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**The Measurement of Depreciation,  
Capital Stocks, and Changes in Stocks  
in the  
U.S. National Income and Product Accounts**

Barbara M. Fraumeni  
Shelby W. Herman

**For additional information please contact:**

Barbara M. Fraumeni  
Shelby W. Herman  
Bureau of Economic Analysis  
U.S. Department of Commerce  
14<sup>th</sup> and Constitution Avenue, N.W. Washington D.C 20230, USA  
Email : [barbara.fraumeni@bea.doc.gov](mailto:barbara.fraumeni@bea.doc.gov) , [Shelby.Herman@bea.doc.gov](mailto:Shelby.Herman@bea.doc.gov)  
[tel : 1 202 606-9603](tel:12026069603)

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# **The Measurement of Depreciation, Capital Stocks, and Changes in Stocks in the U.S. National Income and Product Accounts<sup>1</sup>**

## **I. Introduction**

In recent years the U.S. Bureau of Economic Analysis (BEA) has introduced two major capital stock related innovations in the U.S. National Income and Product Accounts (NIPA's), and is looking forward to introducing another as part of the next comprehensive revision. In 1996, as part of the comprehensive revision of the NIPA's, BEA introduced an improved methodology for calculating depreciation.<sup>2 3</sup> **In 2000, as part of the most recent comprehensive revision of the NIPA's, it released a new table showing the sources of changes in net stock of produced assets.<sup>4</sup> BEA is working towards incorporating information on financial flows in this table. In these ways, the asset accounts in the NIPA's have been substantially improved and are more consistent with the System of National Accounts (SNA).<sup>5</sup>**

## **II. New Depreciation Methodology**

The new BEA depreciation methodology introduced in 1996 reflects the results of empirical studies which have shown that a geometric pattern of depreciation is appropriate for most types of assets. The new BEA methodology also uses a geometric pattern of depreciation as the default option when information on specific assets is unavailable. In either case, the geometric (constant) rate of depreciation is determined from empirical studies of used-assets. For some assets (autos, computers other than personal computers, missiles, and nuclear fuel), empirical studies, BEA data, or technological factors justify the use of a nongeometric pattern of depreciation by BEA. BEA is continuing its work on depreciation and asset lives; during the last comprehensive benchmark revisions were made to depreciation patterns for personal computers and asset lives for highways. In addition a methodology for estimating software depreciation was adopted as part of BEA's recent recognition of business and government expenditures for computer software as investment.<sup>6</sup> **This section of this paper describes BEA's new depreciation methodology and briefly reviews the empirical research on depreciation, the basis for the improvement in BEA methodology.**

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<sup>1</sup> This paper represents views of the authors and is not an official position of the Bureau of Economic Analysis or the Department of Commerce.

<sup>2</sup> See Fraumeni (1997), Katz and Herman (1997), and BEA(1999).

<sup>3</sup> Depreciation is typically called "consumption of fixed capital" in national accounts.

<sup>4</sup> See Herman (2000).

<sup>5</sup> For the SNA, see Commission of the European Communities, et. al. (1993).

<sup>6</sup> See Parker and Grimm (2000) and Seskin (1999).

## IIA. Comparison of prior and current methodology

The BEA estimates of depreciation prior to 1996 were based on a straight-line pattern for depreciation;<sup>7</sup> the switch is to a geometric pattern for depreciation for most assets. A straight-line pattern assumes equal dollar depreciation over the life of the asset. For example, with straight-line depreciation, depreciation,  $d_{i,G}$ , for one dollar of investment

$$d_{i,SL} = 1/n, I = 1,2,3,\dots,n$$

where  $I$  is the age of the asset, and  $n$  is the retirement age of the asset, which can be distributed about the average service life of the asset,  $T$ . A geometric pattern is a specific type of accelerated pattern. An accelerated pattern assumes higher dollar depreciation in the early years of an asset's service life than in the later years. With a geometric pattern

$$d_{i,G} = \delta_G (1 - \delta_G)^{I-1}, I = 1,2,3,\dots$$

where  $\delta_G$  is the geometric rate of depreciation. In BEA calculations geometric depreciation is calculated as a constant fraction of detailed real-cost net capital stocks. BEA assumes that assets on average are placed in service at midyear, so that depreciation on them is equal to one-half the new investment times the depreciation rate. Therefore, the contribution to the real-cost net capital stock at the end of year  $t$ ,  $N_{it}$ , for one real-cost dollar of investment in year  $y$  is given by:

$$N_{ty} = (1 - \delta_G/2) (1 - \delta_G)^{t-y},$$

where  $t$  is greater than or equal to  $y$ .

BEA continues to use a current-cost measure of depreciation and produce investment (and depreciation) on an industry-by-asset basis. Investment by industry and by asset is derived using source data, benchmark input-output capital-flow matrices, and an abbreviated commodity flow method for extrapolation.<sup>8</sup>

## IIB. BEA's definition of depreciation

BEA defines depreciation as "the decline in value due to wear and tear, obsolescence, accidental damage, and aging,"<sup>9</sup> which includes retirements, or discards as they are frequently called. For private fixed assets and for fixed assets of government enterprises, depreciation also includes the value of the damages incurred from natural and other disasters.<sup>10 11</sup> However,

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<sup>7</sup> Once retirements began under the prior BEA methodology, the combined effects of straight-line depreciation and retirements resulted in a depreciation pattern that was more accelerated than a straight-line pattern.

<sup>8</sup> See the chapter "Derivation of Investment Flows" in BEA (1999), pp. M-11 - M-25 for more details.

<sup>9</sup> Katz and Herman (1997), p. 70.

<sup>10</sup> The estimate of disaster damage is added to depreciation subsequent to "other" depreciation being calculated.

for general government assets, depreciation excludes war losses and the value of damage from natural and other disasters.<sup>12 13</sup>

**Obsolescence is a decrease in the value of an asset because a new asset is more productive, efficient, or suitable for production. Obsolescence affects the NIPA depreciation estimates through service lives and through the use of depreciation rates estimated from used-asset prices unadjusted for the effects of obsolescence. Assets may be retired early, when they are still productive, because of obsolescence; this is reflected in BEA's depreciation estimates as service lives affect the estimate of the geometric rates of depreciation for most assets.**

### **IIC. Empirical basis for new BEA depreciation methodology**

In most cases, the rates of geometric depreciation are based on the Hulten-Wyckoff estimates (Hulten and Wyckoff 1981b). Empirical research on depreciation has been conducted on most asset categories included in the U.S. national income and wealth accounts. The largest and most complete studies of depreciation are those of Hulten and Wyckoff and Koumanakos and Hwang, followed by that of Coen. Hulten and Wyckoff (1981a, 1981b) and Koumanakos and Hwang (1988) concluded that the pattern of depreciation is approximately geometric. Coen (1975) concluded that a geometric pattern provided the best fit in the majority of manufacturing industries studied. In addition, he concluded that a convex pattern (geometric being a special case) provided the best fit for all manufacturing industries for equipment and all but two manufacturing industries for structures. The results of the other depreciation studies surveyed in Fraumeni (1997) in general support an accelerated pattern of depreciation. Most conclude that a geometric pattern is preferred, none determine that overall a straight-line pattern is the best choice, and only a few maintain that some other pattern is the appropriate pattern.

A side benefit of using a geometric rate of depreciation, when this is justified by empirical research, is that wealth capital stocks are equal to productive capital stocks under this assumption. It is convenient to have no measurement difference between these two concepts. The wealth capital stock, which is needed for income and wealth accounting, is adjusted for declines in the value of the capital stock due to past, current, and future asset efficiency loss. The productive capital stock, which is needed for production or productivity analysis, is adjusted for past and current asset efficiency loss, and measures the current productive capacity of the asset. There is a direct correspondence between efficiency patterns and depreciation patterns. Declines in efficiency result in depreciation or declines in the value of an asset as it ages. Under some assumptions of efficiency decline patterns, such as one-hoss-shay, the wealth and productive concepts can result in significantly different estimates of capital stocks.<sup>14</sup> **Under at**

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<sup>11</sup> Accidental damage is captured in the depreciation rates or assumptions; disaster damage adjustments reflect only destroyed property.

<sup>12</sup> These damages and losses are not included in NIPA depreciation because general government consumption expenditures is measured by adding up costs, including depreciation. Excluding these losses avoids increasing the measured output of general government fixed assets in GDP when there is war or disaster damage.

<sup>13</sup> The SNA does not include war losses or disasters in depreciation; in the SNA they are included in the account for "Other changes in the volume of assets."

<sup>14</sup> Under one-hoss-shay, it is assumed there is no loss in efficiency and no depreciation until the asset is retired.

least one assumption, geometric, these two concepts result in identical estimates of capital stocks.<sup>15</sup>

### **IID. Specifics of Hulten-Wyckoff methodology<sup>16</sup>**

Initially, Hulten and Wyckoff made no assumption about the form depreciation patterns take. Instead, they estimated used-asset age-price profiles for eight producers' durable equipment or nonresidential equipment assets with a Box-Cox model (Box and Cox 1964). Age-price profiles map ages of assets with their prices. They tested to see whether the resulting depreciation patterns most nearly resembled patterns arising from one-hoss-shay, straight-line, or geometric efficiency patterns.

Hulten and Wyckoff concluded that depreciation patterns for eight assets are accelerated. In addition, although all three patterns were rejected statistically, they concluded that the depreciation pattern was approximately geometric in all cases. In 1977, the eight producers' durable equipment or nonresidential equipment assets - tractors, construction machinery, metalworking machinery, general industrial equipment, trucks, autos, industrial buildings, and commercial buildings - amounted to 55 percent of investment expenditures on producers' durable equipment and 42 percent of spending on nonresidential structures. They assumed that the depreciation pattern for the remaining 24 out of 32 producers' durable equipment and nonresidential structures NIPA classes contemporary to their study was geometric.

Since used-asset prices reflect only surviving assets (a censored-sample problem), Hulten and Wyckoff weighted used-asset prices by the probability of survival before estimating the depreciation patterns. The censored-sample problem can be illustrated by the following example. Suppose that two cars are bought new in 1980. By 1990, one is still in service and one has been junked. The one that is still in service is sold as a used car, say for \$1,000. If we take the used car sales price to be representative of all cars bought new in 1980, we would assume that the 1990 value of all cars bought new in 1980 is \$2,000. In fact, the 1990 value of the cars is \$1,000 or on average \$500 per car. Hulten and Wyckoff, by weighting used-asset prices by the probability of survival, are calculating the used-asset price equivalent of an average 1990 value of \$500 per car bought new in 1980. Their procedure assumes that the used-asset price of nonsurvivors is zero.

Their weighted used-asset prices reflect surviving and retired assets. The probability of survival, their weight, depends upon the mean service lives of assets and on the deviation of retirements around the mean service life.

The used-asset prices were adjusted for the effects of inflation on these prices by the inclusion of a time variable in the Box-Cox estimation procedure.

With a geometric pattern, the rate of depreciation,  $\delta$ , depends only on the declining-balance

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<sup>15</sup> See Fraumeni (1999) p. 2 for a short explanation of the differences between wealth and productive capital stock. See Triplett (1997) and Jorgenson (1974, 1996) for a more detailed explanation of the differences.

<sup>16</sup> See Hulten and Wyckoff (1981a and 1981b) and Wyckoff and Hulten (1979).

rate and the asset's service life:

$$\delta_G = R/T,$$

where  $T$  is the average asset service life, and  $R$  is the estimated declining-balance rate. The rate of declining-balance depreciation is the multiple of the comparable straight-line rate used to calculate the geometric rate of depreciation. For example, a 1.65 declining-balance depreciation rate refers to a geometric rate of depreciation of  $1.65/L$ , where  $L$  is the service life of the asset in years and  $1/L$  is the straight-line rate.  $\delta_G$  is constant over the lifetime of the asset, and depreciation is higher in the early years of an asset's service life. The higher the declining-balance rate,  $R$ , the higher the geometric rate of depreciation,  $\delta_G$ , and the higher depreciation is in the early years of an asset's service life.

For some assets, empirical research by others and the judgement of Hulten and Wykoff were used to estimate  $\delta$ . For the remaining assets, an average declining-balance rate  $R$  was estimated from the 8 assets and combined with information on the lifetime of the 24 assets still remaining to produce an asset-specific  $\delta$ . Hulten and Wykoff determined that, on average, the declining-balance rate for producers' durable equipment was 1.65, and for private nonresidential structures, 0.91. In both cases, the declining-balance rate was estimated on average to be significantly less than a double-declining-balance rate ( $R=2$ ).<sup>17</sup>

### **III. General issues affecting used-asset-price studies**

All used-asset-price studies are potentially biased, because the asset sample may not be representative of the population as a whole or because economic conditions affect the value of assets.<sup>18</sup> **First, surviving-asset samples, e.g., their sale prices, may not represent the population of surviving assets. Second, asset samples normally represent only surviving assets. Third, changes in economic conditions, including taxes and interest rates, may affect used-asset prices. Finally, a used-asset price may be affected by the value of an associated input.**

**There are several reasons why surviving-asset samples or their prices may not represent the population of surviving assets. Business may put up for sale their superior or inferior assets. Whether or not businesses put up for sale their superior or inferior assets depends on whether they are trying to maximize the proceeds from such sales or to sell off less desirable or obsolete assets. In addition, assets may be worth more or less to the buyers than to the sellers. A declining business may be selling off an asset that represents idle**

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<sup>17</sup> A listing of the three categories of assets: 1) Type A, the eight assets for which Hulten and Wykoff estimated age-price profiles, 2) Type B, the assets for which they used empirical research by others and their own research, and 3) Type C, the assets for which they used information from Type A and Type B assets, are given in Table 3, p. 18 of Fraumeni (1997).

<sup>18</sup> The authors who have addressed the question of sample bias in used-asset-price studies include Triplett (1996), De Leeuw (1981), Hulten and Wykoff (1981b) and Boskin, Robinson, and Roberts (1989).

capacity and that another business in the same industry could fully utilize or an asset that has limited use to businesses in other industries. Assets may be configured to meet the needs of a particular business so that they are more valuable to their seller than to their buyer. Finally, buyers may not be able to accurately perceive the value of the assets for sale. It is not clear what is the extent or direction of a possible surviving-asset-sample bias.

The lemons hypothesis is an important element in the debate about whether the sale prices of a sample of used-assets are representative of the potential sale prices of the population of all surviving assets. The lemons hypothesis maintains that the value of assets for sale will underestimate the value of all assets in the stock (Akerlof 1970). It argues that a disproportionate number of assets sold will be lemons, particularly if inspection by buyers does not reveal which assets are lemons. Under the lemons hypothesis, buyers will assume that assets for sale are lemons; therefore, they will offer lower prices for all assets. Sellers have an incentive to offer lemons, since they will be paid lemons prices for both lemons and more desirable assets. Therefore, buyers' assumptions are validated. If sellers have superior assets for sale, the incentive will be to sell these privately to obtain a reasonable price for the asset. Used-asset prices will be less than the average price of the stock of assets because of the disproportionate number of lemons for sale and because buyers will assume all used-assets are lemons. The existence of asymmetric information between buyer and seller is crucial in this hypothesis. Depreciation would be overestimated if inferred from used-asset prices because the average price for assets in the stock would be underestimated.

Hulten and Wykoff argue that most assets are sold in markets with professional buyers who frequently buy and sell assets. Furthermore, these buyers, who have the knowledge and expertise to identify lemons, are not affected by asymmetric information. Hulten and Wykoff tested for the existence of a lemons bias by comparing the depreciation profiles of assets that might have a lemons bias to an asset that arguably would not (heavy construction equipment). Heavy construction equipment is commonly sold at the end of a construction project and repurchased at the beginning of the next construction project. They found that the depreciation profiles for assets possibly with and without a lemons bias were both approximately geometric; therefore, they concluded that the lemons bias is unimportant in depreciation estimates.

The second consideration is the potential impact of asset samples representing only surviving assets. If asset samples represent only surviving assets, then age-price profiles of used-asset samples underestimate depreciation for the population as a whole because retirements are not included. Hulten and Wykoff estimated for commercial and industrial buildings that such an error would underestimate depreciation estimates by more than one-half. There are two possible solutions to this problem. One, retirements can be added to depreciation. In practice, this typically occurs with the adoption of an assumed retirement pattern. Two, a censored-sample adjustment can be made to the used-asset prices before the depreciation pattern is estimated, in a manner similar to Hulten and Wykoff. It is important for the researcher and user to know whether the depreciation pattern includes retirements (as in Hulten-Wykoff) or excludes retirements. The pattern of depreciation including retirements will be affected as a straight-line pattern excluding retirements will no longer be a straight-line pattern once retirements are included, and a geometric pattern excluding retirements will no longer be a geometric pattern once retirements are

included.<sup>19</sup>

**The third consideration is the impact of changing economic conditions. Changes in tax laws, interest rates, and other economic conditions might affect the value of secondhand assets independently of any sample bias problems. For example, changes in allowable tax depreciation taken for corporate income tax purposes may change the prices that businesses are willing to pay for used-assets. Changes in interest rates may affect the cost of borrowing to finance asset acquisition. Finally, demand conditions determine whether businesses are expanding or contracting, affecting both the demand for and supply of used-assets. Obsolescence can also affect used-asset prices, particularly high-tech asset prices.**

**If changes in tax laws, interest rates, and other economic conditions significantly affect the value of secondhand assets, age-price profile or retirement patterns would change over time unless these changes are counterbalanced by offsetting effects. The question of whether the age-price profile or retirement patterns change over time has been discussed in the context of several empirical studies. Hulten and Wykoff (1981a, 1981b) tested the stability of the age-price profiles for office buildings, one of their largest samples. In almost all cases, estimates of the rate of depreciation were stable over time. Hulten, Robertson, Wykoff, and Shriver reached similar conclusions. Hulten, Robertson, and Wykoff (1989) looked at the effect of the energy crisis on used-asset prices for four types of used machine tools and five types of construction equipment. Shriver (1986b) looked at the rates of economic depreciation for industrial machinery and equipment in 3 different years with different demand characteristics. Cockburn and Frank (1992) found in a study of oil tankers that economic depreciation or decay was largely unaffected by economic conditions, but that retirements are quite sensitive to economic conditions. Powers (1988), using book values, found that retirements for two-digit Standard Industrial Classification manufacturing industries exhibit a cyclical pattern. Taubman and Rasche (1971) and Feldstein and Rothschild (1974) discuss in general the impact of variables that change over time on age-price profiles. Taubman and Rasche (1969) in their study of office buildings found that changes in rents and tax laws had little effect on depreciation rates. In most cases, studies have not been done on different vintages of assets to determine whether age-price profiles do significantly change over time. Therefore, there is no definitive answer to the question of whether age-price profiles shift over time.**

**The final consideration is the impact on used asset prices of the value of an associated input. Used-asset prices can reflect the fact that it may be difficult for buyers to separate the value of an asset such as a building from the value of the land on which it sits (the shopping-mall effect). The building may be incorrectly valued because of the value of the site or the land on which it sits. This issue compounds the potential measurement difficulties cited above.**

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<sup>19</sup> For example, in the straight-line case, if assets in a sample have different asset lives, but each depreciate according to a straight-line pattern, once a retirement occurs total depreciation, including retirements, no longer follows a straight-line pattern. See Wykoff (1989) pp. 262-265 for a discussion and a numerical example.



### III. New NIPA Table - - Changes in Net Stock of Produced Assets

The new NIPA table, released in April 2000 as part of the comprehensive revision of the NIPA's, shows the sources of changes in the net stock of produced assets: fixed assets and private inventories. The change estimates cover the net stock of equipment and software and of structures owned by business and government, as well as private inventories. As part of the comprehensive benchmark revisions introduced in October 1999, software is now treated as investment.<sup>20</sup> **The net stock of consumer durables is not included in the new NIPA table, because the NIPA's do not recognize consumer durables as investment.**<sup>21</sup> **Government inventories are not included as no estimates are available. This table provides for the first time an integrated analysis of the changes in the net stock of produced assets from opening balance to closing balance. It fully accounts for changes in the net stock of produced assets by showing how investment, depreciation and disaster losses affect the stock and how its value is affected by nominal and real holding gains. It improves the consistency of the NIPA's with the SNA and is part of BEA's long-term effort to integrate the estimates of stocks and flows.**

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<sup>20</sup> For a detailed discussion of the software methodology, see Parker and Grimm (2000).

<sup>21</sup> The NIPA treatment of consumer durables conforms with that in the SNA; however BEA is considering treating consumer durables as investment in the future.

### IIIA. Overview of the new NIPA table

The new NIPA Table 5.16 is included in this paper as Table 1 (see end of paper) with data for 1996-98.<sup>22</sup> **Table A, which follows, is an abbreviated form of the table for 1998. It provides an overview of the changes, tracing the steps for going from opening balances to closing balances. In 1998, the opening balance of produced assets was \$23.8 trillion, and the closing balance was \$25.1 trillion, a change of \$1.3 trillion. In 1998, gross fixed investment (also called accumulation of produced assets), consumption of fixed capital, and nominal holding gain (also called revaluation) accounted for the majority of the change in the net stock of produced assets. This is also true for the other years presented in Table 1 and all years presented in NIPA Table 5.16, 1951-98, for which there is complete data (Herman, 2000).**

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**Table A - Changes in the Net Stock of Produced Assets (Fixed Assets and Private Inventories)  
1998  
[Trillions of dollars]**

<b>Opening balance</b>	<b>\$23.8</b>
<b>+ Gross fixed investment</b>	<b>\$1.7</b>
<b>- Stock reconciliation adjustments</b>	<b>0</b>
<b>- Consumption of fixed capital, except disasters</b>	<b>\$1.1</b>
<b>+ Change in private inventories</b>	<b>\$.1</b>
<b>- Other changes in volume of assets</b>	<b>0</b>
<b>+ Nominal holding gains (+) or losses (-)</b>	<b>\$.6</b>
<b>= Closing balance</b>	<b>\$25.1</b>

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**The sources of change consist of the following: “Gross fixed investment,” which is expenditures for assets that will be used in the production process for more than 1 year; “Stock reconciliation adjustments,” which are adjustments needed because some types of investment expenditures enter the stock with a delay or do not add to the stock of assets, “Consumption of fixed capital, except disasters,” which is the decline in the value of a fixed asset due to wear and tear, obsolescence, ordinary accidental damage, and aging; change in private inventories, which is the change in the physical volume of goods purchased by private business for use in the production of other commodities or for resale; “Other changes in volume of assets,” which consists of damages from disasters and war losses; and**

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<sup>22</sup> The new NIPA table is available on the BEA web site: <http://www.bea.doc.gov/bea/bench.htm> . The table with data for 1995-98 is on p. 80 of the April Survey of Current Business, which can be accessed at <http://www.bea.doc.gov/bea/pub/0400cont.htm> . Revised 1997-99 data will be available in Fall 2000.

**“Nominal holding gains or losses,” which is the change in value of assets that result from changes in the price level. The table shows the effect of each of these sources on the annual change in net stock (that is, the difference between the opening balance and the closing balance) of produced assets valued at current-cost.**

## **IIB. Detailed table**

The more detailed table, Table 1, presents six separately identified sections, including an addenda.

The first section of the table (lines 1-5) presents the opening balance of produced assets valued at current-cost for the beginning of the period.

The second section (lines 6-27) presents the investment flows that contribute to the accumulation of produced assets during the year. Private and government gross fixed investment in structures and in equipment and software are shown (lines 6-14).

Stock reconciliation adjustments to NIPA investment are subtracted (lines 15-17). These adjustments are needed because some types of investment expenditures enter the stock with a delay or do not add to stock of assets. The components of the stock reconciliation adjustments to NIPA investment are shown in the table in the addenda (lines 49-53).

Consumption of fixed capital (CFC), except for disaster losses, is subtracted (lines 18-26). In the NIPA's, as outlined earlier, CFC consists of charges for wear and tear, obsolescence, accidental damage, and aging; for private fixed assets and for fixed assets of government enterprises, CFC also includes the value of the damages incurred from natural and other disasters. In Table 1, these two types of CFC are shown separately: “CFC, except disasters” is shown under “Accumulation of produced assets” (lines 18-26) and disaster losses are shown under “Other changes in volume of assets” (lines 29 and 32). In the NIPA's, CFC for assets of general government does not include disaster damage and war losses; the value of these losses is shown in the section “Other changes in volume of assets” (line 31).

The change in private inventories (line 27) is added to obtain the net accumulation of produced assets.

The third section (lines 28-32) shows the deductions of “other changes in volume of assets.” For private assets, the deductions consist of the value of damage from natural and other disasters. For government assets, the deductions includes war losses and the value of damage from natural and other disasters.

The fourth section (lines 33-43) shows the revaluation, that is, the effects of price changes.<sup>23</sup> **In addition to changes in the stock that result from investment, CFC, and “other changes in volume of assets,” the current-cost net stock can change because of price changes. These**

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<sup>23</sup> The year-over-year price change for existing produced assets is measured for the period from the year-end of year t-1 to the year-end of year t. The price change for investment, change in private inventories, CFC, and the “Other changes in volume of assets” is for the half-years from the middle of year t to the end of year t.

changes in value resulting from price changes are called nominal holding gains or losses. Nominal holding gains or losses are presented in two parts: Neutral holding gains or losses and real holding gains or losses. Neutral gains or losses (lines 34-38) represent the change in value of assets due to changes in the general price level. In this table, the measure of the general price level is the price index for gross domestic purchases. Neutral holding gains were positive for all years, reflecting increases in the current-cost net stock of produced assets that have resulted from increases in the general price index.

Real holding gains or losses (lines 40-43) reflect the impact of changes in the relative prices of individual assets above or below the change in the general price index. If an asset's price increases more than the general price index, there will be a real holding gain; if it increases less, there will be a real holding loss. Since 1992, there have been real holding gains, as prices of structures rose faster than the general price level and more than offset real holding losses for equipment and software and for private inventories. For 1951-98 (the period for which estimates are available), there were real holding gains for 27 years and real holding losses for 21 years.

The fifth section (lines 44-48) presents the closing balance, that is, the current-cost value at the end of the year for produced assets.

### **IIIC. Comparison to the SNA tables**

Although the new NIPA table is broadly consistent with the SNA tables, differences do exist even within the context of non-financial produced assets. Some differences are methodological differences, e.g., in the case of brokers' commissions and dealer's margins on used-assets, military hardware, construction-in-progress, and the treatment of war losses and disaster damages. In the SNA, brokers' commissions and dealer's margins on used-assets along with other costs of ownership transfers are included in gross fixed capital formation and in the net stocks, in the NIPA, in the case of nonresidential structures they are included in capital formation, but not in the stocks.<sup>24</sup> **In the SNA, military hardware is not capitalized, in the NIPA, it is capitalized. In the SNA, when construction takes place under a contract of sale agreed in advance, construction-in-progress is recorded as gross capital formation by the purchaser; if such a contract does not exist, it is recorded as additions to work-in-progress or to the producers' inventories of finished goods. In NIPA, construction-in-progress is recorded as gross capital formation regardless of the existence of a contract. The difference in the treatment of war losses and disaster damages was described in section IIIB. In addition, differences relate to coverage, e.g., the SNA includes valuables, the new NIPA table does not. Some of these coverage differences represent categories for which BEA would like to report, but does not have the data to do so, e.g., government inventories. Other table differences relate to the level of detail provided, e.g., disposals of existing assets are listed separately in the SNA tables, but not in the NIPA table. Taken together, the magnitude of all differences between the new BEA table and the SNA tables is not large.**

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<sup>24</sup> See Table 1, lines 50 and table footnotes 4 and 14.

#### IV. On-going and Future Work

The innovations described in this paper are part of on-going efforts by BEA to improve the accumulation accounts in the NIPA and to introduce balance sheets into the NIPA. With respect to the accumulation accounts, several changes were made in the most recent comprehensive revision. A new depreciation pattern was adopted for personal computers which resulted in a substantially lower service life. The service life for highways and streets was lowered by 25%. In addition, software was classified as investment. On-going efforts include looking at possible revisions in depreciation patterns and service lives. In addition, it is hoped that research can be undertaken on obsolescence to determine its effects on depreciation patterns and retirements, particularly for rapidly changing information technology assets such as computers. BEA is also looking at alternative definitions of capital, including, for example, treating consumer durables as investment. A major improvement to the new NIPA table would be the incorporation of financial assets. Although much of the necessary information is contained in the Flow of Fund Accounts compiled by the Board of Governors of the Federal Reserve System,<sup>25</sup> **incorporation of financial assets is a significant undertaking. The efforts to improve the accumulation accounts and balance sheets represent only a portion of BEA's efforts to improve economic measurement.**

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<sup>25</sup> See for example Board of Governors of the Federal Reserve System (2000)

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Table 1--Changes in Net Stock of Produced Assets (Fixed Assets and Inventories) millions of dollars				
	Line	1996	1997	1998
Opening balance				
Produced assets	1	21 663 842	22 698 782	23 808 905
Fixed assets	2	20 441 473	21 447 285	22 501 430
Private	3	15 908 450	16 722 529	17 573 362
Government	4	4 533 024	4 724 756	4 928 068
Private inventories /1/	5	1 222 369	1 251 497	1 307 475
Accumulation of Produced Assets				
Gross fixed investment	6	1 462 839	1 573 448	1 728 746
Private /2/	7	1 212 696	1 315 352	1 460 035
Nonresidential	8	899 433	986 145	1 091 289
Structures	9	224 984	254 085	272 786
Equipment and software	10	674 449	732 060	818 503
Residential	11	313 263	329 207	368 746
Government /3/	12	250 143	258 096	268 711
Structures	13	140 326	148 278	151 889
Equipment and software	14	109 817	109 818	116 822
Less: Stock reconciliation adjustments	15	22 628	30 755	37 765
Private /4/	16	29 856	30 864	37 802
Government /5/	17	-7 228	-109	-37
Less: Consumption of fixed capital, except disasters /6/	18	956 197	1 009 069	1 064 590
Private	19	781 931	828 546	878 421
Nonresidential	20	656 324	696 086	739 993
Structures	21	140 342	148 173	155 210
Equipment and software	22	515 982	547 913	584 783
Residential	23	125 607	132 460	138 428
Government	24	174 266	180 523	186 169
Structures	25	71 880	75 625	78 863
Equipment and software	26	102 386	104 898	107 306
Change in private inventories /7/	27	29 994	68 335	71 187
Other changes in volume of assets				
Less: Other changes in volume of assets	28	0	0	0
Private fixed assets /8/	29	0	0	0
Government fixed assets /9/	30	0	0	0
General government	31	0	0	0
Government enterprises	32	0	0	0
Revaluation				
Nominal holding gains or losses (-)	33	520 932	508 164	588 340
Neutral holding gains or losses (-) /10/	34	405 314	239 029	214 971
Fixed assets	35	382 435	225 709	202 983
Private	36	297 862	176 146	158 831
Government	37	84 573	49 563	44 152
Private inventories /1/	38	22 879	13 320	11 988
Real holding gains or losses (-)	39	115 617	269 135	373 369
Fixed assets	40	139 362	294 811	429 542
Private	41	115 309	218 744	366 870
Government	42	24 054	76 067	62 672
Private inventories /1/	43	-23 745	-25 677	-56 173
Closing balance				
Produced assets /11/	44	22 698 782	23 808 905	25 094 823
Fixed assets	45	21 447 285	22 501 430	23 760 346
Private	46	16 722 529	17 573 362	18 642 874
Government	47	4 724 756	4 928 068	5 117 471
Private inventories /1/	48	1 251 497	1 307 475	1 334 477
Addenda:				
Intersectoral auto valuation adjustment /12/	49	17 670	21 269	25 440
Brokers' commissions and dealers' margins on used equipment /13/	50	8 833	9 452	10 504
Electric plants put in place less electric plants put in use /14/	51	-3 875	34	1 821
Private	52	3 353	143	1 858
Government	53	-7 228	-109	-37
Abandoned electric plants /15/	54	0	0	0

- /1/ Estimates of government inventories are not available
- /2/ Private fixed investment shown in NIPA Table 5 2, line 4
- /3/ Gross government investment shown in NIPA Table 5 2, line 20
- /4/ Consists of intersectoral auto valuation adjustment (line 49); brokers' commissions on nonresidential structures and dealers' margins on used equipment (line 50); and private electric plants put in place less electric plants put in use (line 52)
- /5/ Consists of government electric plants put in place less electric plants put in use (line 53)
- /6/ Equals consumption of fixed capital shown in NIPA Table 1 9, line 5, less the other changes in volume of private fixed assets (line 29) and government enterprises fixed assets (line 32)
- /7/ Change in private inventories shown in NIPA Table 1 1, line 12  
Inventory estimates are not adjusted for catastrophic losses, theft, obsolescence, or infestation
- /8/ Consists of catastrophic losses Structures and equipment are valued at current cost
- /9/ Consists of catastrophic and war losses Structures and equipment destroyed are valued at current cost
- /10/ Neutral holding gains are the gains derived from holding an asset if the price of an asset changed in the same proportion as the general price level The price index for gross domestic purchases is used as a measure for the general price level
- /11/ Equals lines 1+6-15-18+27-28+33
- /12/ Used autos are valued at acquisition prices less depreciation in the estimates of the stocks of private fixed assets and consumer durable goods; net purchases of used autos by business from consumers are valued at wholesale prices in gross fixed investment
- /13/ These are included in NIPA fixed investment because they are expenditures for fixed assets that will be used in a production process for more than 1 year However, they are not treated as fixed assets and are not included in the estimates of net stocks
- /14/ This adjustment reflects a timing difference in fixed investment and in the stock of produced assets In investment, the value of structures and equipment for electric plants is recorded on a put-in-place basis; in the stocks, the investment is recorded when the plants are put in use
- /15/ Consists of the value of abandoned nuclear power plants that were never put in use The investment in these plants is included in gross fixed investment, but does not enter the opening or closing balances--it is included in the adjustments to gross fixed investment shown in line 15