Report to Congress on the

Depreciation of Scientific Instruments

Department of the Treasury
March 1990

DEPARTMENT OF THE TREASURY
WASHINGTON

ASSISTANT SECRETARY

March 1990

The Honorable Dan Rostenkowski
Chairman
Committee on Ways and Means
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Section 201(a) of Public Law 99-514, the Tax Reform Act of 1986, required the Treasury to establish an office to study the depreciation of all depreciable assets, and when appropriate, to assign or modify the existing class lives of assets. Treasury's authority to promulgate changes in class lives was repealed by Section 6253 of Public Law 100-647, the Technical and Miscellaneous Revenue Act of 1988. Treasury was instead requested to submit reports on the findings of its studies to the Congress. This report discusses the depreciation of fruit and nut trees.

I am sending a similar letter to Representative Bill Archer.

Sincerely,

Kenneth W. Gideon

Kenneth W. Gideon
Assistant Secretary
(Tax Policy)

DEPARTMENT OF THE TREASURY
WASHINGTON

ASSISTANT SECRETARY

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The Honorable Lloyd Bentsen
Chairman
Committee on Finance
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

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I am sending a similar letter to Senator Bob Packwood.

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Kenneth W. Gideon
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Table of Contents

Chapter I. Introduction and Principal Findings 1
A. Mandate for This Study 1
B. Principal Findings 2

Chapter II. The Useful Life of Scientific Instruments 5
A. The Survey Results 5
B. Determination of the Useful Life of Scientific Instruments From Retirement Data 12
C. Distribution of Useful Lives 15
D. Estimated Total Useful Lives 16

Chapter III. Economic Life of Scientific Instruments 19
A. General Approaches to the Measurement of Economic Lives 19
B. Results 22

Chapter IV. Conclusion and Recommendations 27

References 29

Acknowledgments 31

Appendix A. The Mandate for Depreciation Studies 33

Appendix B. The Survey 37

Appendix C. Determination of Equivalent Economic Lives from the Assumed Pattern of Service Flow and Pattern of Retirements 49

Table of Figures

Figure 1. The Retirement Density Curve for AA 14
Figure 2. Pattern of Decline in Relative Value 20
Figure 3. The Survivor Curve and the Age-Value Curve 21

Table of Tables

Table 1. Response Status of Surveyed Firms 6
Table 2. Responses by Single Digit SIC Industries and Code 7
Table 3. Distribution of Responses in the Chemical Industry 8
Table 4. Reported Book Depreciation Lives and Methods 9
Table 5. Reported Lease and Loan Periods 10
Table 6. Number of Scientific Instruments in Survey 11
Table 7. Instrument Dispositions by Type 12
Table 8. Variation in Useful Lives and Expected Accuracy 15
Table 9. Estimated Useful Life of Scientific Instruments 17
Table 10. Equivalent Economic Life 24

Chapter I. Introduction and Principal Findings

A. Mandate for This Study

This study of the depreciation of scientific instruments has been prepared by the Depreciation Analysis Division of the Office of Tax Analysis as part of its Congressional mandate to study the depreciation of all assets. This mandate was incorporated in Section 168(i)(1)(B) of the Internal Revenue Code (IRC), as modified by the Tax Reform Act of 1986 (see Exhibit 1 of Appendix A). This provision directed the Secretary of the Treasury to establish an office that "shall monitor and analyze actual experience with respect to all depreciable assets", and granted the Secretary authority to change the classification and class lives of assets. The Depreciation Analysis Division was established to carry out this Congressional mandate. The Technical and Miscellaneous Revenue Act of 1988 (TAMRA) repealed Treasury's authority to alter asset classes or class lives, but the revised IRC 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).

The *General Explanation of the 1986 Act* (the "Blue Book") 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 lifespan over all 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 real rate of interest).

The *General Explanation of the Tax Reform Act of 1986* indicates that initial depreciation studies are to include scientific instruments. Under current law scientific instruments are not generally assigned a separate class life, but rather are depreciated over the same period as other productive industry assets unless certain specific provisions apply. Scientific instruments used for research and experimentation purposes are specifically assigned a five year recovery period (IRC Section 168(e)(3)(B)(v)). Qualified technological equipment, which includes high technology medical equipment, is also assigned a five year recovery period (IRC Section 168(e)(3)(B)(iv)).

B. Principal Findings

The principal findings of this study are that the estimated useful lives of the scientific instruments examined range from 10.3 to 15.4 years, with a cost-weighted average useful life of 12.8 years. Industry estimates of the life of currently owned instruments range from 9.1 to 12.2 years, with a cost-weighted average estimated life of 10.4 years. Using only the observed resale prices and retirement patterns, the equivalent economic life for each individual type of scientific instrument could not be reliably established despite the collection of data on over 1,400 dispositions.[1] For the entire group of scientific instruments examined, however, the observed decline in value with age yields an estimated cost-weighted average equivalent economic life of 11.4 years if the taxpayer's loss on disposition is considered (and 10.9 years if such losses are ignored). Because of the limited number of resale observations obtained, undue emphasis should not be placed on this specific estimate. Moreover, if scientific instrument resales for only the years 1986 and 1987 are considered (instead of the years 1984 through 1987), the resulting average equivalent economic life is estimated to be 7.6 years (although the uncertainty associated with this estimate is even greater). To obtain estimates of the equivalent economic life for each separate type of instrument, several alternative approximations were made. These included the use of several assumed net service flow patterns, as well as the use of the observed overall age-price profile for all instruments. These approximations suggest an equivalent economic life for each generic instrument type ranging from 7.3 to 19 years if the taxpayer's loss on disposition is considered (and 7 to 17 years if such losses are ignored).

These results do not support the need for a separate scientific instrument asset class. The current five or seven year recovery period class for scientific instruments used in industries owning such assets appears reasonable, given the above estimates of economic and useful lives that range from about 7 to 19 years. These lives are similar to the class lives of other equipment used in

[1] Given the apparent propensity of firms to retain their older scientific instruments, even a considerable increase in sample size would be unlikely to provide reliable estimates for equivalent economic lives for each separate asset type from resale prices alone.

such industries. Treasury thus does not recommend the establishment of a separate asset class for scientific instruments, which in any case would be extremely difficult to define, and unnecessarily complicate the existing asset classification system.[2]

The Depreciation Analysis Division (DAD) is aware of a 1986 study of the depreciation of 75 scientific instruments conducted by the accounting firm of Price Waterhouse for the Scientific Instruments Makers Association (SAMA). The equivalent economic life of 6.6 years reported in that study is based upon an inappropriate weighting of depreciation rates, rather than present values. When the various present values of economic depreciation calculated in that study are weighted by the amount invested (as is done in this study), the resulting equivalent economic life is approximately 8 years (not allowing for retirements and the resulting tax losses). That analysis of leased instruments, which are generally known to have shorter lives than self-owned assets, is therefore in rough agreement with this study. The evidence from the SAMA study also corroborates the appropriateness of the current 5 to 7 year recovery period for scientific instruments; neither the adjusted (nor the unadjusted) figures reported in the Price Waterhouse study support a four year (or shorter) class life.[3]

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[2] A draft of this report was furnished to the Scientific Apparatus Makers Association (SAMA) and the American Council of Independent Laboratories, Inc. (ACIL) for their review. While SAMA has expressed concern about various aspects of the study (which will be noted as appropriate throughout the report) it concurs with our recommendation that no separate class life for scientific instruments be established, and with our conclusion that it is highly unlikely that scientific instruments decline in economic value at a rate fast enough to make them eligible for depreciation as 3-year recovery property.

[3] The SAMA study is based on the resale prices of under one hundred leased scientific instruments. Although SAMA has appropriately expressed concerns about the limited number (37) of resale observations reported, the lives noted in this study are determined by five different methods, including a direct estimate by the individual respondents of the useful life of each asset owned. The over one hundred firms responding to the study survey (including a number of very large companies) provided data on over one thousand four hundred scientific instrument dispositions, and provided estimates of useful lives for over twice that number of scientific instruments.

Chapter II. The Useful Life of Scientific Instruments

A. The Survey Results

The information used in this study of the depreciation of scientific instruments was obtained through a mail survey of owners and users of scientific instruments.[4] Twelve "workhorse" scientific instruments were selected for study after consultations with industry representatives and government experts. The instruments surveyed consisted of three types of gas and liquid chromatographs, six types of spectrophotometers, two types of electron microscopes, and nuclear magnetic resonance spectrometers. These scientific instruments are generally thought to be subject to as rapid a rate of technological obsolescence as may be experienced by any scientific instrument, and are widely used. A complete list of these 12 instruments is provided in Table 6 and, in more detail, on page 2 of the instruction sheet sent with the survey form (a copy of which is included in Appendix B).

Surveys were sent to 365 firms. As Table 1 shows, useable responses were received from 131 firms covering over 1,400 dispositions and providing information on over 8,000 instruments currently owned by the respondents. A substantial percentage of firms not providing specific data did not own scientific instruments at the time of the survey. No response of any kind was obtained from another 131 firms; although it is possible that some of these firms do not own the specified scientific instruments or are no longer in business, this category of firms is conservatively classified in Table 1 as being able to respond. Two percent of the mailing was returned as undeliverable, and an additional two percent of firms were out of business. Three percent of the firms surveyed indicated that they were unable to participate due to the press of business or because the data requested were not available. A further twenty one percent of the sample indicated that they did not own the specified scientific instruments, and about three percent of the sample provided general information but no data. Of the 131 surveys received with data, several could not be used for various reasons, including insufficient completion of tables or incompatible scientific instrument classification systems.

[4] The Depreciation Analysis Division held public meetings with interested parties on October 16 and November 6, 1987 and on January 22, 1988 to determine the scope of this study and to develop the survey design. With the kind assistance of Lancaster Laboratories and Penniman and Browne, DAD conducted a pilot study of the survey form used in this study.

Table 1 Response Status of Surveyed Firms		
Survey Status	**Number**	**Percent**
Surveys Mailed	365	100.0
Unable to Respond	103	28.2
No Longer in Business	7	6.8
Returned as Undeliverable	8	7.8
Unable to Participate	11	10.7
Do Not Own Specified Scientific Instruments	77	74.8
Able to Respond	262	71.8
No Response Received	131	50.0
Provided General Information	10	3.8
Provided Specific Information	121[5]	46.2

Survey responses classified by the general industry category of the respondent are given in Table 2. The majority of respondents are in the Chemical, Petroleum, or Services sectors. The break-down of respondents in the Chemical industry by three digit SIC industry classification is noted in Table 3. The drug industry provided 24 responses, or 21 percent of the total detailed survey responses.

[5] Note that all respondents did not answer every question. The number of useful responses varies with the question asked. Tables 2 through 5 indicate the number of respondents providing useful answers.

Table 2

Responses by Single Digit SIC Industries and Code

SIC Industry and Code	Number of Responses	Percentage Distribution
1 - Agriculture, Mining and Construction	3	2.6
2 - Food, Textiles, Wood Products, Petroleum, and Chemicals	73	64.0
3 - Rubber, Leather and Stone Products, Primary and Fabricated Metal Products, Electronic, Computer, and Transportation Equipment	11	9.6
5 - Wholesale and Retail Trade	1	0.9
6 - Finance, Insurance, and Real Estate	1	0.9
7 - Hotels, Personal, Business, Amusement and Repair Services	4	3.5
8 - Health, Legal, Educational, Social Engineering, Research and Related Services	21	18.4
Total	114	100.0

Table 3
Distribution of Responses in the Chemical Industry
(SIC Code 28)

SIC Code	Number of Responses	Percentage Distribution
281 - Industrial Inorganic Chemicals	7	13.5
282 - Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic and Other Manmade Fibers, Except Glass	3	5.8
283 - Drugs	24	46.2
284 - Soap, Detergents, and Cleaning Preparations; Perfumes, Cosmetics, and Other Toilet Preparations	3	5.8
285 - Paints, Varnishes, Lacquers, Enamels, and Allied Products	1	1.9
286 - Industrial Organic Chemicals	4	7.7
287 - Agricultural Chemicals	2	3.8
289 - Miscellaneous Chemical Products	8	15.4
Total	52	100.0

Scientific instrument owners report depreciation lives for financial accounting purposes ranging from 4 to 25 years. The most commonly used depreciation life is 10 years (33 percent), and the average reported "book" life is 9.4 years. Most firms (89 percent) report using the unaccelerated straight-line depreciation method. A significant minority (20 percent) report using a five year book life. Table 4 summarizes the number and percentage distribution of reported book depreciation lives and methods.

Table 4
Reported Book Depreciation Lives and Methods

Lives (in years)	Number of Responses	Percentage Distribution
4 - 6	23	23.2
7 - 9	23	23.2
10 - 12	38	38.4
13 - 15	6	6.1
16 - 18	4	4.0
19 - 21	3	3.0
22 - 24	0	0.0
25 +	2	2.0
Total	99	100.0
Average Book Life[6]	9.4 years	
Method		
Straight-line	94	88.7
ACRS	4	3.8
Sum-of-the-years-digits	1	0.9
125% Declining Balance	3	2.8
Double Declining Balance	4	3.8
Total	106	100.0

[6]The average book life varies somewhat by industry. The average book life is 9.6 years for SIC Code 2, 9.4 years for SIC Code 3, and 7.4 years for SIC Code 8. This pattern, although not necessarily each life noted, agrees with that expected by the American Council of Independent Laboratories, Inc.

Fifteen percent of scientific instrument users report leasing scientific instruments. A five year lease is the most common period reported by those leasing scientific instrument. Only a small minority (6 percent) report loans to acquire scientific instruments secured by the instrument. Lease and loan periods are shown in Table 5.[7]

Table 5
Reported Lease and Loan Periods

Period (years)	Lease		Loan	
	Number Reported	Percentage	Number Reported	Percentage
1	2	11.8	0	0.0
2	0	0.0	0	0.0
3	2	11.8	4	66.7
4	1	5.9	0	0.0
5	11	64.7	1	16.7
6	0	0.0	0	0.0
7	1	5.9	1	16.7
Total	17	100.0	6	100.0

The 12 specific types of instruments surveyed are listed in Table 6. The most commonly owned scientific instruments of those studied are gas and liquid chromatographs. Together, these two instrument types represent over 60 percent of all instruments in inventory at the end of 1987. The most expensive scientific instruments studied are the scanning and transmission type electron microscopes and nuclear magnetic resonance spectrometers, which together represent fewer than 6 percent of all the specified instruments but about 24 percent of the reported cost (in constant 1982 dollars) of the scientific instruments.

[7] The Depreciation Analysis Division does not believe loan and lease periods shoud be viewed as primary indicators for the useful life or economic life of scientific instruments. SAMA would place greater emphasis on the results of Table 5.

Table 6
Number and Cost of Scientific Instruments in Survey Inventory

Type	Number Reported	Acquisition Cost[8]	Percentage Distribution	
			Number	Cost
AA - Atomic Absorption Spectrophotometer	219	$27,430	3.7	3.0
GC - Gas Chromatograph	2,138	$22,590	36.4	23.9
GCM - Gas Chromatograph/Mass Spectrometer	321	$91,210	5.5	14.5
IPM - Inductively Coupled Plasma Spectrophotometer (sequential type)	18	$113,727	0.3	1.0
IPQ - Inductively Coupled Plasma Spectrophotometer (simultaneous type)	30	$66,616	0.5	1.0
IR - Infrared Spectrophotometer	413	$34,609	7.0	7.1
LC - Liquid Chromatograph	1,570	$21,231	26.8	16.5
NMR - Nuclear Magnetic Resonance Spectrometer	159	$135,741	2.7	10.7
SEM - Scanning Electron Microscope	148	$140,919	2.5	10.3
TEM - Transmission Electron Microscope	40	$140,007	0.7	2.8
UVS - Ultraviolet/Visible Spectrophotometer	651	$14,407	11.1	4.6
XRF - X-ray Fluorescence Spectrophotometer	160	$58,226	2.7	4.6
Total	5,867		100.0	100.0

[8] The average cost per instrument is expressed in 1982 constant dollars, and as noted in Table 7, generally includes transportation and installation charges.

Virtually all (99 percent) of the scientific instruments were acquired new. Repairs were nearly always expensed (99 percent) rather than depreciated for tax purposes. Most firms in the survey indicated that they included transportation and installation costs in the reported acquisition costs (97 and 72 percent, respectively). Somewhat less than half (42 percent) reported including sales tax in the capitalized cost.

B. Determination of the Useful Life of Scientific Instruments From Retirement Data

The most commonly reported method of disposing of a scientific instruments is its permanent removal from active service, or its junking or sale as scrap. Seventy one percent of the number of instrument dispositions (and 62 percent by cost) are reported to involve such removed or junked or scrapped instruments. Donations are the next most commonly reported method of disposition, accounting for 12.5 percent of the number of asset dispositions (and 18.4 percent by cost). Only eight percent of scientific instruments by number (and 10 percent by cost) are sold in working or repairable condition. Trade-ins on new investment are relatively infrequent, arising in only 2 to 4 percent of the instrument dispositions. These results are summarized in Table 7.

Table 7
Instrument Dispositions by Type

Disposition Type	Percentage Distribution	
	Number	Cost
Sold as working or repairable asset	7.9	9.8
Sold as part of a group of assets	5.4	5.9
Donated	12.5	18.4
Traded-in on new investment	2.4	3.8
Casualty loss	0.3	0.2
Permanently taken out of active service, junked or sold as scrap	71.3	62.1
Total	100.0	100.0

The determination of the average useful life for each type of scientific instrument is the result of several calculations. First, cumulative retirement percentages as a function of age for each type of scientific instrument are fit with a smooth curve. Annual retirement rates are next calculated from the cumulative retirement curves. Finally, the average useful life is obtained by computing a weighted average of the ages, the weights being the percentage of assets retired at each age.

For each type of instrument, cumulative retirement percentages are derived from the reported dispositions and inventory levels. For each of the four years 1984 - 1987 for which retirements were requested, the cumulative retirement percentages were calculated from the observed scientific instrument retirements at each age relative to the stock of instruments of that age.[9] To these four separate "cross sectional" estimates of cumulative retirement percentages, a fifth "time series" estimate of cumulative retirement percentages was obtained by averaging four-year sections of the actual survivor probabilities for all vintages. Because no one of these five separate cumulative retirement curves clearly provides a more satisfactory result than any other, they are collectively fitted with a single fifth degree polynomial in asset age. The resulting "bell shaped" retirement probability density function, which is obtained by differentiating the fitted cumulative retirement curve, is then normalized to unity.[10] Figure 1 shows the resulting normalized retirement probability density for atomic absorption spectrophotometers. The figure suggests that the average (unweighted) useful life is between 14 and 15 years; as noted in Table 8, the more precise value is 14.3 years.[11]

[9] An asset was considered disposed of, rather than sold for reuse, when the revenue received was less than 15 percent of the acquisition cost. The stock of instruments at each age can be calculated at the beginning of each year 1984 - 1987 from the stock of instruments at the end of 1987 and acquisitions and dispositions over the previous four years.

[10] For purposes of this calculation, all 1987 instruments were assumed to be retired after 26 years with no salvage value, even though the survey information regarding the end-of-1987 inventory suggested that some assets were retained for longer periods. This approach insures that the study does not bias upwards the estimated useful life of scientific instruments.

[11] In obtaining average values for instruments of a given type, differences among the costs of the instruments were ignored (i.e., only unweighted averages are shown). However, in obtaining overall average values for all instruments, the contributions of the separate types of instruments are weighted by their average cost (as noted in Table 6); only this cost-weighted average is shown.

Table 8 presents average useful lives for each of eight basic types of scientific instruments on which statistically useful amounts of data were received.[12] As noted in the first column, these lives ranged from 10.3 to 15.4 years. The overall 12.8 year useful life noted is the weighted average, where the weight used is the original cost of the asset, expressed in 1982 dollars.

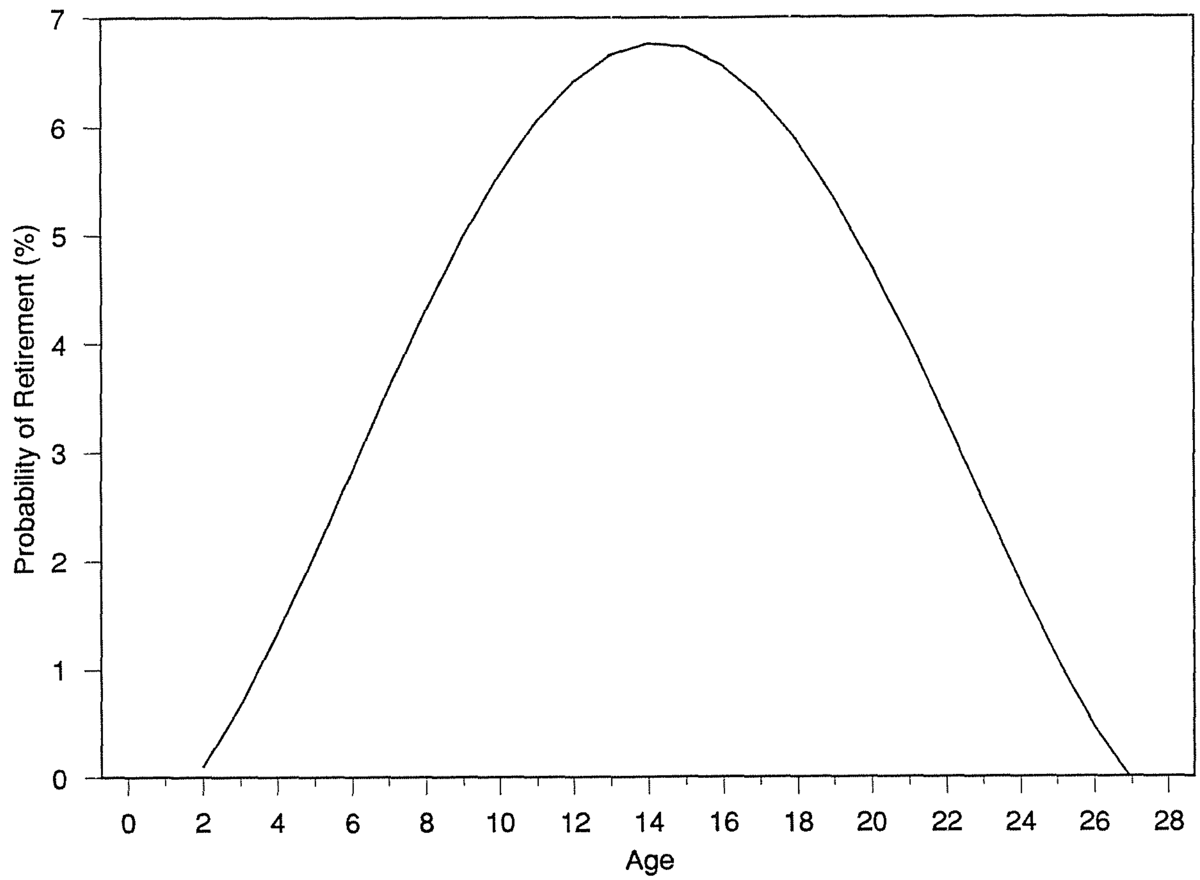

Figure 1. The Retirement Density Curve for Atomic Absorption Spectrophotometers

[12] Because of insufficient retirement data, separate results for IPM and XRF are not shown, and results for SEM and TEM are combined into the single class EM.

Table 8
Variation in Useful Lives and Expected Accuracy of Useful Life Estimates

Scientific Instrument	(1) Average Useful Life (years)	(2) Average Deviation of Useful Life (years)	(3) Number of Observations	(4) Expected Deviation of Average Useful Life (years)
AA	14.3	5.2	33	0.9
EM	13.2	3.3	19	0.8
GC	12.6	4.2	433	0.2
GCM	10.3	4.3	74	0.5
IR	13.2	4.7	63	0.6
LC	14.7	5.2	76	0.6
NMR	11.8	3.5	19	0.8
UVS	15.4	6.0	65	0.7
Average (or Total)	12.8	4.3	782	0.2

C. Distribution of Useful Lives

Not all of the scientific instruments of a given type are retired at the same age. Typically, a negligible fraction of instruments are retired during the first four or five years. Retirements then rise rapidly, and peak near the average useful life. Beyond the useful life, the fraction of retirements drops rapidly, and tends to zero by age 20. The variation in the age at which scientific instruments are retired can be summarized by the "standard deviation" of their age at retirement. This is a rough measure of the range (in years) about the asset's average useful life for which the probability of retirement is fairly high. For example, if the standard deviation for a specific type of asset is three years, then on average such asset will be retired during the period beginning three years before, and ending three years after, the average useful life for the asset. Assuming a "normal" distribution for the average age at retirement, about two-thirds of all assets may be expected to be retired within a period represented by one standard deviation of the average life, and 95 percent may be expected to be retired within two standard deviations of the average life. The average deviation of the useful life for each scientific instrument type is presented in column 2 of Table 8. The average deviations range from about 3 to 6 years.

A significant issue is how "representative" are the average lives reported in the table. This depends in part on the number of observations upon which each is based. The average deviation of the useful life, together with the number of observations of retirements for assets of the given type, determines the accuracy of the estimated average useful life for such assets. If only a few retirement observations were obtained, a different sample might provide a substantially different estimate of the average useful life. The accuracy of the estimated average useful life can be determined by dividing the standard deviation of the useful life, given in column 2 of Table 8, by the square root of the number of observations noted in column 3. This resulting expected standard deviation of the estimate of the average useful life is given in column 4. The average useful life of most of the scientific instruments examined has an expected standard deviation of less than 0.9 years. This means that there is about a two-thirds probability that the estimated average useful life noted in column 1 is within plus or minus 0.9 years of its actual value (and about a 95 percent probability that the useful life estimate is within plus or minus 1.8 years of its actual value). It is thus highly unlikely that the estimated average useful lives are more than two years in error (in either direction).

The standard deviation of the weighted average useful life for all of the instruments is also noted at the bottom of the second column. When this is divided by the square root of the total number of observations, it is found that the expected standard deviation of the weighted average useful life is approximately 0.2 years. This implies that the 12.8 year weighted average useful life is very likely to be within plus or minus 0.4 years of the actual value.

D. Estimated Total Useful Lives

Because useful life estimates from retirement data, as described in Section B, can only reveal the historical pattern of asset use, the Depreciation Analysis Division included questions relating to the age of each instrument at hand at the end of 1987 and its estimated remaining useful life. Not all respondents chose to estimate the remaining useful life of each instrument, and in the case of one respondent all of the several thousand instruments owned were estimated to have a 15 year total useful life.[13] Useful life estimates which appear to reflect a variety of

[13] That respondent is not included in Table 9 because it used a different asset classification system.

estimated remaining lives for over 3,000 other instruments were obtained, and the mean remaining life, together with the corresponding mean total life (end-of-year 1987 age plus estimated remaining life) for each of these instrument types is noted in Table 9.

Table 9
Estimated Useful Life of Scientific Instruments Inventory

Scientific Instrument	Number Reporting Age	Mean Age (years)	Number Reporting Estimated Remaining Life	Mean Estimated Remaining Life (years)	Mean Estimated Total Life (years)	Expected Deviation of Mean Estimated Total Life (years)
AA	219	5.3	128	4.1	10.3	0.4
GC	2,138	5.3	1,046	5.3	11.0	0.1
GCM	321	6.5	168	7.5	12.2	0.2
IPM	18	2.6	13	6.2	9.1	0.7
IPQ	30	5.2	19	5.5	10.4	1.3
IR	412	6.1	215	5.7	10.8	0.3
LC	1,568	4.1	789	5.7	9.5	0.2
NMR	159	4.7	90	6.0	10.7	0.3
SEM	148	4.6	78	5.8	11.1	0.5
TEM	40	6.2	26	3.8	7.7	0.6
UVS	651	6.2	85	5.4	10.0	0.2
XRF	160	4.6	85	5.3	9.9	0.4
Total	5,864	6.2	3,015	5.6	10.4	0.1

The cost-weighted mean age of the instruments in inventory at the end of 1987 is 6.2 years: the cost-weighted mean remaining life of such instruments is 5.6 years. The mean estimated total life ranges from 7.7 to 12.2 years, with a cost-weighted average life of 10.4 years.[14] Based on the expected deviation of the mean total life, the "true" estimated cost-weighted average total life may be expected to be within plus or minus 0.1 years of this cost-weighted average. By comparing the averages in Tables 8 and 9, it would appear that industry estimates (excluding those of a major respondent) are about 2 years shorter than the observed weighted average useful life.

[14] The information obtained regarding the mean estimated total life also addresses two concerns raised by SAMA and ACIL: that the useful lives observed from the accounting data extend beyond actual economic useful lives, and that more recently acquired scientific instruments may have a shorter economic life than older instruments. In particular, by subdividing the assets into three groups - those acquired before 1980, those acquired from 1980 through 1983, and those acquired after 1983 it is possible to answer the latter question (at least with respect to the views of the users of the equipment). For these three groups, the unweighted average lives for instrument types AA, GC, GCM, IR, LC, NMR, SEM, UVS and XRF are 15.4, 11.1, and 9.6 years respectively, so that some decline in estimated average life is observed, as expected by ACIL and SAMA. Also, the mean estimated total life is about 0.7 years shorter in SIC Code 8 industries than all industries combined. This confirms the belief expressed by ACIL that the useful lives of scientific instruments are shorter in this industry.

Chapter III. Economic Life of Scientific Instruments

A. General Approaches to the Measurement of Economic Lives

As specified in the *Explanation of the Tax Reform Act of 1986*, the class life of an asset may be determined from the decline with age in its value. 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, depending upon whether the pattern of its decline in value is more or less rapid than straight-line depreciation. An asset that declines in value less rapidly than straight-line depreciation has a longer economic life, and an asset that declines more rapidly in value than straight-line depreciation has a shorter economic life, than the asset's useful life. (For a more complete discussion see Hulten and Wykoff [1981].)

The desired method of ascertaining the pattern of the decline in value of an asset is to directly examine the market prices of assets sold in working or repairable condition. Despite data on over 1,400 dispositions, an insufficient number of market transactions of working or repairable instruments were encountered in this survey to reliably estimate the pattern of value decline with age of each specific type of instrument. Instead, two alternative approaches are utilized. The first approach assumes a specific service flow pattern from the asset in order to impute its market value as a function of age. The market value of an asset at each age is inferred from the present value of the expected net future service flow produced over its remaining useful life. Each assumed service flow pattern generates a characteristic pattern of decline in the value of the asset relative to its initial cost. Constant service flow assets, with a relatively slow value decline, are equivalent in present value to straight line depreciation patterns with relatively long lives. In contrast, the rapid value decline associated with a geometric decline in service flow is equivalent in present value to straight-line depreciation over a relatively shorter period. The equivalent economic life is the recovery period that has the same present value of straight-line depreciation deductions as the present value of the decline in value of the asset under consideration. Figure 2 illustrates the relationship between the relative age-value profile and the geometrically declining service flows assumed to apply to two assets having different useful lives. For both the 8 and 12 year assets, the relative age-value profile falls somewhat more rapidly than the geometric decline in service flow as a result of the increasingly limited remaining service period. The equivalent economic life for each type of scientific instrument is calculated as the straight-line life with the same present value of decline in value with age as the sum of the present values of the declines in value with age for the observed distribution of useful lives for instruments of that type, as illustrated in Figure 1 for atomic absorption spectrophotometers.

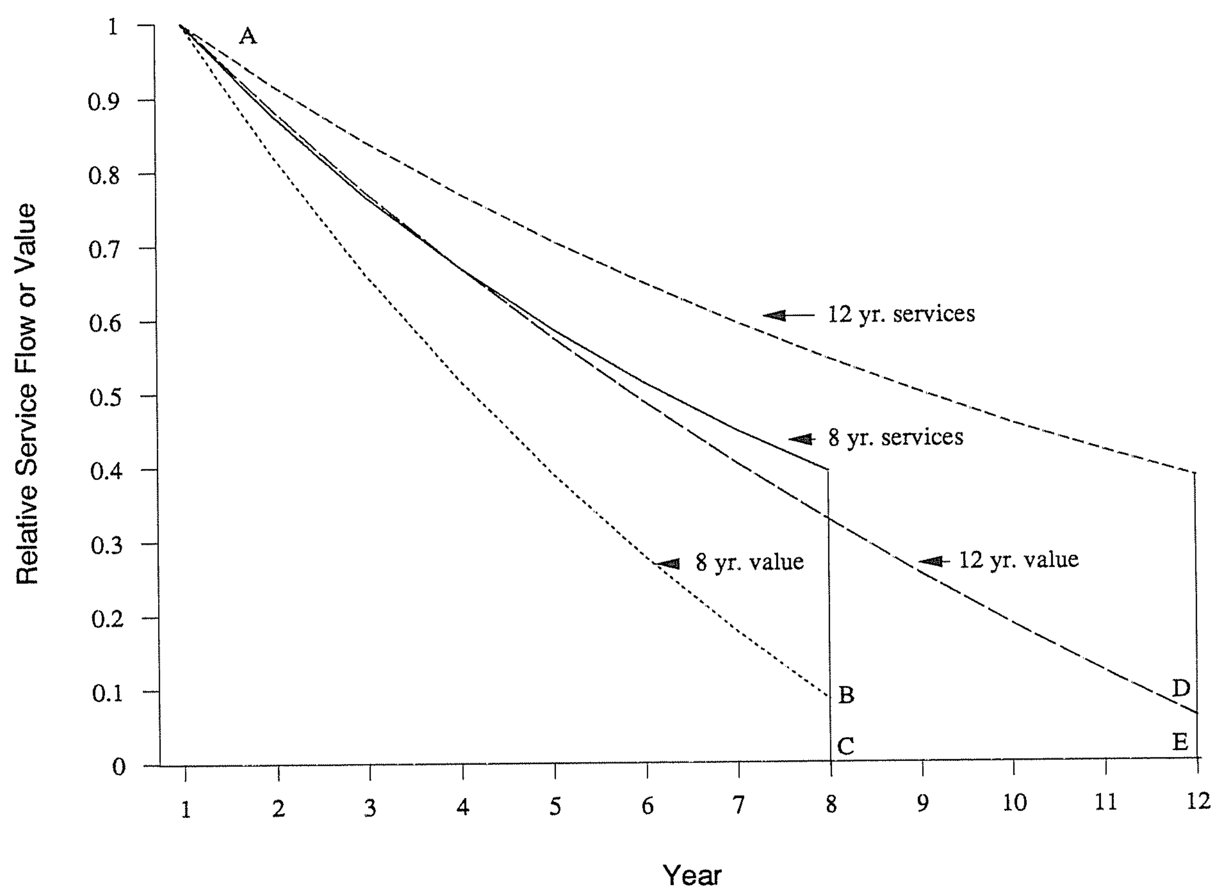

Figure 2. Comparison of the pattern of decline in relative value resulting from an assumed geometric decline in service flow for assets with and 8 and 12 year useful life.

The second approach is to combine the available information on the resale value of all scientific instruments into a single age-value profile, and to use this aggregate profile for each separate instrument type. The overall age-value profile is the middle curve shown in Figure 3. The overall age-price profile was determined statistically by fitting the inflation adjusted relative price path for the 37 working or repairable assets for which adequate data were obtained.[15]

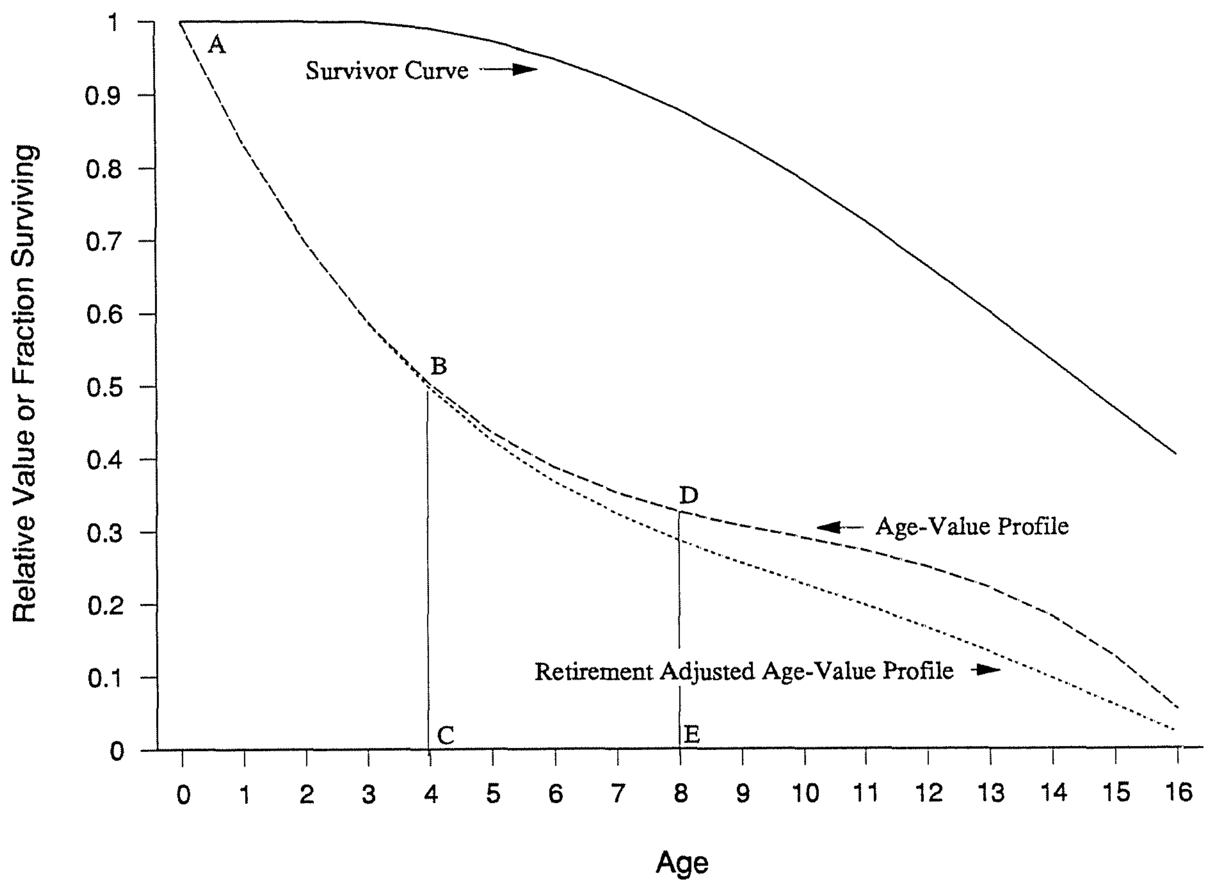

Figure 3. The fraction of scientific instruments of a given type which remain in use as a function of their age (the survivor curve), the relative value of all instruments as a function of their age (the age-value profile), and the resulting retirement adjusted age-value profile for instruments of the given type.

[15] Instruments sold at a higher price than the inflation adjusted original cost, and instruments sold at less than two percent of adjusted original cost, were excluded. The regression equation is (Normalized Value - 1) = a_1 age + a_2 age^2 + a_3 age^3, where the normalized value is unity at age zero.

The retirement-adjusted age-value profile is given by the product of the percentage of unretired assets (the survivor curve) and the average inflation adjusted resale value of the working scientific instruments (the age-value profile). The percentage of unretired assets is the upper curve shown in Figure 3, and the average value for atomic absorption spectrophotometers is the lowest curve shown in Figure 3. In this case, the equivalent overall economic life is that straight-line depreciation service life that has the same present value of depreciation as the average retirement adjusted value; both discounted at a four percent real rate. It should be noted that this approach differs from that used under the service flow assumptions, in that here the pattern of decline in value is assumed to be independent of the age at which any given asset was retired. That is, an asset with a 4 year useful life is assumed to have a value which is given by the curve ABC in Figure 3, while an asset with an 8 year useful life has a value that follows the curve ADE. By contrast, in the service flow approach, it is assumed that assets that retire early have an age-price path that differs from those that retire at a later age. A listing of the relevant equations is presented in Appendix C.

B. Results

Table 10 compares the useful life with the retirement adjusted equivalent economic life under four alternative assumptions regarding the patten of decline in the net service flow with age (assuming a zero salvage value), and with the retirement adjusted equivalent economic life derived by applying the aggregate pattern of resale prices for scientific instruments as a whole to each instrument type. The economic life associated with a constant value of net services, shown in the second column, is about two to three years longer than the observed useful life. The constant value of service flow assumption can be regarded as providing an upper limit estimate for the equivalent economic life of scientific instruments. Although the quantity of net service flow from a scientific instrument may remain relatively constant, technical obsolescence tends to reduce the inflation adjusted value of the service flow over time. Straight line depreciation over the distribution of useful lives encountered for each instrument, for which the results are given in column 3, provides an aggregate economic life only slightly less than the average useful life.

The results based on the assumption of a 100 percent declining balance service flow (over the range of estimated useful lives) are shown in column 4 of Table 10 to yield equivalent economic lives about one year shorter than the useful life. A one hundred percent declining balance service flow for an asset with a 10 year useful life indicates that the constant dollar value of the service flow declines by 10 percent each year. The economic lives associated with the assumption of a more rapid double declining balance service flow are presented in the fifth column. This assumption reduces the equivalent economic lives of scientific instruments by about 4 years below their useful lives, with the average retirement adjusted equivalent economic life of 9 years.

The final column of Table 10 indicates the resulting economic lives obtained when the estimated relative age-price decline pattern found for all scientific instruments as a whole is adjusted by the separate retirement pattern for each instrument type. The resulting economic lives are found to generally lie between the equivalent economic lives associated with the assumed 100 and 200 percent declining balance service flow patterns. The decline in service flow pattern that provides a decline in economic value that most closely matches that obtained using the aggregate age-price profile is characterized by rapid depreciation over the first few years, followed by a period of slowly declining prices after the asset has lost about seventy percent of its initial (real) value, followed by a more rapid decline to a near zero value during the 16th year. The first year decline in economic value for all scientific instruments as a group is estimated to be 18.3 percent. The equivalent geometric rates of decline over the first five and ten years are 16.6 and 12.4 percent, respectively. As shown in the last row of Table 10, the average equivalent economic life is 11.4 years. Because of the limited number of observed sales of working instruments, some reservation should be placed on the certainty associated with this result. Moreover, if only data for 1986 and 1987 sales are used, the resulting average equivalent economic life is found to be 7.6 years (although because this life is based on less than one-half of the already limited data, this result should be viewed with even greater reservations).

The equivalent economic lives presented in Table 10 reflect the prescription of the *General Explanation* that the present values of straight-line depreciation over these lives are the same as the present values of the decline in economic value obtained from the assumed patterns. These lives take into account the tax loss allowed in the event of early retirement, and thus correspond to the use of individual item accounting. The unadjusted equivalent economic lives are up to about one year shorter than the unadjusted values;[16] the Depreciation Analysis Division believes the adjusted values are appropriate in determining class lives.

[16] The unadjusted equivalent economic lives average 13.9 years for constant services, 12.6 years for straight-line depreciation, 11.1 years for declining balance service flow, 8.8 years for double declining balances service flow and 10.9 years using all instrument resale prices.

Table 10
Equivalent Economic Life
(Adjusted for Early Retirements - Individual Asset Accounting)

Scientific Instrument	**Useful Life**	**Equivalent Economic Lives Under Various Assumptions for Service Flows and Prices Over the Useful Life Distribution**				
		Constant Services	Straight Line Deprec-iation[17]	100% Declining Balance Services	200% Declining Balance Services	Using All Instrument Resale Prices
	(1) (years)	(2) (years)	(3) (years)	(4) (years)	(5) (years)	(6) (years)
AA	14.3	17.3	15.1	13.0	10.0	11.0
EM	13.1	15.2	13.5	11.7	9.2	12.6
GC	12.6	14.9	13.2	11.3	8.8	12.3
GCM	10.3	12.3	11.1	9.4	7.3	11.1
IR	13.2	15.8	13.9	12.0	9.3	11.7
LC	14.7	18.1	15.8	13.7	10.5	10.3
NMR	11.8	13.7	12.3	10.5	8.2	10.0
UVS	15.4	19.1	16.4	14.2	10.9	11.4
Average	12.8	15.3	13.5	11.6	9.0	11.4

The adjusted economic life generally exceeds 11 years for all types of instruments for an assumed 100 percent declining balance service flow, and 8 years for an assumed double declining balance service flow - values that span the boundary between 5 and 7 year recovery period classes. To obtain an equivalent economic life of 4 years, which would be required to make scientific instruments eligible for depreciation as 3 year recovery period property, the decline in net service

[17] Straight line depreciation is the result of a specific linear rate of decline in service flow.

flow would have to approximate a 600 percent declining balance pattern over the useful life. This would require a decline in the value of the net service flow of 60 percent per year for an instrument with a 10 year useful life. No evidence was found to support such a rapid rate of decline in the value of services provided by scientific instruments. The inferred rate of depreciation of scientific instruments is instead consistent with that for assets in the 5 to 7 year recovery period classes, where most scientific instruments belong under current law.

Chapter IV. Conclusion and Recommendations

The useful lives, book lives, and equivalent economic lives of scientific instruments are found to be consistent with their treatment as 5 to 7 year recovery period property. As most of the other assets used by industries owning scientific instruments are also classified as 5 or 7 year recovery period property, it does not appear necessary to establish a separate asset class for scientific instruments. While there are benefits to explicitly treating all scientific instruments equally, the difficulties of developing a workable definition for a single asset class are formidable, and the existence of a separate class could unduly complicate tax compliance and administration. Treasury thus recommends that the current treatment of scientific instruments be continued, and a separate class not be established.

References

Hulten, Charles R. and Frank C. Wykoff, "The Measurement of Economic Depreciation", in *Depreciation, Inflation, and the Taxation of Income From Capital*, ed. by C. Hulten, The Urban Institute (Washington, D.C., 1981), pp. 99-103.

Price Waterhouse, "The Depreciation of Scientific Instruments", 1986.

Acknowledgments

This report was prepared by Hudson Milner and edited by Lowell Dworin. David Horowitz provided assistance in supervising the collection of data and Bill Chen contributed programming support. Depreciation studies are conducted by the Depreciation Analysis Division, directed by Lowell Dworin, of the Office of Tax Analysis.

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

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

Code Sec. 168 (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

Code Sec. 168(i) **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.

Exhibit 3. Provisions for Changes in Classification from the General Explanation of the Tax Reform Act of 1986

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, semi-conductor 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. The Survey

OMB Approval No. 1505-0116
Expires July 31, 1989

Survey of Depreciation of

SCIENTIFIC INSTRUMENTS

Instructions

U.S. Department of the Treasury
Office of Tax Policy
Office of Tax Analysis
Depreciation Analysis Division

Please Return Completed Form In The Enclosed Large Postage Paid Envelope To:

**Scientific Instruments Survey
Depreciation Analysis Division
Room 4217, Main Treasury Building
1500 Pennsylvania Avenue, NW
Washington, D.C. 20220**

Please Return By: April 30, 1989

NOTE This survey is authorized by law (Internal Revenue Code, section 168(i)(1). While you are not required to respond, your cooperation is needed to make the results of this survey both accurate and comprehensive. All data collected concerning individual firms will be considered confidential, and no firm-specific information will be contained in any report based on the results of this survey. Your participation is sincerely appreciated.

Please read both the general and specific instructions before completing the questionnaire. If you have any questions, contact the following persons responsible for administering the survey:

H. Hudson Milner
Financial Economist
Depreciation Analysis Division
Room 4217, Main Treasury Building
1500 Pennsylvania Avenue, NW
Washington, D.C. 20220
(202) 566-6350

William J. Strang
Financial Economist
Depreciation Analysis Division
Room 4217, Main Treasury Building
1500 Pennsylvania Avenue, NW
Washington, D.C. 20220
(202) 535-9390

General Instructions

1. Intended Respondents. We have asked your parent firm to distribute this survey to three of its affiliated establishments that own and make the greatest use of analytical and related scientific instruments (as listed on page 2 of these instructions). Please complete the survey items by reference to your property and other records and return the Response Form to your parent firm so that they can mail all completed surveys to our office by April 30, 1989. The information obtained from this survey will enable Treasury to recommend a depreciation class life for scientific instruments. Thank you for your effort.

General Instructions (continued)

2. List of Scientific Instruments Under Study

Asset Type Code	Description of Assets
AA	**Atomic Absorption Spectrophotometer**
GC	**Gas Chromatograph** (including auto samplers)
GCM	**Gas Chromatograph/Mass Spectrometer**
IPQ	**Inductively Coupled Plasma Spectrophotometer** (sequential type)
IPM	**Inductively Coupled Plasma Spectrophotometer** (simultaneous type)
IR	**Infrared Spectrophotometer,** including FTIR (Fourier Transform Infrared Spectrophotometer)
LC	**Liquid Chromatograph,** including HPLC (High Performance Liquid Chromatograph), IC (Ion Chromatograph), auto analyzers, auto samplers, and flow injection analysis
NMR	**Nuclear Magnetic Resonance Spectrometer**
SEM	**Scanning Electron Microscope**
TEM	**Transmission Electron Microscope**
UVS	**Ultraviolet / Visible Spectrophotometer**
XRF	**X-ray Fluorescence Spectrophotometer**

3. Survey Overview. Responses to this survey should be based on information from your accounting and physical property records. **Table I** asks you to classify your establishment according to the appropriate 1987 Standard Industrial Classification (SIC) industry code from the list provided. Table I asks for company and establishment summary information. In particular, it asks for the date on which your fiscal year ends. All dates in the remainder of the survey refer to the fiscal year ending in the stated calendar year. Table I also asks for information concerning financial accounting depreciation methods used by your establishment. Finally, Table I asks for information on various measures that may be indicative of asset lives, such as lease and loan periods. Representative values may be entered for assets of the type listed above.

Table II asks for acquisition, major repair, and disposition information for the specified scientific instruments that were disposed of between 1984 and 1987. Finally, **Table III** asks for more detailed information about your 1987 inventory of the listed scientific instruments.

Specific Instructions

Table I. Summary Information

1. Establishment and Company Name and Address. Please enter your establishment's name and address in the spaces provided. If these are the same as the company name and address, write "SAME" in the company space. If different, enter the name and address of both the parent company and your establishment.

2. Contact Person. Please enter the name, title and telephone number of the person responsible for the completion of the survey. This person will only be contacted in the unlikely event any responses on the questionnaire require clarification.

3. Standard Industrial Classification Code. Please enter your establishment's Standard Industrial Classification (SIC) Code. This entry should reflect the new 1987 industry definitions as presented in the Office of Management and Budget's *Standard Industrial Classification Manual - 1987.* A selected list of 3 and 4-digit codes is attached at the end of the instructions.

4. Number of Employees. Please enter the approximate number of employees at your establishment as of the end of the 1987 fiscal year.

5. Initial Year of Operations. Please enter the year in which your establishment commenced operations.

6. Fiscal Year. Please enter the month and day on which your firm's fiscal year ends. As mentioned in the General Instructions, all dates in the remainder of the survey refer to the fiscal year ending in the stated calendar year. Thus, data for a fiscal year ending on June 30, 1987 should be reported under "1987".

7. Major Products. Please enter descriptions of the major products and services produced by your establishment. Indicate the value of shipments (question 8) of each listed product or service for the fiscal year 1987.

9. Book Depreciation. Please enter the depreciation period and method used in your financial accounts for the scientific instruments listed on page two of these instructions. Examples of desired abbreviation methods are: SL (straight line), 200DB (200 percent declining balance), 150DB/SL (150 percent declining balance switching to straight line), SYD (sum of the years digits). First year conventions (e.g., a mid-year convention) need not be indicated. If more than one depreciation method or period is used you may report the average or most common values.

10. Typical Period of Lease or Loan for Scientific Instruments. Please enter the other requested financial measures of scientific instrument lives (e.g. lease, loan periods). These measures may be shown as average or representative values in cases where several such measures are applicable to instruments of the type listed on page two of these instructions.

11. Treatment of Trade-in Receipts. Please check the method used in accounting for "trade-ins". Suppose, e.g., that $1,000 is offered as a trade-in on a new scientific instrument priced at $10,000. If your accounting method is such that the cost of the new asset would be noted as $9,000 (or $9,000 plus the book value or basis of the old asset), check the line titled "Reduction in Cost of Acquired Asset". If your accounting method regards the $1,000 as proceeds from the sale of the old asset and values the instrument acquired at $10,000 check the line titled "Retired Asset Value". This information will assist us in interpreting the acquisition costs and disposal prices recorded in Table II.

Specific Instructions (continued)

Table II. Scientific Instrument Dispositions 1984 - 1987

Overview. Table II asks for specific data on depreciable assets which your establishment disposed of during fiscal years ending in 1984, 1985, 1986, and 1987. It requests acquisition and disposition dates and values, and information concerning the method of disposal. It also requests data on any repairs performed on the assets which were capitalized for tax purposes while they were held by your firm. Finally, if the asset was purchased "used" Table II asks for the age of the asset when it was acquired. These data are critical for determining changes in asset values with age. **Note: Scientific instruments reported in Table II as being disposed of during 1984 - 1987 should not appear as inventory in Table III. Instruments should be reported in either Table II or Table III, but not in both.**

Item (1). Dispositions. For the purpose of this survey, a "disposition" means the permanent withdrawal of property from use. A disposition may take any of several forms, including sale, exchange, retirement, donation, abandonment, and destruction or other loss. It may mean that an asset has been taken permanently out of active service, although it is still physically retained by the firm. Assets converted to stand-by use or transferred to affiliated establishments within the firm are not considered dispositions.

Note on Aggregation. Your responses for Table II should report individual asset dispositions not aggregates of assets.

Please enter the scientific instrument type code from page two of these instructions and the date on which the instrument was acquired in the first three columns of Item (1). This should be the year in which the asset was acquired by the firm (if different from the year it was acquired by your establishment).

The reported values for initial cost should reflect the original cost basis for tax purposes on which depreciation was allowable. Ignore any reductions in basis related to the investment tax credit which may be shown on the tax records. For an asset transferred from an affiliated establishment, include its initial cost when first acquired by the firm.

The applicable codes from the list below which are included in the acquisition cost should be noted in the "initial cost code" column. For example, TSN would reflect that the reported acquisition cost included transportation and sales tax, but excluded installation costs and was net of the value of a trade-in.

Initial Cost Code	**Determination of Initial Cost**
T	Transportation
S	Sales Tax
N	Net of value of trade-in allowance
I	Installation
U	Not known

Specific Instructions (continued)

Table II. Scientific Instrument Dispositions 1984 - 1987 (continued)

Item (2). Age When Acquired. If a scientific instrument disposed of during this period was acquired "used" by your establishment, please enter its age as of the date of acquisition. Do not include a scientific instrument transferred from an affiliated establishment unless the asset was acquired "used" by the firm. In such case, include its cost when first acquired by the firm in item (1).

Item (3). Cost and Date of Repairs Depreciated. Please enter the amount or amounts of any major repair or overhaul expenditures made to either upgrade or otherwise appreciably increase the value of the scientific instrument. Include only those expenditures that were capitalized for tax accounting purposes. Do not include incidental repair or maintenance costs that were deducted as period costs. Please enter the date or dates on which major repairs or overhauls were performed on the scientific instrument in question. If more than one such repair was made over the life of the instrument, associate the date with the expenditure amount shown. **If no such repairs were made enter "N" for none in the cost column.**

Item (4). Dispositions. Please enter the month and year of disposition for each asset entry. Please note the year should be 1984, 1985, 1986 or 1987. Enter the revenue received, if any, upon disposition of the asset. If sold, either as a working or repairable asset or as scrap, please enter the sales price. Do not include any disposal costs incurred as a result of the sale. If the asset was sold as part of a group of assets, enter the value allocated to the particular asset. If traded-in for a new asset, enter the trade-in value. If exchanged for other property, donated, junked with no scrap value, permanently taken out of active service but retained by the establishment, or if the asset suffered a casualty, then enter an estimated market value (which may be zero). Enter the appropriate code from the list below for the type of disposition. A casualty loss includes asset destruction and other "involuntary conversions," such as theft, seizure, requisition, and condemnation.

Disposal Type Code	Type of Disposition
W	Sold as working or repairable asset
J	Permanently taken out of active service, junked or sold as scrap
A	Sold as part of a group of assets
T	Trade-in on new investment
D	Donated
C	Casualty loss
N	Not known

Specific Instructions (continued)

Table III. Inventory of Listed Scientific Instruments in Use at the End of 1987

Overview. Table III asks for your inventory of the scientific instruments identified on page two of these instructions as of the end of the 1987 fiscal year. It asks for the age at the time of acquisition for instruments purchased "used", the date and amount acquired for new and used assets, and major repair dates and amounts. Finally, estimates of the actual remaining useful life to the establishment and the value of the instrument at the time of disposition are requested. **Note: The inventory of listed scientific instruments should not include instruments indicated as disposed of in Table II.**

Aggregation. The responses for Table III should aggregate costs and revenues as long as the information sought in item (1) on the asset type code, item (2) on the age at acquisition, item (3) for the date of acquisition and item (6) on the estimated useful life, is the same for all instruments included in a single response.

Item (1). Asset Type Code. Please enter the scientific instrument type code from page two of these instructions.

Item (2). Age When Acquired. Please enter the age at the time of acquisition for scientific instruments purchased "used". This should be the age of the scientific instrument when acquired by the firm if different from the age when it was acquired by the establishment. **Please enter an "N" for new in the "yrs." column if acquired new.**

Item (3). Date of Acquisition. Please enter the date on which the scientific instrument was acquired. This should be the date on which the asset was acquired by the firm (if different from the date it was acquired by the establishment).

Item (4). Amount Acquired. Please enter the number of instruments that are aggregated in the figures reported on in each row. Enter the initial cost of the scientific instrument or instruments reported. The reported values for initial cost should reflect the original cost basis for tax purposes on which depreciation was allowable. Ignore any reductions in basis shown on tax records related to the investment tax credit. For an asset transferred from an affiliated establishment, include its initial cost when first acquired by the firm. The applicable item codes included in the original cost (from the list given on page 4 of these instructions) should be shown in the "initial cost codes" column. For example, TSN would reflect that the depreciable cost included transportation and sales tax, but excluded installation costs and was the value net of a trade-in allowance.

Item (5). Repairs Depreciated. Please enter the amount or amounts of any major repair or overhaul expenditures made to either upgrade or otherwise appreciably increase the value of the scientific instrument. Include only those expenditures that were capitalized for tax accounting purposes. Do not include incidental repair or maintenance costs that were deducted as period costs. Please enter the date or dates on which major repairs or overhauls were performed on the scientific instrument in question. If more than one such repair was made over the life of the instrument associate the date with the expenditure amount shown. **If no such repairs were made enter "N" for none in the cost column.**

Item (6). Remaining Life. Please enter the estimated remaining useful life of the instrument if a reasonable estimate can be obtained from persons familiar with the instrument.

Item (7). Estimated Receipts. Please enter the receipts expected at the end of the useful life of the instrument estimated above if a reasonable estimate can be obtained. If the instrument is expected to be traded-in use the retirement convention indicated at the bottom of Table I.

Survey of Depreciation of

SCIENTIFIC INSTRUMENTS

Response Form

Table I. Summary Information

1. Establishment Name: ____________________

   Address: ____________________

   ____

   Company Name: ____________________

   Address: ____________________

   ____

2. Contact Person: ____________________

   Title: ____________________

   Telephone: ( ) ____________________

3. Establishment's 1987 SIC Code: _ _ _ _

4. Number of Employees: ____________

5. Initial Year of Operations: __________

6. End of Fiscal Year: Month __________ Day __________

7. Major Products:

   ____

   ____

8. Value of 1987 Shipments (in dollars):

   ____

   ____

9. Book Depreciation Used for Scientific Instruments (page 3 instructions):

   Life Period (mos./yrs.) _______ / _______

   Method ____________________

10. Typical Period of Lease or Loan for Scientific Instruments:

    Lease (mos./yrs.) _________ / _________

    Loan (mos./yrs) _________ / _________

11. Treatment of Trade-in Receipts (see page 3 of instructions):

    Reduction in Cost of Acquired Asset _____

    Retired Asset Value ____________________

Table II. Scientific Instrument Dispositions 1984 - 1987

Purchase Information About Assets Disposed of 1984 - 1987 Item (1)					Age When Acquired? Item (2)		Repairs Depreciated Rather Than Expensed for Tax Purposes Item (3)			Dispositions Item (4)			
Asset Type Code	Date Acquired		Acquisition Cost	Initial Cost Code			Cost	Date Repair Completed		Date of Disp.		Gross Revenue Received (if any)	Disp. Type Code
(See p.2 of instr.)	mo.	yr.	(in dollars)	(See p.4 of instr.)	yrs.	mo.	(in dollars)	mo.	yr.	mo.	yr.	(in dollars)	(See p.5 of instr.)

Table III. Inventory of Listed Scientific Instruments in Use at End of 1987

Asset Type Code Item (1)	Age When Acquired? Item (2)		Date of Acquisition Item (3)		Amount Acquired Item (4)			Repairs Depreciated Rather Than Expensed for Tax Purposes Item (5)			Estimated Remaining Useful Life to Establishment Item (6)		Estimated Receipts at Retirement Item (7)
	yrs	mos	mo	yr	Number of Assets	Cost (in $)	Initial Cost Code (p.4 inst.)	Cost (in $)	mo	yr	yrs	mos	(in $)

Appendix C. Determination of Equivalent Economic Lives from the Assumed Pattern of Service Flow and Pattern of Retirements

This appendix lists the equations used to calculate the equivalent economic life for specific types of instruments from the assumed service flow and patterns of retirements. The computation of the adjusted equivalent economic life to allow for the retirement of assets before the equivalent economic life is reached is then discussed.

The calculation of the equivalent economic life requires four steps to obtain the present value of economic depreciation for a group of assets from their service flow. A final calculation then finds the straight-line life with the same present value as calculated for the group of assets.

The first step involves obtaining the value of an asset with a given useful life from its service flow pattern. The value of the asset as a function of age is obtained by calculating the discounted value of the future service flow over the remaining life. This value is then differentiated with respect to age to obtain the asset's economic depreciation. Next, the present value of this economic depreciation is found. Finally, the aggregate present value for assets having the observed distribution of useful lives is obtained by weighting the present value of economic depreciation for assets of a given useful life by the proportion of assets with that life.

The value of an asset with a constant service flow, c, over a useful life of L years, at age t is the present value (at rate r) of the discounted service flow from year t to the end of the useful life. Thus:

$$V(t) = \int_{x=t}^{L} ce^{-r(x-t)}dx = c(1 - e^{-r(L-t)}) \tag{1}$$

and the value at age t, relative to the initial value, is given by:

$$\frac{V(t)}{V(0)} = \hat{V}(t) = \frac{1 - e^{-r(L-t)}}{1 - e^{-rL}} \tag{2}$$

Economic depreciation is the negative of the change in value:[18]

$$-\frac{d\hat{V}(t)}{dt} = \frac{re^{-r(L-t)}}{1-e^{-rL}} \tag{3}$$

The present value of economic depreciation, PVED(L), is the total discounted value of economic depreciation:

$$PVED(L) = \int_{t=0}^{L} \frac{re^{-r(L-t)}}{1-e^{-rL}} e^{-rt} dt = \frac{rLe^{-rL}}{1-e^{-rL}} \tag{4}$$

For a group of assets that differ in useful life, the average present value of economic depreciation is given by the product of the retirement density function, R(L), and the present value of an asset with useful life L:

$$PVCS = \int_{L=y}^{z} \frac{rLe^{-rL}}{1-e^{-rL}} R(L) dL \tag{5}$$

where y and z represent the lower and upper useful life limits of the assets under consideration. This equation may be solved by numerical methods. Given an average present value of economic depreciation as calculated above, the straight-line life with the same present value can be determined numerically.

A similar analysis applies when service flow diminishes exponentially at a rate inversely proportional to the useful life (i.e., in a declining balance manner). The value of an asset at age t that provides an initial service flow c which declines at rate Q is given by:

$$V(t) = c \int_{x=t}^{L} e^{-Qx} e^{-r(x-t)} dx = \frac{c(e^{-Qt} - e^{-(QL+rL-rt)})}{Q+r} \tag{6}$$

As before, the relative price can be obtained by dividing by the initial value V(0):

$$\frac{V(t)}{V(0)} = \hat{V}(t) = \frac{e^{-Qt} - e^{-(QL+r(L-t))}}{1-e^{-(Q+r)L}} \tag{7}$$

[18] Economic depreciation and the present value of economic depreciation are expressed as positive quantities, in accord with common usage.

Replacing the rate of exponential service decline, Q, by the ratio of the equivalent declining balance rate, b, to the useful life, L, the economic depreciation may be obtained by taking the negative derivative with age:

$$-\frac{d\hat{V}(t)}{dt}=\frac{\frac{b}{L}e^{-\frac{b}{L}t}+re^{-(b+r(L-t))}}{1-e^{-\left(\frac{b}{L}+r\right)L}} \tag{8}$$

For a double declining balance service flow b = 2, while for (simple) declining balance service flow b = 1. The present value of economic depreciation for an asset with useful life L is obtained by discounting the decline in value over the remaining life:

$$PVED(L)=\int_{t=0}^{L}\frac{\frac{b}{L}e^{-\left(\frac{b}{L}\right)t}+re^{-(b+r(L-t))}}{1-e^{-\left(\frac{b}{L}+r\right)L}}e^{-rt}dt=\frac{\frac{b}{L}}{\frac{b}{L}+r}+\frac{Lre^{-\left(\frac{b}{L}+r\right)L}}{1-e^{-\left(\frac{b}{L}+r\right)L}} \tag{9}$$

The average present value for a group of assets that differ in useful life is given by the integral of the product of the present value function of equation (9) and the retirement density function, R(L). This expression is solved by numerical methods, as noted above in the discussion of equation (5).

The present value of straight-line depreciation over a useful life L is given by:

$$PVSL(L)=\int_{t=0}^{L}\frac{e^{-rt}}{L}dt=\frac{1-e^{-rL}}{rL} \tag{10}$$

Current law allows the taxpayer to claim a loss equal to the difference between the basis of the asset and its retirement value. Eq. 11 corrects Eq. 10 to include the tax loss claimed when assets are retired before the end of their adjusted equivalent economic life, E:

$$PV(E)=\int_{y}^{E}R(t)\frac{1-e^{-rt}}{rE}dt+\int_{E}^{z}R(t)\frac{1-e^{-rE}}{rE}dt+\int_{y}^{E}R(t)e^{-rt}\left(1-\frac{t}{E}\right)dt \tag{11}$$

where y is the shortest and z is the longest useful life in the distribution of useful lives characterized by R(t).

The first term of Eq. 11 reflects the weighted sum of the present values of straight-line depreciation up to the time of retirement, where the weight is the proportion of assets retired at each age. The second term reflects the present value of economic depreciation for the portion of assets retired after the adjusted equivalent economic life, E. The third term of Eq. 11 adds the additional present value associated with the tax loss claimed upon retirement without salvage value before the end of the equivalent economic life. The equation is solved numerically for that life, E, that provides the same present value as determined from the service flow or price pattern associated with the group of assets.