

**Report to Congress  
on the**

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**Depreciation of Business-Use Light Trucks**

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**Department of the Treasury  
September 1991**



DEPARTMENT OF THE TREASURY  
WASHINGTON

ASSISTANT SECRETARY

September 1991

The Honorable Dan Rostenkowski  
Chairman  
Committee on Ways and Means  
U.S. House of Representatives  
Washington, D.C. 20515

Dear Mr. Chairman:

Section 7612(f) of Public Law 101-239, the Omnibus Budget Reconciliation Act of 1989, directs the Secretary of the Treasury or his delegate to conduct a study of the proper class life for cars and light trucks and submit a report to the Congress within one year of enactment. The Omnibus Budget Reconciliation Act of 1990 extended the date for submission of the report to April 15, 1991.

Pursuant to those directives, a study entitled "Report to Congress on the Depreciation of Business-Use Passenger Cars" was submitted to Congress in April. In completion of this mandate, I hereby submit the companion study "Report to Congress on the Depreciation of Business-Use Light Trucks."

I am sending a similar letter to Representative Bill Archer.

Sincerely,

Kenneth W. Gideon  
Assistant Secretary  
(Tax Policy)

Enclosure



DEPARTMENT OF THE TREASURY  
WASHINGTON

ASSISTANT SECRETARY

September 1991

The Honorable Lloyd Bentsen  
Chairman  
Committee on Finance  
United States Senate  
Washington, D.C. 20510

Dear Mr. Chairman:

Section 7612(f) of Public Law 101-239, the Omnibus Budget Reconciliation Act of 1989, directs the Secretary of the Treasury or his delegate to conduct a study of the proper class life for cars and light trucks and submit a report to the Congress within one year of enactment. The Omnibus Budget Reconciliation Act of 1990 extended the date for submission of the report to April 15, 1991.

Pursuant to those directives, a study entitled "Report to Congress on the Depreciation of Business-Use Passenger Cars" was submitted to Congress in April. In completion of this mandate, I hereby submit the companion study "Report to Congress on the Depreciation of Business-Use Light Trucks."

I am sending a similar letter to Senator Bob Packwood.

Sincerely,

Kenneth W. Gideon  
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(Tax Policy)

Enclosure

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## **Chapter I. Introduction and Principal Findings**

### **A. Mandate for This Study**

This study of the depreciation of business-use light trucks has been prepared by the Office of Tax Analysis (OTA) in response to a Congressional mandate in the Omnibus Budget Reconciliation Act of 1989 (P.L. 101-239). Section 7612(f) of the Act, which became effective December 19, 1989, directed Treasury to conduct a study on the proper class life for cars and light general purpose trucks and to report its findings to the Congress within one year. The Omnibus Budget Reconciliation Act of 1990 extended the due date for the report to April 15, 1991. A report on the depreciation of business-use passenger cars was submitted to Congress in April 1991; this report completes the task requested in P.L. 101-239.

OTA conducts studies of the depreciation of assets, including assets not expressly requested for study by the Congress, as part of its general mandate under Section 168(i)(1)(B) of the Internal Revenue Code, as modified by the Tax Reform Act of 1986. (See Exhibit 1 of Appendix A.) This Code provision directed the Treasury to "monitor and analyze actual experience with respect to all depreciable assets", and granted Treasury explicit authority to change the classification and class lives of assets. The Technical and Miscellaneous Revenue Act of 1988 (TAMRA) repealed Treasury's authority to alter asset classes or class lives, but the revised Section 168(i) continued Treasury's responsibility to "monitor and analyze actual experience with respect to all depreciable assets." (See Exhibit 2 of Appendix A.)

### **B. Methodology and Classification Issues**

The General Explanation of the Tax Reform Act of 1986 indicates that the determination of the class lives of depreciable assets should be based on their anticipated useful lives and the anticipated decline in their value over time, after adjustment for inflation. (See Exhibit 3 of Appendix A.) Under current law, the useful life of an asset is taken to be its entire economic life span over all (business) users combined, and not just the period it is retained by a single owner. The General Explanation also indicates that, if the class life of an asset is derived from the decline with age of its market value, such life (which, to avoid confusion, is hereafter referred to as its "equivalent economic life") should be set so that the present value of straight-line depreciation over the equivalent economic life equals the present value of the decline in value of the asset (both discounted at an appropriate rate of interest).

In its study of the depreciation of business-use passenger cars, OTA accounted for not only the decline in the vehicles' market values with age, but also for their conversion from business to non-business use and the tax gains and losses that arise from their sale at different ages. This treatment was necessary because of a particular characteristic of business-use passenger cars. Unlike most other business equipment, passenger cars are typically sold before the end of their useful life as vehicles. Moreover, unlike a number of other business assets for which an established resale market exists, used passenger cars are nearly always acquired for household or other non-business use.

Like passenger cars, business-use light trucks are also frequently sold before the end of their useful life as vehicles. However, in contrast to passenger cars, business-use light trucks are often sold to other businesses. This feature of the business-use light truck market required OTA to modify the methodology used for passenger cars to account for business-use light trucks that are capitalized and depreciated for tax purposes by more than one owner. Moreover, because the period of time light trucks are held by business owners (either the initial owners or subsequent purchasers) can be comparable to their total useful life, it was also necessary to take account of the retirement pattern with age of light trucks, a factor which was not as important for passenger cars.

Revenue Procedure 87-56, which lists the depreciable asset classes and their corresponding class lives, indicates that "light general purpose trucks" have an actual unloaded weight of less than 13,000 pounds, and are to be distinguished from automobiles, buses, heavy general purpose trucks (with an actual unloaded weight of 13,000 pounds or more), over-the-road tractor units, and trailers and trailer-mounted containers. Under current law, light general purpose trucks are assigned to Asset Class 00.241, and have a class life of four years, regardless of whether they are owned, leased, or rented by their business users. Under section 168(e)(3)(B)(i) of the Internal Revenue Code, however, light general purpose trucks are expressly assigned to the (modified) accelerated cost recovery system's five-year property recovery class, regardless of their class life. Likewise, under section 168(g)(3)(D), the alternative depreciation system recovery period for light trucks is five years, independent of their current class life.

Trucks are not generally classified according to their unloaded weight for other legal purposes, including aspects of tax law, motor vehicle safety standards, and fuel economy standards. Classification is commonly based on the vehicle's gross vehicle weight rating (GVWR) and other factors. The GVWR is the value specified by the manufacturer as the vehicle's maximum design loaded

weight; a GVWR must be assigned to each domestically produced truck.<sup>1</sup> Two vehicles possessing similar empty weights may have dramatically different GVWRs. This is because the GVWR depends upon the vehicle's specific characteristics: suspension system, shock absorbers, axle strength, transmission, tires, seating capacity, etc. These characteristics determine, in part, a truck's intended use, and therefore can play an important role in establishing the truck's expected economic life. Moreover, each vehicle's GVWR class is incorporated in the vehicle's identification number (VIN), which is often included in the data used in this study; the unloaded vehicle weights are not so readily available. For these reasons, trucks were classified in this study by their GVWR, rather than by their unloaded weight.

More specifically, "light general purpose trucks" are defined in this report as those trucks having a GVWR of less than 33,000 pounds. The trucks examined are classified into four weight classes: trucks with a GVWR of 6,000 pounds or less (referred to in this report as Class 1 trucks); trucks with a GVWR in the range of 6,001 to 10,000 pounds (Class 2); trucks having a GVWR in the range of 10,001 to 19,500 pounds (Class 3); and trucks with a GVWR of more than 19,500 pounds but less than or equal to 33,000 pounds (Class 4).

An investigation was conducted into the relationship between unloaded truck weights and loaded weight measures. Using the Census' 1987 Truck Inventory and Use Survey, it was found that over 98 percent of business-use trucks with a reported empty weight of less than 13,000 pounds also reported an average loaded weight of 33,000 pounds or less. Thus, virtually all available observations on "light general purpose trucks" as defined by Asset Class 00.241 were included in the analysis. Of those business-use trucks with a reported empty weight of 13,000 pounds or more, 55 percent reported an average loaded weight of more than 33,000 pounds, while 38 percent had an average loaded weight of 19,500 to 33,000 pounds, and 7 percent had an average loaded weight of under 19,500 pounds. Trucks with an empty weight of 13,000 pounds or more constituted about 7 percent of the total number of business-use trucks in Class 3 and about 33 percent of business-use

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<sup>1</sup> In submitting information to the National Highway and Traffic Safety Administration (NHTSA), manufacturers must use the following GVWR classes: Class A: 3,000 pounds or less; Classes B through H: 3,001 to 10,000 pounds, at 1,000 pound increments; Class 3: 10,001 to 14,000 pounds; Class 4: 14,001 to 16,000 pounds; Class 5: 16,001 to 19,500 pounds; Class 6: 19,501 to 26,000 pounds; Class 7: 26,001 to 33,000 pounds; Class 8: 33,001 pounds and over. The U.S. Bureau of the Census, in its Truck Inventory and Use Survey, classifies trucks into either four or fourteen weight categories for reporting purposes. These categories are groupings of the NHTSA classes, although they refer to average loaded weights as reported by survey respondents rather than the assigned GVWRs.



trucks in Class 4. A significant probability thus exists that some "heavy general purpose trucks" belonging to Asset Class 00.242 were also included in the data examined in this study, particularly trucks with a GVWR above 19,500 pounds.<sup>2</sup>

### **C. Principal Findings and Recommendation**

The principal findings of this study are that trucks with a GVWR of 6,000 pounds or less have an equivalent economic life of 4.1 years and a useful life of 7.1 years. Trucks with a GVWR of 6,001 to 10,000 pounds have an equivalent economic life of 4.4 years and a useful life of 10.9 years. Trucks with a GVWR of 10,001 to 19,500 pounds have an equivalent economic life of 4.8 years and a useful life of 16.5 years. Trucks with a GVWR of 19,501 to 33,000 pounds have an equivalent economic life of 6.6 years and a useful life of 16.5 years. As stated above, these categories cover virtually all trucks included in Asset Class 00.241. Based on the adjusted relative annual investment in trucks in each weight class, an overall equivalent economic life for all trucks in Asset Class 00.241 is estimated to be 4.6 years, with a useful life of 9.4 years. If Congress wishes to retain the existing definition of light general purpose trucks, it is recommended that the class life for Asset Class 00.241 be changed from 4 years to 4.5 years.

Buses, heavy general purpose trucks with an unloaded weight of more than 13,000 pounds, tractor units, trailers and trailer-mounted containers, (i.e., vehicles defined in Asset Classes 00.23, 00.242, 00.26, and 00.27) were not expressly examined in this study, and no inference can be made of their equivalent economic lives from the findings of this report.

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<sup>2</sup>This fact was taken into account by adjusting the investment weights used to generate a single overall economic equivalent life for "light general purpose trucks" in Asset Class 00.241. The possible inclusion of heavy trucks belonging to Asset Class 00.242 in the analysis of Classes 3 and 4, however, was unavoidable.

## Chapter II. Industry Background

Trucks are important business assets. According to the Bureau of Economic Analysis (BEA), in 1989 U.S. business spent \$36.5 billion on the purchase of new trucks, trailers, and buses. While BEA does not identify trucks separately from buses and trailers, OTA estimates that nearly 80 percent of the BEA total (\$28.9 billion) was spent on trucks alone (including tractor-trailer combinations). Slightly more than half (52.2 percent) of this latter figure was spent on trucks with a gross vehicle weight of 10,000 pounds or less. Business new truck purchases accounted for nearly one-half of total domestic new private truck sales, and about seven percent of total business investment in new equipment. Table 1 shows 1989 investment in new business-use trucks by gross vehicle weight class.

GVWR Class	Number of Vehicles	Acquisition Cost	Percentage Distribution	
			Number	Cost
6,000 or less	693	10.3	48.3	35.6
6,001-10,000	436	4.8	30.4	16.6
10,001-19,500	51	0.7	3.6	2.4
19,501-33,000	123	4.5	8.6	15.6
More than 33,000	130	8.6	9.1	29.9
<b>Total</b>	1,434	28.9	100.0	100.0

Sources: OTA estimates based on data from Bureau of Economic Analysis, Motor Vehicle Manufacturers Association, and U.S. Bureau of the Census.

As noted in Table 1, trucks with a GVWR of 10,000 pounds or less dominate the number of business purchases of new trucks. Within this weight class are a wide variety of body styles that are designed for carrying passengers, cargo, or both. Such vehicles include four-wheel drive utilities (e.g., Ford Bronco, Chevrolet Blazer, etc.), vans, mini-vans, station wagons built on a truck chassis (e.g., GMC Suburban, Jeep Wagoneer, etc.), compact and conventional pick-up trucks, and other light-duty trucks. Most of these truck types are used by both households and businesses. According

to the Census Bureau's 1987 Truck Inventory and Use Survey (1987 TIUS), in terms of aggregate mileage driven, utility vehicles, vans, and pick-up trucks as a group were used about one-third for business purposes and about two-thirds for household purposes.

In OTA's study of the depreciation of business-use passenger cars, a significant difference in economic lives was found among cars held in fleets of 10 or more and all other ("non-fleet") business-use passenger cars. This difference was attributed primarily to differences in intensity of use, since fleet cars appeared to be driven on average nearly twice as many miles per year as non-fleet passenger cars.<sup>1</sup> While evidence from the 1987 TIUS suggests that business-use light trucks in fleets are driven somewhat more intensively than non-fleet trucks, the difference does not appear to be as significant as for passenger cars.<sup>2</sup> Thus, no distinction was made in this study between fleet and non-fleet status.

Trucks are distinguished from automobiles in this study primarily on the basis of information contained in vehicle identification numbers (VINs). In general, any vehicle identified in its VIN as a truck (whether complete or incomplete) or a multipurpose vehicle is regarded as a "truck." This definition generally includes sport utility vehicles and mini-vans, which are considered by some to be more similar in function to passenger automobiles than to trucks. These vehicles constitute about 10 percent of the business-use trucks in Classes 1 and 2, although their shares of current investment may be higher.<sup>3</sup>

Under safety standard regulations issued by the National Highway and Traffic Safety Administration (NHTSA), "multipurpose passenger vehicles" are distinguished from "passenger cars" by being constructed either on a truck chassis or with special features for occasional off-road operation. "Trucks" are defined as being designed for the transportation of property or special purpose equipment (49 CFR, sec. 571.3). Most passenger vans and sport utility vehicles would be considered as "passenger automobiles" under NHTSA's fuel economy standards regulations.

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<sup>1</sup> It was found that fleet vehicles (passenger cars held by owners of 10 or more cars) were driven on average about 25,000 miles per year, while non-fleet vehicles were driven on average only 15,000 miles per year.

<sup>2</sup> According to the 1987 TIUS, business-use trucks in Classes 1 and 2 held in fleets of 20 or more were driven on average about 16,000 miles per year; those held by businesses owning less than 20 trucks were driven on average 13,000 miles per year.

<sup>3</sup> Vans (excluding mini-vans and multi-stop or step vans) and pick-up trucks constitute roughly 80 percent of business-use trucks having a GVWR of 10,000 pounds or less. Pickups, vans, mini-vans, station wagons on a truck chassis, and sport utility vehicles constitute almost 97 percent of Class 1 business-use trucks. These data come from an analysis of the 1987 Census Truck Inventory and Use Survey.

However, those regulations cover most pick-up trucks as well. "Listed property" under section 280F and "passenger vehicles" subject to the luxury tax under section 4001 of the Internal Revenue Code generally include trucks, vans, and utility vehicles, as long as they have a gross vehicle weight of 6,000 pounds or less and are manufactured primarily for use on public streets, roads, and highways. Regulations proposed under section 4001 explicitly state that the term "truck or van" includes sport utility vehicles and mini-vans. The section 4064 gas "guzzler tax" does not cover sport utility vehicles and pick-up trucks, but does cover "passenger automobiles" as defined under the NHTSA fuel economy standards regulations.

## **Chapter III. Data Collection and Estimation Methods**

### **A. Public meetings**

Public meetings were held at the Treasury Department in January and March of 1990 to determine the scope of the passenger car and light truck study, discuss the study design and general methodology, and describe the kind of data needed for the study. The first public meeting was announced in the Federal Register on December 21, 1989, and invitations were extended to each of the major trade associations representing different sectors of the business-use car and light truck industry. Invitations were also sent to executives of the largest leasing and rental firms in the United States.

At these meetings, it was determined that the scope of the study should include all automobiles and light- and medium-duty trucks designed for use over-the-road and used in a trade or business. This coverage was generally understood by Treasury and industry participants to include both fleet and non-fleet vehicles, and vehicles that are either leased or owned by their users. Although no attempt was made to formally define "light trucks", data collection for trucks was limited to all those with a GVWR of 33,000 pounds or less.

Unlike many of the previous depreciation studies conducted by OTA, no survey of the industry was conducted or proposed. Instead, data were solicited directly from a limited number of owners of business-use vehicles based on vehicle specifications that were proposed and developed at the public meetings. This procedure was adopted because of the relatively short time frame granted by the Congress for completion of this study, and because of the availability of machine-readable data from several of the firms that agreed to participate in the study.

### **B. Description of the Data**

Firms participating in the study were asked to provide OTA with detailed data on certain characteristics of cars and light general purpose trucks either disposed of during the last few years or remaining in their inventory at the time the data were provided. Each observation in each data set was to include, at a minimum, the vehicle's Vehicle Identification Number (VIN), original acquisition cost, the month and year of acquisition, and, in the case of dispositions, the proceeds (net of refurbishing costs), and the month and year of disposition. Some data sets also included the type of disposition and the mileage of the vehicles at disposition. All of the data were received by OTA from May through August of 1990.

<b>Table 2. Distribution of Data Observations By Type of Firm and Analytical Purpose</b>		
<b>Type of Firm</b>	<b>Analytical Purpose</b>	
	<b>Estimation of Age-Price Profile</b>	<b>Estimation of Sales Distribution</b>
Leasing Firms	97.2%	97.3%
Private Fleets	2.7%	2.7%
Non-Fleet Trucks	0.1%	0.0%
<b>Total Observations</b>	<b>33,470</b>	<b>189,283</b>

Data for light general purpose trucks were received from five leasing firms and four truck fleet owners.<sup>1</sup> A data set covering a small number of independent owner-operators was also made available to OTA. In addition, a few observations were also obtained from an analysis of a small sample of IRS returns covering non-fleet truck dispositions. Truck data from three of the leasing firms, from two of the private fleets, and from the non-fleet sources were used.<sup>2</sup> In total, there were about 112,000 total usable observations. Table 2 shows the distribution of observations by type of firm and analytical purpose. It is apparent that data from the leasing companies dominate the usable data, and thus significantly influence the results presented. Nevertheless, the available data do not

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<sup>1</sup> Except for three of the leasing firms and one fleet owner who provided data directly to OTA, the data were first collected from the participating firms and examined by Price Waterhouse, which in turn provided the data, together with a paper summarizing the results of their preliminary analysis, to OTA. This mechanism was chosen by the industry in order to maintain the confidentiality of several of the companies participating in the study, which were not revealed to OTA.

<sup>2</sup> Data provided by one of the leasing firms and one of the private fleet firms were not analyzed because the data were incomplete. However, due to the large sample of complete data, these firms were not asked to resubmit their information.

provide any strong evidence in favor of the view that leasing firm data differ in a systematic manner from the data obtained from non-leasing firms. Table 2 also shows that estimates based on data from non-leasing firms would reflect almost exclusively the prices and retirements from truck fleets.<sup>3</sup>

### C. Structuring the Data

Although the depreciation of trucks may vary by vehicle type and whether the vehicle is designed for passengers or cargo, preliminary analysis of the data suggested that aggregation of the data into four GVWR classes would make the analysis more manageable, and yet capture the more significant differences in intensity of usage. Trucks were classified to the following categories: Class 1 - trucks having a GVWR less than or equal to 6,000 pounds; Class 2 - trucks with a GVWR of more than 6,000 but less than or equal to 10,000 pounds; Class 3 - trucks with a GVWR of more than 10,000 pounds but less than or equal to 19,500 pounds; and Class 4 - trucks with a GVWR of more than 19,500 pounds but less than 33,000 pounds.

Equivalent economic lives, taking into account truck prices, retirements, and sales by age, were derived (as described below and in Appendix B) for trucks in each weight class. A light truck retirement probability distribution was obtained from a previous study of vehicle scrappage rates observed over the period 1978 to 1988.<sup>4</sup> These rates were available through age 25. At that age, about 22 percent of trucks were still registered. For the purpose of this study, all of those remaining trucks were assumed to be retired in year 26. This truncation of the retirement curve does not affect the final estimate of equivalent life, because of the additional assumption that the value of those remaining trucks reaches zero at 26 years of age. The retirement curve used indicates a median retirement age of 16.0 years and a mean age at retirement of 16.5 years.<sup>5</sup>

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<sup>3</sup> According to the 1987 TIUS, less than three percent of trucks in business use with a GVWR of 33,000 pounds or less are operated in fleets of more than 100 trucks. About 10 percent are operated in fleets of more than 20 trucks, while one-half of business-use trucks are operated in small fleets containing between 2 and 19 trucks. About 39 percent belong to firms operating only a single truck. Fleets of ten or more trucks, however, account for about 50 percent of new investment in business-use light trucks.

<sup>4</sup> Scrappage rates by age were produced by Shaw-Pin Miaou, "Study of Vehicle Scrappage Rates," Oak Ridge National Laboratory, Oak Ridge, TN, August 1990. These rates were reported in Stacy C. Davis and Patricia S. Hu, *Transportation Energy Data Book: Edition 11*, Oak Ridge National Laboratory, Oak Ridge TN, January 1991.

<sup>5</sup> The estimate of mean age at retirement is affected by the assumption that all trucks are retired at age 26. The median retirement age, however, is independent of that assumption.

Observations from all data sources were pooled in order to estimate the age-price curve and age-sales probability curve for each weight category. Data for these curves were generally available to about age ten for each GVWR class. Only observations representing bona fide arms-length sales were used to produce estimates of the age-price curves. Sales to lessees or trade-in prices were disregarded. The price curves were obtained by first adjusting observed prices for the effects of inflation; the overall consumer price index for urban workers was used in this regard. Sales prices were then expressed as ratios of the original acquisition costs, and these normalized prices were averaged at each age to obtain a curve showing the mean relative price as a function of age. These mean prices were extrapolated in a linear fashion for ages where price observations were insufficient, reaching zero (by assumption) at age 26.<sup>6</sup> The arbitrary nature of this extrapolation is not important, however, due to the discounting and the small value changes involved at ages above ten years.<sup>7</sup>

All sales data were used in estimating the probability of truck sales at each age. This curve was obtained by dividing the number of sales at each age by the number of assets in the sample examined that had remained in business use to at least that age. The probability of truck sales was set equal to zero for the years where fewer than five observations were available. No further smoothing of either the price curve or sales distribution curve was employed.

All sales of trucks in Classes 3 and 4 were assumed to be to other businesses. For trucks in Class 2, 75 percent of sales were assumed to be to other businesses, while 25 percent of sales were assumed to be to households. For trucks in Class 1, 50 percent of sales were assumed to be to other businesses and 50 percent to households. These repurchase percentages were assumed to be independent of the age of the truck.<sup>8</sup>

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<sup>6</sup> For each truck class at each age, the observed mean price was adopted as long as long as at least five observations were available at that age. This criterion generally could not be met for ages beyond ten or eleven years. Normally, the standard deviations of the mean price estimates were well under one percent, although higher values were often experienced at age one and at ages above eight years.

<sup>7</sup> Assuming that prices trail off to a five percent minimum salvage value, instead of a zero value, increases the estimated equivalent economic life for all light trucks by less than one-tenth of a year.

<sup>8</sup> Analysis indicated that the estimates of equivalent economic lives are only mildly sensitive to these assumptions. For example, raising the percentage of sales assumed to be made to other businesses from 50 percent to 75 percent for Class 1 trucks, or from 75 percent to 100 percent for Class 2 trucks, increases the estimated equivalent economic lives for these trucks by about one-tenth of a year. Assuming that all truck sales in these two classes are to households decreases the estimated equivalent economic life for Class 1 by one-tenth of a year but leaves the equivalent economic life for Class 2 trucks unchanged. However, assuming that no Class 1 trucks are sold to households increases the estimated equivalent economic life by four-tenths of a year (to 4.5 years) for Class 1 trucks.



A single weighted average equivalent economic life for all light general purpose trucks was obtained by weighting the observed characteristics (price-age and sales-age distributions and the probability of business-to-business sales) for each weight class with the observed share of 1989 investment in new general purpose light trucks for the class. The observed investment shares were adjusted to reflect the fact that some trucks in classes 3 and 4 were possibly heavy general purpose trucks with empty weights in excess of 13,000 pounds. The weighted-average characteristics were then used to obtain an overall equivalent economic life for trucks in Asset Class 00.241.<sup>9</sup>

#### **D. Equivalent Economic Lives**

As suggested in the General Explanation of the Tax Reform Act of 1986, the class life of an asset is to be determined from the decline in its value with age. This life (which for clarity has been referred to as the asset's equivalent economic life) can be either longer or shorter than its useful life (i.e., the period over which the asset provides service to business users).

For each weight category, an equivalent economic life was derived by equating the present value of the average loss in economic value over time for those trucks that remain in business use with the present value of tax deductions for those trucks in business use. The loss in economic value includes both the decline in the value of assets which remain in business use and the economic losses that are incurred upon the retirement of trucks from business use. The relevant tax deductions taken into account include both the depreciation allowances available to taxpayers, as determined by applying a straight-line schedule over the equivalent economic life, and the recognized losses resulting from sales of trucks in business use and from retirements of trucks from business use. Gains on sales and retirements are treated as negative losses.<sup>10</sup> Both change-in-value curves are discounted at a four percent annual discount rate.<sup>11</sup>

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<sup>9</sup> These average characteristics are shown in Appendix B, where they are used to illustrate the methods employed to compute equivalent economic lives.

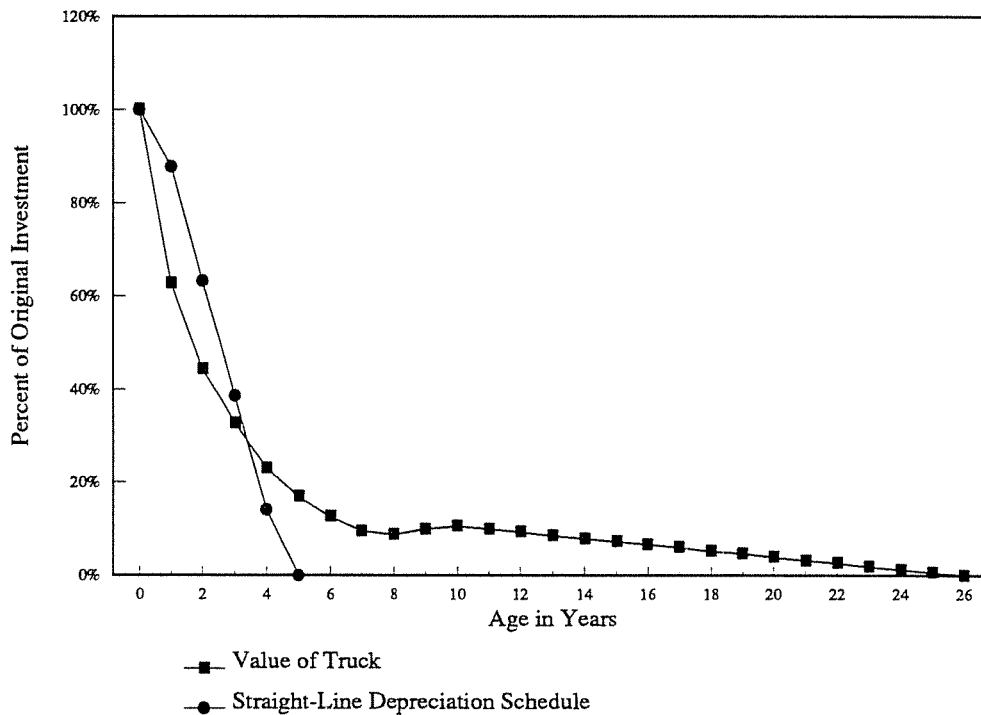
<sup>10</sup> In the analysis, salvage values available upon the retirement of trucks are assumed to be zero. This assumption is immaterial. Salvage value affects the recovery of capital equally under economic depreciation accounting and under tax accounting. It therefore has no direct impact on the value of the estimated equivalent economic life. Salvage can have an indirect impact through an influence on used asset prices, however.

<sup>11</sup> The estimated equivalent economic lives are only mildly dependent upon the actual discount rate chosen. For example, halving the discount rate to two percent raises the estimated equivalent economic life for all trucks by less than one-tenth of a year. Doubling the rate to eight percent lowers the estimated equivalent economic life by two-tenths of a year.

The straight-line tax depreciation allowances are calculated over a recovery period equal to the equivalent economic life, starting with the year of acquisition, with the same recovery period for both new and used trucks. However, both straight-line and economic depreciation are considered only up to the truck's date of sale or retirement. See Appendix B for a more detailed description of the analysis.

## Chapter IV. Results of the Analysis

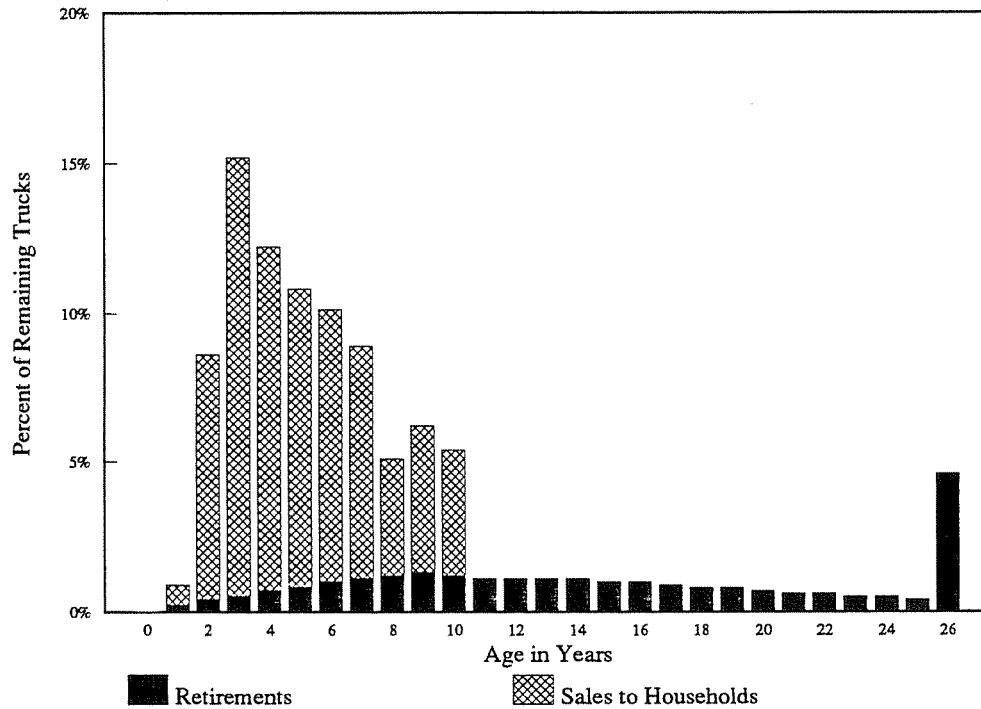
This chapter presents the results of applying the methods described in Chapter III to obtain equivalent economic lives for trucks in each of the four weight categories and the economic life for all trucks in Asset Class 00.241. In addition, the estimated average useful life of trucks in each weight category and the method of depreciation used for financial accounting purposes by the participating firms are noted.



**Figure 1.** Age-price profile and straight-line depreciation schedule for trucks with a GVWR of 6,000 pounds or less (Class 1).

Figure 1 illustrates the relationship between the observed age-price profile and the adjusted basis obtained from the use of a straight-line depreciation schedule with a recovery period of 4.1 years (the estimated equivalent economic life) for trucks with a GVWR of 6,000 pounds or less. The age-price profile drops rapidly over the first year of service, and then at successively slower rates over ages two through eight. A small increase in the average price occurs between ages eight

and ten, but the absolute amount of economic depreciation is constant thereafter by assumption.<sup>1</sup> The straight-line depreciation schedule underlying the tax basis curve in Figure 1 allows for a half-year allowance in the first taxable year, and reaches zero during the fifth taxable year.

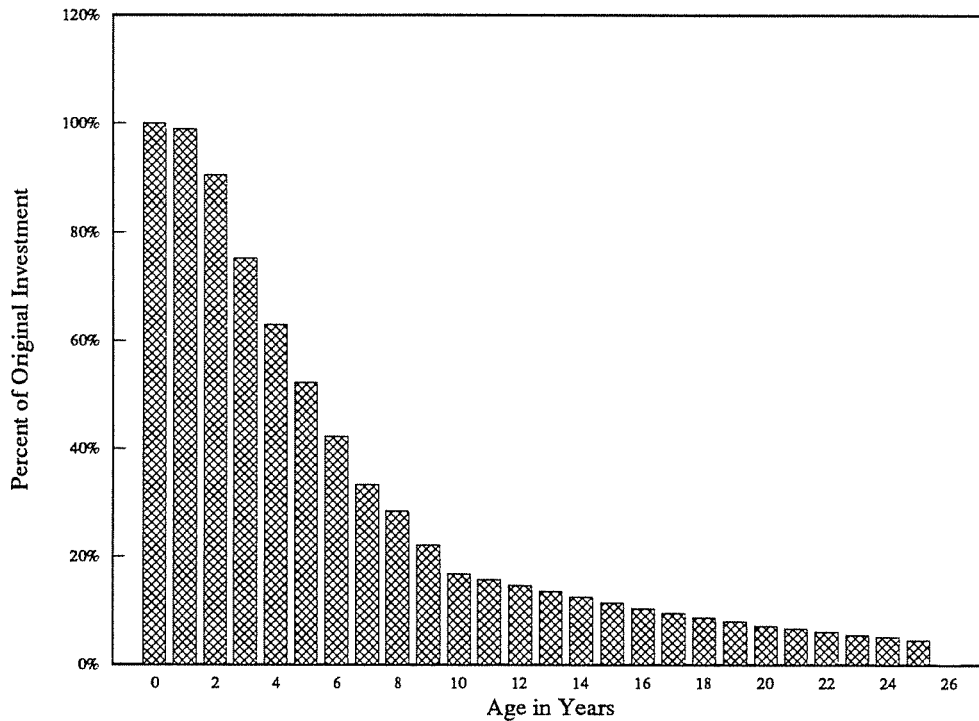


**Figure 2.** Disposition probabilities (retirements and sales to households), by age of truck, for trucks with a GVWR of 6,000 pounds or less (Class 1).

The depreciation of trucks remaining in business use does not reflect the total source of economic loss; losses incurred upon retirement of trucks in business use must also be considered in determining the equivalent economic life. Also, since sales of trucks also trigger the recognition of tax losses or gains, these must also be taken into account.<sup>2</sup>

<sup>1</sup>Price observations were either few or nonexistent for ages above ten years for trucks in this weight class.

<sup>2</sup>Because the adjusted economic basis equals the market value when economic depreciation is used, under this method of accounting no gains or losses are realized when trucks are sold.



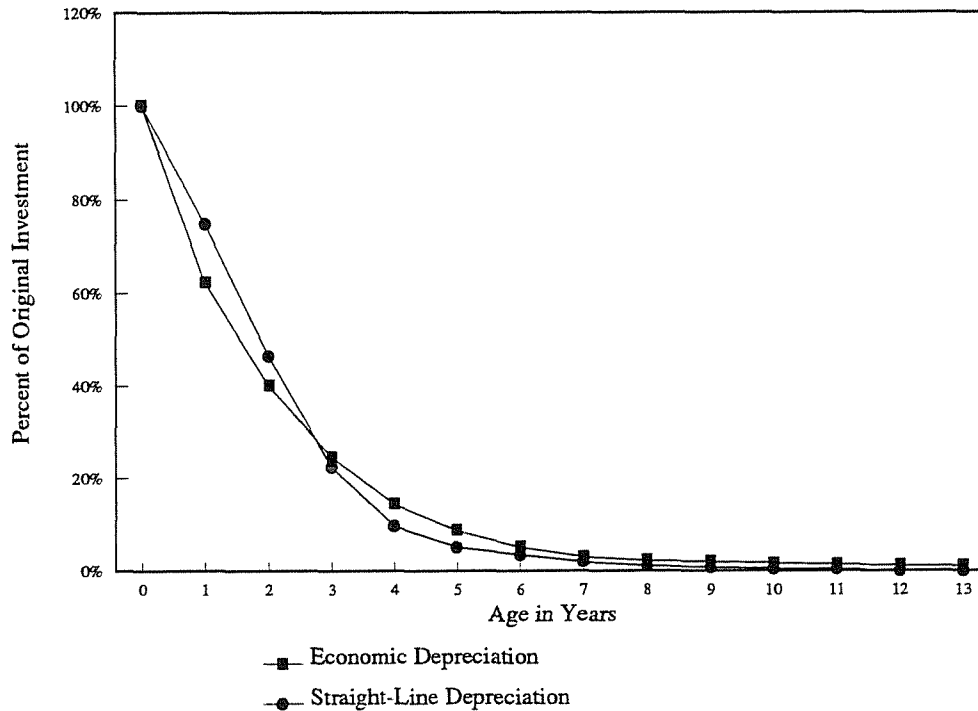
**Figure 3.** Fraction of initial investment in trucks that remains in business use, by age of truck, for trucks with a GVWR of 6,000 pounds or less (Class 1).

The estimated disposition frequencies (the fraction of remaining business-use Class 1 trucks at each age that are either retired or sold to households) are shown in Figure 2.<sup>3</sup> As described in Chapter 3, no sales are assumed to occur after age 10 (the oldest age at which the number of observations was five or more), and all trucks remaining in business use at age 25 were assumed for convenience to be retired at age 26. The resulting fraction of trucks with a GVWR of 6,000 pounds or less remaining in business use at each age are shown in Figure 3.

As is discussed more fully in Appendix B, investment may be recovered in several ways in addition to depreciation allowances. These include losses upon retirement of business-use trucks, gain or loss realized when trucks are sold, salvage value received upon the retirement of trucks, and payments received from the sale of trucks to households. Figure 4 shows the unrecovered

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<sup>3</sup> Since one-half of business sales of Class 1 trucks are assumed to be to households, the values in Figure 2 for sales to households merely need to be doubled in order to obtain the probability of total truck sales at each age.



**Figure 4.** Unrecovered investment value as a fraction of the original investment, by age of truck, based on economic depreciation and on straight-line depreciation, for trucks with a GVWR of 6,000 pounds or less (Class 1).

investment, measured as a fraction of the original investment in new trucks, by age of truck, based on the use of economic depreciation and straight-line depreciation (and the recognition of losses and gains) for trucks in this weight category. The two curves coincide at zero at age 26, when the last trucks are assumed to be retired. The equivalent economic life is determined by equating the present values (discounted at a 4 percent rate) of the annual increase in recovered investment under the two methods shown in Figure 4.

Table 3 lists the estimated equivalent economic lives by weight class, as well as the overall equivalent economic life for trucks in Asset Class 00.241. These results show a positive relationship between the estimated equivalent economic lives and gross vehicle weight; the equivalent economic lives range from 4.1 years for Class 1 trucks to 6.6 years for Class 4 trucks. This is partly due to differences in price profiles and sales distributions and partly due to the fact that lighter trucks are

<b>GVWR Class</b>	<b>Economic Equivalent Life</b>	<b>Average Useful Life</b>
6,000 or less	4.1	7.1
6,001-10,000	4.4	10.9
10,001-19,500	4.8	16.5
19,501-33,000	6.6	16.5
Asset Class 00.241	4.6	9.4

also sold to households. It may also reflect the fact that observations used for analyzing Classes 3 and 4 may include some heavy general purpose trucks.<sup>4</sup> An overall equivalent economic life for trucks in Asset Class 00.241 was estimated to be 4.6 years.

In addition to the equivalent economic lives, Congress has expressed an interest in the useful lives of the assets studied. If the useful life is taken to be the period the trucks are used for business purposes (regardless of the number of owners), the answer obtained is somewhat dependent upon the assumed fraction of trucks sold that are purchased by households. It also is somewhat sensitive to the assumption that all trucks remaining in use at age 25 are retired during the following year. Based on the values of the repurchase percentages assumed for each weight class, useful lives for trucks in each weight class, as well as an overall weighted average useful life for trucks in Asset Class 00.241, may be obtained. These useful lives are noted in Table 3.<sup>5</sup> Since no sales for personal use are presumed to occur for trucks with a GVWR greater than 10,000 pounds, the useful life equals the mean retirement age for trucks in Classes 3 and 4.

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<sup>4</sup>In addition to the categories shown in Table 3, an equivalent economic life was computed separately for multipurpose vehicles with a GVWR of less than 6,000 pounds. These vehicles are comprised mainly of sport utility vehicles and mini-vans; they constitute about 51 percent of the sample of Class 1 trucks. Their equivalent economic life was estimated to be 4.1 years, indicating little difference between multipurpose vehicles and light pickups and vans.

<sup>5</sup>The useful life for Class 1 multipurpose vehicles was estimated to be 6.3 years.

Congress was also interested in the method used to depreciate the assets for financial accounting purposes. All of the companies which reported their methods of accounting for trucks used the straight-line method of depreciation. The recovery periods ranged from 3 to 8 years, with an investment-weighted average recovery period of 4.4 years.



## Chapter V. Conclusions and Recommendation

The principal findings of this study are that trucks with a GVWR of 6,000 pounds or less have an equivalent economic life of 4.1 years, while trucks with a GVWR of between 6,000 and 10,000 pounds have an equivalent economic life of 4.4 years. Trucks with a GVWR between 10,000 and 19,500 pounds have an equivalent economic life of 4.8 years, and those with a GVWR of between 19,500 and 33,000 pounds have an equivalent economic life of 6.6 years. These categories cover virtually all vehicles included in Asset Class 00.241 (trucks having an unloaded weight of less than 13,000 pounds). The values for truck classes 3 and 4 may also reflect the influence of some heavy general purpose trucks with an unloaded weight of 13,000 pounds or more, which are currently classified to Asset Class 00.242. The useful lives of the trucks ranged from 7.1 years (for Class 1 trucks) to 16.5 years (for Class 3 and Class 4 trucks). The overall useful life for light general purpose trucks is 9.4 years.

When the estimated equivalent economic lives for each weight class are combined by weighting the results for each class by the adjusted share of business investment in new trucks in that class, a single overall equivalent economic life of 4.6 years is obtained. Treasury thus recommends that, if the current definition of light general purpose trucks is retained, the class life for Asset Class 00.241 be changed from 4 years to 4.5 years. Tractor units, trailers, trailer-mounted containers, tractor-trailer combinations, and heavy general purpose trucks with an unloaded weight of more than 13,000 pounds (i.e., trucks in Asset Classes 00.242, 00.26, and 00.27) were not expressly examined in this study, and no recommendation is thus made in this report regarding the appropriate class life for such trucks.

Under current law, this recommendation, if adopted, would have no effect on the depreciation deductions claimed by taxpayers for light general purpose trucks. Section 168(e)(3)(B)(i) assigns automobiles and light general purpose trucks to the five-year property recovery class, regardless of their class lives. If this provision were repealed, light trucks would be assigned to the MACRS three-year property recovery class if the recommended change in the class life were not enacted, and to the MACRS five-year property recovery class if the recommendation were enacted.<sup>1</sup> Likewise, under Section 168(g)(3)(D), the alternative depreciation system recovery period for automobiles and light general purpose trucks is currently five years, regardless of their class lives.

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<sup>1</sup>The three-year property recovery class generally includes property with a class life of four years or less. The five-year property recovery class includes property with a class life of greater than four years but less than ten years.

If this provision were repealed, taxpayers using the alternative depreciation system could depreciate their light trucks over four years (based on the current law class life) or over 4.5 years (based on the recommended class life).

## **Appendix A. The Mandate for Depreciation Studies**

### **Exhibit 1.**

#### **Section 168(i)(1)(B) of the Internal Revenue Code as Revised by the Tax Reform Act of 1986**

##### **(i) Definitions and Special Rules.**

For purposes of this section--

##### **(1) Class Life.**

(B) Secretarial authority. The Secretary, through an office established in the Treasury--

- (i) shall monitor and analyze actual experience with respect to all depreciable assets, and
- (ii) except in the case of residential rental property or nonresidential real property--
  - (I) may prescribe a new class life for any property,
  - (II) in the case of assigned property, may modify any assigned item, or
  - (III) may prescribe a class life for any property which does not have a class life within the meaning of subparagraph (A).

Any class life or assigned item prescribed or modified under the preceding sentence shall reasonably reflect the anticipated useful life, and the anticipated decline in value over time, of the property to the industry or other group.

### **Exhibit 2.**

#### **Section 168(i)(1) of the Internal Revenue Code as Revised by the Technical and Miscellaneous Revenue Act of 1988 and the Revenue Reconciliation Act of 1990.**

##### **Definitions and Special Rules.**

For purposes of this section--

- (1) **Class Life.** Except as provided in this section, the term "class life" means the class life (if any) which would be applicable with respect to any property as of January 1, 1986, under subsection (m) of section 167 (determined without regard to paragraph (4) and as if the taxpayer had made an election under such subsection). The Secretary, through an office established in the Treasury, shall monitor and analyze actual experience with respect to all depreciable assets. The reference in this paragraph to subsection (m) of section 167 shall be treated as a reference to such subsection as in effect on the day before the date of the enactment of the Revenue Reconciliation Act of 1990 [11/5/90].

**Exhibit 3.**

**Provisions for Changes in Classification from the General Explanation of the Tax Reform Act of 1986 (pp. 103-104)**

The Secretary, through an office established in the Treasury Department is authorized to monitor and analyze actual experience with all tangible depreciable assets, to prescribe a new class life for any property or class of property (other than real property) when appropriate, and to prescribe a class life for any property that does not have a class life. If the Secretary prescribes a new class life for property, such life will be used in determining the classification of property. The prescription of a new class life for property will not change the ACRS class structure, but will affect the ACRS class in which the property falls. Any classification or reclassification would be prospective.

Any class life prescribed under the Secretary's authority must reflect the anticipated useful life, and the anticipated decline in value over time, of an asset to the industry or other group. Useful life means the economic life span of property over all users combined and not, as under prior law, the typical period over which a taxpayer holds the property. Evidence indicative of the useful life of property, which the Secretary is expected to take into account in prescribing a class life, includes the depreciation practices followed by taxpayers for book purposes with respect to the property, and useful lives experienced by taxpayers, according to their reports. It further includes independent evidence of minimal useful life -- the terms for which new property is leased, used under a service contract, or financed -- and independent evidence of the decline in value of an asset over time, such as is afforded by resale price data. If resale price data is used to prescribe class lives, such resale price data should be adjusted downward to remove the effects of historical inflation. This adjustment provides a larger measure of depreciation than in the absence of such an adjustment. Class lives using this data would be determined such that the present value of straight-line depreciation deductions over the class life, discounted at an appropriate real rate of interest, is equal to the present value of what the estimated decline in value of the asset would be in the absence of inflation.

Initial studies are expected to concentrate on property that now has no ADR midpoint. Additionally, clothing held for rental and scientific instruments (especially those used in connection with a computer) should be studied to determine whether a change in class life is appropriate.

Certain other assets specifically assigned a recovery period (including horses in the three-year class, qualified technological equipment, computer-based central office switching equipment, research and experimentation property, certain renewable energy and biomass properties, semiconductor manufacturing equipment, railroad track, single-purpose agricultural or horticultural structures, telephone distribution plant and comparable equipment, municipal waste-water treatment plants, and municipal sewers) may not be assigned a longer class life by the Treasury Department if placed in service before January 1, 1992. Additionally, automobiles and light trucks may not be reclassified by the Treasury Department during this five-year period. Such property placed in service after December 31, 1991, and before July 1, 1992, may be prescribed a different class life if the Secretary has notified the Committee on Ways and Means of the House of Representatives and the Committee on Finance of the Senate of the proposed change at least 6 months before the date on which such change is to take effect.

## **Appendix B. Determination of Equivalent Economic Lives**

This appendix describes the calculations used in this study to estimate an equivalent economic life for light general purpose trucks. As an aid to the reader, the set of data used to determine the overall equivalent economic life for light trucks has been presented here in order to illustrate the more formal algebra. Results of the calculations using these data are reported in the tables at the end of this appendix.

The computations described assume the availability of certain data. These data include the expected relative prices for trucks remaining in business use by age (the age-price profile), the expected salvage values of retired trucks by age, the probability of retirement of business-use trucks by age (the retirement distribution), the probability of business-use truck sales by age (the gross sales distribution), and the probability that business-use trucks sold will be purchased for business purposes (the repurchase percentage). In this study, the age-price profile and the gross sales distribution are obtained from data provided by the participating firms. The retirement probability is taken from Davis and Hu (1991), while a zero salvage value and fixed repurchase percentage (which vary by weight class) are assumed. In keeping with the dictates of the General Explanation of the Tax Reform Act of 1986, the observed truck prices are adjusted for general inflation prior to their incorporation into the analysis.

The analysis of the depreciation of passenger cars focused on the relative number and relative value of business-use passenger cars as continuous functions of a single variable -- the age of the cars. Because used trucks as well as new trucks are acquired by businesses, in this study a second variable -- the age of the truck at acquisition -- is needed. For convenience, a discrete rather than continuous time framework is used. Thus, the analysis in this study utilizes matrices which specify, among other things, the number of trucks remaining in business use, business-use truck retirements, and business-use truck sales for trucks of a given age that were acquired at the same or an earlier age.

OTA has interpreted the General Explanation as defining the equivalent economic life as that life which, when used as the recovery period for depreciation purposes (in association with the straight-line depreciation method, a half-year depreciation timing convention, and other applicable tax rules), equates the present value of the tax deductions associated with the business use of a group of assets with the present value of the loss in the group's economic value while in business use. This definition takes as given the current law treatment of asset retirements and sales; in particular, it relies on the principle that tangible asset sales and retirements are recognized as taxable events,

and that any gains or losses associated with these taxable events enter together with depreciation allowances into the taxable income of the asset owner.<sup>1</sup> It also relies on the principle that a truck sold from one business to another does not carry over its adjusted tax basis. Instead, the new owner adopts his or her own cost as the new depreciable basis of the truck; the depreciation schedule for the used truck is the same as that for new trucks. Thus, a truck that is sold once or twice during its lifetime will have a different pattern of tax deductions associated with it than would an identical truck that has been held entirely by a single owner.

Constructing the Data Matrices

The number of trucks in business use at the beginning of an accounting period is designated as  $N(t, v)$ , where  $t$  refers to the actual physical age of the trucks in the account, and  $v$  refers to the age at which the trucks were most recently acquired.<sup>2</sup> Thus,  $N(0, 0)$  refers to an initial investment in new trucks at the beginning of some given time period.  $N(1, 0)$  refers to those trucks purchased as new assets in the prior period that were neither retired from use nor sold before the end of that period.  $N(1, 1)$  refers to one-period old trucks that were sold at the end of the initial period and purchased by another business.

Using this notation, the business-use history of the initial truck investment,  $N(0, 0)$ , can be represented by the following matrix:

$$N(t, v) = \begin{pmatrix} N(0, 0) & 0 & \dots & \dots \\ N(1, 0) & N(1, 1) & 0 & \dots \\ N(2, 0) & N(2, 1) & N(2, 2) & \dots \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ N(m, 0) & N(m, 1) & N(m, 2) & \dots \end{pmatrix}.$$

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<sup>1</sup> This assumes that taxpayers account separately for each truck, rather than use general asset accounts.

<sup>2</sup> Trucks are assumed to be placed in service in the middle of the taxable year. Accounting periods for the analysis, therefore, run from the middle of each taxable year to the middle of the following taxable year. Economic depreciation, sales, and retirements are assumed to occur uniformly over each accounting year. Tax depreciation allowances were are assumed to occur uniformly over each taxable year.

The passage of time implies a movement from one row to the next in  $N(t, v)$ . Movement down a particular column traces the number of trucks held in established depreciation accounts. The transfer of a truck from one owner to another means a shift of a truck to the diagonal element lying in a column to the right. For example, the sale of a truck from cell  $N(1, 0)$  implies that  $N(2, 0)$  will be at least one less than  $N(1, 0)$  and that  $N(2, 2)$  will be increased by one. In this matrix,  $m$  designates the maximum age that a business-use truck may reach. Consequently, the order of the matrix is  $(m + 1 \times m + 1)$ . The last row (and column) of this matrix will be comprised of all zeros.

Given the diagonal elements of  $N(t, v)$ , the probabilities of truck retirements and sales will determine the values taken by the lower left-hand off-diagonal elements.<sup>3</sup> Let  $R(t, v)$  and  $S(t, v)$  designate the number of trucks expected to be retired and sold, respectively, during the  $t$ 'th period and which were most recently acquired at age  $v$ . Then,

$$N(t, v) = N(t - 1, v) - R(t, v) - S(t, v), \quad t > v.$$

The incidence of truck retirements and sales are assumed to be a function solely of their age. Let  $r(t)$  be the probability that a truck of age  $t - 1$  will be retired before reaching age  $t$ . Then,

$$\begin{aligned} R(t, v) &= r(t) \times N(t - 1, v), & t > v \\ &= 0, & t \leq v. \end{aligned}$$

Similarly, let  $s(t)$  represent the probability that an asset of age  $t - 1$  which is not retired before age  $t$  will be sold during the following period. Then,

$$\begin{aligned} S(t, v) &= s(t) \times [1 - r(t)] \times N(t - 1, v), & t > v \\ &= 0, & t \leq v. \end{aligned}$$

It follows that

$$N(t, v) = [1 - s(t)] \times [1 - r(t)] \times N(t - 1, v), \quad t > v.$$

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<sup>3</sup>The matrix elements above the diagonal are zero by definition.

The diagonal elements,  $N(t, t)$ , are determined by the probabilities associated with the purchase of used trucks by business. The analysis assumes that (i) used trucks purchased for business purposes are bought only from other businesses, and (ii) the probability of a business-to-business sale is dependent only upon the age of the truck.<sup>4</sup> Let the fraction of trucks sold that are purchased for business use be represented by  $b(t)$ . Then,

$$N(t, t) = b(t) \times S(t),$$

where  $S(t)$  is the total number of sales of trucks of age  $t$  (i.e., the sum over  $v$  of  $S(t, v)$  for  $v < t$ ). Thus, given the initial number of new trucks,  $N(0, 0)$ , and the distributions,  $r(t)$ ,  $s(t)$ , and  $b(t)$ , the complete  $N(t, v)$ ,  $R(t, v)$ , and  $S(t, v)$  matrices can be computed.

The number of trucks remaining in business use at each age,  $N(t)$ , may be obtained by calculating the row sums of  $N(t, v)$ , i.e., by taking the sum over  $v$  of  $N(t, v)$ . Similarly, the number of business truck retirements by age,  $R(t)$ , and of gross business truck sales by age,  $S(t)$ , are obtained from the row sums of  $R(t, v)$  and  $S(t, v)$ , respectively. Used truck purchases by age,  $U(t)$ , are zero for  $t = 0$  and equal to the diagonal elements,  $N(t, t)$ , for  $t > 0$ , while net truck sales to households,  $H(t)$ , are equal to the difference between  $S(t)$  and  $U(t)$ . The first column of  $N(t, v)$  represents the number of remaining trucks that were purchased as new trucks, while the number of trucks remaining at each age that were purchased used,  $W(t)$ , can be obtained by subtracting  $N(t, 0)$  from  $N(t)$ .

The data used here to construct  $N(t, v)$ ,  $R(t, v)$ , and  $S(t, v)$  are displayed in columns (2) through (4) of Table A-1. The percentages shown are  $r(t)$ ,  $s(t)$ , and  $[1 - b(t)] \times s(t)$ , respectively. The maximum age is assumed to be 26, so that  $r(26)$  equals 100 percent. Table A-2 shows a number of the results referred to in the previous paragraph. All numbers have been rounded to the nearest integer for easier reading.

#### Calculation of Economic Loss

The calculation of the loss in economic value requires knowledge of the number of remaining trucks at each age,  $N(t)$ , and the number of retirements at each age,  $R(t)$ . Since no gains or losses are incurred on a truck sale when economic depreciation is used, sales are important in calculating the economic loss only insofar as they determine the number of used trucks of the given vintage that remain in business use. The calculation of economic loss also requires knowledge of the expected price of remaining business assets,  $P(t)$ , and of the salvage value,  $V(t)$ , that can be expected

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<sup>4</sup> A constant repurchase percentage is actually used in the analysis for this report.



to be received from a truck retirement. The hypothetical end-of-year values used in the numerical example for these variables are shown in columns (5) and (6) of Table A-1. These prices have been normalized so that the price of a new truck is unity.

The total loss in economic value is the sum of the loss in value that occurs while a truck is employed in a trade or business (economic depreciation) and the loss in value occurring when trucks are retired from business use. Economic depreciation,  $EDP(t)$ , is a straightforward function of the average number of trucks that are in business use during the prior period, times the depreciation for a representative truck:

$$EDP(t) = \frac{[N(t-1) + N(t)]}{2} [P(t-1) - P(t)], \quad t = 1 \dots m$$

$$= 0, \quad t = 0.$$

Economic loss on retirement,  $ELR(t)$ , is the product of the number of truck retirements during each period and the difference between the average expected price of trucks remaining in use and the average expected truck salvage value at that time:

$$ELR(t) = R(t) \times [P_a(t) - V_a(t)], \quad t = 1 \dots m$$

$$= 0, \quad t = 0,$$

where,

$$P_a(t) = \frac{P(t) + P(t-1)}{2}$$

and

$$V_a(t) = \frac{V(t) + V(t-1)}{2}.$$

Total loss in economic value,  $ELV(t)$ , is simply  $EDP(t) + ELR(t)$ . Its present value,  $PVELV$ , can be calculated directly as

$$PVELV = \sum_{t=0}^m \beta(t)ELV(t),$$

where  $\beta(t)$  is the relevant discount factor.<sup>5</sup> Note that the loss in economic value at time zero,  $ELV(0)$ , is equal to zero and that the loss in value occurring at the beginning of period one,  $ELV(1)$ , is discounted by a single period discount factor.

Values of economic depreciation, losses upon retirement, and total losses in value for the data set are shown in columns (2) through (4) of Table A-3.  $PVELV$  is shown at the bottom of column (4) in the row labeled "PV."<sup>6</sup> The final column of that table displays the remaining economic value at each age,  $REV(t)$ . This value declines to \$148, rather than zero, and represents the revenues obtained through sales to non-business entities.<sup>7</sup> Since there are 594 such sales, these sales have an average price equal to about 25 percent of the initial investment value. The average age of trucks sold at the time of such sales is 5.3 years.

#### Calculation of Tax Deductions and the Equivalent Economic Life

With the present value of the loss in economic value calculated, the equivalent economic life can be computed through an iterative procedure. In this procedure, a trial value is chosen, and the total tax deductions associated with the use of that life for depreciation purposes are calculated. The present value of those tax deductions is computed and compared to the present value of the loss in economic value that was previously calculated. The initial trial value is then adjusted, based on the algebraic sign of the difference in the two present values. The iteration ends when the absolute value of this difference fails to exceed some small preset tolerance value.

The first step in deriving the tax deductions associated with any given trial equivalent economic life is the calculation of the tax depreciation schedule,  $A(t)$ . In this regard, a half-year convention is employed; thus, the initial taxable year's deduction per dollar of investment,  $A(0)$ , is

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<sup>5</sup> A four percent annual discount rate was employed in the example. The resulting discounting function,  $\beta(t)$ , is shown in the last column of Table A-1.

<sup>6</sup> The present values shown in Tables A-3 and A-4 are expressed on a per asset basis; that is, they have been divided by the initial investment value,  $N(0, 0)$ .

<sup>7</sup> If positive salvage values were assumed in the analysis, this would be another source of capital cost recovery.

held to be  $0.5/L$ , where  $L$  is the class life. Scheduled allowances for subsequent taxable years are set at  $1/L$  per dollar of investment, and the final nonzero scheduled deduction is established so as to make the sum of the  $A(t)$  equal unity.<sup>8</sup>

The resulting schedule is applied separately to each column of  $N(t, v)$ , weighted by the average price element,  $P_a(t)$ . The initial deduction is available to taxpayers with respect to the initial investment in new trucks and with respect to each subsequent investment in used trucks. Thus, the diagonal elements,  $P_a(t)N(t, t)$ , are each multiplied by  $A_a(0)$ , whereas the elements one period removed from the diagonal,  $P_a(t)N(t + 1, t)$ , are each multiplied by  $A_a(1)$ , the second element from the averaged depreciation schedule. The remaining off-diagonal elements are similarly constructed. The depreciation allowances are represented by the elements of the tax depreciation matrix,  $D(t, v)$ . The sum over  $v$  of the elements of this matrix provide the total depreciation allowances available by age,  $TDP(t)$ .

Losses or gains on sales are computed from the basis matrix,  $Z(t, v)$  (whose elements indicate the remaining tax basis), the previously computed sales matrix,  $S(t, v)$ , and the retirements matrix,  $R(t, v)$ , along with the price function,  $P(t)$ , and the salvage value function,  $V(t)$ . These calculations take into account the following facts: (i) the basis of each asset differs according to when the asset was last placed in service, and (ii) since a truck's tax basis does not, in general, equal its market value, asset sales as well as retirements result in the recognition of loss or gain for tax purposes.

To compute the remaining tax basis for each truck category, the depreciation matrix,  $D(t, v)$ , is divided element-by-element by the asset matrix,  $N(t, v)$ . This result expresses the depreciation allowances on a per asset basis. Cumulative sums for each column of this result are computed and then subtracted from the column's applicable per asset average cost,  $P_a(v)$ , resulting in a matrix showing the beginning-of-period-basis per truck,  $Z(t, v)$ . In algebraic form,  $Z(t, v)$  is equal to

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<sup>8</sup>The tax basis curve shown in Figure 1 of the main text shows values at the end of each taxable or calendar year. However, tax depreciation allowances are averaged in order to correspond to the accounting periods used in the analysis. Thus, for example, the initial accounting year's tax depreciation per dollar of investment consists of the first taxable year's depreciation allowance (equal to  $0.5/L$ , where  $L$  is the equivalent economic life) plus one-half of the second taxable year's allowance ( $0.5 \times 1/L$ ) for total depreciation in the first accounting year of  $1/L$ . This averaging effect is not reflected in the tax basis curve shown in Figure 1. The averaged depreciation allowances are referred to as  $A_a(t)$

$$Z(t, v) = P_a(v) - \sum_{i=v}^{T-1} \frac{D(i, v)}{N(i, v)}, \quad t > v$$

$$= P_a(v), \quad t = v.$$

In this expression,  $T$  is the minimum of  $t$  and  $\tau$ , where  $\tau$  is the smallest value of  $t$  for which  $N(t, v) = 0$ .

The tax loss (gain) matrix,  $TLG(t, v)$ , is calculated as

$$TLG(t, v) = [Z(t, v) - P_a(t)] \times S(t, v) + [Z(t, v) - V_a(t)] \times R(t, v).$$

Sums over the columns of this matrix yield the total net tax loss (gain) by age,  $TLG(t)$ . Summing  $TDP(t)$  and  $TLG(t)$  yields total tax deductions by age,  $TDD(t)$ . The present value,  $PVTDD$ , is calculated with a formula identical to that used in calculating  $PVELV$ .

The final results from the iterative procedure for the numerical example are shown in Table A-4. The life which yields a  $PVTDD$  of equal value to  $PVELV$  is 4.6 years.<sup>9</sup> The straight-line depreciation schedule associated with this life is shown in column (2) of Table A-4.<sup>10</sup> The depreciation allowances, loss deductions, and total deductions are shown in columns (3)-(5).

Column (6) reports the remaining tax basis,  $RTB(t)$ , associated with the initial investment of \$1,000. As with the remaining economic value column in Table A-3, this series ends with \$148 of remaining value. This value represents capital investment that is recovered not through tax deductions, but through sales to non-business truck users.<sup>11</sup> The remaining tax basis is initially above the remaining economic value curve, but drops below it by year four. This implies that, after that point, truck sales will generate reportable taxable gains.<sup>12</sup>

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<sup>9</sup> The average period of business use for a truck in the example is 9.4 years, while the average retirement age for a truck is 16.5 years. Use of either the average holding period or the average retirement age as a useful life for straight-line depreciation purposes would yield a present value of tax deductions that differs, perhaps substantially, from  $PVELV$ .

<sup>10</sup> The present value of the depreciation schedule is 0.8980, well above 0.7796, the present value of the total economic loss in value. However, these values are not comparable. Only about 85 percent of the original investment outlay in the example is recovered in the form of tax deductions, and reported taxable gains offset a good portion of the depreciation deductions.

<sup>11</sup> The unrecovered investment values shown in Figure 4 in the main text reach zero at age twenty-six. Those curves were obtained by subtracting the proceeds from sales of trucks to households from the remaining values shown in the final columns of Tables A-3 and A-4.

<sup>12</sup> In the early years, the remaining tax basis exceeds the remaining economic value of the original investment. In this period, a sale generates a tax loss. It is assumed that transaction costs are significant enough to inhibit tax-motivated wash sales in tangible depreciable assets, so that the probability of sales remains unchanged.

Table A-1

Truck Prices and Retirement and Sale Probabilities by Age

Initial Investment: \$1,000  
 Period Discount Rate: 4.0 percent

Age $t$	Probability Distributions (Percent)			Prices (Normalized)		Discount Factors $\beta(t)$
	Retire- ments $r(t)$	Gross Sales $s(t)$	Net Sales $[1 - b(t)]s(t)$	Remaining Assets $P(t)$	Salvage $V(t)$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0.0	0.0	0.0	1.000	0.000	1.000
1	0.2	1.0	0.3	0.655	0.000	0.981
2	0.4	10.3	3.5	0.467	0.000	0.943
3	0.6	21.5	7.3	0.344	0.000	0.907
4	0.9	26.5	9.0	0.280	0.000	0.872
5	1.3	41.5	14.0	0.241	0.000	0.838
6	1.9	43.0	14.5	0.172	0.000	0.806
7	2.6	36.5	12.3	0.118	0.000	0.775
8	3.5	25.6	8.7	0.106	0.000	0.745
9	4.5	28.4	9.6	0.109	0.000	0.717
10	5.4	33.7	11.4	0.103	0.000	0.689
11	6.3	15.4	5.2	0.093	0.000	0.662
12	7.0	0.0	0.0	0.087	0.000	0.637
13	7.6	0.0	0.0	0.081	0.000	0.612
14	8.0	0.0	0.0	0.075	0.000	0.589
15	8.3	0.0	0.0	0.068	0.000	0.566
16	8.4	0.0	0.0	0.062	0.000	0.544
17	8.6	0.0	0.0	0.056	0.000	0.524
18	8.7	0.0	0.0	0.050	0.000	0.503
19	8.7	0.0	0.0	0.044	0.000	0.484
20	8.7	0.0	0.0	0.037	0.000	0.465
21	8.8	0.0	0.0	0.031	0.000	0.448
22	8.8	0.0	0.0	0.025	0.000	0.430
23	8.8	0.0	0.0	0.019	0.000	0.414
24	8.8	0.0	0.0	0.012	0.000	0.398
25	8.8	0.0	0.0	0.006	0.000	0.383
26	100.0	0.0	0.0	0.000	0.000	0.368

Table A-2

Retirements, Sales, and Assets Remaining in Business Use by Age of Trucks

Age <i>t</i>	Remaining Business Assets		Business Asset Retirements <i>R(t)</i>	Business Asset Sales		
	Total Assets <i>N(t)</i>	Used Assets <i>W(t)</i>		Gross Sales <i>S(t)</i>	Household Purchases <i>H(t)</i>	Business Purchases <i>U(t)</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	1000	0	0	0	0	0
1	994	7	2	10	3	7
2	956	74	4	102	35	68
3	881	193	6	204	69	135
4	795	294	8	232	78	153
5	675	385	10	326	110	216
6	566	404	13	285	96	188
7	483	383	15	201	68	133
8	426	354	17	119	40	79
9	368	319	19	115	39	76
10	308	277	20	117	40	78
11	274	249	19	44	15	29
12	255	232	19	0	0	0
13	235	214	19	0	0	0
14	217	197	19	0	0	0
15	199	181	18	0	0	0
16	182	166	17	0	0	0
17	166	152	16	0	0	0
18	152	138	14	0	0	0
19	139	126	13	0	0	0
20	127	115	12	0	0	0
21	116	105	11	0	0	0
22	105	96	10	0	0	0
23	96	88	9	0	0	0
24	88	80	8	0	0	0
25	80	73	8	0	0	0
26	0	0	80	0	0	0
Sum	-	-	406	1756	594	1162

Table A-3  
Loss in Economic Value by Age of Trucks

Age $t$	Economic Depreciation $EDP(t)$	Economic Losses on Retirements $ELR(t)$	Total Loss in Economic Value $ELV(t)$	Remaining Economic Value $REV(t)$
(1)	(2)	(3)	(4)	(5)
0	0	0	0	1000
1	344	2	346	654
2	183	2	185	468
3	113	2	115	354
4	54	2	56	297
5	29	3	31	266
6	43	3	45	221
7	29	2	31	190
8	5	2	7	183
9	-1	2	1	182
10	2	2	4	178
11	3	2	5	173
12	2	2	3	170
13	2	2	3	167
14	1	1	3	164
15	1	1	3	161
16	1	1	2	159
17	1	1	2	157
18	1	1	2	155
19	1	1	2	154
20	1	0	1	152
21	1	0	1	151
22	1	0	1	150
23	1	0	1	149
24	1	0	1	149
25	1	0	1	148
26	0	0	0	148
Sum	817	36	852	-
PV	0.7536	0.0260	0.7796	-

Table A-4

Tax Deductions and the Resulting Equivalent Economic Life

Equivalent Economic Life: 4.6 years

Age $t$	Depreciation Schedule $A(t)$	Depreciation Allowances $TDP(t)$	Loss Deductions $TLG(t)$	Total Tax Deductions $TDD(t)$	Remaining Tax Basis $RTB(t)$
(1)	(2)	(3)	(4)	(5)	(6)
0	0.0	0	0	0	1000
1	10.9	218	1	219	781
2	21.8	216	3	219	562
3	21.8	201	-9	193	369
4	21.8	169	-32	137	232
5	21.8	84	-54	30	202
6	2.0	29	-28	1	201
7	0.0	22	-8	14	187
8	0.0	17	-3	14	173
9	0.0	13	-5	7	166
10	0.0	9	-7	2	164
11	0.0	6	-2	4	160
12	0.0	4	1	5	155
13	0.0	3	0	3	151
14	0.0	2	0	2	149
15	0.0	1	0	1	148
16	0.0	0	0	0	148
17	0.0	0	0	0	148
18	0.0	0	0	0	148
19	0.0	0	0	0	148
20	0.0	0	0	0	148
21	0.0	0	0	0	148
22	0.0	0	0	0	148
23	0.0	0	0	0	148
24	0.0	0	0	0	148
25	0.0	0	0	0	148
26	0.0	0	0	0	148
Sum	100.0	995	-143	852	-
PV	0.8980	0.8969	-0.1173	0.7796	-



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## Acknowledgments

The analysis in this report was conducted by David W. Brazell. Robert E. Yuskavage and Lowell Dworin provided editorial assistance.