Fixed Assets and Consumer Durable Goods in the United States, 1925–97

SEPTEMBER 2003

U.S. DEPARTMENT OF COMMERCE
Donald L. Evans, *Secretary*

ECONOMICS AND STATISTICS ADMINISTRATION
Kathleen B. Cooper, *Under Secretary for Economic Affairs*

BUREAU OF ECONOMIC ANALYSIS
J. Steven Landefeld, *Director*
Rosemary D. Marcuss, *Deputy Director*

www.bea.gov

Suggested Citation

U.S. Department of Commerce. Bureau of Economic Analysis. *Fixed Assets and Consumer Durable Goods in the United States, 1925–99*. Washington, DC: U.S. Government Printing Office, September, 2003.

Acknowledgments

This publication was written by Shelby W. Herman, Arnold J. Katz, Leonard J. Loebach, and Stephanie H. McCulla with assistance from Michael D. Glenn. The estimates of fixed assets and consumer durables were prepared by the National Income and Wealth Division and the Government Division of BEA. Specifically, the estimates for the private sector and the chain-type estimates for the private and government sectors were prepared by Michael D. Glenn, Phyllis Barnes, Kurt Kunze, Leonard J. Loebach, and Dennis R. Weikel, under the direction of Shelby W. Herman. The estimates for the government sector were prepared by Charles S. Robinson and Jennifer A. Bennett, under the direction of D. Timothy Dobbs. Paul R. Lally, Chief of the Investment Branch, and Randal T. Matsunaga oversaw preparation of the published volume. Barbara M. Fraumeni, BEA's Chief Economist, recommended the depreciation profiles that were used.

Overall supervision was provided by Carol Moylan, Chief of the National Income and Wealth Division; by Karl Galbraith, former Chief of the Government Division; by Brooks B. Robinson, Chief of the Government Division; and by Brent R. Moulton, Associate Director for National Economic Accounts. Kristina Maze edited the volume and W. Ronnie Foster of Publication Services in the Communications Division coordinated the production of this publication and designed the cover. Duane Hackmann prepared the tables for typesetting.

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Note: Tables are now part of BEA's Interactive Data Table Application on the BEA Web site at: http://www.bea.gov/iTable/index_FA.cfm

Introduction

This publication presents estimates prepared by the Bureau of Economic Analysis (BEA) of the stocks and depreciation of fixed assets and consumer durable goods and of the investment flows used to derive them. Specifically, it presents estimates for the United States of the stocks of private and government fixed assets (durable equipment, software, and structures) and consumer durables for 1925–99. It also presents the underlying investment expenditures for most assets for 1901–99.

The first chapter discusses the conceptual and statistical considerations underlying BEA's estimates of fixed assets and consumer durables. The second and third chapters explain the calculation of the investment flows and the depreciation estimates that are used with the perpetual inventory method to derive estimates of the net stocks of fixed assets and consumer durables. The fourth chapter explains the derivation of net stocks of privately owned automobiles, which are not based on the perpetual inventory method. The final chapter provides a glossary and a detailed guide to types of estimates available in each table—that is, the category of ownership or sector available for different time periods and at different valuations. The balance of the publication comprises the tables themselves.

The estimates incorporate the definitional and statistical improvements introduced in the 1999 comprehensive revision of the national income and product accounts (NIPAs), including the recognition of business and government expenditures for software as investment, a new pattern of depreciation for personal computers, and a new service life for highways.[1] BEA also prepares estimates of stocks of U.S. direct investment abroad and of foreign direct investment in the United States that are consistent with the estimates presented here; these are published annually in the July issue of the SURVEY OF CURRENT BUSINESS.

The estimates in this publication supersede those published in the preceding edition of this publication and in the Survey prior to September 2000.[2] (Abbreviated time series that reflect the revisions made to NIPAs for the previous 3 years are generally published in the September issues of the Survey in the following year; they are made available on the Web site at about the same time.)

Uses of the Estimates

BEA's estimates of the net stocks and depreciation of fixed assets and consumer durables are used in other sets of statistics, such as the Flow-of-Funds Accounts prepared by the Federal Reserve Board, and in studies of national income, product, and wealth. For instance, the estimates of consumer durable goods presented in this volume have been used in preparing alternative estimates of personal savings.[3] Studies of asset valuation based on "Tobin's-Q ratio" often use BEA's measures of capital stock as the denominator; BEA uses the estimates of produced assets presented in this volume in its calculation of Q ratios as well as in its calculation of the rate of return for domestic nonfinancial corporations.[4] The estimates have also been used in international comparisons of profitability.

The depreciation estimates, in the form of consumption of fixed capital (CFC), are also an integral part of the NIPAs. Specifically, CFC is a component of gross domestic income (GDI), which measures output as the costs incurred and the incomes earned in the production of GDP and is therefore the equivalent of GDP on the income side of the National Income and Product Account. As a cost incurred in the production of GDP, CFC reflects the use of private and

1. The new depreciation patterns are discussed in Shelby W. Herman, "Fixed Assets and Consumer Durables," Survey of Current Business 80, (April 2000): 19–20. Revisions to the investment data are discussed in Eugene Seskin, "Improved Estimates of the National Income and Product Accounts for 1959–98: Results of the Comprehensive Revision," Survey 79, (December 1999): 15–43. Results of the 1999 comprehensive revision of the NIPAs are presented in U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts of the United States, 1929–97,* 2 vols. (Washington, D.C: U.S. Government Printing Office, September 2001).

2. See *Fixed Reproducible Tangible Wealth in the United States, 1925–94*, (Washington, D.C: U.S. Government Printing Office, August 1999) and Eugene P. Seskin and David F. Sullivan, "Annual Revision of the National Income and Product Accounts: Annual Estimates, 1997–1999 and Quarterly Estimates, 1997:I–2000:I," Survey 80 (August 2000): 6–33.

3. See Maria G. Perozek and Marshall B. Reinsdorf, "Alternative Measures of Personal Saving," SURVEY 82, (April 2002): 13–24.

4. Property income's rate of return to capital is calculated by BEA as the ratio of property income of domestic nonfinancial corporations—that is, their profits from current production—to the value of produced assets, which is the current-cost value of the net stock of equipment and software and of structures, and the replacement-cost value of inventories. See Dan Larkins, "Note on the Profitability of Domestic Nonfinancial Corporations, 1960–2001," SURVEY 82, (September 2002): 17–20.

government fixed assets located in the United States, and is defined as the decline in the value of the stock of assets due to wear and tear, obsolescence, accidental damage, and aging.[5] CFC is used in the context of measuring sustainable income and product: It is deducted from GDP and GDI to derive net domestic product and net domestic income—rough measures of the level of consumption that can be maintained while leaving capital assets intact. Similarly, CFC is deducted from the appropriate NIPA gross investment flows to obtain net investment in fixed assets for the total economy, for private business, and for government. These measures of net investment are rough indicators of whether the corresponding capital stocks have been maintained intact.

Additionally, the current-cost depreciation estimates for private fixed assets are used to derive the NIPA estimates of capital consumption adjustment (CCAdj), which in turn are used to estimate NIPA estimates of corporate profits and the income of other types of business.[6]

Relationship to the National Income and Product Accounts

The estimates presented in this publication are part of BEA's work on measuring the wealth of the Nation. Fixed assets are produced assets that are used repeatedly, or continuously, in processes of production for more than one year. (Produced assets are nonfinancial assets that have come into existence as outputs from a production process.) The acquisition of fixed assets by private business is presented in the NIPAs as part of gross private domestic investment. The acquisition of fixed assets by government is presented as part of government consumption expenditures and gross investment. Consumer durable goods are tangible commodities purchased by consumers that can be used repeatedly and continuously over a period of three or more years. Purchases of consumer durable goods by persons are presented in the NIPAs as part of personal consumption expenditures. Another part of BEA's work on measuring wealth is estimates of inventories owned by private business. The change in private inventories is presented in the NIPAs as part of gross private domestic investment; estimates of the stocks of private inventories also appear in selected NIPA tables.[7]

Estimates of depreciation for private business and government presented in this publication are generally the same as the CFC estimates presented as a component of GDI in the NIPAs. For private business, the two are identical. However, the adjustments made to general government capital for catastrophic losses are not included in NIPA CFC because general government output is measured by adding up costs including CFC; the inclusion of these losses would cause government output to increase.[8] Except during war times, these differences are minor and the terms are used synonymously in this publication.[9] The NIPA CFC estimates exclude the depreciation of consumer durables, because purchases of consumer durables are not treated as investment in the NIPAs.

Changes in the stock of fixed assets and private inventories are presented together in NIPA table 5.16 to provide an integrated analysis of the changes in the net stock of produced assets (excluding consumer durables)—that is, fixed assets and private inventories—from opening to closing balance sheets. The table fully accounts for changes in the net stock of produced assets excluding consumer durables by showing the sources of change—investment in fixed assets and in inventories, stock reconciliation adjustments, depreciation, catastrophic losses, and nominal and real holding gains—and how each of these factors affects the annual change in the net stock of produced assets valued at current cost.

5. For military facilities and U.S. embassies abroad, the locations of assets are worldwide.

6. For corporations and nonfarm sole proprietorships and partnerships, the CCAdj is the difference between tax-return-based capital consumption estimates and the CFC. The CCAdj restates the tax-return-based measures to be consistent with the NIPA concept of profits from current production. For farm sole proprietorships and partnerships and for other private business, the CCAdj is the difference between two capital consumption measures valued on the basis of BEA's depreciation schedules—one at historical cost and the other at current cost. (The industry depreciation estimates in this publication are not appropriate for deriving industry estimates of the CCAdj for use in the NIPAs because the tax-return-based NIPA estimates of business income and of depreciation are compiled on a company basis, while the depreciation estimates associated with the stock estimates are compiled on an establishment basis.)

Table 8.15 in the NIPAs presents the CCAdj by legal form of organization, and the corresponding estimates of CFC are shown in table 8.14.The estimates of CFC for nonprofit institutions serving households that appear in table 8.14 are also recorded as part of personal consumption expenditures.

7. Estimates of the stock of private inventories appear in tables 5.12 and 5.13 in *National Income and Product Accounts of the United States, 1929–97*, for 1947–97, and in the same tables in the August issues of the Survey for subsequent years. Current estimates of the stock of private inventories appear in the "Selected NIPA Tables" in each issue of the Survey. As available data are insufficient for preparing estimates of investment in inventories by government, the change in government inventories is treated as part of government consumption expenditures.

8. Note that in the NIPAs, the services of general government fixed assets are estimated to be equal to CFC. This does not provide an estimate of the full value of these services because the net return on the underlying assets is not included in this measure. See Robert P. Parker and Jack E. Triplett, "Preview of the Comprehensive Revision of the National Income and Product Accounts: Recognition of the Government Investment and Incorporation of a New Methodology for Calculating Depreciation," Survey 75 (September 1995): 36.

9. See Shelby W. Herman, "Fixed Assets and Consumer Durables," Survey, 80 (April 2000): 17–30.

Other stock measures

Alternative measures of the Nation's capital stock or of the services that it provides are estimated by other government agencies. The Bureau of Labor Statistics (BLS) estimates a capital services index, and corresponding productive capital stock, that is used as a measure of capital input in the estimation of multifactor productivity.[10] The measure of capital services is designed to measure the flow of services provided by capital assets in the production process, similar to the flow of labor hours. The BLS is not able to use a direct measure of these services because companies own, rather than rent, most of the capital assets that they use. Instead, the BLS estimates the capital service flow from historical data on investment, from estimates of the rates of deterioration and depreciation of capital, and from income data of firms utilizing capital. Although BLS uses formulas for deterioration that are not strictly consistent with formulas used by BEA for depreciation, the investment, income, and service-life data used by BLS are roughly similar to the estimates presented by BEA, resulting in depreciation rates that are generally consistent with BEA's estimates.[11]

The Office of Management and Budget (OMB), as part of its annual federal budget presentations to the President, prepares estimates of federally-financed capital stocks. These estimates are described by OMB as "very rough measures over time" of public physical capital, research and development, and education financed by the Federal Government.[12] The OMB estimates differ from those presented here both in terms of coverage and underlying source data. Specifically, while OMB's estimates of public physical capital are similar to BEA's estimates of government fixed assets, OMB also presents estimates of research and development capital and education capital. Likewise, while the coverage of OMB's estimates of "direct federal capital" is similar to that of the estimates of Federal Government stocks in this publication, OMB's estimates of "federally financed physical capital" also include "capital financed by Federal grants," such as highway construction financed by Federal grants-in-aid. Even where the coverage is the same, OMB's estimates differ somewhat from BEA's estimates because of differences in sources and methods. For instance, OMB uses its own fiscal-year historical investment data, which differ somewhat from the investment data underlying BEA's estimates. Additionally, the OMB estimates are prepared at a more aggregated level of detail. For example, defense equipment is a single category in the OMB estimates, while BEA's estimates of defense equipment consist of about 80 sub-categories.

10. For those fixed assets depreciated with a geometric rate, there is no difference between the wealth stock and the productive stock; however, BLS productive stocks are different from BEA's wealth stocks, as they use a different depreciation pattern. For example, the BLS productive stocks for each type of asset are based on estimates of how capital service flows of various vintages "deteriorate" as the asset ages. These measures are then aggregated into indexes of capital inputs using weights based on the implicit rental prices for each type of asset. These capital input indexes are used for productivity studies, such as those conducted by the BLS. Capital input indexes constructed in a similar way are used in studies by Edward F. Denison, John W. Kendrick, and Dale W. Jorgenson. For an explanation of the difference between productive capital stock and wealth stock, see Jack E. Triplett, "Depreciation in Production Analysis and in Income and Wealth Accounts: Resolution of an Old Debate," *Economic Inquiry* 34 (January 1996): 93–115.

11. See Edwin R. Dean and Michael J. Harper, "The BLS Productivity Measurement Program," in *New Developments in Productivity Analysis*, Charles R. Hulten, Edwin R. Dean, and Michael J. Harper (eds.), (Chicago and London, University of Chicago Press, 2001): 55–84.

12. Office of Management and Budget, "Federal Investment Spending and Capital Budgeting," *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2003* (Washington, D.C.: U.S. Government Printing Office, 2002).

Data Availability

Aggregate estimates—valued at current cost, historical cost, and real cost (chained dollars)—and chain-type quantity indexes of net stocks, depreciation, and investment are available on BEA's Web site at www.bea.gov. Detailed estimates—valued at current cost, historical cost, and real-cost—and chain-type quantity indexes, by industry and by type of asset, are also available on these Web sites. All of these estimates are also available on CD–ROM (NCN–0314) upon request. Please call the BEA Order Desk at 1–800–704–0415.

Concepts and Methodologies

Wealth, in the broadest sense, consists of assets that provide the capacity to produce output and income. The components of the Nation's wealth that are measured in this publication are fixed assets (equipment, software, and structures, including owner-occupied housing) owned by private business and nonprofit institutions or by governments, and durable goods owned by consumers.[13]

BEA's featured measure of the nation's fixed nonfinancial wealth is the net stock of fixed assets and consumer durables. Conceptually, the net stock estimates represent the value remaining in the capital stock after depreciating the assets using BEA's assumed depreciation patterns.[14]

Depreciation is defined as the decline in the value of the stock of assets due to wear and tear, obsolescence, accidental damage, and aging. For most types of assets, BEA's estimates of depreciation are based on geometric depreciation patterns, which are supported by empirical studies of the prices of used equipment and structures in resale markets.[15]

In addition to estimates of net stocks and depreciation and the associated investment flows, this volume provides estimates of the average age of the assets remaining in stock after being depreciated. The average age is derived as the weighted average of the ages of all depreciated investment in the stock as of yearend. The weight for each age is based on the proportion of its value as part of the total net stock.

Classification conventions

The estimates in this publication are classified by owner. In general, data limitations require the assumption that assets remain, throughout their lives, in the stock of the sector, industry, or legal form of organization that originally purchased them. However, the estimates do reflect net purchases of used assets among sectors for certain types of assets where data are available, including used autos sold by private business to consumers, exported used equipment, government surplus assets sold to private business, privately-owned public utilities purchased by government, and farm housing shifted to nonfarm use.[16]

Fixed assets held under operating leases are recorded in the stock of the lessor (owner) rather than in that of the lessee (user) in order to be consistent with the NIPA measures of product and income by industry. Assets held under other leases (that is, capital leases) are recorded in the stock of the lessee because the lessee has effective ownership of them.[17]

For private fixed assets, estimates by industry are classified according to the 1987 Standard Industrial Classification (SIC), which groups establishments into industries on the basis of their principal product or

13. Some wealth studies have also included human capital and land. For example, see John W. Kendrick, *The Formation and Stocks of Total Capital* (New York, NY: Columbia University Press, for the National Bureau of Economic Research, 1976) and Robert Eisner, *The Total Incomes System of Accounts* (Chicago, IL: The University of Chicago Press, 1989).

14. One of the improvements to BEA's wealth estimates made in the 1995 comprehensive revision of the NIPAs involves the use of geometric depreciation rates derived from empirical studies instead of the use of the straight-line method. With the previous methodology, all assets were fully depreciated at the end of their (finite) services lives. This method of depreciation allowed BEA to prepare two other "wealth" measures—gross stocks, which is the value of the stock of fixed assets and consumer durables before the deduction of depreciation, and "discards," which is the gross value of the investment that is retired. BEA no longer produces estimates of these two measures because, in using geometric depreciation rates, at least some assets in each vintage of the stock have infinite service lives and are never fully depreciated. For a more complete discussion of these improvements, see Barbara M. Fraumeni, "The Measurement of Depreciation in the U.S. National Income and Product Accounts, Survey 77 (July 1997): 7–23, and Arnold J. Katz and Shelby Herman, "Improved Estimates of Fixed Reproducible Tangible Wealth, 1929–95," Survey 77 (May 1997): 69–89.

15. The basis for BEA's methodology is described in Barbara M. Fraumeni, "The Measurement of Depreciation in the U.S. National Income and Product Accounts," Survey 77 (July 1997): 7–23. The geometric rates are based on studies by Hulten and Wykoff. See for example Frank C. Wykoff and Charles R. Hulten, "Tax and Economic Depreciation of the U.S. Capital Stock: A First Step," Washington D.C.: U.S. Department of the Treasury, Office of Tax Analysis, July 1979. In comparison, the BLS productive stocks for each type of asset are based on estimates of how capital service flows of various vintages "deteriorate" as the asset ages. These measures are then aggregated into indexes of capital inputs using weights based on the implicit rental prices for each type of asset. These capital input indexes are used for productivity studies, such as those conducted by the BLS. Capital input indexes constructed in a similar way are used in studies by Edward F. Denison, John W. Kendrick, and Dale W. Jorgenson.

16. Net purchases of used assets are valued at acquisition cost less accumulated depreciation.

17. Operating leases are chiefly distinguished from capital leases in that the net present value of the payments during the entire lease period is generally less than the cost of the asset. Estimates of net stocks that classify leased assets in the industry of the user may be preferable, but the data necessary to derive such estimates are not available.

service.[18] These industry estimates are for establishments rather than companies. An establishment is an economic unit, generally at a single physical location, where business is conducted or where services or industrial operations are performed. A company consists of one or more establishments owned by the same legal entity or group of affiliated entities. Most source data are collected at the establishment level. Where source data are collected at the company level, those companies are classified into a single SIC industry based on the principal SIC industry of all their establishments. Because large companies often own establishments that are classified in different SIC industries, the industrial distributions of investment, fixed assets, and capital consumption for establishments could be significantly different from the analogous industrial distributions for companies.

For residential assets, each dwelling is considered to be an establishment: Farm dwellings owned by farm operators are classified in the farms industry, and all other dwellings are classified in the real estate industry.

Overview of the estimating methodology

There are two basic methods for measuring net stocks. The physical inventory method applies independently estimated prices to a direct count of the number of physical units of each type of asset. The perpetual inventory method cumulates past investment flows to indirectly estimate the value of the stock. (To simplify the exposition, in this publication the terms "investment" or "fixed investment" denote any addition to the net stocks of fixed assets and consumer durables.) The physical inventory method is more direct, but is used only for autos because they are the only type of asset for which detailed data on the prices and number of units of used assets in the stock of each vintage is available (from registration data). For all other assets, the perpetual inventory method is used.

Perpetual inventory method. Estimates of net stocks and depreciation are generally calculated at the type-of-asset level of detail. For net stocks of private fixed assets, the level of detail is generally the same as that presented in NIPA tables 5.7, 5.9, and 5.15 on private fixed investment. For consumer durable goods, it generally is the same as that presented in NIPA table 2.7 on consumer durable purchases. For net stocks of government fixed assets, the type-of-asset level of detail is greater than that published in the NIPA tables.

For each type of good, the perpetual inventory method calculates the net stock in each year as the cumulative value of gross investment through that year—including both new investment and net purchases of used assets—less the cumulative value of depreciation through that year. In general, the calculations are performed at the type-of-asset level of detail. For current- and real-cost estimates, these detailed estimates are initially constructed in constant-dollar terms and reweighted and aggregated using the appropriate prices as described in the section on "Valuation" below. For historical-cost estimates, the detailed estimates are constructed in current-dollar terms and aggregates are obtained by directly summing the detailed estimates.

Investment. The estimates of investment underlying the estimates of net stocks are developed to be conceptually and statistically consistent with the NIPA estimates of investment as well as with the classifications of the SIC. To ensure this consistency, BEA derives its estimates of investment to meet three requirements: First, for each asset, new investment summed across all industries equals the NIPA estimate of total investment in that asset. Second, industries are classified on an establishment basis. Finally, assets are classified in the industry that purchases them.

The estimates of investment in new assets and of net purchases of used assets are derived from a combination of NIPA data and industry data. These data are reconciled to be consistent with NIPA totals and modified to be consistent with establishment-based industry classifications and ownership. These estimates are described in detail in the chapter on "Derivation of Investment Estimates."

Depreciation. BEA assumes most assets have depreciation patterns that decline geometrically over time. For any given year, the constant-dollar depreciation charge on an existing asset is obtained by multiplying the depreciation charge in the preceding year by one minus the annual depreciation rate.[19] BEA's geometric depreciation rates are derived by dividing declining balance rates by service lives, as illustrated in the equations on page M–7. Declining-balance rates are multiples of the comparable rate of depreciation that would be obtained for the first period of an asset's life using the straight-line method. Thus, when the declining balance rate is equal to 2 (referred to as a "double-declining balance"), the rate of depreciation in the first period of an asset's life is equal to twice the rate that

18. BEA's industry estimates of fixed assets published before 1992 were classified according to the 1972 SIC. For a detailed presentation of the 1987 SIC revisions, see Executive Office of the President, Office of Management and Budget, *Standard Industrial Classification Manual, 1987* (Washington, D.C.: U.S. Government Printing Office, 1987). With the next comprehensive revision of the NIPAs, these industry estimates will be classified according to the North American Industry Classification System (NAICS).

19. New assets are assumed, on average, to be placed in service at midyear, so that depreciation on them in the first year is equal to one-half the new investment times the depreciation rate.

would have been obtained using the straight-line method. Although there are exceptions, the declining-balance rates for specific types of assets are based on the empirical studies of Hulten and Wykoff, and the

Basic Formulas

Net stocks are estimated using the perpetual inventory method with geometric depreciation. The method begins with the investment for each year i in asset j, that is, I_{ij}. For current-cost and real-cost valuation, the investment that is used in the calculation is in constant dollars; that is, investment in current dollars has been deflated by the price index for that type of asset with 1996 as the reference year. For historical-cost valuation, investment in current dollars is used.

The annual geometric rate of depreciation for type of asset j, δ_j, is related to the declining-balance rate for type of asset j, R_j, and to the average service life for type of asset j in years, T_j, by:

$$\delta_j = \frac{R_j}{T_j} \tag{1}$$

Consider the contribution of investment during year i in type of asset j to the real-cost net stock at the end of year t, N_{tij}. New assets are assumed, on average, to be placed in service at midyear; thus, depreciation on them is equal to one-half the new investment times the depreciation rate. Therefore, the contribution to the real-cost net stock at the end of year t is given by:

$$N_{tij} = I_{ij}\left(1-\frac{\delta_j}{2}\right)\left(1-\delta_j\right)^{t-i}, \quad where \quad t \geq i \tag{2}$$

To calculate the real-cost net stock at the end of year t for asset j, N_{tj}, the contributions are summed over all vintages of investment flows for that asset so that:

$$N_{tj} = \sum_{i=1}^{t} N_{tij} \tag{3}$$

The equations used to estimate historical-cost stocks are identical to equations (2) and (3) except that the investment flows are expressed at historical cost rather than real cost.

Current-cost estimates of the net stock of asset j (in dollars), C_{tj}, are obtained by multiplying the constant-dollar net stock at the end of year t for asset j by the value at the end of year t of the price index that was used to deflate nominal investment in asset j, P_{tj}, so that:

$$C_{tj} = P_{tj} N_{tj} \tag{4}$$

The current-cost net stock of assets at the end of the year t, C_t, is estimated as the sum across all types of assets of the stocks derived above, so that:

$$C_t = \sum_j C_{tj} \tag{5}$$

Depreciation on asset j during year t, D_{tj}, equals the net stock of asset j at the end of year t-1 plus investment in asset j during year t less the net stock of asset j at the end of year t, so that:

$$D_{tj} = N_{t-1,j} + I_{tj} - N_{tj} \tag{6}$$

This equation holds under real-cost and historical-cost valuation.

Current-cost depreciation, M_{tj}, is calculated by multiplying constant-dollar depreciation from equation (6) by the average price of asset j during year t, $\bar{P}_{tj}$, so that:

$$M_{tj} = \bar{P}_{tj} D_{tj}. \tag{7}$$

Current-cost depreciation for an aggregate of assets in year t is calculated by summing across the various type so of assets, that is, by:

$$M_t = \sum_j M_{tj} \tag{8}$$

Quantity Indexes

Chain-type quantity indexes are computed using the Fisher ideal index formula. For net stocks, the relative change in the value of the index, Q^N_t, between time t and t-1 is given by

$$\frac{Q^N_t}{Q^N_{t-1}} = \sqrt{\frac{\Sigma_j N_{tj} P_{tj}}{\Sigma_j N_{t-1,j} P_{tj}} \cdot \frac{\Sigma_j N_{tj} P_{t-1,j}}{\Sigma_j N_{t-1,j} P_{t-1,j}}} \tag{9}$$

where N_{tj} is the net stock of asset j at time t, and $\bar{P}_{tj}$ is the end of year price index for asset j at time t.

Similarly, for depreciation, the relative change in the value of the index, Q^D_t, between time t and t-1 is given by

$$\frac{Q^D_t}{Q^D_{t-1}} = \sqrt{\frac{\Sigma_j D_{tj} \bar{P}_{tj}}{\Sigma_j D_{t-1,j} \bar{P}_{tj}} \cdot \frac{\Sigma_j D_{tj} \bar{P}_{t-1,j}}{\Sigma_j D_{t-1,j} \bar{P}_{t-1,j}}} \tag{10}$$

where D_{tj} is the depreciation of asset j at time t, and P_{tj} is the average price index for asset j at time t.

The values for each index are estimated by setting the level of the index to 100 in the reference year and then repeatedly using the quantity relatives from equations (9) or (10) for each pair of years to compute successive values of the index.

service lives are developed by BEA.[20] The chapter on "Derivation of Depreciation Estimates" discusses these estimates in detail.

The main advantage of the perpetual inventory method is that for the most part, comprehensive, detailed, and relatively reliable data on new investment are available to implement it. The main limitations relate to the uncertain accuracy of the depreciation rates (which are generally a function of the assumed service lives), and of the value of net purchases of used assets. The information currently available on service lives is limited with respect to detail and may not fully reflect the effects of changes in business conditions and technology that may have led to variations in service lives over time. The information currently available on the value of net purchases of used assets is largely limited to net purchases between private businesses and governments, consumers, and nonresidents; net purchases between industries or between legal forms of organization within private business are not reflected. These estimates of net purchases at depreciated cost are discussed in the chapter on "Derivation of Investment Estimates."

Valuation

BEA values the net stocks and depreciation of fixed assets and consumer durables at historical cost, current cost, and real cost. The construction and aggregation of each type of estimate is discussed below and illustrated in the equations on page M–7. Estimates of the average age of net stocks are constructed only at historical- and current-cost.

Current-cost valuation. Current-cost estimates of net stocks and depreciation reflect the prices of the given period. For instance, the estimate of the net stock for 1997 reflects the value of the stock expressed in the prices that would have been paid for those assets if they had been purchased at the end of 1997. Similarly, the 1925 net stock estimate reflects the value of the stock in 1925 expressed at the prices that would have been paid for them if they had been purchased in 1925.

In principle, the current-cost net stock is the market, or replacement, value of the stock; that is, the value for which the assets in the stock could be bought or sold in that year. In equilibrium, this market value will equal the present value of all expected future services embodied in existing assets.

Current-cost estimates of net stocks and depreciation are derived by converting the corresponding constant-dollar estimates of depreciation and net stocks to the prices of the current period. Specifically, estimates of investment in current dollars are deflated, using the appropriate price index for that asset for each year, to reflect 1996 prices.[21] Estimates of depreciation are derived by applying to this constant-dollar investment series assumed depreciation patterns and service lives. Following the perpetual inventory method, constant-dollar estimates of net stocks for each year are derived by deducting these estimates of depreciation, summed over all years, from the constant-dollar estimates of investment, also summed over all years. These constant-dollar estimates are then multiplied by the appropriate price indexes of the current year to derive current-dollar estimates of net stocks and depreciation: Net stock estimates are derived using indexes that reflect new asset prices at the end of the given year, and depreciation estimates are derived using indexes that reflect the average prices of new assets over the entire year.[22] (For quarterly CFC estimates in the NIPAs, average quarterly prices are used.) Current-cost aggregates are

20. Information on Hulten and Wykoff's methodology is largely found in the following three sources: (1) Frank C. Wykoff and Charles R. Hulten, "Tax and Economic Depreciation of Machinery and Equipment: A Theoretical Appraisal, Phase II Report," *Economic Depreciation of the U.S. Capital Stock: A First Step,* Washington, D.C.: U.S. Department of the Treasury, Office of Tax Analysis, July 26, 1979; (2) Charles R. Hulten and Frank C. Wykoff, "The Estimation of Economic Depreciation Using Vintage Asset Prices," *Journal of Econometrics 15,* (April, 1981): 367–396; and (3) Charles R. Hulten and Frank C. Wykoff, "The Measurement of Economic Depreciation." In *Depreciation, Inflation, and the Taxation of Income from Capital,* edited by Charles R. Hulten, 81–125. Washington, D.C.: The Urban Institute Press, 1981. For further elaboration on the specific BEA rates, see Fraumeni, "The Measurement of Depreciation."

21. The price indexes used to derive the stock estimates for current-cost and real-cost estimates are the same as those used to derive real GDP and its components. These price indexes are described in "Updated Summary NIPA Methodologies," SURVEY 82 (October 2002), especially in Table 2, "Methodologies Used in Preparing Estimates of Real GDP," pp. 34–38. The price indexes are also described in "The Comprehensive Revision of the U.S. National Income and Product Accounts: A Review of Revisions and Major Statistical Changes," SURVEY 71 (December 1991): 37–40 and "Annual Revision of the U.S. National Income and Product Accounts," SURVEY 72 (July 1992), table 8, pp. 37–42. For personal consumption expenditures for durable goods, see U.S. Department of Commerce, Bureau of Economic Analysis, *Personal Consumption Expenditures,* NIPA Methodology Paper No. 6 (Washington DC: U.S. Government Printing Office, June 1990): 67–73; and for government investment, see U.S. Department of Commerce, Bureau of Economic Analysis, *Government Transactions,* NIPA Methodology Paper No. 5 (Washington DC: U.S. Government Printing Office, November 1988): 50–64.

For investment in electric light and power structures, the NIPA price indexes are modified to reflect price changes in the value of completed plant, in accordance with the modifications to the NIPA investment data described in the section "Investment control totals by type of asset" in the chapter "Derivation of Investment Flows."

22. Beginning with 1947, yearend prices are derived as the average of fourth-quarter prices in the current year and first-quarter prices in the following year. Before 1947, yearend prices are derived as the average of the annual average price of the current year and the annual average price of the following year. Average annual price indexes are equal to 100 in the base period, 1996. Thus, the 1996 values of real-cost and current-cost depreciation (and of discards) are equal, because these are average annual values. The 1996 values of real-cost and current-cost net stocks are usually not equal, because these are yearend values, and prices usually change during the year.

obtained by directly summing the current-cost estimates for the various types of assets.

Real-cost valuation. Real-cost estimates, expressed in this publication as chain-type quantity indexes or as chained (1996) dollars, remove the effects of price change and are often called "physical-volume" estimates. Detailed real-cost estimates for each asset type are the constant-dollar estimates described above. Aggregate real-cost estimates of net stocks and depreciation are derived by weighting and chaining the detailed constant-dollar estimates of net stocks and depreciation described above. That is, the detailed constant-dollar estimates are entered along with price weights (derived by dividing the relevant current-dollar estimates by their constant-dollar counterparts) into a Fisher formula that uses the price weights from adjacent years to calculate the rate of change in quantities from year to year. For example, the 1996–97 rate of change in real investment uses prices for 1996 and 1997 as weights. These annual rates of change are then "chained" (multiplied) together to form a time series of rates of quantity change that is expressed as index numbers or as chained dollars with 1996 as the reference year.

The chain-type quantity indexes provide accurate estimates of the growth rate from one year to the next because they use relevant weights—that is, weights that reflect the composition of prices in adjacent years rather than the weights of a single base year. Thus, when the base year is updated, the levels of the estimates change but the growth rates of the various series do not, and the revisions to the growth rates that result from updating the base period of a fixed-weighted index are avoided.[23]

Quality change. The deflation of current-dollar investment estimates to the prices of a base year to obtain a real-cost investment series is complicated by the need to account for new products or quality changes introduced since the base period. Similarly, depreciation patterns estimated using empirically-measured transactions prices for used assets must also be adjusted for quality change.[24] Where possible, these adjustments are introduced into BEA's estimates of investment, and thus into net stocks and depreciation through the use of quality-adjusted price indexes in the deflation process. The price indexes incorporate adjustments for quality change through a number of methods.[25] For instance, for the deflation of equipment, BEA primarily uses producer price indexes (PPI's) published by BLS. Five methods are used by BLS to adjust the PPI's for quality change.[26]

The explicit quality adjustment method uses the ratio of the producer's cost of the new product to the producer's cost of the old product to evaluate their relative quality so that the price of the new product can be adjusted accordingly. This method is used when quality changes are considered to be significant and when the necessary producer cost data are available.

With the overlap method, the ratio of the price of the new model to that of the old model during the overlap period provides the basis for evaluating relative quality. This method is used when quality change is considered to be significant and the data necessary to implement the explicit quality adjustment method are not available.

The method of linking prices of new and old models attributes all of the difference in prices between old and new models to a change in quality. This method is used when quality changes are considered to be significant, and data are not available to implement either the explicit quality adjustment method or the overlap method. To the extent that pure price changes occur when new models are introduced, this method tends to attribute too much of the difference in price between

23. See Jack E. Triplett, "Economic Theory and BEA's Alternative Quantity and Price Indexes," SURVEY 72 (April 1992): 49–52. The percentage changes calculated from the chained-dollar estimates and from the chain-type quantity indexes are the same; the chained-dollar estimates are most appropriately interpreted as index numbers with a reference value other than 100. However, because the relative prices used as weights for any period other than the reference year differ from those used for the reference year, the chained-dollar values of components will not necessarily sum to the chained-dollar values of aggregates. As the relative prices—or weights—change with time, the difference—or residual—between the sums of the chained-dollar values of the components and chained-dollar values of the aggregate may become larger as one moves further from the reference year. Thus, the chained-dollar estimates become less useful as an approximate measure of relative magnitude as one moves further from the reference year. In general, the use of chained-dollars to calculate component shares or contributions to growth may be misleading for periods away from the reference year.

24. Oliner discussed this problem when he stated that depreciation patterns in the NIPAs should be based on "partial," rather than on "full" depreciation; See Stephen D. Oliner, "Price Change, Depreciation, and Retirement of Mainframe Computers," in *Price Measurements and Their Uses,* Murray F. Foss, Marilyn E. Manser, and Allan H. Young (eds.), Studies in Income and Wealth, vol. 57 (Chicago: University of Chicago Press, for the National Bureau of Economic Research, 1993): 48–61.

25. See Jack E. Triplett, "Concepts of Quality in Input and Output Price Measures: A Resolution of the User-Value Resource-Cost Debate," in *The U.S. National Income and Product Accounts: Selected Topics,* Murray F. Foss (ed.), Studies in Income and Wealth, vol. 47 (Chicago, IL: University of Chicago Press, for the National Bureau of Economic Research, 1983). Also see Robert J. Gordon, The *Measurement of Durable Goods Prices*, National Bureau of Economic Research Monograph Series, (Chicago and London, University of Chicago Press, 1990).

26. The treatment of quality change in the PPI's is described in John F. Early and James H. Sinclair, "Quality Adjustment in the Producer Price Indexes," in *The U.S. National Income and Product Accounts: Selected Topics,* Murray F. Foss (ed.), Studies in Income and Wealth, vol. 47 (Chicago, IL: University of Chicago Press, for the National Bureau of Economic Research, 1983). BLS uses similar methods for the consumer price index, which is the basis for deflating expenditures on consumer durable goods. Also, see James Sinclair and Brian Catron, "An Experimental Price Index for the Computer Industry," *Monthly Labor Review 113* (October 1990): 16–24. For computers and computer peripheral equipment, BEA also uses price indexes that it has developed using hedonic methods.

new and old models to quality change.

Hedonic quality adjustment measures quality change as a weighted average of changes in the physical characteristics of the fixed asset with weights determined by multiple regression analysis.[27] The weights that are estimated by regression analysis can be interpreted as the approximate market valuations of each characteristic.

Finally, the direct price comparison method counts quality change as zero, and prices of new and old models are directly compared. This method is used when quality changes are assumed to be very small.

Adjusting prices for quality change is difficult for some assets. For example, estimates of investment in new permanent-site housing are adjusted for quality change by using separate hedonic price indexes for single-family housing and for multifamily housing in the deflation process.[28] But distinguishing between price and quality change is more difficult for nonresidential structures because the unique nature of many construction projects limits the comparable projects available for price comparisons. As no price indexes that incorporate an explicit adjustment for quality change are available for the types of structures being deflated, these estimates, which are deflated using a variety of price and cost indexes, are not adequately quality-adjusted.[29]

Historical-cost valuation. Historical-cost estimates of net stocks are analogous to book value estimates used on company reports and financial statements in that assets are valued at the prices prevailing when they were purchased. Historical cost estimates of the net stock are the depreciated values of these acquisition costs of assets using BEA's assumed depreciation patterns.

Following the perpetual inventory method, estimates of net stocks at historical cost are derived for each year by deducting historical-cost depreciation estimates, summed over all years, from historical-cost estimates of investment, also summed over all years. Specifically, for each year, investment is depreciated by applying to the acquisition cost of each asset the same depreciation patterns and service lives used to derive the current-cost estimates. These historical-cost depreciation estimates are summed over all years and deducted from the historical-cost estimates of investment summed over all years to derive net stocks for each year. The resulting estimates of depreciation and net stocks are directly summed to derive aggregates at the industry, legal form, and national levels.

Relationship among estimates. As noted above, for historical-cost estimates, the conceptual relationships among investment, net stocks, and depreciation are simple: the change in the net stock from the end of one year to the next equals investment less depreciation, and the sum of depreciation charges for an individual asset over its life (or for a group of assets over their lives) is equal to the amount of the original investment. These relationships do not hold for current- and real-cost estimates. First, the current-cost and real-cost estimates are derived using weights that reflect prices of more than one period and are therefore not additive. Specifically, the first relationship does not hold for current-cost estimates because end-of-year price indexes are used to revalue constant-dollar estimates of net stocks to the prices of each year, while average annual price indexes are used to revalue the estimates of depreciation. Real-cost aggregates are estimated using a chain-type quantity index and therefore do not equal the sum of their components. At the level at which the most detailed estimates of investment are calculated, the real-cost end-of-period net stock does equal the beginning-of-period stock plus investment less depreciation. However, this relationship does not hold for some types of assets for which the estimate of investment is built up from components that have different deflators.[30] The relationship for lifetime depreciation charges does not hold for similar reasons: current-cost depreciation estimates are valued in the prices of the year in which the depreciation occurs, while investment is valued at acquisition costs. At the lowest level of detail, this relationship does hold for real-cost estimates (except when an asset is prematurely retired, such as through surplusing from the stock of government assets), but does not hold for aggregated estimates because the estimates are not additive.[31]

Adjustments for catastrophic losses and obsolescence

BEA adjusts the value of net stocks to account for catastrophes, such as hurricanes, earthquakes, and the terrorist attacks of September 11, 2001, in which large amounts of fixed assets and consumer durables are destroyed.[32] The adjustments for fixed assets are presented in the NIPAs in table 5.16, along with the other

27. See Jack E. Triplett, "The Economic Interpretation of Hedonic Methods," Survey 66 (January 1986): 36–40.

28. See "The Comprehensive Revision of the U.S. National Income and Product Accounts: A Review of Revisions and Major Statistical Changes," Survey 71 (December 1991): 40.

29. For sources of construction prices see *Value of Construction Put in Place,* Appendix D, "Adjustment For Seasonal Variation and Cost Changes," U.S. Bureau of the Census (C40), monthly.

30. In general, when "real" estimates are derived using a chained-type quantity index, the sum of the real values of the various components of an aggregate will differ from the aggregate's real value by a "residual."

31. When the depreciation pattern is strictly geometric, some assets have infinite lives so that this relationship only holds asymptotically.

32. See the "Business Situation," Survey 72 (September 1992): 2, and the "Business Situation," Survey 81(November 2001): 2.

sources of change in the value of the net stocks of fixed assets and private inventories, as described above. In general, the adjustments for catastrophes are made if the cost of the damage equals at least one-quarter of one percent of total private consumption of fixed capital (this proportion of consumption of fixed capital was about $2.1 billion in 1997). The adjustments to general government assets are not included in the NIPA estimates of consumption of fixed capital that are included in gross domestic product (GDP) because government consumption expenditures are measured by adding up costs including CFC. Excluding these adjustments avoids increasing the measured output of fixed government assets in GDP when there are catastrophic losses.

The depreciation schedules used to derive the estimates reflect the effects of normal obsolescence over time. Ideally, the estimates of net stocks should also be adjusted for declines in value caused by unusually or unexpectedly large amounts of obsolescence, as the depreciation rates used to derive the estimates reflect only the effects of normal obsolescence over time.[33] However, the data on the impact of obsolescence that are necessary to make such adjustments are not available.

33. Some argue that government pollution abatement and safety regulations, sudden changes in energy prices, and increased foreign competition have caused certain capital assets to experience significantly higher-than-normal amounts of obsolescence.

Derivation of Investment Estimates

This chapter describes the investment flows underlying BEA's perpetual inventory estimates of net stocks and depreciation. Specifically, this chapter explains the derivation of the estimates of investment in private and government fixed assets and the estimates of expenditures by consumers on durable goods.

Investment in Private Fixed Assets

The estimates of investment by industry and by type of asset used to derive the perpetual inventory estimates of private fixed assets are designed to be consistent with the NIPAs and with the SIC. The estimates reflect three requirements: First, for each asset, new investment summed across all industries equals the NIPA estimate of total investment in that asset. Second, industries are classified on an establishment basis. Finally, assets are classified in the industry that owns them.

In general, estimates are developed in the following manner: First, estimates are derived of investment in new nonresidential and residential assets for each industry and of net purchases of used assets between private business and other types of owners. Second, these estimates are distributed by legal form of organization. Finally, the estimates of investment by type of asset, industry, and legal form of organization are deflated to constant dollars using appropriate price indexes. These estimates are then used in the derivation of current- and real-cost estimates. The first two steps are described in the following sections; deflation is discussed in the section on valuation in the previous chapter.

Sources

The estimates of investment in new nonresidential and residential assets and of net purchases of used assets are primarily based on NIPA data on investment by type of asset and industry data from several sources. The NIPAs provide data on investment by type of asset for years since 1929. Estimates of expenditures on prepackaged, custom, and own account software—now recognized as investment in the NIPAs and included in net stocks of fixed assets—are available for 1959 to 1997. (Before 1959, expenditures on software were insignificant.) To derive estimates of net stocks for 1925–1929, the NIPA investment estimates are extrapolated back to before 1900 for some assets (see the section "Investment controls by type of asset").

The NIPA estimates of investment in equipment and software and in structures are sometimes modified for estimating net stocks, primarily to exclude dealers' margins or brokers' commissions from net purchases of used assets among sectors of the economy.[34] In addition, the NIPA estimates are supplemented to provide detail not available in the NIPAs, primarily on the industrial distribution of investment in private fixed assets.

Estimates of investment by industry in nonresidential assets are available from several sources. Some provide information for selected benchmark years; others provide information for interpolations between and extrapolations from the benchmark years. Wherever possible, the investment control totals are based on capital expenditures data collected from each industry. Where these data are not available, the estimates are derived as the change in net stocks plus depreciation from industry balance sheet data. The balance sheet data are primarily from the *Statistics of Income* published by the Internal Revenue Service (IRS) and from Federal regulatory agencies.

There are five major sources of data on industry capital expenditures. The first, economic censuses conducted by the Bureau of the Census, provide data classified on an establishment basis on capital expenditures in the mining, construction, manufacturing, wholesale trade, retail trade, and selected service industries. Most of these data are available only at intervals of several years (every 5 years since 1967), and all data prior to 1977 provide only a two-way split by type of asset (that is, total equipment and total structures). Beginning with the 1977 economic census, the data on equipment expenditures in the manufacturing industries includes detail on highway vehicles, computers and peripheral equipment, and other equipment. This expanded asset detail is also available beginning with the 1987 census for construction,

34. Dealers' margins for used equipment and brokers' commissions on sales of used structures are included in fixed investment in the NIPAs but are not included in nonresidential fixed stocks.

Table A. Source Data for Preparation of Estimates of New Private Nonresidential Investment by Industry

Industry	Years before 1947	1947–77 (includes census years up to and including 1977)	1978–92		Years after 1992 [2]
			Economic census years 1982, 1987, and 1992	Noncensus years [1]	
Agriculture, forestry, and fishing:					
Farms	USDA, Trends	USDA	USDA, NIPA	USDA, NIPA	USDA, NIPA
Agricultural services, forestry, and fishing	USDA, Trends	P&E	P&E, NIPA	P&E, NIPA	ACES, NIPA, P&E
Mining	HS, EC (CMI and CM), NIPA	EC (CMI), ES, P&E, NIPA, Oil & Gas	EC (CMI), ES, NIPA	P&E, NIPA	ACES, NIPA, P&E
Construction	Boddy & Gort, HS	EC (CCI), ES, P&E, NIPA	EC (CCI), ES, NIPA	P&E, NIPA	ACES, NIPA, P&E
Manufacturing	Chawner, NIPA, CS, HS, EC (CM), Kuznets, Shaw	EC (CM), ASM, ES, P&E, NIPA	EC (CCI), ES, NIPA	ASM, NIPA	ASM, ACES, NIPA
Transportation and public utilities:					
Transportation:					
Railroad transportation	ICC, NIPA, Ulmer, TA, CS	ICC, NIPA, TA,	P&E P&E, NIPA, TA , ICC (1982)	P&E, NIPA	ACES, NIPA
Local and interurban passenger transit	Ulmer, CS, TA, NIPA, ICC	ICC, TA, CS, P&E, NIPA	P&E, NIPA	P&E, NIPA	ACES, NIPA, P&E
Trucking and warehousing	NIPA, Ulmer, TA, ICC	ICC, EC (CWT), EC, (CT) [3], P&E	ICC (1982), P&E, EC, (CT) [3]	P&E, TA, NIPA	ACES, NIPA
Water transportation	NIPA, HS, ICC	NIPA, ICC, P&E	P&E, NIPA, TA	P&E, NIPA	ACES, NIPA. P&E
Transportation by air	NIPA, HS	NIPA, DOT, P&E	DOT, NIPA, P&E, TA	DOT, NIPA, P&E	DOT, ACES, NIPA
Pipelines, except natural gas	ICC, NIPA, CS, HS	ICC, NIPA, P&E	NIPA, P&E	NIPA, P&E	ACES, NIPA
Transportation services	ICC, NIPA, Ulmer, TA, CS	ICC, NIPA, TA, P&E	P&E, NIPA, TA	P&E, NIPA	ACES, NIPA, P&E
Communications:					
Telephone and telegraph	NIPA, CS, USDA, Ulmer	NIPA, TA, CS, USDA, FCC, Crandall, P&E, CAR	FCC, NIPA, CAR, TA, Crandall, ACES, P&E, USDA	FCC, NIPA, CAR, TA, Crandall, ACES, P&E, USDA	ACES, NIPA, FCC, CAR, TA, P&E, USDA
Radio and television	Boddy & Gort	P&E, TA, NIPA	P&E, TA, UC, NIPA	P&E, TA, UC, NIPA	ACES, NIPA
Electric, gas, and sanitary services:					
Electric services	Ulmer, NIPA, CS, USDA, DOE FS	DOE FS, NIPA, USDA, P&E	DOE FS, DOE EP, NIPA, USDA, UC	DOE FS, DOE EP, NIPA, USDA, UC	DOE FS, DOE EP, NIPA, USDA, UC, ACES
Gas services	Ulmer, NIPA, CS, TA, UC	NIPA, CS, UC, TA, P&E	NIPA, P&E, TA	NIPA, P&E, TA	NIPA, ACES
Sanitary services	Ulmer	P&E, DOE FS, TA	P&E, DOE FS, TA	P&E, DOE FS, TA, NIPA	ACES, DOE FS, TA, NIPA
Wholesale trade	Boddy & Gort	EC (CWT) [4], P&E, ES	EC (CWT) [4], ES, TA	P&E, NIPA	ACES, NIPA, P&E, UC
Merchant wholesale	.....	EC (CWT) [4], ES	EC (CWT) [4], ES	.....	.....
Nonmerchant wholesale	.....	EC (CWT), ES	EC (CWT), ES, TA	.....	.....
Retail trade	CS, HS	EC (CRT) [4], P&E	EC (CRT) [4]	P&E, NIPA	ACES, NIPA, UC
Finance, insurance, and real estate:					
Finance and insurance	SOI, HS	P&E, TA	P&E, TA	P&E, NIPA	ACES, NIPA, P&E
Real estate	SOI, HS, CS, UC, TA	P&E, TA, UC, NIPA, SOI	P&E, TA, NIPA, UC, EC(CCI)	P&E, NIPA	ACES, NIPA, P&E
Services:					
Hotel and other lodging places	SOI, UC	EC (CSI) [4], P&E, UC	EC (CSI) [4], NIPA	NIPA	ACES, NIPA
Personal services	SOI, UC	EC (CSI) [4], P&E, UC	EC (CSI) [4]	P&E, NIPA	ACES, NIPA
Business services	SOI, UC	EC (CSI) [4], P&E, UC	EC (CSI) [4], TA	P&E, NIPA	ACES, NIPA
Auto repair, services, and parking	SOI, UC	EC (CSI) [4], P&E, UC	EC (CSI) [4], TA, NIPA	P&E, TA, NIPA	ACES, TA, NIPA, P&E
Miscellaneous repair services	SOI, UC	EC (CSI) [4], P&E, UC	EC (CSI) [4]	P&E, NIPA	ACES, NIPA
Motion pictures	SOI, UC	EC (CSI) [4], P&E, UC	EC (CSI) [4], UC	P&E, UC, NIPA	ACES, UC, NIPA
Amusement and recreation services	SOI, UC	EC (CSI) [4], P&E, UC	EC (CSI) [4], UC	P&E, UC, NIPA	ACES, UC, NIPA
Health services	SOI, TA	P&E, TA	EC (CSI) [4], P&E, NIPA, TA	P&E, NIPA	ACES, NIPA, P&E
Legal services	SOI, TA	P&E	EC (CSI) [4], P&E	P&E, NIPA	ACES, NIPA
Education services	NIPA, CS, SOI, USDE	NIPA, P&E, USDE	EC (CSI 1987, 1992) [4], P&E, NIPA, USDE	P&E, NIPA	ACES, NIPA
Other services [5]	SOI, NIPA, CS	P&E, NIPA	EC (CSI 1987, 1992) [4], P&E, NIPA	P&E, NIPA	ACES, NIPA

1. Used to interpolate between economic census year estimates.
2. Used to extrapolate forward from 1992.
3. Data are from the truck inventory and use survey taken as part of the Census of Transportation for years 1963, 1967, 1972, 1977, 1982, and 1987; and for 1992 taken as part of the Census of Transportation, Communications, and Utilities.
4. Data are from the capital expenditures survey taken as part of the economic census for the years through 1982 and for 1987 and 1992 from the assets and expenditures survey taken as part of the economic census.
5. "Other" services consists of the following industries: Social services; museums; botanical, zoological gardens; membership organizations; engineering and management services; and services, not elsewhere classified.

NOTE. The source data provided in this table are those used to allocate estimates of private nonresidential investment to the various industries. For most economic census years, the distribution is based on the capital flow tables prepared by BEA as part of the benchmark input-output accounts.

ACES — U.S. Department of Commerce, Bureau of the Census, Annual Capital Expenditures Survey (Washington, DC: U.S. Government Printing Office, annually beginning in 1992).

ASM — U.S. Department of Commerce, Bureau of the Census, Annual Survey of Manufactures (Washington, DC: U.S. Government Printing Office, annually).

Boddy & Gort Rayford — Boddy and Michael Gort, "Capital Expenditures and Capital Stocks," Annals of Economic and Social Measurement 2/3 (1973); and "The Derivation of Investment Expenditures and Capital Stocks" (typewritten, 1968).

CAR — Data from company annual reports.

Chawner — Lowell J. Chawner, "Capital Expenditures for Manufacturing Plant and Equipment—1915 to 1940," SURVEY OF CURRENT BUSINESS 21 (March 1941): 9–15; "Capital Expenditures in Selected Manufacturing Industries," SURVEY 21 (December 1941): 19–26; and "Capital Expenditures in Selected Manufacturing Industries, Part II," SURVEY 22 (May 1942): 14–23.

Crandall — Robert W. Crandall, After the Breakup: U.S. Telecommunications in a More Competitive Era (Washington, DC: The Brookings Institution, 1991).

CS — U.S. Department of Commerce, Business and Defense Services Administration, Construction Statistics 1915–64: A Supplement to Construction Review (Washington, DC: U.S. Government Printing Office, 1966).

DOE EP — U.S. Department of Energy, Energy Information Administration, Electric Power Annual, 2 vols. (Washington, DC: U.S. Government Printing Office, annually).

DOE FS — U.S. Department of Energy, Energy Information Administration, Financial Statistics of Selected Investor-Owned Electric Utilities (Washington, DC: U.S. Government Printing Office, annually).

DOT — U.S. Department of Transportation, Air Carrier Financial Statistics (Washington, DC: U.S. Government Printing Office, annually).

EC — U.S. Department of Commerce, Bureau of the Census, Census of Construction Industries (CCI): 1967, 1972, 1977, 1982, 1987, and 1992; Census of Manufactures (CM): 1947, 1958, 1963, 1967 1972, 1977, 1982, 1987, and 1992; Census of Mineral Industries (CMI): 1954, 1958, 1963, 1967, 1972, 1977, 1982, 1987, and 1992; Census of Retail Trade (CRT): 1958, 1963, 1967, 1972, 1977, 1982, 1987, and 1992; Census of Service Industries (CSI): 1958, 1963, 1967, 1972, 1977, 1982, 1987, and 1992; Census of Transportation (CT): 1963, 1967, 1972, 1977, 1982, 1987, and 1992; and Census of Wholesale Trade (CWT): 1958, 1963, 1967, 1972, 1977, 1982, 1987, and 1992 (Washington, DC: U.S. Government Printing Office, quinquennially).

ES — U.S. Department of Commerce, Bureau of the Census, Enterprise Statistics: 1954, 1958, 1963, 1967, 1972, 1977, 1982, 1987, and 1992 (Washington, DC: U.S. Government Printing Office, quinquennially).

FCC — Federal Communications Commission, Statistics of Communications Common Carriers (Washington, DC: Federal Communications Commission, annually).

HS — U.S. Department of Commerce, Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1970, 2 vols. (Washington, DC: U.S. Government Printing Office, 1975).

ICC — Interstate Commerce Commission, Transport Statistics in the United States (Washington, DC: U.S. Government Printing Office, annually).

Kuznets	Simon Kuznets, Capital in the American Economy: Its Formation and Financing (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1961).
NIPA	For 1929–94, U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts of the United States, 1929–94, 2 vols. (Washington, DC: U.S. Government Printing Office, 1998); and for 1995–96, see SURVEY 77 (August 1997): 6–167. See the following tables: Current-dollar expenditures, tables 2.6, 5.6, 5.8, and 5.14 and chain-type quantity and price indexes, tables 7.5, 7.7, 7.8, and 7.13.
Oil & Gas	U.S. Department of Commerce, Bureau of the Census, Annual Survey of Oil and Gas (Washington, DC: U.S. Government Printing Office, annually through 1982).
P&E	U.S. Department of Commerce, Bureau of the Census, Plant and Equipment Survey (unpublished annual data for 1947–93).
Shaw	William H. Shaw, Value of Commodity Output Since 1869 (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1947).
SOI	U.S. Department of the Treasury, Internal Revenue Service, Statistics of Income: Corporation Income Tax Returns; Statistics of Income: Partnership Income Tax Returns; and Statistics of Income: Nonfarm Proprietorship Returns (Washington, DC: U.S. Government Printing Office, annually).
TA	Trade association data (published and unpublished).
Trends	Robert E. Gallman, "Commodity Output, 1839–99," and Marvin W. Towne and Wayne D. Rasmussen, "Farm Gross Product and Gross Investment in the Nineteenth Century," both in Trends in the American Economy in the Nineteenth Century, Studies in Income and Wealth, vol. 24 (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1960).
UC	Unpublished data from the Bureau of the Census.
Ulmer	Melville J. Ulmer, Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing (Princeton, NJ: Princeton University Press for National Bureau of Economic Research, 1960).
USDA	U.S. Department of Agriculture, Farm Income Statistics; Statistical Report, Rural Telephone Borrowers; and Statistical Report, Rural Electric Borrowers (Washington, DC: U.S. Government Printing Office, all annually).
USDE	U.S. Department of Education data (unpublished).

wholesale and retail trade, and services, and beginning with the 1992 census for mining.

The second major source of data, the capital flow tables prepared by BEA as part of the input-output (I-O) accounts, provides distributions of industry investment by type of asset.[35] These data are largely consistent with NIPA definitions, but investment is classified by the using, rather than by the owning, industry, and industries are classified according to the I-O rather than the NIPA classification system (though both are based on the SIC). These data are available only for 1963, 1967, 1972, 1977, 1982, and 1992.[36] (For a list of NIPA industries used for net stocks, see table 3.1 in this publication.)

The third source of data is the Census Bureau's annual survey of manufactures (ASM), which provides annual data on investment in equipment and in structures by manufacturing industries. This survey has been available for noncensus years (that is, years in which an economic census was not conducted) since 1949.

The fourth source, the Census Bureau's plant and equipment expenditures (P&E) survey, which was discontinued in 1993, provided annual data for 1947 to 1993 on investment in nonresidential capital by industry for companies primarily engaged in nonfarm activities. These data are not consistent with the NIPA investment totals (mostly due to industry coverage and definitions of investment), provide only a two-way split by type of asset (total equipment and total structures), and are classified on a company basis.

The fifth source, the Census Bureau's annual capital expenditures survey (ACES), which replaced the P&E survey in 1994, provides data on annual capital expenditures for equipment and structures of the companies surveyed.[37] Periodically, more detailed expenditure data are collected. For estimates for 1992–93, data from both the ACES survey and P&E series are sometimes available. BEA evaluates the quality of each and uses whichever is deemed the most accurate for each industry to extrapolate NIPA estimates of investment in equipment and in structures by industry.[38] Beginning with 1994, for most nonmanufacturing industries, NIPA estimates are extrapolated using ACES data. For manufacturing industries, ASM data are used wherever possible.

Where the industry data do not meet all of the requirements stated above, they are supplemented by data from other sources, as described in Table A and in the section on "Investment controls by industry" below. Additionally, the source data for each industry are adjusted so that the control totals are consistent with respect to definitions and coverage. Specifically, adjustments are made for:

(1) Industrial classification: Establishment-based source data that are not classified according to the 1987 SIC are converted to this basis, primarily using data from the 1987 economic censuses.

(2) Establishment basis: Where necessary, industry investment estimates are adjusted to an establishment basis. The Census Bureau's P&E series and the series published by the IRS in *Statistics of Income* are adjusted from a company to an establishment basis. The Census Bureau's ACES series is adjusted from an activity basis to an establishment basis because a single activity, or business segment, may have establishments in more

35. The capital flow tables through 1992 do not provide data on industry expenditures on software. Expenditures on software were not recognized as investment until the 1999 NIPA comprehensive revision, after the release of the 1992 I-O accounts. See Robert P. Parker and Bruce Grimm, "Recognition of Business and Government Expenditures for Software as Investment: Methodology and Quantitative Impacts, 1959–98," 2000. Paper presented to BEA's Advisory Committee, May 5, 2000. Available at www.bea.doc.gov/bea/papers/software.pdf.

36. More information on the BEA capital flow tables is available: For the 1992 capital flow table, see Belinda Bonds and Tim Aylor, "Investment in New Structures and Equipment in 1992 by Using Industry," SURVEY 78 (December 1998): 26–51.The unpublished 1982 table is provided on BEA's Web site at www.bea.gov/bea/dn2.htm. For the 1977 table, see "New Structures and Equipment by Using Industries, 1977," SURVEY 65 (November 1985): 26–35; for the 1972 table, see U.S. Department of Commerce, Bureau of Economic Analysis, *New Structures and Equipment by Using Industries, 1972: Detailed Estimates and Methodology*, BEA Staff Paper No. 35, Washington, D.C.: U.S. Government Printing Office, 1980; and for the 1963 and 1967 tables, see U.S. Department of Commerce, Bureau of Economic Analysis, *Interindustry Transactions in New Structures and Equipment, 1963 and 1967*, 2nd volume, Springfield, VA: National Technical Information Service, 1975.

37. The Census Bureau's ACES series is not collected on an establishment basis. In some cases, the data are collected on a company basis; in others, the data are collected on a division or major activity basis.

38. The Census Bureau conducted pilot ACES surveys in 1992 and 1993 at the same time as the P&E survey.

than one industry. For example, a manufacturing activity may also include sales branch offices, which are classified as wholesale establishments by the SIC. Where the coverage in principal source data of investment expenditures for an establishment-based industry is incomplete, the gaps are filled using estimates derived from secondary source data such as employment data or trade sources.

(3) Central administrative offices and auxiliaries (CAO's). The SIC classifies auxiliary establishments in the industry they serve. Where source data do not include them, such as for mining, construction, manufacturing, and wholesale trade, BEA adjusts the investment estimates to include them.

(4) Ownership basis: To derive stocks by establishment-based industry on an ownership basis, several conventions are adopted. First, leased assets except those held under capital leases are classified in the industry of the lessor. Assets held under capital leases are classified in the industry of the lessee.[39] Second, for assets used in establishments of multi-industry companies where the legal owner of the assets is the parent company, the assets are classified in the industry of the establishment where they are used. Third, assets owned by manufacturers' sales branches and offices are classified in the wholesale trade industry. Finally, assets owned and used by nonprofit institutions that primarily serve individuals are classified in the real estate industry to provide consistency with the NIPA business-sector treatment and industrial classification of these assets.

(5) Employee-owned autos: The source data for each industry do not include expenditures for autos owned by individuals that are used wholly or partly for business purposes. Therefore, the portion of the expenditures attributable to business use are estimated as discussed in the chapter on "Derivation of Estimates of Privately-Owned Automobiles."

(6) Employee-owned trucks. The source data for each industry do not include expenditures for trucks owned by individuals that are used wholly or partly for business purposes. Therefore, the portion of the expenditures attributable to business use are estimated using data from the Census of Transportation Truck Inventory and Use Survey, from NIPA data on investment, from the capital flow tables for 1982 and 1992, and from the Census Bureau's E*nterprise Statistics.*

(7) Software. The source data for each industry do not include expenditures for software: The Census Bureau's ACES series included expenditures for software that is capitalized in company financial accounts beginning in 1995 (most software, however, is not capitalized). The ASM does not explicitly include expenditures on software. Therefore, software expenditures are distributed in the following manner: For prepackaged software, expenditures are distributed to industries based on NIPA data on expenditures for personal computers. For custom and own-account software, expenditures are distributed to industries based on NIPA data on expenditures for computer processors.

The specific sources and derivation of estimates of investment in nonresidential and residential assets by industry and of net purchases of used assets among sectors are provided below.

New nonresidential investment

Estimates of investment for new nonresidential assets by industry are generally derived in four steps. First, controls for annual investment in total equipment and in total structures for each industry and major industry group are derived as described in the section on "Investment controls by industry" below. Second, limited modifications, as described in "Investment controls by type of asset," are made to the NIPA estimates of new investment by type of asset to make these estimates consistent with the conceptual basis underlying the net stock estimates. Third, these two series are reconciled; that is, the industry controls are adjusted so that total equipment and total structures summed over all industries equal the corresponding asset totals from the modified NIPA estimates. (The differences between these two sets of investment totals are due to differences in definition and measurement problems with both sets of estimates. For the NIPA estimates of investment in fixed assets, these problems include the use of shipments data to estimate purchases of equipment and the allocation of these purchases among final users. For the estimates of investment by industry, they include gaps in coverage.) The adjustments are either prorated among all industries or added to a few industries based on BEA's assessment of the relative quality of the various sources of industry investment data. Finally, distributions of industry investment by asset from the capital flow tables are used to distribute the adjusted industry totals to detailed assets. In this final process, an iterative procedure is used to ensure that: (1) The detailed asset estimates summed over all industries equal the corresponding NIPA estimates; and (2) the totals for equipment and for structures for each

39. Capital expenditures data for the mining, construction, manufacturing, trade, and service industries from the economic censuses include capital leases, which corresponds with NIPA conventions. Capital expenditures for the agriculture, transportation, communication, utilities, and finance industries are adjusted to account for capital leasing. Capital leases are defined here as including "full-payout" and "equity" leases and are included in the industry of the lessee. Also included in the industry of the lessee are assets related to sale and leaseback arrangements and assets related to "safe harbor" leases for the period 1981–83.

industry approximate as closely as possible the controls derived in the first step. As the source data for each industry do not include expenditures for software, software expenditures are distributed to industries based on NIPA data on expenditures for personal computers (for prepackaged software) and on NIPA data on expenditures for computer processors (for custom and own-account software).

Investment controls by industry. As summarized above, the first step in constructing estimates of investment in new nonresidential fixed assets by industry is the derivation of controls for annual investment in total equipment and total structures for each industry and major industry group. To prepare stock estimates for each industry beginning with 1947, BEA must derive control totals for investment in new nonresidential fixed assets by industry back to earlier years (1921 for most types of equipment and before 1900 for most types of structures). To derive stock estimates by major industry group for 1925–1946, it is necessary to derive control totals for investment in new nonresidential fixed assets for farms, for manufacturing, and for nonfarm nonmanufacturing before 1900.

For early years for which neither capital expenditures data nor balance sheet data are available for a particular industry, the investment estimates are interpolated and extrapolated using related data on expenditures for the types of fixed assets purchased by the industry. For the most recent year, where industry capital expenditures data are not yet available, industry-specific indicator series and NIPA investment data by type of asset are used to estimate investment in fixed assets by industry.

Farms. Estimates of investment by the farm industry beginning with 1910 are based on investment data available from the U.S. Department of Agriculture (USDA) and on NIPA data. These estimates are extrapolated using the estimates of Gallman and of Towne and Rasmussen to derive estimates for earlier years.[40]

Agricultural services, forestry, and fisheries. Estimates of investment by the Agricultural services, forestry, and fisheries industry beginning with 1994 are extrapolated using ACES data and NIPA data. For 1947–1993, estimates are based on P&E data and NIPA data. These estimates are extrapolated using the investment estimates for the farms industry to derive estimates for the years before 1947.

Mining. Estimates of investment in the mining industry are based on expenditures data for establishments with payroll available from the census of mineral industries for 1954, 1958, 1963, 1967, 1972, 1977, 1982, 1987, and 1992. Data for equipment only is available for 1939. Expenditures for the oil and gas extraction industry are adjusted to include establishments without payroll, using data on the value of shipments from the Census Bureau's annual survey of oil and gas. Data are not available for making similar adjustments to other mining industries; investment by establishments without payroll in these other industries is considered to be very small. The census data for all mining industries are adjusted to include investment by CAO's using investment data from the Census Bureau's *Enterprise Statistics.*

Estimates of investment in structures for the oil and gas extraction industry—which include expenditures for plants and both capitalized and expensed drilling and exploration costs—beginning with 1994 are extrapolated using ACES data and NIPA data on investment in mining structures. For noncensus years between 1947 and 1993, estimates are derived by interpolating between and extrapolating from census year estimates using P&E data and NIPA data for investment in mining structures. Estimates for years before 1947 are extrapolated using the following sources: For 1929–1946, the NIPA series on investment in petroleum and natural gas exploration, shafts, and wells; for 1901–1928, data on the value of petroleum production from the Census Bureau's *Historical Statistics of the United States.*[41]

Estimates of investment in structures for other mining industries beginning with 1994 are extrapolated using ACES data and NIPA data. For noncensus years between 1947 and 1993, estimates are derived by interpolating between and extrapolating from census year estimates using the P&E data and NIPA data. Estimates for years before 1947 are extrapolated using data on the value of mining production by industry from *Historical Statistics.*

Estimates of investment in equipment by mining industries beginning with 1994 are extrapolated using ACES data and NIPA data. For noncensus years between 1947 and 1993, equipment estimates are derived by interpolating between and extrapolating from census year estimates using the P&E data and NIPA data. For years before 1947, estimates are extrapolated using data on the value of shipments of mining and oil field equipment from the census of manufactures for 1925, 1927, 1929, 1933, 1935, and 1939, and annual data on the value of mining production by industry from

40. Robert E. Gallman, "Commodity Output, 1829–1899" and Marvin W. Towne and Wayne D. Rasmussen, "Farm Gross Product and Gross Investment in the Nineteenth Century," in *Trends in the American Economy in the Nineteenth Century,* Studies in Income and Wealth, vol. 24 (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1960).

41. U.S. Department of Commerce, Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970,* 2 vols. (Washington, D.C.: U.S. Government Printing Office, 1975).

Historical Statistics.

Construction. Estimates of investment for establishments with payroll in the construction industry are available from the census of construction industries for 1967, 1972, 1977, 1982, 1987, and 1992. These estimates are adjusted to include establishments without payroll using receipts data from the censuses and are adjusted to include CAO's using investment data from *Enterprise Statistics.* Census estimates for subdividers and developers are excluded because these establishments are classified by the SIC in the real estate industry (SIC 65).

Estimates of investment in structures beginning with 1994 are extrapolated using ACES data and NIPA data. For noncensus years between 1947–1993, estimates are derived by interpolating between and extrapolating from census year estimates using P&E data and NIPA data. For years before 1947, structures estimates are extrapolated using the following sources: For 1921–1946, the estimates of Boddy and Gort; and for 1900–1920, the F.W. Dodge series on the value of construction contract awards from *Historical Statistics.*[42]

Estimates of investment in equipment beginning with 1993 are extrapolated using ACES data and NIPA data. For noncensus years between 1947 and 1992, estimates are derived by interpolating between and extrapolating from census year estimates using the P&E data and NIPA data on investment in construction tractors and other machinery. For years before 1947, equipment estimates are extrapolated using the estimates of Boddy and Gort.

Manufacturing. Estimates of investment in the manufacturing industry are available for establishments with payroll from the census of manufactures for 1947, 1954, 1958, 1963, 1967, 1972, 1977, 1982, 1987, and 1992. Beginning with 1977, adjustments are made to include establishments without payroll (the adjustment is carried forward to 1997). Before 1977, no data are available for making the adjustments, but investment by these establishments is very small. The census data for all manufacturing industries are adjusted to include investment by CAO's, using investment data from *Enterprise Statistics.*

Estimates of investment in equipment and structures for noncensus years beginning with 1947 are derived by interpolating between and extrapolating from census year estimates using capital expenditures data from the ASM and NIPA data. For years before 1947, equipment investment estimates are extrapolated using the following sources: For 1941–1946, the NIPA series for investment in industrial equipment; for 1921–1940, the estimates of Chawner, Kuznets, and Shaw.[43] For years before 1947, structures estimates are extrapolated using the following sources: For 1929–1946, the NIPA estimates of investment in industrial buildings; for 1915–1928, estimates of the value of new construction put in place for industrial buildings from the U.S. Department of Commerce's *Construction Statistics 1915–1964;*[44] and for 1900–1914, balance sheet data from the census of manufactures for 1900, 1904, 1909, and 1914 and the F.W. Dodge series on the value of construction contract awards from *Historical Statistics.*

Motor vehicle industry equipment estimates before 1972 are adjusted to include investment in special tools and dies, which is excluded from the pre-1972 census data. Estimates of investment for the industrial machinery and equipment industry for census years prior to 1982 are adjusted to include the value of computers leased to other industries.[45]

Railroad transportation. Estimates of investment in structures by the railroad industry beginning with 1929 are based on the NIPA series on investment in railroad structures. Estimates of investment in replacement track for the years before 1929 are based on data published by the Interstate Commerce Commission (ICC) in *Transport Statistics in the United States.*[46] Estimates of investment in structures other than replacement track for the years before 1929 are based on the following sources: For 1915–1928, the data on the value of new construction put in place for railroads from *Construction Statistics, 1915–1964;* and for 1900–1914, data from a study by Melville Ulmer.[47]

Investment estimates for equipment beginning with 1994 are extrapolated using ACES data and NIPA data. For 1977–1993, estimates are based on P&E data and NIPA data. Before 1977, estimates are based on capital expenditures data from *Transport Statistics* and the

42. Rayford Boddy and Michael Gort, "Capital Expenditures and Capital Stocks," *Annals of Economic and Social Measurement,* 1973; and "The Derivation of Investment Expenditures and Capital Stocks," Mimeo, 1968.

43. Lowell J. Chawner, "Capital Expenditures for Manufacturing Plant and Equipment—1915 to 1940," Survey 21 (March 1941): 9–15; "Capital Expenditures in Selected Manufacturing Industries," Survey 21 (December 1941): 19–26; and "Capital Expenditures in Selected Manufacturing Industries, Part II," Survey 22 (May 1942): 14–23. Simon Kuznets, *Capital in the American Economy: Its Formation and Financing* (Princeton, NJ): Princeton University Press, for the National Bureau of Economic Research, 1961. William H. Shaw, *Value of Commodity Output Since 1869* (Princeton, NJ): Princeton University Press, for the National Bureau of Economic Research, 1947.

44. U.S Department of Commerce, Business and Defense Services Administration, *Construction Statistics 1915–64; A Supplement To Construction Review* (Washington, D. C.:U.S. Government Printing Office,1966)

45. These adjustments are not made to the estimates for census years after 1982 because leased computers are included in the data on equipment expenditures from the census of manufactures and from *Enterprise Statistics.*

46. Interstate Commerce Commission, *Transport Statistics in the United States,* Washington D.C: U.S. Government Printing Office, annually.

47. Melville J. Ulmer, *Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing* (Princeton, NJ): Princeton University Press, for National Bureau of Economic Research, 1960.

American Association of Railroads, on the NIPA series on investment in railroad equipment, and on P&E data.

Local and interurban passenger transit. Estimates of investment in structures by the local and interurban passenger transit industry beginning with 1994 are extrapolated using ACES data and NIPA data. For 1973–1993, estimates are based on P&E data and NIPA data. Before 1973, structures estimates are derived for two categories: Electric railway and trolley and "other." For electric railway and trolley, the following series are used: For 1959–1972, balance sheet data from *Transport Statistics* and P&E data; for 1915–1958, the series on the value of new construction put in place for local transit from *Construction Statistics, 1915–1964;* and for estimates before 1915, data from Ulmer's study. For the "other" category, the following sources are used: For estimates for 1940–1972, capital expenditures data from *Transport Statistics* and P&E data; and for estimates before 1940, data from Ulmer's study.

Estimates of investment in equipment beginning with 1994 are extrapolated using ACES data and NIPA data. For 1973–1993, estimates are based on P&E data and NIPA data. Before 1973, equipment estimates are derived separately for four categories: Buses, electric railway and trolley, taxicabs, and "all other." For buses, the estimates for 1940–1972 are based on capital expenditures data from *Transport Statistics,* from *Transit Fact Book,* and on P&E data; the estimates for 1921–1939 are based on data from Ulmer's study.[48] For electric railway and trolley equipment, the estimates for 1940–1972 are based on capital expenditures data from the *Transit Fact Book* and P&E data; the estimates for 1921–1939 are based on data from Ulmer's study. For taxicabs, the estimates for 1929–1972 are based on data from the International Taxicab Association, on the NIPA series on investment in new autos, and on P&E data; estimates for 1921–1928 are based on data from Ulmer's study. For "all other" equipment, estimates for 1940–1972 are based on capital expenditures data from *Transport Statistics* and P&E data; estimates for 1921–1939 are based on data from Ulmer's study.

Trucking and warehousing. Estimates of investment by the trucking and warehousing industry beginning with 1994 are extrapolated using ACES data and NIPA data. For census years between 1977–1993, estimates are based on P&E data and are adjusted to include the unregulated portion of the industry using information from the census of wholesale trade and the census of transportation. Investment estimates for noncensus years between 1977–93 for the unregulated portion of the industry are derived by interpolating between and extrapolating from census year estimates using the P&E series and NIPA data.

For noncensus years between 1940 and 1977, estimates of investment by the regulated portion of the industry are based on balance sheet data from *Transport Statistics.* For years before 1940, estimates are extrapolated using the following sources: For 1929–1939, the NIPA series on investment in trucks, buses, and truck trailers; and for estimates before 1929, data from Ulmer's study and from the American Trucking Association.

Water transportation. Estimates of investment in structures in the water transportation industry beginning with 1994 are extrapolated using ACES data and NIPA data. For 1977–1993, estimates are based on P&E data and NIPA data. Estimates for 1940–1976 are based on balance sheet data from *Transport Statistics* and on P&E data; and before 1940, estimates are extrapolated using data from *Historical Statistics* on the number of ships built.

Estimates of investment in equipment beginning with 1994 are extrapolated using ACES data and NIPA data. For 1977–1993, estimates are based on P&E data and NIPA data. Estimates for 1940–1976 are based on the following sources: Balance sheet data from *Transport Statistics,* the NIPA series on investment in ships and boats, and P&E data. For 1929–1939, estimates are based on the NIPA series on investment in ships and boats; estimates for 1921–1928 are based on data from *Historical Statistics* on the number of ships built. The data for equipment are adjusted to include the value of ships and boats owned and leased to other industries.

Transportation by air. Investment estimates for the transportation by air industry beginning with 1994 are extrapolated using ACES data and NIPA data. For 1965–1993, estimates are based on balance sheet data published by the U.S. Department of Transportation, on P&E data, and on NIPA data.[49] Before 1965, estimates are based on the following sources: For 1929–1964, the NIPA series on investment in aircraft; for years before 1929, data on air carrier operations from *Historical Statistics.*

Pipelines, except natural gas. Estimates of investment in structures by the pipelines (except natural gas) industry beginning with 1994 are extrapolated using ACES data and NIPA series data. For 1983–1993, estimates are based on P&E data and NIPA data. For 1929–1982, estimates are based on the NIPA series on investment in petroleum pipeline structures. For

48. American Public Transit Association, *1996 Transit Fact Book.* (Washington, D.C.: 1996).

49. For 1973–1993, estimates of investment by medium and small private commercial air carrier operations are developed using U.S. Department of Transportation data on the number of planes owned by small carriers and are included in the estimate of investment by the air transportation industry.

1915–1928, estimates are based on the value of new construction put in place for petroleum pipelines from *Construction Statistics, 1915–1964;* for 1900–1914, estimates are extrapolated using data from *Historical Statistics* on petroleum production.

Estimates of investment in equipment beginning with 1994 are extrapolated using ACES data and NIPA data. For 1977–1993, estimates are based on P&E data and on the NIPA series on investment in petroleum pipeline structures. For 1942–1976, estimates are based on data from *Transport Statistics* on capital expenditures and on P&E data; for 1921–1941, estimates are extrapolated using the same data sources as those used for the estimates of structures.

Transportation services. Investment estimates for the transportation services industry—most of which consists of expenditures by establishments engaged in freight forwarding and in the rental of railroad cars—beginning with 1994 are extrapolated using ACES data and NIPA data. For 1973–1993, estimates are based on P&E data and NIPA railroad equipment data. Estimates for 1945–1972 are based on balance sheet data from *Transport Statistics,* on trade association data, on the NIPA series on investment in railroad equipment, and on P&E data. For years before 1945, estimates are extrapolated using the investment flows for the railroad transportation industry.

Telephone and telegraph. The telephone and telegraph industry includes establishments engaged in telephone and nonvocal message communications and in satellite tracking. (Online information retrieval services are classified in business services.) Estimates of investment in equipment and structures beginning with 1994 are extrapolated using ACES data and NIPA data. For 1972–1993, estimates are based on data from the following sources: Industry annual reports made to the Federal Communications Commission (FCC), USDA Rural Utility Service (RUS—formerly the Rural Electrification Administration), trade association data, P&E data, company annual reports, and the Census Bureau data on construction-put-in-place.

Estimates of investment in structures for years before 1972 are based on the following sources: For 1929–1971, the NIPA series on investment in telecommunications structures; for 1915–1928, data from *Construction Statistics 1915–1964* on the value of new construction put in place for the telephone and telegraph industry; and for 1900–1914, data from Ulmer's study.

Investment by rural telephone cooperatives in telephone and telegraph equipment for years before 1972 is estimated using RUS data. Estimates of investment in equipment by private businesses other than cooperatives before 1972 are based on the following sources: For 1947–1971, industry reports to the FCC, trade association data, P&E data, company annual reports, and data from a study by Crandall; and for 1921–46, data from Ulmer's study.[50]

Radio and television. This industry includes establishments providing cable, satellite, and other pay television services. Estimates of investment by radio and television establishments classified as nonprofit institutions primarily serving individuals are derived from Census Bureau data and are reclassified to the real estate industry. Estimates of investment in the radio and television industry beginning with 1994 are extrapolated using ACES data and NIPA data. For 1947–1993, estimates are based on the following sources: P&E data, unpublished census data, and trade association data. For years before 1947, estimates are extrapolated using data from the Boddy and Gort studies.

Electric services. Estimates of investment in the electric services industry includes investment by investor-owned electric services, nonpublic cooperative electric services, nonutility electric services, and the electric services portions of combination utilities including nonpublic combination utilities. Nonutilities include cogenerators and independent power producers. Estimates of investment beginning with 1997 are based on the NIPA electric light and power structures series and on ACES data. For 1972–1996, estimates are based on U.S. Department of Energy (DOE) data, on RUS data, on Census Bureau data, and on the NIPA data.

Before 1972, estimates of investment in structures are based on the following sources: For 1929–1971, the NIPA series on investment in electric light and power structures; for 1915–1928, data from *Construction Statistics, 1915–1964* on the value of new construction put in place for electric light and power; and for 1900–1914, data from Ulmer's study. These data are adjusted from a "value-put-in-place" basis to a "when-completed" basis as described in the section "Investment controls by type of asset."

Before 1972, estimates of investment in equipment are based on the following sources: For rural electric cooperatives, RUS data; for private business other than cooperatives for 1937–1971, DOE data and P&E data, and for 1921–36, data from Ulmer's study.

Gas services. Investment estimates for the gas services industry include investment by the following types of establishments: Natural gas transmission and distribution, certain types of manufactured gas production, and the gas portions of combination utilities. Natural gas exploration and natural gas production are

50. Robert W. Crandall, *After the Breakup: U.S. Telecommunications in a More Competitive Era,* (Washington D.C.: Brookings Institution, 1991).

classified in oil and gas extraction. Estimates beginning with 1929 of investment in structures are based on the NIPA data on investment in gas utility structures. Before 1929, structures estimates are based on the following sources: For 1915–1928, the data from *Construction Statistics, 1915–1964* on the value of new construction put in place for gas; and for 1900–1914, data from Ulmer's study.

Estimates of investment in equipment beginning with 1994 are extrapolated using ACES data and NIPA data. For 1973–1993, estimates of investment in equipment are based on P&E data, NIPA data, and trade association data; for 1946–1972, estimates are based on industry reports to the Census Bureau and P&E data. For 1921–1945, estimates are based on data published by the American Gas Association in *Gas Facts.*[51]

Sanitary services. Estimates of investment by the sanitary services industry include investment by the following types of establishments: Water supply, sanitary services, steam and air-conditioning supply, irrigation systems, and other utility portions of combination utilities. Estimates beginning with 1994 are extrapolated using ACES data and NIPA data. For 1973–1993, estimates are based on P&E data, DOE data, and trade association data; estimates for 1947–1972 are based on P&E data. Before 1947, these data are extrapolated using data from Ulmer's study.

Wholesale trade. The wholesale trade industry includes merchant wholesalers—which are wholesale entities that take title to the assets they sell—and nonmerchant wholesalers—which consist of manufacturers' sales branches, sales offices and agents, brokers, and commission merchants. Investment data for merchant wholesale establishments are available from the capital expenditures survey conducted as part of the census of wholesale trade for 1958, 1963, 1967, 1972, 1977, 1982 and from the assets and expenditures survey (AES) conducted as part of the 1987 and 1992 economic censuses. Beginning with 1978, estimates of investment by merchant wholesalers are adjusted to include expenditures related to CAO's and establishments without payroll.[52]

Estimates of investment by nonmerchant wholesalers (which include estimates for equipment owned by nonmerchant wholesalers but leased to other industries) for 1982, 1987, and 1992 are based on data from *Enterprise Statistics,* the census of wholesale trade, and trade association data. For census years prior to 1982, estimates of investment in equipment are based on Census employment data while estimates of investment in structures are based on Census inventories data. The estimates of investment in equipment by nonmerchant wholesalers are adjusted to include the value of computers owned by manufacturers' sales branches and leased to other industries. No adjustments are made for establishments without payroll, because investment by these establishments is considered to be very small. Estimates of investment by nonmerchant wholesalers are added to the merchant wholesale estimates to derive estimates of investment by the entire wholesale trade industry for Census years. Investment estimates for the total wholesale industry beginning with 1994 are extrapolated using ACES data and NIPA data. For noncensus years between 1947 and 1993, estimates are derived by interpolating between and extrapolating from the census year estimates using P&E and NIPA data; for years before 1947, estimates are extrapolated using data from Boddy and Gort.

Retail trade. Investment data for retail trade establishments are available from the capital expenditures survey taken as part of the census of retail trade for 1958, 1963, 1967, 1972, 1977, and 1982 and from the assets and expenditures survey taken as part of the 1987 and 1992 economic censuses. These surveys cover all of retail trade, including establishments with payroll, CAO's, and except for 1982 and 1987, establishments without payroll. Estimates for 1982 and 1987 are adjusted for establishments without payroll.

Estimates of investment for the retail trade industry beginning with 1994 are extrapolated using ACES data and NIPA data. For noncensus years between 1947 and 1993, estimates are interpolated between and extrapolated from census year estimates, using P&E data and NIPA data. For years before 1947, investment estimates are extrapolated using the following sources: For 1915–1946, the series on value of new construction put in place for stores, restaurants, and garages from *Construction Statistics, 1915–1964;* and before 1915, the F.W. Dodge series on the value of construction contract awards from *Historical Statistics.*

Finance and insurance. Investment estimates for the finance and insurance industry are adjusted to account for leased assets that are not accounted for by the source data series. Investment estimates for this industry were available for most establishments for the first time in the 1992 census of finance, insurance, and real estate. Beginning with 1994, the census data are extrapolated forward using ACES data and NIPA data. For 1947–1993, investment estimates are derived from P&E data and from trade association data. Before 1947, estimates are extrapolated using balance sheet data from *Statistics of Income* and data from *Historical*

51. American Gas Association, *Gas Facts,* annual.

52. Although CAO's are included in the AES results for merchant wholesalers, the capital expenditures related to them may be reduced when the AES results are adjusted to the results of the census of wholesale trade (which excludes CAO's). Beginning with 1982, BEA adjusted the wholesale trade estimate for merchant wholesale CAO's.

Statistics on the activities of the finance and insurance industries. Estimates of investment by insurance and holding company establishments that are classified as nonprofit institutions primarily serving individuals are derived mainly from Census data on tax and tax-exempt payrolls and revenues and are reclassified to the real estate industry.

Real estate, with nonprofit institutions serving individuals. This industry includes establishments of the real estate industry and also establishments of nonprofit institutions serving individuals, which, by NIPA convention, are classified in the real estate industry rather than in the industry of their primary activity. Investment estimates for both of these components beginning with 1994 are extrapolated using ACES data on equipment and on structures and NIPA data. Estimates for 1972–1993 are based on the following series: P&E data, data from the census of construction industries, NIPA data, trade association data, and the series for investment by nonprofit institutions serving individuals, which is based mainly on Census data on tax and tax-exempt payrolls and revenues (see the radio and television, finance and insurance, and services industries sections of this document). For 1947–1971, investment estimates for nonprofit institutions serving individuals are derived from Census data. For entities reporting rental income on IRS Schedule E, investment estimates are derived using the percentage of total industry investment made up of investment by those entities from *Statistics of Income* data on investment for 1977 and data on depreciation for 1960, 1961, 1967, and 1973, as well as the NIPA series for investment in commercial structures. For sole proprietorships, partnerships, and corporations, investment estimates are based on the P&E data. For 1915–1946, investment estimates are extrapolated using the following series on the value of new construction put in place from *Construction Statistics,* 1915–1964: For nonprofit institutions that primarily serve individuals, total investment in structures by religious, educational, hospital and institutional, and amusement and recreational buildings; for the remainder of this industry, commercial buildings. For 1900–1914, the structures estimates are extrapolated using the F.W. Dodge series on the value of construction contract awards from *Historical Statistics.*

Services except health, legal, educational, and "other." Investment data for these services industries are available for equipment and for structures for 1972, 1977, 1982, 1987, and 1992 and for the total of equipment and structures for 1958, 1963, and 1967, from the capital expenditures survey taken as part of the census of service industries through 1982 and from the assets and expenditures survey taken as part of the censuses for 1987 and for 1992.

The investment estimates include CAO's, establishments with payroll, and establishments without payroll. Estimates of investment for selected service industries are also adjusted for the value of certain types of equipment owned by these industries and leased to other industries as follows: Autos, trucks, and trailers in the auto repair, services, and parking industry and aircraft, furniture and fixtures, construction machinery (except tractors), computers (other than those leased by the manufacturers or by manufacturers' sales branches), and other types of equipment in the business services industry. Estimates of investment by nonprofit institutions in the hotel and amusement and recreation industries that primarily serve individuals are derived from Census Bureau data and are reclassified to the real estate industry.

Investment estimates for these service industries beginning with 1994 are extrapolated, in most instances, using ACES data and NIPA data. Investment estimates for noncensus years between 1977 and 1993 are interpolated and extrapolated from census year estimates using one or more of the following sources: P&E data, various types of NIPA structures or equipment investment data, trade association data, Census value-put-in-place structures data, and other indicator series based on NIPA or trade association data where two-digit SIC industry-specific capital expenditures series are not available.[53] For noncensus years between 1947 and 1977, investment estimates are derived by interpolating between and extrapolating from census year estimates using P&E data and NIPA data. Before 1947, estimates are extrapolated using balance sheet data from *Statistics of Income.*

Health services. The health services industry consists of two components: Hospitals and "other" health services. Hospital capital expenditures are available for 1987 and for 1992. Hospital investment for other census years are derived from P&E and NIPA data. Data on the investment of "Other" health services are available from the capital expenditures survey taken as part of the census of service industries for 1982 and from the assets and expenditures survey taken as part of the census of service industries for 1987 and for 1992. The investment estimates include CAO's, establishments with payroll, and establishments without payroll.

Investment estimates beginning with 1994 are extrapolated using ACES data and NIPA data. For noncensus years between 1947 and 1993, estimates are interpolated and extrapolated from census year estimates using P&E data and NIPA data. Before 1947, invest-

53. SIC Industries 70–79 are all included in the single P&E series "personal and business services."

ment estimates are extrapolated using balance sheet data from *Statistics of Income.* Estimates of investment by hospitals and other health services establishments classified as nonprofit institutions primarily serving individuals are derived from Census Bureau and trade association data and are reclassified to the real estate industry.

Legal services. Data on investment for legal services are available from the capital expenditures survey taken as part of the census of service industries for 1982 and from the assets and expenditures survey taken as part of the census of service industries for 1987 and for 1992. Investment for other census years is derived using P&E and NIPA data.

Investment estimates beginning with 1993 are extrapolated using ACES data and NIPA data. Estimates for noncensus years between 1947 and 1992 are interpolated and extrapolated from census year estimates, using P&E data and NIPA data. Before 1947, investment estimates are extrapolated using balance sheet data from *Statistics of Income.* Estimates of investment by legal services establishments that are classified as nonprofit institutions primarily serving individuals are derived from Census Bureau data and are reclassified to the real estate industry.

Educational and "other" services. Data on investment for selected portions of educational services (correspondence and vocational schools), selected portions of "other" services (engineering, research, and management services), and selected portions of social services (job training and vocational rehabilitation, child day care, and residential care) are available from the assets and expenditures survey taken as part of the census of service industries for 1987.[54] Coverage was expanded in the assets and expenditures survey for 1992 to include capital expenditures by the following industry components: Libraries, museums and art galleries, part of membership organizations, and accounting and other professional services. The investment estimates include CAO's, establishments with payroll, and establishments without payroll. These Census tabulations are supplemented as necessary with P&E data and NIPA data on investment for education buildings for 1982 and for 1987.

Investment estimates beginning with 1994 are extrapolated using the ACES data and NIPA data. Investment estimates for noncensus years between 1982 and 1993 are interpolated and extrapolated from census year estimates, using P&E data, NIPA data, or trade association data.

Estimates of investment in structures for years before 1982 are extrapolated using the following sources: For 1947–1981, P&E data and NIPA data; for 1929–1946, NIPA investment in educational buildings and religious buildings; for 1915–1928, data from *Construction Statistics, 1915–1964* on the value of new construction put in place for educational buildings and religious buildings; and for 1900–1914, balance sheet data from *Statistics of Income.*

Estimates of investment in equipment for years before 1982 are extrapolated using the following sources: For 1947–1981, P&E data and NIPA data; before 1947, the same sources as those used for structures. Estimates of investment by educational and "other" services establishments by nonprofit institutions that primarily serve individuals are derived from U.S. Department of Education data and Census Bureau data and are reclassified to the real estate industry.

Investment controls by type of asset. As summarized above, the second step in constructing estimates of investment in new nonresidential fixed assets by industry is the derivation of estimates of investment by type of asset. Beginning with 1929, estimates are derived from the NIPA series on nonresidential fixed investment, a component of gross private domestic investment. In order to derive stock estimates for early years, the NIPA estimates are extrapolated back to the 19th century using data from various public and private sources.[55]

Limited modifications are made to the NIPA estimates in accordance with the conceptual basis underlying estimates of net stocks. The NIPA estimates of investment in electric light and power structures are modified so that the estimates of stock and depreciation will reflect the availability of the capital assets for use in production and will be consistent with the timing of tax depreciation. Specifically, the NIPA estimates are modified from a "value-put-in-place" basis (that is, the value of new construction put in place in a particular year for both completed plants and plants under construction in that year) to a "when-completed" basis (that is, the value of plants actually completed and put into service during the year). NIPA estimates for other

54. "Other" services industries consists of the following industries: Social services; museums and botanical and zoological gardens; membership organizations; engineering and management services; and services not elsewhere classified.

55. These sources are as follows: William H. Shaw, *Value of Commodity Output Since 1869,* Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1947; U.S. Department of Labor and U.S. Department of Commerce, *Construction Volume and Costs 1915–1956: Statistical Supplement to Construction Review,* Washington, D.C.: U.S. Government Printing Office, 1958; Simon Kuznets, *Capital in the American Economy: Its Formation and Financing,* Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1960; U.S. Department of Agriculture, *Farm Income Situation*, Washington, D.C.: U.S. Government Printing Office, 1965; and Robert E. Gallman, "Commodity Output," and Marvin W. Towne and Wayne D. Rasmussen, "Farm Gross Product and Gross Investment." Both are in *Trends in the American Economy in the Nineteenth Century,* vol. 24 (Princeton , N.J.): Princeton University Press, for the National Bureau of Economic Research, 1960.

types of structures are not modified because the value of uncompleted structures has been both small and stable relative to the value of completed plants. For electric light and power plants, however, the value of uncompleted plants has been large, and the ratio of this value to the value of completed plants has fluctuated significantly over time.

Adjustment of industry controls. As summarized above, BEA adjusts the industry controls so that the all-industry totals equal the NIPA totals for new investment in fixed assets. In this process, the data from the economic censuses and ASM are assumed to be the most accurate: Controls for census years for census-covered industries and controls for manufacturing industries in noncensus years are adjusted only where they differ significantly from the NIPA totals. For industries not covered by the economic census in census years, and for nonmanufacturing industries in noncensus years, the difference between the sum of the industry controls and the sum of the NIPA estimates is allocated to industries so that the estimates of assets totaled across industries are consistent with the NIPA totals for those assets.

Distribution by type of asset and industry. Once the control series for investment in total equipment and total structures by industry are adjusted to equal the corresponding totals from the NIPAs, the industry estimates are distributed to detailed assets using data from BEA's capital flow tables for 1963, 1967, 1972, 1977, 1982, and 1992. This requires the conversion of the capital flow tables from the I-O industry classification system to the NIPA industry classification system. Specifically, investment by nonprofit institutions that primarily serve individuals is reclassified to the real estate industry; investment in mining exploration, shafts, and wells is reclassified from construction to the mining industries; and own-account construction is reclassified from the construction industry to the industries performing the construction.[56] The detailed type-of-asset-by-industry distributions are then converted from a use basis to an ownership basis using data from unpublished I-O studies, from industry trade associations, and from secondary sources. These modifications yield the detailed type-of-asset-by-industry distributions for equipment and structures for 1963, 1967, 1972, 1977, 1982, and 1992. BEA did not release a capital flow table on a use basis for 1987; however, a table on an ownership basis was developed specifically to distribute industry estimates to detailed assets. This unpublished table was based on the 1982 and 1992 capital flow tables, 1987 economic census data, P&E data, I-O studies, trade association data, NIPA data, and other sources. Software investment by industry is not included in the capital flow tables; it is allocated by industry using computer investment by industry.

For years between 1963–1992 not covered by capital flow tables, the estimates of investment in total equipment and total structures by industry are distributed to detailed assets by interpolating between and extrapolating from the modified capital flow distributions, including the unreleased table for 1987. For years before 1963, the 1963 table is extrapolated back, and for years beginning with 1993, the 1992 table is extrapolated forward. Once these initial distributions are made, an iterative process is used to ensure that: (1) All-industry totals for investment in each type of asset equal the totals of the NIPA estimates by type of asset and (2) industry totals for equipment and for structures approximate as closely as possible the industry control totals derived from the independent sources described above and in Table A.

The exact iterations used to reconcile the industry controls with the NIPA estimates differ for different periods and for equipment and structures. For years before 1972, detailed estimates of structures and equipment by type of asset and by industry are derived as follows. First, the industry controls of investment in total equipment and in total structures are estimated. Second, these industry controls are allocated to assets using the interpolated or extrapolated capital flow distributions (as described in the previous paragraph). Third, these allocations are totaled across industries and adjusted to equal, in total, the NIPA controls for each type of asset. Fourth, the totals for each industry are recalculated and the second and third steps are repeated so that the following two balancing conditions are met: (1) All industry totals for investment in each type-of-asset equal the NIPA new investment by type of asset totals; and (2) totals for industry investment for equipment and for structures approximate as closely as possible the industry control totals derived from independent sources.

Beginning with 1972, detailed investment in new equipment by type of asset and by industry is estimated in a similar manner. First, the industry estimates of investment in total equipment are adjusted so that the sum across all industries equals the NIPA estimate of investment in total equipment. Second, these adjusted industry controls are allocated to assets using the interpolated or extrapolated capital flow distributions as described above. Third, these allocations are totaled across industries and adjusted to equal, in total,

56. Own account construction is that performed by a business or government entity acting as its own builder or contractor. Examples of own account construction are expenditures on engineers employed by State highway departments to design highways and remodeling crews employed by realtors.

the NIPA controls for each type of asset. The differences between the NIPA estimates and the sum across all industries of investment in detailed types of equipment are allocated to nonmanufacturing industries on the basis of the allocations performed in the second step, using the interpolated and extrapolated capital flow distributions.[57] Fourth, each nonmanufacturing industry equipment total is adjusted accordingly, so that the sum across all industries of investment in total equipment equals the NIPA estimate of total investment in new equipment. Fifth, several iterations may be performed until investment is balanced—that is, until the sums by industry and asset type equal the NIPA estimates and are as close as possible to the industry controls. (As noted above, software investment by industry is not included in the capital flow tables and is allocated by industry using computer investment by industry.)

For structures, the process is similar, but the differences between the NIPA estimates and the industry controls are allocated differently for 1972–1992 and for years beginning with 1993. For the 1972–1992 period, the estimates are modified by an iterative balancing process similar to that described for years before 1972, until additional iterations yield only small improvements in the allocations by type of asset and by industry. For industries other than mining and utilities, the remaining residual differences between NIPA estimates of new structures by type of structures and the sum across all industries of detailed structures are allocated to the real estate industry.[58] For the mining and utilities industries, the remaining residual differences are allocated to mining and utilities. Beginning with 1993, detailed investment in new structures by type of asset and by industry is estimated using the same procedure as that described above for equipment.

New residential investment

Estimates of net stocks and depreciation of residential assets are presented by industry—either farm or real estate—and within these industries, by tenure group—that is, tenant- or owner-occupied. Beginning with 1929, estimates of investment in new residential fixed assets by industry are taken directly from the NIPA estimates of residential fixed investment, a component of gross private domestic investment. For years before 1929, the estimates are based on data from various public and private sources.[59]

These NIPA estimates are then distributed to industries as follows. First, NIPA estimates of investment in farm residential structures are allocated between owner and tenant-occupied structures for both 1-to-4-unit structures and for mobile homes using USDA data. All owner- and tenant-occupied farm residential structures owned by farm operators are included in the farm industry, while tenant-occupied farm structures owned by nonfarm landlords are included in the real estate industry. Estimates of investment in nonfarm residential structures (dormitories, fraternity and sorority houses, nurses' homes, etc.) are grouped separately and are allocated between owner- and tenant-occupied separately for 1-to-4-unit structures, 5-or-more-unit structures, and mobile homes using information from the Census Bureau's census of housing (decennial) and American housing survey (biennial). All nonfarm residential structures are included in the real estate industry. All residential equipment, which consists of equipment owned by landlords and rented to tenants, is also included in the real estate industry.

Net purchases of used assets

Data are available only to adjust for net purchases of used assets among different types of owners (private business, governments, households, and nonresidents). These data are based for the most part on modified NIPA flows for net purchases of used assets. Data are not available to adjust for net purchases among industries or among legal forms of organization within the private sector.

Nonresidential assets. The largest net purchases of used nonresidential assets between private business and other types of owners involve sales of used autos by private business to households, exports of used equipment, purchases of government surplus assets, and government purchases of privately owned public utilities. As annual data are available on stocks and unit values of autos by type of owner, the physical inventory method—which applies prices to direct counts of the physical units of an asset—is used, and it is not necessary to make explicit adjustments for net purchases of used autos among types of owners.

In the NIPAs, exports of used equipment and purchases of government surplus assets by private business are valued at secondhand sales prices. For the stock

57. Distributions are only made to nonmanufacturing industries because the estimates for manufacturing industries are based on interpolations or extrapolations of census year estimates using ASM establishment data, which more closely approximate BEA industry definitions in terms of coverage.

58. For 1972–92, adjustments are made to estimates of investment by the real estate industry in structures and in equipment to correct for undercoverage of both the number of establishments and the growth of capital expenditures in structures and equipment in the P&E data on the real estate industry.

59. These sources are as follows: U.S. Department of Labor and U.S. Department of Commerce, *Construction Volume and Costs 1915–1956: Statistical Supplement to Construction Review* (Washington, D.C.: U.S. Government Printing Office, 1958); David M. Blank, *The Volume of Residential Construction, 1889–1950* (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1954); and *Historical Statistics.*

estimates, however, these NIPA estimates of exports and most of the estimates of government surplus assets are revalued at their original acquisition prices less accumulated depreciation so that the value of the transferred assets is consistent with the value of the assets remaining in the stock of the original owner. Government surplus assets that were built during wartime with special characteristics that are of no use to their new peacetime owners are valued at the prices that would have been paid for equally productive new assets designed for the uses to which the surplus assets are put by their new owners.[60] Revalued estimates of exports of used equipment and government surplus assets are distributed by year of transfer and type of asset to industries using the following sources: For exports of used equipment, data from the Census Bureau's foreign trade statistics and for purchases of government surplus assets, surplus property reports from the General Services Administration and the U.S. Department of Defense.

Estimates of net purchases of power plants between the private sector and the Federal Government during the 1980s are derived from Department of Energy (DOE) data. Similar estimates are derived for purchases by State and local governments of privately owned railroads, transit systems, electric utilities, and water systems. Separate estimates of the original value of equipment and structures are derived for utilities and transit systems. These estimates are based on data from the following sources: For railroads, Moody's transportation manuals; for transit, Moody's transportation manuals and the American Public Transit Association; for electric utilities, Moody's public utility manuals and two U.S. Department of Energy publications, *Statistics of Privately Owned Electric Utilities in the United States* and *Statistics of Publicly Owned Electric Utilities in the United States;* and for water systems, Moody's public utility manuals.

Residential assets. The largest net purchases of used residential assets between private business and other types of owners and between industries involve purchases of private housing by State and local governments, conversions of Federal military housing to private ownership, and purchases of farm housing by nonfarm owners. The estimates of net purchases between private business and government are derived from the NIPA estimates; the estimates of conversions of farm housing are derived from the census of housing. Net purchases of existing residential structures between government and private business consist primarily of State and local government acquisitions of private housing to acquire land for new roads or buildings. In the NIPAs, these net purchases are offset in estimates of government and private fixed investment and are valued at sales prices. In the stock estimates, however, these transferred structures are treated as permanent losses from the housing stock rather than as shifts from the private to the public stock. The housing involved in these purchases is removed from the stock of the real estate industry in the year of government acquisition because they are acquired to allow construction of highways or buildings. World War II Federal military housing converted to private ownership after the war is estimated using NIPA data and transferred from the Federal Government stock to the stock of the real estate industry in the year of conversion.

The post-World War II shift of farm housing in urban fringe areas to nonfarm housing affects the industry stock estimates, but not the NIPA estimates of investment. Estimates of the value of these net purchases are derived from the census of housing and reclassified from the farm industry to the real estate industry in the year of transfer.

Investment by legal form of organization

The estimates of investment in new and used assets for each industry are also distributed by legal form of organization—corporate business, which is further split into financial and nonfinancial; sole proprietorships and partnerships; and other private business—persons, nonprofit institutions serving individuals, and tax exempt cooperatives. Persons and nonprofit institutions are included in the real estate industry, while tax exempt cooperatives are included in the communications, electric utilities and wholesale industries. The data that support the distributions do not support adjustments for shifts from one legal form to another (for example, when an unincorporated enterprise incorporates).

Nonresidential investment. In general, investment in nonresidential assets is allocated annually by legal form of organization within industries by using percentages based on Census data, where available.

For the mining, construction, manufacturing, retail trade, and selected services industries, Census data are available for all Census years. For selected transportation, communication, utility, finance, insurance, and real estate industries, Census coverage began in 1992. Where Census data are used, the allocation of nonresidential investment by legal form of organization is usually based on the proportions of total capital expenditures that are attributed to corporations, sole

60. The derivation and revaluation of the estimates of investment for exports of used equipment and business purchases of government surplus assets is explained in more detail in Robert C. Wasson, John C. Musgrave, and Claudia Harkens, "Alternative Estimates of Fixed Business Capital in the United States, 1925–1968," SURVEY 50 (April 1970): 18–36.

proprietorships and partnerships. When data on capital expenditures by legal form of organization are unavailable, the allocations are based on data on revenue, sales, or receipts from the economic censuses. When necessary, adjustments are made to the Census data for establishments without payroll and CAO's. For non-census years, the allocations are based on distributions of expenditures interpolated by depreciation data from *Statistics of Income.*

For industries not covered by the economic census, percentage distributions of investment by legal form of organization are based on the distribution-of-depreciation data by legal form from *Statistics of Income.*

For the farm industry beginning with 1973, the allocation to legal forms of organization is based on capital expenditures data from USDA's annual farm costs and returns survey. For years before 1973, the allocation is based on assets data from the census of agriculture.

For the telephone and telegraph industry and the electric services industry, and wholesale trade industry, nonresidential investment is first allocated to "other private business;" the remainder is then allocated to the other legal forms of organization. Within other private business, the percentage of investment allocated to tax exempt cooperatives is based on RUS data for the telephone and telegraph industry and the electric services industry and from the census of wholesale trade for the wholesale industry. The percentage allocated to persons is based on investment by entities reporting rental income on nonresidential property on IRS Schedule E, derived from data on investment and depreciation from *Statistics of Income.* The percentage allocated to nonprofit institutions that primarily serve individuals is derived from data from the following sources: the economic censuses for 1982, 1987, and 1992; Census Bureau data on the value of new construction put in place; trade association data; American Hospital Association data; and DOE data. The remaining investment is then distributed between corporate business and sole proprietors and partnerships. For the telephone and telegraph industry, the percentages for years before 1992 are based on capital expenditures data from RUS, the FCC, the United States Telephone Association, and company annual reports; for years after 1992, percentages are based on estimates derived from the economic censuses extrapolated by RUS, FCC, and trade data and depreciation from *Statistics of Income.* For the electric services industry, the percentages for years before 1992 are based on capital expenditures data from RUS and DOE. Those after 1992 are derived from census data extrapolated by RUS, DOE, and trade data and depreciation from *Statistics of Income.* For the wholesale industry, percentages are based on data from economic censuses, adjusted where necessary for non-employers and CAO's. Where these data are not available, the percentages are based on depreciation data from *Statistics of Income.*

For the real estate industry for 1992 forward, the percentages of investment allocated to each legal form are based on economic census data for 1992 extrapolated by *Statistics of Income* data on depreciation. For years before 1992, the percentages are based on these same depreciation data.

Residential investment. Among private businesses, only the farm and real estate industry invest in residential assets. For the farm industry, estimates of investment in owner-occupied residential assets are assigned by convention to sole proprietorships and partnerships; investment in tenant-occupied residential assets is distributed to all legal forms of organization using USDA data. For the real estate industry, estimates of investment in owner-occupied residential assets and other nonfarm residential structures (such as dormitories, fraternity and sorority houses, and nurses' homes) are assigned by convention to other private business, while investment in tenant-occupied residential assets is distributed to all legal forms of organization, using data from the Census Bureau's survey of residential finance.

Government-Owned Fixed Assets

Government fixed assets are presented for Federal and for State and local governments. Federal government assets are further split into defense and nondefense assets. The underlying estimates of investment by government beginning with 1929 are derived from the NIPA series on gross government investment and are modified for the revaluation of net purchases of used assets, as described in the section "Net purchases of used assets." Estimates for years before 1929 are derived by extrapolating these estimates backward using data from Raymond Goldsmith.[61]

Consumer Durable Goods

Estimates of additions to the stock of consumer durable goods beginning with 1929 are taken directly from the NIPA series on personal consumption expenditures for durable goods. Estimates for years before 1929 are derived by extrapolating the NIPA estimates backwards using data from Shaw.[62]

61. Raymond W. Goldsmith, *A Study of Saving in the United States,* 3 volumes (Princeton, NJ: Princeton University Press, 1955).

62. William H. Shaw, *Value of Commodity Output Since 1869* (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1947).

Derivation of Depreciation Estimates

In the perpetual inventory method, the pattern of depreciation charges for an asset of a given type is determined by its "depreciation profile"—that is, how the price of that type of asset declines as it ages in the absence of inflation. The profile for a given type of asset of a given vintage is assumed to be constant over time. However, the profile for one vintage of a given asset may differ from the profile of a different vintage of the same asset.

BEA bases its depreciation patterns on empirical evidence of used asset prices in resale markets wherever possible. For computer and computer peripheral equipment and for autos, information on used asset prices is extensive, and the actual empirical profiles are used. These profiles are provided in table B. The profile for personal computers (PCs) is based on a study of the fair-market value of personal property including PCs in California. The resulting truncated geometric pattern of depreciation results in a residual value of less than 10 percent of a PC's original value by the end of the fifth year.[63] For other categories of computers and peripheral equipment, the profiles are taken from studies prepared by Oliner.[64] For autos, the profiles are derived from new car prices and used car prices (from the National Automobile Dealer Association's *Official Wholesale Used Car Trade-In Guide*) for a sample of models.

For most other assets, geometric patterns are used because the available data suggest that they more closely approximate actual profiles of price declines than straight-line patterns.[65]

The geometric rates for specific types of assets are determined by dividing the appropriate declining-balance rate for each asset by the asset's assumed service life, as illustrated in equation (1) on page M–7. The declining-balance rates used by BEA are derived from estimates made by Hulten and Wykoff under the auspices of the U.S. Department of the Treasury and are shown in table C.[66] For the purposes of determining the appropriate rates, they divided assets into three major types. Type A assets are those for which extensive data were available for estimating declining-balance rates: Tractors, construction machinery, metalworking machinery, general industrial equipment, trucks, autos, industrial buildings, and commercial buildings.[67] In 1977, these categories accounted for about 55 percent of investment expenditures on equipment and 42 percent of spending on nonresidential structures.

Type B assets are those for which the limited studies on depreciation or other relevant data did not support defensible estimates of the rate of declining balance. For these assets, Hulten and Wykoff used the results of empirical research by others, including the research of BEA, Dale Jorgenson, the Bureau of Labor Statistics, and Jack Faucett Associates, as well as their own judgement.

No data were available for Type C assets. Hulten and Wykoff estimated the average declining-balance rates from information on the eight categories of type A assets combined with information on the average life of the type B assets. They determined that, on average, the declining-balance rate for equipment was 1.65 and that for private nonresidential structures was 0.91.

63. As a result of an earlier application of this methodology, the California State Board of Equalization recommended depreciation schedules for computers that were widely adopted across California and in several other western states. For further details, see Richard N. Lane, "Appraisal Report 'Large Aerospace Firm' Personal Property, Los Angeles County, March 1, 1995," revised February 2, 1999.

64. A general description of this work appears in Stephen D. Oliner, "Constant-Quality Price Change, Depreciation, and Retirement of IBM Mainframe Computers," in Murray F. Foss, Marilyn E. Manser, and Allan H. Young (eds.), *Price Measurements and Their Uses*, Conference on Research in Income and Wealth (Chicago, IL: University of Chicago Press, for the National Bureau of Economic Research, 1993). The depreciation profiles used by BEA were taken from that article and from unpublished detail provided by Oliner.

65. Except for missiles and nuclear fuel rods, where an explicit retirement pattern and distribution of service lives is used, the BEA depreciation profiles are for an entire cohort of assets of a given type. When different assets within a cohort have different service lives, the profile for the cohort as a whole will be more convex (accelerated) than the profile for a single asset. For further discussion of this point, see Frank C. Wykoff, "Economic Depreciation and the User Cost of Business-Leased Automobiles," *Technology and Capital Formation* (Cambridge, MA: MIT Press, 1989): 262–265.

66. The following discussion is extracted from Fraumeni, "The Measurement of Depreciation", *op cit* 16–20.

67. As noted above, an actual empirical profile is used for autos rather than the geometric rate estimated by Hulten and Wykoff.

These averages serve as the rates for assets where no data are available.

At the time of the Hulten-Wykoff studies, computer software was not treated as a capitalized asset in the NIPAs. As there have been no subsequent studies of software depreciation, pre-packaged, custom, and own-account software are treated as type C assets.

The geometric depreciation rates and the underlying declining-balance depreciation rates and service lives used by BEA to derive the estimates of net stocks and depreciation are shown in table C. Separate depreciation rates and service lives are used for each type of asset at the level of detail for which annual data are available from the NIPAs. For some types of private fixed assets, different depreciation rates and service lives are also used in different industries.

For missiles and nuclear fuel rods, depreciation is estimated using a straight-line pattern (to reflect the pattern of rotation and replacement of nuclear fuel) and a Winfrey retirement pattern, as discussed below.

Service lives

As with depreciation patterns, service lives should reflect actual experience as closely as possible—separate

Table B. Depreciation Schedules for Autos, Computers, and Computer Peripherals

[In values relative to the price of a new asset]

Age in years	Year asset was initially installed				
	Automobiles	Computer mainframes			Personal computers
	All years	1958–69	1970–79	1980–94	All years
1	0.8208	0.9787	0.9787	0.8980	0.7790
2	0.5890	0.9074	0.8917	0.6893	0.4730
3	0.4862	0.7779	0.7411	0.4901	0.2870
4	0.4063	0.6429	0.5575	0.2989	0.1740
5	0.3258	0.4891	0.4002	0.1732	0.1060
6	0.2414	0.3498	0.2694	0.0894	0.0640
7	0.1811	0.2412	0.1666	0.0434	0.0390
8	0.1280	0.1618	0.0968	0.0197	0.0240
9	0.0749	0.1090	0.0549	0.0087	0.0140
10	0.0363	0.0734	0.0302	0.0035	0.0090
11	0.0184	0.0483	0.0164	0.0015	0.0050
12	0.0092	0.0323	0.0089	0.0007	0.0030
13	0.0000	0.0222	0.0056	0.0004	0.0020
14	0.0000	0.0118	0.0029	0.0003	0.0010
15	0.0000	0.0057	0.0017	0.0002	0.0010
16	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000

Age in years	Year asset was initially installed				
	Computer printers				
	1958–69	1970–75	1976–80	1981–85	1986–94
1	0.9274	0.9255	0.9004	0.8750	0.8478
2	0.7870	0.7808	0.7109	0.6410	0.5678
3	0.6534	0.6434	0.5415	0.4470	0.3570
4	0.5277	0.5189	0.4031	0.3049	0.2205
5	0.4206	0.4174	0.3002	0.2075	0.1343
6	0.3333	0.3333	0.2231	0.1403	0.0822
7	0.2606	0.2606	0.1656	0.0955	0.0516
8	0.2017	0.2017	0.1237	0.0662	0.0335
9	0.1559	0.1559	0.0936	0.0452	0.0220
10	0.1217	0.1217	0.0722	0.0321	0.0144
11	0.0960	0.0960	0.0553	0.0247	0.0093
12	0.0752	0.0752	0.0411	0.0178	0.0059
13	0.0576	0.0576	0.0299	0.0128	0.0037
14	0.0426	0.0426	0.0210	0.0090	0.0024
15	0.0302	0.0302	0.0141	0.0062	0.0015
16	0.0208	0.0208	0.0092	0.0041	0.0010
17	0.0140	0.0140	0.0059	0.0025	0.0006
18	0.0088	0.0088	0.0035	0.0014	0.0004
19	0.0053	0.0053	0.0020	0.0008	0.0002
20	0.0020	0.0020	0.0007	0.0003	0.0001

Age in years	Year asset was initially installed				
	Computer terminals and displays				
	1958–69	1970–75	1976–80	1981–85	1986–94
1	0.9793	0.9777	0.9749	0.9704	0.9208
2	0.9061	0.9006	0.8887	0.8702	0.7318
3	0.7799	0.7707	0.7450	0.7084	0.5216
4	0.6265	0.6180	0.5834	0.5388	0.3474
5	0.4786	0.4754	0.4404	0.3957	0.2220
6	0.3558	0.3558	0.3250	0.2821	0.1377
7	0.2586	0.2586	0.2359	0.1986	0.0851
8	0.1854	0.1854	0.1712	0.1407	0.0538
9	0.1333	0.1333	0.1261	0.1023	0.0352
10	0.0979	0.0979	0.0958	0.0776	0.0237
11	0.0750	0.0750	0.0750	0.0614	0.0164
12	0.0603	0.0603	0.0603	0.0507	0.0118
13	0.0505	0.0505	0.0505	0.0438	0.0088
14	0.0442	0.0442	0.0442	0.0400	0.0069
15	0.0402	0.0402	0.0402	0.0387	0.0058
16	0.0381	0.0381	0.0381	0.0381	0.0055
17	0.0368	0.0368	0.0368	0.0368	0.0055
18	0.0355	0.0355	0.0355	0.0355	0.0058
19	0.0342	0.0342	0.0342	0.0342	0.0049
20	0.0264	0.0264	0.0264	0.0264	0.0037

Age in years	Year asset was initially installed				
	Computer tape drives				
	1958–69	1970–75	1976–80	1981–85	1986–94
1	0.9229	0.9205	0.9175	0.9139	0.9094
2	0.7741	0.7671	0.7566	0.7437	0.7272
3	0.6333	0.6228	0.6031	0.5795	0.5516
4	0.5010	0.4907	0.4655	0.4369	0.4045
5	0.3875	0.3805	0.3544	0.3251	0.2921
6	0.2948	0.2902	0.2661	0.2372	0.2060
7	0.2184	0.2144	0.1958	0.1700	0.1435
8	0.1576	0.1542	0.1419	0.0755	0.0998
9	0.1113	0.1086	0.1015	0.0602	0.0698
10	0.0776	0.0755	0.0723	0.0418	0.0483
11	0.0535	0.0519	0.0504	0.0402	0.0325
12	0.0358	0.0347	0.0335	0.0282	0.0210
13	0.0229	0.0221	0.0213	0.0182	0.0129
14	0.0138	0.0132	0.0127	0.0112	0.0075
15	0.0077	0.0074	0.0071	0.0065	0.0042
16	0.0040	0.0038	0.0037	0.0028	0.0023
17	0.0020	0.0019	0.0018	0.0012	0.0012
18	0.0009	0.0008	0.0008	0.0008	0.0005
19	0.0004	0.0003	0.0003	0.0003	0.0002
20	0.0001	0.0001	0.0001	0.0001	0.0001

Age in years	Year asset was initially installed				
	Computer storage devices				
	1958–69	1970–75	1976–80	1981–85	1986–94
1	0.9975	0.9925	0.9800	0.9700	0.9549
2	0.9875	0.9775	0.9400	0.9100	0.7806
3	0.9753	0.9598	0.9026	0.8426	0.5326
4	0.8538	0.8376	0.7736	0.6913	0.3231
5	0.6269	0.6213	0.5585	0.4779	0.1767
6	0.4255	0.4255	0.3737	0.3063	0.0911
7	0.2692	0.2692	0.2369	0.1877	0.0459
8	0.1623	0.1623	0.1456	0.1134	0.0229
9	0.0958	0.0958	0.0890	0.0687	0.0111
10	0.0569	0.0569	0.0553	0.0417	0.0053
11	0.0343	0.0343	0.0343	0.0255	0.0025
12	0.0210	0.0210	0.0210	0.0160	0.0012
13	0.0130	0.0130	0.0130	0.0103	0.0006
14	0.0082	0.0082	0.0082	0.0069	0.0003
15	0.0054	0.0054	0.0054	0.0050	0.0002
16	0.0038	0.0038	0.0038	0.0038	0.0001
17	0.0029	0.0029	0.0029	0.0029	0.0001
18	0.0023	0.0023	0.0023	0.0023	0.0001
19	0.0022	0.0022	0.0022	0.0022	0.0001
20	0.0011	0.0011	0.0011	0.0011	0

lives should be used for each industry in which a particular type of asset is purchased, and service lives should be varied over time to account for changes in business conditions and technology. Because of data limitations, the service lives BEA uses fall short of this ideal in two ways. First, service lives can be computed only for those types of assets and industries shown in table C. Second, service lives can be varied over time only for those types of assets and industries shown in table C. All other service lives by type of asset and

Table C. BEA Rates of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wykoff Categories

Type of Asset	Rate of depreciation	Service life (years)	Declining balance rates	Hulten-Wykoff category [1]
Private nonresidential equipment				
Software:				
Prepackaged	0.5500	3	1.65	C
Custom	0.3300	5	1.65	C
Own-account	0.3300	5	1.65	C
Office, computing, and accounting machinery [2]:				
Years before 1978	0.2729	8	2.1832	B
1978 and later years	0.3119	7	2.1832	B
Communications equipment:				
Business services [3]	0.1500	11	1.65	C
Other industries [3]	0.1100	15	1.65	C
Instruments [4]	0.1350	12	1.6203	C
Photocopy and related equipment [5]	0.1800	9	1.6203	C
Nuclear fuel [6]	.....	4	.....	.....
Other fabricated metal products [7]	0.0917	18	1.65	C
Steam engines and turbines [8]	0.0516	32	1.65	C
Internal combustion engines [8]	0.2063	8	1.65	C
Metalworking machines [9]	0.1225	16	1.96	A
Special industrial machinery, n.e.c.	0.1031	16	1.65	C
General industrial, including materials handling equipment	0.1072	16	1.715	A
Electrical transmission, distribution, and industrial apparatus	0.0500	33	1.65	C
Trucks, buses, and truck trailers:				
Local and interurban passenger transit [10]	0.1232	14	1.7252	A
Trucking and warehousing; and auto repair, services, and parking [10]	0.1725	10	1.7252	A
Other industries	0.1917	9	1.7252	A
Autos [11]	.....	.....	.....	.....
Aircraft:				
Transportation by air, depository institutions, and business services:				
Years before 1960	0.1031	16	1.65	C
1960 and later years	0.0825	20	1.65	C
Other industries:				
Years before 1960	0.1375	12	1.65	C
1960 and later years	0.1100	15	1.65	C
Ships and boats	0.0611	27	1.65	B
Railroad equipment	0.0589	28	1.65	C
Household furniture and fixtures [12]	0.1375	12	1.65	C
Other furniture [12]	0.1179	14	1.65	C
Farm tractors [13]	0.1452	9	1.3064	A
Construction tractors [13]	0.1633	8	1.3064	A
Agricultural machinery, except tractors	0.1179	14	1.65	C
Construction machinery, except tractors	0.1550	10	1.5498	A
Mining and oil field machinery	0.1500	11	1.65	C
Service industry machinery:				
Wholesale and retail trade [14]	0.1650	10	1.65	C
Other industries [14]	0.1500	11	1.65	C
Household appliances [15]	0.1650	10	1.65	C
Other electrical equipment [16]	0.1834	9	1.65	C
Other [4]	0.1473	11	1.623	C
Private nonresidential structures				
Industrial buildings	0.0314	31	0.9747	A
Mobile offices [17]	0.0556	16	0.8892	A
Office buildings [17]	0.0247	36	0.8892	A
Commercial warehouses [17]	0.0222	40	0.8892	A
Other commercial buildings [17]	0.0262	34	0.8892	A
Religious buildings	0.0188	48	0.9024	C
Educational buildings	0.0188	48	0.9024	C
Hospital and institutional buildings	0.0188	48	0.9024	B
Hotels and motels [18]	0.0281	32	0.899	B
Amusement and recreational buildings [18]	0.0300	30	0.899	B
All other nonfarm buildings [18]	0.0237	38	0.899	B
Railroad replacement track [19]	0.0249	38	0.948	C
Other railroad structures [19]	0.0176	54	0.948	C
Telecommunications [19]	0.0237	40	0.948	C
Electric light and power [19]:				
Years before 1946	0.0237	40	0.948	C
1946 and later years	0.0211	45	0.948	C
Gas [19]	0.0237	40	0.948	C
Petroleum pipelines [19]	0.0237	40	0.948	C
Farm [20]	0.0239	38	0.91	C
Mining exploration, shafts, and wells:				
Petroleum and natural gas [21]:				
Years before 1973	0.0563	16	0.9008	C
1973 and later years	0.0751	12	0.9008	C
Other [21]	0.0450	20	0.9008	C
Local transit [22]	0.0237	38	0.899	C
Other [22]	0.0225	40	0.899	C
Residential capital (private and government)				
1-to-4-unit structures–new [20]	0.0114	80	0.91	A
1-to-4-unit structures–additions and alterations [20]	0.0227	40	0.91	A
1-to-4-unit structures–major replacements [20]	0.0364	25	0.91	A
5-or-more-unit structures–new [20]	0.0140	65	0.91	A
5-or-more-unit structures–additions and alterations [20]	0.0284	32	0.91	A
5-or-more-unit structures–major replacements [20]	0.0455	20	0.91	A
Manufactured homes [20]	0.0455	20	0.91	A
Other structures [20]	0.0227	40	0.91	A
Equipment [23]	0.1500	11	1.65	C
Durable goods owned by consumers [24]				
Furniture, including mattresses and bedsprings	0.1179	14	1.65	B
Kitchen and other household appliances	0.1500	11	1.65	C
China, glassware, tableware, and utensils [25]	0.1650	10	1.65	C
Other durable house furnishings [25]	0.1650	10	1.65	C
Video and audio products, computers and peripheral equipment, and musical instruments [26]	0.1833	9	1.65	B
Jewelry and watches [25]	0.1500	11	1.65	C
Ophthalmic products and orthopedic appliances [25]	0.2750	6	1.65	C
Books and maps [25]	0.1650	10	1.65	C
Wheel goods, sports and photographic equipment, boats, and pleasure aircraft [27]	0.1650	10	1.65	C
Autos [11]	.....	.....	.....	.....
Other motor vehicles [28]	0.2316	8	1.853	A
Tires, tubes, accessories, and other parts [28]	0.6177	3	1.853	A
Government nonresidential equipment [29]				
Federal:				
National defense:				
Aircraft:				
Airframes:				
Bombers	0.0660	25	1.65	C
F–14 type	0.0868	19	1.65	C
Attack, F–15 and F–16 types	0.0825	20	1.65	C
F–18 type	0.1100	15	1.65	C
Electronic warfare	0.0717	23	1.65	C
Cargo and trainers	0.0660	25	1.65	C
Helicopters	0.0825	20	1.65	C
Engines	0.2750	6	1.65	C
Other:				
Years before 1982	0.1179	14	1.65	C
1982 and later years	0.1650	10	1.65	C
Missiles: [30]				
Strategic	.....	20	.....	.....
Tactical	.....	15	.....	.....
Torpedoes	.....	15	.....	.....
Fire control equipment	.....	10	.....	.....
Space programs	.....	20	.....	.....
Ships:				
Surface ships	0.0550	30	1.65	C
Submarines	0.0660	25	1.65	C
Government furnished equipment:				
Electrical	0.1834	9	1.65	C
Propulsion	0.0825	20	1.65	C
Hull, mechanical	0.0660	25	1.65	C
Ordnance	0.1650	10	1.65	C
Other	0.1650	10	1.65	C
Vehicles:				
Tanks, armored personnel carriers, and other combat vehicles	0.0825	20	1.65	C
Noncombat vehicles:				
Trucks	0.2875	6	1.7252	C
Autos [31]	.....	.....	.....	.....
Other	0.2465	7	1.7252	C
Electronic equipment:				
Computers and peripheral equipment [32]	.....	.....	.....	.....
Electronic countermeasures	0.2357	7	1.65	C
Other	0.1650	10	1.65	C
Other equipment:				
Medical	0.1834	9	1.65	C
Construction	0.1550	10	1.5498	C
Industrial	0.0917	18	1.65	C
Ammunition plant	0.0868	19	1.65	C
Atomic energy	0.1375	12	1.65	C
Weapons and fire control	0.1375	12	1.65	C
General	0.1650	10	1.65	C

See footnotes at the end of the table.

industry are held constant over time. Book value comparisons suggest that the use of constant service lives has not produced any systematic bias in the BEA estimates of private fixed assets for the period (1959–81).[68]

As indicated in table C, the service lives for some types of government fixed assets are varied over time while others are held constant depending upon the availability of data. The lives used for durable goods owned by consumers are held constant over time, because the information necessary to estimate changing lives over time was not available.

Private equipment. BEA's service lives for private equipment are based on service lives obtained from industry studies conducted during the 1970s by the former Office of Industrial Economics (OIE) of the U.S. Department of the Treasury and from industry studies conducted during the 1980s and 1990s by the Office of Tax Analysis (OTA) of the U.S. Department of the Treasury, with the following exceptions: Nuclear fuel; office, computing, and accounting machinery; software; autos; and railroad equipment.[69] The OIE results are particularly useful for manufacturing industries because they provide separate industry estimates

68. Book value data, which relate directly to capital stocks, can be used as checks on the validity of the information used to implement the perpetual inventory method. Examples of such checks on the BEA estimates are given in John A. Gorman, John C. Musgrave, Gerald Silverstein, and Kathy A. Comins, "Fixed Private Capital in the United States: Revised Estimates, 1925–81 and Estimates by Industry, 1947–81," SURVEY 65 (July 1985): 36–59.

69. The results of the OIE studies are given in David W. Brazell, Lowell Dworin, and Michael Walsh, *A History of Federal Tax Depreciation Policy*, U.S. Department of the Treasury, OTA Paper 64 (Springfield, VA: National Technical Information Service, May 1989): 33–58. The results of the OTA studies that are used in the BEA wealth calculations are given in U.S. Department of the Treasury, *Report to the Congress on Depreciation of Scientific Instruments* (Washington, D.C.: March 1990); U.S. Department of the Treasury, *Report to the Congress on Depreciation of Business-Use Passenger Cars* (Washington, D.C.: April 1991); and U.S. Department of the Treasury, *Report to the Congress on Depreciation of Business-Use Light Trucks* (Washington, D.C.: September 1991).

Table C. BEA Rates of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wykoff Categories—Continued

Type of Asset	Rate of depreciation	Service life (years)	Declining balance rates	Hulten-Wykoff category [1]
Other	0.1375	12	1.65	C
Nondefense:				
General government:				
Computers and peripheral equipment [32]	.....	.....	.....	.....
Aerospace equipment	0.1100	15	1.65	C
Vehicles	0.4533	5	2.2664	C
Other	0.1650	10	1.65	C
Enterprises:				
U.S. Postal Service:				
Computers and peripheral equipment [32]	.....	.....	.....	.....
Vehicles	0.3238	7	2.2664	C
Other	0.1100	15	1.65	C
Tennessee Valley Power Authority	0.0500	33	1.65	C
Bonneville Power Authority	0.0500	33	1.65	C
Other	0.0660	25	1.65	C
State and local				
Power tools, lawn and garden equipment	0.1650	10	1.65	C
Miscellaneous metal products	0.0917	18	1.65	C
Agricultural machinery and equipment	0.1833	9	1.65	C
Construction machinery and equipment	0.1650	10	1.65	C
Metalworking machinery and equipment	0.1031	16	1.65	C
General purpose machinery and equipment	0.1500	11	1.65	C
Special industry machinery and equipment	0.1500	11	1.65	C
Integrating and measuring instruments	0.1375	12	1.65	C
Motors, generators, motor generator sets	0.0516	32	1.65	C
Switchgear and switchboard equipment	0.0500	33	1.65	C
Electronic components and accessories	0.1833	9	1.65	C
Miscellaneous electrical machinery	0.1375	12	1.65	C
Calculating and accounting machines	0.2357	7	1.65	C
Typewriters	0.2357	7	1.65	C
Computers and peripheral equipment	.....	.....	.....	.....
Machine shop products	0.2063	8	1.65	C
Wood commercial furniture	0.1179	14	1.65	C
Metal commercial furniture	0.1179	14	1.65	C
Household appliances	0.1500	11	1.65	C
Home electronic equipment	0.1500	11	1.65	C
Motor vehicles	0.1650	10	1.65	C
Motorcycles	0.1650	10	1.65	C
Aircraft	0.1100	15	1.65	C
Railroad equipment	0.0590	28	1.65	C
Sporting and athletic goods	0.1650	10	1.65	C
Photographic and photocopying equipment	0.1650	10	1.65	C
Mobile classrooms, mobile offices, etc	0.1650	10	1.65	C
Musical instruments	0.1834	9	1.65	C
Other equipment	0.1375	12	1.65	C
Government nonresidential structures [33]				
Federal, State, and local:				
Buildings:				
Industrial	0.0285	32	0.91	C
Educational	0.0182	50	0.91	C
Hospital	0.0182	50	0.91	C
Other	0.0182	50	0.91	C
Nonbuildings:				
Highways and streets	0.0202	45	0.91	B*
Conservation and development	0.0152	60	0.91	C
Sewer systems	0.0152	60	0.91	C
Water systems	0.0152	60	0.91	C
Military facilities	0.0182	50	0.91	C
Other	0.0152	60	0.91	C

* This type of asset was categorized by BEA rather than by Hulten and Wykoff.

1. This column refers to Hulten-Wykoff categories. Type A assets are types of assets for which Hulten-Wykoff specifically estimated age-price profiles. Type B assets are those for which Hulten-Wykoff used empirical research by others and their judgement to estimate the depreciation rate. Type C assets are assets for which Hulten-Wykoff estimated an average declining-balance rate from data for all type A and B assets.
2. The depreciation rate for this type of asset is not used for computers and peripheral equipment. Depreciation rates for these assets are taken from Oliner as described in the text.
3. The declining-balance rate is from the Hulten-Wykoff communications equipment aggregate.
4. Instruments and other private nonresidential equipment, called producer durable equipment by Hulten-Wykoff, are classified by them to be of type C, but appear to be of type B as they were given a declining-balance rate of 1.6203.
5. The declining-balance rate is from the Hulten-Wykoff other producer durable equipment aggregate.
6. The depreciation rates for nuclear fuel are based on a straight-line rate pattern and a Winfrey retirement pattern.
7. The declining-balance rate is from the Hulten-Wykoff fabricated metal products aggregate.
8. The declining-balance rate is from the Hulten-Wykoff engines and turbines aggregate.
9. The depreciation rate and service life listed apply to nonmanufacturing industries; the service lives and depreciation rates used for manufacturing industries differ by industry. The Hulten-Wykoff type of asset listed applies to all industries.
10. The declining-balance rate is from the Hulten-Wykoff trucks, buses and truck trailer aggregate.
11. Depreciation rates for autos are derived from data on new and used auto prices.
12. The declining-balance rate is from the Hulten-Wykoff furniture and fixtures aggregate.
13. The declining-balance rate is from the Hulten-Wykoff tractors aggregate.
14. The declining-balance rate is from the Hulten-Wykoff service industry machinery aggregate.
15. The declining-balance rate is set to the Hulten-Wykoff producer durable equipment default.
16. The declining-balance rate is from the Hulten-Wykoff electrical equipment (not elsewhere classified) aggregate.
17. The declining-balance rate is from the Hulten-Wykoff commercial aggregate.
18. The declining-balance rate is from the Hulten-Wykoff other private nonresidential structures aggregate, which consists of buildings used primarily for social and recreational activities and buildings not elsewhere classified.
19. The declining-balance rate is from the Hulten-Wykoff public utilities aggregate.
20. The declining-balance rate is set to the Hulten-Wykoff private nonresidential structures default.
21. The declining-balance rate is from the Hulten-Wykoff mining exploration, shafts and wells aggregate.
22. The declining-balance rate is from the Hulten-Wykoff other private nonresidential structures aggregate, which consists of streets, dams and reservoirs, sewer and water facilities.
23. The declining-balance rate is set to the Hulten-Wykoff producer durable equipment default.
24. For all consumer durables except for motor vehicles and parts and computing equipment, the declining-balance rate is set to the Hulten-Wykoff producer durable equipment default.
25. The corresponding Hulten-Wykoff consumer durables category is other.
26. Depreciation rates for computers and peripheral equipment are taken from Oliner as described in the text. The information listed applies to video and audio products and musical instruments. The corresponding Hulten-Wykoff aggregate is radio and television receivers, recorders, and musical instruments. Radio and television receivers, recorders, and musical instruments are classified by Hulten-Wykoff to be of type B, but are indistinguishable from type C as their declining-balance rate is 1.65.
27. The corresponding Hulten-Wykoff consumer durables category is wheel goods, durable toys, sports equipment.
28. The declining-balance rate is from the Hulten-Wykoff motor vehicles and parts aggregate. The declining-balance rate for this category is calculated under the assumption that the service life for consumer durables motor vehicles and parts is equal to the service life for producer durable equipment autos previously used by BEA.
29. For most government nonresidential equipment, the declining-balance rate is set to the Hulten-Wykoff producer durable equipment default. Where possible, the rate is set equal to the rate used for comparable equipment in the private sector.
30. Missiles are depreciated using straight-line patterns of depreciation and a Winfrey retirement pattern.
31. Depreciation rates for government-owned autos are derived from data on autos that are privately owned.
32. Depreciation rates for these assets are taken from Oliner as described in the text.
33. For all government nonresidential structures, the declining-balance rate is set to the Hulten-Wykoff private nonresidential structures default.

of service lives for production-type equipment—metalworking machinery; special industry machinery, not elsewhere classified; and general industrial machinery, including materials handling equipment. The information on the service life for nuclear fuel was obtained from Professor Madeline Feltus of the Pennsylvania State University. The service life for office, computing, and accounting machinery is derived, in part, from the study by Oliner based on industry data.[70] The service lives for software were set judgmentally by BEA during the 1999 comprehensive revision. The derivation of stocks of autos does not require an explicit service-life assumption, as explained in the section "Derivation of Estimates of Privately-owned Automobiles." The service life for railroad equipment is derived from information on service lives submitted by railroads to the Interstate Commerce Commission as part of the 1983 annual reports of individual railroads.

Private nonresidential structures. For farm structures, the average service life is derived from USDA studies. For telephone and telegraph, electric light and power, gas, and petroleum pipelines structures, the service lives are derived by comparing book value data provided by regulatory agencies with various perpetual inventory estimates calculated using alternative service lives. For railroad structures, service lives are derived from the same source as for railroad equipment (see above). For petroleum and natural gas exploration, shafts, and wells, the lives are based on data from the Census Bureau's annual surveys of oil and gas for 1979–1982. For other types of nonfarm structures, service lives are based on published and unpublished data from studies conducted during the 1960s and 1970s by the U.S. Department of the Treasury.[71]

Residential structures. The average service lives for most types of new residential structures are taken from a study by Goldsmith and Lipsey.[72] Improvements to residential structures are assigned the following lives: Additions and alterations are assumed to have lives one-half as long as those for new structures; and lives for residential major replacements are based on industry estimates for items replaced during the 1970s. Mobile homes are assigned a life of 20 years, based on trade association data.

Government-owned fixed assets. Service lives for most government assets are derived from those used for corresponding assets owned by private business. For some Federal Government equipment (primarily military equipment), depreciation patterns are based on service lives estimated from U.S. Government administrative sources (primarily U.S. Department of Defense data).

Based on recent studies, the service life for highways was shortened to 45 years from 60 years so the geometric rate is 0.0202 instead of 0.0152 as it had been in previously published estimates.[73] The new rate is based on the default declining balance rate (0.91).

Durable goods owned by consumers. For durable goods owned by consumers, the average service lives are based on unpublished trade association data, the assumptions of other researchers, several USDA studies, and the age distribution of the stock of various consumer durables reported in the 1960–61 and 1972–73 BLS surveys of consumer expenditures.[74]

Retirement patterns

Assets are "retired" from the stock when their value declines to zero. This normally occurs at the end of their assumed service lives. However, some assets are retired prematurely because of catastrophic losses and, for military equipment and structures, because of surplusing by the Federal Government. For missiles and nuclear fuel rods, the depreciation profile is assumed to decline to zero in a straight-line manner, but each vintage of a given type of asset is divided into several dozen cohorts, each of which is assumed to have a different service life. These lives are assumed to be distributed about the mean according to a pattern calculated using a modified version of a curve developed by Winfrey (see table D).[75] Specifically, a Winfrey S–3 curve, which is a bell-shaped distribution centered on the average service life of the asset, is modified so

70. Oliner, 1993.

71. See U.S. Department of the Treasury, Office of Industrial Economics, *Business Building Statistics* (Washington, D.C.: U.S. Government Printing Office, August 1975).

72. See Raymond W. Goldsmith and Robert Lipsey, *Studies in the National Balance Sheet of the United States, Volume 1* (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1963).

73. For information on the service life of highways, see Richard Beemiller, *Experimental Estimates of State and Local Government Highway Capital Stocks* (paper presented at the 1999 annual meeting of the Southern Regional Science Association, Richmond, VA, April 1999); and Barbara M. Fraumeni, *Productive Highway Capital Stock Measures*, a report prepared for the Federal Highway Administration, U.S. Department of Transportation, January 1999.

74. See Lenore A. Epstein, *Consumers' Tangible Assets, Studies in Income and Wealth,* Volume 12 (Princeton, NJ): Princeton University Press, for the National Bureau of Economic Research, 1950, 410–460; Raymond W. Goldsmith, *The National Wealth of the United States in the Postwar Period* (Princeton, NJ: Princeton University Press, for the National Bureau of Economic Research, 1962); Marilyn Doss Ruffin and Katherine S. Tippett, "Service-Life Expectancy of Household Appliances: New Estimates from USDA," *Home Economics Research Journal* 3 (March 1975): 159–170; and U.S. Bureau of Labor Statistics, "Survey of Consumer Expenditures, 1960–61, Expanding Ownership of Household Equipment," BLS Report No. 238–7, November 1964, and "Consumer Expenditure Survey Series: Interview Survey, 1972–73, Inventories of Vehicles and Selected Household Equipment, 1973," BLS Report No. 455–5, 1978.

75. See Robley Winfrey, *Statistical Analyses of Industrial Property Retirements*, Bulletin 125 Revised (Ames, IA: Engineering Research Institute, Iowa State University, April 1967); and J.G. Russo and H.A. Cowles, "Revalidation of the Iowa Type Survivor Curves," *The Engineering Economist* 26 (Fall 1980): 1–16.

that retirements start at 45 percent and end at 155 percent of the average service life.[76] This retirement pattern results in a decline in the value of the net stock of an entire vintage of missiles or nuclear fuel rods in a manner that is somewhat more accelerated than that given by the simple straight-line pattern.

For all other assets, no explicit retirement patterns are used in constructing the estimates of the stocks, but the depreciation rates that are used are based on empirical estimates that reflect the pattern of actual retirements. Retirements of autos are determined from vehicle registration data, although all autos that are more than 12 years old are fully depreciated. Computer equipment is implicitly retired at various ages; that is, when it is fully depreciated, according to the assumed empirical profile. All remaining assets are assumed to have geometric depreciation profiles; their assumed service lives only serve to help determine the appropriate depreciation rates.

76. Winfrey developed a number of retirement curves. Some were symmetric about the mean; others were asymmetric. The designation S–3 means it is the third of three variations of a symmetric curve.

Table D. Modified Winfrey S–3 Retirement Pattern for Missiles and Nuclear Fuel Rods

Percent of average service life	Cumulative percent of expenditures discarded	Percent of average service life	Cumulative percent of expenditures discarded
Less than 45	0	105	61.6
45	1.2	110	68.8
50	2.4	115	75.4
55	4.1	120	81.3
60	6.5	125	86.3
65	9.7	130	90.3
70	13.7	135	93.5
75	18.7	140	95.9
80	24.6	145	97.6
85	31.2	150	98.8
90	38.4	155	100.0
95	46.1	More than 155	100.0
100	53.9		

Derivation of Estimates of Privately Owned Automobiles

The extensive data available on automobiles[77] allows the use of the physical inventory method in deriving estimates of net stocks and depreciation. As a result, it is not necessary to assume a service life or retirement pattern for autos or to make explicit adjustments to the investment data for net purchases of used autos between different types of owners.

The number of autos in use and their respective ages are estimated using registration data by model year tabulated annually by R.L. Polk and Company. This information is used to derive estimates of the total stock of autos owned by private business, government, and consumers. The allocation of unit stocks (measured in numbers of vehicles) among sectors is based on information on new auto sales by sector and assumed retention rates for private business and for government autos. Estimates of the stock of consumer autos are based on the difference between the total stock and the stocks owned by business and by government.

The first step in deriving estimates of auto stocks held by business, by government, and by consumers involves the calculation of the total stock of autos in use regardless of ownership. First, the number of new autos entering the stock each year is estimated from trade source data. Second, survival rates for each year of original registration are estimated using annual Polk tabulations of car registrations by model year. Finally, the survival rates are applied to the estimates of new autos to derive annual estimates of the total stock of autos in use by year of original sale.[78]

The second step involves separating the total stock of autos into stocks held by consumers, government, and business, using Polk tabulations of registrations of new autos as well as BLS and Census Bureau data on autos owned by individuals but used wholly or partly for business purposes. New autos owned by businesses are assigned to the business stock, and new autos owned by individuals that are used exclusively for personal purposes are assigned to the consumer stock. New autos owned by individuals that are used wholly or partly for business purposes are allocated between consumer and business stocks, according to the share of business usage of these autos.[79] The portion of these autos allocated to the business stock provides the estimates of employee-owned autos discussed in the section "Investment controls by type of industry" in the chapter "Derivation of Investment Flows." These estimates are adjusted for purchases by consumers of used autos from both business and government using assumed retention rates, based on an average retention period of slightly more than one year for rental autos and between 3 and 4 years for other autos owned by business and government.

Third, the average unit values for business and consumer autos in each year of original sale are derived from list prices by model (including options) from trade sources. These prices are adjusted for transportation costs, discount factors, rebates, and sales taxes. Average unit values in 1996 prices are obtained by deflation using the price indexes for the new-auto category of private equipment and personal consumption expenditures, which are based on the consumer price index for new autos. The annual real-cost net stocks of business and consumer autos are obtained by multiplying the number of business autos and consumer autos for each year of original sale by the corresponding deflated unit values, which are then adjusted for age, according to the estimated depreciation profile.

Finally, the total business stock of autos is distributed by industry using data from capital flow tables that have been adjusted to the NIPA industry classification and to an ownership basis.

77. The estimates of stocks of autos are derived from data used to estimate purchases of autos by private business and by consumers in the NIPAs. A detailed description of the derivation of auto data for cars-in-use and expenditures data is given in *Personal Consumption Expenditures,* 55–58.

78. Survival rates for autos that are at least 4 years old are computed directly from Polk cars-in-use data; survival rates for autos less than 4 years old are estimated judgementally.

79. The data on business usage of household-owned autos are derived from U.S. Department of Labor, Bureau of Labor Statistics, *Survey of Consumer Expenditures* (Washington, D.C.: U.S. Government Printing Office, 1964); U.S. Department of Commerce, Bureau of the Census, *Consumer Buying Indicators* (Washington, D.C.: U.S. Government Printing Office, July 1971); and U.S. Department of Commerce, Bureau of the Census, *Current Population Reports: Household and Family Characteristics* (Series P–20) (Washington, D.C.: U.S. Government Printing Office, annually).

Glossary and Guide to the Tables

Glossary

Average age of net stock at the end of a given year is a weighted average of the ages of all depreciated investment in the stock as of yearend. The weight for each age is based on the proportion of its value as part of the total net stock. The average ages of net stocks are presented only for the current-cost and historical-cost valuations.

Consumer durables. See *Durable goods owned by consumers.*

Corporate business consists of all entities required to file Federal corporate income tax returns (IRS Form 1120 series), including mutual financial institutions and cooperatives subject to Federal income tax, nonprofit organizations that primarily serve business, Federal Reserve banks, and federally sponsored credit agencies.

Current-cost valuation measures the value of fixed assets and consumer durables in the prices of the given period, which are at year end for net stocks and annual averages for depreciation.

Depreciation is the charge for the using up of private and government fixed assets and consumer durables. Specifically, it is defined as the decline in value due to wear and tear, obsolescence, accidental damage, and aging. For the estimates presented here, most assets are assumed to have depreciation patterns that decline geometrically over time so that, for a given year, the constant-dollar depreciation charges on existing assets are obtained by multiplying the prior year's charge by one minus the annual depreciation rate.

Durable goods owned by consumers are commodities purchased by consumers for their nonbusiness use that can be used repeatedly and continuously over a period of three or more years.

Financial industries consists of the following SIC industries: Depository institutions, nondepository institutions, security and commodity brokers, insurance carriers, regulated investment companies, small business investment companies, and real estate investment trusts.[80]

Fixed assets consists of structures, equipment, and software that are owned by private business, nonprofit institutions, Federal, and State and local government agencies including government enterprises that are located in the United States (except for national defense equipment, for which coverage is worldwide).

Government fixed assets consists of equipment, software, and structures that are owned by Federal or State and local governments, including government enterprises, and that are located in the United States (except for national defense equipment and U.S. embassies abroad, for which coverage is worldwide).

Gross investment is the value of purchases of new fixed assets and net purchases of used assets at depreciated cost from other types of owners (private business, governments, households, and nonresidents). Data are not available to adjust for net purchases of used assets at depreciated cost among industries or among legal forms of organization. In this volume, purchases of consumer durables are also treated as part of gross investment, in contrast to the NIPAs, which do not treat them as investment.

Historical-cost valuation measures the value of fixed assets and consumer durables in the prices of the periods in which the assets were purchased new.

National defense fixed assets consists of equipment, software, and structures owned by the U.S. Department of Defense. It excludes family housing for the armed forces, civil works construction by the Army Corps of Engineers, industrial facilities, military hospitals, and the Soldiers' and Airmen's Home.

Net stock is the value of fixed assets and consumer durables after accounting for depreciation. For historical-cost valuation and for real-cost valuation at the deflation level, the perpetual inventory method calculates the net stock as the cumulative value of past gross investment less the cumulative value of past depreciation, with adjustments for catastrophic losses and for net purchases of used assets at depreciated cost. For current-cost valuation, the net stock is the value of the items in the real-cost net stock measured in current, yearend prices.

Nondefense fixed assets consists of all structures and equipment and software owned by the Federal Government other than National defense structures and

80. Regulated investment companies, small business investment companies, and real estate investment trusts are included in the SIC classification "holding and other investment offices" and are not shown separately in the NIPA tables or in the estimates presented here.

equipment and software.

Nonfinancial industries consists of all SIC private industries other than those classified as financial industries (and listed above).

Other private business consists of all entities that are required to report rental and royalty income on the individual income tax return in IRS Schedule E (Supplemental Income and Loss) if the individual meets the filing requirements, tax-exempt cooperatives, owner-occupied nonfarm housing, and buildings and equipment owned and used by nonprofit institutions that primarily serve individuals.

Owner-occupied residential assets consists of housing occupied by private owners.

Partnerships consists of all entities required to file Federal partnership income tax returns, IRS Form 1065 (U.S. Partnership Return of Income).

Private fixed assets consists of equipment, software, and residential and nonresidential structures, including owner-occupied housing, that are owned by private business or nonprofit institutions.[81] All privately-owned fixed assets located in the United States are included regardless of whether they are owned by U.S. residents.

Real-cost valuation measures the value of fixed assets and consumer durables after the effects of price change have been removed. Estimates for the aggregates are presented as chain-type quantity indexes, with 1996 equal to 100. These indexes are computed using annual-weighted Fisher-type indexes to obtain year-to-year growth rates, which are chained together to obtain cumulative growth rates. Estimates for selected higher-level aggregates are also presented in chained (1996) dollars.[82]

Sole proprietorships consists of owner-occupied farm housing and of all entities that are required to file IRS Schedule C (Profits or Loss From Business) or Schedule F (Farm Income and Expenses) when the proprietor meets the filing requirements.

Tenant-occupied residential assets consists of rental housing, including all government-owned residential assets.

Guide to the Tables

The tables in this publication are presented in eight sections. Section 1, which consists of seven tables, presents summary estimates of private fixed and government assets and durable goods owned by consumers. Section 2, which consists of five tables, presents estimates of private fixed equipment and software and structures by type of asset. Section 3, which consists of five tables, presents estimates of private fixed nonresidential and residential equipment and software and structures by industry. Section 4, which consists of five tables, presents estimates of fixed nonresidential private assets, by major industry group and by legal form of organization. Section 5, which consists of five tables, presents estimates of residential fixed assets by type of owner, by legal form of organization, by industry, and by tenure group. Section 6, which consists of five tables, presents estimates of private fixed assets by legal form of organization and by industry. Section 7, which consists of four tables, presents estimates of fixed government assets. Section 8, which consists of four tables, presents estimates of durable goods owned by consumers by type of good. Section 9, which consists of 3 tables, presents chained dollar estimates of net stocks, depreciation, and investment.

81. For private business and government, equipment is defined as assets with a life expectancy of at least one year.

82. The most detailed estimates presented in this volume are generally at the deflation level, the lowest level of detail for which investment price indexes exist. Estimates presented at this level are equivalent to estimates measured in constant (1996) prices. However, a few of the detailed investment series within private equipment and software are more aggregated than the deflation level; where the detailed components have different deflators, the estimates are measured in constant (1996) prices and differ slightly from comparable estimates measured in chained (1996) dollars. For a discussion of the difference between chained-dollar and constant-price estimates, see J. Steven Landefeld and Robert P. Parker, "BEA's Chain Indexes, Time Series, and Measures of Long-Term Economic Growth," SURVEY 77 (September 1997): 58–68.

Footnotes to the Tables

The following footnotes apply to all tables in the section in which they appear.

Section 2. Private Fixed Assets by Type

1. Excludes software "embedded" or bundled in computers and other equipment.

2. Consists of office buildings, except those occupied by electric and gas utility companies.

3. Consists primarily of stores, restaurants, garages, service stations, warehouses, and other buildings used for commercial purposes.

4. Consists of buildings not elsewhere classified, such as passenger terminals, greenhouses, and animal hospitals.

5. Consists primarily of streets, dams, reservoirs, sewer and water facilities, parks, and airfields.

6. Consists primarily of dormitories and of fraternity and sorority houses.

n.e.c. Not elsewhere classified.

Section 3. Private Fixed Assets by Industry

1. Fixed assets of nonprofit institutions serving individuals are included in the real estate industry.

2. Consists of social services; museums, botanical and zoological gardens; membership organizations; engineering and management services; and services, not elsewhere classified.

NOTE. Estimates in this table are based on the 1987 Standard Industrial Classification (SIC).

Section 5. Residential Fixed Assets by Type of Owner, Legal Form of Organization, Industry, and Tenure Group

1. Excludes stocks of other nonfarm residential fixed assets, which consist primarily of dormitories and of fraternity and sorority houses.

Section 7. Government Fixed Assets

1. Consists of the fixed assets of general government and government enterprises.

2. Consists primarily of general office buildings, police and fire stations, courthouses, auditoriums, garages, and passenger terminals.

3. Consists of Department of Defense structures, except family housing.

4. Consists primarily of electric and gas facilities, transit systems, and airfields.

Section 8. Consumer Durable Goods

1. Consists of recreational vehicles and accessories and parts.

2. Consists of refrigerators and freezers, cooking ranges, dishwashers, laundry equipment, stoves, air conditioners, sewing machines, vacuum cleaners, and other appliances except for built-in appliances, which are classified as part of residential structures.

3. Includes floor coverings, comforters, quilts, blankets, pillows, picture frames, mirrors, art products, portable lamps, and clocks. Also includes writing equipment and hand, power, and garden tools.

Note: Tables are now part of BEA's Interactive Data Table Application on the BEA Web site at:
http://www.bea.gov/iTable/index_FA.cfm