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Comparisons of Empty and Gross Weights of Commercial Vehicles

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The need for a uniform weight classification base for commercial vehicles and the possibility of determining such a base from available information are described in this article. Because more adequate descriptions of commercial vehicles would permit better research and planning for the highways now being planned and built for the more than 100 million vehicles expected by 1972, an analysis has been made of available information.

Comparisons were made of data samples on commercial vehicles taken from the 1957 and 1961 loadometer studies and from special California vehicle records. Each sample group of data was satisfactorily representative of the total available information and correlations from selected groups of data were made by empty weights and by registered gross weights of vehicles.

The tabulations and the accompanying graphic materials are expected to be useful as guides in the solution of many vehicle classification problems. This analysis revealed that it would be very difficult, if not impossible, to develop a usable set of weight relationships from present registration data. However, the data considered in this study tend to give mutual support and the results of the 1957 loadometer study remain generally applicable.

•A SIGNIFICANT portion of highway research is dependent on the basic data that can be obtained on the numbers and types of motor vehicles that are, or are likely to be, in use. It is somewhat of an oddity that in this Nation of highly developed motor-vehicle mobility, one of the greatest single problems of highway research is the understanding, description, and cataloging of the numbers and kinds of vehicles in use for which highways must be provided.

There are nearly 80 million vehicles in the United States, and highways are now being planned and built for the more than 100 million expected 10 years from now. Yet, although each motor vehicle is required to be registered each year with a State motor vehicle department, it is possible to describe these 80 million vehicles in only the most general terms from the basic annual records. Although considerably more uniform information would be desirable on passenger vehicles the primary concern is the lack of uniform data on the types and weights of the truck fleet that at present is comprised of more than 12 million vehicles. The problems encountered are (a) the amount and quality of the data required and recorded on the annual registration application and on the registration certificate, and (b) the different weight bases used by the States for tax purposes. It often is not possible to combine, or to compare, the information on trucks registered in two neighboring States because the weight classification for tax purposes is entirely different. One State may register vehicles on the basis of the empty weight of the power unit, and another State may register its vehicles on the basis of the owner's declared maximum gross weight of vehicle and load. Data gathering is further complicated be-

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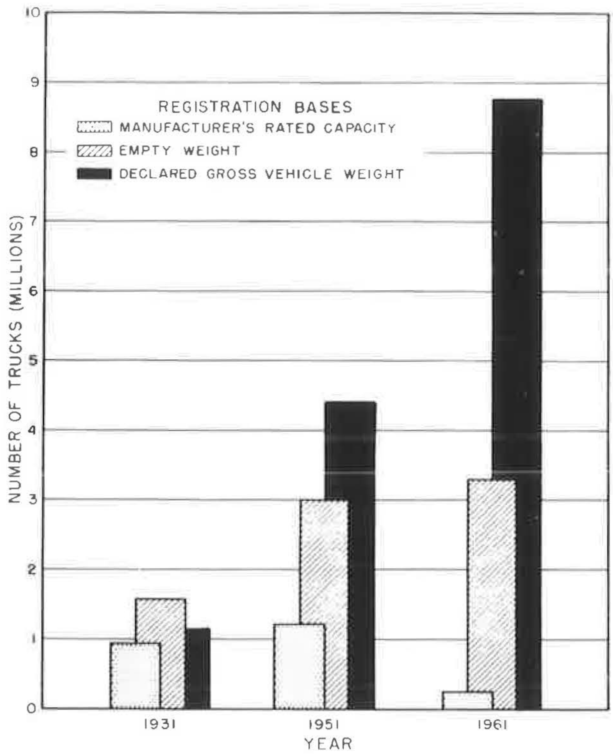

Figure 1. Number of trucks and combinations registered in 1931, 1951, and 1961, segregated by registration base; data for 1931 and 1951 are comparable but 1961 data include registrations in Alaska and Hawaii in the empty weight bar.

cause the State using empty weight has no means for gross weight identification, and the State using gross weight frequently does not require the empty weight of the power unit for its records. Any significant comparison of the effect of the bases used for truck registration should include the numbers of vehicles registered by each method. The application of the three main weight classifications employed in State registration systems to the truck fleets in 1931, 1951, and 1961 is shown in Figure 1. During the period from 1931 to 1961 truck registrations increased nearly fourfold, from 3.6 million to 12.3 million. (Data for the 1931 and 1951 comparisons were collected from 48 States and the District of Columbia; information from Alaska and Hawaii has been included in 1961 figures.)

Disparity in the methods of registration required has also been disappearing since 1931 when 26 States registered about 945,000 trucks on the basis of the manufacturers' rated capacities; 13 States registered approximately 1.6 million trucks on the basis of empty weight, and the remaining 10 States registered 1.1 million trucks on the basis of declared gross vehicle weight. By 1961 only Alabama retained the requirement for registration on the basis of manufacturers' rated capacity--239,000 trucks were registered. The rest of the States required trucks to be registered either by empty weight or by some form of declared gross weight. A total of 3.3 million trucks were registered in 14 States by empty weight, and 8.8 million trucks were registered in 36 States by declared gross weight. Except for the small 2-axle truck, commonly appearing as a pickup or panel vehicle and having characteristics similar to a passenger car, the many different types and sizes of trucks and combinations that compound the problems of classification and taxation are shown in silhouette in Figure 2.

Several samples of data that relate vehicle empty weights and declared gross weights have been compared to establish a set of usable weight correlations by visual vehicle

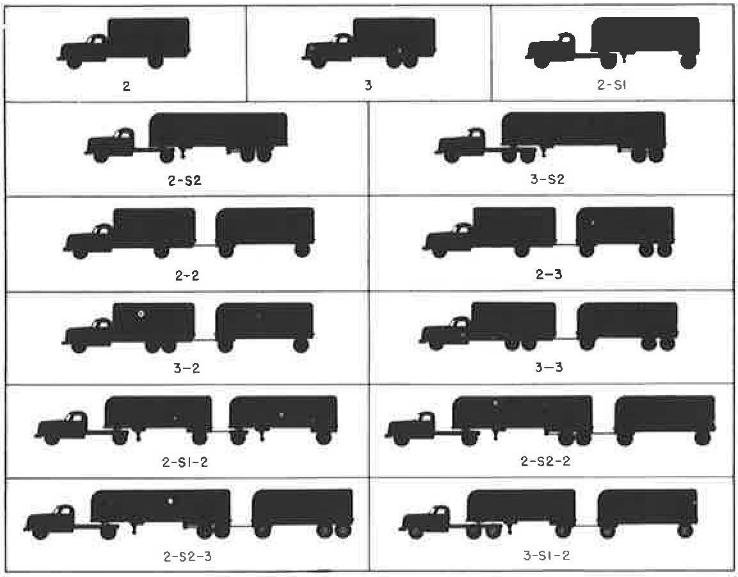

Figure 2. Commercial vehicle types as designated by code based on axle arrangement.

classes. The resultant weight comparisons are given in tabular form and both the vehicle distributions and their percentage counterparts shown. These comparisons (Tables 11-17) provide an additional classification tool for research and planning activities.

The research covered by this report will have many uses, important to the Federal and the State governments. The data presented can be used as an aid in the analysis of the application and equitability of road-user taxes, and they are expected to enhance the effectiveness of administration of motor-vehicle tax laws. They will be useful in determining the probable effects of legislation proposed, and they also will be of value to those concerned with highway planning, and to industry in materials, product, and market research.

VEHICLE CLASSIFICATION STUDIES

One of the early efforts to count and classify commercial motor vehicles was a comprehensive study of registrations and fees (1). Information for this study was compiled by the Bureau of Public Roads from State and local motor-vehicle records and from questionnaires that requested data on vehicles and taxes in considerable detail. Another study, known as the Nationwide Truck and Bus Inventory, was begun in 1940 by the Bureau of Public Roads in cooperation with the States. Although the work was eventually completed, it was expensive, and it used manufacturers' rated capacities as a uniform measure of truck weight. Since the use of that classification was rapidly waning, the study had limited value for comparing current vehicle classification data, and the results of the study have not been published.

The next major vehicle classification study was made by the Bureau of Public Roads, in cooperation with the States, to provide basic information for the highway cost allocation study that was required by Section 210 of the Highway Revenue Act of 1956. The findings of this classification study were included in the comprehensive series of highway cost allocation study reports made to the Congress, and also were published in 1960 by the Bureau of Public Roads as the "Classification of Motor Vehicles, 1956-57." This study is the most recent inventory of highway rolling stock, and it will be referred to herein as the classification study.

When the classification study was undertaken, an effort was made by Public Roads and State authorities to obtain the needed data in each of the States. Intensive reviews were made of the existing registration records, special questions were added to some motor-vehicle registration application forms for the following year, and special questionnaires were mailed to vehicle owners by many States in an effort to obtain information to supplement the data in the registration files. A valuable lesson was learned during this study. The motor-vehicle data needed for highway research were unavailable from any public source in a usable form. Even if it had been possible to obtain a complete summary and analysis of the vehicle records of each State, the data obtained would have been so lacking in uniformity that it would have been impossible with the knowledge then available, to combine them into a workable, usable body of data for use in research. One result of these findings is the cooperative effort of the States and Public Roads to develop standard vehicle descriptions and information that will be useful to both government and industry. Substantial progress is being made under the auspices of the American Association of Motor Vehicle Administrators.

Many differences existed in the registration requirements and records of the States but the one that posed the greatest problem was the requirement of several States for registration of vehicles on the basis of empty weight or on variations of gross and empty weights. Most States registered and recorded vehicles on the basis of the owners' declared gross weight (the weight of the vehicle, fully equipped and ready for service, plus the maximum load to be carried).

When it is necessary, in studies of motor vehicles or motor-vehicle revenues, to bring the basic motor-vehicle data of all States into uniformity, a relationship must be established between the bases and all of the data must be converted to a uniform structure for analysis.

To analyze the composition of the vehicle fleet properly an understanding of the factors affecting the selection of the vehicles in use is necessary. Tax structures, terrain, kind of goods transported, and literally dozens of factors affect owners' vehicle selections. Some carriers may elect to buy lightweight power equipment to perform the same job that is done by another carrier with heavier and costlier power units. The lighter power units would depreciate more rapidly but, because of other factors, they might provide lower overall operation cost. The subject of vehicle ownership and operating costs is discussed in considerable detail in HRB Bull. 301 (2).

SOURCES OF DATA FOR WEIGHT COMPARISONS

Traffic and Loadometer Data, 1957

During the course of the extensive 1957 motor-vehicle traffic counting, classification, and loadometer operations, approximately 600,000 vehicles were weighed, and data concerning empty weight, registered weight, make, body, axle arrangement, and other items on vehicle classification and operation were obtained. More than 150,000 commercial vehicles, for which weight data were complete, were selected from the group of 600,000 for special study to relate empty and registered gross vehicle weights. Gross vehicle weight was available from the registration certificates for only vehicles registered on that basis, but it is believed that a good representative sample was obtained because States using this basis were very well distributed geographically. The data concerning the 150,000 commercial vehicles are referred to herein as the "1957 loadometer data." Information from more recent weighing studies and spot vehicle classification counts made by the States have been added to the 1957 loadometer data. The locations of the weighing stations were selected with the objective of making the data collected from them representative of the vehicles being used in that area.

Loadometer Data, 1961

Rather than wait until the 1961 loadometer study had been completed and the complete record of weighings was available for use, a special group of data was collected from a limited sample of vehicles throughout the United States. This sample was obtained as a part of the regular loadometer study, but was collected at the first station or first tow stations operated in each State at the beginning of the weighing operations. The study instructions stipulated that vehicles were to be weighed at each station until at least 10 loaded and 10 empty vehicles of each visual type (Fig. 2) had been observed.

A field crew member was assigned to interview each driver and to obtain registration card information while the vehicle was being weighed by other members of the crew. These data were placed on punched cards, which were forwarded to the Washington office of the Bureau of Public Roads. In order to check the accuracy of the sample, Public Roads sent the record of each of these vehicles to the State in which it was registered to be verified against the registration file. It is believed that this check eliminated many of the inconsistencies, which might otherwise have gone undetected, and that data for the resultant group of vehicles identified herein as the "1961 loadometer data" have a relatively high degree of accuracy. Although the sample was not expanded, a comparison of the data with those obtained from other sources showed the information to be representative in all major weight cells. The usable sample from the 1961 loadometer data totaled approximately 14,000 vehicles, and the information gathered included empty and gross weights, vehicle type, number of axles, body type, class of use, some information on fuel used, year model, make of vehicle, and commodity carried. Only the information that applies specifically to weight comparisons has been summarized here. Processing of the remaining data is in progress and, if these data are found to be representative, they will be used in other studies.

Some unexplained differences were noted in a comparison of the 1957 and 1961 loadometer data. These differences probably were caused by the highway system coverage and the distribution of the loadometer stations. Because of the scope and purpose of the 1957 loadometer study, more urban stations were included and a greater coverage of secondary and local road systems was obtained. The 1961 loadometer data, however, are more indicative of the type of vehicles used on main rural highways.

California Data

The third group of data was obtained from the State of California for vehicles registered under the Uniform Proration Compact. California maintains an excellent file on motor-vehicle fleets that are registered in other States on different registration bases and that are operated in California under the Proration Compact. Uniform empty and gross weight data and other vehicle information were available for these vehicles. The California authorities permitted the authors to use the information and provided much assistance in interpreting it. This availability of another source of data was an important factor in the decision to present this study.

Unlike the truck samples obtained in the loadometer surveys, the California data represented principally over-the-road fleets from the Western States. The records included the declared gross vehicle weight of the vehicle or combination; the empty weight of the power unit; and the type of carrier, make, year model, and number of axles; and the type of motor fuel used. Data on approximately 8,000 vehicles were supplied by the State, and information on 6,700 has been used in the present comparisons. Information on approximately 1,300 vehicles could not be included in the study because one or more of the basic weight factors had not been included in the reports to the State.

Data from Other Sources

The State motor-vehicle registration authorities make their annual registration counts, by vehicle type, available to the Bureau of Public Roads and other interested groups. These data are consolidated (3) for use by government transportation and planning authorities, industry marketing groups, and private individuals. A few States prepare special tabulations on commercial vehicles by weight classes for their own uses, and copies of these have been supplied to the Bureau for studies of vehicle characteristics, distribution, and use.

DISCUSSION OF DATA

Registered Gross Weights by Vehicle Types

Table 1 summarizes the vehicles registered on a gross weight basis for which empty weights were available; these data were obtained in the 1957 and 1961 loadometer surveys.

Table 1.—Trucks and combinations, observed during 1957 and 1961 loadometer studies, grouped by number of axles and by registered gross vehicle weights [1]

Registered gross vehicle weight	Single-unit trucks				Combinations consisting of—											
					Tractor and semitrailer						Truck and full trailer				Tractor, semi-trailer and full trailer	
	2-axles		3-axles		3-axles (2-S1)		4-axles (2-S2)		5-axles (3-S2)		3-axles (2-1)		5-axles (3-2)		5-axles (2-S1-2)	
Pounds	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*
0–3,999																
4,000–4,999	49,279	36.0														
5,000–5,999	26,846	19.6														
6,000–7,999	12,767	9.3														
8,000–9,999	6,637	4.9														
10,000–11,999	5,456	4.0														
12,000–13,999	4,560	3.3														
14,000–15,999	4,236	3.1														
16,000–17,999	6,855	5.0	152	2.1	2											
18,000–19,999	4,431	3.2	47	0.6	106	1.6					28	9.2				
20,000–21,999	5,761	4.2	65	0.9	77	1.2					14	4.6				
22,000–23,999	3,000	2.2	106	1.5	93	1.5	29	0.3			17	5.5				
24,000–25,999	4,732	3.5	193	2.6	241	3.8	35	0.4			14	4.6				
26,000–27,999	1,153	0.8	205	2.8	127	2.0	22	0.2			16	5.2				
28,000–29,999	294	0.2	214	2.9	187	3.0	11	0.1			14	4.6				
30,000–31,999	520	0.4	322	4.4	394	6.3	38	0.4			14	4.6				
32,000–35,999	103	0.1	708	9.6	1,040	16.5	47	0.5			38	12.4				
36,000–39,999	103	0.1	1,174	16.0	987	15.7	101	1.1			53	17.3				
40,000–44,999	97	0.1	1,657	22.5	2,188	34.8	280	3.2			86	28.1				
45,000–49,999	41		2,273	30.9	301	4.8	361	4.1	191	3.3	12	3.9				
50,000–54,999	21		233	3.2	376	6.0	1,843	20.8	151	2.6					1	1.5
55,000–59,999	9				66	1.0	4,061	45.9	192	3.3			17	2.4		
60,000–64,999	56				104	1.7	1,737	19.6	1,070	18.3			5	0.7	2	2.9
65,000–69,999					6	0.1	261	3.0	1,216	20.9			42	5.9	4	5.9
70,000–74,999							34	0.4	2,595	44.5			311	43.5	28	41.2
75,000–79,999									416	7.1			319	44.6	30	44.1
80,000 and over													21	2.9	3	4.4
TOTAL	136,957	100.0	7,349	100.0	6,295	100.0	8,860	100.0	5,831	100.0	306	100.0	715	100.0	68	100.0

[1] Data from 1957 and 1961 special, field - weighing reports are combined in this table. The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each vehicle type.

Numbers and percentages of vehicles of each type are given by registered gross weights. Heavy lines in the table enclose data for approximately 90 percent of the vehicles in each visual type. The extremes, representing approximately 10 percent of the vehicles, are "fenced out" above and below the main group. Thus a visual comparison can be made of the total range of the data. This comparison shows the approximately 90 percent spread of gross weights for each of the vehicle types, and it illustrates that as the vehicles became larger the gross weight range was smaller. Registered gross weights for each vehicle type, however, overlap the weights for both adjacent vehicle types.

The 1961 loadometer data presented in this study for the 2-axle trucks cannot be separated into 4-tire and 6-tire classes. Other sources (4) have shown however that, taken as separate groups, the 2-axle, 4-tire class would show a rapid diminution of numbers over 8,000 lb and, with the greater load flexibility permitted by additional tires, the 2-axle, 6-tire class would peak at about 12,000 to 18,000 lb and would taper off slowly in numbers at approximately 28,000 lb. Within the enclosed area of the table, the data for successive vehicle types form a group of steps to the larger gross weights.

Comparison of 1957 and 1961 Loadometer Data and California Data

Table 2 shows the California data by registered gross weights and by visual vehicle types. The heavy lines enclose approximately 90 percent of the vehicles in each type. A comparison of the vehicle distributions from the loadometer weighings in Table 1 with those obtained from the California data reveals considerable disparity in the information from the two sources. Because vehicles represented in the California data were used principally in intercity service, much less dispersion in gross weights was noted in these data than in the information obtained from the loadometer studies.

Frequency distributions and least squares comparisons of empty to gross weights are shown in Figures 3 through 9 for the main visual types of vehicles. The California data, represented by the medium-length dash least squares lines in the upper panels of these figures, with certain exceptions, showed that the average empty weights of vehicles in relation to given gross weights were higher than the empty weight to gross weight relations recorded by loadometer data. A similar empty weight relationship was not recorded for the 3-S2 vehicle combinations; the slope of the line for the 1961 loadometer data (Fig. 7) suggests the effect of too small a sample. However, this relationship of the empty to gross weight probably is not entirely accurate as the Public Roads' vehicle classification counts indicate that use of the 3-S2 vehicle combinations has become more widespread geographically than in 1957, and therefore the relationship of empty to gross weight could have been different than shown by the 1961 loadometer data.

As shown in Figure 8, an exception to the higher empty weights in relation to gross weights was recorded in the 1957 loadometer data, which included information on an unusually large number of 3-2 truck-trailer combinations registered at 50,000 to 55,000-lb gross combination weight and reported as having empty weights of more than 16,000 lb for the truck alone. Such a reported distribution of so many 3-2 combinations at 55,000 pounds in 1957 was not normal because in the classification study nearly 97 percent of the 3-2 combinations were reported to have been registered at more than 60,000-lb gross combination weight.

A percentage comparison of the gross weight distribution of combined 1957 and 1961 loadometer data and of the California data with the nationwide gross weight distribution of all vehicles of each type reported in the 1956-57 classification study is given in the bottom panels of Figures 3 through 6. The loadometer data distribution by gross weight was close to that for the classification study (Fig. 3). This close relationship implies that the gross weights for vehicles sampled in the loadometer studies were relatively proportional to the gross weights for all such vehicles registered. But, as stated earlier, the California data consisting largely of registrations of over-the-road 2-axle, 6-tire vehicles showed a much larger sample for vehicles having 18,000- to 26,000-lb gross weights. The 2-axle classification given in Figure 3 includes both the 2-axle, 4-tire and the 2-axle, 6-tire vehicles. Nationwide more than 90 percent of the 2-axle, 4-tire vehicles were registered for gross weights under 8,000 lb. More than 67 percent of the 2-axle, 6-tire trucks were registered for gross weights in excess

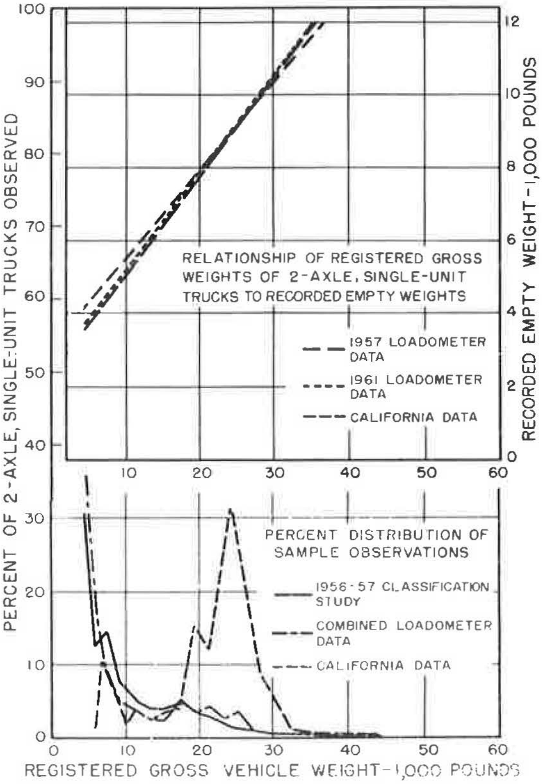

Figure 3. Empty to gross weight relationships and relative distribution of 2-axle, single-unit trucks.

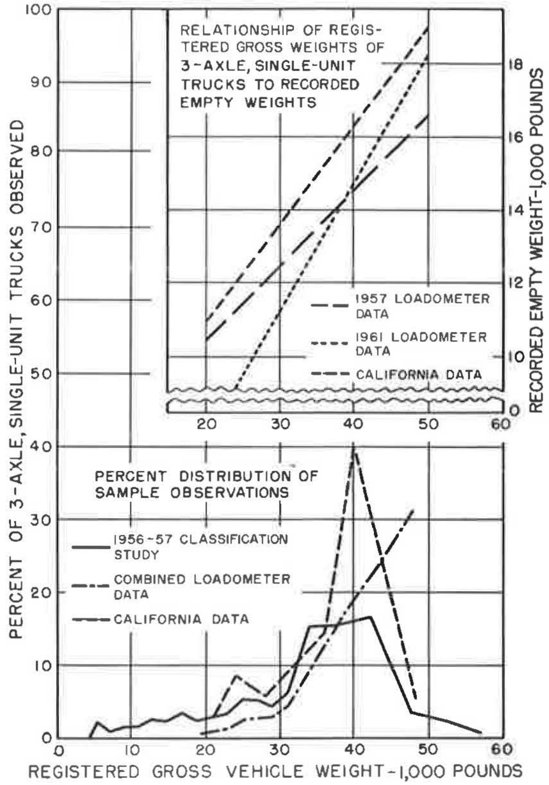

Figure 4. Empty to gross weight relationships and relative distribution of 3-axle, single-unit trucks.

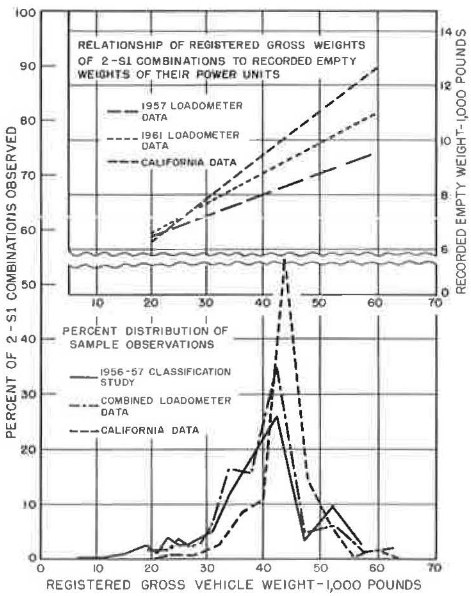

Figure 5. Empty to gross weight relationships and relative distribution of 3-axle, tractor-semitrailer combinations (2-S1).

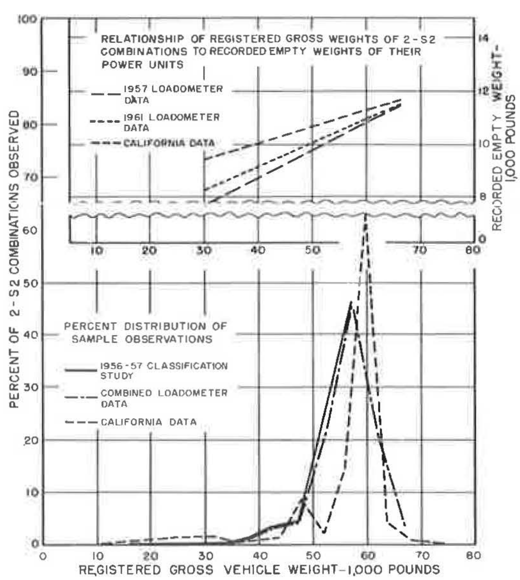

Figure 6. Empty to gross weight relationships and relative distribution of 4-axle, tractor-semitrailer combinations (2-S2).

of 12,000 lb, and nearly 47 percent was registered for gross weights in excess of 16,000 lb.

Figures 4 through 9 show that the gross weights of the sampled vehicles in the loadometer studies follow closely the gross weight distributions of the vehicle population. Gross weight comparisons for information from the classification study have not been included in Figures 7 through 9 for the 3-S2, 3-2, and the 2-S1-2 vehicle combinations because these vehicles generally are registered for the State maximum permitted gross weights of over 60,000 lb and their registrations were shown in the classification study in that maximum weight class.

Combined Loadometer Data

In Figure 10, straight lines illustrate the empty to gross weight relationships obtained by the least squares method. The lines were based on the combined data from the loadometer surveys, and they provide a quick visual comparison of relationships for five vehicle types. The lines for the single-unit trucks follow a parallel course, they overlap in the gross weights from 22,000 to 32,000 lb, and they are separated by about 1,500 lb of empty weight. This greater empty weight is accounted for largely by the third axle in the 3-axle truck. The slope of these two lines is much steeper than the slope of the lines for the tractor power units, shown in combination as 2-S-1, 2-S2, and 3-S2, because the payload carrying body is included in the empty weight for single-unit trucks but is not included for the combination vehicles. A considerable gross vehicle weight overlap is shown for the 2-S1 and 2-S2 combinations because of differences in size and weight requirements; some States require an additional axle to carry loads that can be carried by the 2-S1 combination in other States. Also, factors of terrain, power requirements, and types of loads carried are considered by operators in their choice of vehicles.

Comparison of 1957 and 1961 Loadometer Data

A percentage comparison of the distribution of gross weights of vehicles from the 1957 loadometer data with the distribution of the gross weights of vehicles from the 1961 loadometer data is given in Table 3. The 1957 study was designed to sample vehicles on all types of rural and urban

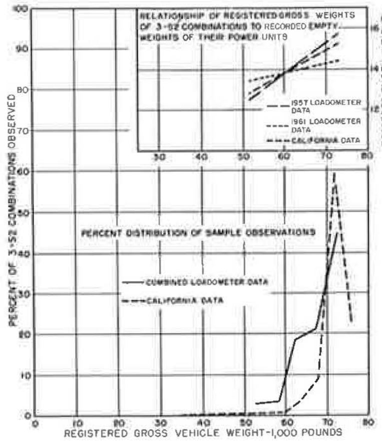

Figure 7. Empty to gross weight relationships and relative distribution of 5-axle, tractor-semitrailer combinations (3-S2).

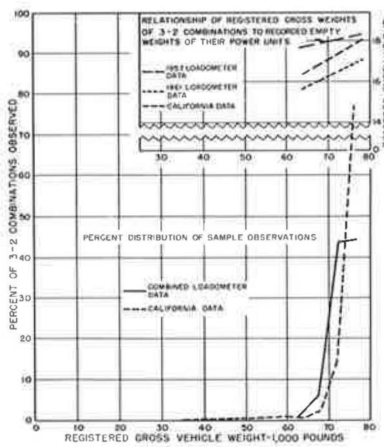

Figure 8. Empty to gross weight relationships and relative distribution of 5-axle, truck-full trailer combinations (3-2).

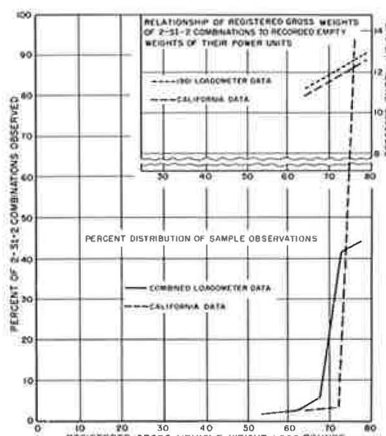

Figure 9. Empty to gross weight relationships and relative distribution of 5-axle, tractor-semitrailer, full trailer combinations (2-S1-2).

Table 2.—Trucks and combinations grouped by number of axles and by registered gross vehicle weights, from California interstate proration records[1]

Registered gross vehicle weight	Single-unit trucks				Combinations consisting of— Tractor and semitrailer						Truck and full trailer				Tractor, semitrailer and full trailer	
	2-axles		3-axles		3-axles (2-S1)		4-axles (2-S2)		5-axles (3-S2)		3-axles (2-1)		5-axles (3-2)		5-axles (2-S1-2)	
Pounds	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*	*No.*	*Pct.*
0-3,999																
4,000-4,999																
5,000-5,999	8	1.3														
6,000-7,999	70	11.2														
8,000-9,999	40	6.4														
10,000-11,999	21	3.3					1	0.1								
12,000-13,999	15	2.4					1	0.1			1	7.7				
14,000-15,999	22	3.5														
16,000-17,999	24	3.8														
18,000-19,999	96	15.2														
20,000-21,999	74	11.7	1	2.8	2	0.1										
22,000-23,999	112	17.8			1	0.1	3	0.4			4	30.8				
24,000-25,999	85	13.5	3	8.3	9	0.7	8	1.2			4	30.8				
26,000-27,999	43	6.8	1	2.8	4	0.3					1	7.7				
28,000-29,999	8	1.3	1	2.8	3	0.2	11	1.6			2	15.3				
30,000-31,999	7	1.1			24	1.8	9	1.3					1	0.2		
32,000-35,999	3	0.5			15	1.1	2	0.3								
36,000-39,999			11	30.6	140	10.4	3	0.4	3	0.1	1	7.7				
40,000-44,999	1	0.2	17	47.2	818	60.5	8	1.2	5	0.2						
45,000-49,999			2	5.5	226	16.7	64	9.3	1				2	0.4		
50,000-54,999					81	6.0	45	6.6	8	0.3			2	0.4		
55,000-59,999					22	1.7	310	45.3	16	0.5			3	0.6		
60,000-64,999					2	0.1	207	30.2	89	3.0			2	0.4	11	2.1
65,000-69,999					1	0.1	10	1.5	289	9.6			13	2.5	1	0.2
70,000-74,999					2	0.1	2	0.3	2,160	71.6			86	16.7	101	19.5
75,000-79,999					2	0.1	1	0.2	445	14.7			406	78.8	405	78.2
80,000 and over																
TOTAL	629	100.0	36	100.0	1,352	100.0	685	100.0	3,016	100.0	13	100.0	515	100.0	518	100.0

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each vehicle type.

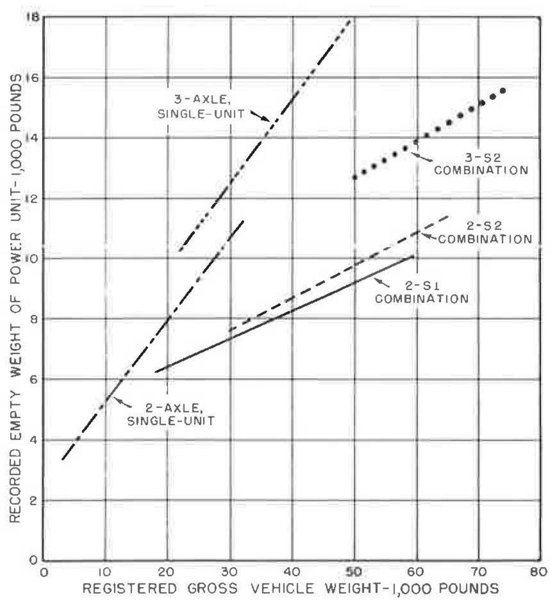

Figure 10. Relationship of the recorded empty weights of the power units to the registered gross weights of the vehicles based on combined 1957 and 1961 loadometer data.

highways as uniformly as possible, but the 1961 data were obtained to a larger extent at stations on main rural roads. The comparison indicates that the traffic on main rural roads has a much greater concentration of heavy vehicles than the total traffic on all types of rural and urban highways.

Table 4 gives a distribution of the same vehicles by empty weights of the trucks and power units for the 1957 and 1961 loadometer surveys. The information in both tables shows that the empty and gross weights were consistently heavier in the 1961 loadometer data. The percentage distributions for each weight group, within each vehicle type, have been cumulated inversely as an additional check on the differences between the 1957 and 1961 loadometer data. At first glance it might appear that trucks and combinations have gotten heavier since 1957, and to some degree this may be true. However, evidence from continuing vehicle and classification counts has led the authors to conclude that most of the difference between the two sets of data was caused by the difference in the size and scope of the samples.

To show a more complete cross-section of information on the three vehicle types given in Tables 3 and 4, a set of two-way frequency distributions of empty weight to gross vehicle weight has been given for each of the three vehicle types separately for the 1957 and 1961 loadometer samples in Tables 5 through 10. With the data arrayed in this manner it is possible to examine either the frequency distribution by empty weights of vehicles in a given class interval of registered gross weight, or the distribution by registered gross weights of vehicles in a given class interval of empty weight. Both numerical and percentage distributions are given, and heavy lines enclose approxi-

Table 3.—Comparison of relative numbers of motor vehicles observed in the 1957 and 1961 loadometer studies by gross vehicle weight groups

Registered gross vehicle weight	Single-unit trucks				Vehicle combinations							
	2-axle				3-axle (2-S1)				4-axle (2-S2)			
	1957		1961		1957		1961		1957		1961	
Pounds	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]
Under[2] 5,000	36.1	100.0	32.8	100.0								
Under[2] 18,000					(3)	(3)	0.2	100.0				
Under[2] 24,000									0.2	100.0	0.6	100.0
5,000-5,999	19.9	63.9	13.1	67.2								
6,000-7,999	9.0	44.0	15.8	54.1								
8,000-9,999	4.7	35.0	8.0	38.3								
10,000-11,999	3.9	30.3	5.4	30.3								
12,000-13,999	3.3	26.4	4.3	24.9								
14,000-15,999	3.2	23.1	1.6	20.6								
16,000-17,999	5.1	19.9	2.2	19.0								
18,000-19,999	3.3	14.8	2.6	16.8	1.9	100.0	0.3	99.8				
20,000-21,999	4.3	11.5	2.9	14.2	1.4	08.1	0.3	99.5				
22,000-23,999	2.2	7.2	2.4	11.3	1.7	96.7	0.3	99.2				
24,000-25,999	3.4	5.0	3.9	8.9	4.3	95.0	1.3	98.9	0.5	99.8	0.2	99.4
26,000-27,999	0.8	1.6	1.7	5.0	2.3	90.7	0.4	97.6	0.3	99.3	0.1	99.2
28,000-29,999	0.2	0.8	0.6	3.3	3.3	88.4	1.4	97.2	0.1	99.0	0.1	99.1
30,000-31,999	0.4	0.6	0.9	2.7	6.9	85.1	2.8	95.8	0.5	98.9	0.1	99.0
32,000-35,999	(3)	(3)	0.9	1.8	18.2	78.2	6.8	93.0	0.6	98.4	0.3	98.9
36,000-39,999	0.1	0.2	0.4	0.9	15.7	60.0	15.3	86.2	1.3	97.8	0.6	98.6
40,000-44,999	0.1	0.1	0.2	0.5	33.6	44.3	41.2	70.9	3.4	96.5	2.3	08.0
45,000-49,999	(3)	(3)	0.1	0.3	4.0	10.7	9.4	29.7	4.6	93.1	2.1	95.7
50,000-54,999	(3)	(3)	(3)	(3)	5.6	6.7	8.1	20.3	24.4	88.5	6.8	93.6
55,000-59,999	(3)	(3)	0.1	0.2	0.7	1.1	3.0	12.2	47.6	64.1	39.2	86.8
60,000-64,999					0.4	0.4	8.6	9.2	14.2	16.5	40.5	47.6
65,000-69,999									2.1	2.3	6.2	7.1
60,000 and over[2]	(3)	(3)	0.1	0.1								
65,000 and over[2]					(3)	(3)	0.6	0.6				
70,000 and over[2]									0.2	0.2	0.9	0.0
TOTAL	100.0		100.0		100.0		100.0		100.0		100.0	

[1] Percentages in this column are an inverse cumulation of the percentages in the preceding column.
[2] Open-end weight classes are shown for each visual vehicle type at the lower end and upper end of the weight classification scale. Each open-end class applies to a specific visual vehicle type.
[3] Less than 0.1 percent.

Table 4.—Comparison of relative numbers of motor vehicles observed in the 1957 and 1961 loadometer studies by recorded empty weights of power units

Recorded empty weight of power unit	Single-unit trucks				Vehicle combinations							
	2-axle				3-axle (2-S1)				4-axle (2-S2)			
	1957		1961		1957		1961		1957		1961	
Pounds	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]	*Pct.*	*Cumulated Pct.*[1]
Under[2] 3,000	1.8	100.0	1.5	100.0								
Under[2] 5,000					4.0	100.0	0.5	100.0	0.1	100.0	0.3	100.0
3,000-3,999	42.4	98.2	39.4	98.5								
4,000-4,999	22.1	55.8	24.0	59 1								
5,000-5,999	7.8	33.7	9.5	35.1	9.1	96.0	2.6	99.5	0.6	99.9	0.8	99.7
6,000-6,999	7.8	25.9	7.2	25.6	22.0	86.9	7.3	96.9	3.7	99.3	2.8	98.9
7,000-7,999	7.3	18.1	3.6	18.4	23.4	64.9	16.7	89.6	4.7	95.6	2.6	96.1
8,000-8,999	5.1	10.8	4.1	14.8	18.4	41.5	24.3	72.9	9.7	90.9	8.5	93.5
9,000-9,999	2.7	5.7	3.5	10.7	14.3	23.1	18.3	48.6	23.7	81.2	15.0	85.0
10,000-10,999	1.4	3.0	2.6	7.2	5.2	8.8	15.8	30.3	26.0	57.5	23.1	70.0
11,000-11,999	0.6	1.6	1.8	4.6	3.6	3.6	6.8	14.5	12.4	31.5	20.4	46.9
12,000-12,999	0.4	1.0	1.1	2.8					12.4	19.1	18.2	26.5
13,000-13,999									4.5	6.7	5.7	8.3
12,000 and over[2]					(3)	(3)	7.7	7.7				
13,000 and over[2]	0.6	0.6	1.7	1.7								
14,000 and over[2]									2.2	2.2	2.6	2.6
TOTAL	100.0		100.0		100.0		100.0		100.0		100.0	

[1] Percentages in this column are an inverse cumulation of the percentages in the preceding column.
[2] Open-end weight classes are shown for each visual vehicle type at the lower end and upper end of the weight classification scale. Each open-end class applies to only one visual vehicle type.
[3] Less than 0.1 percent.

Table 5.—Comparison of number and percent of 2-axle, single-unit trucks by recorded empty weights and by registered gross vehicle weights, 1957 loadometer data [1]

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)																					Total	
	4,000–4,999	5,000–5,999	6,000–7,999	8,000–9,999	10,000–11,999	12,000–13,999	14,000–15,999	16,000–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000 and over	Number	Percent of total
0–2,999:																								
Number	1,614	621	66	1	2	3	1	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	2,311	1.8
Percent	69.9	26.9	2.9	(2)	0.1	0.1	(2)	—	—	—	0.1	(2)	—	—	—	—	—	—	—	—	—	—		
3,000–3,999:																								
Number	34,176	15,530	4,804	955	123	22	11	6	4	1	—	—	—	—	—	—	—	—	—	—	—	—	55,632	42.4
Percent	61.5	27.9	8.7	1.7	0.2	(2)	(2)	(2)	(2)	(2)	—	—	—	—	—	—	—	—	—	—	—	—		
4,000–4,999:																								
Number	11,618	7,968	4,948	2,079	1,223	459	220	273	145	79	10	—	1	—	2	—	1	1	—	1	—	—	29,028	22.1
Percent	40.0	27.5	17.0	7.2	4.2	1.6	0.8	0.9	0.5	0.3	(2)	—	(2)	—	(2)	—	(2)	(2)	—	(2)	—	—		
5,000–5,999:																								
Number	—	1,979	1,738	1,793	1,388	945	669	893	335	208	79	109	27	5	10	—	3	—	—	2	—	—	10,203	7.8
Percent	—	19.4	17.0	17.6	13.6	9.3	6.7	8.8	3.3	2.0	0.8	1.1	0.3	(2)	0.1	—	(2)	—	—	(2)	—	—		
6,000–6,999:																								
Number	—	—	300	1,068	1,438	1,312	1,103	1,854	976	1,176	342	501	120	9	43	6	8	15	6	2	—	2	10,281	7.8
Percent	—	—	2.9	10.4	14.0	12.8	10.7	18.0	9.5	11.4	3.3	4.9	1.2	0.1	0.4	0.1	0.1	0.1	0.1	(2)	—	(2)		
7,000–7,999:																								
Number	—	—	10	257	758	730	967	1,832	1,107	1,672	646	1,369	160	22	80	5	12	11	13	2	—	1	9,654	7.3
Percent	—	—	0.1	2.7	7.8	7.6	10.0	19.0	11.5	17.3	6.7	14.2	1.7	0.2	0.8	0.1	0.1	0.1	0.1	(2)	—	(2)		
8,000–8,999:																								
Number	—	—	—	22	184	533	511	1,011	886	1,181	802	1,201	186	31	103	6	13	13	6	6	—	5	6,700	5.1
Percent	—	—	—	0.3	2.7	8.0	7.6	15.1	13.2	17.6	12.0	17.9	2.8	0.5	1.5	0.1	0.2	0.2	0.1	0.1	—	0.1		
9,000–9,999:																								
Number	—	—	—	6	23	245	321	453	474	698	414	539	177	60	75	1	5	5	1	1	1	15	3,514	2.7
Percent	—	—	—	0.2	0.7	7.0	9.2	12.9	13.5	19.9	11.8	15.4	5.0	1.7	2.1	(2)	0.1	0.1	(2)	(2)	(2)	0.4		
10,000–10,999:																								
Number	—	—	—	—	7	51	246	214	154	288	291	311	136	37	38	2	13	5	3	3	1	23	1,823	1.4
Percent	—	—	—	—	0.4	2.8	13.5	11.7	8.4	15.8	15.9	17.1	7.5	2.0	2.1	0.1	0.7	0.3	0.2	0.2	(2)	1.3		
11,000–11,999:																								
Number	—	—	—	—	—	8	63	117	62	94	132	187	81	20	34	5	3	3	3	—	—	6	818	0.6
Percent	—	—	—	—	—	1.0	7.7	14.3	7.6	11.5	16.1	22.9	9.9	2.4	4.1	0.6	0.4	0.4	0.4	—	—	0.7		
12,000–12,999:																								
Number	—	—	—	—	—	4	12	51	58	88	71	91	79	35	23	11	6	1	4	—	—	—	534	0.4
Percent	—	—	—	—	—	0.7	2.2	9.6	10.9	16.5	13.3	17.0	14.8	6.6	4.3	2.1	1.1	0.2	0.7	—	—	—		
13,000 and over:																								
Number	—	—	—	—	—	1	2	23	79	109	76	201	87	39	61	16	19	32	—	3	4	—	752	0.6
Percent	—	—	—	—	—	0.1	0.3	3.1	10.5	14.5	10.1	26.7	11.6	5.2	8.1	2.1	2.5	4.3	—	0.4	0.5	—		
TOTAL:																								
Number	47,408	26,098	11,866	6,181	5,146	4,313	4,146	6,727	4,280	5,594	2,865	4,510	1,054	258	469	52	83	86	36	20	6	52	131,250	100.0
Percent	36.1	19.9	9.0	4.7	3.9	3.3	3.2	5.1	3.3	4.3	2.2	3.4	0.8	0.2	0.4	(2)	0.1	0.1	(2)	(2)	(2)	(2)		

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.
[2] Less than 0.1 percent.

Table 6.—Comparison of number and percent of 2-axle, single-unit trucks by recorded empty weights and by registered gross vehicle weights, 1961 loadometer data [1]

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)																						Total number	Percent of total
	4,000–4,999	5,000–5,999	6,000–7,999	8,000–9,999	10,000–11,999	12,000–13,999	14,000–15,999	16,000–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000 and over		
0–2,999: Number	64	18	5					1															88	1.5
Percent	72.7	20.5	5.7					1.1																
3,000–3,999: Number	1,348	445	365	73	9	2	2	2	1			1									1		2,249	39.4
Percent	60.0	19.8	16.2	3.3	0.4	0.1	0.1	0.1	([2])			([2])									([2])			
4,000–4,999: Number	459	228	376	159	86	34	9	1	4	9	2	4										1	1,372	24.0
Percent	33.4	16.6	27.4	11.6	6.3	2.5	0.6	0.1	0.3	0.7	0.1	0.3										0.1		
5,000–5,999: Number		57	132	137	97	71	8	17	6	3	5	4		1		3							541	9.5
Percent		10.5	24.4	25.3	17.9	13.1	1.5	3.2	1.1	0.6	0.9	0.7		0.2		0.6								
6,000–6,999: Number			23	82	101	99	20	27	19	11	8	12	3	3		1							409	7.2
Percent			5.6	20.1	24.7	24.2	4.9	6.6	4.7	2.7	2.0	2.9	0.7	0.7		0.2								
7,000–7,999: Number				2	10	17	12	28	28	29	24	44	8		3	1	1				1		208	3.6
Percent				1.0	4.8	8.2	5.8	13.5	13.5	13.9	11.5	21.1	3.8		1.4	0.5	0.5				0.5			
8,000–8,999: Number				2	2	13	20	19	36	35	33	54	8	6	5	2	1						236	4.1
Percent				0.8	0.8	5.5	8.5	8.1	15.3	14.8	14.0	22.9	3.4	2.6	2.1	0.8	0.4							
9,000–9,999: Number					2	6	12	13	30	26	30	36	23	5	8	4	1	1					197	3.5
Percent					1.0	3.1	6.1	6.6	15.2	13.2	15.2	18.3	11.7	2.5	4.1	2.0	0.5	0.5						
10,000–10,999: Number					1	2	4	7	12	25	15	29	28	4	6	7	3	1	1			1	146	2.6
Percent					0.7	1.4	2.7	4.8	8.2	17.1	10.3	19.9	19.2	2.7	4.1	4.8	2.0	0.7	0.7			0.7		
11,000–11,999: Number				1	2	2	1	5	11	14	7	18	12	7	8	7	2	3			1		101	1.8
Percent				1.0	2.0	2.0	1.0	4.9	10.9	13.9	6.9	17.8	11.9	6.9	7.9	6.9	2.0	3.0			1.0			
12,000–12,999: Number						1	1	5	1	9	3	7	12	7	6	7	2		2				63	1.1
Percent						1.6	1.6	7.9	1.6	14.3	4.8	11.1	19.0	11.1	9.5	11.1	3.2		3.2					
13,000 and over: Number							1	3	3	6	8	13	5	3	15	19	10	6	2	1		2	97	1.7
Percent							1.0	3.1	3.1	6.2	8.2	13.4	5.1	3.1	15.5	19.6	10.3	6.2	2.1	1.0		2.1		
TOTAL: Number	1,871	748	901	456	310	247	90	128	151	167	135	222	99	36	51	51	20	11	5	1	3	4	5,707	100
Percent	32.8	13.1	15.8	8.0	5.4	4.3	1.6	2.2	2.6	2.9	2.4	3.9	1.7	0.6	0.9	0.9	0.4	0.2	0.1	0.0	0.1	0.1		

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.
[2] Less than 0.1 percent.

mately 90 percent of the vehicles in each empty weight group. When special consideration is given to the 90 percent portion of the sample in each table, the array of each vehicle type is much more compact. Although an appreciable number of vehicles are shown at the extremes, those having heavy empty weights and light gross weights and

Table 7.—Comparison of number and percent of 3-axle, tractor-semitrailer combinations (2-S1) by tractor recorded empty weights a by registered gross vehicle weights, 1957 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds): 0-17,999	18,000-19,999	20,000-21,999	22,000-23,999	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,999	45,000-49,999	50,000-54,999	55,000-59,999	60,000-64,999	Total number	Percen of tota
0-4,999: Number	—	28	4	6	18	12	10	17	20	36	58	3	1	—	1	214	4.0
Percent	—	13.1	1.9	2.8	8.4	5.6	4.7	7.9	9.3	16.8	27.1	1.4	0.5	—	0.5		
5,000-5,999: Number	—	25	15	39	48	16	32	40	88	64	97	12	10	1	2	489	9.1
Percent	—	5.1	3.1	8.0	9.8	3.3	6.5	8.2	18.0	13.1	19.8	2.5	2.0	0.2	0.4		
6,000-6,999: Number	—	23	14	13	79	32	51	78	317	219	282	24	17	—	—	1,182	22.0
Percent	—	1.9	1.2	1.1	6.7	2.7	4.6	6.6	29.4	18.5	23.9	2.0	1.4	—	—		
7,000-7,999: Number	—	17	28	18	34	20	25	146	315	263	336	24	28	1	2	1,257	23.4
Percent	—	1.4	2.2	1.4	2.7	1.6	2.0	11.6	25.1	20.9	26.7	1.9	2.2	0.1	0.2		
8,000-8,999: Number	—	8	8	8	36	28	33	17	93	146	457	60	51	7	3	985	18.4
Percent	—	0.8	0.8	0.8	3.7	2.8	3.4	1.8	9.4	14.8	46.4	6.1	5.2	0.7	0.3		
9,000-9,999: Number	—	2	5	4	8	10	11	26	70	68	360	67	120	14	2	767	14.3
Percent	—	0.3	0.7	0.5	1.1	1.3	1.4	3.4	9.1	8.9	46.9	8.7	15.6	1.8	0.3		
10,000-10,999: Number	—	—	—	1	3	3	5	6	29	30	129	16	40	8	7	277	5.2
Percent	—	—	—	0.4	1.1	1.1	1.8	2.1	10.5	10.8	46.6	5.8	14.4	2.9	2.5		
11,000-11,999: Number	—	—	—	1	3	2	4	8	15	19	86	8	34	7	7	194	3.6
Percent	—	—	—	0.5	1.6	1.0	2.1	4.1	7.8	9.8	14.3	4.1	17.5	3.6	3.6		
TOTAL: Number	—	103	74	90	229	123	174	368	977	845	1,805	214	301	38	24	5,365	100.0
Percent	—	1.9	1.4	1.7	4.3	2.3	3.3	6.9	18.2	15.7	33.6	4.0	5.6	0.7	0.4		

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.

Table 8.—Comparison of number and percent of 3-axle, tractor-semitrailer combinations (2-S1) by tractor recorded empty weights a by registered gross vehicle weights, 1961 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds): 0-17,999	18,000-19,999	20,000-21,999	22,000-23,999	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,999	45,000-49,999	50,000-54,000	55,000-59,999	60,000-64,999	65,000 and over	Total number	Percen of tota
0-4,999: Number	—	2	1	—	—	—	—	—	—	—	2	—	—	—	—	—	5	0.5
Percent	—	40.0	20.0	—	—	—	—	—	—	—	40.0	—	—	—	—	—		
5,000-5,999: Number	—	—	—	—	—	—	1	1	8	5	7	1	1	—	—	—	24	2.6
Percent	—	—	—	—	—	—	4.2	4.2	33.3	20.8	29.1	4.2	4.2	—	—	—		
6,000-6,999: Number	—	1	—	1	1	2	1	5	14	10	32	1	—	—	—	—	68	7.3
Percent	—	1.5	—	1.5	1.5	2.9	1.5	7.3	20.6	14.7	47.0	1.5	—	—	—	—		
7,000-7,999: Number	—	—	—	1	3	1	6	5	14	47	68	3	3	4	—	—	155	16.7
Percent	—	—	—	0.7	1.9	0.7	3.9	3.2	9.0	30.3	43.9	1.9	1.9	2.6	—	—		
8,000-8,999: Number	2	—	1	1	4	1	3	7	14	37	115	17	17	3	3	1	226	24.3
Percent	0.9	—	0.4	0.5	1.8	0.5	1.3	3.1	6.2	16.4	50.9	7.5	7.5	1.3	1.3	0.4		
9,000-9,999: Number	—	—	1	—	3	—	—	5	7	24	77	21	14	5	13	—	170	18.3
Percent	—	—	0.6	—	1.8	—	—	3.0	4.1	14.1	45.3	12.4	8.2	2.9	7.6	—		
10,000-10,999: Number	—	—	—	—	1	—	1	2	2	10	44	25	26	6	28	2	147	15.8
Percent	—	—	—	—	0.7	—	0.7	1.4	1.4	6.8	29.9	17.0	17.7	4.1	19.0	1.3		
11,000-11,999: Number	—	—	—	—	—	—	—	—	4	3	22	5	6	4	17	2	63	6.8
Percent	—	—	—	—	—	—	—	—	6.4	4.8	34.9	7.9	9.5	6.3	27.0	3.2		
12,000 and over: Number	—	—	—	—	—	—	1	1	—	6	16	14	8	6	19	1	72	7.7
Percent	—	—	—	—	—	—	1.4	1.4	—	8.3	22.2	19.5	11.1	8.3	26.4	1.4		
TOTAL: Number	2	3	3	3	12	4	13	26	63	142	383	87	75	28	80	6	930	100.0
Percent	0.2	0.3	0.3	0.3	1.3	0.4	1.4	2.8	6.8	15.3	41.2	9.4	8.1	3.0	8.6	0.6		

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.

Table 9.—Comparison of number and percent of 4-axle, tractor-semitrailer combinations (2-S2) by tractor recorded empty weights and by registered gross vehicle weights, 1957 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)														Total number	Percent of total
	0-23,999	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,990	45,000-49,999	50,000-54,999	55,000-59,999	60,000-64,999	65,000-69,999	70,000 and over		
0-4,999: Number	2							3	2						7	0.1
Percent	28.6							42.8	28.6							
5,000-5,999: Number	1	3	7	2	2	1	1	2	7	13	2	1			42	0.6
Percent	2.4	7.1	16.6	4.8	4.8	2.4	2.4	4.8	16.6	30.9	4.8	2.4				
6,000-6,999: Number	6	16	3	2	6	7	23	31	71	50	38	6			259	3.7
Percent	2.3	6.2	1.1	0.8	2.3	2.7	8.9	12.0	27.4	19.3	14.7	2.3				
7,000-7,999: Number	1	3	2	3	10	8	11	43	32	118	70	27		1	329	4.7
Percent	0.3	0.9	0.6	0.9	3.0	2.4	3.4	13.1	9.7	35.9	21.3	8.2		0.3		
8,000-8,999: Number	2	1	4	1	1	8	18	56	53	264	182	95			685	9.7
Percent	0.3	0.1	0.6	0.1	0.1	1.2	2.6	8.2	7.7	38.6	26.6	13.9				
9,000-9,999: Number	4	3	2	1	11	12	27	54	79	546	648	279	4	2	1,672	23.7
Percent	0.2	0.2	0.1	0.1	0.7	0.7	1.6	3.2	4.7	32.7	38.8	16.7	0.2	0.1		
10,000-10,999: Number	1	2	1	1	2	4	5	28	42	417	985	310	35	2	1,835	26.0
Percent	0.1	0.1	0.1	0.1	0.1	0.2	0.3	1.5	2.3	22.7	53.6	16.9	1.9	0.1		
11,000-11,999: Number			1		4	1	3	11	8	190	505	107	40	2	872	12.4
Percent			0.1		0.5	0.1	0.3	1.3	0.9	21.8	57.0	12.3	4.6	0.2		
12,000-12,999: Number	1	1					1	7	13	83	650	91	21	5	873	12.4
Percent	0.1	0.1					0.1	0.8	1.5	9.5	74.5	10.4	2.4	0.6		
13,000-13,999: Number		3					1	3	7	18	206	41	39		318	4.5
Percent		0.9					0.3	0.9	2.2	5.7	64.8	12.9	12.3			
14,000 and over: Number								1	8	21	64	44	9	5	152	2.2
Percent								0.7	5.3	13.8	42.1	28.9	5.9	3.3		
TOTAL: Number	18	32	20	10	36	41	90	239	322	1,720	3,350	1,001	148	17	7,044	100.0
Percent	0.2	0.5	0.3	0.1	0.5	0.6	1.3	3.4	4.6	24.4	47.6	14.2	2.1	0.2		

[1] The portion of the table boxed by heavy lines represents 60 percent or more of the vehicles in each empty weight group.

Table 10.—Comparison of number and percent of 4-axle, tractor-semitrailer combinations (2-S2) by tractor recorded empty weights and by registered gross vehicle weights, 1961 loadometer data [1]

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)														Total number	Percent of total
	0-23,999	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,999	45,000-49,999	50,000-54,999	55,000-59,999	60,000-64,999	65,000-69,999	70,000 and over		
0-4,999: Number		1							1	2		1		1	6	0.3
Percent		16.6							16.7	33.3		16.7		16.7		
5,000-5,999: Number	2	1							1	4	5	1			14	0.8
Percent	14.3	7.1							7.2	28.6	35.7	7.1				
6,000-6,999: Number	2	1			1			1	5	14	22	4			50	2.8
Percent	4.0	2.0			2.0			2.0	10.0	28.0	44.0	8.0				
7,000-7,999: Number							4		3	9	21	11			48	2.6
Percent							8.3		6.3	18.8	43.7	22.9				
8,000-8,999: Number	1					1	4	5	5	27	87	22	1	1	154	8.5
Percent	0.6					0.6	2.6	3.3	3.3	17.5	56.5	14.3	0.7	0.6		
9,000-9,999: Number						2	3	6	8	27	136	82	9		273	15.0
Percent						0.7	1.1	2.2	2.9	9.9	49.8	30.1	3.3			
10,000-10,999: Number	4			1	1	2		6	5	22	139	205	31	3	419	23.1
Percent	1.0			0.2	0.2	0.5		1.4	1.2	5.3	33.2	48.9	7.4	0.7		
11,000-11,999: Number						1		8	2	7	147	167	37	2	371	20.4
Percent						0.3		2.2	0.5	1.9	39.6	45.0	10.0	0.5		
12,000-12,999: Number	2		2					5	6	9	109	169	24	5	331	18.2
Percent	0.6		0.6					1.5	1.8	2.7	32.9	51.1	7.3	1.5		
13,000-13,999: Number								10	3	2	25	50	10	3	103	5.7
Percent								9.7	2.9	2.0	24.3	48.5	9.7	2.9		
14,000 and over: Number											20	24	1	2	47	2.6
Percent											42.5	51.1	2.1	4.3		
TOTAL: Number	11	3	2	1	2	6	11	41	39	123	711	736	113	17	1,816	100.0
Percent	0.6	0.2	0.1	0.1	0.1	0.3	0.6	2.3	2.1	6.8	39.2	40.5	6.2	0.9		

[1] The portion of the table boxed by heavy lines represents 90 percent or more of the vehicles in each empty weight group.

Table 11.—Table for estimating the distribution of 2-axle, single-unit trucks grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)																						Total number	Percent of total
	4,000–4,999	5,000–5,999	6,000–7,999	8,000–9,999	10,000–11,999	12,000–13,999	14,000–15,999	16,000–17,999	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000–54,999	55,000–59,999	60,000 and over		
0–2,999: Number	1,678	639	71	1	2	3	1	1			2	1											2,399	1.8
Percent	70.0	26.7	3.0	(1)	0.1	0.1	(1)	(1)			0.1	(1)												
3,000–3,999: Number	35,524	15,975	5,169	1,028	132	24	13	8	5	1		1									1		57,881	42.3
Percent	61.4	27.6	9.0	1.8	0.2	(1)	(1)	(1)	(1)	(1)		(1)									(1)			
4,000–4,999: Number	12,077	8,196	5,324	2,238	1,309	493	229	274	149	88	12	4	1		2		1	1		1		1	30,400	22.2
Percent	39.7	27.0	17.5	7.4	4.3	1.6	0.8	0.9	0.5	0.3	(1)	(1)	(1)		(1)		(1)	(1)		(1)		(1)		
5,000–5,999: Number		2,036	1,870	1,930	1,485	1,016	697	910	341	211	84	113	27	6	10	3	3			2			10,744	7.8
Percent		19.0	17.4	18.0	13.8	9.5	6.5	8.5	3.2	2.0	0.8	1.1	0.2	(1)	(1)	(1)	(1)			(1)				
6,000–6,999: Number			323	1,150	1,539	1,411	1,123	1,881	995	1,187	350	513	123	12	43	7	8	15	6	2		2	10,690	7.8
Percent			3.0	10.8	14.4	13.2	10.5	17.6	9.3	11.1	3.3	4.8	1.2	0.1	0.4	0.1	0.1	0.1	(1)	(1)		(1)		
7,000–7,999: Number			10	259	768	747	979	1,860	1,135	1,701	670	1,413	168	22	83	6	13	11	13	2	1	1	9,862	7.2
Percent			0.1	2.6	7.8	7.6	9.9	18.9	11.5	17.3	6.8	14.3	1.7	0.2	0.9	0.1	0.1	0.1	0.1	(1)	(1)	(1)		
8,000–8,999: Number				24	186	546	531	1,030	922	1,216	835	1,255	194	37	108	8	14	13	6	6		5	6,936	5.1
Percent				0.3	2.7	7.9	7.7	14.9	13.3	17.5	12.0	18.1	2.8	0.5	1.6	0.1	0.2	0.2	0.1	0.1		(1)		
9,000–9,999: Number				6	25	251	333	466	504	724	444	575	200	65	83	5	6	6	1	1	1	15	3,711	2.7
Percent				0.2	0.7	6.7	9.0	12.6	13.6	19.5	12.0	15.5	5.4	1.7	2.2	0.1	0.2	0.2	(1)	(1)	(1)	0.4		
10,000–10,999: Number					8	53	250	221	166	313	306	340	164	41	44	9	16	6	4	3	1	24	1,969	1.4
Percent					0.4	2.7	12.7	11.2	8.4	15.9	15.5	17.3	8.3	2.1	2.2	0.5	0.8	0.3	0.2	0.2	0.1	1.2		
11,000–11,999: Number				1	2	10	64	122	73	108	139	205	93	27	42	12	5	6	3		1	6	919	0.7
Percent				0.1	0.2	1.1	7.0	13.3	7.9	11.8	15.1	22.3	10.1	2.9	4.6	1.3	0.5	0.7	0.3		0.1	0.7		
12,000–12,999: Number						5	13	56	59	97	74	98	91	42	29	18	8	1	6				597	0.4
Percent						0.8	2.2	9.4	9.9	16.3	12.4	16.4	15.2	7.0	4.9	3.0	1.3	0.2	1.0					
13,000 and over: Number						1	3	26	82	115	84	214	92	42	76	35	29	38	2	4	4	2	849	0.6
Percent						0.1	0.4	3.1	9.7	13.5	9.9	25.2	10.8	4.9	9.0	4.1	3.4	4.5	0.2	0.5	0.5	0.2		
TOTAL: Number	49,279	26,846	12,767	6,637	5,456	4,560	4,236	6,855	4,431	5,761	3,000	4,732	1,153	294	520	103	103	97	41	21	9	56	136,957	100.0
Percent	36.0	19.6	9.3	4.9	4.0	3.3	3.1	5.0	3.2	4.2	2.2	3.5	0.8	0.2	0.4	0.1	0.1	0.1	(1)	(1)	(1)	(1)		

1 Less than 0.1 percent.

Table 12.—Table for estimating the distribution of 3-axle, single-unit trucks grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of truck (pounds)	Registered gross vehicle weight (pounds)													Total number	Percent of total
	Under 18,000	18,000–19,999	20,000–21,999	22,000–23,999	24,000–25,999	26,000–27,999	28,000–29,999	30,000–31,999	32,000–35,999	36,000–39,999	40,000–44,999	45,000–49,999	50,000 and over		
Under 9,000:															
Number	99	33	34	29	63	42	42	58	51	54	99	9	1	614	8.3
Percent	16.1	5.4	5.5	4.7	10.3	6.8	6.8	9.5	8.3	8.8	16.1	1.5	0.2		
9,000–9,999:															
Number	21	3	11	16	52	17	32	51	93	69	42	2	2	411	5.6
Percent	5.1	0.7	2.7	3.9	12.7	4.1	7.8	12.4	22.6	16.8	10.2	0.5	0.5		
10,000–10,999:															
Number	11	4	6	9	23	41	30	36	145	137	63	4	----------	509	6.9
Percent	2.1	0.8	1.2	1.8	4.5	8.0	5.[illegible]	7.1	28.5	26.9	12.4	0.8	----------		
11,000–11,999:															
Number	8	1	5	19	19	20	38	28	70	133	72	7	4	424	5.7
Percent	1.9	0.2	1.2	4.5	4.5	4.7	9.0	6.6	16.5	31.4	17.0	1.6	0.9		
12,000–12,999:															
Number	7	1	2	4	11	12	15	18	63	134	140	101	21	529	7.2
Percent	1.3	0.2	0.4	0.7	2.1	2.3	2.8	3.4	11.9	25.3	26.5	19.1	4.0		
13,000–13,999:															
Number	1	1	2	10	7	11	21	33	74	72	99	104	3	438	6.0
Percent	0.2	0.2	0.5	2.3	1.6	2.5	4.8	7.5	16.9	16.4	22.6	23.8	0.7		
14,000–14,999:															
Number	2	2	2	2	5	9	7	26	40	124	119	153	13	504	6.9
Percent	0.4	0.4	0.4	0.4	1.0	1.8	1.4	5.1	7.9	24.6	23.6	30.4	2.6		
15,000–15,999:															
Number	1	----------	1	3	1	11	7	23	27	50	212	470	12	818	11.1
Percent	0.1	----------	0.1	0.4	0.1	1.3	0.9	2.8	3.3	6.1	25.9	57.5	1.5		
16,000–16,999:															
Number	1	----------	----------	9	6	9	10	15	29	32	144	204	27	486	6.6
Percent	0.2	----------	----------	1.8	1.2	1.8	2.1	3.1	6.0	6.6	29.6	42.0	5.6		
17,000–17,999:															
Number	1	----------	----------	1	3	2	7	5	42	99	173	15	18	366	5.0
Percent	0.3	----------	----------	0.3	0.8	0.5	1.9	1.4	11.5	27.0	47.3	4.1	4.9		
18,000–18,999:															
Number	----------	2	2	1	1	12	3	5	14	111	118	156	14	439	6.0
Percent	----------	0.5	0.5	0.2	0.2	2.7	0.7	1.1	3.2	25.3	26.9	35.5	3.2		
19,000–19,999:															
Number	----------	----------	----------	1	----------	3	1	3	50	47	212	108	43	468	6.4
Percent	----------	----------	----------	0.2	----------	0.6	0.2	0.6	10.7	10.1	45.3	23.1	9.2		
20,000 and over:															
Number	----------	----------	----------	2	2	16	1	21	10	112	164	940	75	1,343	18.3
Percent	----------	----------	----------	0.1	0.1	1.2	0.1	1.6	0.8	8.3	12.2	70.0	5.6		
TOTAL:															
Number	152	47	65	106	193	205	214	322	708	1,174	1,657	2,273	233	7,349	100.0
Percent	2.1	0.6	0.9	1.5	2.6	2.8	2.9	4.4	9.6	16.0	22.5	30.9	3.2		

Table 13.—Table for estimating the distribution of 3-axle, tractor-semitrailer combinations (2-S1) grouped by recorded empty weig by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)																Total number	Perc of to
	Under 18,000	18,000-19,999	20,000-21,999	22,000-23,999	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,999	45,000-49,999	50,000-54,000	55,000-59,999	60,000-64,999	65,000 and over		
Under 5,000: Number		30	5	6	18	12	10	17	20	36	60	3	1		1		219	3.
Percent		13.7	2.3	2.7	8.2	5.5	4.6	7.8	9.1	16.4	27.4	1.3	0.5		0.5			
5,000-5,999: Number		25	15	39	48	16	33	41	96	69	104	13	11	1	2		513	8.
Percent		4.9	2.9	7.6	9.4	3.1	6.4	8.0	18.7	13.5	20.3	2.5	2.1	0.2	0.4			
6,000-6,999: Number		24	14	14	80	34	55	83	361	229	314	25	17				1,250	19.
Percent		1.9	1.1	1.1	6.4	2.7	4.4	6.7	28.9	18.3	25.1	2.0	1.4					
7,000-7,999: Number		17	28	19	37	21	31	151	329	310	404	27	31	5	2		1,412	22.
Percent		1.2	2.0	1.3	2.6	1.5	2.2	10.7	23.3	22.0	28.6	1.9	2.2	0.4	0.1			
8,000-8,999: Number	2	8	9	9	40	29	36	54	107	183	572	77	68	10	6	1	1,211	19.
Percent	0.2	0.7	0.7	0.7	3.3	2.4	3.0	4.5	8.9	15.1	47.2	6.4	5.6	0.8	0.5	(1)		
9,000-9,999: Number		2	6		11	10	11	31	77	92	437	88	134	19	15		037	14.
Percent		0.2	0.6	0.4	1.2	1.1	1.2	3.3	8.2	9.8	46.7	9.4	14.3	2.0	1.6			
10,000-10,999: Number				1	4	3	6	8	31	40	173	41	66	14	35	2	424	6.
Percent				0.2	0.9	0.7	1.4	1.9	7.3	9.4	40.8	9.7	15.6	3.3	8.3	0.5		
11,000-11,999: Number				1	3	2	4	8	19	22	108	13	40	11	24	2	257	4.
Percent				0.3	1.1	0.8	1.6	3.1	7.4	8.6	42.0	5.1	15.6	4.3	9.3	0.8		
12,000 and over: Number							1	1		6	16	14	8	6	19	1	72	1.
Percent							1.4	1.4		8.3	22.2	19.5	11.1	8.3	26.4	1.4		
TOTAL: Number	2	106	77	93	241	127	187	394	1,040	987	2,188	301	376	66	104	6	6,295	100.
Percent	(1)	1.6	1.2	1.5	3.8	2.0	3.0	6.3	16.5	15.7	34.8	4.8	6.0	1.0	1.7	0.1		

[1] Less than 0.1 percent.

Table 14.—Table for estimating the distribution of 4-axle, tractor-semitrailer combinations (2-S2) grouped by recorded empty weig by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)														Total number	Perce of tot
	Under 24,000	24,000-25,999	26,000-27,999	28,000-29,999	30,000-31,999	32,000-35,999	36,000-39,999	40,000-44,999	45,000-49,999	50,000-54,999	55,000-59,999	60,000-64,999	65,000-69,999	70,000 and over		
Under 5,000: Number	2	1						3	3	2		1		1	13	0.
Percent	15.4	7.7						23.1	23.1	15.3		7.7		7.7		
5,000-5,999: Number	3	4	7	2	2	1	1	2	8	17	7	2			56	0.
Percent	5.3	7.1	12.5	3.6	3.6	1.8	1.8	3.6	14.2	30.4	12.5	3.6				
6,000-6,999: Number	8	17	3	2	7	7	23	32	76	64	60	10			309	3.
Percent	2.6	5.5	1.0	0.6	2.3	2.3	7.4	10.4	24.6	20.7	19.4	3.2				
7,000-7,999: Number	1	3	2	3	10	8	15	43	35	127	91	38		1	377	4.
Percent	0.3	0.8	0.5	0.8	2.7	2.1	3.9	11.4	9.3	33.7	24.1	10.1		0.3		
8,000-8,999: Number	3	1	4	1	1	9	22	61	58	201	269	117	1	1	839	9.
Percent	0.4	0.1	0.5	0.1	0.1	1.1	2.6	7.3	6.9	34.7	32.1	13.9	0.1	0.1		
9,000-9,999: Number	4	3	2	1	11	14	30	60	87	573	784	361	13	2	1,945	22.
Percent	0.2	0.2	0.1	0.1	0.5	0.7	1.5	3.0	4.5	29.5	40.3	18.6	0.7	0.1		
10,000-10,999: Number	5	2	1	2	3	6	5	34	47	439	1,124	515	66	5	2,254	25.
Percent	0.2	0.1	(1)	0.1	0.1	0.3	0.2	1.5	2.1	19.5	49.9	22.9	2.9	0.2		
11,000-11,999: Number			1		4	2	3	19	10	197	652	274	77	4	1,243	14.
Percent			0.1		0.3	0.2	0.2	1.5	0.8	15.9	52.5	22.0	6.2	0.3		
12,000-12,999: Number	3	1	2				1	12	19	92	759	260	45	10	1,204	13.
Percent	0.3	0.1	0.2				0.1	1.0	1.6	7.6	63.0	21.6	3.7	0.8		
13,000-13,999: Number		3					1	13	10	20	231	91	49	3	421	4.
Percent		0.7					0.2	3.1	2.4	4.8	54.9	21.6	11.6	0.7		
14,000 and over: Number								1	8	21	84	68	10	7	199	2.
Percent								0.5	4.0	10.6	42.2	34.2	5.0	3.5		
TOTAL: Number	29	35	22	11	38	47	101	280	361	1,843	4,061	1,737	261	34	8,860	100.
Percent	0.3	0.4	0.2	0.1	0.4	0.5	1.1	3.2	4.1	20.8	45.9	19.6	3.0	0.4		

[1] Less than 0.1 percent.

Table 15.—Table for estimating the distribution of 5-axle, tractor-semitrailer combinations (3-S2) grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)							Total number	Percent of total
	Under 50,000	50,000–54,999	55,000–59,999	60,000–64,999	65,000–69,999	70,000–74,999	75,000 and over		
Under 12,000:									
Number	136	48	55	197	129	172	5	742	12.7
Percent	18.3	6.5	7.4	26.5	17.4	23.2	0.7		
12,000–12,999:									
Number	27	57	42	215	316	207	8	872	15.0
Percent	3.1	6.6	4.8	24.7	36.2	23.7	0.9		
13,000–13,999:									
Number	12	20	42	164	183	234	5	660	11.3
Percent	1.8	3.0	6.4	24.8	27.7	35.5	0.8		
14,000–14,999:									
Number	11	16	36	199	145	438	13	858	14.7
Percent	1.3	1.9	4.2	23.2	16.9	51.0	1.5		
15,000–15,999:									
Number	2	7	8	167	154	345	45	728	12.5
Percent	0.3	1.0	1.1	22.9	21.1	47.4	6.2		
16,000–16,999:									
Number	2	2	2	93	211	205	34	549	9.4
Percent	0.4	0.4	0.4	16.9	37.3	38.4	6.2		
17,000–17,999:									
Number	1		3	17	37	712	49	819	14.1
Percent	0.1		0.4	2.1	4.5	86.9	6.0		
18,000 and over:									
Number		1	4	18	41	282	257	603	10.3
Percent		0.2	0.7	3.0	6.8	46.7	42.6		
TOTAL:									
Number	191	151	192	1,070	1,216	2,595	416	5,831	100.0
Percent	3.3	2.6	3.3	18.3	20.9	44.5	7.1		

Table 16.—Table for estimating the distribution of 5-axle truck, full-trailer combinations (3-2) grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of truck (pounds)	Registered gross combination weight (pounds)						Total number	Percent of total
	Under 60,000	60,000–64,999	65,000–69,999	70,000–74,999	75,000–79,999	80,000 and over		
Under 14,000:								
Number	10	2	3	14	7		36	5.0
Percent	27.8	5.6	8.3	38.9	19.4			
14,000–14,999:								
Number			2	21	7	1	31	4.3
Percent			6.5	67.7	22.6	3.2		
15,000–15,999:								
Number	1	1	5	11	28	1	47	6.6
Percent	2.1	2.1	10.7	23.4	59.6	2.1		
16,000–16,999:								
Number			5	31	57	5	98	13.7
Percent			5.1	31.6	58.2	5.1		
17,000–17,999:								
Number	1		11	52	52	2	118	16.5
Percent	0.8		9.3	44.1	44.1	1.7		
18,000–18,999:								
Number		1	11	87	54	5	158	22.1
Percent		0.6	7.0	55.0	34.2	3.2		
19,000–19,999:								
Number		1	5	75	56	3	140	19.6
Percent		0.7	3.6	53.6	40.0	2.1		
20,000–20,999:								
Number	5			10	40	4	59	8.3
Percent	8.5			16.9	67.8	6.8		
21,000–21,999:								
Number				2	18		20	2.8
Percent				10.0	90.0			
22,000 and over:								
Number				8			8	1.1
Percent				100.0				
TOTAL:								
Number	17	5	42	31(	319	21	715	100.0
Percent	2.4	0.7	5.9	43.5	44.6	2.9		

Table 17.—Table for estimating the distribution of 5-axle, tractor-semitrailer full trailer combinations (2-S1-2) grouped by recorded empty weights, by groups of probable registered gross vehicle weights

Recorded empty weight of tractor (pounds)	Registered gross combination weight (pounds)							Total number	Percent of total
	50,000–54,999	55,000–59,999	60,000–64,999	65,000–69,999	70,000–74,999	75,000–79,999	80,000 and over		
Under 10,000:									
Number	1					1		2	3.0
Percent	50.0					50.0			
10,000–10,999:									
Number				1	6	2		9	13.2
Percent				11.1	66.7	22.2			
11,000–11,999:									
Number			1	2	6	4	1	14	20.6
Percent			7.1	14.3	42.9	28.6	7.1		
12,000–12,999:									
Number			1	1	14	9	2	27	39.7
Percent			3.7	3.7	51.9	33.3	7.4		
13,000–13,999:									
Number						7		7	10.3
Percent						100.0			
14,000 and over:									
Number					2	7		9	13.2
Percent					22.2	77.8			
TOTAL:									
Number	1		2	4	28	30	3	68	100.0
Percent	1.5		2.9	5.9	41.2	44.1	4.4		

those having light empty weights and heavy gross weights constituted only a small proportion of all vehicles in that class. A large proportion of some vehicles of a given empty weight were concentrated in two or three gross-weight intervals.

Conversion Tables

Tables 11 through 17 give the comparisons of empty weights to gross weights of the combined 1957 and 1961 loadometer data for seven of the most commonly used types of vehicles. Information on all the vehicles for which the weight data collected was usable for this article has been included. The numbers and percentages (horizontally) of the gross weight distribution of these vehicles are given. The numbers of vehicles that had unusual empty to gross weight relationships have been included even though they represent a very small percentage. The 166,000 vehicles that are classified by weights are representative of the national distribution of vehicles and their classification provides a tool for the solution of problems of weight conversions. These data will be useful for making revenue estimates, as well as being a working tool in many areas of market research.

The process of conversion is illustrated as follows. Assume that Table 13 was considered appropriate, in a given situation, for converting 3-axle, tractor-semitrailer (2-S1) combinations registered by empty tractor weights into an array representing their probable distribution by registered gross weight of combination in a State requiring that method of registration. The number of vehicles in each class interval of empty weight should be multiplied by the corresponding horizontal percentages in Table 13, and the numbers so obtained should be added vertically to obtain the distribution by registered gross weights. Conversely, a conversion from registered gross weight of combination to empty weight of tractor can be performed by distributing the number of vehicles in each gross weight class interval proportionate to the corresponding vertical distribution of vehicles by empty weights in Table 13 and then adding the numbers so obtained horizontally.

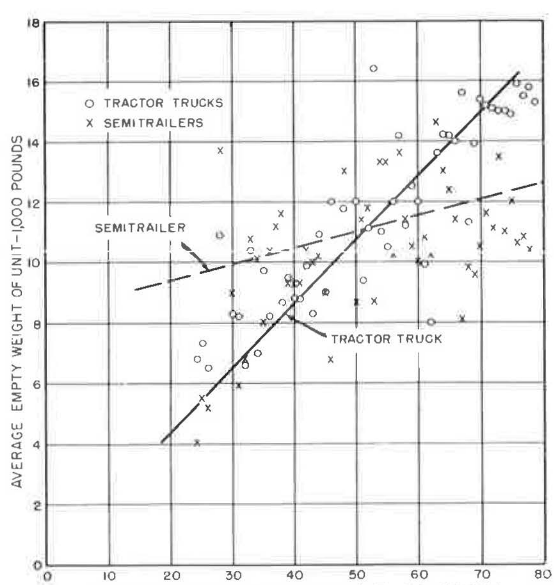

Figure 11. Scattergram of average empty weight of tractor trucks and of semitrailers by registered gross combination weight, and lines of best fit (California data).

Weight Relationship of Trailer and Combination

In Figure 11, a scattergram of the mean average empty weights and the lines of best

Table 18.—Empty weight to gross weight ratios of single-unit trucks and tractor-semitrailers, at selected gross vehicle weights

Vehicle type	Ratio of gross vehicle weight to—	
	Empty weight of power unit only	Empty weight of entire vehicle
Single-unit trucks:		
2-axle		
4,000 pounds GVW	1.2	
32,000 pounds GVW	2.7	
3-axle		
22,000 pounds GVW	2.2	
50,000 pounds GVW	2.8	
Vehicle combinations:		
3-axle (2-S1)		
20,000 pounds GVW	3.2	1.3
50,000 pounds GVW	5.5	2.5
4-axle (2-S2)		
30,000 pounds GVW	3.9	1.7
65,000 pounds GVW	5.8	2.8
5-axle (3-S2)		
50,000 pounds GVW	4.0	2.1
75,000 pounds GVW	4.8	2.7

fit reflects the approximate empty to gross weight relationship of tractors and semitrailers shown in the California data. Straight lines were computed for 1- and 2-axle, semitrailers and for the 2- and 3-axle tractor trucks used with them. The scattergram shows a wide range of empty weights of semitrailers in each type of tractor-semitrailer combination and at all gross weight levels. However, regardless of the type of combination, whether 2-S1, 2-S2, or 3-S2, even with substantial increases in gross combination weights, only moderate increases were noted in the semitrailer average empty weight. But for the tractor truck power units a much steeper gradation in empty weight in relation to gross weight is shown.

Empty Weight to Gross Weight Ratios

Employing the power unit relationship used in Figure 10 and the data from the semitrailer line in Figure 11, empty weight to gross weight ratios given in Table 18 indicate

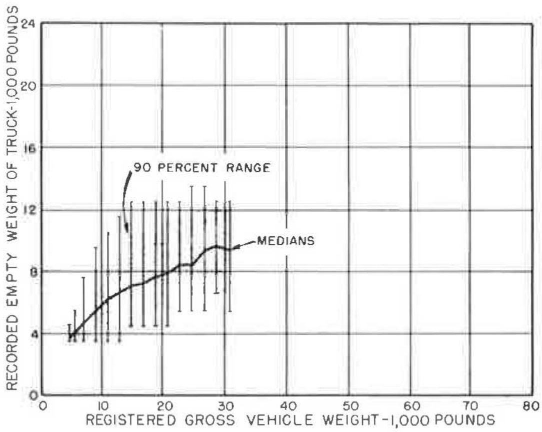

Figure 12. Range of recorded empty weights of 2-axle trucks registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

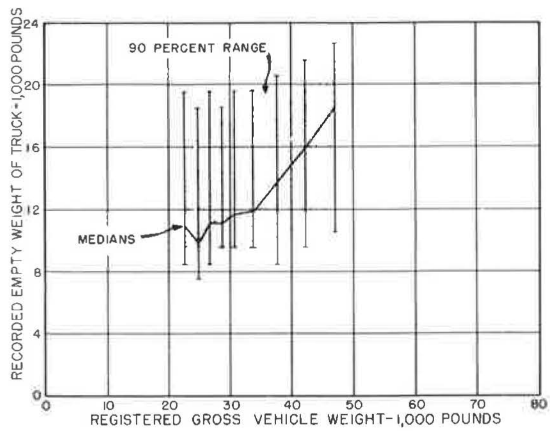

Figure 13. Range of recorded empty weights of 3-axle trucks registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

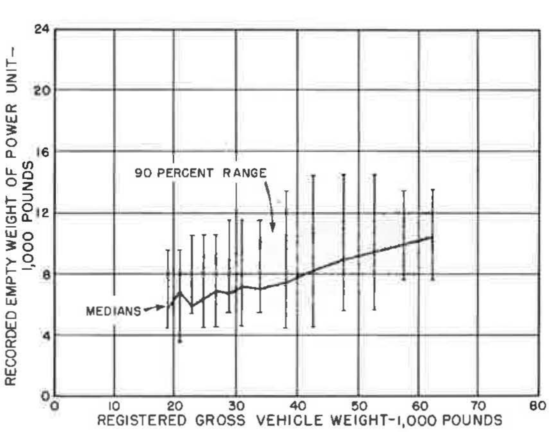

Figure 14. Range of recorded tractor empty weights of 3-axle, tractor-semitrailer combinations (2-S1) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

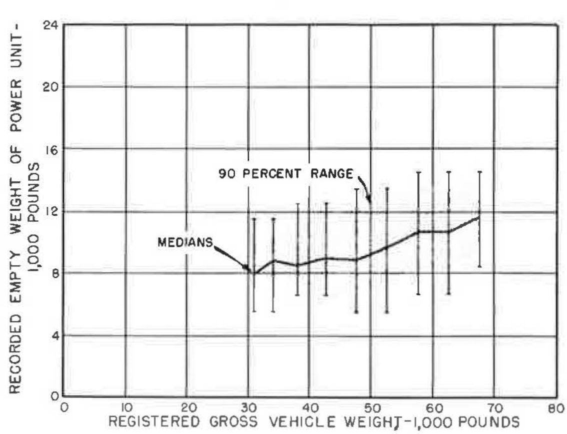

Figure 15. Range of recorded tractor empty weights of 4-axle, tractor-semitrailer combinations (2-S2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

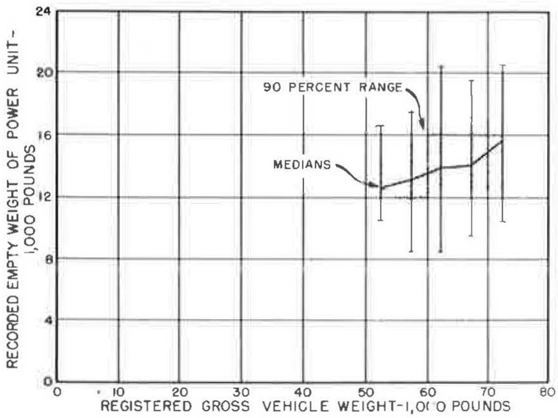

Figure 16. Range of recorded tractor empty weights of 5-axle, tractor-semitrailer combinations (3-S2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

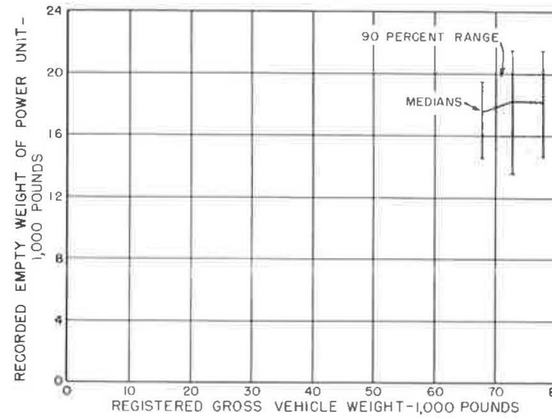

Figure 17. Range of recorded truck empty weights of 5-axle, truck full-trailer combinations (3-2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

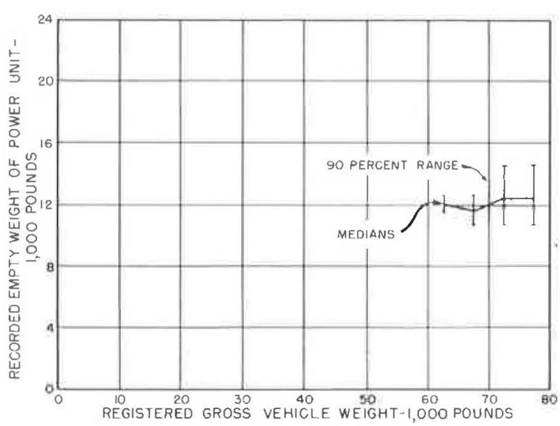

Figure 18. Range of recorded tractor empty weights of 5-axle, tractor-semitrailer full trailer combinations (2-S1-2) registered by gross vehicle weights, based on the combined 1957 and 1961 loadometer data.

that vehicle gross weights ranged from 1.2 times the empty weight at the low-weight interval of the smallest vehicle to a high of 2.8 at the high-weight interval for the larger vehicles. It may be of significance that a vehicle type selected and registered at near the maximum weight of its class is capable of operating with the most favorable empty weight to gross weight ratio. The results for the upper gross weight limit of each vehicle type are similar for all five vehicle types.

Range of Conversion

Figures 12 through 18 show both the wide range of empty weights for each gross weight, and the range that contained approximately 90 percent of the vehicles. Although the 90 percent range eliminates the extremes, the band of weight comparison is still too wide to allow the use of a point of conversion. It would be very difficult, if not impossible, to develop a usable set of weight relationships that would permit a point, or even a narrow band, of weight conversion to be used for any purpose.

CONCLUSIONS

In general, data from the vehicle weight comparison series included in "Classification of Motor Vehicles, 1956-57," the information from the 1957 and 1961 loadometer data, and the California data tend to give strong mutual support. Therefore, the results of the 1957 loadometer study remain generally applicable, and this study is a further refinement of the data. In applying weight comparison factors from any of the data, however, some caution should be exercised to allow for the increasing trend toward use of diesel-powered vehicles and for the anticipated effects of any changes in vehicle size and weight laws.

The 1961 loadometer data and the California data have provided information that permits the addition of another large vehicle combination to the vehicle weight comparison series—the 2-S1-2. This combination was not covered in earlier studies. Additional investigation in this area is warranted, not only to obtain more data on the vehicle weight relationships, but also to keep the findings from these investigations up-to-date. Comprehensive studies of vehicles on a carefully tailored regional basis would provide information even more usable. In the selection of regions for these studies, the State size and weight restrictions, the geographic features, and the predominance of certain types of vehicles favored for their adaptability to commerce or terrain of the region should be considered.

Tables 11 through 17 give a reasonable nationwide picture of the relationship between recorded empty and declared gross weights of different vehicle types. These comparisons demonstrate clearly that it would not be practicable to try to develop a set of weight relationships that would permit a point, or even a narrow band, of weight conversion to be used for any purpose. Conditions in individual States may be such that modifications or adaptations of the data may be required before they can be applied. However, the data provide a useful tool that can serve as a guide, or reference point, for local conversion problems. The local situation would have to dictate any adjustment factors necessary to make the data in these tables applicable to the problems being considered.

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Dimensions and Weights of Highway Trailer Combinations and Trucks—1959

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•A SAMPLING of the weights of highway freight trailer combinations and single-unit trucks is obtained by the highway departments in most of the States each year. In 1959, data regarding the dimensions of weighed vehicles were also obtained. Some 90, 200 trailer combinations and 65, 100 single-unit trucks were weighed and measured. Both empty and loaded categories were included in these 155, 300 vehicles.

The sample is believed to give a cross-section of the automotive freight vehicles in use in the continental United States. Insofar as trailer combinations are concerned, the data portray the trucking industry's use of sizes and weights under the legal limitations that had prevailed for several years before 1959.

A 1958 study was concerned with the demand for highway transportation (1) in terms of shipping densities of commodities and tons involved in the five principal media of transportation. A 1961 study contains estimates of the number of cargo vehicles in the United States by type (2). The present study shows a distribution of highway freight vehicles in terms of weights and dimensions.

DIMENSIONS AND WEIGHTS

Loaded and empty weights plus the dimensions of highway cargo vehicles were obtained at truck weighing stations in 46 States during 1959. From the information collected, the vehicles were classified as to axle arrangement and type of cargo body. The lengths of cargo bodies were arrayed in 2-ft intervals, which provided a means of investigating the cubic capacities of cargo bodies in use. The greatest number of cargo bodies was in the length range of 32 to 36 ft. Because new cargo bodies of 40 ft and over are entering the traffic stream, there is a need for repeating the size and dimensions study periodically so that data on cargo-carrying capabilities of highway vehicles can be kept current.

Loaded and empty weights were averaged and the results were used to compute average payloads by type and length of cargo body for each vehicle classification. Average empty weights of five different classes having van bodies increased in step intervals of approximately 5, 000 lb. The five average empty weights were 2-axle, dual rear tire truck, 9, 300 lb; 3-axle truck, 15, 200 lb; 2-S1 trailer combination, 20, 100 lb; 2-S2 trailer combination, 24, 800 lb; and 3-S2 trailer combination, 30, 700 lb. The 4-axle, (2-S2) tractor van semitrailer combination carried on the average about 6 tons more payload than the 3-axle (2-S1) tractor van semitrailer combination, and 2 tons less than the 5-axle (3-S2) tractor van semitrailer combination.

In the States limiting gross weights of motor vehicles to 56, 000 to 60, 000 lb, the greatest percentage of loaded gross weights occurred in the 50, 000 to 60, 000-lb weight bracket. But weights recorded in three other groups for States having higher gross weight limits had the greatest percentage in the 60, 000 to 70, 000-lb weight bracket.

About 1 percent of all trailer combinations and 1 percent of all 2- and 3-axle dual tire trucks exceeded 8. 3 ft in width across the wheels and approximately 0. 3 percent of the vehicles exceeded 13. 5 ft in height.

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Because of several factors, including multiple registration of trailers in more than one State, short trailers used principally in city service, and trailers dedicated to utility and construction purposes, no precise census of the number and type of trailers in highway freight service is available in the United States. It has been estimated (2) that in 1957 there were 712,129 semitrailers and full trailers in highway freight service in the United States used by 602,475 trailer combinations of all classes that were engaged in rural intercity highway freight transportation.

During the weight studies made in the summer of 1959, 90,200 trailer combinations and 65,100 single-unit trucks were weighed and measured. Of course, it is possible that some vehicles and combinations may have been weighed and measured more than once because of the location of the weight stations, the period of time for which the stations were used at a specific location, and the random selection of vehicles and combinations in transit. In spite of these factors, the sample is believed to give a cross-section of the dimensions and weights of highway freight vehicles on rural roads, and insofar as trailer combinations are concerned, the data portray the trucking industry's selection and use of sizes and weights under the legal limitations that had prevailed for several years before the 1959 weight studies.

Vehicle sizes and cubic capacities are not immediately changed to take advantage of permitted increases in sizes, although any additional weight allowances are used to advantage in hauling heavier commodities in the currently owned vehicles. Older and smaller vehicles usually are run until no longer serviceable, although a pressure develops for their earlier retirement and replacement when legal limitations are raised. Changes in legal limitations have waited for technological developments of vehicles, for changes in the characteristics and amount of highway freight transport, and for improvement in the design and construction of a State's highway system. The amount of highway freight has been increasing during the past several years, and this increase has caused the motor carriers to press for larger, more efficient vehicles.

During recent years, legal limitations have been raised to afford additional transport efficiency to motor carriers. The extent of these changes over the 5-yr period, May 1957 to July 1962, can be seen from the data in the Appendix showing the increases in lengths allowed for semitrailers. It is likely that the length limitations of 1957 and previous years had a controlling influence on the lengths of semitrailers recorded in the 1959 weight studies.

In 1957, 31 States permitted semitrailers 40 ft or more in length, although 18 States prevented the use of 40-ft semitrailers in long-haul interstate service. By 1962, this prohibition had been eased and only West Virginia (35 ft) and Georgia (39.5 ft) restricted trailer length to less than 40 ft. It was assumed that for States having no statutory limit on semitrailer length, the maximum possible semitrailer length was 7 ft less than the permitted length of the tractor semitrailer combination. This 7-ft dimension consists of a bumper-to-rear-of-cab dimension of 4 ft, obtainable for cab-over-engine tractors, plus 3 ft of clearance between rear of cab and nose of semitrailer.

DEFINITIONS OF TERMS

Identification of Classes of Trailer Combinations

Trailer combinations are classified according to the axle classification code developed by the Bureau of Public Roads. In this code, each digit represents the number of axles of one vehicle in the combination. The symbol for a trailer combination consists of two or three digits separated by hyphens. The first digit represents the power vehcile, either a truck tractor or a tractive truck (a truck equipped to carry a cargo body and haul a full trailer). An "S" before the second digit indicates a semitrailer, the power vehicle being a tractor. A digit appearing without an "S" in either the second or third position in a combination symbol indicates a full trailer. For example, 3-S2 is the code for a 3-axle tractor and a 2-axle semitrailer combination. Codes for double cargo body combinations include 3-2 for a 3-axle tractive truck and a 2-axle full trailer and 2-S1-2 for a 2-axle tractor plus a 1-axle semitrailer and a 2-axle full trailer. Such combinations are also known as double-trailer combinations.

Identification of Types of Cargo Bodies

Some 40 types of cargo bodies are defined in the SAE Standard Commercial Motor Vehicle Nomenclature (3). However, this number of cargo body types does not permit convenient recording and analysis in this study. Therefore, the following list of descriptive terms was used to group those various types of cargo bodies that have considerable similarity in cargo containing characteristics:

Flatbed—includes platform (flat or stake), low-bed, riggers or oil field, lumber, and express or pickup bodies.

Van—includes rack, livestock rack, canopy, open-top box, van fully enclosed, insulated van, furniture or moving van, bottler, multi-stop or standup delivery, and panel truck bodies.

Log—includes log, pulpwood, or pipe bodies.

Dump—includes grain, dump low side open box, and hopper bodies.

Tank—includes petroleum insulated and uninsulated, bituminous distributor, and other liquid product bodies (milk, acids, sugars, etc.).

Auto—consists of bodies designed primarily for transportation of other vehicles.

Concrete—consists of bodies designed and equipped to mix and agitate concrete.

Utility—includes wrecker, utility (transportation of tools, equipment, and supplies for construction, maintenance and repair purposes), garbage, refuse, lift and equipment (tank-mounted cranes, well drills, compressors, etc.) bodies.

Empty Vehicle Weight

The empty vehicle weight is the weight of a vehicle or trailer combination with fuel and without cargo or payload, but may include fixtures permanently carried to support the payload.

Loaded Gross Weight

The loaded gross weight is the empty weight plus the weight of the cargo or payload carried.

SUMMARY OF FINDINGS

1. Van and flatbed cargo bodies of semitrailer combinations were predominantly 35 ft in length in 1959. Because 40-ft cargo bodies have been constructed since 1959 in significant numbers, periodic study of cargo body lengths will be necessary to provide current information on highway freight movement usage and capabilities.

2. Van cargo bodies on 2-axle, 6-tire trucks averaged about 12 to 14 ft in length and van cargo bodies on 3-axle trucks averaged about 18 to 20 ft.

3. Empty weights of 3-S2, 2-S1-2 and 3-2 trailer combinations averaged about 30,000 lb, and 2-S1 and 2-S2 combinations averaged about 20,000 and 25,000 lb, respectively. Average empty vehicle weights of five different vehicle classes having van bodies increased in step intervals of approximately 5,000 lb as follows: 2-axle, 6-tire trucks, 9,300 lb; 3-axle trucks, 15,200 lb; 2-S1 combinations, 20,100 lb; 2-S2 combinations, 24,800 lb; and 3-S2 combinations, 30,700 lb.

4. Average empty weights of van body, single-unit trucks were panels, 6,100 lb; other 2-axle, 4-tire trucks, 6,400 lb; 2-axle, 6-tire trucks, 9,300 lb; and 3-axle trucks, 15,200 lb.

5. The 2-S2 combinations on the average had loaded gross weights of about 15,000 lb more than those of the 2-S1 combinations of the same body types. The loaded gross weights of 3-S2 combinations having flatbed, van, and tank cargo bodies were about 11,000 lb more on the average than those for the 2-S2 combinations having these same body types. The loaded gross weights of 2-S1-2 combinations were between 28,000 and 38,000 lb more than those for the 2-S1 combinations in the States where the double-cargo combinations are permitted.

6. The average payload of 10,800 lb carried by 2-S1 van combinations was 12,000 lb less than the payload carried by 2-S2 van combinations and 16,000 lb less than that carried by 3-S2 van combinations.

7. The number of trailer combinations having loaded gross weights of more than 60,000 lb was 35 percent of the total number of the loaded combinations weighed in States having a maximum gross weight limit of 60,000 lb, 41 percent in States having a maximum limit of 65,000 lb, 50 percent in States having a maximum of 76,000 lb, and nearly 64 percent in States having gross weight limits of 78,000 lb and over.

8. Approximately 10 percent of the total of the 2-axle, 6-tire trucks, the 3-axle trucks, and the trailer combinations exceeded the 8-ft width limitation, and only about 1 percent of the total exceeded the width of 8.3 ft.

9. Approximately 0.3 percent of all vehicles were more than 13 ft 6 in. in height. A greater percentage of the 3-S2 combinations exceeded this height than any of the other classes of vehicles.

LENGTHS OF CARGO BODIES IN THE TRAFFIC STREAM

In 1959, the length, height, and width of 155,300 commercial cargo vehicles were recorded as the vehicles were weighed at truck weighing stations in 46 States (District of Columbia included). Although at least one estimation (4) had been made by the motor vehicle industry of the lengths of van trailers by year of construction, no industry tabulation had been made available that would give a cross-section of cargo motor vehicles operating on the highways at any given time. Dimensional information concerning new vehicles going into the traffic stream each year would be useful, but a cross-section of the vehicles, old and new, on the highways would give a better understanding of highway freight movement capabilities.

Trailer Combinations

Figure 1 shows the percentage distributions of cargo body lengths and the cumulative percentage curves of 2-S1 trailer combinations. The 20,544 sample of 2-S1 combinations included flatbed, van, auto, log, dump, tank, and utility bodies. Fifty percent of the flatbed bodies were more than 30 ft long and 50 percent of the van bodies were more than 32 ft long. The greatest number of dump bodies were 16 to 18 ft long, and the greatest number of tanks were 24 to 26 ft long. Automobile carrier bodies were predominantly 34 to 36 ft long and log bodies were mostly 16 to 18 ft long. Utility body lengths were spread rather evenly over the wide range of 14 to 42 ft.

Figure 2 shows a rather marked difference in the distributions of cargo body lengths in 2-S2 combinations as compared to 2-S1 combinations. The distributions of cargo body lengths in 2-S2 combinations show a predominance of 32- to 34-ft lengths for all but vans and auto carriers, which were mostly 34 to 36 ft long. The data are for 1959, before 40-ft cargo bodies appeared in appreciable numbers.

Because 40-ft trailers have been built in considerable numbers since 1959, it would seem advisable to repeat this vehicle dimension study every 3 to 5 yr. Periodic studies would also reflect what lengths of cargo bodies were being retired from service. In this connection it should be noted that of the 34,405 van cargo bodies measured on 2-S2 combinations, approximately 36 percent were 34 to 36 ft long and 30 percent were 32 to 34 ft long, or two-thirds were 32 to 36 ft long. Forty-two and 47 percent, respectively, of the 2-S1 and 3-S2 van cargo bodies were 32 to 36 ft long.

The 3-S2 tractor semitrailer combinations had a marked predominance of 35-ft cargo bodies except for the log and utility body types (Fig. 3). Fifty-eight percent of the 3-S2 tanks were at least 36 ft long but only about 14 percent of the 2-S2 tanks and 1 percent of the 2-S1 tanks were 36 ft long. Length of cargo bodies for log trailers ranged evenly from 30 to 46 ft. Only thirty 5-axle tractor-utility-trailers were counted in this study and their cargo bodies were 28 to 42 ft long.

Although high percentages of the total double-cargo body combinations counted were weighed and measured, the samples were small compared to single-cargo body combinations. Figure 4 shows the data for the 3-2, tractive truck, full trailer combinations. Figure 5 shows the data for the 2-S1-2 tractor, semitrailer, full trailer combinations. The lengths of the semitrailers in the 2-S1-2 combinations were the same as the lengths of the full trailers in such combinations.

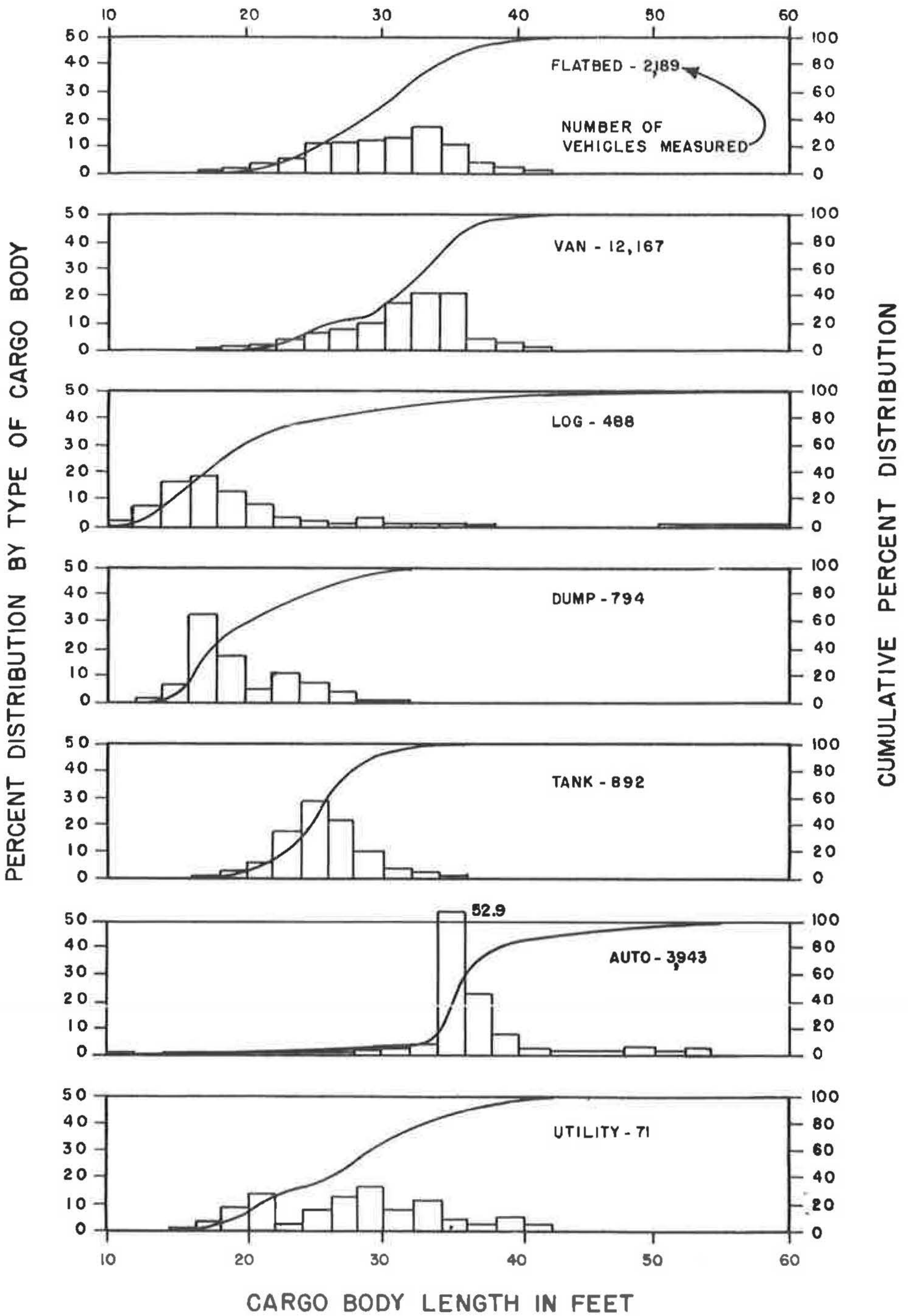

Figure 1. Percent distribution of cargo body lengths, 3-axle trailer combinations (2-S1).

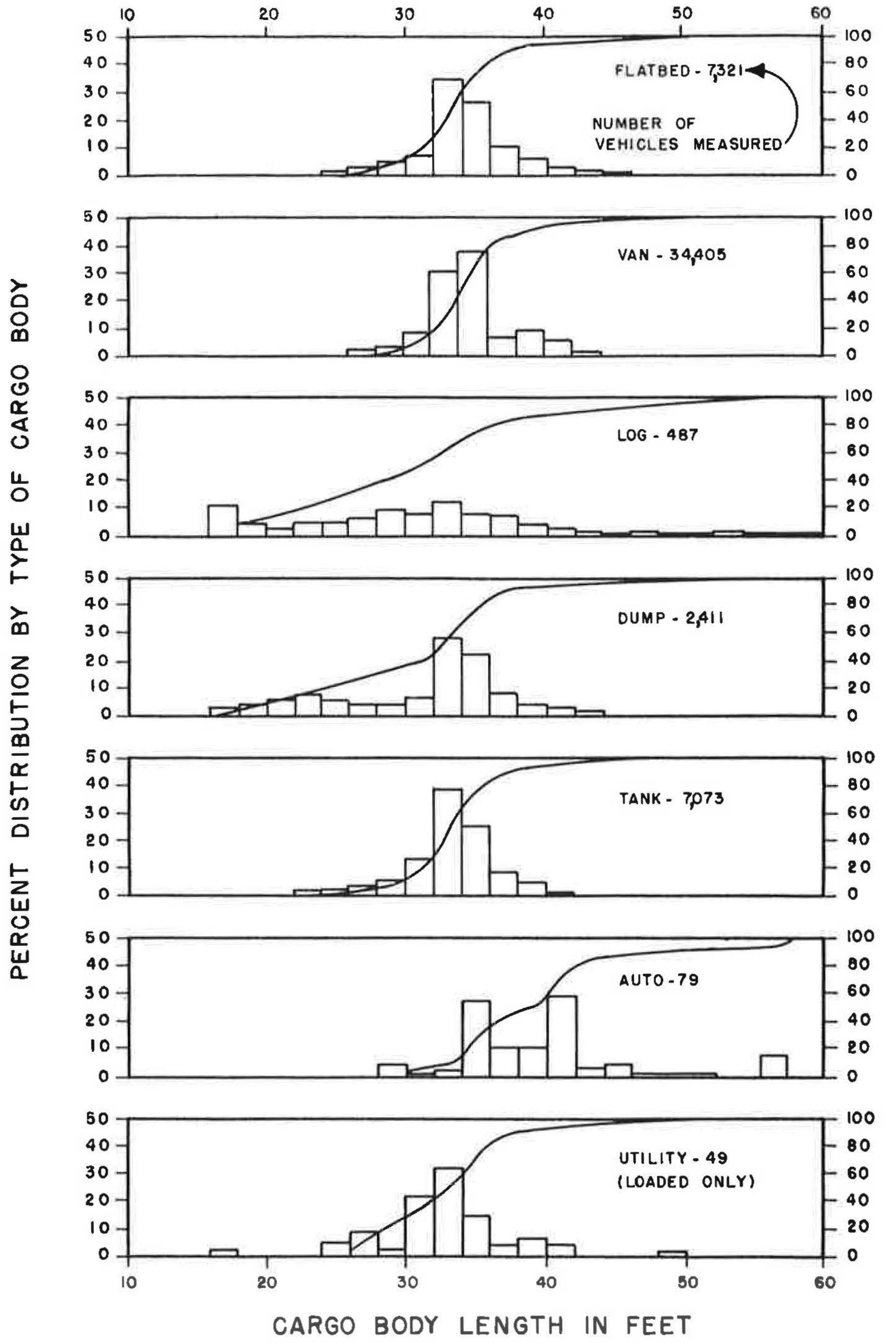

Figure 2. Percent distribution of cargo body lengths, 4-axle trailer combinations (2-S2).

TABLE 1

NUMBER AND PERCENT DISTRIBUTION OF TRAILER CARGO BODY LENGTHS IN TRAILER COMBINATIONS

Trailer Body Length (ft)	2-S1 No.	2-S1 %	2-S2 No.	2-S2 %	3-S2 No.	3-S2 %	3-2 No.	3-2 %	2-S1-2 No.	2-S1-2 %
(a) Flatbed										
10-11.9	4	0.2	—	—	—	—	—	—	—	—
12-13.9	11	0.5	—	—	—	—	—	—	4	1.5
14-15.9	7	0.3	—	—	—	—	—	—	29	10.9
16-17.9	32	1.5	12	0.2	3	0.2	80	16.7	17	6.4
18-19.9	40	1.8	4	0.1	1	0.1	104	21.8	22	8.2
20-21.9	105	4.8	16	0.2	3	0.2	168	35.2	130	48.7
22-23.9	118	5.4	33	0.5	9	0.5	55	11.5	31	11.6
24-25.9	251	11.5	80	1.1	10	0.6	35	7.3	23	9.0
26-27.9	269	12.3	168	2.3	21	1.3	20	4.2	3	1.1
28-29.9	278	12.7	433	5.9	57	3.5	7	1.5	4	1.5
30-31.9	294	13.4	875	12.0	113	6.8	2	0.4	—	—
32-33.9	367	16.7	2,534	34.5	202	12.2	1	0.2	—	—
34-35.9	223	10.2	1,843	25.1	578	35.0	—	—	—	—
36-37.9	101	4.6	655	8.9	219	13.3	—	—	—	—
38-39.9	55	2.5	373	5.1	205	12.4	—	—	—	—
40-41.9	16	0.7	181	2.5	137	8.3	—	—	—	—
42-43.9	9	0.4	45	0.6	38	2.3	—	—	—	—
44-45.9	1	0.1	34	0.5	31	1.9	1	0.2	—	—
46-47.9	--	—	11	0.2	5	0.3	—	—	—	—
48-49.9	5	0.2	10	0.1	7	0.4	2	0.4	—	0.4
50-51.9	2	0.1	5	0.1	4	0.2	—	—	—	—
52 and over	1	0.1	9	0.1	9	0.5	3	0.6	2	0.7
Total	2,189	100.0	7,321	100.0	1,652	100.0	478	100.0	265	100.0
(b) Van										
10-11.9	8	0.1	—	—	—	—	—	—	—	—
12-13.9	9	0.1	—	—	—	—	—	—	1	0.2
14-15.9	15	0.1	—	—	—	—	—	—	3	0.8
16-17.9	69	0.6	21	0.1	12	0.1	38	19.0	6	1.5
18-19.9	83	0.7	14	0.1	10	0.1	9	4.5	8	2.0
20-21.9	314	2.6	38	0.1	12	0.1	19	9.5	44	11.2
22-23.9	490	4.0	91	0.3	10	0.1	19	9.5	100	25.3
24-25.9	774	6.4	117	0.3	21	0.2	29	14.5	220	55.8
26-27.9	947	7.8	199	0.6	13	0.1	38	19.0	5	1.3
28-29.9	1,200	9.9	799	2.3	36	0.4	27	13.5	3	0.8
30-31.9	2,011	16.5	3,212	9.3	134	1.4	2	1.0	—	—
32-33.9	2,561	20.9	10,329	30.0	744	7.8	1	0.5	—	—
34-35.9	2,543	20.9	12,386	35.9	3,786	39.5	3	1.5	2	0.5
36-37.9	518	4.3	2,233	6.5	793	8.3	1	0.5	—	—
38-39.9	416	3.4	2,941	8.5	2,129	22.2	1	0.5	1	0.3
40-41.9	158	1.3	1,648	4.8	1,386	14.4	4	2.0	—	—
42-43.9	28	0.2	259	0.8	230	2.4	—	—	—	—

Total	12,167	100.0	34,405	100.0	9,593	100.0	200	100.0	394	100.0
(c) Log										
10-11.9	13	2.7	—	—	—	—	—	—	—	—
12-13.9	42	8.6	—	—	—	—	—	—	—	—
14-15.9	84	17.2	—	—	—	—	—	—	—	—
16-17.9	96	19.7	55	11.3	2	0.3	13	35.2	—	—
18-19.9	67	13.7	21	4.3	1	0.1	10	27.0	—	—
20-21.9	45	9.2	19	3.9	2	0.3	5	13.5	—	—
22-23.9	21	4.3	27	5.6	1	0.1	2	5.4	—	—
24-25.9	20	4.1	28	5.8	—	—	1	2.7	—	—
26-27.9	13	2.7	34	7.0	13	2.0	—	—	—	—
28-29.9	9	1.8	44	9.0	32	4.8	—	—	—	—
30-31.9	17	3.5	40	8.2	128	19.0	—	—	—	—
32-33.9	10	2.1	70	14.4	59	8.8	1	2.7	—	—
34-35.9	10	2.1	44	9.0	80	12.0	—	—	—	—
36-37.9	11	2.3	34	7.0	103	15.3	—	—	—	—
38-39.9	9	1.8	21	4.3	72	10.7	—	—	—	—
40-41.9	6	1.2	15	3.1	76	11.3	—	—	—	—
42-43.9	3	0.6	8	1.6	48	7.1	—	—	—	—
44-45.9	2	0.4	4	0.8	30	4.8	—	—	—	—
46-47.9	2	0.4	6	1.2	9	1.3	2	5.4	—	—
48-49.9	2	0.4	4	0.8	3	0.4	1	2.7	—	—
50-51.9	—	—	2	0.4	9	1.3	—	—	—	—
52 and over	6	1.2	11	2.3	3	0.4	2	5.4	—	—
Total	488	100.0	487	100.0	671	100.0	37	100.0	—	—
(d) Dump										
10-11.9	1	0.1	—	—	—	—	—	—	—	—
12-13.9	8	1.0	—	—	—	—	—	—	1	0.4
14-15.9	58	7.3	—	—	—	—	—	—	3	1.4
16-17.9	267	33.6	76	3.2	—	—	20	26.3	57	25.6
18-19.9	133	16.8	88	3.6	8	1.2	7	9.2	85	38.1
20-21.9	69	8.7	141	5.8	20	2.9	27	35.6	59	26.5
22-23.9	39	4.9	155	6.4	26	3.8	8	10.5	17	7.6
24-25.9	90	11.3	120	5.0	20	2.9	12	15.8	—	—
26-27.9	57	7.2	100	4.1	14	2.0	—	—	—	—
28-29.9	31	3.9	101	4.2	19	2.7	—	—	—	—
30-31.9	16	2.0	147	6.1	43	6.2	—	—	—	—
32-33.9	12	1.5	659	27.3	104	15.0	—	—	—	—
34-35.9	3	0.4	496	20.6	221	31.9	—	—	—	—
36-37.9	7	0.9	173	7.2	95	13.7	—	—	1	0.4
38-39.9	2	0.3	82	3.4	63	9.0	1	1.3	—	—
40-41.9	1	0.1	40	1.7	36	5.2	—	—	—	—
42-43.9	—	—	21	0.9	13	1.9	—	—	—	—
44-45.9	—	—	6	0.2	6	0.9	1	1.3	—	—
46-47.9	—	—	2	0.1	2	0.3	—	—	—	—
48-49.9	—	—	2	0.1	2	0.3	—	—	—	—
50-51.9	—	—	—	—	—	—	—	—	—	—
52 and over	—	—	2	0.1	1	0.1	—	—	—	—
Total	794	100.0	2,411	100.0	693	100.0	76	100.0	223	100.0

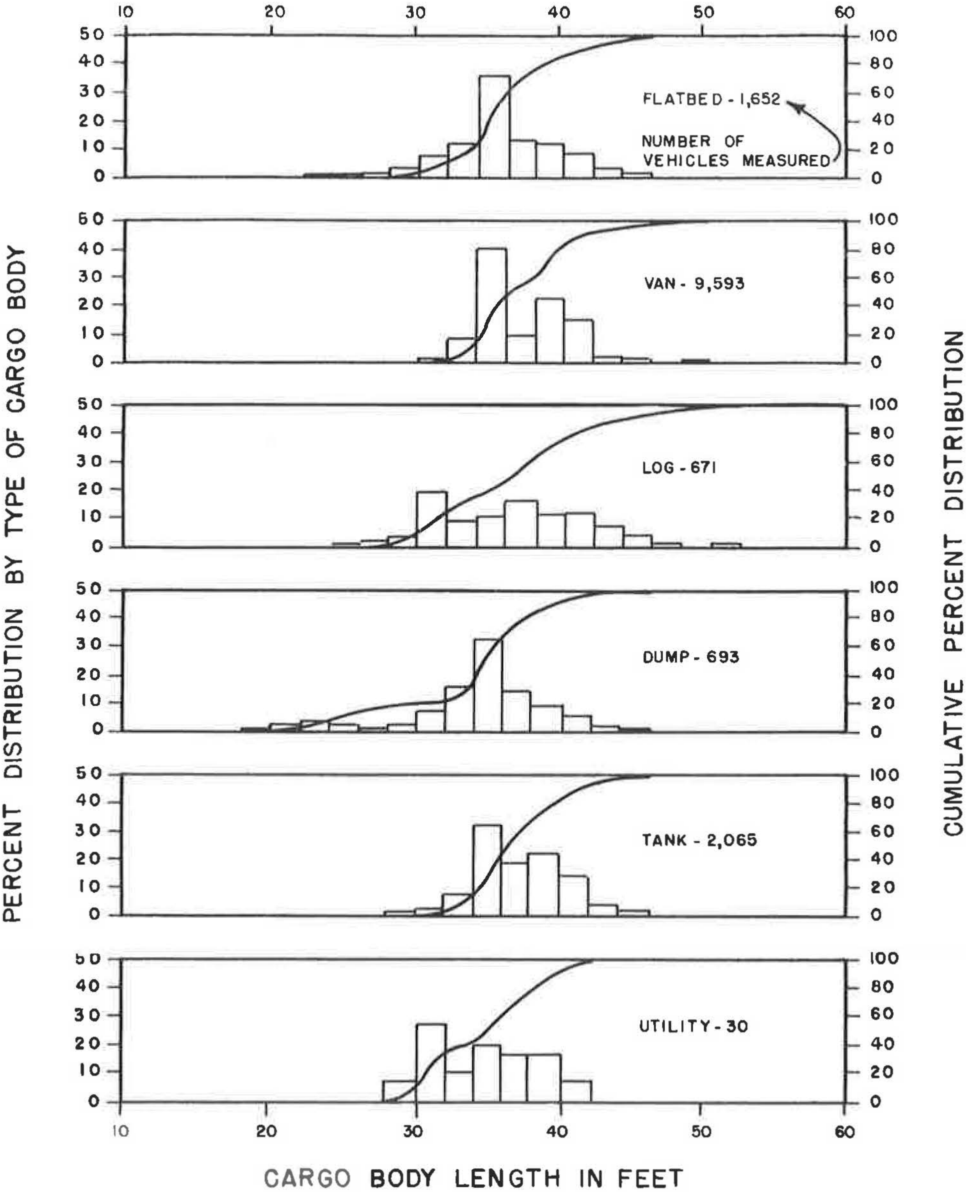

Figure 3. Percent distribution of cargo body lengths, 5-axle tractor trailer combinations (3-S2).

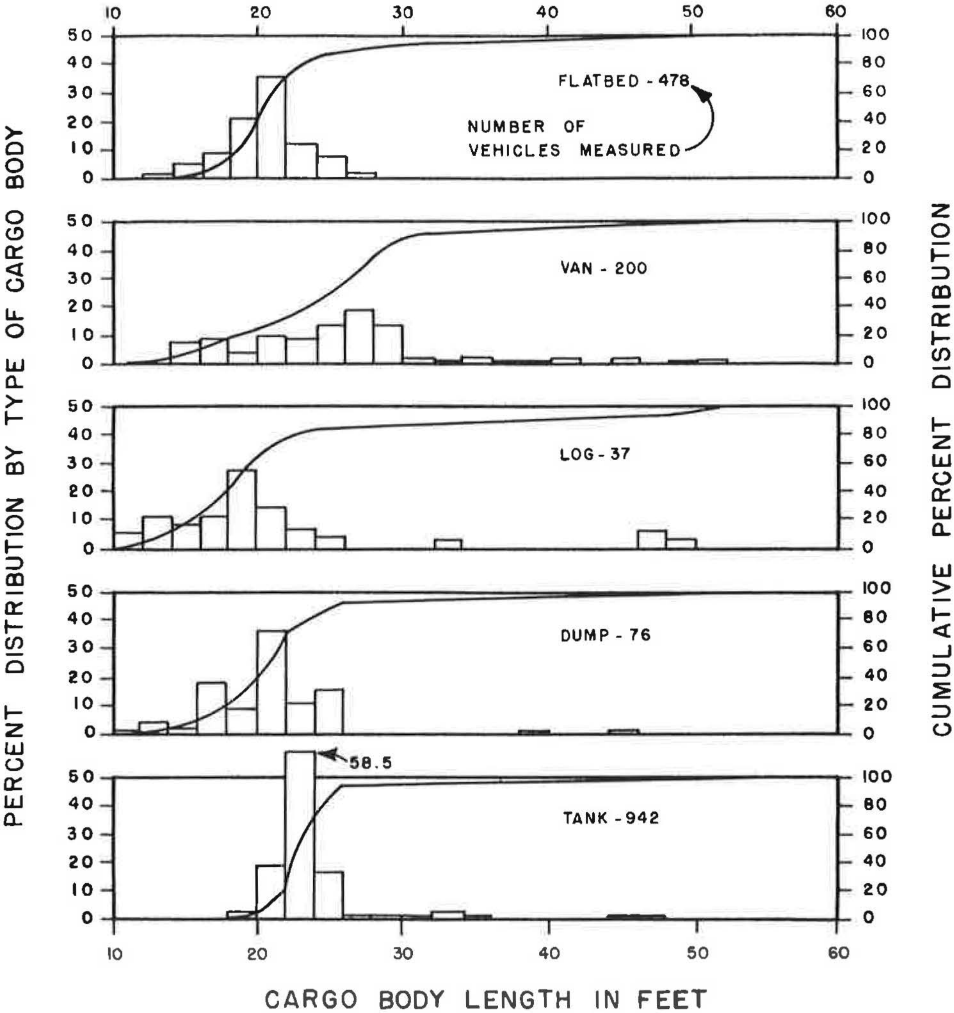

Figure 4. Percent distribution of cargo body lengths, tractive truck full trailer combinations (3-2).

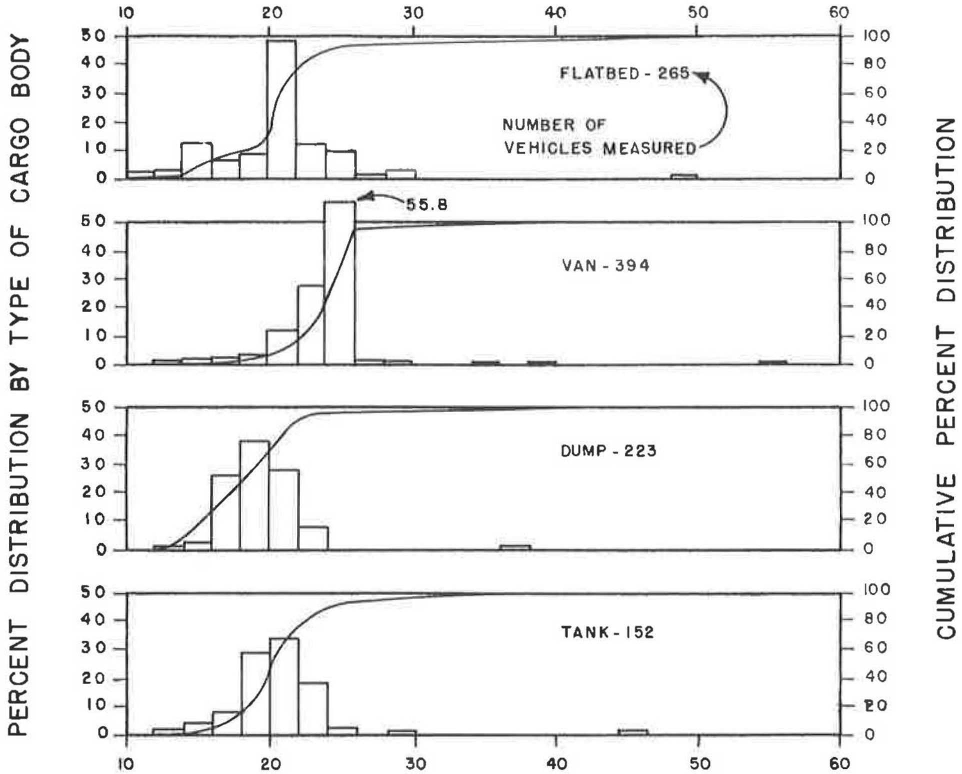

Figure 5. Percent distribution of cargo body lengths, tractor semitrailer full trailer combinations (2-S1-2).

Most of the flatbed, full trailers used in the 3-2 and 2-S1-2 trailer combinations were 20 ft long. Ninety percent of the van, full trailers in the 3-2 combinations were less than 30 ft long, and 97 percent of the van, full trailers used in the 2-S1-2 combinations were less than 26 ft long. Dump, full trailers were mostly 16 to 22 ft long. Tank, full trailers in 3-2 combinations were mostly 22 to 24 ft long, and lengths of the tank trailers in the 2-S-2 combinations were rather evenly distributed from 18 to 24 ft.

The basic data used for Figures 1 through 5 are given in Tables 1 and 2.

Figure 6 shows trailer length distributions of five different double-cargo body trailer combinations for 50 to 100 observations for each combination. The 2-1 class trailer combination has a limited local use, usually as a seasonal, auxiliary freight vehicle in agricultural areas. The trailers in such combinations were flatbed, balanced full trailers and were from 14 to 20 ft long. In the 2-2 class, with lengths ranging predominately only flatbed full trailers were observed, from 14 to 26 ft. Apparently this 2-2 class was not adequately sampled because other body types are used.

Also shown are data collected for tractor semitrailer, and full trailer combinations (2-S2-2, 3-S1-1, and 3-S3-2), three classes of trailer combinations less frequently used than others. All had van full trailers. The 2-S2-2 van trailers were mostly 16 to 18 ft long. The lengths of van trailers in both 3-axle tractor combinations were spread over a wide range from 14 to 40 ft and most of them were from 18 to 26 ft long.

Cumulative percentage curves for all the 2-S1, 2-S2, 3-S2, 3-2 and 2-S1-2 combinations by cargo body type are shown in Figure 7 for comparison. Of course, some long cargo bodies reported may have been special permit vehicles. No predominant length of trailer for all purposes is indicated, and the predominant range of lengths varies from 20 to 40 ft.

TABLE 2

NUMBER AND PERCENT DISTRIBUTION OF TRAILER CARGO BODY LENGTHS IN TRAILER COMBINATIONS

Trailer Body Length (ft)	2-S1 No.	2-S1 %	2-S2 No.	2-S2 %	3-S2 No.	3-S2 %	3-2 No.	3-2 %	2-S1-2 No.	2-S1-2 %
(a) Tank										
12-13.9	1	0.1	—	—	—	—	—	—	3	2.0
14-15.9	2	0.2	—	—	—	—	—	—	7	4.5
16-17.9	11	1.2	9	0.1	2	0.1	14	1.5	13	8.5
18-19.9	32	3.6	3	0.1	—	—	26	2.7	45	29.4
20-21.9	54	6.1	13	0.2	—	—	177	18.7	52	33.9
22-23.9	152	17.0	41	0.6	—	—	554	58.5	28	18.3
24-25.9	265	29.7	73	1.0	3	0.1	146	15.4	2	1.3
26-27.9	203	22.8	164	2.3	6	0.3	2	0.2	—	—
28-29.9	108	12.1	393	5.6	22	1.1	2	0.2	1	0.7
30-31.9	30	3.4	931	13.2	36	1.7	5	0.5	—	—
32-33.9	17	2.0	2,682	38.0	157	7.6	8	0.9	—	—
34-35.9	9	1.0	1,734	24.5	636	30.8	2	0.2	—	—
36-37.9	4	0.4	564	8.0	357	17.3	—	—	—	—
38-39.9	4	0.4	353	5.0	441	21.4	—	—	—	—
40-41.9	—	—	60	0.8	283	13.7	—	—	—	—
42-43.9	—	—	30	0.4	74	3.6	—	—	—	0.7
44-45.9	—	—	17	0.2	42	2.0	1	0.2	—	—
46-47.9	—	—	2	0.0	3	0.1	1	0.1	—	—
48-49.9	—	—	2	0.0	1	0.1	—	—	—	—
50-51.9	—	—	1	0.0	—	—	—	—	1	0.7
52 and over	—	—	1	0.0	2	0.1	4	0.9	—	—
Total	892	100.0	7,073	100.0	2,065	100.0	942	100.0	152	100.0
(b) Auto										
10-11.9	4	0.1	—	—	—	—	—	—	—	—
12-13.9	1	0.0	—	—	—	—	—	—	—	—
14-15.9	2	0.1	—	—	—	—	—	—	—	—
16-17.9	3	0.1	—	—	—	—	—	—	—	—
18-19.9	2	0.1	—	—	—	—	—	—	—	—
20-21.9	5	0.1	—	—	—	—	—	—	—	—
22-23.9	2	0.1	—	—	—	—	—	—	—	—
24-25.9	8	0.2	—	—	—	—	—	—	—	—
26-27.9	11	0.3	—	—	—	—	—	—	—	—
28-29.9	19	0.5	3	3.8	—	—	—	—	—	—
30-31.9	22	0.6	1	1.3	—	—	—	—	—	—
32-33.9	138	3.5	2	2.5	—	—	—	—	—	—
34-35.9	2,090	52.9	21	26.6	—	—	—	—	—	—
36-37.9	855	21.6	8	10.1	—	—	—	—	—	—
38-39.9	282	7.2	8	10.1	—	—	—	—	—	—
40-41.9	81	2.0	22	27.8	—	—	—	—	—	—
42-43.9	32	0.8	2	2.5	—	—	—	—	—	—
44-45.9	34	0.9	3	3.8	—	—	—	—	—	—
46-47.9	85	2.2	1	1.3	—	—	—	—	—	—
48-49.9	127	3.2	1	1.3	—	—	—	—	—	—
50-51.9	44	1.1	1	1.3	—	—	—	—	—	—
52 and over	96	2.4	6	7.6	—	—	—	—	—	—
Total	3,943	100.0	79	100.0	—	—	—	—	—	—
(c) Utility										
14-15.9	1	1.4	—	—	—	—	—	—	—	—
16-17.9	2	2.8	1	2.0	—	—	—	—	—	—
18-19.9	6	8.4	—	—	—	—	—	—	—	—
20-21.9	10	14.1	—	—	—	—	—	—	—	—
22-23.9	2	2.8	—	—	—	—	—	—	—	—
24-25.9	6	8.5	2	4.1	—	—	—	—	—	—
26-27.9	9	12.7	4	8.2	—	—	—	—	—	—
28-29.9	11	15.5	1	2.0	2	6.4	—	—	—	—
30-31.9	5	7.1	11	22.5	8	25.7	—	—	—	—
32-33.9	8	11.3	15	30.6	3	9.7	—	—	—	—
34-35.9	3	4.2	7	14.3	6	19.4	—	—	—	—
36-37.9	2	2.8	2	4.1	5	16.2	—	—	—	—
38-39.9	3	4.2	3	6.1	4	16.2	—	—	—	—
40-41.9	2	2.8	2	4.1	—	—	—	—	—	—
42-43.9	—	—	—	—	2	6.4	—	—	—	—
44-45.9	—	—	—	—	—	—	—	—	—	—
46-47.9	1	1.4	—	—	—	—	—	—	—	—
48-49.9	—	—	1	2.0	—	—	—	—	—	—
Total	71	100.0	49	100.0	30	100.0	—	—	—	—

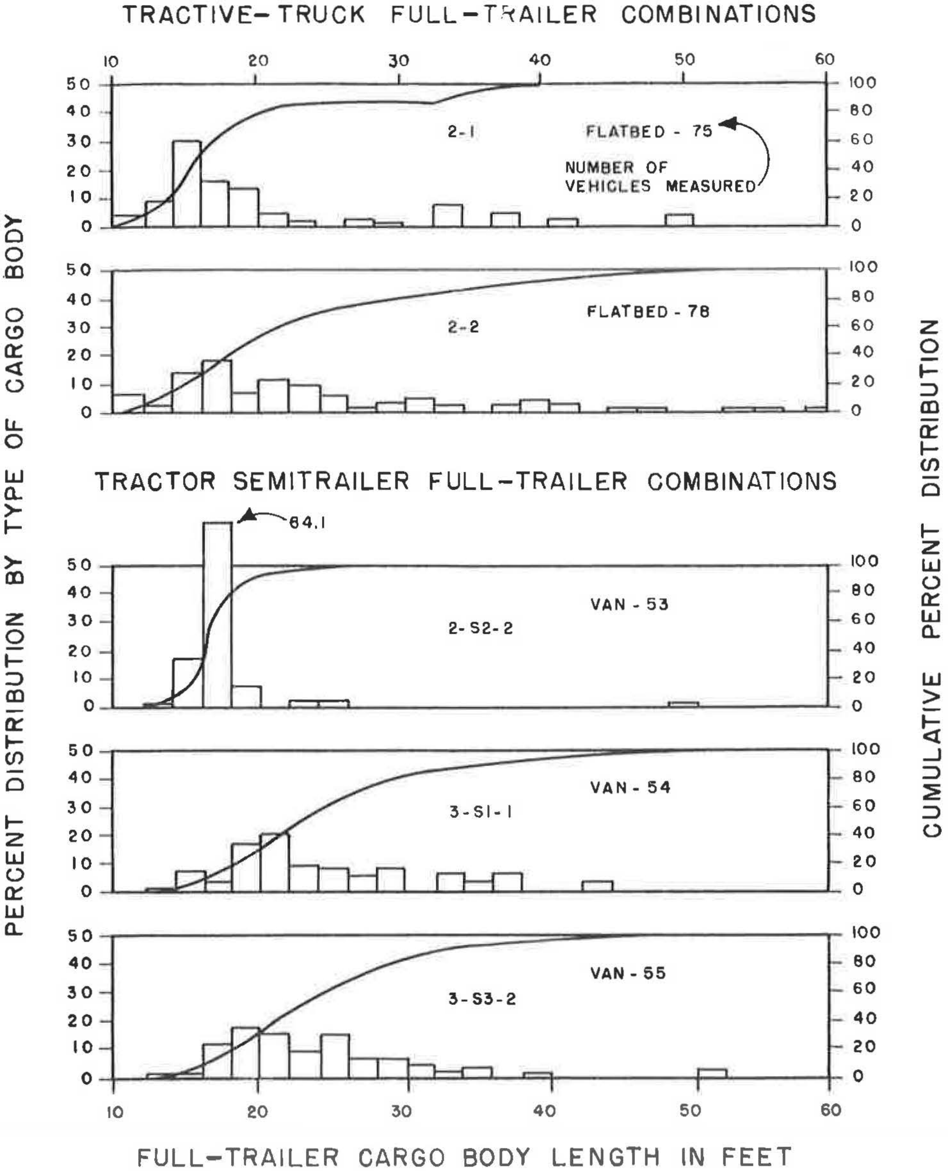

Figure 6. Percent distribution of cargo body lengths, miscellaneous vehicle class.

Trucks

Of the 268 pickup trucks, 85 percent had cargo bodies 6 to 10 ft long and the 614 panel trucks were evenly distributed as to length over the 2-ft intervals from 6 to 18 ft. (Fig. 8 and Table 3). Few panel and pickup trucks are found on rural roads; their primary use is in urban areas.

Two-axle motor trucks with 4 tires, other than panels and pickups, had cargo body measurements similar to the panels and pickups, most of the flatbed bodies were 6 to 10 ft long and the length of van bodies ranged from 6 to 20 ft (Fig. 8 and Table 3).

Two-axle motor trucks with 6 tires had cargo body lengths mostly in the range of 12 to 16 ft, except for dump trucks and utility vehicles. Dump bodies had average lengths

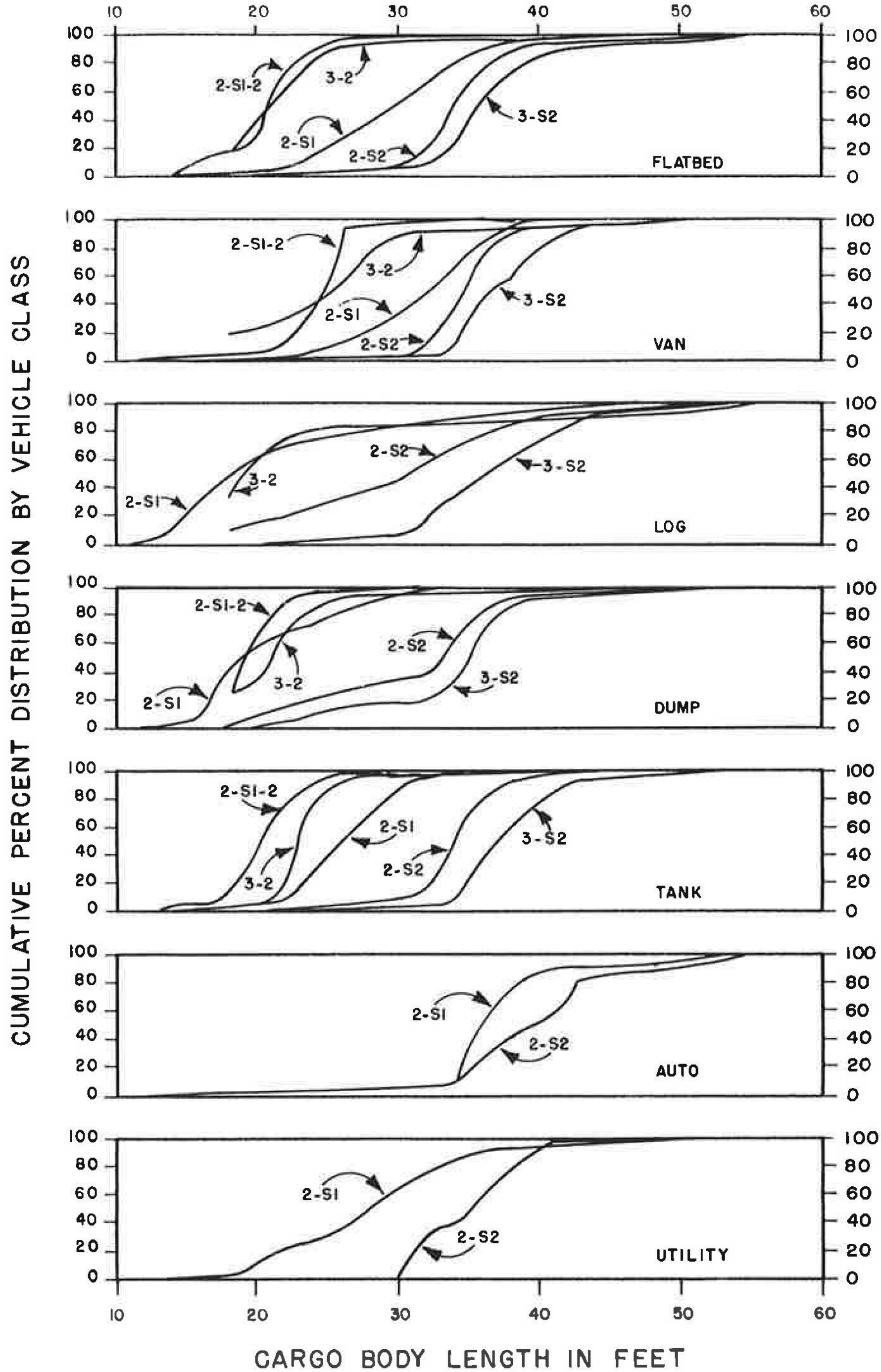

Figure 7. Cumulative percent distribution by vehicle class and cargo body length.

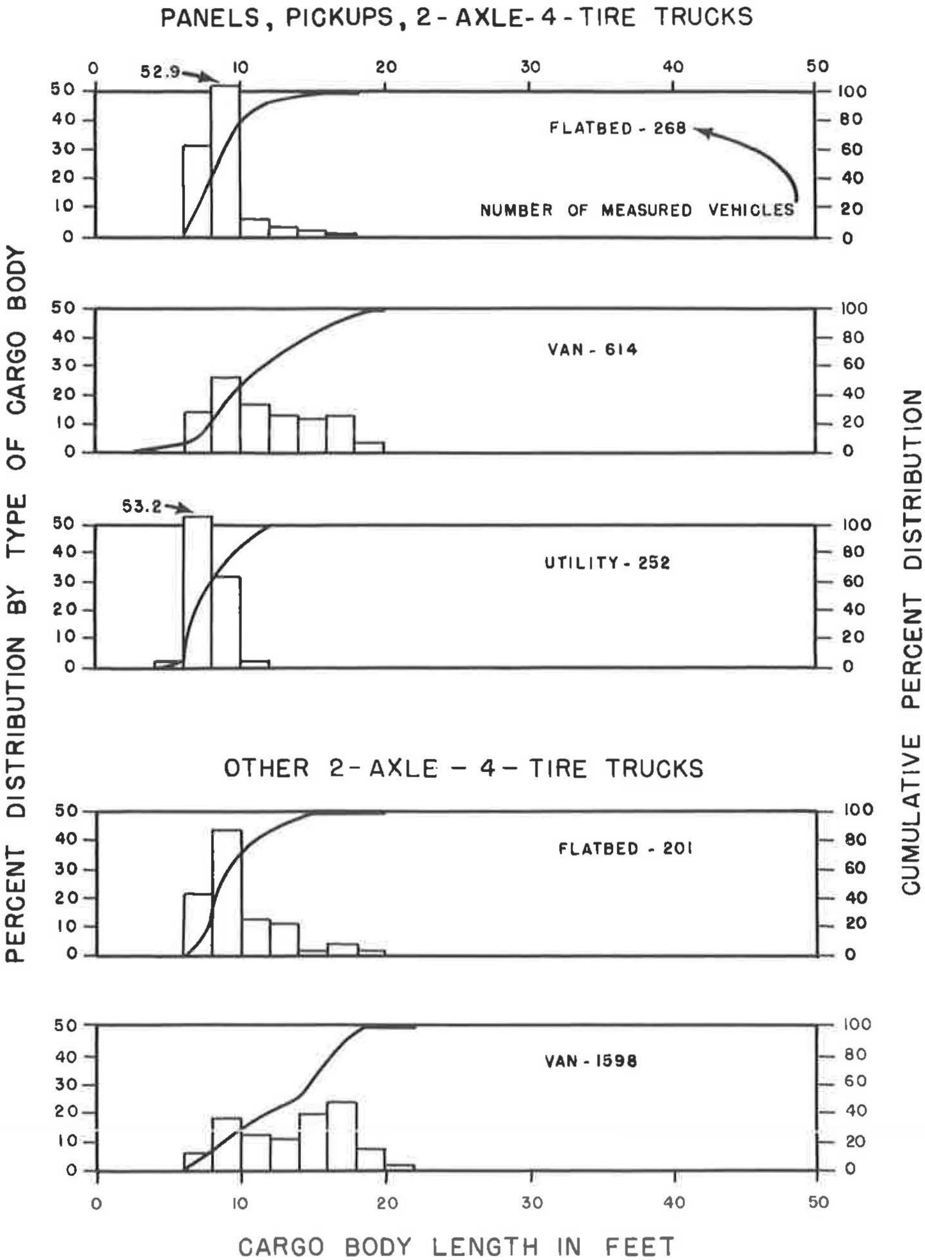

Figure 8. Percent distribution of cargo body lengths, 2-axle-4-tire motor trucks.

of about 10 ft and lengths of utility bodies were rather evenly distributed over the range of 8 to 16 ft (Fig. 9 and Tables 3 and 4).

Considerable differences were noted with respect to the length distributions of the different types of cargo bodies of 3-axle trucks (Fig. 10). Lengths of flatbed and van bodies were predominantly in the range of 16 to 22 ft, and log and tank bodies had lengths mostly in the 14- to 20-ft range. Nearly two-thirds of the dump trucks and 85 percent of the ready-mix concrete trucks were equipped with cargo bodies 12 to 16 ft long.

TABLE 3

NUMBER AND PERCENT OF LENGTH BY 2-FT INTERVALS OF CARGO BODIES IN SINGLE-UNIT TRUCKS

Cargo Body Length (ft)	Panels, Pickups, 4 Tires		Other 2-Axles, 4 Tires		2-Axles 6 Tires		3-Axle	
	No.	%	No.	%	No.	%	No.	%
Under 6.0	–	–	2	1.0	22	0.2	–	–
6-7.9	87	32.5	43	21.4	68	0.6	–	–
8-9.9	142	52.9	90	44.8	921	8.1	1	0.1
10-11.9	17	6.3	26	12.9	1,023	9.0	11	0.9
12-13.9	9	3.4	24	11.9	3,983	35.1	70	5.8
14-15.9	8	3.0	4	2.0	2,714	24.0	118	9.7
16-17.9	2	0.7	8	4.0	1,511	13.3	342	28.1
18-19.9	1	0.4	4	2.0	589	5.2	309	25.4
20-21.9	–	–	–	–	254	2.2	233	19.2
22-23.9	–	–	–	–	122	1.1	60	4.9
24-25.9	–	–	–	–	62	0.5	29	2.4
26-27.9	1	0.4	–	–	39	0.3	12	1.0
28-29.9	–	–	–	–	15	0.1	12	1.0
30-31.9	–	–	–	–	8	0.1	4	0.3
32-33.9	–	–	–	–	6	0.1	8	0.7
34-35.9	–	–	–	–	13	0.1	4	0.3
36-37.9	–	–	–	–	3	0.0	–	–
38-39.9	–	–	–	–	1	0.0	1	0.1
40-41.9	1	0.4	–	–	–	–	1	0.1
Total	268	100.0	201	100.0	11,354	100.0	1,215	100.0

(b) Van

Cargo Body Length (ft)	Panels, Pickups, 4 Tires No.	%	Other 2-Axles, 4 Tires No.	%	2-Axles 6 Tires No.	%	3-Axle No.	%
Under 4.0	3	0.5	1	0.1	–	–	–	–
4-5.9	1	0.2	3	0.2	39	0.1	–	–
6-7.9	90	14.7	91	5.7	136	0.4	–	–
8-9.9	160	26.0	289	18.0	1,857	6.0	6	0.4
10-11.9	105	17.0	206	12.9	2,288	7.3	10	0.7
12-13.9	77	12.5	197	12.3	9,888	31.7	43	2.8
14-15.9	71	11.6	308	19.3	7,960	25.6	103	6.8
16-17.9	79	12.9	379	23.6	5,251	17.0	319	20.8
18-19.9	27	4.4	105	6.6	1,988	6.4	446	29.2
20-21.9	–	–	9	0.6	712	2.3	345	22.6
22-23.9	–	–	6	0.4	391	1.3	130	8.5
24-25.9	1	0.2	3	0.2	258	0.8	74	4.9
26-27.9	–	–	–	–	161	0.5	15	1.0
28-29.9	–	–	–	–	86	0.3	13	0.9
30-31.9	–	–	–	–	33	0.1	6	0.4
32-33.9	–	–	–	–	40	0.1	4	0.3
34-35.9	–	–	–	–	34	0.1	6	0.4
36-37.9	–	–	1	0.1	14	0.0	1	0.1
38-39.9	–	–	–	–	2	0.0	1	0.1
40-41.9	–	–	–	–	3	0.0	–	–
42-43.9	–	–	–	–	2	0.0	–	–
44-45.9	–	–	–	–	2	0.0	–	–
46-47.9	–	–	–	–	–	–	–	–
48-49.9	–	–	–	–	–	–	–	–
50-51.9	–	–	–	–	1	0.0	1	0.1
Total	614	100.0	1,598	100.0	31,146	100.0	1,523	100.0

(c) Log

Cargo Body Length (ft)	Panels, Pickups, 4 Tires No.	%	Other 2-Axles, 4 Tires No.	%	2-Axles 6 Tires No.	%	3-Axle No.	%
Under 6.0	–	–	–	–	3	0.5	–	–
6-7.9	–	–	–	–	1	0.2	–	–
8-9.9	–	–	–	–	12	2.1	2	0.5
10.11.9	–	–	–	–	35	6.1	15	3.6
12-13.9	–	–	–	–	276	48.2	38	9.1
14-15.9	–	–	–	–	158	27.6	76	18.2
16-17.9	–	–	–	–	55	9.6	127	30.3
18-19.9	–	–	–	–	15	2.6	98	23.4
20-21.9	–	–	–	–	7	1.2	37	8.9
22-23.9	–	–	–	–	6	1.0	8	1.9
24-25.9	–	–	–	–	4	0.7	9	2.2
26-27.9	–	–	–	–	–	–	4	1.0
28-29.9	–	–	–	–	–	–	3	0.7
30-31.9	–	–	–	–	–	–	–	–
32-33.9	–	–	–	–	–	–	–	–
34-35.9	–	–	–	–	1	0.2	1	0.2
Total	–	–	–	–	573	100.0	418	100.0

(d) Dump

Cargo Body Length (ft)	Panels, Pickups, 4 Tires No.	%	Other 2-Axles, 4 Tires No.	%	2-Axles 6 Tires No.	%	3-Axle No.	%
Under 6.0	–	–	–	–	20	0.3	–	–
6-7.9	–	–	–	–	228	3.2	–	–
8-9.9	–	–	–	–	2,952	41.7	75	2.8
10-11.9	–	–	–	–	1,587	22.4	444	16.5
12-13.9	–	–	–	–	1,338	19.0	1,028	38.3
14-15.9	–	–	–	–	598	8.4	642	24.0
16-17.9	–	–	–	–	245	3.5	225	8.4
18-19.9	–	–	–	–	76	1.1	167	6.2
20-21.9	–	–	–	–	16	0.2	60	2.2
22-23.9	–	–	–	–	6	0.1	26	1.0
24-25.9	–	–	–	–	3	0.0	8	0.3
26-27.9	–	–	–	–	3	0.0	2	0.1
28-29.9	–	–	–	–	1	0.0	1	0.0
30-31.9	–	–	–	–	–	–	2	0.1
32-33.9	–	–	–	–	2	0.0	3	0.1
34-35.9	–	–	–	–	4	0.1	1	0.0
36-37.9	–	–	–	–	1	0.0	–	–
38-39.9	–	–	–	–	1	0.0	1	0.0
Total	–	–	–	–	7,081	100.0	2,685	100.0

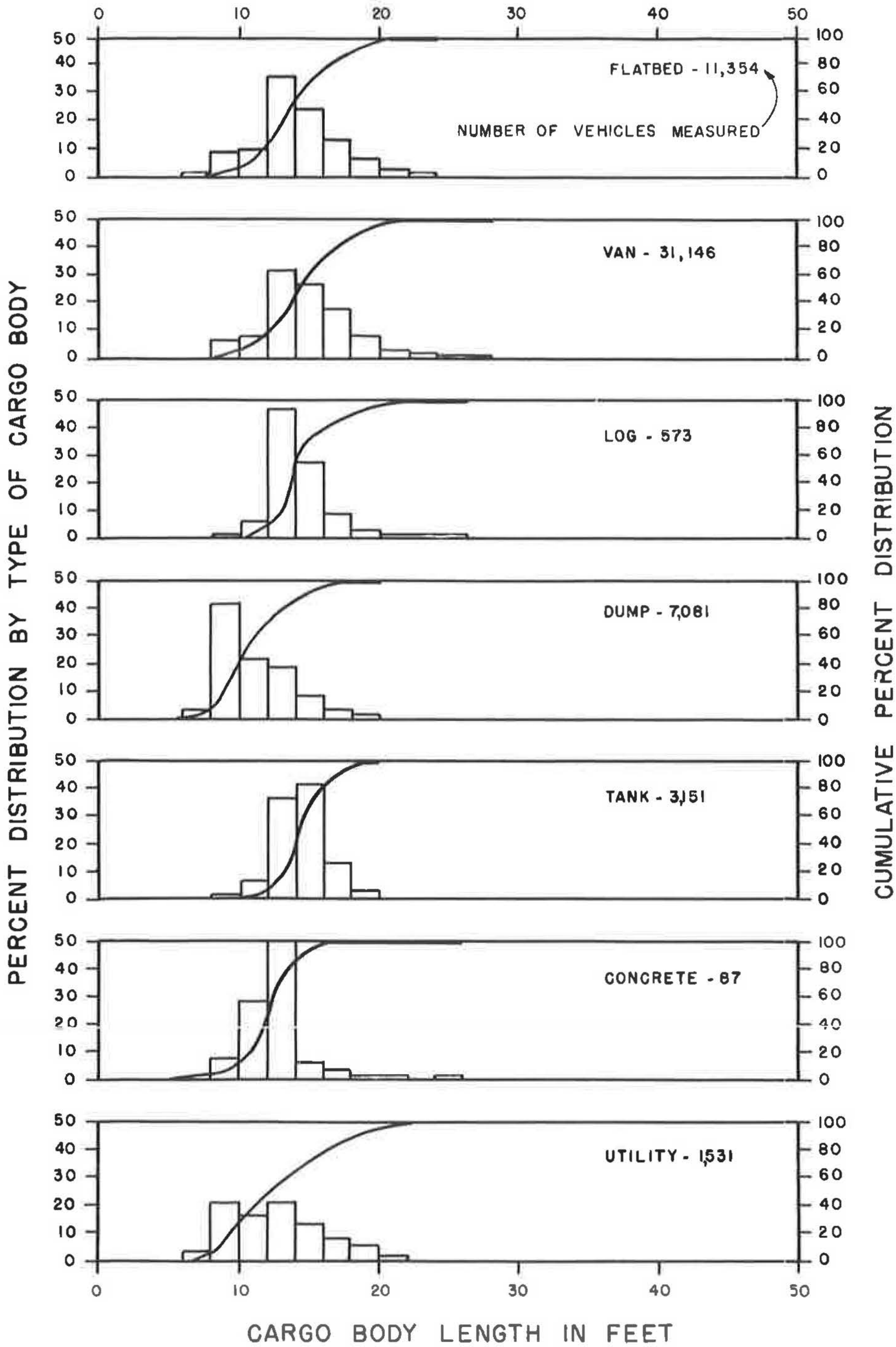

Figure 9. Percent distribution of cargo body lengths, 2-axle-6-tire motor trucks.

TABLE 4

NUMBER AND PERCENT OF LENGTH BY 2-FT INTERVALS, OF CARGO BODIES OF SINGLE-UNIT TRUCKS

Cargo Body Length (ft)	Panels, Pickups, 4 Tires		2-Axles 6 Tires		3-Axle	
	No.	%	No.	%	No.	%
(a) Tank						
Under 6.0	—	—	4	0.1	—	—
6-7.9	—	—	3	0.1	—	—
8-9.9	—	—	45	1.4	—	—
10-11.9	—	—	166	5.3	3	1.1
12-13.9	—	—	1,115	35.4	14	5.4
14-15.9	—	—	1,315	41.8	66	25.3
16-17.9	—	—	396	12.6	71	27.2
18-19.9	—	—	78	2.5	63	24.2
20-21.9	—	—	11	0.3	35	13.4
22-23.9	—	—	6	0.2	4	1.5
24-25.9	—	—	6	0.2	3	1.1
26-27.9	—	—	1	0.0	—	—
28-29.9	—	—	—	—	—	—
30-31.9	—	—	—	—	1	0.4
32-33.9	—	—	1	0.0	—	—
34-35.9	—	—	2	0.1	—	—
36-37.9	—	—	1	0.0	—	—
38-39.9	—	—	—	—	—	—
40-41.9	—	—	1	0.0	—	—
42 and over	—	—	—	—	1	0.4
Total	—	—	3,151	100.0	261	100.0
(b) Concrete						
6-7.9	—	—	1	1.1	—	—
8-9.9	—	—	6	7.0	3	0.3
10-11.9	—	—	25	28.7	54	5.9
12-13.9	—	—	44	50.6	384	41.6
14-15.9	—	—	5	5.8	396	42.9
16-17.9	—	—	3	3.5	63	6.8
18-19.9	—	—	1	1.1	10	1.1
20-21.9	—	—	1	1.1	3	0.3
22-23.9	—	—	—	—	6	0.7
24-25.9	—	—	1	1.1	2	0.2
26-27.9	—	—	—	—	1	0.1
28-29.9	—	—	—	—	—	—
30-31.9	—	—	—	—	—	—
32-33.9	—	—	—	—	—	—
34-35.9	—	—	—	—	1	0.1
Total	—	—	87	100.0	923	100.0
(c) Utility						
Under 6.0	4	1.6	22	1.4	—	—
6-7.9	134	53.2	56	3.7	—	—
8-9.9	81	32.1	335	21.9	13	5.6
10-11.9	28	11.1	269	17.6	23	9.9
12-13.9	4	1.6	340	22.2	34	14.7
14-15.9	—	—	214	14.0	28	12.1
16-17.9	1	0.4	124	8.1	30	12.9
18-19.9	—	—	83	5.4	39	16.8
20-21.9	—	—	24	1.6	24	10.3
22-23.9	—	—	13	0.8	9	3.9
24-25.9	—	—	18	1.2	10	4.3
26-27.9	—	—	14	0.9	5	2.2
28-29.9	—	—	5	0.3	5	2.2
30-31.9	—	—	6	0.4	1	0.4
32-33.9	—	—	2	0.1	1	0.4
34-35.9	—	—	3	0.2	1	0.4
36-37.9	—	—	2	0.1	—	—
38-39.9	—	—	1	0.1	—	—
40-41.9	—	—	—	—	—	—
42-43.9	—	—	—	—	—	—
44-45.9	—	—	—	—	1	0.4
46-47.9	—	—	—	—	2	0.9
48-49.9	—	—	—	—	1	0.4
50 and over	—	—	—	—	5	2.2
Total	252	100.0	1,531	100.0	232	100.0

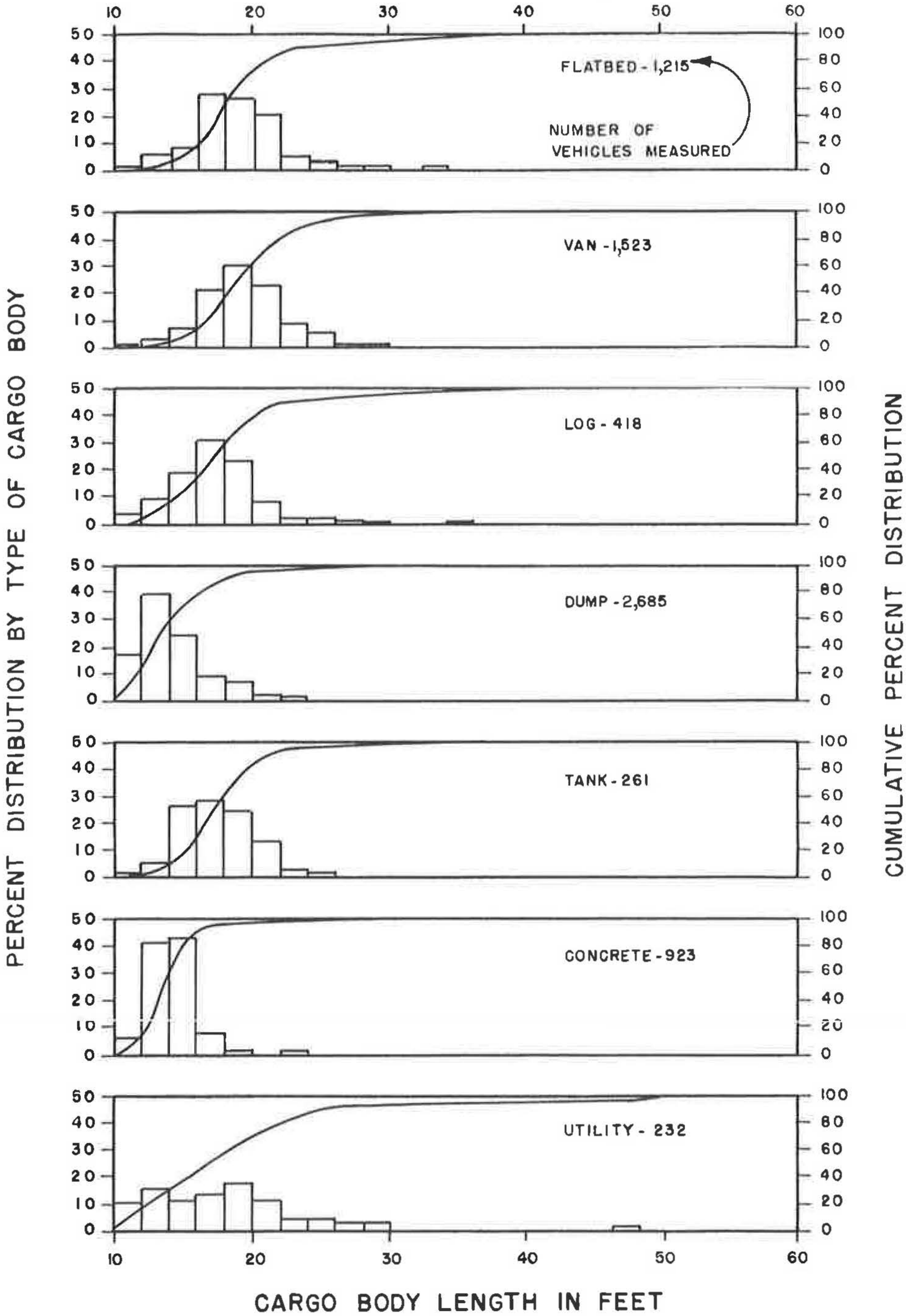

Figure 10. Percent distribution of cargo body lengths, 3-axle motor trucks.

EMPTY VEHICLE WEIGHTS

Trailer Combinations

Empty weights were obtained for 27,144 trailer combinations for the five classifications for which the greatest number of trailer combinations occurred—2-S1, 2-S2, 3-S2, 3-2, and 2-S1-2 (Table 5). The weighted average empty weights by class of combination and type of cargo body provide a means of computing average payload weights when average loaded gross weights are known. The empty 2-S2 combinations weighed on the average about 5,000 lb more than the 2-S1 empty van combinations and about 5,000 lb less than the 3-S2 empty van combinations. Other variations in empty weights between these three classes of combinations and the six types of cargo bodies are given in Table 5. Sometimes the sample of weighed vehicles was small. Averages computed from these data are not as reliable as data might have been if a larger sample could have been obtained. The sizes of the samples are shown in Table 5 for use in evaluating the reliability of the data for average empty weights.

In Figure 11, average empty weights of trailer combinations have been arranged by cargo body types to show the variations in weight of the same body type for the five main combination classes. Similarly, in Figure 12, average empty weights have been arranged by the five main combination classes to show the variations in weight for the different cargo body types.

Single-Unit Trucks

The four classes of single-unit trucks weighed and measured were panels and pickups having 4 tires, other 2-axle trucks having 4 tires, 2-axle trucks having 6 tires, and 3-axle trucks (Table 6). The total number of these trucks observed was 23,844. Empty weights averaged 4,800 lb for pickup trucks and 6,100 lb for panel trucks. Other 2-axle, 4-tire trucks having van cargo bodies on the average had empty weights of only about 300 lb more than the panel trucks. Two-axle trucks equipped with six tires had empty weights that were approximately 3,000 lb heavier than trucks having four tires. Empty weights of 3-axle flatbed, van, and dump trucks ranged between 15,000 and 16,000 lb and empty weights of tank trucks averaged about 19,000 lb. Ready-mixed concrete trucks and utility trucks weighed empty 22,500 and 25,000 lb, respectively. Equipment was a regular part of their empty weight.

In Figure 13, average empty weights have been arranged by cargo body types to show the differences in weight of the same body type for the four different vehicle classes. Similarly, in Figure 14, average empty weights have been arranged by the four vehicle classes to show the differences in weights for the eight cargo body types.

AVERAGE LOADED AND PAYLOAD WEIGHTS OF TRAILER COMBINATIONS

The average empty weights in Table 5 were subtracted from average loaded gross weights in Tables 7 and 8 giving average payload weights in Table 9. Although there is little correlation between cargo body length and average payload weights, there is a considerable difference in average payload weights between different combination classes and cargo body types. For instance, the 2-S1 flatbed combinations had an average payload of 15,000 lb but 2-S1 van combinations carried average payloads of about 11,000 lb. Corresponding average payloads for the 2-S2 combinations were 24,000 and 22,000 lb and for the 3-S2 combinations 28,000 and 26,000 lb.

The 2-S2 combinations for all body types, except auto and utility, operated with gross vehicle weights, on the average, of about 15,000 lb more than 2-S1 combinations with the same body types. The 3-S2 combination having flatbed, van, and tank body types operated with gross vehicle weights between 10,000 and 12,000 lb more, on the average, than the 2-S2 combinations having these body types. The 3-S2 dump combination gross vehicle weights, on the average, were 14,000 lb heavier than the 2-S2 dump combination.

In those States where the double-cargo body combination is permitted, the addition of a 2-axle full trailer to the 2-S1 combination resulted in an average increase in gross vehicle weight of 28,000 lb for the flatbed and van combinations and gross vehicle weights of 36,000 to 38,000 more pounds for the dump and tank combinations.

TABLE 5

AVERAGE EMPTY WEIGHTS OF TRAILER COMBINATIONS BY LENGTH AND TYPE OF CARGO BODY

Trailer Body Length (ft)	Body Type (wt. in lb)						
	Flatbed	Van	Log	Dump	Tank	Auto	Utility
(a) 2-S1							
10-11.9	—	23,600	11,900	—	—	—	—
12-13.9	—	17,500	9,400	18,300	—	—	—
14-15.9	16,000	17,900	9,600	15,500	—	20,000	—
16-17.9	14,200	18,000	10,500	16,800	18,100	12,600	21,400
18-19.9	17,300	18,300	10,700	15,700	19,500	—	12,200
20-21.9	15,200	17,800	10,800	15,400	19,900	—	21,200
22-23.9	16,500	18,600	12,300	16,400	20,200	—	—
24-25.9	17,000	18,900	13,400	15,600	19,400	17,700	19,600
26-27.9	16,700	19,100	11,300	15,300	22,100	20,600	17,000
28-29.9	17,500	19,300	—	16,500	22,200	18,100	22,700
30-31.9	13,300	20,400	12,400	16,700	22,700	20,100	22,100
32-33.9	13,800	20,400	15,000	20,000	21,100	19,900	20,000
34-35.9	13,200	21,200	11,700	—	17,000	19,000	—
36-37.9	17,300	20,900	12,300	16,800	—	18,600	—
38-39.9	17,300	21,300	11,000	—	19,800	19,300	21,800
40-41.9	16,400	21,500	13,500	—	—	20,100	17,800
42-43.9	20,400	23,400	—	—	—	19,300	—
44-45.9	16,000	17,900	—	—	—	19,000	—
46-47.9	—	22,300	10,100	—	—	20,400	—
48-49.9	—	—	10,400	—	—	21,300	—
50-51.9	—	—	—	—	—	20,700	—
52 and over	—	17,700	—	—	—	22,100	—
Weighted avg.	17,500	20,100	10,600	16,200	20,600	19,200	19,900
No. weighed	866	3,447	216	337	395	1,672	16
(b) 2-S2							
Under 16	25,700	25,700	—	19,900	—	—	—
16-17.9	18,900	25,100	14,600	21,200	—	—	—
18-19.9	—	19,000	16,200	23,300	24,200	—	—
20-21.9	15,000	27,000	13,000	24,500	24,400	—	—
22-23.9	25,400	24,300	16,900	25,700	31,400	—	—
24-25.9	24,400	25,500	17,500	26,200	25,200	—	—
26-27.9	22,300	23,100	19,700	24,800	25,000	—	—
28-29.9	23,900	24,400	19,300	23,800	25,700	—	—
30-31.9	22,100	24,100	20,200	24,000	25,400	—	—
32-33.9	22,300	24,200	18,700	24,700	24,400	—	—
34-35.9	22,500	25,100	20,400	22,500	24,700	21,600	—
36-37.9	22,300	25,400	20,300	23,400	25,200	20,100	—

Under 18	37,800	–	–	–	–	–	–
18-19.9	32,800	17,100	–	26,300	–	–	–
20-21.9	38,000	23,400	22,100	28,300	–	–	–
22-23.9	28,400	27,300	–	27,900	–	–	–
24-25.9	35,600	30,800	–	30,500	–	–	–
26-27.9	31,600	22,300	24,600	29,300	32,200	–	–
28-29.9	32,300	25,400	–	34,900	29,200	–	32,900
30-31.9	29,100	30,000	19,800	27,300	33,000	–	25,500
32-33.9	30,800	28,000	–	27,400	30,900	–	25,000
34-35.9	31,000	31,100	24,500	29,300	27,600	–	25,800
36-37.9	32,500	30,500	22,500	27,500	28,800	–	–
38-39.9	30,300	31,400	24,000	28,200	27,700	–	–
40-41.9	28,500	31,500	–	27,200	25,000	–	–
42-43.9	31,900	33,300	–	26,600	26,700	–	–
44-45.9	31,100	30,600	–	25,600	25,800	–	–
46-47.9	30,500	30,600	–	31,000	–	–	–
48-49.9	–	34,400	–	23,000	–	–	–
50-51.9	–	39,600	–	–	–	–	–
52 and over	–	33,300	–	27,000	–	–	–
Weighted avg.	31,000	30,700	23,500	28,500	27,800	–	26,400
No. weighed	611	1,522	14	212	973	–	8

(d) 3-2

14-15.9	28,200	24,400	–	28,800	–	–	–
16-17.9	29,600	26,000	27,800	28,300	30,800	–	–
18-19.9	27,400	24,600	27,200	28,500	27,400	–	–
20-21.9	28,200	23,800	24,600	32,900	29,600	–	–
22-23.9	31,900	25,000	–	29,000	28,300	–	–
24-25.9	29,100	31,400	–	37,000	27,000	–	–
26-27.9	28,200	36,300	–	–	24,800	–	–
28-29.9	35,400	34,300	–	–	29,800	–	–
30-31.9	–	–	–	–	27,000	–	–
32-33.9	–	–	–	–	24,600	–	–
34-35.9	–	–	–	–	29,500	–	–
Weighted avg.	29,400	28,600	26,300	31,200	28,400	–	–
No. weighed	156	89	6	27	415	–	–

(e) 2-S1-2

Under 16	25,400	–	–	33,500	31,400	–	–
16-17.9	25,900	–	–	25,300	29,700	–	–
18-19.9	26,900	29,500	–	28,700	34,400	–	–
20-21.9	28,300	33,500	–	30,300	31,700	–	–
22-23.9	30,600	29,800	–	33,700	33,300	–	–
24-25.9	24,800	34,300	–	–	31,500	–	–
26-27.9	–	35,800	–	–	–	–	–
28-29.9	40,600	–	–	–	–	–	–
Weighted avg.	28,000	33,000	–	28,800	32,700	–	–
No. weighed	80	77	–	98	73	–	–

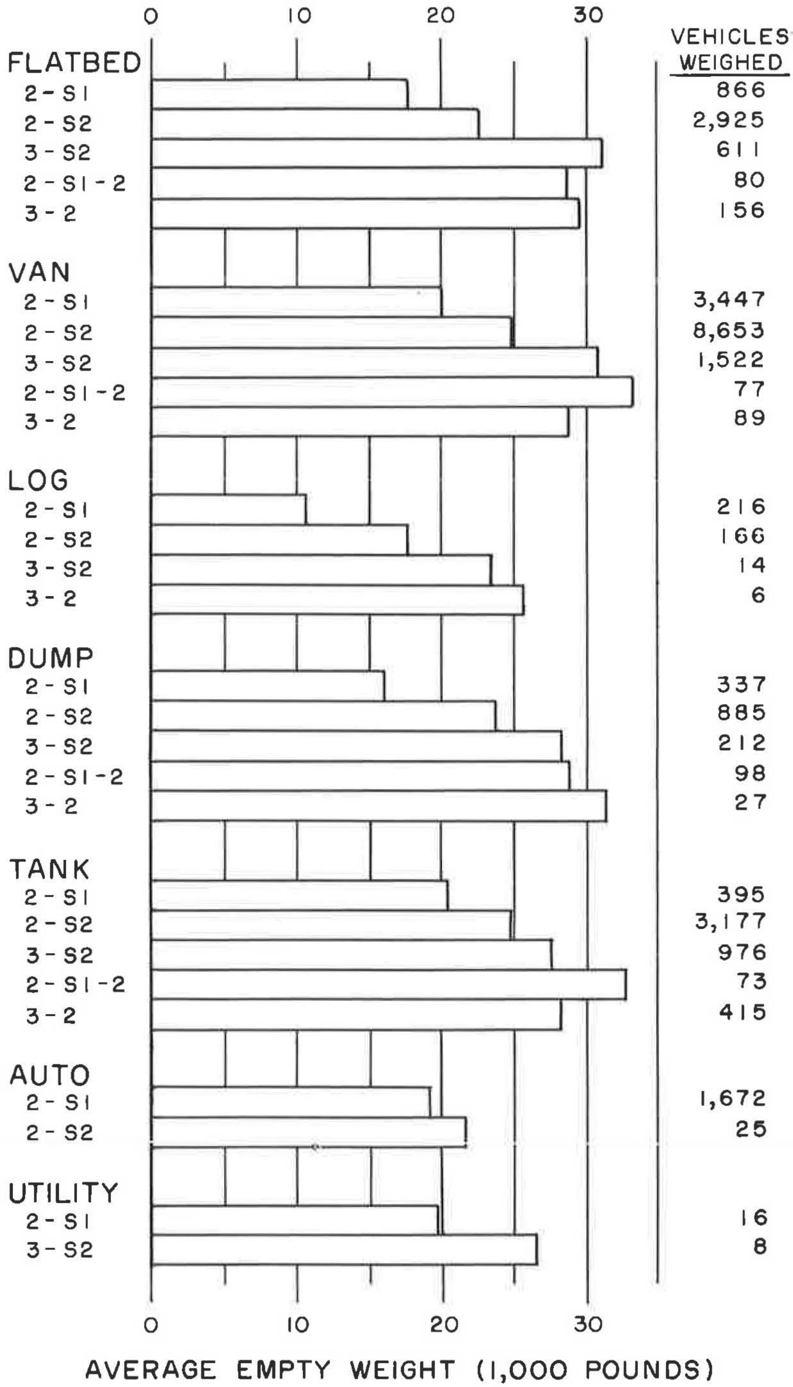

Figure 11. Average empty weights of trailer combinations by vehicle class and cargo body type.

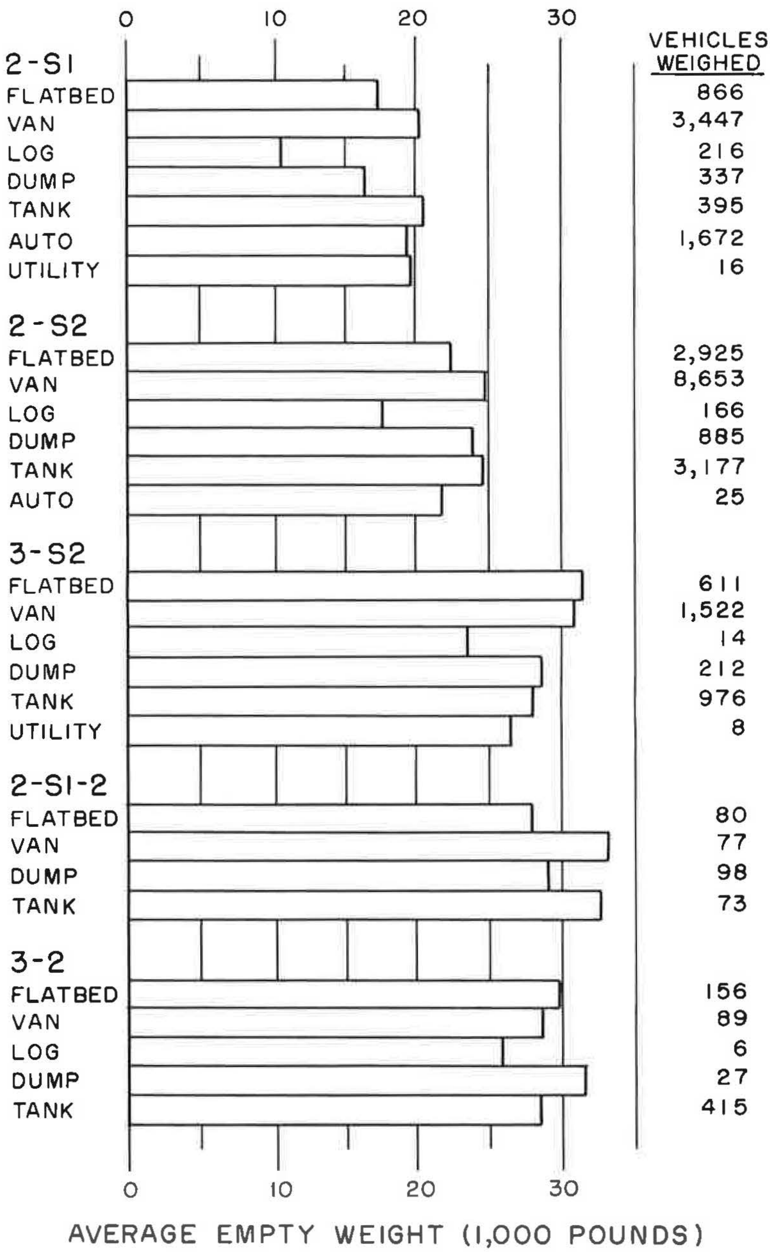

Figure 12. Average empty weights of trailer combinations by cargo body type and vehicle class.

TABLE 6

AVERAGE EMPTY WEIGHTS OF SINGLE-UNIT TRUCKS BY LENGTH AND TYPE OF CARGO BODY

Cargo Body Length (ft)	Body Type (wt. in lb)								Total Vehicles Weighed
	Flatbed	Van	Log	Dump	Tank	Auto	Concrete	Utility	
(a) Panels, Pickups, 4 Tires									
6.0- 7.9	4,200	4,600	–	4,600	–	–	–	4,100	–
8.0- 9.9	4,800	5,400	–	5,800	–	–	–	5,100	–
10.0-11.9	5,400	5,700	–	5,600	–	–	–	5,100	–
12.0-13.9	7,000	6,600	–	8,400	–	–	–	–	–
14.0-15.9	7,200	7,900	–	–	–	–	–	–	–
16.0-17.9	10,000	10,400	–	–	–	–	–	–	–
18.0-19.9	–	6,400	–	–	–	–	–	–	–
Weighted avg.	4,800	6,100	–	5,700	–	–	–	4,900	–
No. weighed	144	218	–	20	–	–	–	26	408
(b) Other 2-Axles, 4 Tires									
Under 6.0	–	6,500	–	–	–	–	–	–	–
6.0- 7.9	4,500	4,600	–	–	–	–	–	4,600	–
8.0- 9.9	5,000	5,000	–	–	–	–	–	6,500	–
10.0-11.9	5,500	5,800	–	–	–	–	–	10,000	–
12.0-13.9	8,400	7,300	–	–	–	–	–	5,200	–
14.0-15.9	6,200	6,300	–	–	–	–	–	–	–
16.0-17.9	7,700	6,600	–	–	–	–	–	–	–
18.0-19.9	7,200	6,800	–	–	–	–	–	–	–
20.0-21.9	–	7,600	–	–	–	–	–	–	–
22.0-23.9	–	8,600	–	–	–	–	–	–	–
Weighted avg.	5,400	6,400	–	–	–	–	–	7,500	–
Veh. weighed	110	423	–	–	–	–	–	11	544
(c) 2-Axles, 6 Tires									
Under 6.0	7,400	7,900	9,800	9,200	8,800	5,900	–	6,000	–
6.0- 7.9	6,500	6,900	7,200	9,900	10,400	–	–	7,500	–
8.0- 9.9	6,200	6,600	7,200	9,900	8,100	–	11,800	8,600	–
10.0-11.9	7,100	7,600	7,200	9,900	9,700	–	14,000	9,600	–
12.0-13.9	7,700	8,800	7,200	9,100	10,600	8,800	14,200	10,500	–
14.0-15.9	8,400	9,800	7,500	9,700	11,400	9,600	15,400	12,600	–
16.0-17.9	9,200	10,300	8,700	9,500	13,400	12,500	13,300	12,200	–
18.0-19.9	9,900	11,000	10,400	11,500	14,400	–	–	13,400	–
20.0-21.9	10,400	11,800	9,100	9,400	16,100	–	–	12,100	–
22.0-23.9	9,600	11,900	8,000	–	15,600	–	–	5,900	–
24.0-25.9	11,000	12,700	7,600	–	19,200	–	22,000	10,800	–
26.0-27.9	9,400	12,700	–	12,600	–	–	–	10,900	–
28.0-29.9	10,200	13,700	–	–	–	–	–	8,400	–
30.0-31.9	10,800	14,200	–	–	–	–	–	10,800	–
32.0-33.9	11,000	13,200	–	6,500	–	–	–	–	–
34.0-35.9	9,800	16,500	–	8,700	11,000	–	–	17,500	
36.0-37.9	8,100	9,300	–	8,400	–	–	–	–	–
38.0-39.9	–	–	–	–	–	–	–	–	–
40.0-41.9	–	–	–	–	–	–	–	–	–
42.0-43.9	–	7,000	–	–	–	–	–	–	–
44.0-45.9	–	21,700	–	–	–	–	–	–	–
Weighted avg.	8,000	9,300	7,600	9,700	11,300	9,100	14,300	10,200	–
Veh. weighed	4,901	9,479	337	3,799	967	7	33	429	19,952
(d) 3-Axle									
Under 6.0	–	–	25,100	16,400	–	–	–	24,700	–
6.0- 7.9	–	12,600	24,200	17,200	–	–	–	–	–
8.0- 9.9	–	16,700	–	12,400	–	–	26,200	25,500	–
10.0-11.9	14,300	12,800	22,500	13,800	–	–	20,900	22,300	–
12.0-13.9	14,300	15,700	22,500	16,900	13,500	–	20,900	20,400	–
14.0-15.9	13,500	15,000	24,000	17,600	16,400	–	23,400	23,000	–
16.0-17.9	13,900	13,600	13,700	18,200	18,500	–	26,600	23,100	–
18.0-19.9	14,400	15,300	16,900	16,800	19,000	–	20,500	26,100	–
20.0-21.9	15,400	15,300	22,200	16,400	27,100	–	–	18,100	–
22.0-23.9	21,400	17,000	20,800	17,300	23,400	–	20,300	36,400	–
24.0-25.9	20,400	15,200	12,900	14,200	25,600	–	–	40,200	–
26.0-27.9	30,400	15,700	15,100	17,700	–	–	26,700	29,800	–
28.0-29.9	35,400	15,200	18,800	–	–	–	–	21,400	–
30.0-31.9	–	19,400	–	13,800	–	–	–	–	–
32.0-33.9	18,000	14,700	–	15,400	–	–	–	–	–
34.0-35.9	12,200	17,000	–	–	–	–	25,800	–	–
36.0-37.9	–	–	–	–	–	–	–	–	–
38.0-39.9	–	28,000	–	–	–	–	–	–	–
40.0-41.9	–	–	–	–	–	–	–	–	–
42.0-43.9	–	–	–	–	–	–	–	–	–
44.0-45.9	–	–	–	–	–	–	–	–	–
46.0-47.9	–	–	–	–	–	–	–	52,700	–
48 and over	–	–	–	–	–	–	–	63,000	–
Weighted avg.	15,100	15,200	19,600	16,600	18,900	–	22,500	25,000	–
Veh. weighed	485	564	137	1,232	96	–	361	65	2,940
Total weighed	5,640	10,684	474	5,051	1,063	7	394	531	23,844

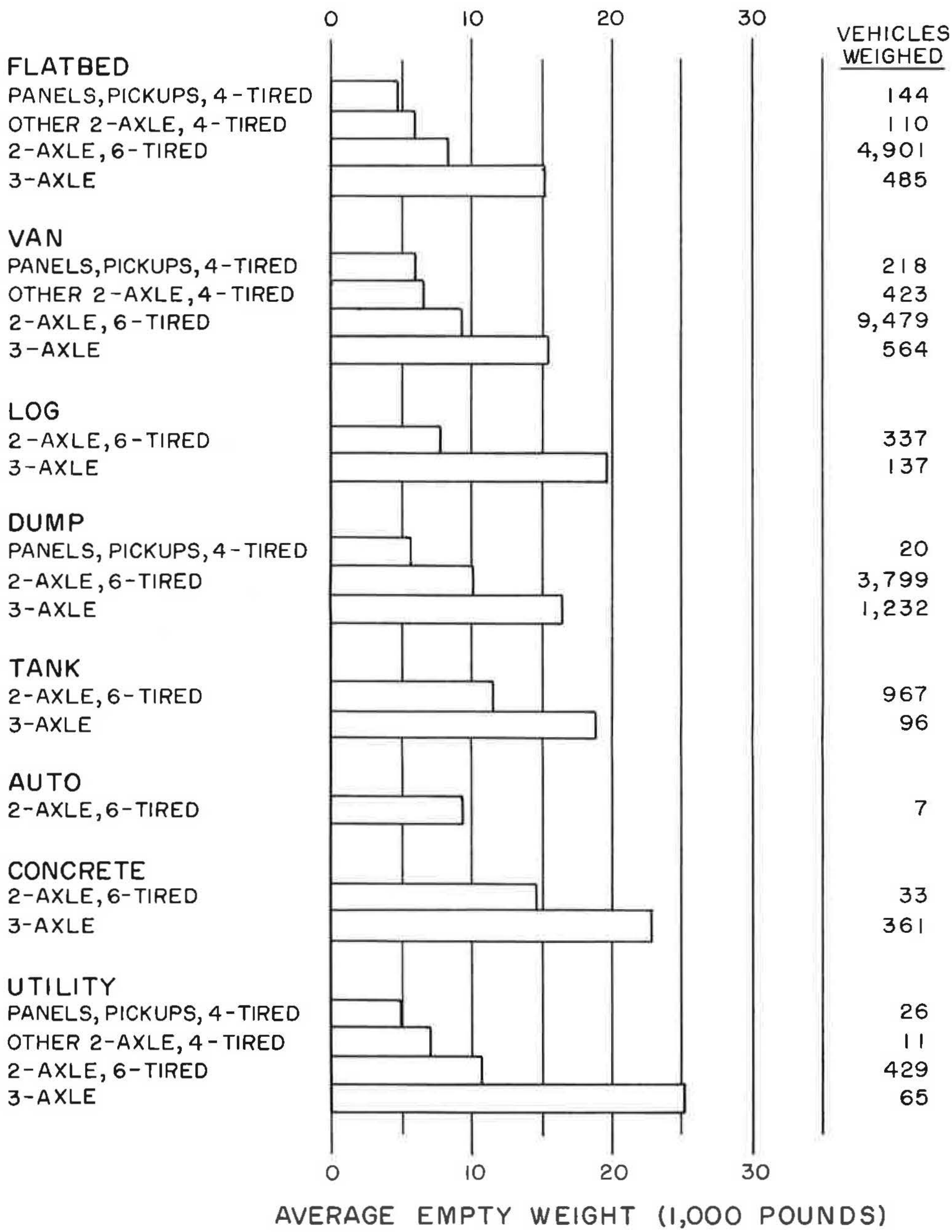

Figure 13. Average empty weights of single-unit trucks by vehicle class and cargo body type.

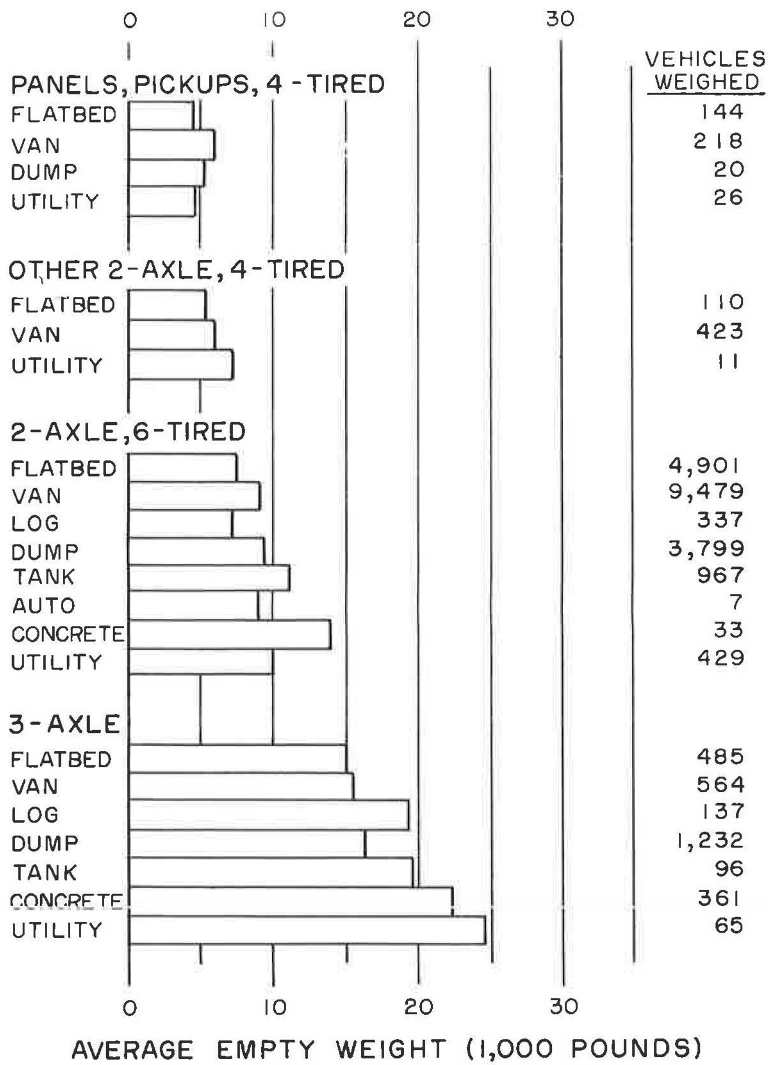

Figure 14. Average empty weights of single-unit trucks by cargo body type and vehicle class.

TABLE 7

AVERAGE LOADED WEIGHTS OF TRAILER COMBINATIONS BY LENGTH AND TYPE OF CARGO BODY

Trailer Body Length (ft)	Body Types (wt. in lb)						
	Flatbed	Van	Log	Dump	Tank	Auto	Utility
(a) 2-S1							
Under 10.0	—	36,300	—	40,400	—	42,200	—
10.0-11.9	43,400	49,200	31,100	—	—	24,800	—
12.0-13.9	30,000	24,700	34,600	37,100	15,900	32,700	—
14.0-15.9	36,700	31,400	33,000	42,500	38,500	—	18,200
16.0-17.9	31,600	33,100	34,000	44,100	27,800	26,600	20,000
18.0-19.9	30,400	30,200	33,700	40,400	34,700	32,200	30,100
20.0-21.9	31,800	29,000	39,300	38,700	35,700	26,100	34,300
22.0-23.9	31,100	28,900	38,400	38,600	36,100	34,800	15,600
24.0-25.9	32,500	29,400	30,200	38,800	38,900	29,900	28,800
26.0-27.9	33,900	30,100	29,300	36,500	42,300	28,400	24,100
28.0-29.9	32,100	30,700	36,400	37,500	44,700	32,600	35,500
30.0-31.9	33,300	30,500	21,400	31,800	40,900	35,500	26,500
32.0-33.9	34,200	30,600	32,700	32,400	42,300	32,400	30,600
34.0-35.9	31,000	32,000	36,200	34,500	38,900	33,300	23,500
36.0-37.9	30,300	32,600	37,700	35,800	29,300	33,700	23,800
38.0-39.9	30,800	32,900	34,700	29,900	34,300	33,800	26,800
40.0-41.9	30,600	32,300	26,200	21,200	—	33,200	37,600
42.0-43.9	30,000	35,100	33,500	—	—	32,900	—
44.0-45.9	—	38,500	42,000	—	—	35,600	—
46.0-47.9	—	36,400	17,800	—	—	36,500	42,000
48.0-49.9	27,400	—	16,400	—	—	34,500	—
50.0-51.9	29,500	—	—	—	—	38,600	—
52 and over	46,600	26,400	31,900	—	—	39,600	—
Weighted avg.	32,500	30,900	33,700	40,300	39,400	33,800	29,200
Veh. weighed	1,323	8,720	272	457	497	2,271	55
(b) 2-S2							
Under 10.0	—	19,200	—	—	35,700	—	—
10.0-11.9	46,500	37,300	—	—	—	—	—
12.0-13.9	25,900	38,700	32,300	52,200	50,900	—	—
14.0-15.9	18,600	35,400	47,800	48,800	54,500	—	—
16.0-17.9	16,000	—	49,600	54,500	—	—	7,800
18.0-19.9	36,200	51,900	43,800	58,800	56,600	—	—
20.0-21.9	45,000	46,100	41,400	55,500	46,600	—	—
22.0-23.9	48,300	48,700	46,000	60,600	52,200	—	—
24.0-25.9	44,900	46,500	46,800	57,400	51,600	—	33,800
26.0-27.9	45,500	46,800	50,500	56,700	53,400	—	27,400
28.0-29.9	47,000	45,700	47,300	55,700	53,200	45,900	—
30.0-31.9	47,800	47,100	51,400	52,600	54,400	—	38,800
32.0-33.9	47,700	47,300	49,000	53,000	55,100	50,700	39,000
34.0-35.9	47,700	47,400	48,600	53,000	55,700	30,200	48,800
36.0-37.9	46,000	47,300	51,200	56,400	56,600	25,500	38,600
38.0-39.9	46,200	47,200	49,700	56,000	59,000	36,300	40,800
40.0-41.9	46,000	48,300	48,800	52,400	55,800	46,800	41,200
42.0-43.9	46,300	48,500	55,100	55,400	56,300	32,600	—
44.0-45.9	46,400	49,100	43,200	59,000	58,400	13,600	—
46.0-47.9	43,500	47,000	54,700	51,800	58,700	—	—
48.0-49.9	36,500	46,600	46,700	62,400	65,800	—	34,200
50.0-51.9	37,900	48,700	46,400	—	67,800	47,400	—
52 and over	36,400	57,200	44,800	—	—	27,400	—
Weighted avg.	47,200	47,300	48,500	54,600	55,300	36,900	38,700
No. weighed	4,396	25,752	321	1,526	3,896	54	49
(c) 3-S2							
Under 10.0	63,400	62,200	—	—	70,900	—	—
10.0-11.9	62,600	—	36,700	—	—	—	—
12.0-13.9	—	36,900	—	—	—	—	—
14.0-15.9	—	20,500	60,700	—	—	—	—
16.0-17.9	—	20,500	—	—	—	—	—
18.0-19.9	—	20,500	83,600	67,600	—	—	—
20.0-21.9	66,800	51,900	62,100	71,000	—	—	—
22.0-23.9	64,300	60,600	64,900	69,500	—	—	—
24.0-25.9	68,000	59,800	—	65,200	67,100	—	—
26.0-27.9	65,500	62,100	67,100	69,300	66,400	—	—
28.0-29.9	55,200	60,300	70,400	68,900	59,200	—	41,700
30.0-31.9	52,600	55,900	71,500	71,500	60,600	—	43,100
32.0-33.9	55,700	53,300	70,100	65,700	64,800	—	58,300
34.0-35.9	58,100	57,800	68,900	64,900	66,900	—	57,800
36.0-37.9	59,200	58,100	70,600	66,800	66,900	—	65,300
38.0-39.9	60,000	57,000	69,600	65,800	66,500	—	81,200
40.0-41.9	62,700	57,100	70,200	65,800	65,700	—	—
42.0-43.9	61,900	59,000	70,700	66,800	66,500	—	84,100
44.0-45.9	63,100	57,100	70,300	61,700	66,000	—	—
46.0-47.9	74,600	50,700	67,900	70,600	58,300	—	—
48.0-49.9	62,200	56,800	64,300	64,800	61,900	—	—
50.0-51.9	68,600	56,000	62,000	—	—	—	—
52 and over	62,600	59,200	60,200	—	—	—	—
Weighted avg.	58,800	57,100	70,000	68,500	66,300	—	61,400
No. weighed	1,041	8,071	657	481	1,089	—	22

TABLE 8

AVERAGE LOADED WEIGHTS OF TRAILER COMBINATIONS BY LENGTH AND TYPE OF CARGO BODY

Trailer Body Length (ft)	Body Types (wt. in lb)				
	Flatbed	Van	Log	Dump	Tank
			(a) 3-2		
Under 10.0	—	20,500	—	74,700	75,700
10.0-11.9	—	—	69,400	—	69,900
12.0-13.9	50,800	—	78,400	57,600	62,300
14.0-15.9	63,700	30,500	66,900	—	70,600
16.0-17.9	64,600	48,400	74,400	68,300	67,200
18.0-19.9	68,700	62,000	71,900	75,200	66,000
20.0-21.9	68,900	57,000	73,400	77,200	72,200
22.0-23.9	62,100	51,600	65,200	74,800	71,200
24.0-25.9	57,600	61,300	74,600	88,700	72,800
26.0-27.9	63,000	67,500	—	—	72,600
28.0-29.9	71,800	68,700	—	—	72,300
30.0-31.9	46,100	16,400	—	—	76,000
32.0-33.9	—	50,100	73,800	—	78,500
34.0-35.9	—	47,000	—	—	76,000
36.0-37.9	—	74,500	—	—	—
38.0-39.9	—	59,500	—	60,400	—
40.0-41.9	—	20,500	—	—	—
42.0-43.9	—	—	—	—	—
44.0-45.9	—	—	—	68,800	73,400
46.0-47.9	—	—	67,800	—	55,700
48.0-49.9	63,800	—	64,500	—	—
50.0-51.9	—	45,500	—	—	—
52 and over	61,800	23,800	70,000	—	66,600
Weighted avg.	66,100	56,700	71,800	75,200	71,500
No. weighed	322	111	31	49	527
			(b) 2-S1-2		
10.0-11.9	78,000	—	—	—	—
12.0-13.9	66,800	72,200	—	74,000	58,600
14.0-15.9	66,300	61,700	—	77,000	51,100
16.0-17.9	72,600	48,500	—	78,000	70,200
18.0-19.9	65,200	62,200	—	78,600	83,000
20.0-21.9	56,200	59,000	—	75,700	70,800
22.0-23.9	67,600	57,100	—	88,700	80,200
24.0-25.9	64,500	59,400	—	—	80,600
26.0-27.9	62,000	69,400	—	—	—
28.0-29.9	—	47,700	—	—	40,400
30.0-31.9	—	—	—	—	—
32.0-33.9	—	—	—	—	—
34.0-35.9	—	46,500	—	—	—
36.0-37.9	—	—	—	71,400	—
38.0-39.9	—	59,100	—	—	—
— —	—	—	—	—	—
50.0-51.9	—	—	—	—	55,600
52 and over	84,300	69,300	—	—	—
Weighted avg.	61,600	58,600	—	78,300	74,600
No. weighed	185	317	—	125	79

TABLE 9

AVERAGE PAYLOAD WEIGHTS OF TRAILER COMBINATIONS BY LENGTH AND TYPE OF CARGO BODY

Trailer Body Length (ft)	Body Types (wt. in lb)						
	Flatbed	Van	Log	Dump	Tank	Auto	Utility
			(a) 2-S1				
10.0-11.9	–	–	19,600	–	–	–	–
12.0-13.9	–	–	25,200	18,800	–	–	–
14.0-15.9	20,700	13,500	23,400	27,000	–	–	–
16.0-17.9	17,400	15,100	23,500	27,300	9,700	14,000	–
18.0-19.9	13,100	11,900	23,000	24,700	15,200	–	17,900
20.0-21.9	16,600	14,000	28,500	23,300	15,800	–	13,100
22.0-23.9	14,500	12,500	26,100	22,200	15,900	–	–
24.0-25.9	15,500	10,500	16,800	23,200	19,500	12,200	9,200
26.0-27.9	17,200	11,000	18,000	21,200	20,200	7,800	7,100
28.0-29.9	14,600	11,400	–	21,000	22,500	14,500	12,800
30.0-31.9	15,000	10,100	9,000	15,100	18,200	15,400	4,400
32.0-33.9	15,400	10,200	17,700	12,400	21,200	12,500	10,600
34.0-35.9	12,800	10,800	24,500	–	21,900	14,300	–
36.0-37.9	13,000	11,700	25,400	19,000	–	15,100	–
38.0-39.9	13,500	11,600	23,700	–	14,500	14,500	5,000
40.0-41.9	14,200	10,800	12,700	–	–	13,100	19,800
42.0-43.9	9,600	11,700	–	–	–	13,600	–
44.0-45.9	–	20,600	–	–	–	16,600	–
46.0-47.9	–	14,100	7,700	–	–	16,100	–
48.0-49.9	–	–	6,600	–	–	13,200	–
50.0-51.9	–	–	–	–	–	17,900	–
52 and over	–	–	–	–	–	17,500	–
Weighted avg.	15,000	10,800	23,100	24,100	18,800	14,600	9,300
No. weighed	1,306	8,705	252	450	490	2,257	40
			(b) 2-S2				
16.0-17.9	–	–	35,000	33,300	–	–	–
18.0-19.9	–	32,900	27,600	35,500	–	–	–
20.0-21.9	30,000	19,100	28,400	32,200	–	–	–
22.0-23.9	22,900	24,400	29,100	34,900	–	–	–
24.0-25.9	20,500	21,000	29,300	31,200	–	–	–
26.0-27.9	23,200	23,700	30,800	31,900	–	–	–
28.0-29.9	23,100	21,300	28,000	31,900	27,500	–	–
30.0-31.9	25,700	23,000	31,200	28,600	–	–	–
32.0-33.9	25,400	23,100	30,300	28,300	30,700	–	–
34.0-35.9	25,200	22,300	28,200	30,500	31,000	8,600	–
36.0-37.9	23,700	21,900	30,900	33,000	–	5,400	–
38.0-39.9	23,300	21,800	31,700	33,600	34,000	13,900	–
40.0-41.9	23,700	22,400	29,700	31,000	30,200	22,400	–
42.0-43.9	24,600	27,200	–	33,800	32,700	–	–
44.0-45.9	23,200	23,300	–	39,200	–	–	–
46.0-47.9	18,200	23,000	–	30,600	–	–	–
Weighted avg.	24,700	22,500	30,700	30,700	30,800	15,100	–
No. weighed	4,363	25,712	271	1,519	2,918	39	–
			(c) 3-S2				
18.0-19.9	–	–	–	41,300	–	–	–
20.0-21.9	28,800	28,500	40,000	42,700	–	–	–
22.0-23.9	35,900	33,300	–	41,600	–	–	–
24.0-25.9	32,400	29,000	–	34,700	–	–	–
26.0-27.9	33,900	39,800	42,500	40,000	34,200	–	–
28.0-29.9	22,900	34,900	–	34,000	30,000	–	8,800
30.0-31.9	23,500	25,900	51,700	44,200	27,600	–	17,600
32.0-33.9	24,900	25,300	–	38,300	33,900	–	25,300
34.0-35.9	27,100	26,800	44,400	35,600	39,300	–	32,000
36.0-37.9	26,700	27,600	48,100	39,300	31,800	–	–
38.0-39.9	29,700	25,600	45,600	37,600	38,800	–	–
40.0-41.9	34,200	25,600	–	38,600	40,700	–	–
42.0-43.9	30,000	25,700	–	40,200	39,800	–	–
44.0-45.9	32,000	26,500	–	36,100	40,200	–	–
46.0-47.9	44,100	20,200	–	39,600	–	–	–
48.0-49.9	–	22,400	–	41,800	–	–	–
50.0-51.9	–	16,400	–	–	–	–	–
52 and over	–	25,900	–	–	–	–	–
Weighted avg.	27,800	26,400	46,500	40,000	38,500	–	22,700
No. weighed	1,022	8,059	384	481	1,084	–	11
			(d) 3-2				
14.0-15.9	35,500	–	–	–	–	–	–
16.0-17.9	35,000	22,400	46,600	40,000	36,400	–	–
18.0-19.9	41,300	37,400	44,700	46,700	38,600	–	–
20.0-21.9	40,700	33,200	48,800	44,300	42,600	–	–
22.0-23.9	30,200	26,600	–	45,800	42,900	–	–
24.0-25.9	28,500	29,900	–	51,700	45,800	–	–
26.0-27.9	34,800	31,200	–	–	47,800	–	–
28.0-29.9	36,400	34,400	–	–	42,500	–	–
30.0-31.9	–	–	–	–	49,000	–	–
32.0-33.9	–	–	–	–	53,900	–	–
34.0-35.9	–	–	–	–	46,500	–	–
Weighted avg.	36,700	28,100	45,500	44,000	43,100	–	–
No. weighed	315	91	14	43	515	–	–
			(e) 2-S1-2				
16.0-17.9	47,200	–	–	52,700	40,500	–	–
18.0-19.9	39,300	32,700	–	49,900	48,600	–	–
20.0-21.9	27,900	25,500	–	45,400	39,100	–	–
24.0-25.9	39,700	27,300	–	55,000	46,900	–	–
24,0-25.9	39,700	25,100	–	–	49,100	–	–
26.0-27.9	–	33,600	–	–	–	–	–
Weighted avg.	33,600	25,600	–	49,500	41,800	–	–
No. weighed	163	300	–	122	74	–	–

TRAILER CARGO BODY LENGTHS CHOSEN BY INDUSTRY FOR DIFFERENT LOADED GROSS WEIGHTS, 1959

An analysis was made to determine whether any significant difference existed in lengths of trailer cargo bodies for different gross weights. For this purpose, the gros weights of the various combination classes, broken down by cargo body types, were arrayed in 10,000-lb intervals of gross vehicle weight. Each 10,000-lb interval was further arrayed as to length of cargo body (Figs. 15, 16, 17) for the three main combination classes—the 2-S1, 2-S2, and 3-S2 tractor semitrailer combinations having van cargo bodies. The configurations are similar in weight intervals from 20,000 to 70,000-lb gross weights. No significant increase in lengths of cargo bodies as gross weights increased can be detected. The median of cargo body lengths of 2-S1 combinations for 10,000-lb weight intervals between 20,000 and 60,000 lb was 32 ft, and for the 2-S2 combination the median cargo body length was 35 ft.

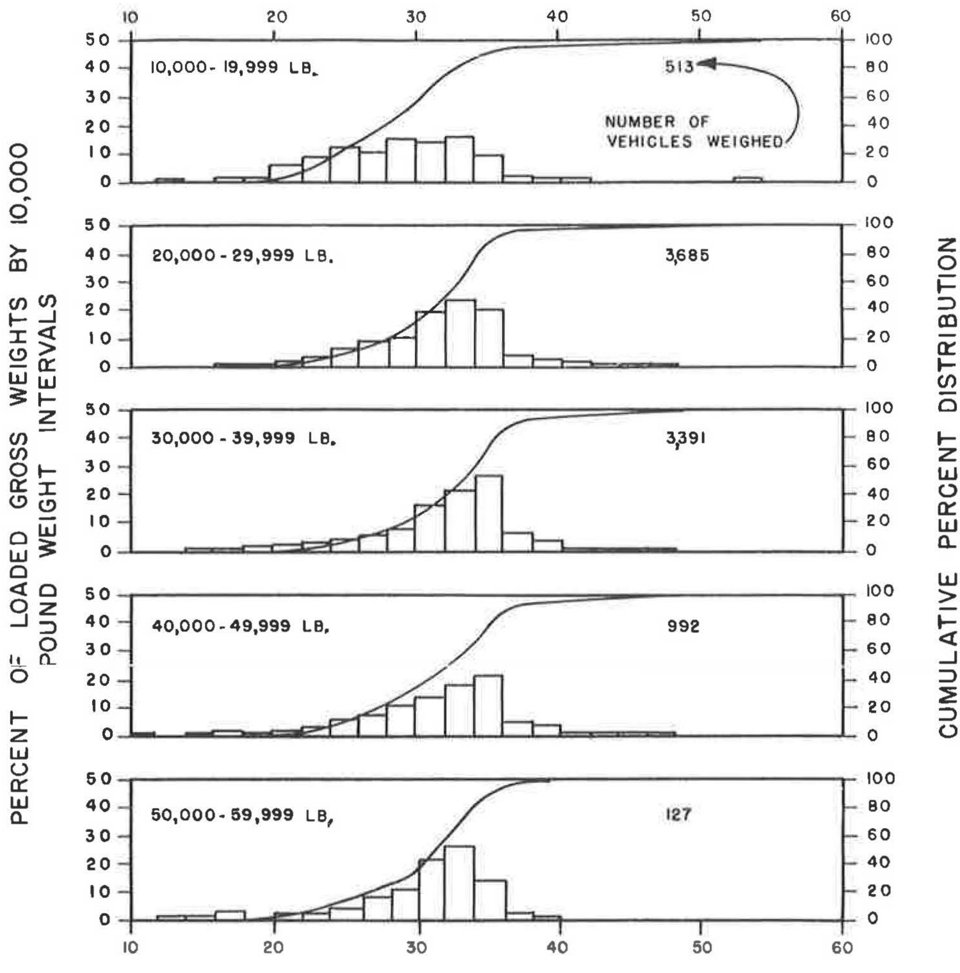

Figure 15. Percent distribution of loaded gross weights of 3-axle tractor semitrailers (2-S1) with van cargo bodies, in 10,000-lb weight group and by lengths of cargo bodies.

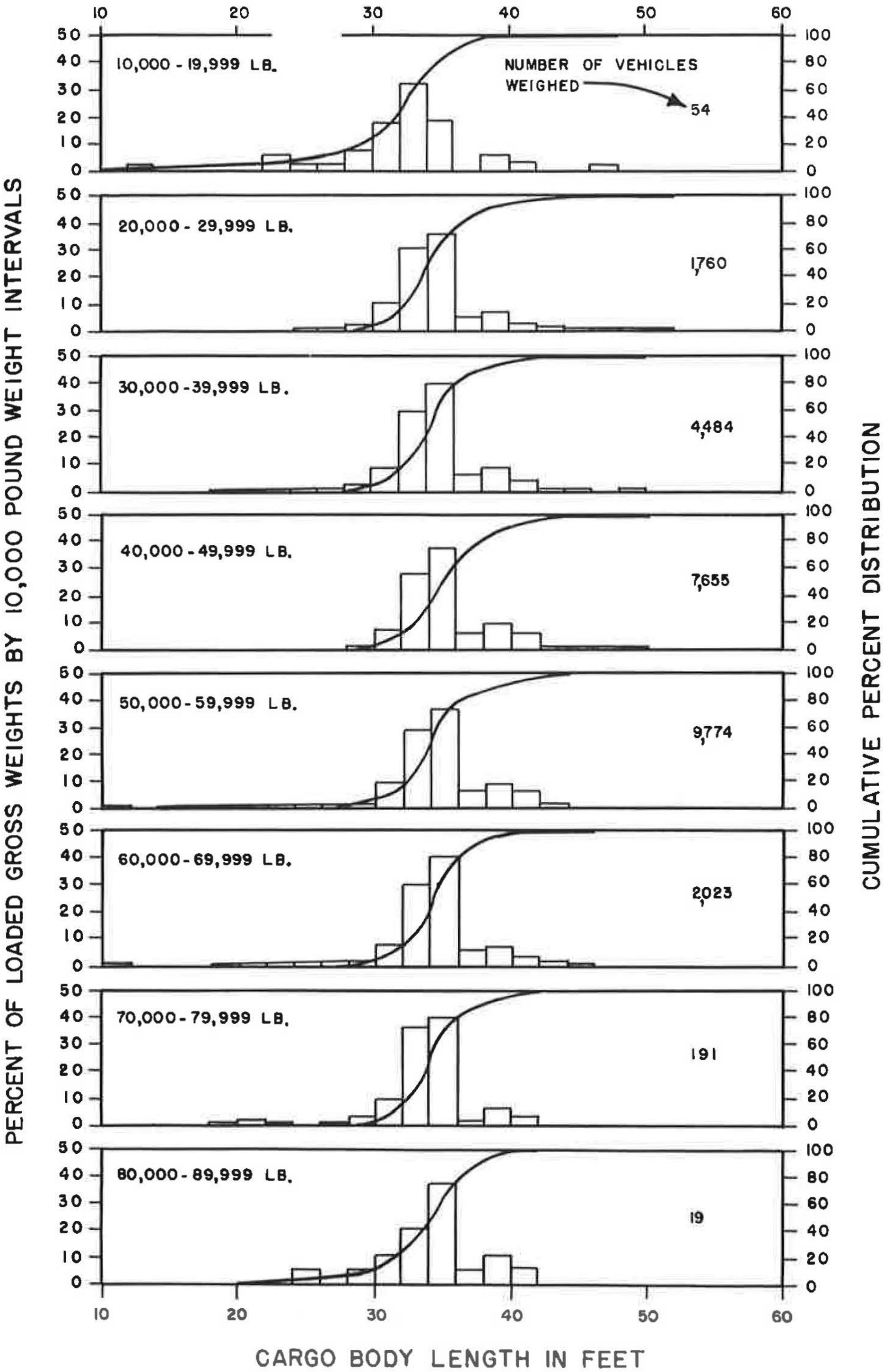

Figure 16. Percent distribution of loaded gross weights of 4-axle tractor semitrailers (2-S2) with van cargo bodies, in 10,000-lb weight group and by lengths of cargo bodies.

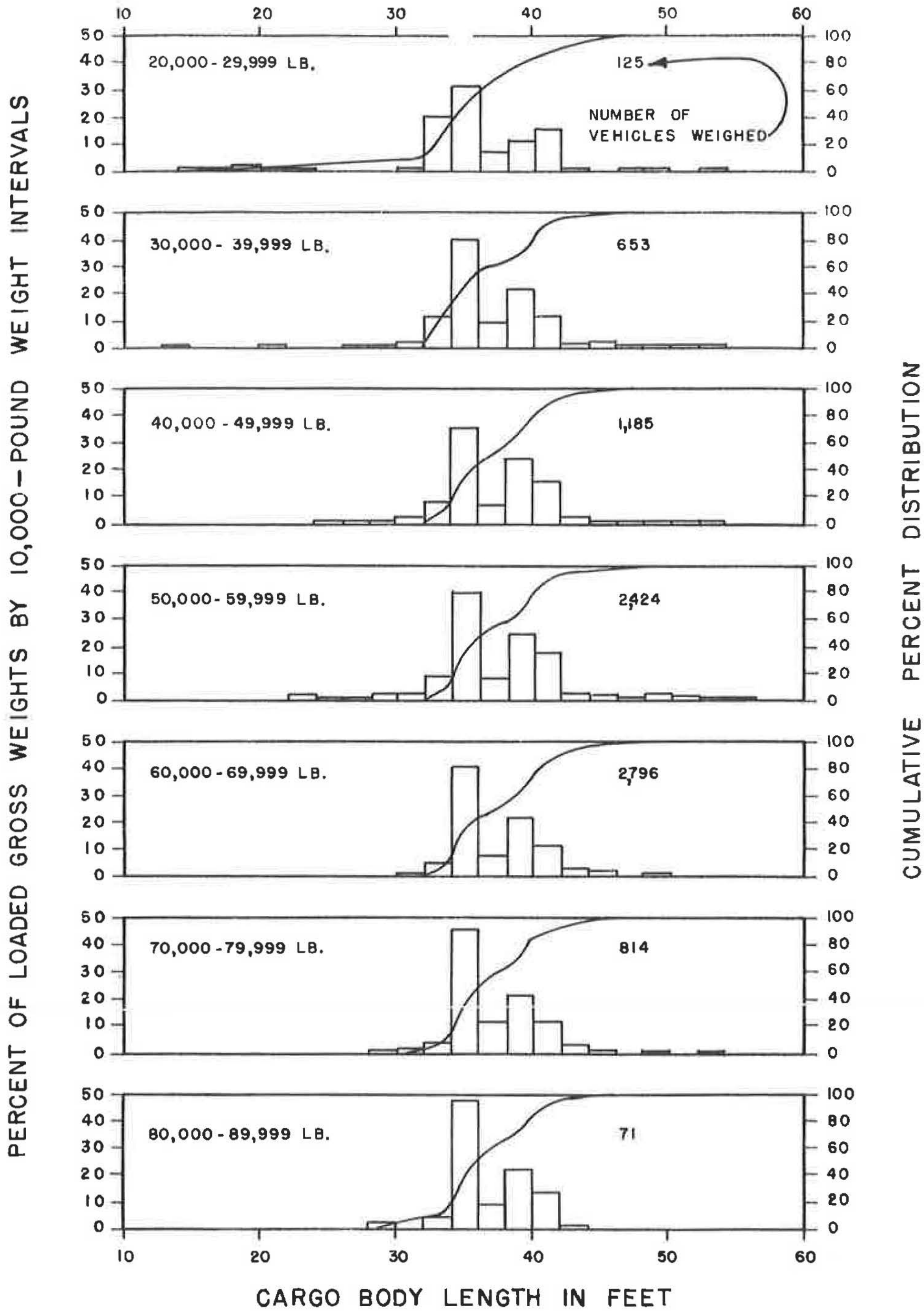

Figure 17. Percent distribution of loaded gross weights of 5-axle tractor semitrailers (3-S2) with van cargo bodies, in 10,000-lb weight group and by lengths of cargo bodies.

Commodity data, not collected in this study, would be needed to further analyze choice of trailer body lengths made by industry.

EFFECT OF GROSS WEIGHT LIMITS ON LOADED GROSS WEIGHTS

Of the 45 States and District of Columbia, which made weight studies in 1959, 7 prescribed maximum gross weight limits for permitted classes of trailer combination in

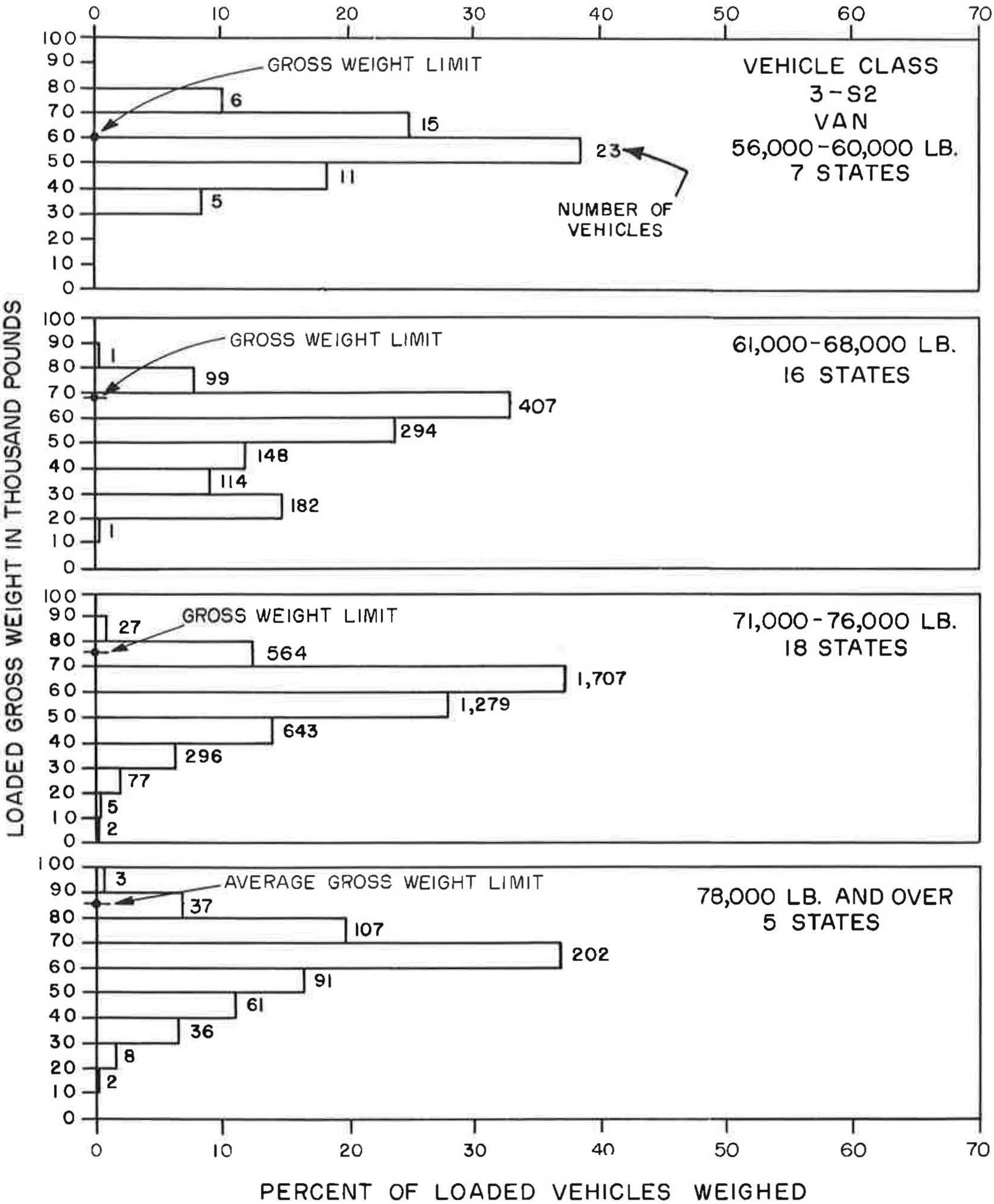

Figure 18. Percent distribution of gross weights by body type and axle classification in relation to permitted weight limits.

the range of 56,000 to 60,000 lb; 16 in the range of 60,000 to 68,000 lb; 18 in the range of 71,000 to 76,000 lb; and 5 in the range of 78,000 lb and over. The loaded trailer combinations were grouped by their loaded gross weights into these four weight categories. The combinations in each weight category were arranged in 10,000-lb class intervals of gross vehicle weight, and the number of loaded combinations observed in each weight category were converted to percentage of total loaded combinations observed.

Weights of 3-S2 Tractor Semitrailer Combinations

Depending upon the axle limits allowed, the 3-S2 combination can legally operate at a gross vehicle weight of 72,000 lb where 32,000-lb tandem axles are specified and at about 80,000 lb where 36,000-lb tandem axles are specified. Figure 18 shows the percentages of loaded trailer combinations for the 3-S2 combination having van cargo bodies. As gross weight limits increased, a higher percentage of the loads was more than 60,000 lb. For example, the percentages of combinations above and the maximum gross weights permitted by the States were 35 percent and 60,000-lb, nearly 41 percent and 68,000-lb, 50 percent and 76,000-lb, and nearly 64 percent and 78,000-lb or more.

These figures would seem to indicate from the freight standpoint that there was a demand for heavier permitted gross weight in the States limiting it to 60,000 lb and that this demand was held in check by the permitted low weight limits. The greatest percentage of loaded gross weights in the States having maximum limits of 56,000 to 60,000 lb occurred in the 50,000- to 60,000-lb weight bracket, and in the other three groups of States a preference was shown for 60,000- to 70,000-lb gross loads. In a similar analysis of the data for 3-S2 flatbed loaded vehicles (Fig. 19), the findings were parallel.

Tractor, Semitrailer, Full Trailer Combination 2-S1-2, and Tractive Truck Full Trailer Combination 3-2

The 2-S1-2 trailer combination, if operating at single-axle limitations of 18,000 lb, would have a gross weight of about 80,000 lb; and if operating at single-axle limitations of 22,400 lb, would have a gross weight of about 98,000 lb. The 3-2 trailer combinations, if operating with 18,000-lb single axles and 32,000-lb tandem axles, would have a maximum gross weight of about 77,000 lb. The 3-2 combination, if operating with 22,400-lb single axles and 36,000-lb tandem axles, would have a maximum gross weight of about 91,000 lb.

The 2-S1-2 tractor, semitrailer, full trailer combinations and the 3-2 tractive truck full trailers combinations were observed chiefly in two groups of States; 18 States that have maximum weight limits of 71,000 to 76,000 lb and 5 States that have maximum weight limits of 78,000 lb and over.

The percentage of 2-S1-2 trailer combinations having gross weights of 80,000 lb or more was higher in the 5 States having weight limits of 78,000 lb and over than in the 18 States having maximum weight limits of 71,000 to 76,000 lb (Fig. 20). The same trend existed in percentage relationship for the three major body types — flatbed, van, and tank. Similar trends in the relationship of gross weights and the permitted weights were noted for the 3-2 tractive truck full trailer combination (Fig. 21). The percentages for gross weights of combinations of more than 80,000 lb are given in Table 10.

The data (Figs. 20 and 21 and Table 10) indicated that tank cargo body combinations can most consistently use the maximum permitted, or higher, gross weights. The two other cargo body types of combinations regularly carried loads that weighed much below the maximum permitted weights. Hence, it may be concluded that not all freight carriers could use to advantage any increase in permitted gross weights. This situation presents a difficult problem in allocating any increased highway construction and maintenance costs for higher load-capacity roadways only to those vehicles that could and would use such increased load-carrying capacities built into a road system. Enough use might not be made of vehicles to carry heavier loads to pay for the increased roadway costs occasioned by permitting heavier axle and larger gross-weight limits.

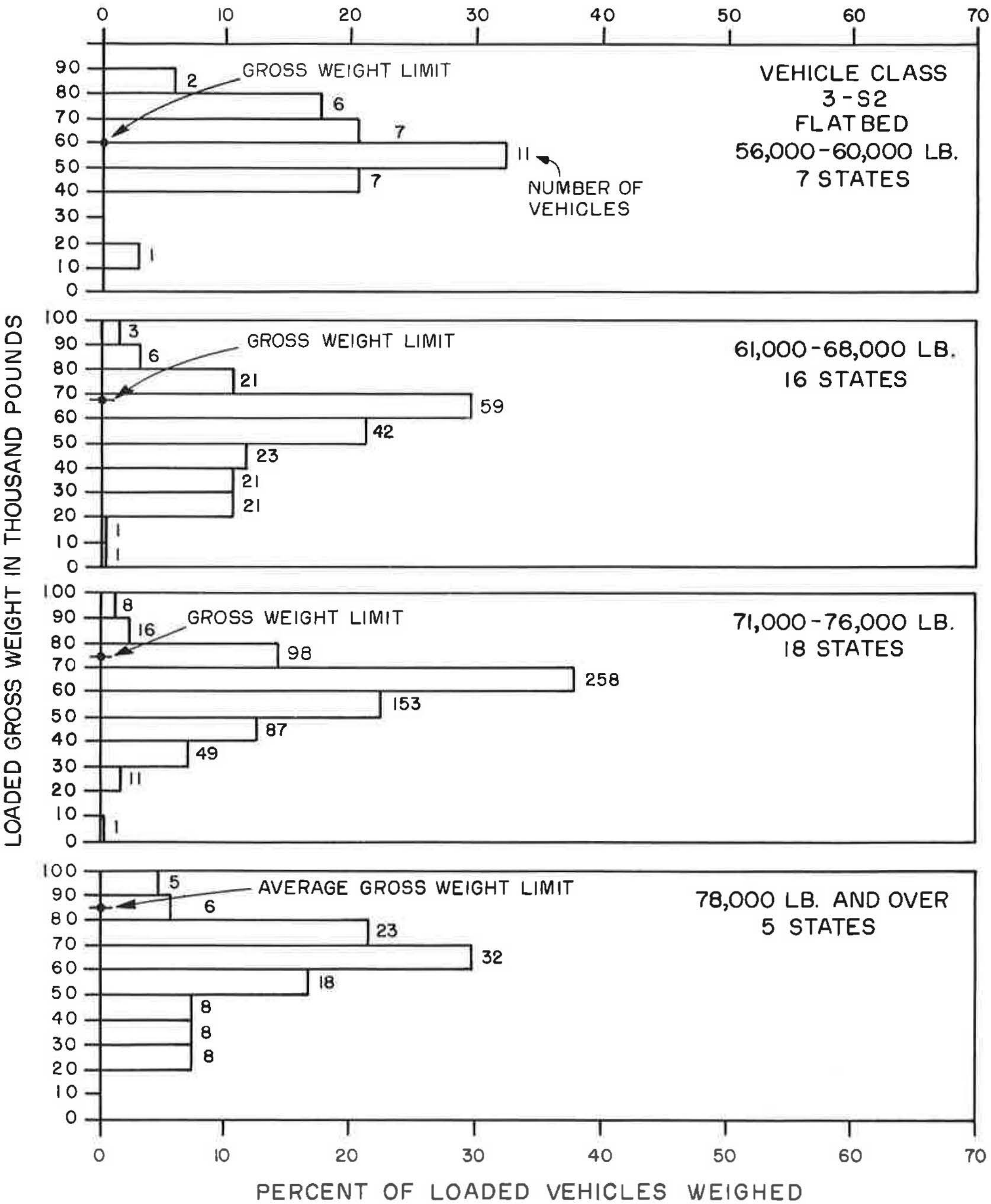

Figure 19. Percent distribution of gross weights by body type and axle classification in relation to permitted weight limits.

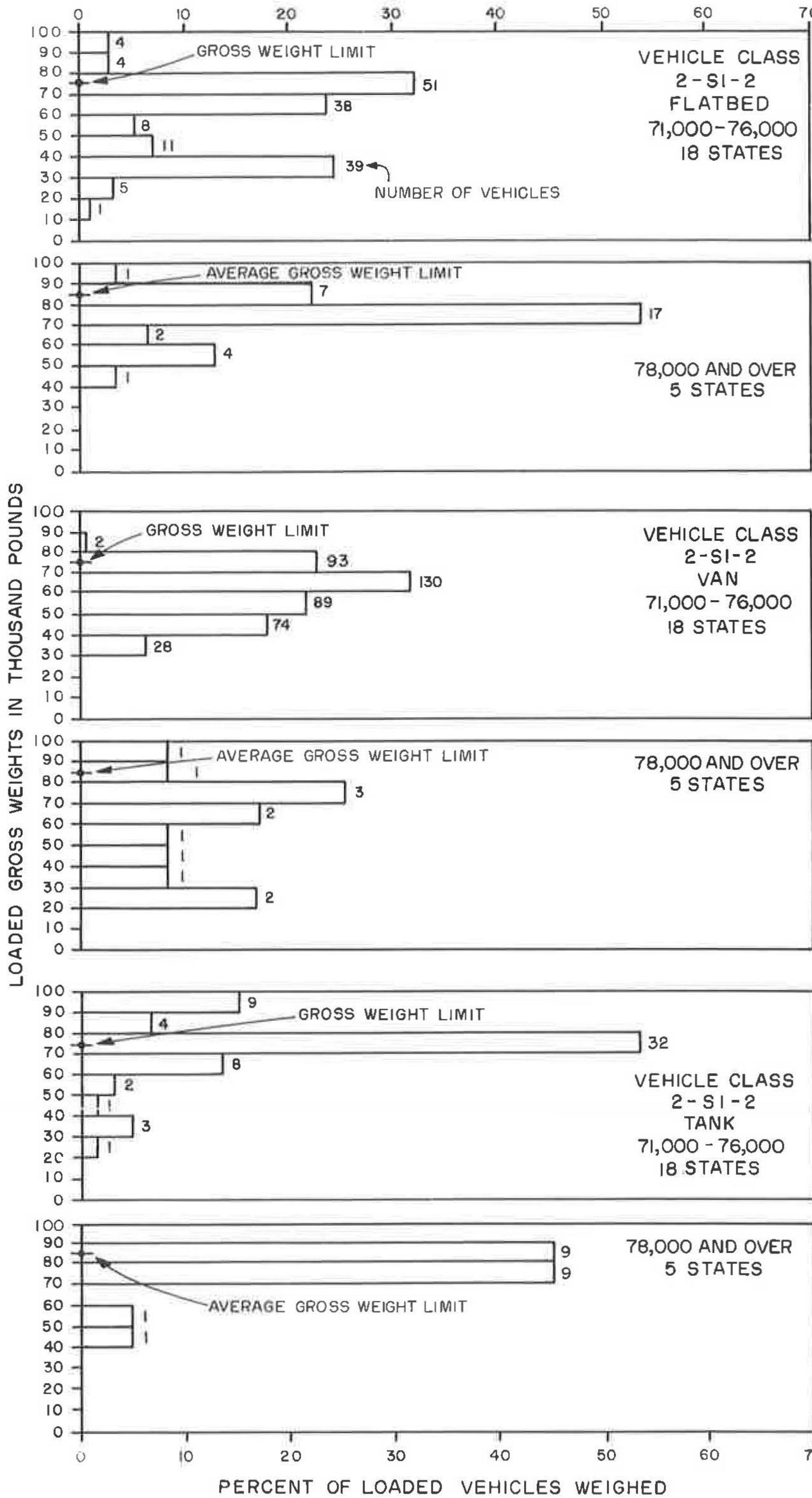

Figure 20. Percent distribution of gross weights by body and axle classification in relation to permitted weight limits.

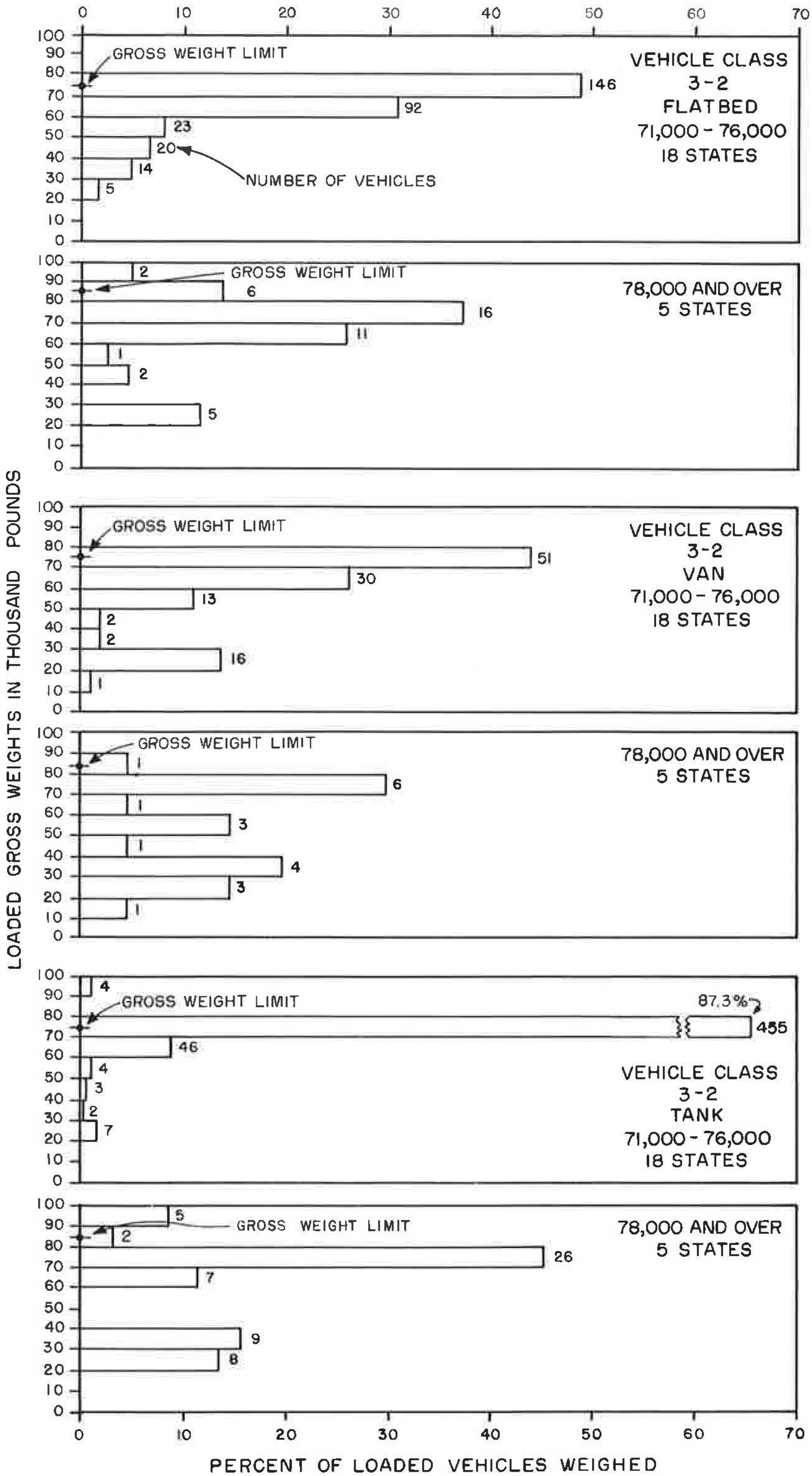

Figure 21. Percent distribution of gross weight by body and axle classification in relation to permitted weight limits.

TABLE 10

PERCENTAGES OF 2-S1-2 AND 3-2 TRAILER COMBINATIONS THAT WEIGHED MORE THAN 80,000-LB GROSS WEIGHT

Body Type	18 States 71,000 - 76,000 Lb Maximum (%)	5 States 78,000 Lb and Above Maximum (%)
2-S1-2 trailer combination:		
Flatbed cargo	6	25
Van cargo	1	16
Tank cargo	7	45
3-2 trailer combination:		
Flatbed cargo	0	23
Van cargo	0	5
Tank cargo	1	12

OBSERVED WIDTHS AND HEIGHTS

During the 1959 truck weight study, cargo vehicles less than 7 ft wide or less than 10 ft high were not recorded in most States. Measurements were recorded for cargo vehicle of these dimensions and larger.

Connecticut and Rhode Island permitted widths of 8.5 ft in 1959, but all other continental States limited widths to 8 ft exclusive of safety equipment. In 1959, of the continental States, 2 had no height limitations; 2 specified 14.0 ft; 26, 13.5 ft; 2, 13.0 ft; an 17, 12.5 ft. Thus, in 1959, 30 States permitted heights of 13.5 ft or more. As of Decer ber 31, 1961, 44 of the continental States had height limitations of 13.5 ft or more and retained limitation of 12.5 ft.

Because of the trend toward the 8-ft width and 13.5-ft height, measurements taken a truck weight stations were tabulated to show measurements in excess of these two moda figures. Some of the figures showing measurements greater than the permitted widths and heights probably may be ascribed to special permit loads and to mounting tires lar than the 10.00 x 20 size. When 11.00 x 20 and larger size tires are placed on highway freight vehicles having body widths of exactly 8 ft, frequently a projection of as much a 2 in. of tire beyond the body frame may occur on each side. With this in mind, width measurements were separated into intervals of 8.0 to 8.3 ft (8 ft 3.6 in.), 8.4 to 8.5 ft 8.6 to 9.0 ft, and 9.1 ft and over. Although approximately 10 percent of the total truck having six or more tires and the trailer combinations exceeded the 8-ft width limitation only about 1 percent of the total of these vehicles exceeded the width of 8 ft 3.6 inches, (Table 11).

Approximately 0.3 percent of all trailer combinations and trucks having six or more tires were more than 13.5 ft high. More of the 3-S2 combinations exceeded this height than any other type of vehicle (Table 12).

ACKNOWLEDGMENT

Instructions and procedures for obtaining the data as part of the 1959 truck weights study were developed by Alexander French of the Planning Services Branch. Mildred M Milazzo, Madaline Kendall, and Kathleen V. Toole of the Vehicle Performance Branch assisted in the arrangement of the field data, preparation of data for machine analysis, and in the development of summary tables and charts. John H. Jones of the Data Processing Branch made the machine tabulations of the data.

TABLE 11

NUMBER AND PERCENT OF SINGLE-UNIT TRUCKS AND TRAILER COMBINATIONS MEASURED AND FOUND TO EXCEED 8.0 FT IN WIDTH

Body Width (ft)	Body Type								
	Flatbed	Van	Log	Dump	Tank	Auto	Concrete	Utility	Total
2-axle, 6 tires, truck:									
8.1-8.3	712	1,905	10	255	87	—	8	66	3,043
8.4-8.5	61	84	3	9	10	—	3	7	177
8.6-9.0	57	41	1	13	6	—	0	4	122
9.1 and over	32	8	0	5	3	—	0	1	49
Total over 8.0	862	2,038	14	282	106	—	11	78	3,391
Total over 8.3	150	133	4	27	19	—	3	12	348
Total units	11,354	31,146	573	7,081	3,151	—	87	1,531	54,923
Percent over 8.0	7.6	6.5	2.4	4.0	3.3	—	12.6	5.0	6.1
Percent over 8.3	1.3	0.4	0.7	0.4	0.6	—	3.4	0.8	0.6
3-axle truck, single unit:									
8.1-8.3	146	125	55	339	11	—	143	24	843
8.4-8.5	14	5	7	17	3	—	24	15	85
8.6-9.0	17	1	1	19	15	—	18	8	79
9.1 and over	7	1	0	1	0	—	1	2	12
Total over 8.0	184	132	63	376	29	—	186	49	1,019
Total over 8.3	38	7	8	37	18	—	43	25	176
Total units	1,215	1,523	418	2,685	261	—	923	232	7,257
Percent over 8.0	19.2	8.7	15.1	14.0	11.2	—	20.2	21.1	14.6
Percent over 8.3	4.0	0.5	1.9	1.4	6.9	—	4.7	10.8	2.5
2-S1 combination:									
8.1-8.3	229	1,148	42	65	104	360	—	6	1,954
8.4-8.5	18	43	6	0	9	11	—	1	88
8.6-9.0	23	20	2	2	1	7	—	0	55
9.1 and over	17	5	3	0	0	0	—	0	25
Total over 8.0	287	1,216	53	67	114	378	—	7	2,122
Total over 8.3	58	68	11	2	10	18	—	1	168
Total units	2,189	12,167	488	794	892	3,943	—	71	20,544
Percent over 8.0	13.1	10.1	10.9	8.4	12.8	9.6	—	9.9	10.3
Percent over 8.3	2.6	0.6	2.3	0.3	1.1	0.5	—	1.4	0.8
2-S2 combination:									
8.1-8.3	807	3,161	74	225	895	7	—	5	5,174
8.4-8.5	67	85	16	6	64	2	—	1	241
8.6-9.0	37	51	5	4	28	0	—	1	126
9.1 and over	27	8	3	1	2	1	—	4	46
Total over 8.0	938	3,305	98	236	989	10	—	11	5,587
Total over 8.3	131	144	24	11	94	3	—	6	413
Total units	7,321	34,405	487	2,411	7,073	79	—	49	51,825
Percent over 8.0	12.8	9.6	20.2	9.8	14.0	12.7	—	22.4	10.8
Percent over 8.3	1.8	0.4	5.0	0.5	1.3	3.8	—	12.2	0.8
3-S2 combination:									
8.1-8.3	278	890	90	68	97	—	—	3	1,426
8.4-8.5	15	10	15	7	6	—	—	0	53
8.6-9.0	22	8	21	0	2	—	—	1	54
9.1 and over	27	3	6	2	1	—	—	5	44
Total over 8.0	342	911	132	77	106	—	—	9	1,577
Total over 8.3	64	21	42	9	9	—	—	6	151
Total units	1,652	9,593	671	693	2,065	—	—	30	14,704
Percent over 8.0	20.7	9.5	20.1	11.1	5.1	—	—	40.9	10.7
Percent over 8.3	3.9	0.2	6.4	1.3	0.4	—	—	27.3	1.0
2-S1-2 combination:									
8.1-8.3	36	70	—	32	46	—	—	—	184
8.4-8.5	5	1	—	1	0	—	—	—	7
8.6-9.0	4	0	—	0	3	—	—	—	7
9.1 and over	0	0	—	0	0	—	—	—	0
Total over 8.0	45	71	—	33	49	—	—	—	198
Total over 8.3	9	1	—	1	3	—	—	—	14
Total units	265	394	—	223	152	—	—	—	1,034
Percent over 8.0	17.0	18.0	—	14.8	32.2	—	—	—	19.1
Percent over 8.3	3.4	0.3	—	0.4	2.0	—	—	—	1.4
3-2 combination:									
8.1-8.3	105	30	2	33	164	—	—	—	334
8.4-8.5	1	0	1	0	4	—	—	—	6
8.6-9.0	1	0	2	0	0	—	—	—	3
9.1 and over	1	0	0	1	0	—	—	—	2
Total over 8.0	108	30	5	34	168	—	—	—	345
Total over 8.3	3	0	3	1	4	—	—	—	11
Total units	478	200	37	76	942	—	—	—	1,733
Percent over 8.0	22.6	15.0	13.5	44.7	17.8	—	—	—	19.3
Percent over 8.3	0.6	—	8.1	1.3	0.4	—	—	—	0.6
Other trucks:									
Panels, pickups, 4 tires	268	614	0	0	0	0	0	252	1,134
Other, 2-axles, 4 tires	201	1,598	0	0	0	0	0	0	1,799
Other combinations:									
2-1	75	—	—	—	—	—	—	—	75
2-2	78	—	—	—	—	—	—	—	78
2-S2-2	—	53	—	—	—	—	—	—	53
3-S1-1	—	54	—	—	—	—	—	—	54
3-S3-2	—	55	—	—	—	—	—	—	55
Total units	25,096	91,802	2,674	13,963	14,536	4,022	1,010	2,165	155,268
Total 7 vehicle classes	24,474	89,428	2,674	13,963	14,536	4,022	1,010	1,913	152,020
Total over 8.0	2,766	7,703	365	1,105	1,561	388	197	154	14,239
Total over 8.3	453	374	92	88	157	21	46	50	1,281
Percent over 8.0	11.3	8.6	13.6	7.9	10.7	9.6	19.5	8.1	9.4
Percent over 8.3	1.9	0.4	3.4	0.6	1.1	0.5	4.6	2.6	0.8

TABLE 12

NUMBER AND PERCENT OF SINGLE-UNIT TRUCKS AND TRAILER COMBINATIONS MEASURED AND FOUND TO EXCEED 13.5 FT IN HEIGHT

Body Height (ft)	Body Type								
	Flatbed	Van	Log	Dump	Tank	Auto	Concrete	Utility	Total
2-axles, 6 tires, truck:									
13.6 to 14.0	17	0	0	2	0	—	0	0	19
14.1 to 14.5	7	1	0	0	0	—	0	0	8
14.6 and over	5	1	0	0	0	—	0	0	6
Total 13.6 and over	29	2	0	2	0	—	0	0	33
Total units	11,354	31,146	573	7,081	3,151	—	87	1,531	54,923
Percent 13.6 and over	0.3	0.0	—	0.0	—	—	—	—	0.1
3-axle truck:									
13.6 to 14.0	1	2	2	0	0	—	0	3	8
14.1 to 14.5	0	0	0	0	0	—	0	0	0
14.6 and over	0	0	0	1	0	—	0	0	1
Total 13.6 and over	1	2	2	1	0	—	0	3	9
Total units	1,215	1,523	418	2,685	261	—	923	232	7,257
Percent 13.6 and over	0.1	0.1	0.5	0.0	—	—	—	1.3	0.1
2-S1 combinations:									
13.6 to 14.0	14	6	0	0	0	34	—	1	55
14.1 to 14.5	1	0	0	0	0	10	—	0	11
14.6 and over	3	2	0	0	0	1	—	0	6
Total 13.6 and over	18	8	0	0	0	45	—	1	72
Total units	2,189	12,167	488	794	892	3,943	—	71	20,544
Percent 13.6 and over	0.8	0.1	—	—	—	1.1	—	1.4	0.4
2-S2 combinations:									
13.6 to 14.0	38	11	3	1	0	5	—	0	58
14.1 to 14.5	12	0	0	0	0	2	—	0	14
14.6 and over	8	14	0	0	0	0	—	0	22
Total 13.6 and over	58	25	3	1	0	7	—	0	94
Total units	7,321	34,405	487	2,411	7,073	79	—	49	51,825
Percent 13.6 and over	0.8	0.1	0.6	0.0	—	8.9	—	—	0.2
3-S2 combinations:									
13.6 to 14.0	34	105	11	3	1	—	—	1	155
14.1 to 14.5	8	3	3	0	0	—	—	0	14
14.6 and over	21	5	3	1	0	—	—	1	31
Total 13.6 and over	63	113	17	4	1	—	—	2	200
Total units	1,652	9,593	671	693	2,065	—	—	30	14,704
Percent 13.6 and over	3.8	1.2	2.6	0.6	0.0	—	—	9.1	1.4
2-S1-2 combinations:									
13.6 to 14.0	3	26	—	0	0	—	—	—	29
14.1 to 14.5	1	2	—	0	0	—	—	—	3
14.6 and over	0	0	—	0	0	—	—	—	0
Total 13.6 and over	4	28	—	0	0	—	—	—	32
Total units	265	394	—	223	152	—	—	—	1,034
Percent 13.6 and over	1.5	7.1	—	—	—	—	—	—	3.1
3-2 combinations:									
13.6 to 14.0	0	1	0	0	0	—	—	—	1
14.1 to 14.5	0	2	0	0	0	—	—	—	2
14.6 and over	0	0	0	0	0	—	—	—	0
Total 13.6 and over	0	3	0	0	0	—	—	—	3
Total units	478	200	37	76	942	—	—	—	1,733
Percent 13.6 and over	—	1.5	—	—	—	—	—	—	0.2
Other trucks:									
Panels, pickups, 4 tires	268	614	0	0	0	—	0	252	1,134
Other, 2-axles, 4 tires	201	1,598	0	0	0	—	0	0	1,799
Other combinations:									
2-1	75	—	—	—	—	—	—	—	75
2-2	78	—	—	—	—	—	—	—	78
2-S2-2	—	53	—	—	—	—	—	—	53
3-S1-1	—	54	—	—	—	—	—	—	54
3-S3-2	—	55	—	—	—	—	—	—	55
Total units	25,096	91,802	2,674	13,963	14,536	4,022	1,010	2,165	155,268
Total, 7 vehicle classes	24,474	89,428	2,674	13,963	14,536	4,022	1,010	1,913	152,020
Total 13.6 and over	173	181	22	8	1	52	0	6	443
Percent 13.6 and over	0.7	0.2	0.8	0.1	0.0	1.3	—	0.3	0.3

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Appendix

SUMMARY OF LEGALLY PERMISSIBLE[1] LENGTHS OF SEMITRAILERS, CONTINENTAL UNITED STATES[2]

Vehicle Type	Legal Length (ft)	No. of States	
		May 1, 1957[3]	July 1, 1962[4]
Semitrailer	35	15	1[5]
Semitrailer	39½	1	1[6]
Semitrailer	40	6	12
Semitrailer	42	1	1
Semitrailer	45	3	1
Semitrailer	50	0	1
Semitrailer	55	1	1
Tractor semitrailer	45	2	-
Tractor semitrailer	48	1	-
Tractor semitrailer	50	13	17
Tractor semitrailer	55	-	5
Tractor semitrailer	60	4	6
Tractor semitrailer	65	1	2
Tractor semitrailer	(No. Restr.)[7]	1	1
Permitted 40 ft	-	6	12
Permitted over 40 ft	-	25	35

[1] In States where there are no restrictions on length of semitrailers the maximum possible length (van bodies) is assumed 7 ft less than the permitted tractor semitrailer combination length. Automobile transporter bodies may exceed these lengths when an automobile is carried above the tractor cab, a practice which is permitted in most States.
[2] Includes District of Columbin.
[3] From "Summary of Size and Weight Limits and Reciprocity Authority (By Regions), in effect as of May 1, 1957." American Trucking Assoc.
[4] From "Summary of Size and Weight Limits and Reciprocity Authority (By Regions) in effect as of July 1, 1962." American Trucking Assoc.
[5] West Virginia.
[6] Georgia.
[7] Nevada.

Trends and Forecasts of Auto Trips Across The Hudson River Screenline in New York-New Jersey Metropolitan Area

NATHAN CHERNIACK, Economist, The Port of New York Authority

•IN AN EFFORT to visualize the time when a new interstate (New York-New Jersey) vehicular crossing may be needed, it was deemed advisable to make an intensive study in depth of the past trends of trans-Hudson auto trips, and to foresee as clearly as possible the probable overall expansion of interstate auto trip demand in the next 20 yr.

Currently, trans-Hudson auto trips represent about 84 percent of total trans-Hudson vehicular traffic; truck and bus trips account for the remainder. To a large extent, therefore, autos determine present usage of existing trans-Hudson vehicular capacity. Also, because of the strength of rates of auto trip expansion in the past and the likelihood of the continuance of a high rate of expansion in the future, auto usage is likely to continue to determine, to a large extent, the future need for interstate vehicular crossings.

TECHNIQUES OF PROJECTIONS

A generally common method of gaging trends of vehicular traffic has been first to ascertain past annual rates of growth over as long a series of years as the available data permitted. Such a time series is then projected on the basis of some adopted mathematical model with respect to time. It is usually assumed that one or more of the parameters will remain the same in the future. An annual time series for trans-Hudson auto trips is available from 1925 to 1962 (see Fig. 2).

Expressing anticipated expansion in a time series like trans-Hudson auto trips at approximately the same percentage rate of growth as that established in some selected period in the past, for example, predicates the future on the mere passage of time. To be sure, in the cases of many socio-economic time series, the researcher is often faced with no alternative except to apply some type of intuitive judgment, in projecting the series into the future, adopting the same rates as in the past, or revising them upward or downward according to someone's judgment.

However, the technique of projecting a time series could, in many instances, be improved by first considering the series at hand as being dependent on another correlative time series. Such a correlative series must, of course, be more basic, to some extent at least, causative. Data for such a series must also be available for approximate the same period in the past as the dependent series. It is also desirable that projection of the more basic time series be made in the past and later in the future by various other researchers for a number of different purposes.

AUTO OWNERSHIPS DETERMINE TRANS-HUDSON AUTO TRIPS

Past analyses have repeatedly confirmed the fact that trans-Hudson auto trips were closely correlated with auto ownership in the "traffic shed," consisting of the 18-county New York-New Jersey metropolitan area—nine in New York and nine in New Jersey (Fig. 1). To the extent that auto ownership in this traffic shed could be considered at least partially a causative factor, it may be regarded as an effective determinant of past trans-Hudson auto trip demand. An annual series of autos registered

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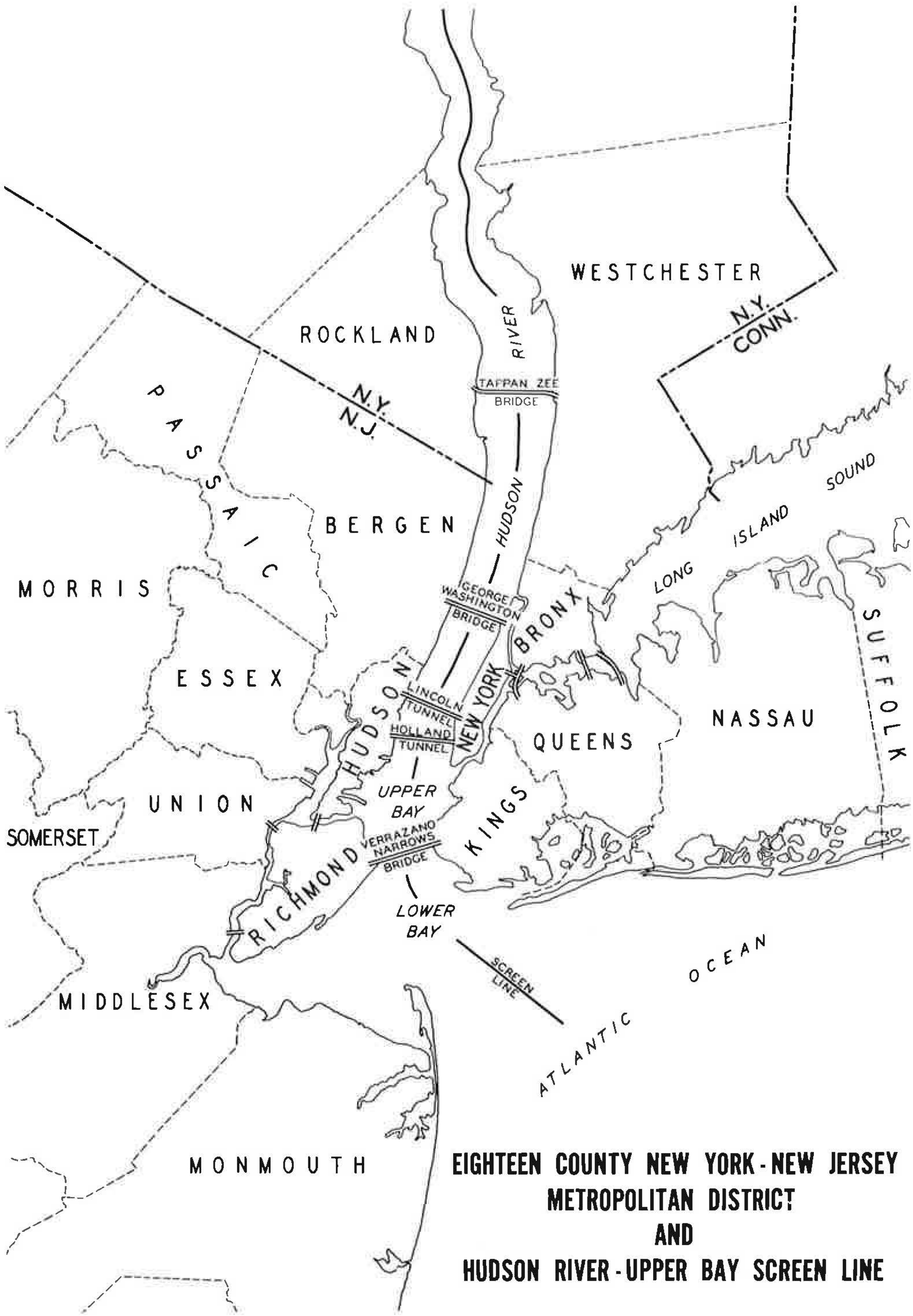
WESTCHESTER
ROCKLAND
PASSAIC
BERGEN
MORRIS
ESSEX
UNION
SOMERSET
MIDDLESEX
MONMOUTH
HUDSON
NEW YORK
BRONX
QUEENS
NASSAU
SUFFOLK
KINGS
RICHMOND
N.Y.
N.J.
N.Y.
CONN.
HUDSON RIVER
TAPPAN ZEE BRIDGE
GEORGE WASHINGTON BRIDGE
LINCOLN TUNNEL
HOLLAND TUNNEL
UPPER BAY
VERRAZANO NARROWS BRIDGE
LOWER BAY
SCREEN LINE
LONG ISLAND SOUND
ATLANTIC OCEAN
EIGHTEEN COUNTY NEW YORK-NEW JERSEY
METROPOLITAN DISTRICT
AND
HUDSON RIVER-UPPER BAY SCREEN LINE

Figure 1.

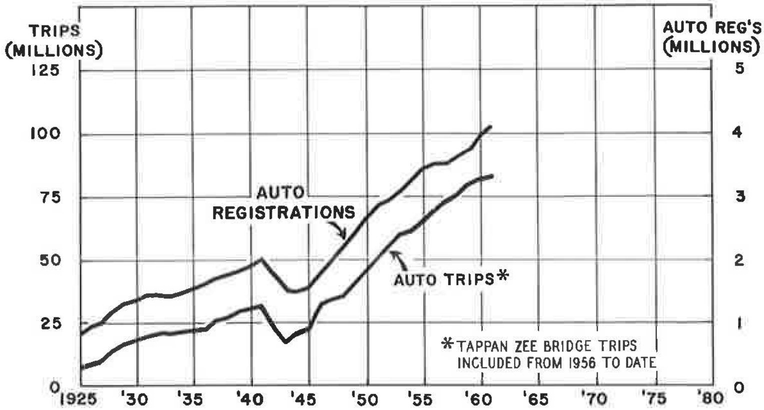

Figure 2. Annual trans-Hudson auto trips and annual auto registrations.

in the 18-county traffic shed is available from 1925 to 1962. Figure 2 shows that trans Hudson auto trips are fairly well correlated with auto ownership in the traffic shed tributary to the lower Hudson River screenline.

However, by plotting trans-Hudson auto trips against auto ownership in the traffic sh (Fig. 3 and Table 1), a quantification of the correlation was determined graphically as a "regression line." This regression line indicated on the average that for every addit al auto owned in the traffic shed, a total of about 22.7 incremental auto trips were generated across the Hudson River screenline during one year. In any given year, tran Hudson auto trips could also be computed from this regression line by deducting from the given year's auto registration in the traffic shed 550,000, and multiplying the adjusted registrations by 22.7 trips. In 1961 auto registrations amounted to 4,103,000. Deducting 550,000 leaves 3,553,000 as the adjusted registrations which, when multipli

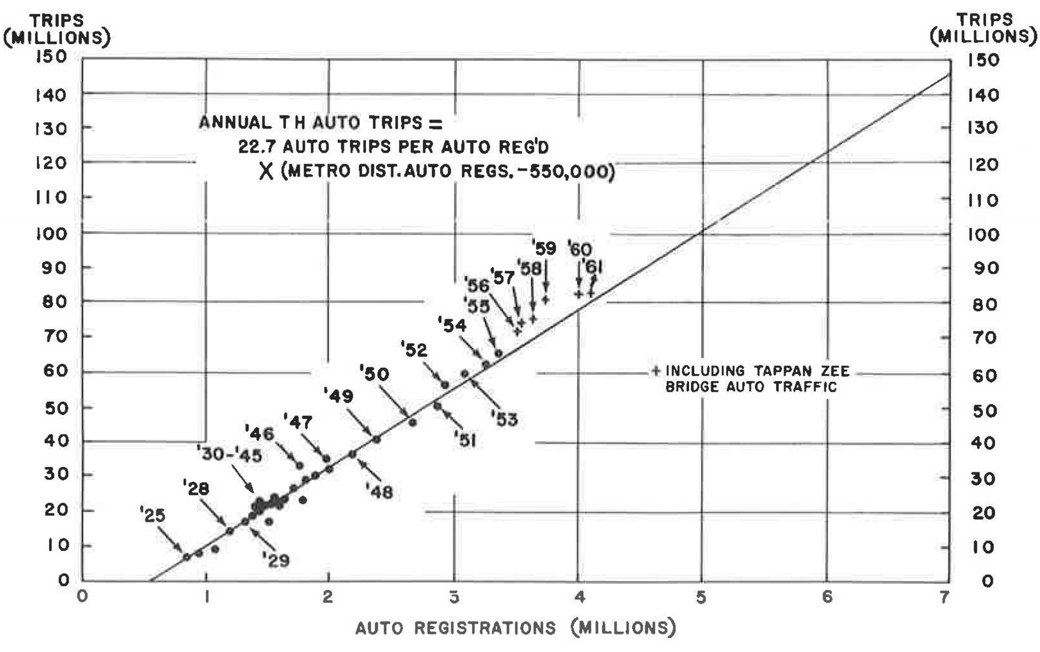

Figure 3. Annual trans-Hudson auto trips vs annual auto registrations.

TABLE 1

RECORDED, COMPUTED AND PROJECTED ANNUAL TRANS-HUDSON AUTO TRIPS ON ALL DAYS AND AUTOS REGISTERED IN 18 COUNTY TRAFFIC SHED, 1930-1980

Year	Recorded Auto Trips (1,000's)	Recorded Auto Regist. (1,000's)	Recorded Trips per Recorded Regist. (No.)	Adjusted[1] Auto Regist. (1,000's)	Recorded Trips per Adjusted Regist. (No.)	Computed Trips per Recorded Regist. (No.)	Computed[2] Auto Trips (1,000's)	Deviations[3] Recorded Minus Computed Auto Trips (1,000's)	(%)
1930	18,811	1,387	13.6	837	22.5	13.7	19,000	- 189	- 1.0
31	20,643	1,442	14.3	892	23.1	14.0	20,250	+ 393	+ 1.9
32	21,972	1,447	15.2	897	24.5	14.1	20,360	+1,612	+ 7.9
33	21,509	1,434	15.0	884	24.3	14.0	20,070	+1,439	+ 7.2
34	22,000	1,484	14.8	934	23.6	14.3	21,200	+ 800	+ 3.8
35	22,944	1,531	15.0	981	23.4	14.5	22,270	+ 674	+ 3.0
36	23,793	1,629	14.6	1,079	22.1	15.0	24,490	- 697	- 2.8
37	26,320	1,724	15.3	1,174	22.4	15.5	26.650	- 330	- 1.2
38	27,218	1,770	15.4	1,220	22.3	15.6	27,690	- 472	- 1.7
39	29,377	1,822	16.1	1,272	23.1	15.8	28,870	+ 507	+ 1.8
1940	30,231	1,903	15.9	1,353	22.3	16.1	30,710	- 479	- 1.6
41	32,318	2,014	16.0	1,464	22.1	16.5	33,230	- 912	- 2.7
42	23,399	1,796	13.0	1,246	18.8	15.7	28,280	-4,881	-17.3
43	17,309	1,522	11.4	972	17.8	14.5	22,060	-4,751	-21.5
44	21,224	1,507	14.1	957	22.2	14.4	21,720	- 496	- 2.3
45	23,481	1,567	15.0	1,017	23.1	14.7	23,090	+ 391	+ 1.7
46	32,875	1,763	18.6	1,213	27.1	15.6	27,540	+5,335	+19.4
47	34,852	1,982	17.6	1,432	24.3	16.4	32,510	+2,342	+ 7.2
48	36,314	2,192	16.6	1,642	22.1	17.0	37,270	- 956	- 2.6
49	41,197	2,399	17.2	1,849	22.3	17.5	41,970	- 773	- 1.8
1950	45,773	2,680	17.1	2,130	21.5	18.0	48,350	-2,577	- 5.3
51	51,074	2,865	17.8	2,315	22.1	18.3	52,550	-1,476	- 2.8
52	56,345	2,927	19.3	2,377	23.7	18.4	53,960	+2,385	+ 4.4
53	60,067	3,071	19.6	2,521	23.8	18.6	57,230	+2,837	+ 5.0
54	62,617	3,253	19.2	2,703	23.2	18.9	61,360	+1,257	+ 2.0
55	65,326	3,459	18.9	2,909	22.5	19.1	66,030	- 704	- 1.1
56	71,526	3,520	20.3	2,970	24.1	19.2	67,420	+4,106	+ 6.1
57	74,705	3,539	21.1	2,989	25.0	19.2	67,850	+6,855	+10.1
58	76,101	3,650	20.8	3,100	24.5	19.3	70,370	+5,731	+ 8.1
59	80,898	3,724	21.7	3,174	25.5	19.3	72,050	+8,848	+12.3
1960	82,641	3,983	20.7	3,433	24.1	19.6	77,930	+4,711	+ 6.0
61	83,310	4,103	20.3	3,553	23.4	19.7	80,650	+2,660	+ 3.3
62	89,284	-	-	-	-	-	-	-	-
				Projected					
1965	92,300	4,615	20.0	4,065	22.7	20.0	92,300		
1970	108,700	5,340	20.4	4,790	22.7	20.4	108,700		
1975	126,100	6,105	20.7	5,555	22.7	20.7	126,100		
1980	143,800	6,885	20.9	6,335	22.7	20.9	143,800		

[1]Adjusted registrations = recorded registrations - 550,000.
[2]Computed auto trips = 22.7 (recorded registrations - 550,000).
[3]Deviations shown or smaller, 24 out of 32 years, ± 2,837; ± 7.2.
Note: Auto trips include those via Tappan Zee Bridge.

by 22.7, yields 80,650,000 as the trans-Hudson auto trips for 1961 as computed from auto registrations. This compared with 83,310,000 trans-Hudson auto trips recorded for 1961 or 3.3 percent above that computed.

It may be interpreted that the regression line intercept on the X-axis indicates that there may be about 550,000 autos in the traffic shed which do not cross the Hudson River at all, and that the other autos average 22.7 trans-Hudson trips a year. This interpretation cannot be directly supported by available data. It does not seem unreasonable, however, when one considers the number of municipally- or county-owned cars like New York City's police cars, taxicabs, doctors' cars and others that seldom, if ever, have occasion to go beyond their circumscribed areas of operations.

Again, while the regression line expresses only an empirical relationship, a priori reasoning would seem to indicate that the more autos there are in the traffic shed, the more auto trips will be made in the course of the year within the traffic shed. Also, by the law of probabilities it may be reasoned that the greater the total number of auto trips within the traffic shed, the greater the number of trips that would cross the Hudson River screenline that divides the traffic shed.

Other students of traffic have demonstrated similar relationships, except that their relationships held at a given time over a number of small areas. Thus, in the Chicago study area, the data indicated that the more cars owned per acre in the various residential zones, the more person trips per acre were generated to and from homes.[1]

Thus, whether dealing with differences, as among small zones in an urban area at a given time, or with changes over a long period of time in the same traffic shed area, the more cars owned, the more trips across a screenline. An additional car owned yields a fairly constant number of trips. In the New York-New Jersey area, over time, an additional car owned in the traffic shed means 22.7 additional auto trips in the cours of a year across the Hudson River screenline. In the Chicago area, a difference of one car, as between zones, means a difference of 4.2 person trips a day to and from home (Table 2).

To test the accuracy of the regression line in the New York area over the 32-yr period (1930-1961, inclusive), each year's trans-Hudson auto trips were computed from the known auto registrations for the same years and compared with the recorded trips for the corresponding years (see Fig. 8 and Table 1).

Out of the 32 annual trans-Hudson auto trips computed from known auto registrations for those years, 24 are within ± 7.2 percent of the recorded trips. Out of the 12 years when differences exceeded ± 7.2 percent, seven were abnormal years which could have been recognized contemporaneously. Thus, trans-Hudson auto travel was held down in two World War II years (1942 and 1943) under gasoline rationing. On the other hand, there was super-normal travel in 1946 and 1947 as a reaction to wartime gas rationing, and in 1957, 1958 and 1959 after the Tappan Zee Bridge was opened to traffic. In other words, the level of trans-Hudson auto travel computed from past known current auto registrations in the 18-county traffic shed came within ± 7.2 percent of recorded trans-Hudson auto trips in 24 out of 25 individual "normal" years.

Over the past 32 years, the aggregate of autos registered in the traffic shed has constituted the single most important determinant of the levels of annual trans-Hudson auto trip demand, irrespective of the declines in trans-Hudson railroad commuter passengers and the steady growth of trans-Hudson bus passengers in the same period.

Auto ownership will apparently continue to be the single determinant that will largely establish annual levels of auto trips across the lower Hudson River-Upper Bay screenline. But how does one project auto registrations into the future in 18 individual counti as well as in the 18-county traffic shed? This brought up a new difficulty. Extrapolati county auto registrations as a time series, would again employ a weak statistical metho because it would ignore the different demographic changes in population and the different changes in the social and economic environments that will influence auto ownerships A more desirable method would be to predicate future auto registrations on the basis of carefully prepared demographic projections of populations; after all, people determine auto ownerships. Here another statistical difficulty arose. Although county auto registrations have been available annually, population census figures are available only decennially. Intercensal annual population figures were merely population estimates. This paucity of recorded annual population figures thus limited the data for establishing correlations between auto registrations and populations to decennial data.

SIZES OF HOUSEHOLDS DECLINING

A priori reasoning would seem to suggest that numbers of households would be bette indicators of car ownerships than would population figures proper. The auto is a house hold ownership rather than a personal ownership item. Also, in the past, numbers of households have expanded at a faster rate than populations proper, because the number of persons in household groups has been declining not only in the New York region, but in the country at large even though average family size has been increasing in recent years.

Declining household size has been brought about by the larger numbers of unmarried adults and elderly persons maintaining separate living accommodations. Best judgment of demographers in the New York region indicated that factors that brought about declin

[1] HRB Bull. 253, p. 179, Fig. 2 (1960).

in the average size of households in the past are likely to operate in the future. Consequently, "persons-per-household" factors were likely to continue to decline in the future. This means that there are likely to be more households per 1,000 additional persons in the future than in the past. In fact, in the past decade, population in some counties has actually declined and households expanded. Moreover, individual counties

TABLE 2

RECORDED VS COMPUTED RESIDENTIAL ZONAL PERSON TRIP DESTINATIONS ON BASIS OF ZONAL AUTO REGISTRATIONS IN THE CHICAGO TRANSPORTATION STUDY AREA IN 1956

		Residential		Deviations	
Zone	Auto Regist.[a] (1,000's)	Person Trip Computed (at 4.18[b] trips per auto regist.) (1,000's)	Destinations Recorded[c] (1,000's)	Recorded / Computed (Col. 4 ÷ Col. 3) (%)	Rec'd-Comptd[d] / Comptd (Col. 5 - 100) (%)
01	1.3	6	25	4.17	
11	48.9	204	240	1.18	+ 18
21	29.5	123	131	1.07	+ 7
22	23.2	97	88	0.91	- 9
23	30.0	126	122	0.97	- 3
24	17.7	74	67	0.91	- 9
25	11.9	50	42	0.84	- 16
26	8.7	36	34	0.94	- 6
27	15.1	63	83	1.32	+ 32
31	41.0	171	156	0.91	- 9
32	42.0	175	169	0.97	- 3
33	36.8	154	149	0.97	- 3
34	23.1	96	89	0.93	- 7
35	15.9	67	63	0.94	- 6
36	19.5	81	87	1.07	+ 7
37	37.3	156	174	1.12	+ 12
41	58.7	245	214	0.87	- 13
42	50.1	209	183	0.88	- 12
43	62.7	262	243	0.93	- 7
44	38.0	159	144	0.91	- 9
45	21.8	91	89	0.98	- 2
46	54.1	227	222	0.98	- 2
47	68.3	285	303	1.06	+ 6
51	33.5	140	146	1.04	+ 4
52	42.0	175	164	0.94	- 6
53	35.0	146	138	0.95	- 5
54	23.5	99	87	0.88	- 12
55	20.0	84	81	0.96	- 4
56	38.5	161	159	0.99	- 1
57	37.1	155	169	1.09	+ 9
61	25.1	105	117	1.11	+ 11
62	32.3	135	135	1.00	-
63	38.4	160	147	0.92	- 8
64	27.8	116	120	1.03	+ 3
65	16.3	68	63	0.93	- 7
66	43.4	182	196	1.08	+ 8
67	26.9	112	141	1.26	+ 26
71	20.6	86	85	0.99	- 1
72	26.4	110	106	0.96	- 4
73	20.0	84	84	1.00	-
74	20.0	84	79	0.94	- 6
75	4.2	18	17	0.94	- 6
76	38.1	159	182	1.14	+ 14
77	16.9	71	73	1.03	+ 3
Total	1,341.6	5,607	5,607	100	

[a]Table 19, Vol. 1, CATS.

[b] $\frac{5,607,000 \text{ residential person trip destinations}}{1,341,600 \text{ auto registrations}}$ = 4.18 person trips per auto registered.

[c]Table 23, Vol. 1, CATS.

[d]33 out of 44 deviations ± 9% or less.

in the traffic shed differed widely in average size of households and in the rate at which household size was declining.

In the case of each county, two assumptions were consistently made: (a) the number of persons per household would continue to decline in the years, 1960-80, and (b) the rate of decline would be approximately the same as in the past 20 years (Table 3). In this way, future individual households were derived from the demographic projections of the populations for each county and for the aggregate of the 18 counties for the years 1965-80 in 5-yr intervals.

For the traffic shed as a whole, the effect of projecting declining household sizes in the individual counties indicated a decline in average size from about 3.16 persons per household in 1960, to about 2.79 persons by 1980. This represents a decline of about 11.7 percent in size of households for the next 20 years.

The demographic population projections for the traffic shed indicate that by 1980, population will expand by about 25 percent over 1960. The anticipated 11.7 percent decline in average size of households between 1960-80 would expand households per 1,000 persons by about 14 percent. Therefore, the number of households would expand by about 41 percent.

EXPANDING AUTO OWNERSHIP RATES

The geographical distribution of auto ownership in the traffic shed is dependent, to a large extent, on the spatial distribution of population and, more specifically, on the

TABLE 3
PERSONS PER HOUSEHOLD FOR 1940-1960-1980 AND PERCENTAGE CHANGES IN 20-YEAR PERIODS

Area	Persons per Household			Changes	
	1940 (No.)[a]	1960 (No.)[a]	1980 (No.)[b]	1960/1940 (%)	1980/1960 (%)
18 N.Y. - N.J. Counties	3.71	3.16	2.79	85.2	88.3
9 N.Y. counties	3.68	3.10	2.67	84.2	86.8
9 N.J. counties	3.79	3.33	3.01	87.9	90.4
New York City	3.64	2.93	2.38	80.5	81.2
N.Y. counties:					
New York	3.45	2.44	1.73	70.7	70.7
Bronx	3.69	3.07	2.55	83.2	83.2
Richmond	4.05	3.60	3.20	88.9	88.9
Kings	3.76	3.09	2.54	82.2	82.2
Queens	3.59	3.10	2.68	86.4	86.4
Nassau	3.76	3.73	3.70	99.2	99.2
Suffolk	4.14	3.85	3.58	93.0	93.0
Westchester	3.88	3.35	2.89	86.3	86.3
Rockland	4.57	3.94	3.40	86.2	86.2
N.J. counties:					
Bergen	3.71	3.38	3.08	91.1	91.1
Passaic	3.69	3.23	2.83	87.5	87.5
Hudson	3.76	3.08	2.52	81.9	81.9
Essex	3.78	3.20	2.71	84.7	84.7
Union	3.87	3.36	2.92	86.8	86.8
Morris	3.96	3.64	3.35	91.9	91.9
Middlesex	4.02	3.60	3.23	89.6	89.6
Monmouth	3.69	3.48	3.28	94.3	94.3
Somerset	4.04	3.59	3.19	88.9	88.9

[a] Computed from population and household data from U.S. Bureau of the Census.
[b] Computed by applying to 1960 county persons per household, the corresponding 1960/1940 county percentage changes.

TABLE 4

AUTOS PER 100 HOUSEHOLDS VS HOUSEHOLDS PER ACRE, 1960

County	State	Households per Acre of Committed Land[1]	Autos Per 100 Households
Rockland	N.Y.	0.6	137
Somerset	N.J.	0.7	105
Morris	N.J.	0.8	146
Suffolk	N.Y.	1.0	146
Monmouth	N.J.	1.0	128
Middlesex	N.J.	1.6	127
Westchester	N.Y.	2.0	128
Passaic	N.J.	2.4	111
Nassau	N.Y.	2.5	142
Richmond	N.Y.	2.5	100
Bergen	N.J.	2.7	129
Union	N.J.	3.0	135
Essex	N.J.	4.9	103
Queens	N.Y.	9.2	81
Hudson	N.J.	11.1	77
Bronx	N.Y.	19.2	47
Kings	N.Y.	20.8	51
New York	N.Y.	51.0	25

[1] Land committed to residential, industrial, commercial, institutional and transportation uses and publicly owned open spaces.

spatial distribution of households. However, it is also dependent on the varying degrees of conduciveness to auto ownership in the different counties. Availability of mass transit in four of the five boroughs of New York City and in Hudson and Essex Counties in New Jersey, for example, has made car ownership less necessary than in the more outlying counties. There is also a consistent tendency for counties developed at low residential densities to display high auto ownership rates (expressed as autos per 100 households) and for high density counties to have low ownership rates (Table 4).

In the past two decades, auto ownership rates have risen in most of the counties. In the whole 18-county traffic shed, auto ownership rates rose from 59.7 autos per 100 households in 1940, to 69.8 in 1950, to 83.4 by 1960. It is apparent from these rising auto ownership rates that auto ownership in most counties has expanded even faster than households.

When individual county auto registrations were plotted against county households in censal years 1940, 1950 and 1960, the reason was clear. In Figures 4, 5 and 6,

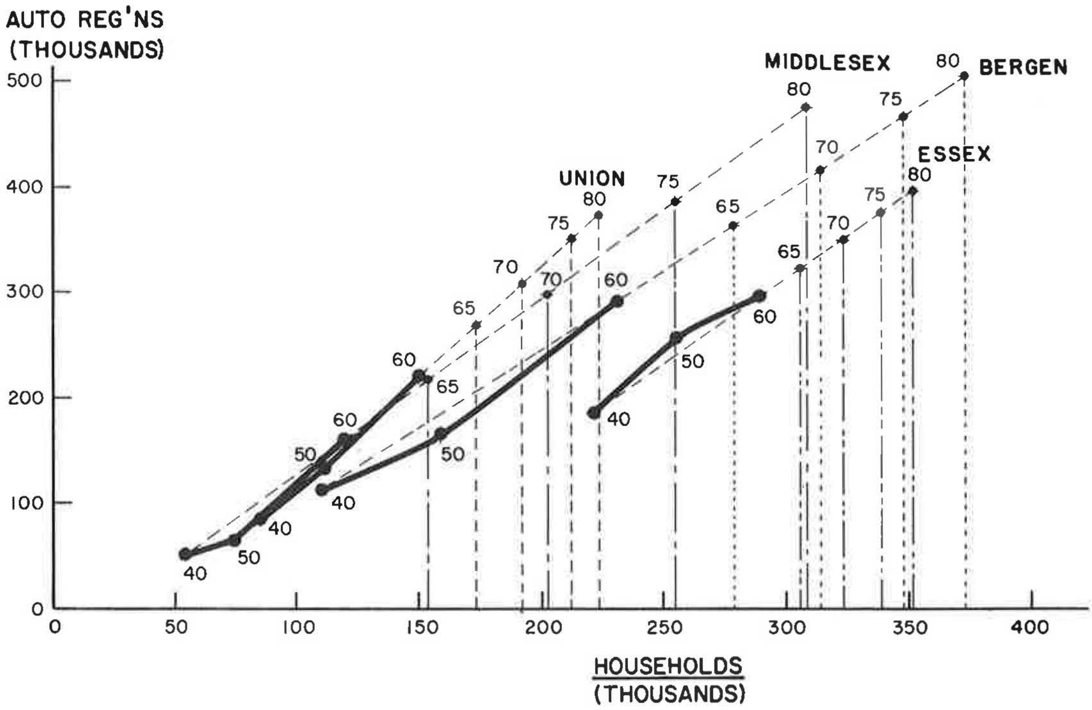

Figure 4. Auto registrations vs households, 4 N. J. counties.

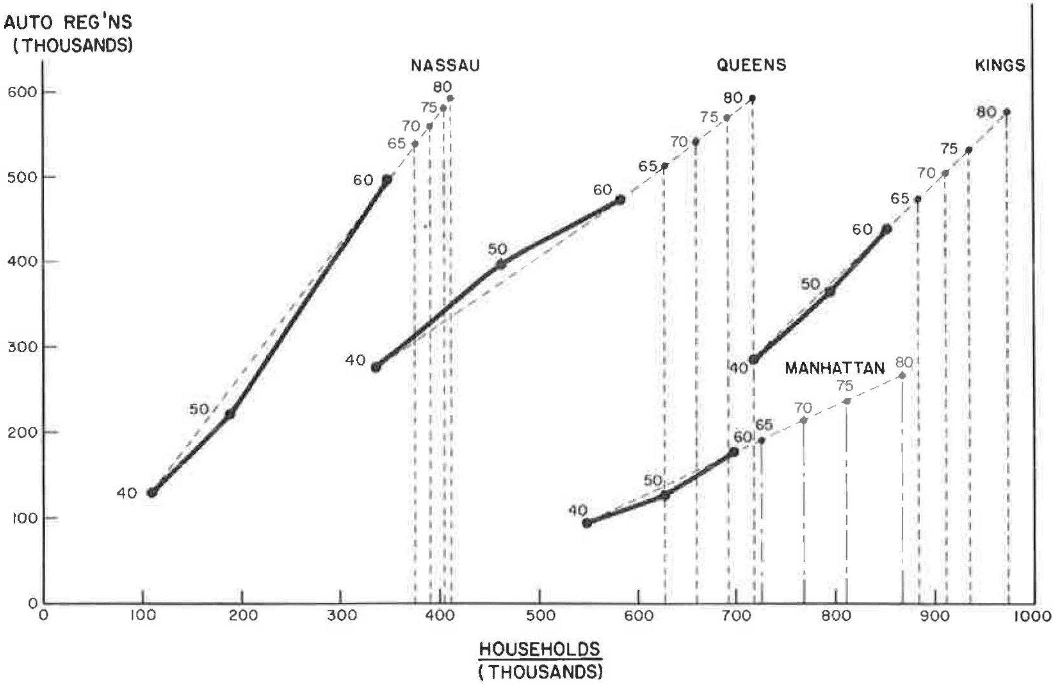

Figure 5. Auto registrations vs households, 4 N. Y. counties.

straight lines are fair representations of the correlations between each county's auto ownership and its households. These straight-line relationships indicate that over the past two decades the average incremental individual county auto ownership rates have been uniform but consistently higher than such rates in any of the three censal years. Thus for the 18-county traffic shed, in the 20-yr interval, an approximate average of 131 autos were added for every 100 additional households. This incremental auto owne ship rate is considerably higher than the auto ownership rate that prevailed even in the last year, 1960, when the rate stood at 83.4 autos per 100 households. Consequently, it would appear that county auto ownership rates in the traffic shed will probably continue to rise in the future.

However, it should be pointed out that the 131 autos added per 100 households added in the traffic shed during 1940-60, are not to be equated to the average auto ownership of new households added in the 20-yr period. Older households also increased their auto ownership rates in that period. There were no statistical data to determine how much of the auto ownership increment was absorbed by new and how much by old households.

Even though these high levels of overall incremental car ownership rates are subjec to statistical data "blind spots," nevertheless they do reflect two important factors that have been responsible for the continuing rise in car ownership rates. One has been the postwar suburban residential developments that have been largely low density where cars have been essential for suburban living. As a consequence, the cars added per 100 households were usually much higher than car ownership rates in older more dense populated areas. The other factor contributing to rising car ownership rates has been the rising trend in the standard of living which has increased ownership rates even in fully developed urban counties.

Thus, Hudson County, N.J. and Kings County, N.Y. are examples of two counties where land uses have been largely developed. Their populations actually declined between 1950 and 1960, but their number of households has increased. Their auto registrations and auto ownership rates per household have also increased. In Hudson County the auto ownership rate rose from 72 autos per 100 households to 77. In Kings County the ownership rate rose from 45 autos per 100 households to 51.

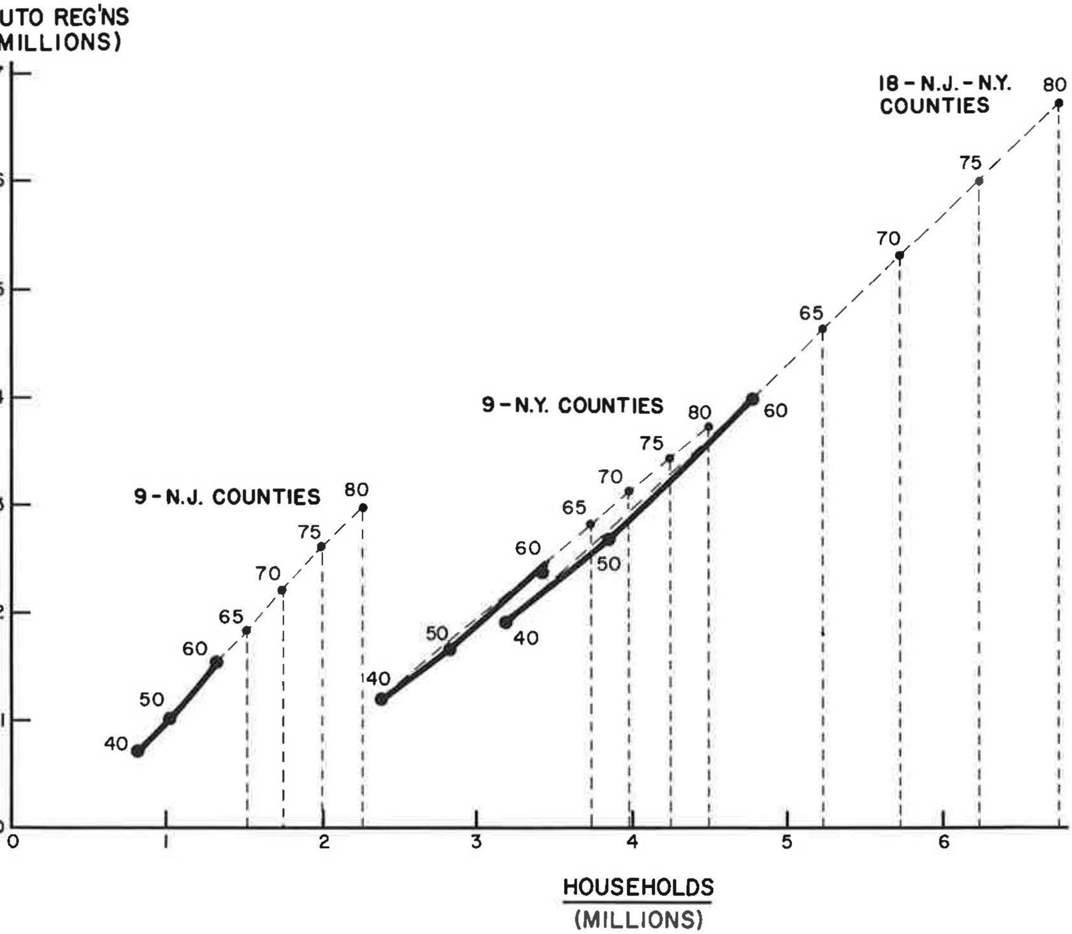

Figure 6. Auto registrations vs households.

In projecting individual county auto-ownership rates, it was assumed on the basis of such data as shown in Figures 3, 4 and 5 that the average incremental auto-ownership rates (auto ownerships added per 100 additional households) of each of the 18 counties experienced during the 1940-60 period would be the same in the next two decades. If this assumption were realized approximately, then the average number of autos per 100 households for the traffic shed, about 83 in 1960, would rise to about 100 autos per 100 households by 1980.

SUMMARY

Through the chain of relationships which were established between county populations and households, county households and auto registrations, and between registrations in the traffic shed and trans-Hudson auto trips, the carefully prepared demographic projections of county populations were translated into interstate auto trip demand across the lower Hudson River-Upper Bay screen line (Fig. 7).

Table 5 gives the translation from (a) demographic projections of population, to (b) the correlative households, (c) to the correlative auto registrations, and to (d) the interstate auto trip demand. It indicates, that in the 1960-80 period an anticipated 27 percent expansion in the population of the traffic shed would mean a 44 percent expansion in households, an overall expansion of 73 percent in auto ownership, and 85 percent expansion in interstate auto trip demand across the lower Hudson River-Upper Bay screenline.

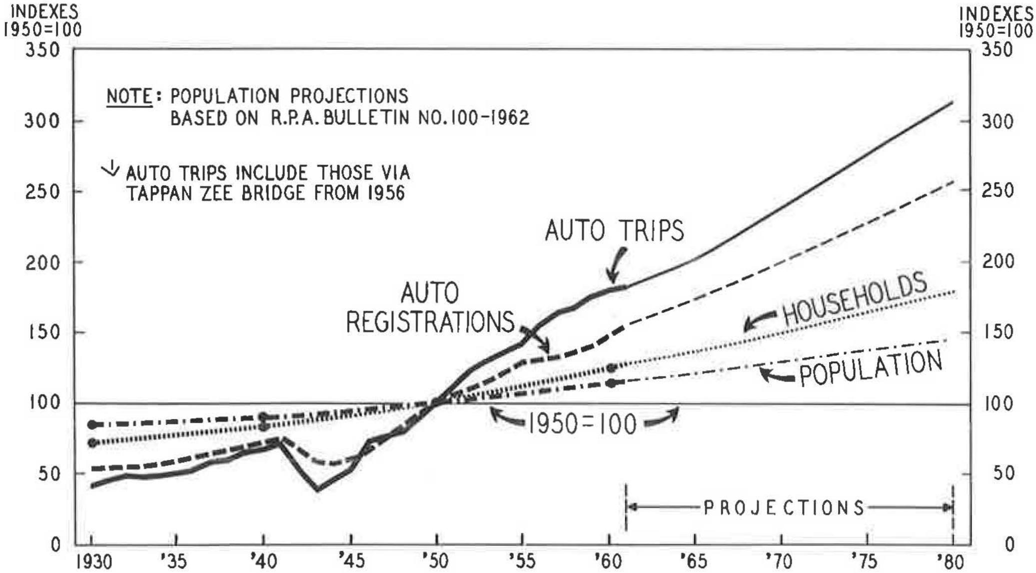

Figure 7. Recorded and projected population, households, auto registrations, and trans-Hudson auto trips in the traffic shed.

In absolute terms, an anticipated increase in population of 4,075,000 persons would produce an increase of about 2,090,000 households which, in turn, would produce an increase in car ownership of about 2,902,000. These cars would yield an increase in interstate auto trips of about 65,870,000. This is equivalent to a rate of growth of about 3 percent a year, compounded.

This compares with an overall average rate of growth of trans-Hudson auto trips between 1930 and 1960 of about 5.1 percent a year, compounded (Fig. 8). If the future annual rate of growth of trans-Hudson auto trips were to continue at the same average rate established in the 30-yr period, their annual volume would double in about 14 yr. If continued at that same rate during the 1960-80 period, the 1960 annual volume of trans-Hudson auto trips of approximately 82.6 million would reach a total of about 222 million trips. This would represent a 20-yr increase of about 139 million trans-Hudso auto trips.

This 139 million increase compares with the increase of about 65.9 million interstate auto trips predicated on demographic projections of county populations and the chain of relationships with households, auto ownerships, and auto trips herein described.

On the basis of the experience of about 5.0 million annual auto trips per bridge lane the 65.9 million additional interstate auto trip demand which would be developed between 1960 and 1980, could be accommodated with about 13 additional lanes. This incremental annual volume in the next two decades could thus be accommodated by the margins of annual capacity available in 1960 plus the six lanes of the lower deck of the George Washington Bridge opened on August 29, 1962, plus six of the 12 lanes of the Narrows Verrazano Bridge which would be devoted to interstate vehicular traffic. Three of these will be available in 1965 and three more after 1975.

There would, of course, be additional need to accommodate the 20-yr expansion of interstate truck and bus traffic. Consequently the need for a new interstate vehicular crossing would become felt before 1980. Planning for such a crossing would undoubted begin long before 1980.

TABLE 5

RECORDED AND PROJECTED POPULATION, HOUSEHOLDS, AND AUTO REGISTRATIONS IN THE NY-NJ TRAFFIC SHED AND INTERSTATE AUTO TRIP DEMAND AND TRANS-HUDSON TRIPS, SELECTED YEARS, 1930-1980

Year	Population (1,000's)	Households per 1,000 Persons	Households (1,000's)	Autos per 100 Households	Auto Regist. (1,000's)	Annual Auto Trip Demand per Auto Regist.	Annual Interstate Auto Trip Demand (1,000's)	Annual Recorded Trans-Hudson Auto Trips
Recorded								
1930	11,011	246	2,708[a]	-	1,387	13.7	19,000[e]	18,811
1940	11,822	270	3,190	59.7	1,903	16.1	30,710	30,231
1950	13,137	292	3,841	69.8	2,680	18.0	48,350	45,773
1960	15,095	316	4,775	83.4	3,983	19.6	77,930	82,641
1961	-	-	-	-	4,103	19.7	80,650	83,310
1962	-	-	-	-	-	-	-	89,284
Projected								
1965	15,990[b]	327	5,230[c]	88.2	4,615[d]	20.0	92,300[e]	-
1970	17,040[b]	337	5,750[c]	92.9	5,340[d]	20.4	108,700[e]	-
1975	18,120[b]	347	6,295[c]	97.0	6,105[d]	20.7	126,100[e]	-
1980	19,170[b]	358	6,865[c]	100.3	6,885[d]	20.9	143,800[e]	-
Changes (%)								
60/40	128	117	150	140	209	122	254	-
80/60	127	113	144	120	173	107	185	-
Computed Changes per Year (%)								
60/40	1.2	0.8	2.1	1.7	3.8	1.0	4.8	-
80/60	1.2	0.6	1.8	0.9	2.8	0.3	3.1	-

[a] Families.
[b] RPA Bulletin 100 9/62, Table 5, p. 36, Appendix.
[c] Based on declining county projections of persons per household (1940-1960).
[d] Based on county incremental auto registrations per incremental households (1940-1960).
[e] Based on formula: annual auto trip demands = 22.7 × (auto regist. - 550,000).

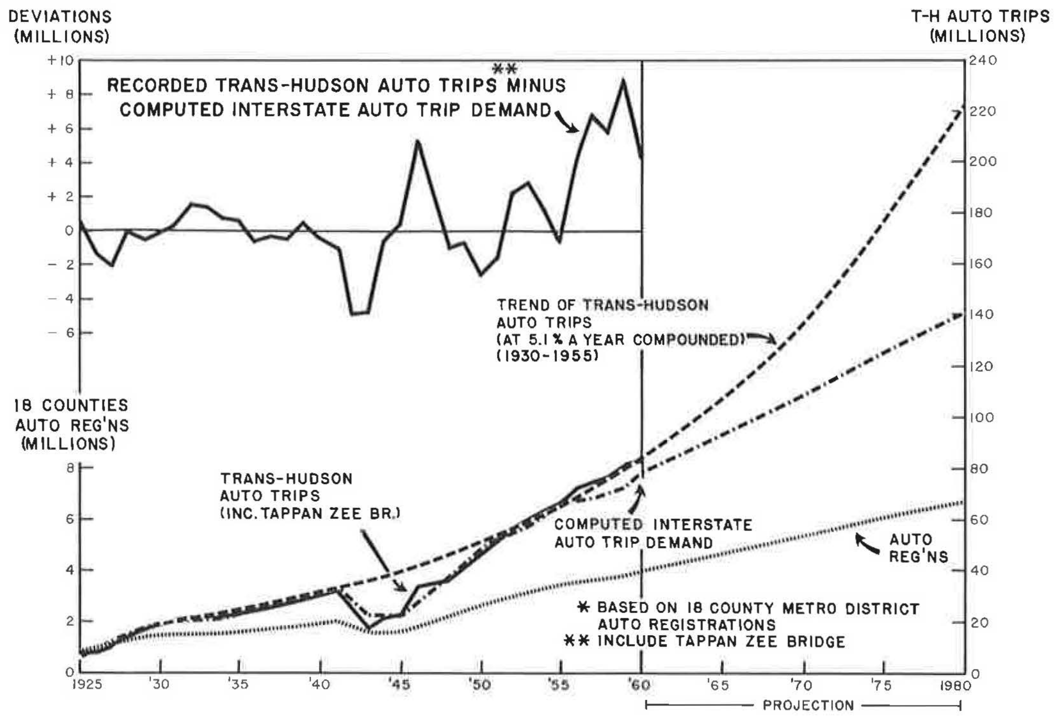

Figure 8. Annual trans-Hudson auto trips vs interstate auto trip demand.

FURTHER STUDY OF AUTO OWNERSHIPS

It has been shown that auto ownerships are the prime determinants of auto trips in a metropolitan area. Auto registrations become available annually. On the other han determinants of future auto ownerships, population and households, become available as recorded census data only decennially. In intercensal years, population and house-hold data are only estimates, consequently there is a need to check auto ownership projections based on demographic population and household projections more often tha every 10 years. Auto ownership projections should be checked preferably with annual projections of their determinant series, recorded indicators which could be checked annually themselves.

Auto registrations are also closely related to licensed drivers as might be expecte Nationally, for example, in the past 15 years, an average of about 90 autos has been added for every 100 new licensed drivers. Annual projections of licensed drivers cou therefore be forged into powerful tools for forecasting annual auto ownerships and checking the goodness of these forecasts annually through recorded auto registrations.

The 1960 census data of population recorded the boys and girls who, each year, for the next 20 years will become potential licensed auto drivers. They also record the number of oldsters who are likely to give up driving, in the next 20 years. Thus by aging the 1960 population data year by year, the net potential drivers who will be adde each year could be determined. These data could then be converted into annual fore-casts of probable licensed drivers from which future annual auto registrations could b estimated.

Thus the 1960 census of population by sex and age composition in single year steps could be used as excellent determinants of annual auto registrations whether in a metr politan area or in the entire nation. This is a worthwhile project.