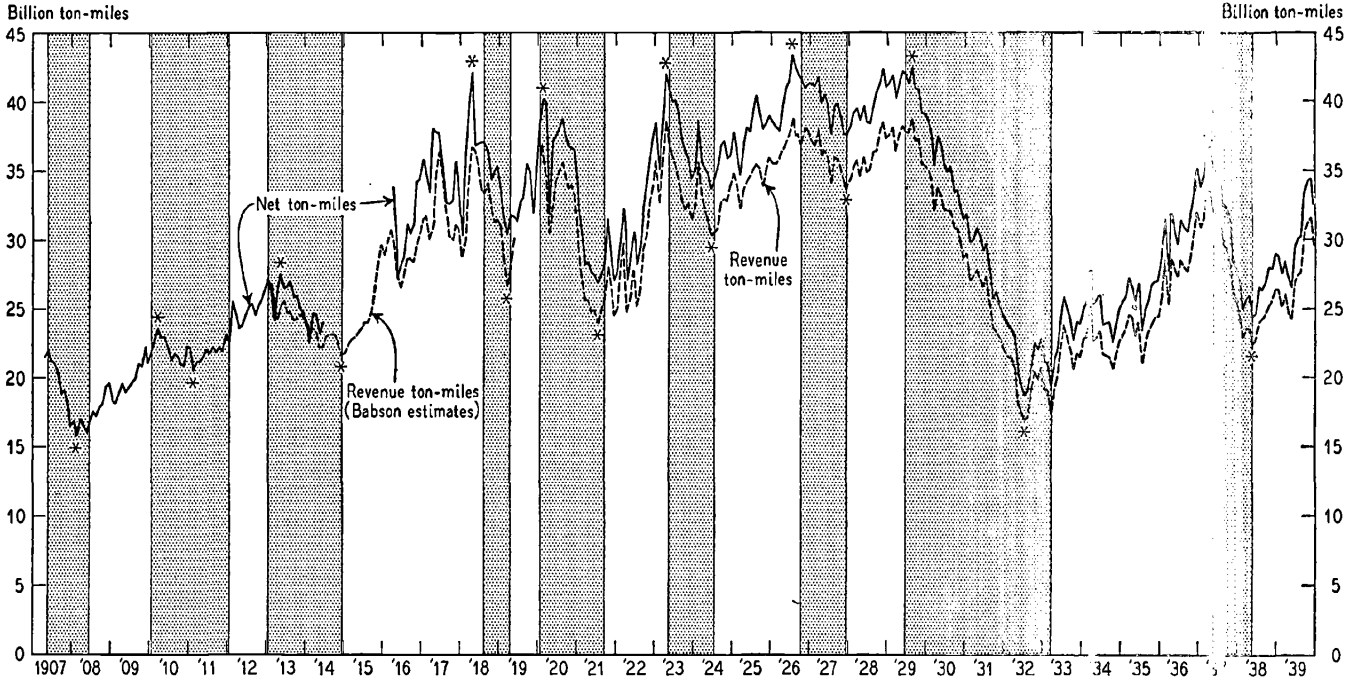
[b] Individual railway, 1882–1900; U. S. railways as a system, 1900–38.

[c] Increase or decrease of 0.5 percent or less.

Ton-miles also, as one might therefore expect, have conformed positively to the business chronology. From July 1907 onward, a period for which monthly figures representing an actual count or

CHART 7

Ton-miles, May 1907—December 1939



Shaded periods are reference contractions.

something close to it are available, every reference phase can be matched with a corresponding fall or rise in ton-miles (Chart 7).[13] Before 1908 annual data show that ton-miles increased from year to year in all the expansions for which we have data (Chart 8). But they increased in 7 of the 10 contractions also. In every one of the 7, however, the average rate of growth per year was smaller than in the adjacent expansions. Traffic invariably either diminished in contraction or increased at a slower rate than in expansion.

One should not infer from the mere deceleration indicated by the annual data in some reference contractions that there were no actual declines in traffic. Monthly figures sometimes disclose a 'specific' contraction when annual totals do not. Monthly estimates of ton-miles before 1908, prepared by the Babson Statistical Organization, suggest that there were periods of diminishing traffic corresponding to the reference phases 1873–79, 1882–85, and 1903–04, as well as others corresponding to the three—1893–94, 1896–97, and 1907–08—in which even the annual data reveal dwindling movement of freight (Chart 9).[14] In still other reference contractions even the monthly estimates show only retarded growth.

[13] Data on net ton-miles before 1918 were collected by the American Railway Association (now the Association of American Railroads). Those for 1907–14 are published in its *Proceedings*, May 1914, pp. 525 ff., and Nov. 1914, p. 745, and those for 1916 and 1917 in the *Survey of Current Business*, Dec. 1923, p. 52.

Revenue ton-miles before 1920 were estimated by the Babson Statistical Organization from net ton-miles or from ICC monthly data on freight revenue and annual data on revenue per ton-mile.

All other figures are from ICC sources directly. Net ton-miles differ from revenue ton-miles in that they include the movement of the railways' own materials and supplies as well as that of commercial shipments. But judging by actual data for both after 1919, the former exceeds the latter by only about 10 per cent, and the two curves look alike.

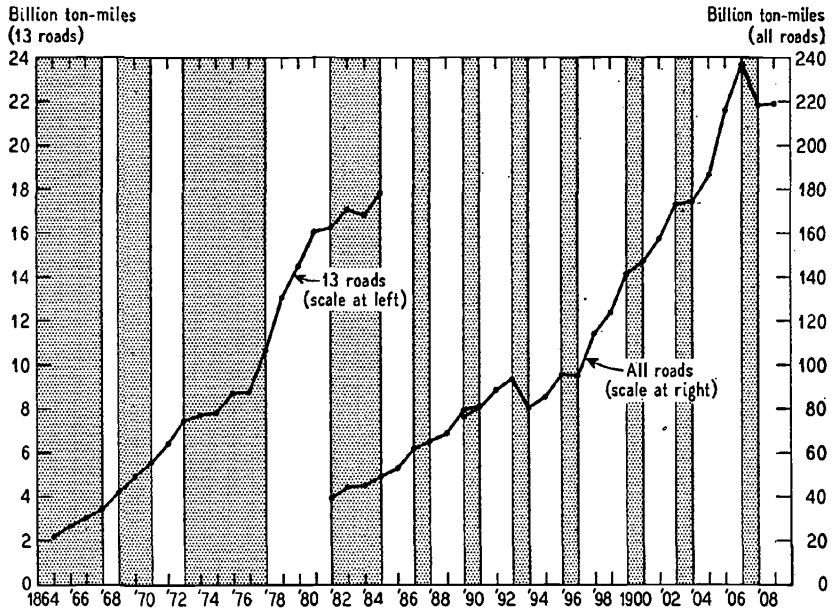
Turning points in the different kinds of ton-mile figures, in periods for which two kinds are shown, were identical, except in 1913, where we have marked the ARA rather than the Babson peak.

[14] We are indebted to the Babson Organization for its courtesy in permitting us to use these figures as well as those on Chart 7. Its point of departure in making the estimates was a painstaking compilation of monthly revenues (from all sources) of roads for which the information could be found. The totals for all such roads were seasonally adjusted. Monthly ton-miles were estimated with the aid of annual figures on the ratio of ton-miles of all roads (estimated by Carl Snyder) to revenues of the sample roads, 1866–82; and annual data on the ratio of freight revenue of all roads to total revenue of the sample roads, and on revenue per ton-mile of all roads, 1882–1909.

Railway mileage increased from year to year in all business contractions before the first World War as well as in the expansions. The growth of aggregate ton-miles was therefore compatible with declines in freight traffic density, i.e., in revenue ton-miles per mile of line. Even as measured by annual data, density on the thirteen roads was reduced a little during two periods within the 1873–78 reference contraction (Chart 10[15]). The persistent downward trend on these roads after 1879 is puzzling, but data for all roads beginning with 1882 show that traffic thinned during part or all of each contraction except 1900–01 and perhaps 1890–91.

CHART 8

Ton-miles: Thirteen Railroads, 1865–1885; All Railroads, 1882–1909



Shaded periods are reference contractions.

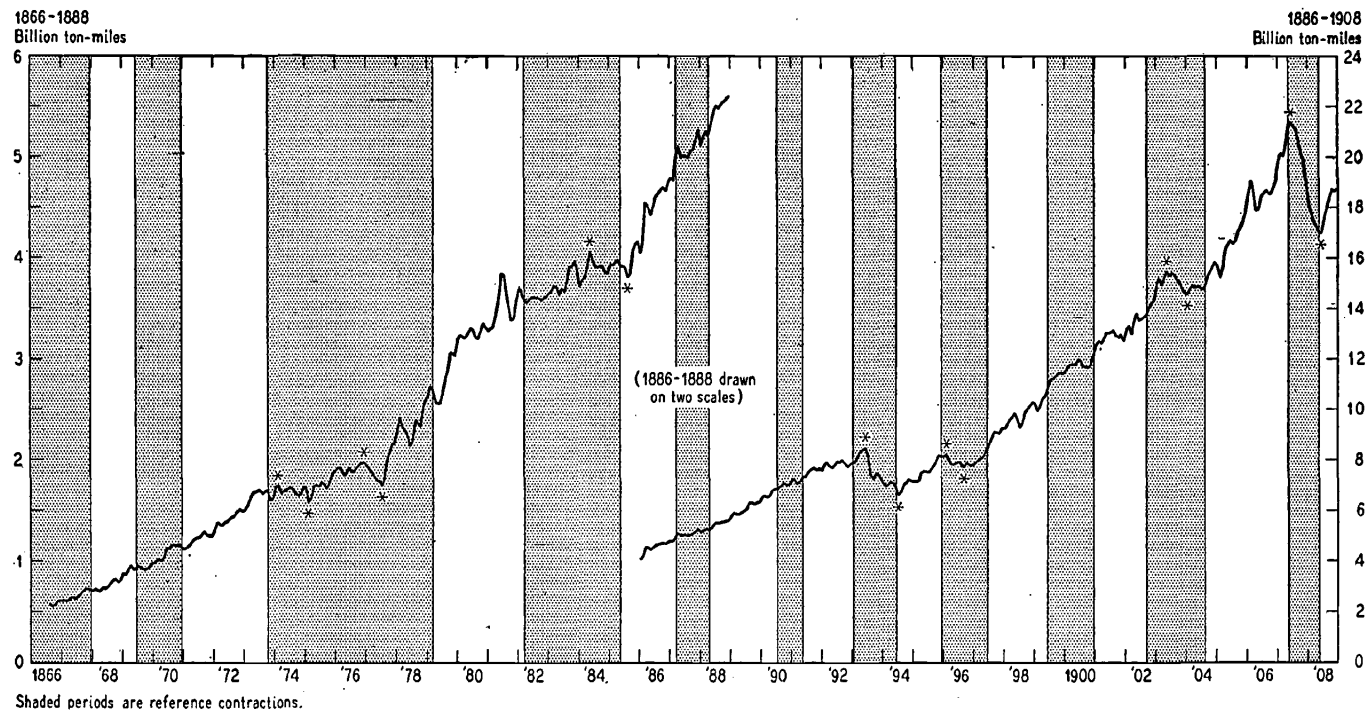
Turning points

When there were contractions and expansions in ton-miles corresponding to those in the 'business' chronology, their beginning and

[15] 1871–86, 1882–90, miles operated at beginning and end of each year averaged to give divisor for year. Mileage incomplete for 13 roads before 1871. Beginning 1890, density as computed by ICC.

CHART 9

Ton-miles, Babson Estimates, August 1866—December 1908

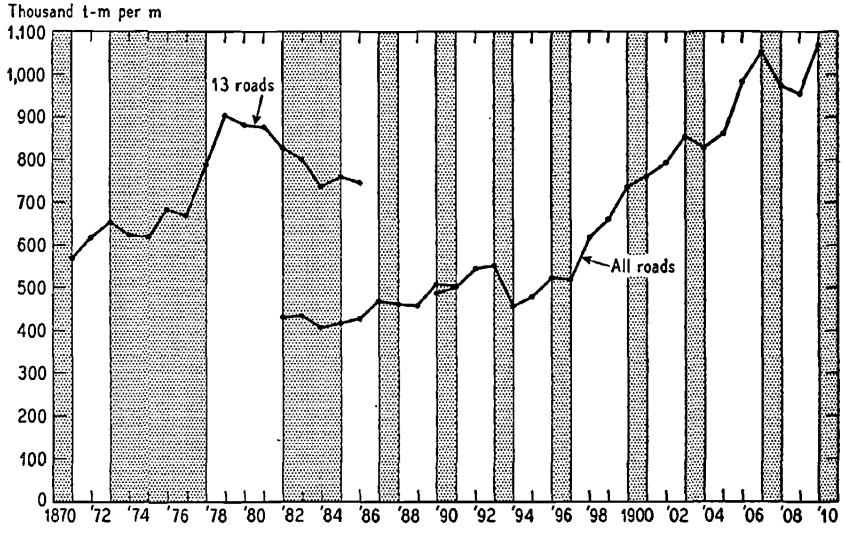


Shaded periods are reference contractions.

ending months seldom coincided with the reference dates (Chart 11). Since 1913 the differences in time have been relatively small, except in 1932–33. Some of the earlier intervals, however, were so long that they invite comment. Instead of a protracted decline from October 1873 to March 1879, the monthly estimates show only a brief, mild, and interrupted one. We are accustomed to think of the later '70's as a bad depression, yet the shrinkage in traffic was small. Burns and Mitchell locate a peak in March 1882, but traffic, according to the estimates, continued to grow until May 1884. As the subsequent decline halted soon after May 1885, it was therefore very short in comparison with the reference phase. The reduction was again very mild, from 3.98 billions (average for April, May, and June 1884) to 3.84 (average for July, August, and September 1885), or about 4 per cent.

CHART 10

Ton-miles per Mile of Line: Thirteen Railroads 1871–1886; All Railroads, 1882–1910



Shaded periods are reference contractions.

Although the business chronology must roughly identify periods of swelling and those of diminishing commodity flow, it is not necessarily true that the flow, properly weighted by the initial importance of the various commodities as components of the traf-

fic, had cyclical turns exactly at the reference dates. A difference between flow and reference dates may account for the interval between the freight trough in 1911 and the reference trough 11 months later. Bituminous coal and iron and steel products[16] accounted for 31 to 33 per cent of all tonnage originated, 1908–12. The production of coal reached bottom in the same month as traffic, and that of steel ingots only two months before. These commodities are widely used in other industries, and activity in a number of the latter may have revived at about the same time. The low point in composite flow may not have been as far from that in ton-miles as the reference date suggests. Similar remarks apply to the shorter interval in 1908. Bituminous coal and steel ingots were at their nadir in January, within a month of traffic, rather than four months later.[17]

Another striking difference in turning dates occurred in the long depression following 1929. The trough in ton-miles came in July 1932; that in business, in March 1933. Various measures indicate that this depression had a double bottom: business activity turned up from a low point in the summer of 1932, then declined to a second low in March 1933, when the banks were closed. The seasonally adjusted Federal Reserve index of industrial production, which touched bottom in July at 53, rose to 60 in October, then fell back, but only to 54 in March.[18] The business turning date is placed in 1933 rather than in 1932.[19] Traffic followed the Reserve index; but the differences in level between July and March are very slight, and might be reversed by small changes in the statistical techniques underlying the figures.

Ton-miles usually reached a peak later and a trough earlier than business. Traffic continued to grow for a while after business began to decline, and began to increase before business began to improve; 10 of 14 'specific' high points followed, 9 of 14 low points preceded, the corresponding reference dates.

[16] Iron, pig and bloom; iron and steel rails; other castings and machinery; bar and sheet metal.

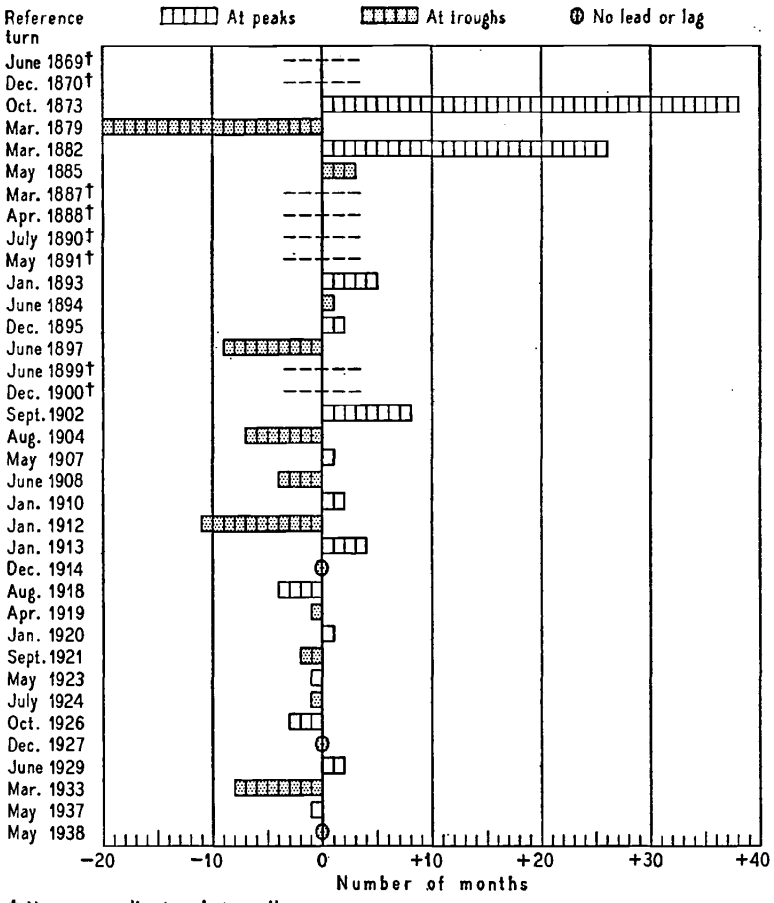
[17] In both instances a wider range of commodities than we have data for would have to be considered for a conclusive test of the explanation suggested.

[18] Board of Governors of the Federal Reserve System, *Federal Reserve Index of Industrial Production*, Oct. 1943, p. 24.

[19] The problem of choosing between these alternatives is discussed in *Measuring Business Cycles*, pp. 82–3.

CHART 11

Number of Months by which Turn in Ton-miles Preceded (−) or Followed (+) Reference Turn



† No corresponding turn in ton-miles.

The forces operating to increase the share of the railroad companies in the flow of commodities and to lengthen the average haul in both expansions and contractions during much of this period might cause the increase in traffic to continue for a time after the improvement in business had stopped, and might cause traffic to increase even before business began to improve. The fact that these forces have been losing their effectiveness in recent cycles would help to explain why the intervals between turns in

business and in traffic have become shorter and less consistent in respect of the order of events.

Table 5
Turning Points in Ton-miles

Date of turn	Level	Data on which based
February 1908	Trough	Net ton-miles
March 1910	Peak	" " "
February 1911	Trough	" " "
May 1913	Peak	" " "
December 1914	Trough	Revenue ton-miles (estimated)
April 1918	Peak	Net ton-miles
March 1919	Trough	" " "
February 1920	Peak	Revenue ton-miles†
July 1921	Trough	" " "
April 1923	Peak	" " "
June 1924	Trough	" " "
July 1926	Peak	" " "
December 1927	Trough	" " "
August 1929	Peak	" " "
July 1932	Trough	" " "
April 1937	Peak	" " "
May 1938	Trough	" " "

Derived from Chart 7.

The 1926, 1927, 1929, 1932, and 1937 turns differ somewhat from those shown in National Bureau of Economic Research *Occasional Paper 5*, pp. 45, 47, because we have revised our seasonal adjustment of the original data.
† Turns in net ton-miles identical, 1920–38.

The level of ton-miles at some of the specific turns we have designated was only a little different from the level in other nearby months. In such cases a slight modification of our processes of seasonal adjustment might shift the dates somewhat. Yet the movement of freight was unmistakably greater at each of the chosen peaks than at the nearest troughs. In subsequent chapters we shall inquire into the effects or concomitants of cyclical fluctuations in traffic. There we shall employ the dates after 1907 to mark out the periods that promise the best test of such accompaniments or consequences. For convenience of future reference we show them in Table 5.

Big and little expansions and contractions

Phases of growth in freight traffic, like phases of shrinkage, differed greatly in respect of both the amplitude of fluctuation and

duration (Table 6). From the trough in 1877 to the peak in 1884 ton-miles increased 124 per cent, from 1927 to 1929 only 11 per cent. In the deepest contraction, 1929–32, traffic diminished 55 per cent, in 1884–85 only 4 per cent. Annual figures blunt the variation, but even they indicate a substantial difference among phases.

Table 6
Percentage Change in Ton-miles between Peaks and Troughs in Ton-miles

Monthly data[a]				Annual data			
Expansions		Contractions		Expansions		Contractions	
Dates[b]	%	Dates[b]	%	Dates	%	Dates	%
1877–84	124	1929–32	−55	1897–1907[c]	149	1929–32	−48
1885–93[c]	117	1920–21	−31	1932–37	54	1920–21	−25
1896–1903	98	1937–38	−31	1915–18	48	1937–38	−20
1932–37	93	1918–19	−21	1921–23	35	1893–94	−14
1914–18	64	1893–94	−19	1894–96	19	1918–19	−10
1921–23	51	1907–08	−19	1911–13	19	1907–08	−8
1904–07	45	1923–24	−17	1908–10	17	1913–15	−8
1908–10	40	1913–14	−17	1924–26	14	1923–24	−6
1911–13	26	1926–27	−10	1919–20	13	1926–27	−3
1919–20	27	1876–77[d]	−9	1927–29	4	1896–97	[e]
1924–26	23	1910–11	−8			1910–11	[e]
1875–76[d]	20						
1894–96	20						
1927–29	11	1903–04	−5				
		1874–75[d]	−4				
		1896–96	−4				
		1884–85	−4				

[a] Based on estimated revenue ton-miles, 1877–1908, 1913–18; net ton-miles, 1908–13, 1918–20; revenue ton-miles, 1920–38. Computed from averages for month of turn and preceding and following months; e.g., average for April, May, June 1884 was 124 percent higher than that for June, July, August 1877.

[b] For exact dates see Table 5 and Chart 9.

[c] Period of expansion in ton-miles includes one or more reference contractions and does not correspond to any single reference expansion.

[d] One of three specific phases within reference phase 1873–79.

[e] Decrease of less than 0.5 percent.

Excluding those which cannot be paired with any reference phase, expansions range in length from the 11-month recovery after World War I to the 82 months from July 1877 to May 1884 (Table 7). Contractions were as short as 7 months (1896) and as long as 35 (1929–32).

Table 7
Duration of Phases and Full Cycles in Ton-miles

Expansions		Contractions		Full cycles[a]	
Dates[b]	Months	Dates[b]	Months	Dates[b]	Months
1885–93[c]	94	1929–32	35	1885–94[d]	107
1877–84	82	1913–14	22	1877–85	97
1896–1903[c]	80	1920–21	17	1896–1904[d]	88
1932–37	57	1926–27	17	1932–38	70
1904–07	41	1884–85	15	1927–32	55
1914–18	40	1923–24	14	1904–08	53
1911–13	27	1893–94	13	1914–19[e]	51
1908–10	25	1937–38	13	1911–14[e]	45
1924–26	25	1874–75[f]	12	1924–27	42
1875–76[f]	22	1907–08	12	1908–11	36
1921–23	21	1910–11	11	1921–24	35
1927–29	20	1918–19	11	1875–79	29
1894–96	19	1903–04	8	1919–21	28
1919–20	11	1876–77[f]	7	1894–96	26
		1896–96	7		

Estimated revenue ton-miles, 1877–1908, 1913–18; net ton-miles, 1908–13, 1918–20; revenue ton-miles, 1920–38; except as noted.

[a] Measured from trough to trough.

[b] For exact months see Table 5 and Chart 9.

[c] Does not correspond to any single reference phase.

[d] Does not correspond to any single reference cycle.

[e] Estimated revenue ton-miles for full cycle, since net ton-miles are available for only one phase. In these estimates the expansion of 1911–13 has 23 months instead of 27.

[f] One of three specific phases within reference phase 1873–79.

Table 8
Ton-miles at Successive Peaks

Date of peak in ton-miles	Amount at peak[a] (billions)	Ratio to amount at preceding peak	Date of peak in ton-miles	Amount at peak[a] (billions)	Ratio to amount at preceding peak
February 1874	1.71	...	February 1913[b]	26.28	...
December 1876	1.96	1.15	April 1918	35.77	1.36
May 1884	3.98	2.03			
June 1893	8.33	2.09	April 1918	39.6	...
February 1896	8.08	0.97	February 1920	39.5	1.00
May 1903	15.35	1.90			
June 1907	21.30	1.39	February 1920	35.59	...
April 1910[b]	21.94	1.03	April 1923	37.14	1.04
			July 1926	37.93	1.02
March 1910[b]	23.2	...	August 1929	37.84	1.00
May 1913[b]	26.9	1.16	April 1937	33.06	0.87

[a] Average for peak, preceding and following months, e.g., October, November, December 1876. Babson estimated revenue ton-miles, 1876–1910, 1913–18; net ton-miles, 1910–13, 1918–20; revenue ton-miles, 1920–37.

[b] The Babson and ARA data show peaks in different months.

Preceding peaks more widely and frequently exceeded in expansions before 1919–20

Most of the contractions before 1918–19 in the amount of freight movement, like those in the tonnage, proved to be mere temporary interruptions of growth (Table 8). The peaks of 1884, 1903, 1907, 1913, and 1918 overtopped their immediate predecessors by percentages ranging from 16 to 109. Only two failed to exceed the highest previous record appreciably. Traffic in January, February, and March 1896 was 3 per cent below the preceding peak;[20] recovery was incomplete. 1910 exceeded 1907 by only 3 per cent. On the other hand, no peak after 1918 surpassed its preceding peak by more than 4 per cent. At the high point in 1937, the movement of goods was 13 per cent smaller than at the high point in 1929. Not until the second world war, which had extraordinary effects on volume of commodity output, distances of shipment, and the position of competitors, did traffic again break all previous records.[21]

The reasons for this contrast are similar to those already noted in discussing a corresponding break in the history of tonnage. Percentage net increases in the aggregate flow of commodities were probably smaller in the 1920's than in earlier decades; from 1929 to 1937 the flow declined. Before 1929 the railroads won a growing share from waterways and local markets; afterwards they lost, especially to motor trucks. The average haul for the kinds of traffic lost, however, was shorter than that for the kinds retained; the latter continued to increase, and the stagnation or decline in ton-mileage was therefore less marked than in the quantity of goods handled.

Subsidiary fluctuations

The growth or shrinkage of traffic between its own cyclical peaks and troughs was somewhat unsteady, like that of many other economic activities. Most of the irregularities were minor, some outstanding. The movement of freight, which had increased materially as long as the United States was neutral, diminished

[20] Throughout this book, except as noted, we use an average of the figures for the month of peak or trough, the month immediately preceding it, and the month immediately following it to represent the level of an activity at a peak or trough. The purpose is to minimize the effect of any temporary abnormal occurrences.

[21] See Thor Hultgren, Railway Traffic Expansion and Use of Resources in World War II, NBER *Occasional Paper 15*, Feb. 1944.

sharply after its entry into the war (April 1917), although a subsequent brief recovery carried it to a peak in April 1918. After an abrupt drop in April 1920, traffic in the 1920–21 contraction almost regained its initial level. A sudden spurt in January and February 1924 brought it part way back to its 1923 peak before it fell to its low point in June. In the great depression, three more baby cycles followed the already noted subcycle from July 1932 to March 1933. A fairly persistent recovery did not set in until the beginning of 1935. Later chapters will show that such fluctuations within phases often had consequences like those of the main waves.

Some at least of the intra-phase disturbances were not confined to the railroad industry. The production of bituminous coal, which moves by rail in greater volume than any other commodity, declined during the latter part of 1917. The output of both coal and steel ingots, the raw material for many important items of freight, revived somewhat in the third quarter of 1920. There was a transient partial recovery of both in the winter of 1923–24. Each had four small waves of growth and decline between the middle of 1932 and the first months of 1935. Expansion and contraction, on the railroads and elsewhere, are sometimes far from smooth and continuous processes.

CHANGES IN THE COMPOSITION OF TRAFFIC

Durable vs. nondurable goods

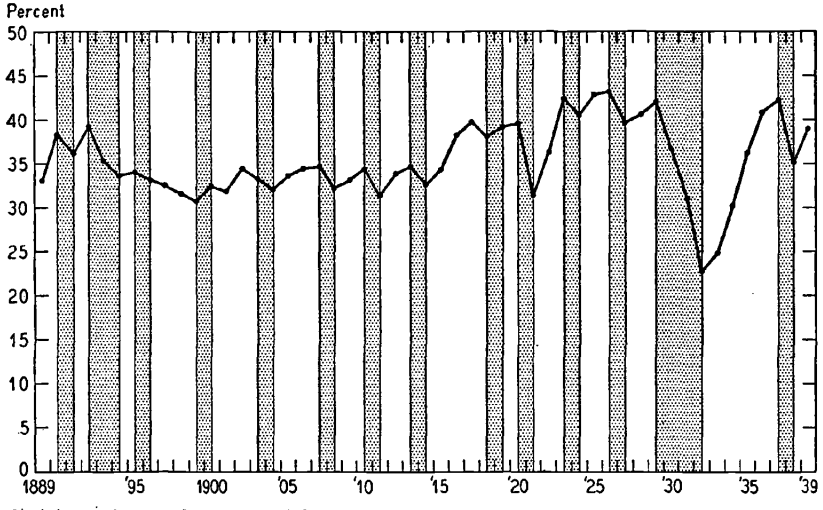
The output of some commodities fluctuates more violently during business cycles than that of others. These differences are reflected in the character of railway traffic.

The flow of durable goods is generally believed to vary more widely than that of other articles. Studies conducted at the National Bureau by Simon Kuznets and William H. Shaw strengthen this impression. They made annual estimates of the value in constant prices of perishable, semidurable, and durable commodities flowing to domestic consumers and durable goods added to the equipment of domestic producers, all of which they call "finished commodities". In addition they estimated the value of construction materials, which, in view of their use, may also be regarded as durable. We have added their figures for the three durable groups

in each year and have compared the net change, during each reference phase, in the total so derived with the net change in perishables. The flow of durables increased by a greater percentage than that of nondurables (which diminished in one instance) during all the expansions. In 9 of 11 contractions durables decreased, while nondurables decreased by a smaller percentage, did not change, or increased. The percentage ratio of durables to total finished commodities plus construction materials therefore conformed positively to the reference chronology, rising in 12 of 13 expansions, falling in 12 of 14 contractions (Chart 12). The aggregate flow of durables obviously increased more than that of other goods in the former phases, declined more in the latter.

CHART 12

Flow of Consumer Durable Goods, Producer Durable Goods, and Construction Materials: Percentage of All Finished Commodities plus Construction Materials, 1889–1939



Shaded periods are reference contractions.

A similar contrast may be observed in railway traffic. We have classified tons originated from 1899 to 1939 as durable or other than durable. For various reasons our classification differs from that of Kuznets and Shaw.[22] Furthermore, in their work different

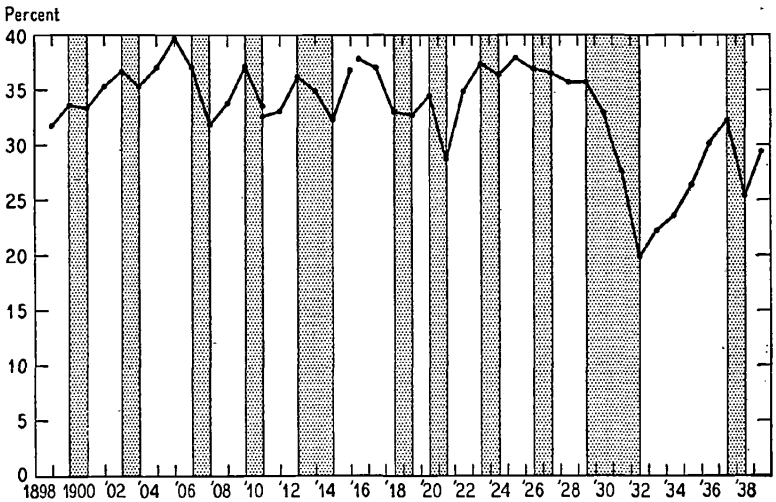
[22] We have counted the following ICC statistical categories as durable:

1899–1919: coke; ores; stone, sand, and other like articles; lumber; iron, pig and bloom; iron and steel rails; other castings and machinery; bar and sheet metal;

commodities are in effect added on the basis of their average values, while our figures pertain to aggregate physical weight. Nevertheless, the ratio of durable to all tonnage rose in all reference expansions except 1927–29, fell in all contractions (Chart 13).[23]

CHART 13

Durable Goods: Percentage of Total Tons Originated, 1899–1939



Shaded periods are reference contractions.

cement, brick and lime; agricultural implements; wagons, carriages, tools, etc; household goods and furniture.

1920–27: coke; iron ore; other ores and concentrates; clay, gravel, sand and stone; asphaltum; logs, posts, poles and cordwood; ties; lumber, timber, and box shooks, staves and headings; boat and vessel supplies; iron, pig and bloom; bar and sheet iron, structural iron, and iron pipe; rails and fastenings; castings, machinery and boilers; base bullion and matte; other metals; pig, bar and sheet; cement; brick and artificial stone; lime and plaster; sewer pipe and draintile; agricultural implements and vehicles other than automobiles; automobiles and auto trucks; furniture.

1928–39: statistical classes 310, 320, 330, 331, 332, 333, 350, 351, 352, 353, 370, 400, 401, 410, 430, 432, 490, 491, 500, 510, 511, 512, 513, 520, 521, 522, 523, 530, 540, 550, 551, 552, 560, 561, 570, 580, 581, 582, 583, 590, 591, 592, 610, 611, 692, 693, 696, 697.

Our list includes not only articles that are themselves lasting but also commodities that are consumed chiefly in the production of durables.

[23] The average annual decline in 1927–29 was at the same rate as in 1926–27 but negligible when compared with that in 1929–32. Most but not all of the rise in 1904–07, 1915–18, and 1924–26 disappeared in the last year of two of the phases.

Farm vs. other products

Any classification of nondurable goods would include almost all farm products and articles manufactured from them. Agricultural output does not rise on full employment as consistently in business cycles as industrial output does. Comparison of the Barger-Landsberg index of agricultural production with the Barger-Schurr index of mineral output and with the Fabricant index of manufacturing production shows that the net percentage increase in the first was smaller than that in the other indexes during every reference expansion. In most of the contractions production on farms did not diminish as much as production in mines and factories; in some it even increased. The flow of commodities from farms therefore tended to become more abundant relatively to total flow during contractions and relatively less abundant during expansions. The point can be emphasized by computing the ratio of the agricultural to the mineral or manufacturing index. Each may be thought of as measuring output in terms of units. (One unit of production, in any year, would be an amount of production equivalent to 1 per cent of the total output in the base year of the index[24]). For example, if the agricultural index for any year is 97, we may say that farmers produced 97 units of product in that year. The number of units of agricultural output per unit of mineral output, or of manufacturing output, fell in all 10 of the reference expansions from 1899 to 1938, rose in 9 of the 11 contractions (Chart 14).

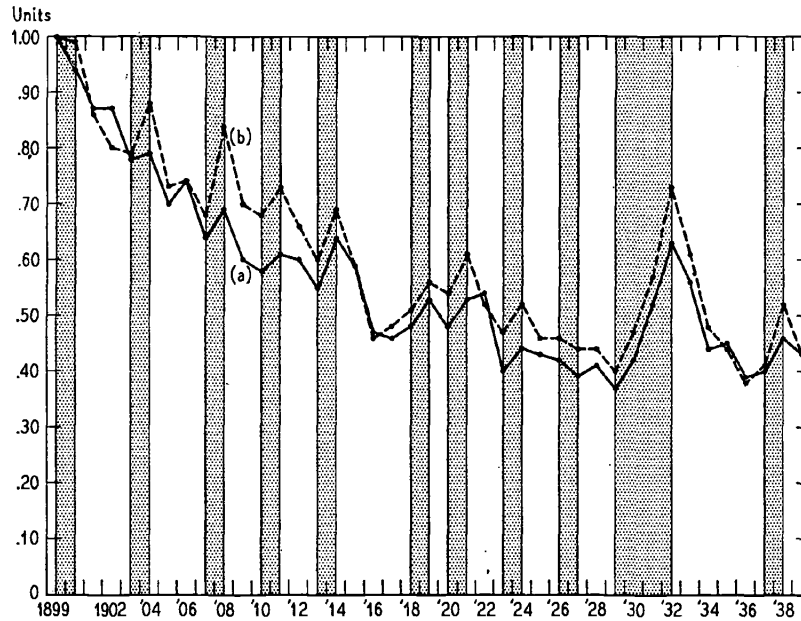
Different farm products, or industrial products, were added together in the computation of these indexes on the basis of average value rather than their importance as railway traffic. The ICC Bureau of Statistics study of traffic and supply previously cited, however, contains indexes of the supply of products of agriculture and animals and products, weighted as we would like them to be. Such an index for all other traffic can be computed from the same source. Here certain manufactures, such as flour and meat, are grouped with farm products, although they would be included in the Fabricant manufacturing group rather than in the Barger agricultural group. Nevertheless, the supply of agricultural and animal commodities was decidedly more stable than that of other

[24] For the method of adding different commodities, and other details, see the volumes cited in Table 2, note a.

goods (Chart 15). Both farm indexes fell only slightly in 1929–32, while other articles declined more than 50 per cent. The latter recovered sharply in 1932–37, while the first two were relatively steady. In 1937–38 products of agriculture and animals and products increased somewhat while other goods diminished.

CHART 14

Units of Agricultural Output per Unit of (a) Mineral Output, (b) Manufacturing Output, 1899–1939



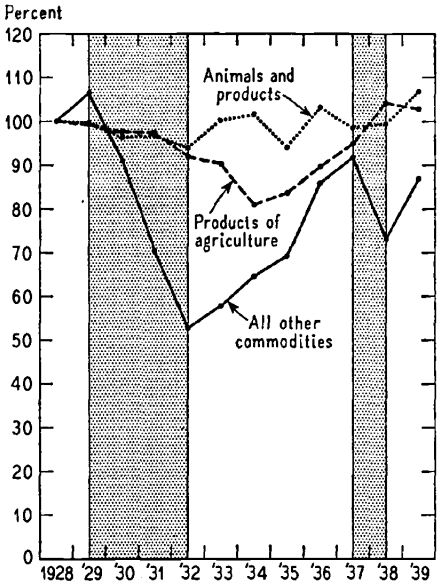
Shaded periods are reference contractions.

We have expressed agricultural tonnage as a percentage of total tonnage originated, following the ICC rather than the Barger-Fabricant classification (Chart 16[25]). The ratio rose in every contraction, fell in every expansion except 1911–13. Averaging the changes in the two years of that phase yields a slight rise, which, however, was less rapid than in the adjoining contractions. The flow of farm products was a stabilizing factor in the business of the

[25] We omitted less than carload tonnage from the computations because of uncertainty concerning the extent to which it may be agricultural or non-agricultural.

CHART 15

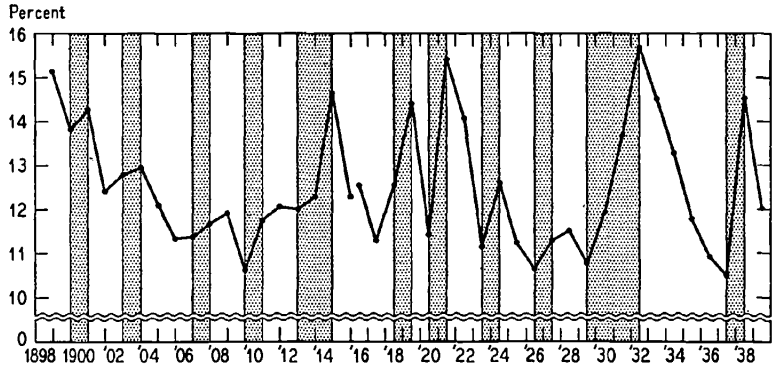
Flow of Farm and Other Products into all Forms of Disposal: Indexes Weighted by Tons Handled by Railroads in 1928



Shaded periods are reference contractions.

CHART 16

Products of Agriculture plus Animals and Products: Percentage of All Railroad Tonnage Originated, 1899–1939

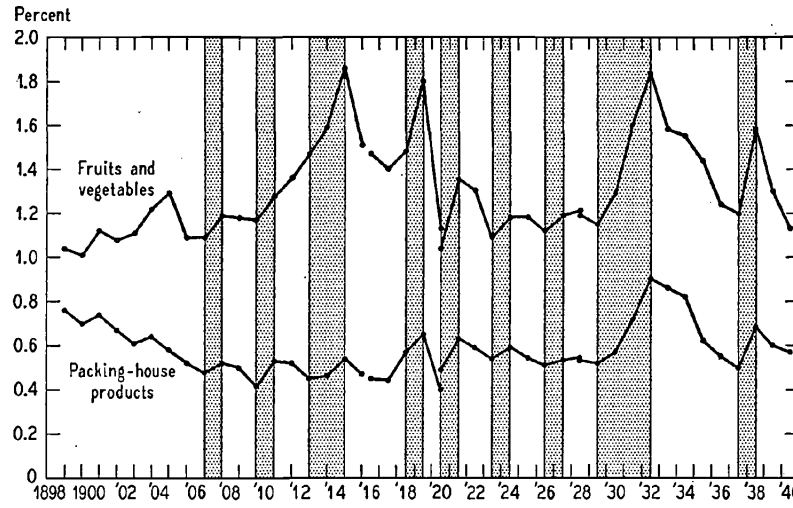


Shaded periods are reference contractions.

railroads; if it shrank at all, it did not shrink as fast as other traffic in contraction; in expansion, it did not grow as rapidly, if at all.

CHART 17

Perishable Foods: Percentage of Total Tonnage Originated, 1899–1940



Shaded periods are contractions in revenue ton-miles.

Specific examples of stable traffic: Perishables and petroleum

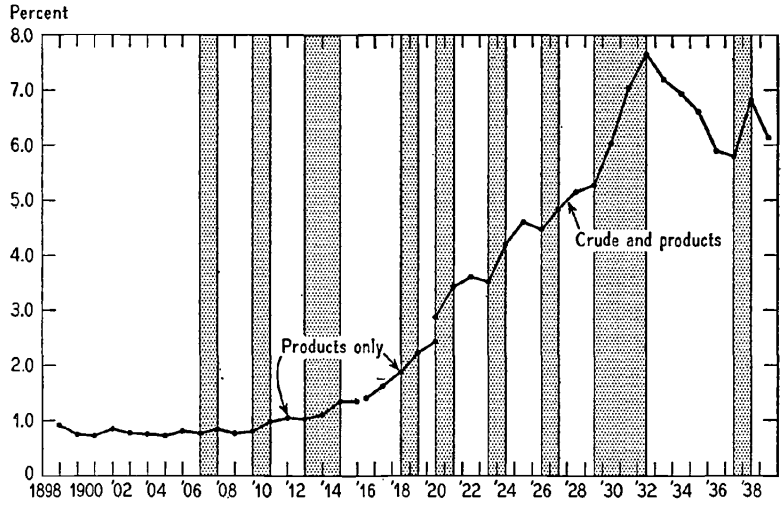
The comparative stability of two kinds of traffic—perishable foodstuffs, and petroleum and its products—has a special interest because of its effect on empty car movement (Ch. 4). The ratio of fruit and vegetable tonnage to the total originated increased in every contraction of the latter from 1907 onward, diminished in every expansion except 1911–13. This was also true of packing house products except in the expansion of 1915–18 when, as a result of a rise in the last year, there was a small net increase for the phase as a whole (Chart 17).[26] A similar ratio for petroleum traffic

[26] The ICC statistical categories included in computing the ratio for fruits and vegetables are: 1899–1920, fruits and vegetables; 1920–28, citrus fruits, other fresh fruits, potatoes, other fresh vegetables; 1928–39, *Freight Commodity Statistics* classes 110–125, 127–143, 152. Packing house products include: 1899–1920, dressed meats, other packing house products; 1920–28, fresh meats, other packing house products, poultry, eggs, butter and cheese; 1928–39, classes 210–222, 231–251. In making up both groups we tried to confine them to commodities shipped in refrigerator cars. J. R. Van Arnum, Traffic Consultant, National League of Whole-

increased in all contractions and fell in some expansions. In the others the rise was usually less rapid than in the neighboring phases; the ratio conformed to cycles in ton-miles (Chart 18).[27]

CHART 18

Manufactured Petroleum and Other Oils, 1899–1920; Crude Petroleum and Its Products, 1920–1939: Percentage of Total Tonnage Originated



Shaded periods are contractions in revenue ton-miles.

DIVERSITY AND IMMEDIACY OF DEMAND PREVENTED EXTREME FLUCTUATIONS

The preceding paragraphs suggest that the production of some articles fluctuates violently in both expansion and contraction, the production of others mildly. Still other commodities present a different picture in one kind of phase than in the other. The output of relatively new articles that are winning their way into general

sale Fresh Fruit and Vegetable Distributors, kindly gave us the benefit of his experience on this point, and we followed his recommendations exactly, 1928–39. Prior to that the statistics do not permit as complete a segregation.

Because of the nature of our problem in Chapter 4, we show the relation of these ratios to trade cycles rather than to the occasionally somewhat different reference cycles.

[27] ICC categories: 1899–1920, petroleum and other oils (including some vegetable oils); 1920–28, crude petroleum, refined petroleum and its products; 1928–39, classes 360, 450–453.

acceptance is likely to decline less than that of most others, or even to increase, in contraction, while the output of commodities that are becoming obsolescent or are in process of displacement is likely to fall by larger than ordinary percentages. In expansion, however, the new articles are likely to increase more, not less, than others, and the old commodities are likely to increase less than most others, if indeed they do not decline. In any one phase, nevertheless, progress and obsolescence contribute to the diversity of fluctuation.

Table 9
Ton-miles, Production of Paper, and Production of Steel Ingots
Percentage Change in Each between Its Own Turning Points

Approximate date	Level	% change from preceding date		
		Ton-miles	Paper[a]	Ingots[b]
1903[c]	Peak	...		...
1904	Trough	−5		−40
1907	Peak	45		161
1908	Trough	−19		−51
1910	Peak	40		143
1911	Trough	−8		−28
1913	Peak	26		61
1914	Trough	−17		−44
1918	Peak	64		135
1919	Trough	−21		−35
1920	Peak	27	39	43
1921	Trough	−31	−38	−66
1923	Peak	51	76	229
1924	Trough	−17	−10	−40
1926	Peak	23	31	85
1927	Trough	−10	−4	−21
1929	Peak	11	17	56
1932	Trough	−55	−35	−82
1937	Peak	93	95	422
1938	Trough	−31	−30	−61

For method of computation see Table 10. Note that exact date varies from one activity to another, depending on the turning points in each.

[a] Based on data from the Federal Trade Commission, *Monthly Statistical Summary of the Paper Industry;* Department of Commerce, *Survey of Current Business;* and correspondence with the latter. Not available before 1919–20.

[b] Production per working day. Based on data from the *Iron Age.*

[c] 1903–04 is earliest specific phase in ton-miles for which data on a corresponding phase of ingot production are available.

Cyclical variations in traffic, measured between their own peaks and troughs, are bound to be less extreme than those in the most changeable forms of production. Largely because fluctuations in

various kinds of output differ in amplitude and even direction, fluctuations among the corresponding kinds of traffic are also certain to differ. As a result of building up or depletion of stocks at points of origin, altered choices between means of disposal, and shifts between near and remote markets, expansions and contractions in the movement of any one commodity are not necessarily of the same size, percentagewise, as those in its output. Nevertheless, changes in stocks, etc., cannot wholly wipe out the differences in the behavior of production, and some kinds of traffic must fluctuate more than others. But the percentage change in total traffic is an average of the changes in its component individual species. It is therefore smaller than those in the most extremely fluctuating and larger than those in the most stable components. Changes in railway traffic in any phase are comparable with those in the output of those commodities which have moderate fluctuations in that phase.

Table 10
Specimen Calculations for Table 9

	Date of		Amount[a] at		% increase (2) over (1)
	Trough	Peak	Trough (1)	Peak (2)	
Ton-miles (billions)[b]	Mar. 1919	Feb. 1920	31.1	39.5	27
Paper production (short tons)	Mar. 1919	Jan. 1920	459,200	639,000	39
Steel ingot production (long tons)[c]	May 1919	Aug. 1920	94,300	134,900	43

[a] Three-month average; date shown is middle month.
[b] ICC net ton-miles used for this phase.
[c] Per working day.

This would not necessarily be true if traffic consisted predominantly of a small group of articles with extremely large, or extremely small, cyclical variations. The percentage change in aggregate ton-miles would still be an average of those in its components, but that average might be very high or very low compared with the median change in all kinds of output. When we come to consider waterways and pipelines (Ch. 11), which are largely confined to a few commodities, we shall find that their traffic reflects the cyclical peculiarities of the production of those commodities. But the business of the railways is more diversified.

In 1932 bituminous coal, the most important single commodity, accounted for 34 per cent of the carload ton-miles. Fourteen other articles—farm products, nonfarm nondurables, and durables—each accounted for over 1 per cent.[28] The movement of all fifteen, however, was only 65 per cent of total carload ton-miles; 35 per cent was divided among a great variety of other goods.

On the other hand, mere diversity of demand does not assure an industry that fluctuations in its total business will be moderate. Almost all parts of the economy use steel, for example, directly, or indirectly in buildings, machinery, and equipment; yet cyclical variations in the output of steel are among the most violent, and far greater than those in ton-miles (Table 9). Most industries can vary the quantities in which they purchase steel and durable goods made of it enormously, relatively to their own production. But the quantity of ton-miles an industry buys, despite flexibility of stocks, etc., must be related much more closely to its current scale of operations.

Some commodities resemble freight transportation with respect to both universality of demand and close relation of need to current production. A good example is paper, used by all kinds of industries for a variety of current purposes, as well as by private individuals for personal consumption. Cyclical fluctuations in its output resemble those in ton-miles much more nearly than fluctuations in ingot production.

[28] Wheat, corn, flour, grain mill products n.o.s., oranges and grapefruit, potatoes, fresh vegetables n.o.s., fresh meats, anthracite, lumber, refined petroleum, fuel oil, fifth class iron and steel, cement. Products of mines, n.o.s., and manufactures and miscellaneous, n.o.s., also accounted for over 1 percent each, but these categories are too heterogeneous to include in the list.