Improved Estimates of Capital Formation in the National Health Expenditure Accounts

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The National Health Expenditure Accounts (NHEA) were revised with the release of the 2004 estimates. The largest revision was the incorporation of a more comprehensive measure of investment in medical sector capital. The revision raised total health expenditures' share of gross domestic product (GDP) from 15.4 to 15.8 percent in 2003. The improved measure encompasses investment in moveable equipment and software, as well as expenditures for the construction of structures used by the medical sector.

INTRODUCTION

The NHEA measure spending on health care in the U.S. With the most recent release of estimates for 1960-2004, the NHEA underwent a comprehensive or benchmark revision. The largest revision to the NHEA was due to the changes to the investment estimates. Figure 1 demonstrates the significance of this revision. To more accurately measure investment in medical capital, and to comply with internationally accepted standards, such as the System of Health Accounts (SHA) developed in 2000, by the Organization for Economic Co-operation and Development (OECD), the NHEA definition of construction has been revised and expanded. Specifically, a number of government-sponsored advisory panels have recommended that the capital equipment acquired by health care providers be added to the NHEA definition of investment. In an effort to address these recommendations, CMS contracted for an evaluation of the available sources of data for improving the NHEA estimates of investment (Donahoe, 2002).

The revised estimates of investment in medical sector capital embody several distinct advantages over the previous construction estimates. First, by including moveable medical equipment and software in the definition of capital goods, the NHEA provides a more accurate picture of the total investment required to deliver health care services in the U.S. Second, by including office buildings occupied by health care providers in the estimates of spending for medical structures, the NHEA more accurately reflect the national investment in structures required for the current level of health care delivery. Third, by creating a set of estimates that reflect not only the current level of investment, but include economic depreciation and the net stock of medical sector capital as well, the medical sector can be compared to the economy at large, and to other industrial sectors in terms of capital requirements and the efficiency of investment. As such, the redefinition of investment more closely aligns the scope and definitions of the NHEA with National Income and Product Accounts (NIPAs) maintained by the Bureau of Economic Analysis (BEA) an agency of the U.S. Department of Commerce. Additionally, the redefinition aligns the NHEA more closely with the SHA.

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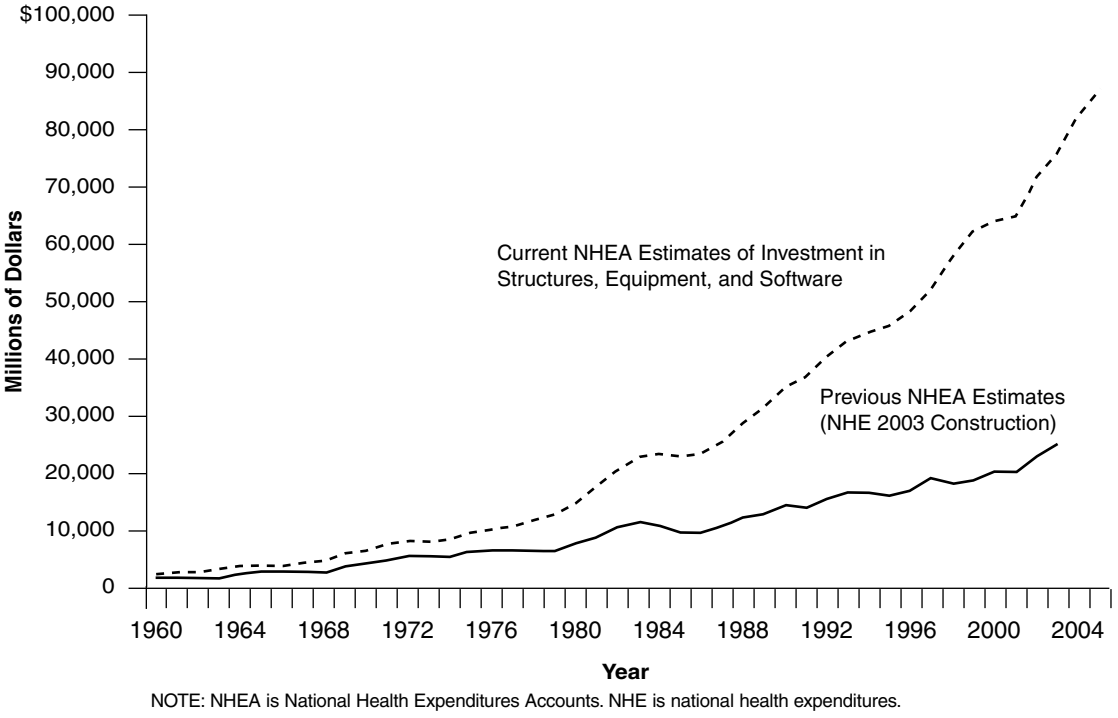
Figure 1

Estimates of Investment in Medical Sector Structures, Equipment and Software: Calendar Years 1960-2004



NOTE: NHEA is National Health Expenditures Accounts. NHE is national health expenditures.

SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary: Data from the National Health Statistics Group, 1960-2004.

NATIONAL ECONOMIC ACCOUNTS

"National economic accounts give systematic empirical form to the structure, patterns, and performance of an economy" (Young and Tice, 1985). Many of the concepts and definitions that underlie national economic accounts served as the basis for the national health accounts that were subsequently developed in the U.S. and elsewhere. In most countries, national economic accounts are prepared using internationally accepted principles and conventions. These principles and conventions are codified in the System of National Accounts (SNA) which has been accepted and endorsed by the United Nations and several other international organizations. The SNA "…consists of a coherent, consistent and integrated set of macroeconomic accounts, balance sheets, and tables based on a set of internationally agreed upon on concepts, definitions, classifications, and accounting rules" (United Nations, 1993). To explain the revised estimates of investment in the NHEA it is important to briefly describe some of the national economic accounting principles pertaining to investment and capital formation.

In the U.S., the national economic accounts consist of three sets of accounts, prepared and maintained by the BEA, and by the Board of Governor's of the Federal Reserve System. The BEA is responsible for the Input/Output Accounts and the NIPAs. The Board of Governor's of the Federal Reserve System is responsible for the third set of accounts known as the Flow of Funds Accounts.

The NHEA are most directly related to the NIPAs. The NIPAs are the comprehensive set of accounts that measure the total

value of final goods and services GDP produced by the U.S. economy and the total of incomes earned in producing that output (gross domestic income [GDI]) (Bureau of Economic Analysis, 2000a). In effect, the NHEA attempt to measure the total value of final goods and services produced in the medical sector.

The concept of investment is one of the concepts utilized in a national economic accounting system. Investment can be described as output not consumed in the current annual accounting period; that is output dedicated to the production of capital goods (structures, equipment, and software) that will be used to create goods and services in the future. Various categories of investment are identified in the NIPAs. Gross private domestic investment (GPDI) is business investment including investment in new housing, which is treated as a business in the NIPAs. GPDI is divided into fixed investment and inventory investment.[1] The criterion for the types of commodities classified as investment is somewhat loosely considered to be goods that have a useful economic life (or that contribute to production and generate income over a period) of more than one year. The differences between the NIPAs and both tax accounting and business accounting are related to conventions that have been established in the national accounts to ensure that the Nation's production is properly measured.

The concept of capital is another of the economic concepts utilized in a national economic accounting system. National economic accounts distinguish between two related measures of capital: capital formation, also known as capital accumulation, is new investment in structures, equipment, and software for use in production while capital stock represents the value of the stock of existing capital (e.g., structures, equipment, and software) at some point in time. Capital formation or new investment can be measured gross or net of the current year's depreciation—the consumption of, or using up of, fixed capital in the production process. The gross investment measure includes capital goods that replace capital goods that have been used up (depreciation) as well as capital goods that expand the Nation's capital stock. While most aggregate measures in national economic accounts are expressed as gross of depreciation, net investment is also important in that it reflects investment over and above that necessary to replace capital used up in production. Net investment reflects the amount by which the productive capacity has expanded during the year.

The cumulation of capital formation yields stock of capital. Measured at year end, gross stock is the accumulation of past years' investment, and is calculated as the gross stock at the beginning of the year plus gross investment during the year less discards (sometimes referred to as retirements or disposals) during the year. If we express the stock of a particular type of capital good (for example, hospital beds) in dollar terms, we can combine that with the dollar value of other capital stock, such as buildings, computers, and ambulances. The net stock of capital is a measure of the wealth that is embedded in the capital; it is calculated as gross stock minus the accumulated depreciation. The net stock is the value that the business might expect to realize if it sold the asset. Depreciation is the difference between the values of two assets that are identical, except for their age.

NHE ACCOUNTING

Using national economic accounting principles and concepts as a platform, the NHEA were designed to describe and

[1] SNA does not include inventories in the capital account (Mead, Moses, and Moulton, 2004).

measure economic activity related to the provision of health care services and goods in the U.S. Typically, national health accounts show total NHE as a percentage of GDP, health care expenditures by type of service or product, and health expenditures by source of funding, including changes over time in these measures.

Spending for health care goods and services is measured at three levels of aggregation in the NHEA:

- *Personal Health Care Expenditures* (PHCE)— is comprised of therapeutic goods or services rendered to treat or prevent a specific disease or condition in a specific person. In the NHEA, this spending is broken down by type of provider (hospital services, physician services, etc.) and source of funding (private health insurance, Medicare, Medicaid, etc.)
- *Health Services and Supplies*—is the sum of PHCE, government public health activity, and program administration (which includes the net cost of private health insurance). Health services and supplies represent spending for medical care rendered during the year.
- *NHE*—is the sum of all health care expenditures is comprised of health services and supplies plus investment—the sum of the non-commercial research and the capital formation estimates (Centers for Medicare and Medicaid Services, 2004). Table 1 shows the dollar amounts of these aggregations.

The boundary of economic activity included in the NHEA does not encompass spending for public and private functions that often overlap the health sector, such as nutrition and food safety programs, sanitary water and sewage systems, and many social assistance programs (for example, old age homes and group homes for the disabled).

EVALUATION OF POTENTIAL DATA SOURCES

Medical Sector Capital Estimates

The first step in the study undertaken by CMS was to survey possible data sources on investment in private and public medical sector structures and equipment. Potential data sources were evaluated from Federal Government statistical programs, as well as data available from private sources. The search for potential data sources narrowed the possibilities to six statistical series discussed below; two are produced at the U.S. Census Bureau, three are prepared by the BEA, and the sixth is a composite of data series produced by both agencies. These data sources are described in Tables 2 and 3. This identification and evaluation of potential data sources was the foundation of the methodology CMS adopted to create the revised investment time series.[2]

Each potential data source was evaluated using the following criteria:

- Coverage—What types of establishments (private or public sector), and what parts of the health industry are covered?
- Asset Boundaries—What type of assets are included: are structures, equipment, and software included?
- Sample Type—Whether the data series is constructed from a census or a sample, how is the sample structured?
- Frequency of Publications—How often are the data series published?
- Timeliness of Publication—How soon after the close of the reference period is the data series published?
- Prevalence of Measurement Errors—How reliable are the data series?

[2] Two additional sources of data were considered in the study, but are not examined in this article. These are Medicare Cost Report and the American Hospital Association Annual Survey.

Table 1

Derivation of National Health Expenditures: Selected Calendar Years, 1960-2004

National Health Care Estimates Components	1960	1970	1980	1990	2000	2001	2002	2003	2004
					Amount in Millions				
Personal Health Care Expenditures	$23,320	$62,943	$215,330	$607,470	$1,139,925	$1,239,071	$1,341,372	$1,445,684	$1,560,242
Hospital Care	9,179	27,589	101,008	251,551	417,049	451,440	488,604	525,453	570,756
Physician and Clinical Services	5,354	13,981	47,071	157,532	288,587	313,143	337,854	367,015	399,883
Dental Services	1,963	4,669	13,323	31,502	61,975	67,523	73,341	76,861	81,532
Other Professional Services	392	744	3,609	18,170	39,111	42,809	45,658	49,087	52,720
Other Personal Health Care	616	1,246	3,256	9,560	37,076	41,884	46,337	50,370	53,272
Home Health	57	220	2,377	12,567	30,560	32,244	34,299	38,121	43,181
Nursing Home Care	812	4,040	19,023	52,623	95,269	101,526	105,730	110,442	115,210
Prescription Drugs	2,676	5,497	12,049	40,290	120,803	138,559	157,941	174,112	188,452
Other Non-Durable Medical Goods	1,625	3,325	9,801	22,452	30,165	30,306	30,857	32,147	32,284
Durable Medical Equipment	646	1,632	3,814	11,223	19,330	19,637	20,752	22,078	22,951
Government Administration and Net Cost of Private Health Insurance	1,211	2,770	12,213	39,241	81,241	89,644	106,104	124,856	136,654
Government Public Health Activities	417	1,393	6,434	19,959	43,364	46,791	51,680	53,966	56,117
Health Services and Supplies	24,948	67,105	233,977	666,671	1,264,530	1,375,506	1,499,157	1,624,507	1,753,013
Non-Commercial Research	694	1,953	5,429	12,678	25,599	28,754	32,548	35,628	38,952
Medical Sector Capital Investment									
Structures[1]	1,553	4,828	8,664	16,917	24,939	25,811	29,129	31,637	33,830
Equipment[1]	338	1,008	5,866	17,752	38,270	38,880	42,333	44,255	46,794
National Health Expenditures[1]	27,534	74,895	253,936	714,018	1,353,339	1,468,951	1,603,167	1,736,026	1,872,589
Upward Revision Due to Revision to Structures	547	1,052	1,850	3,189	5,103	6,124	6,399	7,160	—
Upward Revision Due to Addition of Equipment	338	1,008	5,866	17,752	38,270	38,880	42,333	44,255	—

[1] Corrected for data processing error detected after release of the 2004 National Health Expenditures estimates. This correction will be reflected in the 2005 National Health Expenditures release.

NOTE: Personal Health Care Expenditures *plus* Government Administration and Net Cost of Private Health Insurance *and* Government Public Health Activities *equals* Health Services and Supplies. National Health Expenditures *equals* Health Services and Supplies *plus* Non-Commercial Research *and* Medical Sector Capital Investment.

SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary: Data from the National Health Expenditures Accounts, 1960-2004.

Table 2

Coverage of Sources of Fixed Investment Data for Health Industry: 1960-2004

Data Source	Sector: Private/Government	Coverage of Structures, Equipment, and Software	Health Industry, Assets, or Institutions
Construction Put-in-Place Survey	Both	Structures	Type of Institution: Private - Hospital and institutional includes health care institutional facilities, sanatoria convalescent and rest homes, nursing homes, orphanages, and similar establishments for prolonged care, and surgical and outpatient clinics affiliated with a hospital. Federal - Health care and institutional facilities such as veterans' hospital and clinics. State and Local - Health care and institutional facilities such as hospitals, clinics and infirmaries, rest homes, nursing homes, sanatoria, psychiatric institutions, schools for the handicapped, orphanages, half-way homes, outpatient clinics, etc. All of the asset types exclude buildings used primarily as offices.
Commodity Flow Procedure	Private	Equipment and Software	Industry - None Asset Type: Various types of capital equipment.
Annual Capital Expenditures Survey	Private	Structures and Equipment	Industry - SIC 80 and SIC 830, "Social services institutions" by company of purchaser. Asset Type - Total structures and total equipment annually; detail by type of structure at 5-year intervals.
Capital Flow Table	Private	Structures and Equipment	Industry - SIC 80 by establishment, based on using industry. Asset Type - Various types of structures and equipment.
Bureau of Economic Analysis (BEA) Industry Capital Stock Program	Private	Structures, Equipment, and Software	Industry - SIC 80 by establishment, based on owning industry. Asset Type - Various types of structures and equipment.
BEA - U.S.Census Bureau Government Investment for Health	Government	Structures, Equipment, and Software	Function - Social services and income maintenance, which includes public welfare, hospitals, health, and “other”.

NOTES: SIC 80 includes (1) offices and clinics of doctors of medicine and osteopathy, (2) offices and clinics of dentists, (3) offices and clinics of other health care practicioners, (4) nursing and personal care facilities, (5) hospitals, (6) home health care services, and (7) other health and allied services. These categories are published separately in the Annual Capital Expenditure Survey beginning in 1997; less detail is available for earlier years.

SOURCE: Beginning with the publication of data for 1999, the Annual Capital Expenditures Survey is presented on the basis of the North American Industry Classification System (NAICS). Data for 1998 are restated to NAICS in that publication. NAICS industry 62 "health care and social assistance" combines "nursing and residential care facilities" (NAICS 623) and includes "social assistance" (NAICS 624).

Table 3

Statistical Characteristics of Sources of Fixed Investment Data for Health: 1999-2000

Data Source	Type of Sample	Frequency	Timeliness: Latest Year Available[1]	Timing of Reporting	Real, or Price Adjusted, Measures Available	End-of-Year Stocks Available
Construction Put-in-Place Survey	Probability	Monthly[2]	2000	Put in Place	Yes	No
Commodity Flow Procedure	Hybrid	Annual[3]	2000	Delivery	Yes	No
Annual Capital Expenditures Survey	Probability	Annual	1999	Hybrid	No	No
Capital Flow Table	Hybrid	5-Year Intervals	1992	Hybrid	No	No
Bureau of Economic Analysis (BEA) Industry Capital Stock Program	Hybrid	Annual	1999	Hybrid	Yes	Yes
BEA-Census Bureau Government Investment for Health	Probability	Annual	2000[4]	Hybrid	No	No

[1] The latest year available shown when original study was performed in 2002. More recent data is now available.

[2] Annual estimates derived as sum of the months.

[3] Most recent 2 years are extrapolated using less detailed quarterly estimates, based on an abbreviated procedure.

[4] BEA estimates for 2000 are based on judgments. The latest government finances available is preliminary, based on State governments only (no local governments) for fiscal year 1999.

SOURCE: G.F. Donahoe, *Capital in the National Health Accounts, 2002.*

- Statistical Characteristics—These include whether real (inflation adjusted) observations are available and whether end-of-year stocks are available.

The first data source examined was the Value of Construction Put in Place (VPIP) survey, conducted by the U.S. Census Bureau (2003a). The VPIP reports, also known as the C-30 reports, are published monthly. For private non-residential and for State and local government buildings, the data are from the Bureau's Construction Progress Reporting Survey. The Federal Government gathers data directly from government agencies or from budget documents. The second potential data source examined was the Annual Capital Expenditures Survey (ACES), also produced by the U.S. Census Bureau (2006). This survey of companies has been conducted by the bureau since 1992 and runs through the latest survey for 2005. Although the ACES is collected on a company basis, the bureau requests that companies separate capital expenditures along divisional lines or lines of business.

The BEA produces several data series on investment in capital goods in the U.S., three of which have particular relevance to the NHEA estimates of medical sector capital goods. The third potential data source examined in this study was the output of the commodity-flow procedure (CFP) calculated by the BEA largely with data from the U.S. Census Bureau (Bureau of Economic Analysis, 1998). The CFP is used in the production of the input-output tables and the NIPAs. The starting data source for the CFP is manufacturers' shipments, collected at 5-year intervals (for years ending in 2 and 7) in the Census of Manufacturers and annually in the Annual Survey of Manufacturers (ASM), both conducted by the U.S. Census Bureau. Note that the CFP does not yield independent estimates of investment by industry. The CFP is discussed here because it is an input to the procedure used by the BEA to estimate investment by industry and in a similar procedure proposed for use by CMS.

The fourth potential data source examined was the capital flow tables (CFT), produced by the BEA using data from

the economic censuses and other sources (Bonds and Aylor, 1998). These data series, published only for economic census years (years ending in 2 and 7), measure the purchases of capital (structures, equipment, and software by type) by the using industries. The fifth potential data source examined was the BEA capital stock program which includes estimates of investment, depreciation, and capital stock by industry, derived largely from the U.S. Census Bureau and BEA sources. These investment flows are adjusted from an industry-of-use to an industry-of-ownership basis using information on leasing from trade sources and other data. In addition, BEA had until recently reclassified investment by nonprofit institutions to the real estate industry.[3]

The sixth and last potential data source reviewed for creating estimates of investment in medical sector capital goods by government(s) is a composite of series prepared by the U.S. Census Bureau and the BEA. The Census Bureau collects data on State and local government investment by functional category in a Census of Governments conducted every 5 years (in years ending in 2 and in 7). In addition, the bureau conducts annual surveys of all of the State governments and a sample of local governments. For example, the survey of government finances for 2000 included all county governments with 1997 populations of 100,000 or more and all municipalities with 1997 populations of 75,000 or more. Governments of jurisdictions with smaller populations are sampled (U.S. Census Bureau, 2003b). Federal Government data are derived by the bureau from the Budget of the United States and related documents.

[3] Effective with their latest comprehensive revision, BEA changed this procedure. The resulting estimates are more compatible with the NHEA, and will facilitate CMS' use of BEA estimates in the future.

The BEA publishes government gross investment data for medical capital on a regular basis as part of the NIPAs. For State and local governments, BEA estimates are based largely on census of governments and government finance data. BEA subtracts expenditures for land and existing assets, converts the government finance data from fiscal years to calendar years, and adds estimates of capital expenditures for software (Bureau of Economic Analysis, 2000b). The resulting investment spending conforms to the International Classifications of the Functions of Government (United Nations Statistical Commission, 1999).

Each of the six potential data sources was evaluated using the seven criteria previously listed. Table 2 contains information on the first two of the evaluation criteria—the coverage and asset boundaries of the six potential data sources. Note that in Table 2, only two potential data sources, the BEA industry capital stock program and the BEA-Census government health investment series cover all components of capital formation; that is structures, equipment, and software. Also note that the asset boundary, i.e., what is included in and excluded from investment, differs by data source. For the VPIP survey, this determination is by type of structure. In the CFP, the CFT, and the BEA industry capital stock program this determination is by asset type. In ACES and in the BEA-Census government investment for health series, the companies, nonprofit institutions, and government units that own or use the capital and file reports in these programs determine what is included as capital.

Table 3 details the evaluation of the potential data sources for the remaining five evaluation criteria—sample type, frequency of publication, timeliness of publication,

prevalence of measurement errors, and statistical characteristics. Table 3 contains the characteristics of the potential data sources at the time the study was done. More recent years of data have become available since the study was done, and this limitation only effects the information on the latest year of data available. The remaining characteristics remain as described for the most current releases of these series.

Table 3 shows the sample type and the frequency of publication of each data source and describes the characteristics of each potential data source with regard to the fifth evaluation criterion, timeliness of publication. Two other criteria used to evaluate the potential data sources are also detailed in Table 3: the publication lag, or the number of months between the end of the reference year and the month that the data become available, as well as the timing of reporting which shows the point in time at which the investment is measured. The desired timing of the reporting or recording of investment is the point in time when the asset is installed and available for use. The delivery basis, which is indicated only for the CFP comes close to this desired timing. The put-in-place timing of the VPIP is somewhat earlier than desired, and the other sources are hybrids of delivery and put-in-place timing. The remaining columns show the availability of price adjusted measures of investment and whether end-of-year stocks are available. These correspond to the last evaluation criterion, statistical characteristics. Note that only two of the six sources (the CFP and the BEA industry capital stock program) provide price-adjusted measures, and only the BEA industry capital stock program provides end-of-year stock levels.

The sixth evaluation criterion—prevalence of measurement errors—must be inferred from the other evaluation criteria, notably sample type. Data from nearly every statistical source contain some measurement errors, which result from a wide variety of causes. For example, it is difficult to keep a universe list of establishments up to date because of statistical births and deaths. [4] Errors can also result from inability to obtain information about all entities in the sample as well as from response errors, definition difficulties, differences in the interpretation of questions, mistakes in recording or coding the data; and other errors of collection, response, and coverage (U.S. Census Bureau, 2001). Most aspects of these errors cannot be evaluated; there is little information from the sources on the extent of errors because the organizations that produce the statistics often have no way of knowing the effect of these errors on the statistics.

Another type of measurement error, sampling error, can only be calculated if the data are collected in a probability sample. Table 3 shows that the VPIP, ACES, and government finances (which underlies the BEA-census government investment in health measure) are based on probability samples and as such are subject to sampling error. In the case of VPIP this difficulty is compounded by the fact that the universe from which the sample is drawn excludes a significant part of construction activity. The VPIP estimates are adjusted upward by a fixed percentage for every period to account for small projects not covered by the Dodge Contract Awards data.[5] This adjustment could have a significant negative impact over time on the accuracy of the estimates.

The manufacturers' shipments data, the main ingredient in the calculation of the CFP estimates, are based on a virtual

[4] A complete enumeration is often considered to be the optimal estimation tool. However, complete enumerations (or censuses) are rare and more expensive than samples.

[5] F.W. Dodge Division, McGraw-Hill Information Systems Company conducts this survey on projects values at $75,000 or more. The data from the survey are inputs to the Census C-30 Value Put-in-Place construction reports.

complete count in census years (e.g., 1992 and 1997) so that sampling is not an issue. Data for other years are based on the ASM, which is a probability sample. The ASM covers all manufacturers above a certain size and uses sampling for smaller manufacturers. The shipments data for the latest 2 years, however, are usually based on a monthly sample of companies (with some divisional reporting) that is not a probability sample. In addition, the shipments available from the monthly sample are industry-based rather than product-based and are available only in a greatly reduced level of detail. Many other data sources are involved in the commodity-flow estimation procedure (for example, export and import data) so that the sample type in the table to describe the commodity flow procedure estimates is labeled hybrid.

The other data sources—the CFT and the BEA industry capital stock program—are also labeled as hybrid. The CFT is only calculated for census years and much of the source data are therefore largely based on universe counts. However, the data used to allocate the investment flows by industry are very limited. The BEA capital stock program embodies data from the VPIP, the commodity flow estimates, ACES, and the CFT and, therefore, reflects both the statistical strengths and weaknesses of these sources.

METHODOLOGY

Revised Estimates of Investments in Medical Sector Capital

None of the data sources on private capital formation previously described are exactly appropriate for the private capital component of the NHEA. Data from the health industry part of BEA's industry capital program comes closest to the needs of CMS for purposes of estimating capital formation in the NHEA. These BEA health industry estimates are prepared using estimates of private investment from the other four data sources previously discussed. However, the BEA health estimates cover the assets owned by health industry firms rather than those used by the health industry. Consequently, CMS developed estimates on an "industry of use" basis, including non-profit organizations. This section briefly describes the sources and procedures used to develop the private and public investment estimates recently published in the NHEA. The private sector estimates have been developed using procedures similar to those used for the BEA estimates.[6] The government estimates are based on the BEA-Census estimates of government investment in health activities. These estimates are reasonable for this purpose, and there are no better alternatives that cover structures, equipment, and software. The depreciation and net stock estimates were developed from the new investment flows using somewhat more simplified procedures than employed by BEA.

The revised CMS estimates for private sector investment flows, capital stocks and depreciation are a blend of data from other sources, as is the case for the BEA estimates. The estimates are calculated as follows (major differences from the BEA estimates are also noted):

- An aggregate, or control series for medical capital investment was developed for all years (1960 to 2004). The aggregate series for years 1993 forward was based on ACES data for structures and equipment. The ACES estimates have been adjusted for several inconsistencies on the basis of ACES improvements introduced in 1996 (from covering companies

[6] BEA has provided CMS with estimates of investment for the health industry including non-profit institutions. However, BEA has not developed corresponding estimates of depreciation and net stocks.

with five or more employees to companies with one or more employees) and in 1999 (from covering industries with one or more employees to covering industries with payrolls).

- The aggregate series for years prior to 1993 was developed using the CFT level for 1992, extrapolated backward using separate series for investment in health industry structures and equipment. The trends in the control series for structures were determined from the U.S. Census Bureau's construction VPIP series. The trends in the control series for equipment were determined by a composite series based on the Bureau's manufacturer's shipments series.
- Data on the mix of assets purchased by the health industry were needed to derive estimates of stocks and depreciation, and the CFT served as the starting point. These estimates were available for the following benchmark years: 1963, 1967, 1972, 1977, 1982, 1992, and 1997. The intervening years were interpolated linearly; the 1963 distribution was used for years prior to 1963, and the 1997 distribution was used for years since 1997.
- The CFT data were used to distribute the aggregate series by asset type. Estimates of software purchases by the health industry were added after this step because software was not included in the CFT levels.
- Appropriate depreciation rates were then applied to the investment flows by asset type to calculate depreciation; net stocks were calculated as cumulated gross investment less cumulated depreciation.

The revised CMS estimates for public or government sector investment flows, capital stocks and depreciation are based directly on the BEA estimates of government investment in medical capital.

The estimating procedures used by CMS differ from those employed by BEA as follows:

- The CMS estimates have not been adjusted from an industry-of-use to an industry-of-ownership basis. The use of assets in health care is the more relevant concept for the NHEA because it reflects the use of capital in the production of health services. While ownership plays an important role in the measurement of rates of return, it is not an important enough consideration to diverge from a use basis. Also, the difference between the ownership and use basis is probably not as large in the health industries as in some other industries of concern to the BEA (for example, the transportation industry).
- An iterative statistical procedure used by BEA to balance the all-asset series to the totals of investment for all industries is not relevant for the CMS measures because CMS' goal is to derive estimates for the health care industry only, not for all private industries.
- For some asset types, CMS procedures used more simplified depreciation and net stock calculations than those used by BEA.

SUMMARY AND CONCLUSIONS

The revised estimates of investment in medical sector capital for 1960 to 2004 were introduced in the NHEA estimates released in January 2006 (Smith et al., 2006).[7] These estimates of are presented in Table 4. The redefinition of medical sector structures and the addition of medical sector capital equipment, and software increased total NHE by $51.4 billion in

[7] A data processing error in these estimates resulted in an overstatement of State and local structures. This error was corrected and will be reflected in the January 2007 release of the NHEA.

Table 4

National Health Expenditure Accounts Estimates of Gross Investment in the Medical Sector[1]: Selected Years, 1960-2004

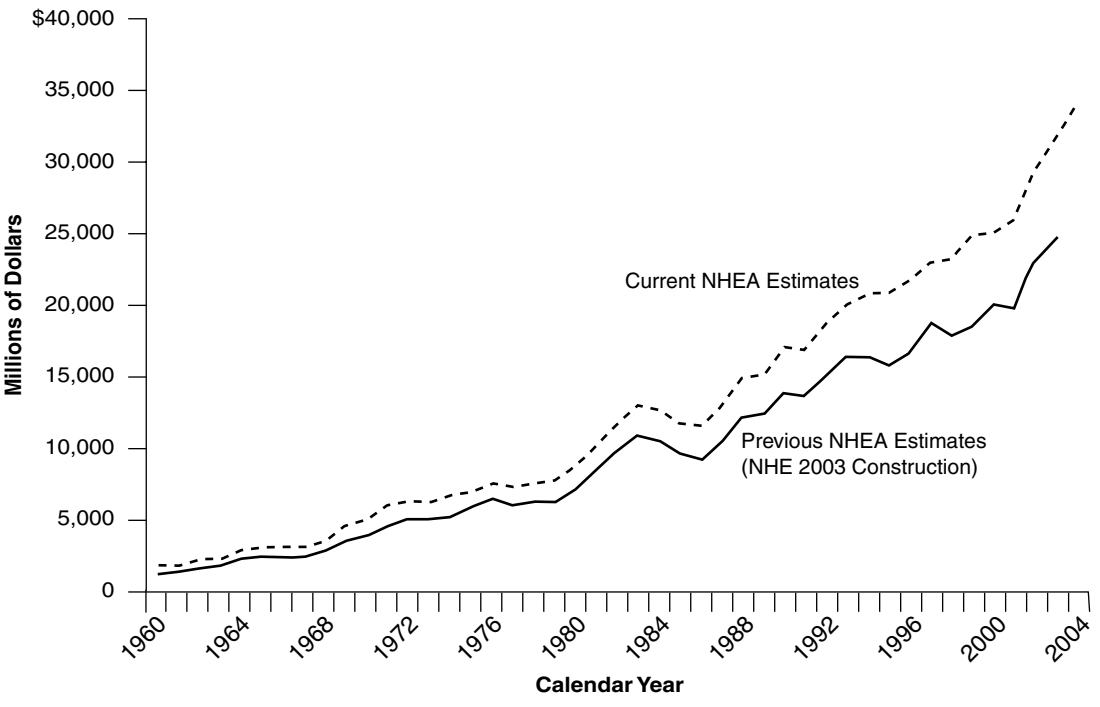
Year	Total			Private			Federal Government			State and Local Government		
	Total	Structures	Equipment and Software	Total	Structures	Equipment and Software	Total	Structures	Equipment and Software	Total	Structures	Equipment and Software
	Amount in Millions											
1960	$1,891	$1,553	$338	$1,281	$1,009	$272	$610	$202	$190	$12	$408	$354	$54
1965	3,341	2,723	618	2,411	1,926	485	930	428	393	35	502	404	98
1970	5,836	4,828	1,008	4,253	3,530	722	1,583	574	506	68	1,009	792	217
1975	8,959	6,716	2,243	6,168	4,572	1,596	2,791	857	641	216	1,934	1,503	431
1980	14,510	8,644	5,866	10,288	5,879	4,409	4,222	1,289	787	502	2,933	1,977	956
1985	22,464	11,463	11,000	15,945	8,374	7,571	6,519	2,610	1,185	1,425	3,909	1,905	2,004
1990	34,669	16,917	17,752	25,443	13,059	12,385	9,226	3,398	1,355	2,043	5,828	2,504	3,324
1991	36,365	16,643	19,722	26,707	12,697	14,010	9,659	3,538	1,184	2,353	6,121	2,762	3,359
1992	40,289	18,558	21,730	29,833	13,802	16,030	10,456	3,711	1,467	2,243	6,746	3,289	3,457
1993	42,898	19,940	22,958	31,639	15,010	16,629	11,259	4,139	1,506	2,633	7,120	3,424	3,696
1994	44,145	20,601	23,544	33,172	16,073	17,099	10,972	4,151	1,322	2,829	6,822	3,206	3,616
1995	45,388	20,623	24,766	33,842	15,813	18,029	11,546	4,568	1,494	3,074	6,979	3,316	3,663
1996	48,256	21,616	26,640	35,730	16,406	19,324	12,526	5,323	1,747	3,576	7,203	3,463	3,740
1997	51,668	22,859	28,809	38,190	17,422	20,768	13,478	5,831	1,982	3,849	7,647	3,455	4,192
1998	57,725	23,130	34,595	43,864	18,336	25,528	13,861	5,875	1,401	4,474	7,986	3,393	4,593
1999	61,982	24,673	37,309	47,889	20,197	27,692	14,093	5,975	1,222	4,753	8,118	3,254	4,864
2000	63,210	24,939	38,270	48,481	20,214	28,266	14,729	6,112	1,278	4,834	8,617	3,447	5,170
2001	64,691	25,811	38,880	49,355	20,880	28,475	15,337	6,362	1,175	5,187	8,974	3,756	5,218
2002	71,462	29,129	42,333	55,851	23,194	32,656	15,611	6,269	1,367	4,902	9,343	4,568	4,775
2003	75,892	31,637	44,255	59,286	24,943	34,342	16,606	6,850	1,508	5,342	9,756	5,186	4,570
2004	80,624	33,830	46,794	62,736	26,814	35,922	17,888	7,043	1,204	5,839	10,845	5,811	5,033

[1] Corrected for data processing error detected after release of the 2004 National Health Expenditures estimates. This correction will be reflected in the 2005 National Health Expenditures release.

SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary: Data from the National Health Statistics Group, 1960-2004.

Figure 2

Estimates of Investment in Medical Structures: Calendar Years 1960-2004



NOTES: NHEA is national health expenditures accounts. NHE is national health expenditures.

SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary: Data from the National Health Statistics Group.

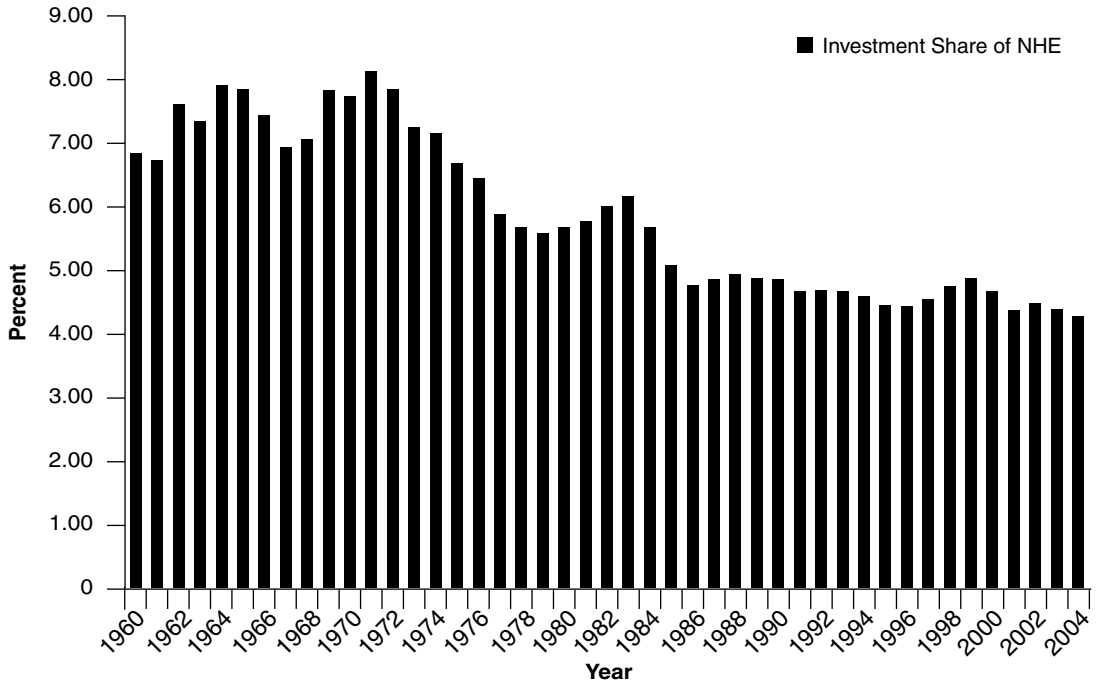
2003. The 2003 estimates of investment in structures (previously titled construction) were revised upward by $7.1 billion (Figure 2). The addition of estimates of investment in capital, equipment, and software used by the medical sector increased total NHE by an additional $44.3 billion. The impact of the revisions on total NHE varies over time.

The relationship between total health care expenditures and investment in structures, equipment, and software used by the medical sector changes considerably over the 44 years in the time series. In 1960 total investment in structures and capital equipment used by the medical sector represented 6.9 percent of total health care spending. This share increased to a high 8.1 percent in 1971, then declined slowly so that by 2004, medical sector investment in capital accounted for 4.3 percent of NHE (Figure 3). The asset mix in the revised estimates changes considerably over time. In 1960, investment in equipment and software was roughly one-fifth of investment in structures (Figure 4). By 1980, the investment in equipment and software was about three-fifths the investment in structures. By 1995, investment in equipment slightly exceeded investment in structures, and by 2004 equipment investment was more than 20 percent greater than the investment in structures. This change in the asset mix has implications for studies of multifactor productivity, the impact of technological change, and the relationship of investment to total health spending.

In summary, CMS commissioned a study on investment in structures and capital equipment including software used by the medical sector. This study led to the preparation of revised estimates on investment in

Figure 3

Investment in Medical Sector Structures, Equipment and Software as a Share of Total National Health Expenditures (NHE): 1960-2004



SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary: Data from the National Health Statistics Group.

capital in the NHEA. The broader measure of investment by the medical sector in the revised estimates improved the usefulness of the NHEA and makes them more comparable with other measures of aggregate economic activity, such as GDP. The revised investment estimates improved NHE as an indicator of the share of the economy engaged in the provision of health care goods and services. Finally, the changes in methodology and definition brought the NHEA closer to various economic accounting standards, including those recognized by the OECD and the United Nations.

ACKNOWLEDGMENTS

Gerald F. Donahoe performed the study on which the revised estimates are based. The authors would like to thank Frank C. Wykoff and Jack E. Triplett for two related papers that informed the research that this article is based on. The article also benefited from the support, direction, and suggestions of CMS staff: Stephen Heffler, Mark Freeland, John Poisal, Randy Matsunaga, and Cathy Cowan, as well as comments from other government agencies.

REFERENCES

Bonds, B. and Aylor, T.: Investment in New Structures and Equipment in 1992 by Using Industries. *Survey of Current Business,* 78(12):26-51, December 1998.

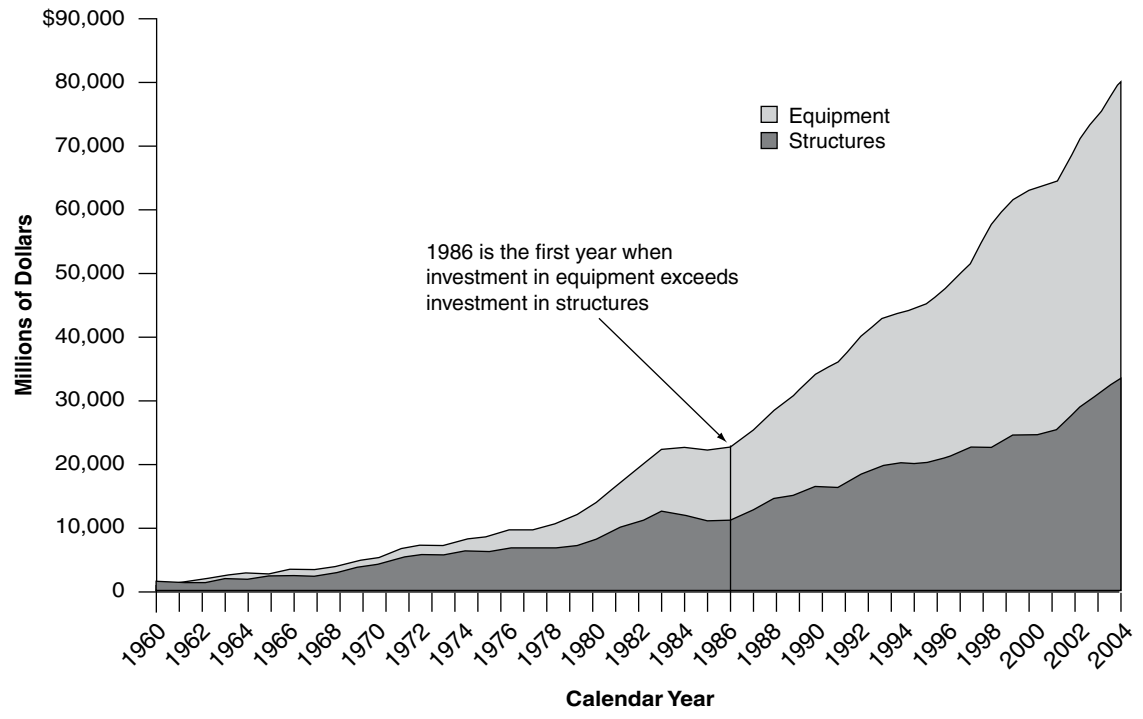
Bureau of Economic Analysis: *Benchmark Input-Output Accounts of the United States*. Page M-5. 1998.

Bureau of Economic Analysis: *GDP:* One of the Great Inventions of the 20th Century. S*urvey of Current Business* 80(1):7-9, January 2000a.

Bureau of Economic Analysis: Government Spending by Function: A New Presentation. *Survey of Current Business* 80(6):18-24, June 2000b.

Figure 4

Estimates of Investment: Calendar Years 1960-2004



SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary: Data from the National Health Statistics Group.

Centers for Medicare and Medicaid Services: *National Health Accounts: Definitions, Sources, and Methods Used in the NHE 2004*. Internet address: http://www.cms.hhs.gov/NationalHealthExpendData/downloads/dsm-04.pdf (Accessed 2006.)

Donahoe, G.F.: *Capital in the National Health Accounts, 2002*. Unpublished paper is available as a pdf file at: http://www.cms.hhs.gov/NationalHealthExpendData (Accessed 2006.)

Organisation for Economic Co-operation and Development: *A System of Health Accounts: Version 1.0*. 2000.

Mead, C.I., Moses, K.E., and Moulton, B.R.: The NIPAs and the System of National Accounts, *Survey of Current Business* 84(12):17-32, December 2004.

Moulton, B.M. and Seskin, E.P.: Preview of the 2003 Comprehensive Revisions of the National Income and Product: Changes in Definitions and Classifications. *Survey of Current Business* 83(6):17-34, June 2003.

Smith, C., Cowan, C., Heffler, S., et al.: The National Health Accounts Team: Trends: National Health Spending In 2004: Recent Slowdown Led By Prescription Drug Spending. *Health Affairs*. 25(1):186-196, January/February 2006.

United Nations: *System of National Accounts (SNA93)*. Prepared Under the Auspices of the Inter-Secretariat Working Group on National Accounts. Brussels/Luxembourg, New York, Paris, and Washington DC., 1993.

United Nations Statistical Commission: *Classification of Expenditures According to Purpose*. Statistical Papers: Series M, Number 84. United Nations. March 1999.

U.S. Census Bureau: *Annual Capital Expenditures, 1999*. May 2001.

U.S. Census Bureau: *Government Finances, 1999-2000*. January 2003b.

U.S. Census Bureau: *Current Construction Reports, Series C-30 Value of New Construction Put in Place, 2002*. May 2003a.

U.S. Census Bureau: *Annual Capital Expenditures, 2005*. July 2006.

Young, A. H. and Tice, H. S.: An Introduction to National Economic Accounting. *Survey of Current Business* 65 (3):65-76, March 1985.

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