Concepts and Methods of the U.S. National Income and Product Accounts

(Chapters 1–13)

November 2017

Preface

The "NIPA Handbook" begins with introductory chapters that describe the fundamental concepts, definitions, classifications, and accounting framework that underlie the national income and product accounts (NIPAs) of the United States and the general sources and methods that are used to prepare the NIPA estimates. It continues with separate chapters that describe the sources and methods that are used to prepare the expenditure and income components of the accounts and presents an appendix that defines each entry in the seven summary NIPA accounts and a glossary of terms that are associated with the NIPAs. The Handbook is intended to be a living reference that can be updated to reflect changes in concepts or methodology as they are introduced into the NIPAs.

This release of the NIPA Handbook updates the existing chapters to reflect the 2017 annual update of the NIPAs and incorporates a new chapter 12 for Rental Income of Persons. Additional chapters will be incorporated as they become available.

Acknowledgments

Douglas R. Fox, formerly of the Bureau of Economic Analysis (BEA), planned the structure and the content this Handbook. He and **Stephanie H. McCulla** of BEA's National Income and Wealth Division (NIWD) prepared the chapters, with major contributions from **Shelly Smith** (NIWD), and **Eugene P. Seskin,** formerly of NIWD. Technical expertise has been provided by the staffs of BEA's NIWD, Balance of Payments Division, and Government Division. **Erich Strassner**, BEA's Associate Director for National Economic Accounts, and **David B. Wasshausen**, Chief of NIWD, along with **Brent R. Moulton**, former Associate Director for National Economic Accounts, and **Carol E. Moylan and Nicole M. Mayerhauser**, former Chiefs of NIWD, have provided overall guidance.

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CHAPTER 1: INTRODUCTION

The U.S. national income and product accounts (NIPAs) are a set of economic accounts that provide the framework for presenting detailed measures of U.S. output and income. This chapter introduces the NIPAs by answering several basic questions about their nature and purpose.

CHAPTER 2: FUNDAMENTAL CONCEPTS

The NIPAs are based on a consistent set of concepts and definitions. This chapter establishes the type and scope of the economic activities that are covered by the NIPA measures, and it describes several of the principal NIPA measures of these activities. It then discusses the classifications used in presenting the NIPA estimates, and it describes the accounting framework that underlies the NIPAs.

CHAPTER 3: PRINCIPAL SOURCE DATA

The NIPAs incorporate a vast amount of data from a variety of public and private sources. This chapter describes the principal source data that are used to prepare the current quarterly NIPA estimates, to prepare the annual revisions of the NIPAs, and to prepare the quinquennial comprehensive revisions of the NIPAs.

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Estimating methods are the steps that are taken to transform source data into estimates that are consistent with the concepts, definitions, and framework of the NIPAs. This chapter briefly describes some of the general methods that are used to prepare the current-dollar, quantity, and price estimates for the NIPAs. An appendix describes some of the statistical tools and conventions that are used in preparing and presenting the NIPA estimates.

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This glossary presents the definitions of terms that are associated with the concepts, classifications, and accounting framework of the NIPAs and with the general sources and methods that are used to prepare the NIPA estimates.

CHAPTER 1: INTRODUCTION

(Updated: November 2017)

What are the NIPAs?
How did the NIPAs originate?
How have the NIPAs evolved?
How are the NIPA estimates used?
How useful are the NIPA estimates?
How are the NIPA estimates prepared?
Why are the NIPA estimates revised?
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What are the NIPAs?

The national income and product accounts (NIPAs) are one of the three major elements of the U.S. national economic accounts. The NIPAs present the value and composition of national output and the types of incomes generated in its production. (For information on the concepts and definitions underlying the NIPAs, see "Chapter 2: Fundamental Concepts.")

The other major elements of the U.S. national economic accounts are the industry accounts, which are also prepared by the Bureau of Economic Analysis (BEA), and the financial accounts of the United States (formerly the flow of funds accounts), which are prepared by the U.S. Board of Governors of the Federal Reserve System. The industry accounts consist of the input-output (I-O) accounts, which trace the flow of goods and services among industries in the production process and which show the value added by each industry and the detailed commodity composition of national output, and the gross domestic product (GDP) by industry accounts, which measure the contribution of each private industry and of government to GDP.[1] The financial accounts record the acquisition of nonfinancial and financial assets (and the incurrence of liabilities) throughout the U.S. economy, the sources of the funds used to acquire those assets, and the value of assets held and of liabilities owed.[2]

In addition, BEA prepares two other sets of U.S. economic accounts: the international accounts, which consist of the international transactions (balance of payments) accounts and the international investment position accounts; and the regional accounts, which consist of the estimates of GDP by state and by metropolitan area, of

[1] See Mary L. Streitwieser, "A Primer on BEA's Industry Accounts," *Survey of Current Business* 89 (June 2009): 40–52. See also U.S. Bureau of Economic Analysis, *Concepts and Methods of the U.S. Input-Output Accounts* (September 2006); go to www.bea.gov, and click on "Industry," "Methodologies," and then "Benchmark input-output."

[2] See U.S. Board of Governors of the Federal Reserve System, *Guide to the Flow of Funds Accounts (*Board of Governors, Washington, DC, 2006); and see Albert M. Teplin, "The U.S. Flow of Funds Accounts and Their Uses," *Federal Reserve Bulletin* (July 2001): 431–441.

state personal income, and of local area personal income.[3] Finally, the U.S. Bureau of Labor Statistics prepares estimates of productivity for the U.S. economy (which are partly based on the estimates of GDP). Altogether, the system of U.S. economic accounts presents a coherent, comprehensive, and consistent picture of U.S. economic activity.

The NIPAs provide information to help answer three basic questions. First, what is the output of the economy—its size, its composition, and its use? Second, what are the sources and uses of national income? Third, what are the sources of saving, which provides for investment in future production? The NIPA estimates are presented in a set of integrated accounts that show U.S. production, income, consumption, investment, and saving. The conceptual framework of the accounts is illustrated by seven summary accounts, and detailed estimates are provided in approximately 300 supporting NIPA tables. The NIPA information is supplemented by a set of fixed-asset accounts, which show the U.S. stock of fixed assets and consumer durable goods.[4]

The NIPAs feature some of the most closely watched economic statistics that influence the decisions made by government officials, businesses, and households. Foremost among these estimates is GDP, the most widely recognized measure of the nation's production. In particular, the quarterly estimates of inflation-adjusted GDP provide the most comprehensive picture of current economic conditions in the United States. Other key NIPA estimates include the monthly estimates of personal income and outlays, which provide current information on consumer income, spending, and saving, and the quarterly estimates of corporate profits, which provide an economic measure of U.S. corporate financial performance.

How did the NIPAs originate?

Prior to the development of official statistics in the 1930s, there were only fragmentary and sometimes conflicting data on the state of the economy. This lack of comprehensive economic data hampered efforts to develop policies to combat the Great Depression. In response to this need, and in keeping with the economic identity that "income equals production," the U.S. Department of Commerce commissioned future Nobel Laureate Simon Kuznets to develop estimates of national income to serve as an indicator of both U.S. income and U.S. output.[5] He coordinated the work of a group of researchers at the National Bureau of Economic Research and of his staff at the

[3] Go to www.bea.gov; click on "International" and then on "Methodologies," and also click on "Regional" and then on "Methodologies."

[4] See U.S. Bureau of Economic Analysis, *Fixed Assets and Consumer Durable Goods in the United States, 1925–97* (September 2003); go to www.bea.gov and click on "National," then on "Methodologies," and then on "Fixed Assets and Consumer Durable Goods."

[5] The proposition that for a country as a whole, goods and services produced must equal incomes earned by its residents is precisely true only for a closed economy. In the 1930s, when statistical measures were being formulated and international flows were relatively small, the identity was retained by using a measure of production derived from labor and capital supplied by U.S. residents wherever the production takes place—that is, gross national product rather than gross domestic product.

Commerce Department, and initial estimates were presented in a 1934 report to the U.S. Senate, *National Income, 1929–32*. Shortly thereafter, work began on monthly measures that could track income developments more quickly. These measures of income payments to individuals were first published in 1938 and were the predecessor of BEA's personal income estimates. They revealed their usefulness immediately, as they showed that incomes had dropped 11 percent from a post-Great Depression peak in August 1937 to the recession trough in March 1938. Annual statistics could not track these developments.

Similar efforts occurred internationally. In 1928, the League of Nations held the International Conference Relating to Economic Statistics to encourage countries to develop internationally comparable official statistics. As in the United States, the Great Depression underscored the urgency of developing reliable economic measures and in 1939 the League of Nations published national income estimates for 26 countries. As with the United States' measures, the usefulness of the measures was quickly recognized.

The planning needs for a wartime economy in the United States in the early 1940s highlighted the need for a measure of national production that could answer questions that national income measures could not address, such as the tradeoffs associated with mobilizing for war. Annual estimates of "gross national expenditure," which gradually evolved to gross national product (GNP), were introduced early in 1942 to provide information about major categories of expenditures in the economy; the measure also served as a complement to the estimates of national income.[6] Over time, both the income and expenditure measures were refined and expanded. The first U.S. national income and product statistics were presented as part of a complete and consistent double-entry accounting system in the summer of 1947. The accounts presented a framework for classifying and recording the economic transactions among major sectors: households, businesses, government, and international (termed "rest of the world"). This framework placed the GNP statistics in the broader context of the economy as a whole and provided a more complete picture of how the economy works.[7]

International efforts also continued, and after the war, the League's Committee of Statistical Experts formed a Sub-Committee on National Income Statistics, which produced a report in 1947, written by Sir Richard Stone.[8] This report was the foundation of the modern-day *System of National Accounts* (SNA)—the internationally accepted guidelines for the compilation of national accounts.

[6] Until 1991, GNP was the featured measure of U.S. production. For an explanation of the difference between GNP and GDP, see the section "Geographic coverage" in chapter 2.
[7] See Rosemary D. Marcuss and Richard E. Kane, "U.S. National Income and Product Statistics: Born of the Great Depression and World War II," *Survey* 87 (February 2007): 32–46.
[8] Sir Richard Stone subsequently won the Nobel Prize for "having made fundamental contributions to the development of systems of national accounts and hence greatly improved the basis for empirical economic analysis."

How have the NIPAs evolved?

The evolution of the NIPAs from their earliest origins in the 1930s to their current form exemplifies the balance between theoretically ideal measures, the availability of source data and other resources, and the economic questions of the day. Put another way, the NIPAs evolved, and continue to evolve, in an effort to produce the best possible measures of the economy that are at once accurate, reliable, and relevant.

The improvements BEA introduced into its accounts over the years have reflected its own experience, research and strategic planning, and the recommendations of scholars and other experts. For example, in the 1950s, there were two major reviews of the accounts, one by the National Bureau of Economic Research and another by the Conference on Research in Income and Wealth.[9] In 1971, BEA published a special volume commemorating its 50th anniversary that contained recommendations contributed by some of the country's most prominent economists.[10] Also in the 1970s, reports were prepared by the Advisory Committee on Gross National Product Data Improvement and by the Conference on Research in Income and Wealth; in 1982, the General Accounting Office reviewed quarterly GNP revisions.[11] BEA regularly conducts its own reviews; for example, in 1995, BEA began a comprehensive review of its national, international, and regional economic accounts and sought outside advice from experts; this effort was the predecessor of the advisory committee established by BEA in 2000.[12] And in 2004, BEA participated in a Conference on Research in Income and Wealth on "A New Architecture for the U.S. National Accounts," which initiated the development of a comprehensive and fully integrated set of U.S. national accounts that would be integrated with other U.S. economic statistics such as the productivity measures prepared by the Bureau of Labor Statistics and the financial accounts prepared by the Federal Reserve Board.[13]

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[9] U.S. Congress, Joint Economic Committee, Subcommittee on Economic Statistics, "The National Economic Accounts of the United States: Review, Appraisal, and Recommendations," in *The National Economic Accounts of the United States*, report by the National Accounts Review Committee, National Bureau of Economic Research, 85th Congress, October 1957 and "A Critique of the United States Income and Product Accounts," *Studies in Income and Wealth*, vol. 22. Princeton, JN: Princeton University Press, for the National Bureau of Economic Research, 1958.

[10] "The Economic Accounts of the United States: Retrospect and Prospect," *Survey* 51 (July 1971), Part II, 50th anniversary issue.

[11] Office of Federal Statistical Policy and Standards, *Gross National Product Data Improvement Project Report*, report of the Advisory Committee on Gross National Product Data Improvement, Washington, DC: U.S. Department of Commerce, 1977; Murray F. Foss, ed., "The U.S. National Income and Product Accounts: Selected Topics," *Studies in Income and Wealth*, vol. 47, Chicago: University of Chicago Press, for the National Bureau of Economic Research, 1983; and Comptroller General, *The Bureau of Economic Analysis Should Lead Efforts to Improve GNP Estimates* (Washington, DC: General Accounting Office, 1982).

[12] BEA's Advisory Committee papers are available on BEA's Web site at www.bea.gov. See also "Mid-Decade Strategic Review of BEA's Economic Accounts: Maintaining and Improving Their Performance," *Survey* 75 (February 1995): 36-66, and "Mid-Decade Strategic Review of BEA's Economic Accounts: An Update," *Survey* 75 (April 1995): 48-55.

[13] Dale W. Jorgenson, J. Steven Landefeld, and William D. Nordhaus, eds., "A New Architecture for the U.S. National Accounts," *Studies in Income and Wealth*, vol. 66, Chicago: University of Chicago Press, for the National Bureau of Economic Research, 2006.

Since World War II, the U.S. national accounts and the SNA have continued to evolve together: BEA actively participated in the 1993 and 2008 revisions of the SNA, and as part of its mission, BEA supports the goal of international harmonization by adopting the SNA guidelines to the extent feasible. Since 1993, BEA has incorporated many improvements to the NIPAs and its other economic accounts that have resulted in increased consistency with major SNA guidelines on GDP, investment, and saving.[14]

As a result of these continuous efforts, at the end of 1999, the Commerce Department named the invention and ongoing development of the NIPAs and its marquee measure GDP as "its greatest achievement of the century."[15] The following are examples of some of the major changes that have been introduced into the NIPAs to keep them accurate and relevant in the face of a changing economy.

- In the early 1950s, BEA developed and began to publish inflation-adjusted, or "real," measures of output in response to inflation concerns that had persisted since WWII and in order to assess trends in national productivity and standards of living. Later in the same decade, BEA introduced measures of personal income by size and by state in response to similar needs for information on the composition of consumer markets. Additionally, BEA introduced quarterly measures of real GNP to meet the need for more timely data that indicated the pace of inflationary or deflationary changes.
- In the 1960s, GNP components were benchmarked to BEA's input-output accounts to better integrate the U.S. economic estimates. Interest payments to individuals were excluded from GNP to better reflect productive activity.
- In the 1970s, BEA introduced economic measures of capital consumption that were valued at replacement cost rather than historical cost to better reflect the depletion of capital assets and to enhance the picture of the Nation's productive capacity.
- In the 1980s, BEA significantly expanded its coverage of international trade in services in response to the growing size and diversity of these global transactions.
- In the 1990s, BEA introduced more accurate measures of real output and of prices, developed estimates of investments in computer software, instituted the treatment of government purchases of structures, equipment, and software as investment, and incorporated improved measures of high-tech products.
- In the early 2000s, BEA introduced improved measures of insurance and banking services, a new treatment of government as a producer of goods and services, and a new, improved format for presenting the NIPAs.
- In the late 2000s, BEA updated the classification system for personal consumption expenditures to provide more useful categories for analysis of

[14] For more information, see Charles Ian Mead, Karin E. Moses, and Brent R. Moulton, "The NIPAs and the System of National Accounts," *Survey* 84 (December 2004): 17–32. For the latest edition of the SNA, see http://unstats.un.org/unsd/nationalaccount/SNA2008.asp

[15] "GDP: One of the Great Inventions of the 20th Century," *Survey* 80 (January 2000): 6–14.

spending by households and nonprofit institutions serving households. BEA also changed the treatment of disasters to better reflect the distinctions between current and capital transactions, and events that directly affect balance sheets.

- In 2013, BEA expanded the asset boundary in the accounts by recognizing expenditures by business, government, and nonprofits institutions serving households for research and development and expenditures by private enterprises for the creation of entertainment, literary, and artistic originals as fixed investment to allow better measurement of the effects of innovation and intangible assets on the economy. BEA also began measuring pension income on an accrual basis.

How are the NIPA estimates used?

The NIPAs provide government policymakers, business decision-makers, academics and other researchers, and the general public with information that enables them to follow and understand the performance of the U.S. economy. The following are among the principal uses of the NIPA estimates.

- Since their inception in the 1930s and 1940s, the NIPAs have become the mainstay of modern macroeconomic analysis. They provide comprehensive and consistent time series that can be used for measuring the long-term path of the U.S. economy, for analyzing trends and identifying factors in economic growth and productivity, and for tracking cyclical fluctuations in economic activity.

- The NIPAs provide the basis for macroeconomic forecasting models. These mathematical models are developed using historical NIPA estimates and other variables with the aim of predicting short-term economic activity or long-term economic trends.

- Key NIPA estimates serve as primary indicators of the current condition of the U.S. economy. In particular, the releases of the quarterly estimates of GDP and its components, of the quarterly estimates of corporate profits, and of the monthly estimates of personal income and personal consumption expenditures are closely anticipated and followed by Wall Street investors and analysts, the news media, and the general public.

- The NIPA estimates provide critical inputs to the formulation and execution of macroeconomic policy and to the assessment of the effects of these policies. They are used by the White House and by Congress in formulating fiscal policy and by the Federal Reserve Board in formulating monetary policy.

- The NIPA estimates are used by the White House and Congress in preparing the federal budget and tax projections.

- The NIPA estimates are used in comparisons of the U.S. economy with the economies of other nations. Comparable international statistics facilitate assessments of relative economic performance among nations, and they provide the basis for tracking and analyzing the global economy.

- Detailed NIPA estimates can be used in examining interrelationships between various sectors of the economy. For example, estimates of benefits paid under government assistance programs track flows of transfer payments from governments to households.

- The NIPA estimates are used by businesses and individuals in planning financial and investment strategies. Such planning heavily depends on the near- and long-term prospects for economic growth.

- The NIPAs are an important data source for the other national economic accounts and other economic statistics. For example, the NIPA estimates of owner-occupied housing, of motor vehicle output, and of bank-service charges are among the primary source data used in preparing the I-O accounts. In addition, the NIPA estimates are used in various analytical measures; for example, business-sector output is used as the numerator in the Bureau of Labor Statistics' estimates of productivity for the U.S. economy.

- The NIPA framework provides the basis for developing analytical tools such as satellite accounts, which are supplementary accounts that focus on the activities of a specific sector or segment of the economy. For example, the NIPAs provide the structural and statistical basis for the travel and tourism satellite accounts.[16]

How useful are the NIPA estimates?

The usefulness of the NIPA estimates is determined by how effective they are in meeting the above needs. This effectiveness may be summarized in terms of four characteristics: accuracy, reliability, relevance, and integrity.

Accuracy. Accuracy may be described in terms of how close the estimates come to measuring the concepts they are designed to measure. In the case of GDP, the estimate is accurate when it captures all production for final use but does not include production for intermediate use. In order to keep pace with innovations in the economy, such as the development of new online services, BEA must periodically review and update the definitions and methodologies of the NIPA aggregates and components to ensure that they represent complete and consistent estimates.

[16] For example, see Steven Zemanek, "U.S. Travel and Tourism Satellite Accounts for 2003–2011," *Survey* 92 (June 2012): 19–33.

Reliability. Reliability refers to the size and frequency of revisions to the NIPA estimates. An important indicator of reliability is the effectiveness of the initial estimates of GDP in providing a useful picture of U.S. economic activity. The results of periodic studies have confirmed that the initial estimates provide a reliable indication of whether economic growth is positive or negative, whether growth is accelerating or decelerating, whether growth is high or low relative to trend, and where the economy is in relation to the business cycle.[17]

Relevance. Relevance has two dimensions. First, relevance refers to the length of time before the estimates become available. Estimates that are not available soon enough for the intended use are not relevant. However, there is an implicit tradeoff between timeliness and accuracy, so BEA has developed a release cycle for the estimates that addresses this tradeoff (see the section "Why are the NIPA estimates revised?"). Second, relevance refers to the ability of the accounts to provide summary and detailed estimates in analytical frameworks that help answer the questions being asked about the economy. Issues of relevance change as the economy changes, as policy concerns evolve, and as economic theory advances; as discussed above, BEA's accounts have evolved over time in order to maintain their relevance.

Integrity. One critical factor underlying the usefulness of the accounts is confidence on the part of users that the NIPA estimates represent a truthful picture of the economy. That is, the preparation and release of the estimates must reflect the best methods and technical judgments available, free from any political or other inappropriate influence.

In recognition of the importance of its statistics and the trust placed in their integrity, BEA strives to make its processes open and transparent and its releases objective and timely. For example, the NIPA estimates that are designated as "principal economic indicators"—GDP, personal income and outlays, and corporate profits—are prepared in accordance with Statistical Policy Directive Number 3 of the Office of Management and Budget, which provides standards for data collection, estimation, and evaluation and for the timely and orderly release of these sensitive economic statistics. BEA employs such standards in the preparation of all of its estimates.

> As Alan Greenspan, former Chair of the Federal Reserve Board, stated about the national economic accounts, and specifically the estimates of GDP:
> Though these estimates have a profound influence on markets when published and are the basis for federal budget projections and political rhetoric, I do not recall a single instance when the integrity of the estimates was called into question by informed observers. This is so despite the fact that, for many of the published preliminary figures, judgmental estimates for data not yet available are made, many of which affect the message of the accounts. It is a testament to the professionalism

[17] For more information, see Dennis J. Fixler, Ryan Greenaway-McGrevy, and Bruce T. Grimm, "Revisions to GDP, GDI, and Their Major Components," *Survey* 91 (July 2011): 9–31.

> of the analysts that these judgments are never assumed to be driven by political imperatives. This cannot be said of statistical operations of all countries, and I think it is fair to say that the consequent ability of people to make decisions with greater confidence in the information at their disposal has contributed, in at least a small way, to our nation's favorable economic performance.[18]

How are the NIPA estimates prepared?

The NIPA estimates are prepared by the staff of the Directorate for National Economic Accounts within the Bureau of Economic Analysis, an agency of the U.S. Department of Commerce. The process starts with identifying and obtaining source data that are appropriate as the basis for the estimates. These data largely originate from public sources, such as government surveys and administrative data, and they are supplemented by data from private sources, such as data from trade associations. (For more information, see "Chapter 3: Principal Source Data.")

Ideally, the source data for each detailed component of the NIPAs would correspond exactly to the concepts and structure of the accounts. Additionally, these data would be accurate, would have the needed coverage, would have the appropriate time of recording and valuation, and would be available quickly. In practice, the source data will never meet all of these criteria. Thus, BEA must develop estimating methods that adjust the data to the required concepts and that fill gaps in coverage and timing. (For more information, see "Chapter 4: Estimating Methods.")

Why are the NIPA estimates revised?

BEA revises the NIPA estimates for two related reasons. First, as noted earlier, the NIPAs serve a multitude of purposes, some of which require frequent and immediately available estimates and others of which require consistent, long-term time series. Second, much of the source data that BEA uses to prepare the estimates are part of statistical programs that provide, over time, more complete or otherwise better coverage—for example, monthly surveys that are superseded by an annual survey that is drawn from a larger sample or that collects more detailed information. To address this implicit tradeoff between estimates that are the most timely possible and estimates that are the most accurate possible, BEA has developed a release cycle for the NIPA estimates. This cycle progresses from current quarterly estimates, which are released soon after the end of the quarter and which are based on limited source data, to comprehensive-revision estimates, which are released about every 5 years and which incorporate the most extensive source data available.

[18] "GDP: One of the Great Inventions of the 20th Century," 13.

For GDP and most other NIPA series, the set of three current quarterly estimates are released on the following schedule. "Advance" estimates are released near the end of the first month after the end of the quarter. Most of these estimates are based on initial data from monthly surveys for either 2 or 3 months of the quarter; where source data are not yet available, the estimates are generally based on previous trends and judgment (see the box "Source Data and Key Assumptions for the Advance Estimates of GDP for the Second Quarter of 2012" in the section "Source data for the current estimates" in chapter 3).[19]

"Second" and "third" quarterly estimates are released near the end of the second and third months, respectively; these estimates incorporate new and revised data from the monthly surveys and other monthly and quarterly source data that have subsequently become available. The current quarterly estimates provide the first look at the path of U.S. economic activity.[20]

Annual updates of the NIPAs are usually carried out each summer. These updates incorporate source data that are based on more extensive annual surveys, on annual data from other sources, and on later revisions to the monthly and quarterly source data, and they generally cover the 3 previous calendar years.[21] These revised NIPA estimates improve the quality of the picture of U.S. economic activity, though the overall picture is generally similar to that shown by the current quarterly estimates.

Comprehensive updates are carried out at about 5-year intervals and may result in revisions that extend back for many years.[22] These estimates incorporate the best available source data, such as data from the quinquennial U.S. Economic Census. Comprehensive updates also provide the opportunity to make definitional, statistical, and presentational changes that improve and modernize the accounts to keep pace with the ever-changing U.S. economy. Thus, these NIPA estimates represent the most accurate and relevant picture of U.S. economic activity.

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[19] Information on the assumptions used for unavailable source data is provided in a technical note that is posted with the GDP news release on BEA's Web site. Within a few days after the release, a detailed "Key Source Data and Assumptions" file is posted on the Web site. Additionally, in the middle of each month, an analysis of the current quarterly estimate of GDP and related series, including information on key source data and assumptions, is made available on the Web site; click on *Survey of Current Business*, "GDP and the Economy."

[20] Unless noted otherwise, annual data are presented on a calendar-year basis (i.e., covering January through December). Quarter data are also presented on a calendar basis (i.e., the first quarter (Q1) covers January, February, and March; Q2 covers April, May, and June; Q3 covers July, August, and September; and Q4 covers October, November, and December).

[21] Starting in 2010, BEA instituted a "flexible" approach to annual updates that allows for the incorporation of improvements in methodology and for the extension of the 3-year revision period to earlier periods; see "BEA Briefing: Improving BEA's Accounts Through Flexible Annual Revisions," *Survey* 88 (June 2008): 29–32.

[22] The following is a list of the 14 NIPA comprehensive updates to date: July 1947, July 1951, July 1954, July 1958, August 1965, January 1976, December 1980, December 1985, December 1991, January 1996, October 1999, December 2003, July 2009, and July 2013.

Where are the NIPA estimates available?

Information on the NIPA estimates is provided in BEA news releases, in BEA's monthly journal, the *Survey of Current Business*, and on BEA's website at www.bea.gov. News releases provide the earliest information on the current quarterly NIPA estimates and the annual and comprehensive revisions of the NIPAs. These releases, which contain a brief description of the estimates and summary data tables, are posted on BEA's website by 8:30 on the morning of the release in accordance with a previously published schedule,

The most comprehensive source of the latest vintage of NIPA data is BEA's website presentation of the entire set of NIPA tables, which is updated soon after the news release is posted. The website provides the estimates in an interactive environment that enables users to view and download specified tables for selected time spans and in a variety of formats.[23] In addition, the website provides descriptions of the methodologies underlying the estimates and release schedules for the estimates, as well as articles and working papers that describe BEA's current research. Users can be notified via e-mail, RSS feeds, and Twitter accounts of new data releases.

The current NIPA estimates are also discussed each month in the article "GDP and the Economy" in the *Survey* and are presented in a set of selected NIPA tables. The annual updates are described in an article that is generally included in the August issue, which also includes most of the NIPA tables for the most recent time period. The results of the comprehensive update, articles that explain changes in definitions, methodologies, and presentation made in connection with the comprehensive update, and articles on other topics related to the NIPAs are published periodically.

The presentation of the NIPA tables in the *Survey* and on the website is organized to group tables with similar purposes by section. For example, most government sector tables are shown in section 3. To assist users in identifying the type of estimate in a table, BEA developed a table-numbering system that highlights the type of estimate (such as current dollars, quantity indexes, and percent changes) in the table. The system is outlined below.

Table numbers are in the format "X.Y.Z." where "X" indicates the NIPA table section, "Y" indicates the table number in the section, and "Z" indicates the type of estimate presented.

The table sections are numbered as follows:

1. Domestic Product and Income
2. Personal Income and Outlays
3. Government Current Receipts and Expenditures

[23] Go to www.bea.gov, and click on "National" and then on "Interactive Tables." Interactive tables for BEA's international, regional and industry economic accounts are also available on the website.

4. Foreign Transactions
5. Saving and Investment
6. Income and Employment by Industry
7. Supplemental Tables

The table numbers within each section are numbered sequentially. The types of estimates are numbered as follows:

1. Percent change from preceding period in real estimates (most at annual rates)
2. Contributions to percent change in real estimates
3. Real estimates, quantity indexes
4. Price indexes
5. Current dollars
6. Real estimates, chained dollars
7. Percent change from preceding period in prices
8. Contributions to percent change in prices
9. Implicit price deflators
10. Percentage shares of GDP
11. Percent change from quarter one year ago (available only for real GDP)

For example, GDP is presented in table group 1.1; the current-dollar estimates are presented in table 1.1.5, and the chained-dollar estimates are presented in table 1.1.6. The tables that present estimates that are only available in current dollars use only the first two terms of the numbering system. For example, the table "Government Current Receipts and Expenditures" is numbered 3.1.

For some tables, a letter suffix following the table number indicates that there are different versions of the table for different time periods; for example, table 4.3A shows the relation of foreign transactions in the NIPAs to the corresponding items in the international transactions accounts for the period 1946–85, and table 4.3B shows the same relation (with additional detail) beginning with 1986.

An "Index to the NIPA Tables," which identifies the NIPA table (or tables) for each NIPA series and each topic covered by the NIPAs, and which includes cross references for commonly used business and economic terms to the appropriate NIPA item, is available on BEA's Web site in the Interactive NIPA table section.

CHAPTER 2: FUNDAMENTAL CONCEPTS

(Updated: October 2016)

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Scope of the Estimates

Production boundary

One of the fundamental questions that must be addressed in preparing the national economic accounts is how to define the production boundary—that is, what parts of the myriad human activities are to be included in or excluded from the measure of the economy's production. According to the international *System of National Accounts* (SNA), "Economic production may be defined as an activity carried out under the control and responsibility of an institutional unit that uses inputs of labour, capital, and goods and services to produce outputs of goods or services. There must be an institutional unit that assumes responsibility for the process of production and owns any resulting goods or knowledge-capturing products produced or is entitled to be paid, or otherwise compensated, for the change-effecting or margin services provided."[1]

[1] Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, and the World Bank, *System of National Accounts 2008*: 6.24 at http://unstats.un.org/unsd/nationalaccount/SNA2008.asp.

Under this definition, certain natural processes may be included in or excluded from production, depending upon whether they are under the ownership or control of an entity in the economy. For example, the growth of trees in an uncultivated forest is not included in production, but the harvesting of the trees from that forest is included.

The general definition of the production boundary may then be restricted by functional considerations. In the SNA (and in the U.S. accounts), certain household activities—such as housework, do-it-yourself projects, and care of family members—are excluded, partly because by nature these activities tend to be self-contained and have limited impact on the rest of the economy and because their inclusion would affect the usefulness of the accounts for long-standing analytical purposes, such as business cycle analysis.[2]

In the U.S. economic accounts, the production boundary is further restricted by practical considerations about whether the productive activity can be accurately valued or measured. For example, illegal activities, such as gambling and prostitution in some states, should in principle be included in measures of production. However, these activities are excluded from the U.S. accounts because they are by their very nature conducted out of sight of public scrutiny and so data are not available to measure them.

Asset boundary

In general, the boundary for assets in the U.S. economic accounts is comparable to that for production. According to the SNA, assets "are entities that must be owned by some unit, or units, and from which economic benefits are derived by their owner(s) by holding or using them over a period of time."[3] Economic assets may be either financial assets or nonfinancial assets. Financial assets consist of all financial claims—that is, the payment or series of payments due to a creditor by a debtor under the terms of a liability—shares or other equity in corporations plus gold bullion held by monetary authorities as a reserve asset.[4] These assets are covered in the financial accounts of the United States, which are maintained by the Federal Reserve Board.

Two broad categories of nonfinancial assets are identified. *Produced assets* are assets that have come into existence as a result of a production process. The three types of produced assets are the following: fixed assets, inventories, and valuables such as precious metals that are primarily held as stores of value. *Nonproduced assets* are assets that arise from means other than a production process; a primary example is naturally occurring resources, such as mineral deposits and uncultivated forests.[5]

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[2] SNA 2008: 6.28–6.29. See also Benjamin Bridgeman *et al*, "Accounting for Household Production in the National Accounts," *Survey of Current Business* 92 (May 2012): 23–36.
[3] SNA 2008: 1.46.
[4] SNA 2008: 11.7–11.8.
[5] BEA does not prepare estimates of the stocks of nonproduced assets, though it does prepare estimates of net purchases and sales of these assets. However, in the mid-1990s, BEA developed an analytical framework for a set of environmental accounts along with prototype estimates for the value of the stocks of mineral resources. See "Integrated Economic and Environmental Satellite Accounts," *Survey* 74 (April

At present, BEA prepares estimates of capital stocks for private and government fixed assets, for inventories owned by private business, and for consumer durable goods (which are included in BEA's fixed assets and consumer durable goods accounts).[6]

- Fixed assets are produced assets that are used repeatedly, or continuously, in the processes of production for more than 1 year. BEA's estimates of fixed assets cover structures, equipment, and intellectual property products, but not cultivated assets such as livestock or orchards. The acquisition of fixed assets by private business is included in the NIPA measure "gross private domestic investment," and the acquisition of fixed assets by government is included in the NIPA measure "government consumption expenditures and gross investment." The depreciation of fixed assets—that is, the decline in their value due to physical deterioration, normal obsolescence, and accidental damage except that caused by a catastrophic event—is captured in the NIPA measure "consumption of fixed capital."[7]
- The stock of private inventories consists of materials and supplies, work in process, finished goods, and goods held for resale. The change in private inventories is included in the NIPA measure "gross private domestic investment."
- Consumer durable goods are tangible commodities purchased by consumers that can be used repeatedly or continuously for a prolonged period (for example, motor vehicles). Purchases of these goods are included in the NIPA measure "personal consumption expenditures."

Thus, in the NIPAs, acquisitions of fixed assets by private business and by government are treated as investment, but acquisitions of consumer durable goods by households are treated as consumption expenditures rather than as investment.[8]

Sometimes, the asset boundary may change as a result of changes in definition or in the ability to measure or value an asset. For example, in the 2013 comprehensive update of the NIPAs, BEA introduced two major changes that broadened the definition of fixed investment and thus expanded the boundary of its capital stock estimates. First, BEA began treating expenditures by business, government, and nonprofit institutions serving households for research and development as fixed investment. Second, BEA began treating expenditures by business and nonprofit institutions serving households on

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1994): 33–49; and "Accounting for Mineral Resources: Issues and BEA's Initial Estimates," *Survey* 74 (April 1994): 50–72.

[6] See "Fixed Asset Tables," www.bea.gov/national/FA2004/index.asp; see also "Methodology," *Fixed Assets and Consumer Durable Goods in the United States, 1925–97*, September 2003, go to www.bea.gov and click on "National," then on "Methodologies," and then on "Fixed Assets and Consumer Durable Goods."

[7] In the 2009 comprehensive update, BEA introduced a new treatment of disasters in which the value of irreparable damage to, or the destruction of, fixed assets is no longer recorded as consumption of fixed capital; see Eugene P. Seskin and Shelly Smith, "Preview of the 2009 Comprehensive Revision of the NIPAs: Changes in Definitions and Presentations," *Survey* 89 (March 2009): 11–15.

[8] However, estimates of the stocks of consumer durables are included in household balance sheets in the Federal Reserve Board's financial accounts of the United States as well as in BEA's capital stock estimates.

entertainment, literary, and other artistic originals as fixed investment. These changes recognize that these intangible assets have ownership rights, are long-lasting, and are used in the production process. Private investment in research and development and in entertainment originals, along with that in software (which has been treated as a fixed asset since the 1999 comprehensive NIPA revision), is now shown in the NIPAs in the subcategory "intellectual property products" in nonresidential fixed investment. Similarly, government investment in research and development, along with that in software, is shown in "intellectual property products" in gross government fixed investment.

Also as part of the 2013 comprehensive update, BEA began recognizing as capital investment *all* of the nonfinancial ownership transfer costs that are associated with the purchase of a residential asset. These costs include title insurance; title, abstract, and attorney fees; payments for state and local government documentary and stamp taxes; and payments for surveys and engineering services; as well as the previously capitalized brokers' commissions on the sale of residential structures.[9]

Market and nonmarket output

The output that is included in the economic accounts is classified as "market," "produced for own use," or "nonmarket." Most production and distribution takes place within the market economy—that is, goods and services are produced for sale at prices that are "economically significant."[10] Thus, the current market price of the produced good or service provides a rational and viable basis for valuing this production.

Output for own final use consists of goods and services that are retained by the owners of the enterprises that produced them. Such output includes food produced on farms for own consumption, special tools produced by engineering firms for own use, and specialized software developed or improved in-house rather than purchasing custom-made software from a software development company. Goods or services produced for own final use are valued at the market prices of similar products or by their costs of production.[11]

Nonmarket output consists of goods and of individual or collective services that are produced by nonprofit institutions and by government that are supplied for free or at prices that are not economically significant. Individual services, such as education and health services, are provided at below-market prices as a matter of social or economic policy. Collective services, such as maintenance of law and order and protection of the environment, are provided for the benefit of the public as a whole and are financed out of

[9] For more information on these changes, see "Preview of the 2013 Comprehensive Revision of the National Income and Product Accounts: Changes in Definitions and Presentations," *Survey* 93 (March 2013): 13–21.
[10] Prices are "economically significant" when they have a significant influence on the amounts the producers are willing to supply and on the amounts the purchasers are willing to buy; see SNA 2008: 6.95.
[11] See SNA 2008: 6.114, 6.124–6.125.

funds other than receipts from sales. The values of the nonmarket output of nonprofits and of government are estimated based on the costs of production.[12]

In the NIPAs, a number of *imputations* for own-use and nonmarket transactions are made in order to include in the accounts the value of certain goods and services that have no observable price and are often not associated with any observable transaction.[13] Additionally, imputations keep the accounts invariant to how certain activities are carried out (for example, an employee may be paid either in cash or in kind).[14] Both a measure of production and the incomes associated with that production are imputed (for example, the imputation for food furnished to employees is included in PCE and in personal income).

The largest NIPA imputation is that made to approximate the value of the services provided by owner-occupied housing. This imputation is made so that the treatment of owner-occupied housing in the accounts is comparable to that for tenant-occupied housing (which is valued by rent paid), thereby keeping GDP invariant as to whether a house is owned or rented. In the NIPAs, the purchase of a new house (excluding the value of the unimproved land) is treated as an investment, the ownership of the home is treated as a productive enterprise, and a service is assumed to flow, over its economic life, from the house to the occupant. For the homeowner, the value of this service is measured as the income the homeowner could have received if the house had been rented to a tenant.

Another large imputation is that made to account for services (such as checking-account maintenance and loan services to borrowers) provided by banks and other financial institutions either without charge or for a small fee that does not reflect the entire value of the service. For the depositor, this "imputed interest" is measured as the difference between the interest paid by the bank and the interest that the depositor could have earned by investing in "safe" government securities (referred to as the "reference rate"). For the borrower, it is measured as the difference between the interest charged by the bank and the interest the bank could have earned by investing in those government securities.[15]

Geographic coverage

Another important consideration is the geographic boundary that defines what is included in the accounts. In the NIPAs, and in the industry accounts, the "U.S. estimates" cover the 50 states, the District of Columbia, and U.S. military installations, embassies,

[12] See SNA 2008: 6.128–6.129.
[13] The SNA reserves the term "imputation" for situations in which a transaction must be "constructed" as well as "valued." See SNA 2008: 3.75.
[14] For a complete list of the NIPA imputations, see NIPA table 7.12, "Imputations in the National Income and Product Accounts"; go to BEA's website at www.bea.gov, and click on "National," and then on "Interactive Tables."
[15] In the 2013 comprehensive update of the NIPAs, BEA introduced improved methods for measuring the implicitly priced services provided by commercial banks (see Kyle K. Hood, "Measuring the Services of Commercial Banks in the National Income and Product Accounts: Changes in Concepts and Methods in the 2013 Comprehensive Revision," *Survey* 93 (February 2013): 8–19).

and consulates abroad. This treatment aligns gross domestic product (GDP), the principal measure of U.S. production, with other U.S. statistics, such as population and employment. In BEA's International Transactions Accounts (ITAs), the U.S. territories, Puerto Rico, and the Northern Mariana Islands are also treated as part of the domestic economy. This geographic difference between the two sets of accounts is reconciled through a "territorial adjustment."[16]

In the NIPAs, a distinction is made between "domestic" measures and "national" measures. Domestic measures cover activities that take place within the geographic borders of the United States, while national measures cover activities that are attributable to U.S. residents.[17] Thus, domestic measures are concerned with where an activity takes place, while national measures are concerned with to whom the activity is attributed. For example, GDP measures the market value of the goods, services, and structures produced within the nation's economy in a given period, while gross national product (GNP) measures the market value of the goods, services, and structures produced by labor and property supplied by U.S. residents. GNP is equal to GDP plus income receipts from the rest of the world less income payments to the rest of the world, and it is conceptually equivalent to gross national income (though it is estimated using different source data). Thus, for an assembly plant that is owned by a Japanese auto company and located in the United States, all of its output is included in GDP, but only the portion of the value that reflects U.S. residents' labor and property is included in GNP. And, for an assembly plant that is owned by a U.S. auto company and located in Great Britain, none of its output is included in GDP, but the portion of the value that reflects U.S. residents' labor or property is included in GNP.

Income and saving

Some economic theorists have broadly defined income as the maximum amount that a household, or other economic unit, can consume without reducing its net worth;

[16] See NIPA table 4.3B, "Relation of Foreign Transactions in the National Income and Product Accounts to the Corresponding Items in the International Transactions Accounts." Effective with the 2009 comprehensive update, BEA includes most transactions between the U.S. government and economic agents in Guam, American Samoa, the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands in federal government receipts and expenditures. Thus, like private transactions (such as trade in goods and services), government transactions with these areas are treated as transactions with the rest of the world. BEA's long-run goal is to make the geographic coverage in the NIPAs consistent with that in the ITAs (see Seskin and Smith, 15–16). See also Aya Hamano, "BEA Briefing: GDP for American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands," *Survey* 91 (September 2011): 41–49.

[17] "U.S. residents" includes individuals, governments, business enterprises, trusts, associations, nonprofit institutions, and similar organizations that have the center of their economic interest in the United States and that reside or expect to reside in the United States for 1 year or more. (For example, business enterprises residing in the United States include U.S. affiliates of foreign companies.) In addition, U.S. residents include all U.S. citizens who reside outside the United States for less than 1 year and U.S. citizens residing abroad for 1 year or more who meet one of the following criteria: owners or employees of U.S. business enterprises who reside abroad to further the enterprises' business and who intend to return within a reasonable period; U.S. government civilian and military employees and members of their immediate families; and students who attend foreign educational institutions.

saving is then defined as the actual change in net worth.[18] In the NIPAs, the definition of income is narrower, reflecting the goal of measuring current production. That is, the NIPA aggregate measures of current income—gross domestic income (GDI) for example—are viewed as arising from current production, and thus they are theoretically equal to their production counterparts (GDI equals GDP). NIPA saving is measured as the portion of current income that is set aside rather than spent on consumption or related purposes.

Consequently, the NIPA measures of income and saving exclude the following items that affect net worth but are not directly associated with current production:

- Capital gains or losses, or holding gains (or losses), which reflect changes in the prices of existing assets and thus do not represent changes in the real stock of produced assets;
- Capital transfers, which reflect changes in the ownership of existing assets; and
- Events, such as natural disasters, that result in changes in the real stock of existing assets but do not reflect an economic transaction.

Thus, for example, the NIPA estimate of personal income includes ordinary dividends paid to stockholders, but it excludes the capital gains that accrue to those stockholders as a result of rising stock prices. Personal saving is equal to personal income less personal outlays and personal taxes; it may generally be viewed as the portion of personal income that is used either to provide funds to capital markets or to invest in real assets such as residences.[19]

GDP and Other Major NIPA Measures

Three ways to measure GDP

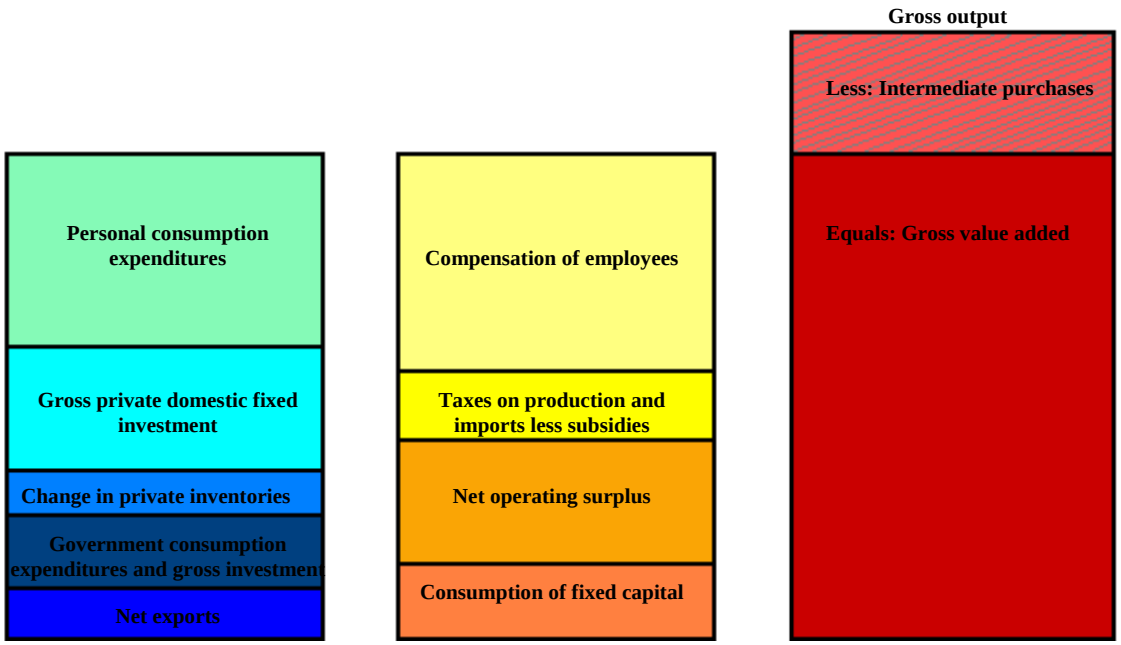
In the NIPAs, GDP is defined as the market value of the goods, services, and structures produced by the economy in a given period. Conceptually, this measure can be arrived at by three separate means: as the sum of goods and services sold to final users, as the sum of income payments and other costs incurred in the production of goods and services, and as the sum of the value added at each stage of production (chart 2.1). Although these three ways of measuring GDP are conceptually the same, their calculation may not result in identical estimates of GDP because of differences in data sources, timing, and estimation techniques.

1. As the sum of goods and services sold to final users. This measure, known as the *expenditures approach*, is used to identify the goods and services purchased by persons, businesses, governments, and foreigners. It is calculated by summing the following final expenditures components.

[18] Other theorists have limited this definition to expected income, a definition that would include regular capital gains but would exclude an unexpected windfall, such as a jackpot lottery payoff.
[19] See "Alternative Measures of Personal Saving," *Survey* 92 (March 2012): 23–26.

- *Personal consumption expenditures*, which measures the value of the goods and services purchased by, or on the behalf of, persons—that is, households, nonprofit institutions that primarily serve households, private noninsured welfare funds, and private trust funds.
- *Gross private fixed investment*, which measures additions and replacements to the stock of private fixed assets without deduction of depreciation. Nonresidential fixed investment measures investment by businesses and nonprofit institutions in nonresidential structures, equipment, and intellectual property products. Residential fixed investment measures investment by businesses and households in residential structures and equipment, primarily new construction of single-family and multifamily units.
- *Change in private inventories*, which measures the value of the change in the physical volume of inventories owned by private business over a specified period, valued in the average prices of that period.
- *Net exports of goods and services*, which is calculated as exports less imports. Exports consist of goods and services that are sold, given away, or otherwise transferred by U.S. residents to foreign residents. Imports consist of goods and services that are sold, given away, or otherwise transferred by foreign residents to U.S. residents.
- *Government consumption expenditures and gross investment*, which comprises two components. Current consumption expenditures consists of the spending by general government in order to produce and provide goods and services to the public. Gross investment consists of spending by both general government and government enterprises for fixed assets (structures, equipment, and intellectual property products) that benefit the public or that assist government agencies in their productive activities.

Chart 2.1—Three Ways to Measure GDP



GDP = **GDI** = **Gross Value Added**

GDP: The sum of final expenditures

GDI: The sum of income payments and costs incurred in production

Gross Value Added: The sum of gross value added—gross output less intermediate purchases—across all private industries and government

Thus, GDP is equal to personal consumption expenditures (PCE) plus gross private domestic fixed investment plus change in private inventories plus government consumption expenditures and gross investment plus exports minus imports. In this calculation, imports offset the non-U.S. production that is included in the other final-expenditure components. For example, PCE includes expenditures on imported cars as well on domestically produced cars; thus, in order to properly measure *domestic* production, the sales of foreign-produced cars that are included in PCE are offset by a comparable entry in the imports of these cars.[20]

2. As the sum of income payments and other costs incurred in the production of goods and services. This measure, known as the *income approach*, is used to examine the purchasing power of households and the financial status of businesses. The aggregate measure, referred to as GDI, is derived by summing the following components.

- *Compensation of employees*, which is the total remuneration of employees in return for their work. It consists of wages and salaries (primarily the monetary remuneration of employees) and supplements (employer contributions for employee pension and insurance funds and employer contributions for government social insurance).

[20] The offset covers the foreign-produced portion of the value of these sales; the domestic value-added (such as the margin provided by domestic dealerships) on imported cars is measured by the difference between the two and is included in GDP.

- *Taxes on production and imports*, which consist of taxes payable on products when they are produced, delivered, sold, transferred, or otherwise disposed of by their producers (including federal excise taxes, custom duties, and state and local sales taxes) and of other taxes on production, such as taxes on ownership of assets used in production (including local real estate taxes). These taxes do not include taxes on income.
- *Subsidies*, which are subtracted in the calculation of GDI, are payments by government agencies to private business (for example, federal subsidies to farmers) and to government enterprises (for example, federal subsidies to state and local public housing authorities) to support their current operations.
- *Net operating surplus*, which is a profits-like measure that shows the incomes earned by private and government enterprises from current production before deducting any explicit or implicit interest charges, rent, or other property incomes payable on financial assets, land, or other natural resources required to carry out production. Net operating surplus plus consumption of fixed capital is equal to *gross operating surplus*.
- *Consumption of fixed capital*, which is the NIPA measure of economic depreciation—that is, the decline in the value of the stock of assets due to physical deterioration, normal obsolescence, and accidental damage except that caused by a catastrophic event.[21]

Thus, GDI is equal to compensation of employees, plus taxes on production and imports less subsidies, plus net operating surplus, plus consumption of fixed capital. Subsidies are implicitly included in the measure of net operating surplus, but because they do not represent incomes paid or costs incurred in domestic production, they must be subtracted in calculating GDI. In the NIPAs, subsidies are shown as a subtraction from "taxes on imports and production" because they are transfers from government to business and thus, in effect, represent a negative tax by government.

3. As the sum of "value added" by all industries in the economy. This measure, known as the *value-added, or production, approach*, is used to analyze the industrial composition of U.S. output. In the input-output (I-O) accounts, value added is defined as the difference between an industry's gross output (sales or receipts plus other operating income and inventory change) and its intermediate inputs (goods and services that are used in production). When value added is aggregated across all industries in the economy, industry sales to and purchases from each other cancel out, and the remainder is industry sales to final users, or GDP.[22]

[21] In the 2009 comprehensive update, BEA introduced a new treatment of disasters in which the value of irreparable damage to, or the destruction of, fixed assets is no longer recorded as consumption of fixed capital; see Eugene P. Seskin and Shelly Smith, 11–15.
[22] In the I-O accounts, "all industries" includes government industries (such as the U. S. Postal Service) and certain "special industries" (such as owner-occupied housing).

The I-O accounts focus on gross output because they are designed to measure the productive activities and interrelationships of all industries, regardless of whether the goods and services produced by these industries are for intermediate or for final use.

Thus, gross output is sometimes referred to as "gross duplicated domestic output," because it double-counts the industry output that is purchased by other industries and used as inputs for their production. Because GDP counts only industry sales to final users, it is sometimes referred to as a "nonduplicative" measure of production in the economy.

To illustrate, a new car shipped from an auto assembly plant reflects not only the costs and profit associated with final assembly but also the costs and profit associated with all of the stages of production that preceded final assembly. At an earlier stage, the tires that were put on that car were recorded as output of the tire plant and reflected the costs and profit associated with their manufacture. Thus, in gross output, the value of the tires is counted twice—once in the value of the auto manufacturer's output and once in the value of the tire manufacturer's output. Further, including the value of the rubber and metal that were shipped to the tire plant would constitute triple counting, and so on. In contrast, in the measurement of auto-industry value added, the value of the tires shipped to the assembly plant represents an intermediate input and so is subtracted from the value of the shipments of completed cars from the assembly plant.

Because the nation's total value added is equal to its GDP and the nation's total gross output is equal to its GDP plus its total intermediate inputs, total gross output is much larger than GDP. For example, in the 2007 benchmark year, U.S. gross output was $26.2 trillion, while GDP was $14.5 trillion.

Major NIPA aggregates

In the NIPAs, the measure of domestic production that is derived as the sum of the final expenditures components is referred to as GDP, and the measure that is derived as the sum of the income payments and the costs incurred in production is referred to as GDI. These two measures and their components make up the "Domestic Income and Product Account," the first of the summary NIPA accounts (see the section "Accounting Framework"). In general, the source data for the expenditures components are considered more reliable than those for the income components, and the difference between the two measures is called the "statistical discrepancy."[23]

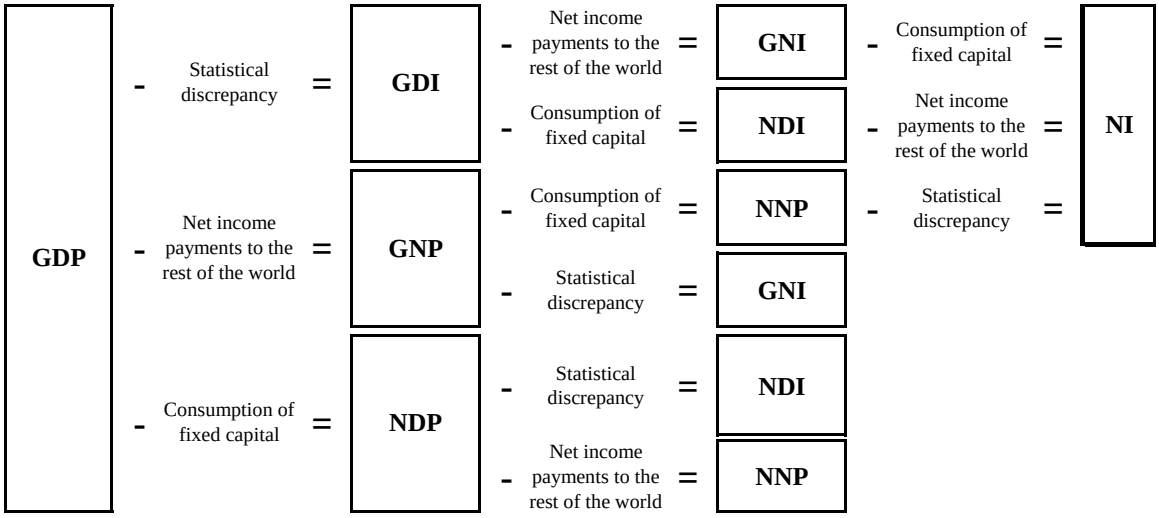
BEA also provides the equally-weighted mathematical average of GDP and GDI, as a number of reliability studies concluded that the average of these measures would better reflect the economic growth in a particular period by diminishing the known measurement inconsistencies between the two statistics, such as timing differences, gaps

[23] See Dylan G. Rassier, "The Role of Profits and Income in the Statistical Discrepancy," *Survey* 92 (February 2012): 8–22.

in underlying source data, and survey measurement errors.[24] The average of GDP and GDI is also one of the macroeconomic indicators used by the National Bureau of Economic Research's business cycle dating commission when determining turning points in the U.S. business cycle. Chart 2.2 illustrates the relationships between GDP, GDI, and several other important aggregate NIPA measures. These measures are distinguished by whether they are "product" or "income," "gross" or "net," and "domestic" or "national." In general, one moves

- from a "product" measure to an "income" measure by subtracting the statistical discrepancy,
- from a "gross" measure to a "net" measure by subtracting consumption of fixed capital (CFC), and
- from a "domestic" measure to a "national" measure by subtracting net income payments to the rest of the world (or equivalently, by adding net income receipts from the rest of the world).[25]

Chart 2.2—Relationships Between Major NIPA Measures of Income and Product



GDI Gross domestic income
GDP Gross domestic product
GNI Gross national income
GNP Gross national product
NDI Net domestic income
NDP Net domestic product
NI National income
NNP Net national product

[24] The average of GDP and GDI was introduced as part of the 2015 annual update of the NIPAs. For more on the reliability studies, see Dennis J. Fixler, Ryan Greenaway-McGrevy, and Bruce T. Grimm, "The Revisions to GDP, GDI, and Their Major Components," Survey of Current Business 94 (August 2014) and William D. Nordhaus, "Income, Expenditures, and the 'Two Map Problem'" (paper presented at the BEA Advisory Committee Meeting, Washington, DC, November 2011).

[25] Net income payments to the rest of the world is equal to current payments to the rest of the world (primarily income paid to foreign residents on investments in U.S. assets) less current receipts from the rest of the world (primarily income received by U.S. residents on investments in assets abroad).

Gross national product (GNP), which was discussed earlier in this chapter (see the section "Geographic coverage"), is equal to GDP minus net income payments to the rest of the world.

Net domestic product (NDP) is a measure of how much of the nation's output is available for consumption or for adding to the nation's wealth. It is equal to GDP minus CFC.

Gross national income (GNI) measures the costs incurred and the incomes earned in the production of GNP. It is equal to GNP minus the statistical discrepancy. It is also equal to GDI minus net income payments to the rest of the world.

Net national product (NNP) is the net market value of goods and services produced by labor and property supplied by U.S. residents (see the earlier description of GNP). It is equal to GNP minus CFC. It is also equal to NDP minus net income payments to the rest of the world.

Net domestic income (NDI) measures the costs incurred and the incomes earned in the production of NNP. It is equal to NNP minus the statistical discrepancy. It is also equal to GDI minus CFC.

National income is the sum of all net incomes earned in production (and thus it could also be termed "net national income"). It is equal to GNI minus CFC, NNP minus the statistical discrepancy, and NDI minus net income payments to the rest of the world. It is also equal to the sum of compensation of employees, proprietors' income with inventory valuation adjustment (IVA) and capital consumption adjustment (CCAdj), rental income with CCAdj, corporate profits with IVA and CCAdj, net interest and miscellaneous payments, taxes on production and imports less subsidies, business current transfer payments (net), and current surplus of government enterprises.

The following are several other important NIPA aggregates.

Personal income is the income that persons receive in return for their provision of labor, land, and capital used in current production, plus current transfer receipts less contributions for government social insurance (domestic).[26] Personal income is equal to national income minus corporate profits with IVA and CCAdj, taxes on production and imports less subsidies, contributions for government social insurance, net interest and miscellaneous payments on assets, business current transfer payments (net), and current surplus of government enterprises, plus personal income receipts on assets and personal current transfer receipts.[27]

[26] "Persons" consists of households, nonprofit institutions that primarily serve households, private noninsured welfare funds, and private trust funds.
[27] For more information, see *State Personal Income 2005 Methodology* at www.bea.gov/regional/docs/spi2005.

Gross domestic purchases is the market value of goods and services purchased by U.S. residents, regardless of where those goods and services were produced. It is equal to GDP minus net exports. It is also equal to the sum of PCE, gross private domestic investment, and government consumption expenditures and gross investment.

Final sales of domestic product is equal to GDP less change in private inventories. It is also equal to the sum of PCE, gross private fixed investment, government consumption expenditures and gross investment, and net exports of goods and services.[28]

Final sales to domestic purchasers is equal to gross domestic purchases less change in private inventories. It is also equal to the sum of PCE, gross private fixed investment, and government consumption expenditures and gross investment.

Final sales to private domestic purchasers is equal to final sales to domestic purchasers less government consumption expenditures and gross investment. It is also equal to the sum of PCE and private fixed investment. As this measure excludes the more volatile components of GDP, such as net exports and government spending, it reflects the more persistent movements in spending by consumers and businesses in the United States.[29]

Principal quantity and price measures

The market values and imputations used to measure GDP and the other NIPA estimates are in current dollars—that is, they reflect transactions in terms of their value in the periods in which they take place. Although many technical problems arise in preparing these estimates, measuring the change in current-dollar GDP from one period to the next is conceptually straightforward, because it is the actual change in spending that occurs in the economy between the two time periods.

For many analyses, it is useful to separate the changes in current-dollar GDP that are due to changes in quantity from those that are due to changes in price.[30] However, aggregate quantity change and aggregate price change cannot be observed directly in the economy. Instead, these changes must be calculated, and the calculation method is determined by analytic requirements. In the NIPAs, the changes in quantities and prices are computed from chain-type indexes that are calculated using a Fisher formula. (For a

[28] While analytically useful, the interpretation of final sales of domestic product is complicated by the fact that additions to inventories come from both domestic production and imports. Source data are not available to distinguish the portion of imported goods that flows into inventories from the portion that is sold directly, so the measure does not, strictly speaking, identify the sales from domestic product.
[29] This measure was introduced as part of the 2015 annual update of the NIPAs; see Stephanie McCulla and Shelly Smith, "Preview of the 2015 Annual Revision of the National Income and Product Accounts," *Survey of Current Business* 95 (June 2015): 1-8.
[30] In this separation, changes in the quality of the goods and services provided are treated as changes in quantity; BEA uses quality-adjusted price indexes to deflate goods and services to yield quantity estimates; these indexes are described in the appendix to chapter 4.

discussion of the statistical methods used to prepare these measures, see "Chapter 4: Estimating Methods.")

In the NIPAs, the featured measure of growth in the U.S. economy is the *percent change in real GDP*—that is, the quantity-change measure for GDP from one period to another.[31] Thus, changes in real GDP provide a comprehensive measure of economic growth that is free of the effects of price change.

In the NIPAs, the featured measure of inflation in the U.S. economy is the *percent change in the price index for gross domestic purchases*. This index measures the prices of goods and services purchased by U.S. residents, regardless of where the goods and services were produced. It is derived from the prices of PCE, gross private domestic investment, and government consumption expenditures and gross investment. Thus, for example, an increase in the import price of a foreign-produced car would raise the prices paid by U.S. residents and thereby directly affect the price index for gross domestic purchases.[32]

Another aggregate price measure is the GDP *price index*, which measures the prices of goods and services produced in the United States. In contrast to the price index for gross domestic purchases, the GDP price index would not be directly affected by an increase in the import price of a foreign-built car, because imports are not included in GDP.

Another important NIPA price measure is the *PCE price index*, which measures the prices paid for the goods and services purchased by "persons." This index is frequently compared with the consumer price index, which is produced by the Bureau of Labor Statistics. The two indexes are similar, but there are differences in terms of coverage, weighting, and calculation.[33]

Further, BEA provides variants of the above price indexes that exclude their particularly volatile food and energy components. These variants are sometimes used to indicate the "core inflation" in the U.S. economy.

BEA publishes several aggregate measures of real income as counterparts to its aggregate measures of real production. *Real GDI* is calculated as current-dollar GDI deflated by the implicit price deflator (IPD) for GDP; *real GNI* is calculated as current-dollar GNI deflated by the IPD for GNP; and *real net domestic income* is calculated as current-dollar net domestic income deflated by the IPD for net domestic product.[34]

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[31] Until 1991, GNP was the featured measure of U.S. production; see "Gross Domestic Product as a Measure of U.S. Production," *Survey* 71 (August 1991): 8.

[32] This example assumes the entire price increase is passed on to the car buyer—that is, the wholesale or retail margins are unchanged.

[33] See Clinton P. McCully, Brian C. Moyer, and Kenneth J. Stewart, "Comparing the Consumer Price Index and the Personal Consumption Expenditures Price Index," *Survey* 87 (November 2007): 26–33.

[34] Implicit price deflators for an aggregate or component are calculated as the ratio of the current-dollar value to the corresponding chained-dollar value, multiplied by 100 (see the section "Chained-dollar measures" in chapter 4).

In addition, BEA prepares alternative measures of real GDP and real GNP that measure the real purchasing power of the income generated from the production of the goods and services by the U.S. economy. These measures, which in the NIPAs are called *command-basis GDP* and *command-basis GNP*, reflect the impact of changes in the terms of trade as well as changes in production (BEA also prepares alternative command-basis measures of NNP and NDP).[35] In calculating command-basis GDP, exports and imports of goods and services are each deflated by the price index for gross domestic purchases to yield exports on a command-basis and imports on a command basis; then, command-basis exports are added to, and command-basis imports are subtracted from, real gross domestic purchases.[36] The calculation of command-basis GNP is the same, except income receipts from the rest of the world are deflated along with exports, and income payments to the rest of the world are deflated along with imports.[37] In effect, the calculations are the same as deriving command-basis GDP (GNP) by deflating current-dollar GDP (GNP) by the price index for gross domestic purchases. Thus, the command-basis measures are alternative measures of real GDP and real GNP that reflect the prices of purchased goods and services, while the primary measures of real GDP and real GNP reflect the prices of produced goods and services.

BEA also prepares several measures that show the relationship between the prices that are received by U.S. producers and the prices that are paid by U.S. purchasers. The broadest measure, the *trading gains index*, is the ratio of the GDP price index to the price index for gross domestic purchases. An increase (decrease) in this ratio would indicate an increase (decrease) in the purchasing power of the income generated in producing GDP. Successively narrower measures specifically focus on the relationship between the prices of the U.S. goods and services that are produced for consumption by the rest of the world and the prices of the goods and services that are produced by the rest of the world for U.S. consumption. The *terms of trade index*, is the ratio of the price index for exports of goods and services to the price index for imports of goods and services; ratios for the terms of trade in goods and in nonpetroleum goods are also prepared. Movements in these trading indexes reflect the interaction of several factors—including movements in exchange rates, changes in the composition of traded goods and services, and changes in producers' profit margins.

In addition, BEA provides statistical measures that supplement the current-dollar, quantity-index, and price-index measures. Foremost among these are measures of the contributions of major components to the percent change from the preceding year or

[35] In the SNAs, these measures are referred to as real GDI and real GNI. However, as noted in the preceding paragraph, BEA uses a different method to derive those aggregates.
[36] In this case, adding and subtracting these estimates is acceptable because all three aggregates are derived using the same deflator.
[37] This methodology for calculating the command-basis aggregates was introduced in the 2010 annual update of the NIPAs; see Eugene P. Seskin and Shelly Smith, "Annual Revision of the National Income and Product Accounts," *Survey* 90 (August 2010): 21. For additional technical and historical background, see Marshall B. Reinsdorf, "Terms of Trade Effects: Theory and Measurement," *Review of Income and Wealth* 56 (June 2010): S177-S205.

quarter in real GDP, in other principal product-side aggregates, in GDP prices, and in gross domestic purchases prices. BEA also provides measures of the percentage shares of current-dollar GDP and GDI that are accounted for by their major components.

Classification

The application of common classification systems for the NIPAs, and for all of the U.S. economic accounts, is extremely important because classification provides the structure necessary to prepare and present the estimates uniformly and consistently. Further, common classifications enable users to effectively compare and analyze data across the broad spectrum of economic statistics.

In the NIPAs, the estimates of production and expenditures may be classified by sector, by type of product, and by function, while the estimates of income may be classified by industry and by legal form of organization.

Sector

For measuring domestic production in the NIPAs, the contribution, or value added, of various institutions can be broken down into three distinct groups, or sectors—business, households and institutions, and general government (table 2.1). A fourth sector, referred to as "the rest-of-the-world," covers transactions between U. S. residents and foreign residents.

Table 2.1—Gross Value Added by Sector

Gross domestic product
Business
Nonfarm
Farm
Households and institutions
Households
Nonprofit institutions serving households
General government
Federal
State and local
Note. Adapted from NIPA table 1.3.1.

Business: The business sector comprises all corporate and noncorporate businesses that are organized for profit, other entities that produce goods and services for sale at a price that is based on the costs of production, and certain other entities that are treated as businesses in the NIPAs. These other entities include mutual financial institutions, noninsured pension funds, cooperatives, nonprofit organizations (that is, entities classified as nonprofit by the Internal Revenue Service in determining income tax

liability) that primarily serve business, federal reserve banks, federally sponsored credit agencies, and government enterprises. The gross value added of the business sector is measured as GDP less the gross value added of households and institutions and of general government.[38]

Households and institutions: The households and institutions sector comprises households (families and unrelated individuals) and nonprofit institutions serving households (NPISHs). The gross value added of households is measured by the services of owner-occupied housing and the compensation paid to domestic workers. The gross value added of NPISHs is measured by the compensation paid to the employees of these institutions, the rental value of fixed assets owned and used by these institutions, and the rental income of persons for tenant-occupied housing owned by these institutions.[39]

General government: The general government sector comprises all federal government and state and local government agencies except government enterprises. The gross value added of general government is measured as the sum of the compensation of the employees of these agencies and of their consumption of fixed capital.

Type of product

In the NIPAs, classifications by type of product—goods, services, and structures—are presented for GDP and for the components of final sales of domestic product (table 2.2).[40]

Table 2.2—Gross Domestic Product by Major Type of Product

Gross domestic product
Final sales of domestic product
Change in private inventories
Goods
Final sales
Change in private inventories
Durable goods
Final sales
Change in private inventories
Nondurable goods
Final sales
Change in private inventories

[38] Measures of gross value added for financial and for nonfinancial corporations are also shown in the NIPA tables. They are calculated based on the costs incurred and the incomes earned from production.
[39] For more information on NPISHs, see the technical note in "Chapter 5: Personal Consumption Expenditures."
[40] Development of the North American Product Classification System (NAPCS), the commodity counterpart to the North American Industry Classification System (see the section "Industry") by the United States, Canada, and Mexico is ongoing. NAPCS is designed to be an integrated and comprehensive list of products, product definitions, and product codes organized using a demand-side, market-oriented classification framework for both goods and services.

Services
Structures
Note. Adapted from NIPA table 1.2.1.

Goods consists primarily of tangible products that can be stored or inventoried, but this category also includes certain intangibles, such as intellectual property products.

Services are products, such as medical care, that cannot be stored and are usually consumed at the place and time of their purchase. Government consumption expenditures, which are for services produced by government, are included in this category.[41] By convention, goods purchased by U.S. residents abroad are also included.

Structures are products—such as commercial buildings, highways, dams, and single-family houses—that are usually constructed at the location where they will be used and that typically have long economic lives.

Function

"Functional" classifications identify the purposes or objectives for which expenditures are made. In the NIPAs, functional breakdowns of expenditures are provided for PCE and for government expenditures.

For PCE, expenditures by function are classified into the following broad categories (table 2.3).[42] These classifications are largely consistent with the SNA "Classification of Individual Consumption by Purpose" (COICOP).[43]

Table 2.3—Personal Consumption Expenditures by Function

Personal consumption expenditures
Food and beverages purchased for off-premises consumption
Clothing, footwear, and related services
Housing, utilities, and fuels
Furnishings, household equipment, and routine household maintenance
Health
Transportation
Communication
Recreation
Education

[41] The value of these services, most of which are not sold in the market, is measured by the cost of inputs: compensation, CFC, and purchased goods and services less own-account investment and sales to other sectors (which are reflected in other final expenditures components, such as PCE).
[42] This classification was introduced in the 2009 comprehensive update; see Clinton P. McCully and Teresita D. Teensma, "Preview of the 2009 Comprehensive Revision of the National Income and Product Accounts: New Classifications for Personal Consumption Expenditures," *Survey* 88 (May 2008): 6–17.
[43] McCully and Teensma, 14.

Food services and accommodations
Financial services and insurance
Other goods and services
Net foreign travel and expenditures abroad by U.S. residents
Final consumption expenditures of nonprofit institutions serving households
Note. Adapted from NIPA table 2.5.5.

The functional classifications for government are largely consistent with the SNA "Classification of the Functions of Government" (COFOG).[44] For the federal government, expenditures are classified into nine categories, and for state and local governments, expenditures are classified into eight categories (national defense is omitted) (table 2.4).

Table 2.4—Government Consumption Expenditures and Gross Investment by Function

Government
General public service
National defense
Public order and safety
Economic affairs
Housing and community services
Health
Recreation and culture
Education
Income security
Note. Adapted from NIPA table 3.15.5.

Industry

The North American Industry Classification System (NAICS) is the official industry classification system for the United States.[45] NAICS was developed during the 1990s through a collaborative effort by the United States, Canada, and Mexico to facilitate better comparisons of the economies of the three countries.[46] Prior to the adoption of NAICS, most U.S. statistics were based on the Standard Industrial Classification (SIC).[47] The SIC system, which was initially developed in the late 1930s,

[44] See Karl Galbraith, "Government Spending by Function: A New Presentation," *Survey* 80 (June 2000): 18–23. See also Bruce E. Baker, Pamela A. Kelly, and Brooks B. Robinson, "Estimates of Real Government Consumption Expenditures and Gross Investment by Function," *Survey* 84 (October 2004): 5–10 and also see SNA 2008: 9.99.

[45] See Office of Management and Budget, *North American Industry Classification System, United States, 2007* (Washington, DC: Bernan Press, 2007); Office of Management and Budget, *North American Industry Classification System, United States, 2002* (Washington, DC: Bernan Press, 2002); and Office of Management and Budget, *North American Industry Classification System, United States, 1997* (Washington, DC: Bernan Press, 1998).

[46] For information of the development and implementation of NAICS, see John Kort, "The North American Industry Classification System in BEA's Accounts," *Survey* 81 (May 2001): 7–13.

[47] See Office of Management and Budget, Statistical Policy Division, *Standard Industrial Classification Manual, 1987* (Washington, DC: U.S. Government Printing Office (GPO), 1988); Office of Management

was concentrated in manufacturing, which dominated the U.S. economy at that time. The switch from the SIC to NAICS provided more detailed classifications for services industries and for high-tech industries. Moreover, by organizing establishments based on their production methods rather than on the products they produced, NAICS provided a better conceptual basis for industrial classification.

NAICS was introduced into the national economic accounts in late 2002 with the release of the 1997 benchmark I-O accounts, which were based on the 1997 Economic Census. Effective with the 2003 comprehensive update, NAICS became the industry classification system for the NIPAs.

In the NIPAs, industrial distributions are presented for national income and most of its components, capital consumption allowances, employment and hours, and the change in private inventories and the stock of private inventories (see, for example, table 2.5 below).[48] For income and employment, the classification of the estimates for 1998 forward is based on NAICS; for inventories, the classification of the estimates for the first quarter of 1997 forward is based on NAICS. In general, the estimates by industry before these dates are on an SIC basis.[49]

Industrial distributions of government activities are not provided; instead, they are combined into a single category. For most series, separate estimates are shown for the activities of the federal government, of state and local governments, and of government enterprises.

Table 2.5—National Income Without Capital Consumption Adjustment by Industry

National income without capital consumption adjustment
Domestic industries
Private industries
Agriculture, forestry, fishing, and hunting
Mining
Utilities
Construction
Manufacturing
Durable goods
Nondurable goods
Wholesale trade
Retail trade
Transportation and warehousing
Information
Finance, insurance, real estate, rental, and leasing
Professional and business services

and Budget, Statistical Policy Division, *Standard Industrial Classification Manual,1972* (Washington, DC: GPO, 1972); and Bureau of the Budget, *Standard Industrial Classification Manual,1942* (Washington, DC: GPO, 1942).

[48] An industrial distribution of fixed investment based on data collected from establishments is prepared as part of the procedure used to estimate fixed assets. For further information, see "Methodology, *Fixed Assets and Consumer Durable Goods in the United States, 1925–97*," September 2003; go to www.bea.gov, and click on "National," then on "Methodologies," and then on "Fixed Assets and Consumer Durable Goods."

[49] NAICS-based estimates for GDP by industry and for fixed assets are available for earlier periods.

Educational services, health care, and social assistance
Arts, entertainment, recreation, accommodation, and food services
Other services, except government
Government
Rest of the world
Note. Adapted from NIPA table 6.1D.

The industrial distributions for wages and salaries and for inventories are generally based on data collected from "establishments," while those for the other NIPA components are generally based on data collected from "companies" (also called "enterprises," or "firms"). Companies consist of one or more establishments owned by the same legal entity or group of affiliated entities. Establishments are economic units, generally at a single physical location, where business is conducted or where services or industrial operations are performed (for example a factory, mill, store, hotel, movie theater, mine, farm, airline terminal, sales office, warehouse, or central administrative office). Establishments are classified into an industry on the basis of their principal production method, and companies are classified into an industry on the basis of the principal industry of all their establishments. Because large multi-establishment companies typically contain establishments that are classified in different industries, the industrial distribution of the same economic activity on an establishment basis can differ significantly from that on a company basis. For example, the measure of corporate profits by steel-manufacturing companies will include the profits of establishments that do not manufacture steel but are part of companies that are classified as steel-manufacturing companies. Similarly, this measure will exclude the profits of establishments that manufacture steel but are part of companies that are not classified as steel-manufacturing companies.

Moreover, individual industry series are not fully comparable over time. First, the composition of industries may change because of revisions to NAICS or to the SIC. This factor affects estimates based on establishment data and on company data. Second, historical comparability may be affected by a change over time in the industrial classification of the same establishment or company. For example, the classification of a company may change as a result of shifts in the level of consolidation of entities for which company reports are filed or as a result of mergers and acquisitions. This factor affects company-based estimates much more than establishment-based estimates.

In addition, some NIPA tables show the following special industry groupings:

Financial industries consists of the NAICS industry "Finance and insurance" and of "Offices of bank holding companies" and "Offices of other holding companies" in the NAICS industry "Management of companies and enterprises." Finance and insurance consists of Federal Reserve banks; credit intermediation and related activities; securities, commodity contracts, and investments; insurance carriers and related activities; and funds, trusts, and other financial vehicles.

Nonfinancial industries consists of all other private industries.

Private goods-producing industries consists of the following NAICS divisions: agriculture, forestry, fishing, and hunting; mining; construction; and manufacturing.

Private services-producing industries consists of the following NAICS divisions: utilities; wholesale trade; retail trade; transportation and warehousing; information; finance and insurance; real estate and rental and leasing; professional, scientific, and technical services; management of companies and enterprises; administrative and waste management services; educational services; health care and social assistance; arts, entertainment, and recreation; accommodation and food services; and other services, except government.

Legal form of organization

For the domestic business sector in the NIPAs, classification by legal form of organization is shown for national income and its components. Legal forms of organization are based on IRS filing requirements for corporate business and for noncorporate business, which comprises sole proprietorships and partnerships, other private business, and government enterprises (employee compensation and current surplus of enterprises) (table 2.6).

Table 2.6—National Income by Legal Form of Organization

National income
Domestic business
Corporate business
Noncorporate business
Sole proprietorships and partnerships
Other private business
Government enterprises
Households and institutions
General government
Rest of the world
Note. Adapted from NIPA table 1.13.

Corporate business: This legal form comprises all entities required to file federal corporate tax returns, Internal Revenue Service (IRS) Form 1120 series. It includes mutual financial institutions and cooperatives subject to federal income tax, private noninsured pension funds, nonprofit institutions that primarily serve business, Federal Reserve banks, and federally sponsored credit agencies.

Sole proprietorships: This legal form comprises all entities that are required to file IRS Schedule C (Profits or Loss from Business) or Schedule F (Farm Income and Expenses) or that would be required to file if the proprietor met the filing requirements.

Partnerships: This legal form comprises all entities that are (or would be) required to file federal partnership income tax returns, IRS Form 1065 (U.S. Partnership Return of Income).

Other private business: This legal form comprises (1) all entities that are (or would be) required to report rental and royalty income on IRS Schedule E (Supplemental Income and Loss) of the individual income tax return and (2) tax-exempt cooperatives.

Government enterprises: This legal form consists of government agencies that cover a substantial proportion of their operating costs by selling goods and services to the public and that maintain their own separate accounts. For example, the U.S. Postal Service is a federal government enterprise, and public water and sewage agencies are local government enterprises.

Accounting Framework

The NIPAs consist of a set of integrated accounts that provide statistics on the output of the U.S. economy. The NIPA accounting framework is designed to provide context for these statistics, so that they are presented logically, consistently, and according to established economic-accounting principles and standards. The NIPAs are generally consistent with the SNA, which now serves as the internationally accepted set of guidelines for the compilation of national accounts.[50]

For an in-depth discussion of the conceptual framework of the NIPAs and the NIPA summary accounts and of the underlying accounting principles and common financial statements, see U.S. Bureau of Economic Analysis, *An Introduction to National Economic Accounting,* Methodology Paper No. 1 (updated), September 2007.[51] The definitions of the line items that make up the seven summary accounts are presented in the appendix to this Handbook, "Summary National Income and Product Accounts."

Accounting principles

Double-entry bookkeeping is one of the most fundamental principles used in economic accounting and in financial accounting. In financial accounting, activities that affect the resources available to a business are recorded at least once as a source of

[50] See Stephanie H. McCulla and Karin E. Moses, "The National Income and Product Accounts and the System of National Accounts 2008: Comparison and Research Plans," Survey 95 (June 2015): 1-17, and see Charles Ian Mead, Karin E. Moses, and Brent R. Moulton, "The NIPAs and the System of National Accounts," *Survey* 84 (December 2004): 17–32.
[51] Go to www.bea.gov, and click on "National," then on "Methodologies."

financing (credit) and at least once as a use of financing (debit). Thus, double-entry bookkeeping provides a means to validate the accounting entries, because the sum of the entries on each side of an account must be equal. In national economic accounting, each transaction is recorded as a payment by one sector and as a receipt by the same sector or by another sector—for example corporate income tax is a payment by a corporation and a receipt of the government.[52] In addition to providing a means to validate entries, this system also provides alternative ways to calculate a measure when complete information is not available for one of the sectors.

The accrual-accounting method is another principle important to both financial and economic accounting. This method is generally used to ensure that related revenues and expenses are recorded in the same accounting period. In accrual accounting, revenues are recorded when they are earned, and expenses are recorded when they are incurred, regardless of when the cash is actually received or paid. The accrual-accounting method may be contrasted to the cash-accounting method, which records revenues when cash is received and expenses when cash is paid.

Financial accounting and economic accounting generally apply different principles in valuing transactions. In financial accounting, assets (and depreciation) are commonly valued at historical costs—that is, at the prices relevant at the time of the acquisition; subsequent changes in the value of these assets are ignored. In economic accounting, assets (and depreciation) are valued at current costs—that is, at the market prices that prevail at the time they are valued. In preparing the NIPAs, various adjustments, such as the inventory valuation adjustment and the capital consumption adjustment, are made so that the estimates will reflect current costs rather than historical costs.

Conceptual derivation of the NIPAs

The NIPAs represent consolidations of the production, the income and outlay, and the saving and investment accounts for each sector of the economy (business, households, government, and foreign). These sector accounts, in turn, represent aggregations of the accounts belonging to individual transactors in the economy, regardless of whether formal accounting statements exist explicitly for all of them.

Specifically, for each sector, the *production account* records the value of the production that is attributable to that sector and the uses of the income arising from that production. The *income and outlay account* records the sources of the sector's income, its current outlays, and its saving. The *saving and investment* account (also known as the

[52] A fully articulated set of national accounts (showing payments and receipts by all sectors) actually leads to a quadruple-entry system (in which each transaction is recorded as a debit and a change in assets for one sector and as a credit and a change in assets for another sector) . However, transactions are usually recorded only twice in the NIPAs because the changes in assets or liabilities that are associated with the changes in revenues or expenses are recorded in the Federal Reserve Board's flow of funds accounts.

capital account) records the sector's gross saving and gross investment, where gross investment is net acquisitions of assets less net increase in liabilities.

Chart 2.3 illustrates the relationship between the summary NIPAs and the underlying production, income and outlay, and saving and investment accounts for the sectors of the economy.

Chart 2.3—NIPA Summary Accounts

<table>
<tr><th>Transactions</th><th colspan="3">Domestic accounts
Economic sectors</th><th>Rest of the world</th></tr>
<tr><td></td><td>Business</td><td>Government</td><td>Personal</td><td></td></tr>
<tr><td>Production</td><td colspan="3">Domestic income and product account (Account 1)</td><td rowspan="2">Foreign transactions current account (Account 5)</td></tr>
<tr><td>Income and outlay</td><td>Private enterprise income (Account 2)</td><td>Government current receipts and expenditures (Account 4)</td><td>Personal income and outlay (Account 3)</td></tr>
<tr><td>Saving and investment</td><td colspan="3">Domestic capital account (Account 6)</td><td>Foreign transactions capital account (Account 7)</td></tr>
</table>

The NIPA summary "domestic income and product account" represents a consolidation of the production accounts for business, households and institutions, and general government.

The income and outlay accounts for the sectors are shown in three separate summary accounts. Income and outlays for the personal sector, including income accruing to unincorporated businesses, are shown in the "personal income and outlay account." Income and outlays for the government sector, including income accruing to government enterprises, are shown in the "government current receipts and expenditures account. Income and outlays for business enterprises and for households and institutions in their role as producers are shown in the "private enterprise income account." In order to provide analytically useful aggregates associated with all private business, the coverage in this account includes the income and outlays of unincorporated businesses as well as those of corporate businesses.

The saving and investment accounts are consolidated into a single summary "domestic capital account." For saving, a breakdown by sector is shown for corporate, personal, and government saving. For investment, because of source data limitations, the breakdown is shown for private fixed and inventory investment and for government fixed investment.

The transactions for the foreign (or rest-of-the-world) "sector"—that is, transactions between U.S. residents and foreign residents—are shown separately in two

summary accounts. Current receipts and expenditures, such as exports and imports of goods and services, are shown in the "foreign transactions current account," and capital transactions, such as capital transfers, are shown in the "foreign transactions capital account."

The summary NIPAs

The seven summary NIPAs constitute the accounting framework for presenting the value of production, distribution, consumption, and saving for the U.S. economy.[53] (The summary accounts tables are presented at the end of this chapter. For definitions of all of the line entries in these tables, see the appendix to this handbook.) Each of the entries in a summary account also appears again in that account or in one of the other summary accounts; most of these entries are also shown in one or more of the tables that make up the full set of NIPA tables. For example, the item "supplements to wages and salaries" is shown in line 5 of summary account 1 and in line 14 of summary account 3; it is also shown in line 8 of NIPA table 1.10 and in line 6 of NIPA table 2.1.

Taken together, the summary accounts constitute a double-entry system in which a use (or expenditure) recorded in one account for one sector is also recorded as a source (or receipt) in an account of another sector or of the same sector. This system of integrated, double-entry accounts provides a comprehensive measure of economic activity in a consistently defined framework without double-counting. Thus, the NIPAs, in combination with BEA's industry, wealth, and other economic accounts, can be used to trace the principal economic flows among the major sectors of the economy.

Account 1: Domestic Income and Product Account

This account represents an aggregation of the underlying production accounts for the domestic sectors of the U.S. economy. The right (product) side of the account shows GDP measured as the sum of goods and services sold to final users rather than as the sum of value-added by the sectors. The left (income) side of the account shows GDP as measured by the incomes earned in production—GDI—plus the "statistical discrepancy" (the difference between GDP and GDI). Product and income are both presented on a domestic basis—that is, they are produced by labor and property located in the United States.

Account 2: Private Enterprise Income Account

[53] Prior to the 2003 comprehensive update, the NIPAs were summarized in five accounts, as shown in table A on pages 38–39 of the August 2002 *Survey*. For a discussion of the differences between the old and new summary accounts, see Nicole Mayerhauser, Shelly Smith, and David F. Sullivan, "Preview of the 2003 Comprehensive Revision of the National Income and Product Accounts: New and Redesigned Tables," *Survey* 83 (August 2003): 8–15.

This account presents information on the sources and uses of the income of private businesses and other private enterprises.[54] It combines the accounts of private businesses, of homeowners for owner-occupied housing (which is treated as if it were a business), and of NPISHs.

Sources of private enterprise income—such as income receipts on assets and net operating surplus—are shown on the right side of the account.[55] The left side of the account shows the uses of income as income payments on assets (such as holders of financial liabilities and equity claims of other businesses), business current transfer payments, and income that accrues to the owners of business (namely proprietors' income, rental income of persons, and corporate profits). Corporate profits, a widely used measure in the United States, is distributed to government (taxes on corporate income) and to shareholders (net dividends) or is retained (undistributed profits, which can be thought of as a measure of corporate saving).

Account 3: Personal Income and Outlay Account

This account shows the sources and uses of income received by persons—that is, households, NPISHs, private noninsured welfare funds, and private trust funds. The right side of the account shows the sources of personal income—such as employee compensation and interest and dividend income. The left side shows personal taxes and outlays and personal saving, which is derived as personal income minus personal taxes and outlays.

Account 4: Government Receipts and Expenditures Account

This account summarizes the combined transactions of the federal government and of the state and local governments. The right side of the account shows government current receipts—such as tax receipts from persons and contributions for government social insurance. The left side shows government current expenditures—such as compensation of government employees and transfer payments to persons—and net saving, which is derived as current receipts less current expenditures.

Account 5: Foreign Transactions Current Account

This account summarizes all the current transactions between the United States and the rest of the world. It presents information on receipts and payments associated with foreign trade, income receipts and payments, and current taxes and other transfer payments. This account does not include transactions involving the acquisition or

[54] Government enterprises are not included in account 2, because complete estimates on sources and uses of government enterprise income, notably the income payments and income receipts on assets, are not currently available. The sources and uses of government enterprise income are included, but not separately identified, in the government receipts and expenditures account.

[55] Summary account 2 presents the components of private enterprise income on a national basis—that is, for income accruing to U.S. residents. Consequently, for the net operating surplus to be shown in account 2 on a domestic basis consistent with summary account 1, several components showing income flows to and from the rest of the world are added to account 2.

disposal of nonproduced nonfinancial assets nor capital transfers, which are shown in the foreign transactions capital account, nor does it include transactions in financial assets and liabilities. The left side of this account shows current receipts from the rest of the world—mainly exports of goods and services, income receipts on assets, and current taxes, contributions for government social insurance, and transfer receipts from the rest of the world. The right side shows current payments to the rest of the world—mainly imports of goods and services, income payments on assets, and current taxes and transfer payments to the rest of the world. In addition, it includes the balance on current account, which is derived as current receipts less current payments.

Account 6: Domestic Capital Account

This account presents information on saving and investment for the economy. The right side of the account shows gross saving and the statistical discrepancy. Given the theoretical equality between GDP and GDI, the statistical discrepancy can be viewed as actual (positive or negative) income that is not captured by the data used to measure GDI and, therefore, not distributed to the sectors; instead, it is shown as a source of (positive or negative) saving in this account. The left side of the account shows gross domestic investment, capital-account transactions (net), and net lending or net borrowing, which is derived as gross saving and the statistical discrepancy minus gross domestic investment and capital-account transactions (net).

Account 7: Foreign Transactions Capital Account

This account presents information on transactions between the United States and the rest of the world that involve the acquisition or disposition of nonproduced nonfinancial assets and capital transfers. The left side of the account shows the balance on current account. The right side shows capital-account transactions (net) and net lending or borrowing, which is derived as the balance on current account minus capital-account transactions (net).

CHAPTER 3: PRINCIPAL SOURCE DATA

(Updated: November 2017)

Source data as determinants of initial release and revision schedules
Source data for the current quarterly estimates
Source data for the annual updates
Source data for the comprehensive updates

Source data are the information BEA uses to prepare the NIPA estimates, and estimating methods are the steps BEA takes to transform the source data into these estimates. The interaction of source data and estimating methods determines the accuracy, reliability, and relevancy of the accounts.

The data that BEA uses are collected from a variety of sources and are usually collected for purposes other than for incorporation into BEA's estimates. Data collected by federal government agencies provide the backbone of the estimates; these data are supplemented by data from trade associations, businesses, international organizations, and other sources. The Government data are from a number of agencies, including the Commerce Department's Census Bureau, the Labor Department's Bureau of Labor Statistics (BLS), the Treasury Department, the Office of Management and Budget, and the Agriculture Department. “Administrative” data are data that are tabulated by federal government and by state and local government agencies as a byproduct of administering their programs—such as processing corporate tax returns, regulating public utilities, and issuing building permits. Examples of important administrative sources of data for the NIPAs include the Internal Revenue Service’s Statistics of Income program, which provides data for a number of NIPA income estimates, the *Budget of the United States Government* from the Executive Office of the President, which is the major source of data for the NIPA estimates of federal government consumption expenditures and gross investment, the social insurance programs of the Center for Medicare and Medicaid Services and the Social Security Administration, which provide data on health insurance and social security incomes, and the military payroll systems of the U.S. Department of Defense. “Statistical” data are data collected by the federal statistical agencies, such as the Census Bureau and BLS. These data consist of periodic economic and population censuses and a wide range of sample surveys, such as those that collect data on manufacturing and trade, employment, and prices. The relatively few surveys that BEA conducts cover international trade in services and international direct investment, both by foreign companies in the United States and by U.S. companies in foreign countries.

The source data available to BEA are not always ideal for the preparation of the NIPAs. BEA must develop methods that transform the best available data into estimates that are consistent with the NIPA concepts and framework and that fill gaps in the coverage of the source data. (See “Chapter 4: Estimating Methods.”)

Source data as determinants of initial release and revision schedules

The availability of the source data is an important consideration in determining the schedules for the initial release and the subsequent revisions of the NIPA estimates. One factor affecting availability is the speed with which the source data are collected, compiled, and released. Another factor is whether the source data are part of a statistical program that, over time, provides more complete or otherwise better coverage—for example, if the sample is larger or if more detailed information is collected for an annual survey than for the monthly surveys.

In general, the most comprehensive source data for the expenditure components of gross domestic product (GDP) are available at the 5-year intervals associated with the economic census of establishments conducted by the Census Bureau. The economic census is the primary data source for BEA's input-output accounts, which are used to "benchmark" the NIPA estimates for the quinquennial census years. Related annual surveys are drawn from samples of the establishments covered in the economic census; these surveys generally collect less detailed data than those collected in the economic census. Many of the annual surveys are supplemented by monthly surveys that involve smaller samples and that collect less detailed data than the annual surveys.[1] In addition, responding to the censuses and annual surveys is generally mandatory, while responding to most of the quarterly and monthly surveys is voluntary.

The data from the monthly surveys are available first, and they provide much of the information that is used to prepare the initial, or "current," quarterly (and for a few components, monthly) NIPA estimates. These estimates are subsequently revised as additional reports become available from the monthly surveys. Annual updates, which are timed to incorporate newly available annual source data, are usually carried out each summer. Comprehensive updates, which incorporate the most complete source data as well as other improvements to the accounts, are carried out at about 5-year intervals.[2]

Thus, revisions do not reflect errors. On the contrary, revisions are mainly driven by the incorporation of more complete and revised source data, and the release of the revised estimates is determined by the availability of these data. The source data used to prepare

[1] Many of the annual and monthly surveys are based on "probability sampling" (sometimes known as "scientific sampling"). In this process, establishments are first placed into various "strata" on the basis of their size. Depending on the distribution of establishments, an establishment in the largest strata could have a 100-percent probability of selection and thus have a sampling weight of 1—that is, the establishment would represent only itself. An establishment in a smaller stratum would have a smaller probability of selection, say 1 percent, but in that case the establishment would have a sampling weight of 100—that is, the sampled establishment would represent 100 establishments.

[2] Unless noted otherwise, annual data are presented on a calendar-year basis (i.e., covering January through December). Quarter data are also presented on a calendar basis (i.e., the first quarter (Q1) covers January, February, and March; Q2 covers April, May, and June; Q3 covers July, August, and September; and Q4 covers October, November, and December).

the estimates of GDP and gross domestic income (GDI) can be grouped into five general categories based on their quality, availability, and use.[3]

- *Comprehensive data* provide comprehensive or nearly comprehensive coverage of the relevant population. They are either consistent with the concepts, coverage, or timing underlying the national accounts, or they can be made consistent with only minor adjustments.
- *Adjusted comprehensive data* provide comprehensive or nearly comprehensive coverage of the relevant population; however, these data require substantial adjustments in order to conform to the concepts underlying the national accounts.
- *Direct indicator data* are used to indicate the movements of a series rather than the levels of a series; they are closely related to the comprehensive data that are ultimately incorporated into the estimates, but they are less detailed or do not provide comprehensive coverage of the relevant population.
- *Indirect indicator data* are used to prepare indicator series when more suitable data are not available. They include volume or activity indicators and other NIPA estimates.
- *Trend-based data* are used when no data are available; they are typically based on previous estimates, using moving averages, regressions, growth factors, or judgment.

The following sections describe the most important federal government source data that are used for the current quarterly estimates and for the annual and comprehensive updates of the NIPAs. In the preparation of the estimates, these sources are augmented by a wealth of information from other public sources and from private sources, such as trade associations.

Source data for the current quarterly estimates

Data from Census Bureau monthly surveys are among the primary sources for the current quarterly estimates (table 3.1). For the most part, the samples for these voluntary surveys are drawn from the economic census, from the corresponding annual surveys, and from the Business Register; the samples are updated periodically to account for new businesses ("births") and for businesses that discontinue operations ("deaths").[4]

Table 3.1—Principal Sources for the Current Quarterly Estimates

Source	Agency
Monthly survey of manufacturers' shipments, inventories, and orders	Census Bureau
Monthly wholesale trade survey	Census Bureau

[3] For more information, see Alyssa E. Holdren, "Gross Domestic Product and Gross Domestic Income: Revisions and Source Data," *Survey of Current Business* 94 (June 2014): 1–11.

[4] The Business Register is a comprehensive database of U.S. business establishments and companies that is maintained by the Census Bureau for statistical program use. A "business" is defined as legal or administrative entity that is assigned an employer identification number (EIN) by the Internal Revenue Service.

Monthly retail trade and food services survey	Census Bureau
Quarterly services survey	Census Bureau
Monthly construction spending (value put in place)	Census Bureau
Monthly U.S. international trade in goods and services	Census Bureau and Bureau of Economic Analysis
U.S. international transactions accounts	Bureau of Economic Analysis
Annual projections and quarterly farm data	Agriculture Department
Monthly current employment statistics	Bureau of Labor Statistics
Quarterly financial report	Census Bureau
Monthly treasury statement	Treasury Department
Consumer price index	Bureau of Labor Statistics
Producer price index	Bureau of Labor Statistics
International price indexes	Bureau of Labor Statistics

Monthly Survey of Manufacturers' Shipments, Inventories, and Orders (M3) is a Census Bureau survey of manufacturing companies. Although the survey is by company rather than by establishment, most large, diversified companies file separate reports for "divisions" with significant activity in different industrial areas. Data are collected on the value of shipments, on total inventories and inventories by stage of fabrication, and on new orders received and unfilled orders. These source data are primarily used in estimating investment in private equipment, change in private inventories, and nonfarm proprietors' income. An advance report on durable-goods manufacturers' shipments and orders is released about 3½–4 weeks after the close of the "reference" month.[5] The composite M3 data are released about 5 weeks after the close of the reference month.

Monthly Wholesale Trade Survey (MWTS) is a Census Bureau sample survey of companies that are primarily engaged in merchant wholesale trade (merchant wholesalers that take title to the goods they sell—such as jobbers, industrial distributors, exporters, and importers). Data are collected on the dollar values of wholesale sales and end-of-month inventories. The MWTS data are primarily used in estimating change in private inventories and nonfarm proprietors' income. The MWTS reports are released about 6 weeks after the close of the reference month and are incorporated into BEA's 2nd and 3rd estimates of GDP; the Census Bureau makes an advanced report on wholesale trade available to BEA in time to incorporate the data into its advance GDP estimates.

Monthly Retail Trade and Food Services Survey is a Census Bureau sample survey of companies that sell merchandise and related services to final consumers. Data are collected on the dollar value of retail sales and end-of-month inventories. These source data are primarily used in estimating personal consumption expenditures (PCE) and change in private inventories. An advance report on monthly sales for retail and food services (MARTS) is released about 1½–2 weeks after the close of the reference month. The composite retail sales and inventories data are released about 6 weeks after the close of the reference month and are incorporated into BEA's 2nd and 3rd estimates of GDP; the

[5] The "reference" period (in this case month) is the period for which the data are collected.

Census Bureau makes an advanced report on retail inventories available to BEA in time to incorporate the data into its advance GDP estimates.

Quarterly Services Survey (QSS) is a Census Bureau sample survey that was initiated in 2003–2004 in order to improve the coverage of the service industries in the U.S. economy. The coverage of the QSS has since been expanded several times so that it now covers most of the categories of health care, transportation services, recreation services, communication services, and professional and other services.[6] The QSS data are primarily used in estimating PCE and private investment in intellectual property products. The QSS data are released about 2½ months after the close of the reference quarter.

The Census Bureau also makes advance QSS data available to BEA approximately 50 days following the end of each reference quarter, in time for the data to be incorporated into several PCE services estimates and estimates of private fixed investment in software as part of the second GDP release for each quarter.

Monthly construction spending (value put-in-place) is a Census Bureau measure of the value of construction installed or erected during a given period. The data for private nonresidential buildings, for government structures, and for multifamily residential buildings are derived from data collected by sampling the owners of construction projects.[7] The data for single-family residential buildings are derived indirectly using information collected in a series of sample surveys that track the number of housing-unit permits, starts, sales, and completions. The data for "other construction" are derived from a variety of sources covering farm, utility, communication, and railroad structures. These source data are primarily used in estimating private and government investment in structures. The data for construction put-in-place are released about 1 month after the close of the reference month.

Monthly U.S. international trade in goods and services consist of Census Bureau estimates of trade in goods and BEA estimates of trade in services. The Census Bureau tabulations of exported and imported goods are from documents filed with Customs and Border Protection, U.S. Department of Homeland Security; they cover all shipments above a certain size and a sample of the remaining shipments. The reports are incorporated into BEA's 2nd and 3rd estimates of GDP; the Census Bureau makes an advanced report on trade in goods available to BEA in time to incorporate the data into its advance GDP estimates. The BEA estimates of trade in services are primarily based on 11 mandatory BEA surveys of selected services receipts, payments, and other data. These data are supplemented by a combination of monthly indicator source data, partial data from U.S. government agencies and from foreign central statistical offices and banks, and

[6] For a discussion of the newly available QSS data beginning with 2011, see Eugene P. Seskin and Alyssa E. Holdren, "Annual revision of the National Income and Product Accounts," *Survey of Current Business* 92 (August 2012): 24.

[7] In contrast, the census of construction, which is part of the economic census, measures construction on the basis of reports by establishments primarily engaged in construction. Thus, value put-in-place captures some important parts of construction activity that are not included in the census—such as nonemployer construction, architectural and engineering costs, own-account construction, homeowner construction, and construction done as a secondary source of revenue by nonconstruction establishments.

other secondary source data. These source data are primarily used in estimating private investment in equipment and in software and in estimating exports and imports. The U.S. international trade statistics are jointly released by the two agencies about 5 weeks after the close of the reference month.

International Transactions Accounts (ITAs), prepared by BEA, summarize the quarterly transactions between the United States and the rest of the world. In the ITAs, the current account records exports and imports of goods and services, receipts and payments of income on assets, and unilateral transfers (net gifts to other countries). In the capital and financial account, the capital account records capital transfers (such as debt forgiveness) and the financial account records transactions involving exchanges of financial assets for other financial assets or for tangible resources and gifts or grants of financial assets. These source data are primarily used in estimating corporate profits. The ITAs are released about 2½ months after the close of the reference quarter.

Annual projections and quarterly farm data, from the U.S. Department of Agriculture, consist of annual projections of crop output, quarterly projections of cash receipts and of inventories for livestock, and annual projections of government subsidy payments and production expenses for both crops and livestock. These data are primarily used in estimating change in private inventories and farm proprietors' income.

Monthly Current Employment Statistics (CES) survey is a sample survey of business establishments that is conducted by state employment security agencies in cooperation with BLS. The CES (also known as BLS-790) covers payroll employment in private nonagricultural industries during the pay period that includes the 12th of the month. The data collected include series for total employment, number of production or nonsupervisory workers, average hourly earnings, average weekly hours, average weekly earnings, and average weekly overtime hours in manufacturing industries. (BLS has developed experimental series that extend coverage to all employees and that include irregular payments, such as bonuses.) These source data are primarily used in estimating PCE, wages and salaries, and nonfarm proprietors' income. The CES data are usually released on the first Friday following the close of the reference month.

Quarterly Financial Report (QFR), prepared by the Census Bureau, provides aggregate statistics on the financial position of U.S. corporations. Based on a sample survey of firms above specified asset sizes, the QFR presents estimated statements of income and retained earnings, balance sheets, and related financial and operating ratios for manufacturing, mining, and trade corporations by industry and by asset size. These source data are primarily used in estimating corporate profits. The QFR statistics for manufacturing, mining, and wholesale trade are released about 2 ½ months after the close of the reference quarter, and the statistics for retail trade are released about 1 month later.

Monthly Treasury Statement (MTS), prepared by the Financial Management Service of the U.S. Department of the Treasury, summarizes the financial activities of the federal government and off-budget federal entities in accordance with the Budget of the U.S. Government. The MTS presents a summary of receipts and outlays, surplus or

deficit, and means of financing. The data are provided by federal entities, disbursing officers, and Federal Reserve banks. These source data are primarily used in estimating federal government receipts and expenditures and federal government consumption expenditures and gross investment. The MTS is usually released about 8 days after the close of the reference month.

Consumer Price Index (CPI), prepared by BLS, is a family of indexes that measure the average monthly change in the prices paid by urban consumers for a fixed market basket of goods and services. The CPI covers "out-of-pocket" expenditures, including user fees (such as water and sewer service) and sales and excise taxes paid by the consumer but excluding income taxes and investment items (such as stocks, bonds, and life insurance). The CPI is estimated from a statistical set of samples of urban areas, of consumers within those areas, of retailers and other outlets, and of specific, unique items purchased. CPIs are primarily used in deflating PCE, change in private inventories, and state and local government purchases. The CPI is released 2–3 weeks after the close of the reference month.

Producer Price Index (PPI), prepared by BLS, is a family of indexes that measure the average monthly change in prices received by domestic producers of goods and services. Effective early in 2014, BLS will significantly expand its current coverage of the United States economy to over 75 percent of in-scope domestic production. The expansion features a transition from stage-of-processing to final demand-intermediate demand aggregation by incorporating PPIs for services, construction, government purchases, and exports.[8] The PPI is estimated from data collected from a sample of establishments that participate in the Unemployment Insurance System, a joint federal and state program that covers about 97 percent of wage and salary workers. PPIs are primarily used in deflating private investment in structures and equipment, change in private inventories, government purchases, and exports and imports. The PPI is released about 2 weeks after the close of the reference month.

International Price Indexes, prepared by BLS, measure monthly changes in the prices of goods and services that are sold by U.S. producers to foreign buyers (exports) and that are purchased from abroad by U.S. buyers (imports). The price indexes for exports of goods to Canada are based primarily on sampling information obtained from the Canadian Customs Service, and the indexes for exports of goods to other countries are based on sampling information obtained from the U.S. Census Bureau. The price indexes for imports of goods are based on sampling information obtained from Customs and Border Protection, U.S. Department of Homeland Security. The price indexes for exports and imports of services are based on sampling information that is developed separately for each service category. These price indexes are primarily used in deflating private investment in equipment, change in private inventories, and exports and imports. The international price indexes are released about 2 weeks after the close of the reference month.

[8] See "Producer Price Index to Transition from Stage-of-Processing to Final Demand-Intermediate Demand Aggregation System," at www.bls.gov.

Estimating schedule

For GDP and most other NIPA series, the estimates for each quarter are prepared on a schedule that calls for three successive "current" estimates—"advance," "second," and "third."[9] The specific release date for each month is primarily determined by the availability of the monthly reports on retail sales, manufacturing shipments, and international trade in goods from the Census Bureau (along with the time it takes BEA to process them).

- The advance quarterly estimate of GDP is released near the end of the month that follows the close of the reference quarter. For most of the product-side components, the estimate is based on source data for either 2 or 3 months of the quarter. In most cases, however, the source data for the second and third months of the quarter are subject to revision by the issuing agencies. Where source data are not available, the estimate is based primarily on BEA projections. For an example of how this information is provided in the *Survey of Current Business*, see the box "Source Data and Key Assumptions for the Advance Estimates of GDP for the First Quarter of 2014" on the next page (which was adapted from "GDP and the Economy" in the May 2014 *Survey*).[10]
- One month later, the advance estimate is replaced by the second estimate, which is typically based on source data for all 3 months of the quarter. However, in some instances, the source data used for the second estimate, particularly the data for the third month of the quarter, are subject to further revision.
- One month later, the second estimate is replaced by the third estimate, which incorporates revisions to source data for the third month of the quarter and newly available quarterly source data for some components.

For certain "income-side" series—gross national product, gross domestic income, national income, and corporate profits—"advance" estimates are not prepared, because of a lag in the availability of source data. For the first, second, and third quarters of the year, the release of the second GDP estimate presents the initial estimates for these income-side series, and the third GDP release presents revised estimates. For the fourth quarter, the estimates for these series are presented only in the third GDP release.

In addition, when the second estimate of GDP for the current quarter is released, the preceding quarter's estimates of private wages and salaries and affected income-side aggregates are revised to incorporate newly available preliminary tabulations from the

[9] In the 2009 comprehensive update of the NIPAs, BEA introduced new names for the second two vintages of the current quarterly estimates. Formerly, the "second" estimate was known as the "preliminary" estimate, and the "third" estimate" was known as the "final" estimate. The initial estimate continues to be named the "advance" estimate. (See Eugene P. Seskin and Shelly Smith, "Preview of the 2009 Comprehensive Revision of the NIPAs: Changes in Definitions and Presentations," *Survey* 89 (March 2009): 19–20.)

[10] Information on the assumptions used for unavailable source data is also provided in a technical note that is posted with the GDP news release on BEA's Web site. Within a few days after the release, a detailed "Key Source Data and Assumptions" file is posted on the Web site, and the "GDP and the Economy" analysis is available in the middle of each month in the *Survey*.

BLS quarterly census of employment and wages (QCEW).[11] (For a description of the QCEW, see the section on source data for annual updates.)

[11] Affected aggregates include gross domestic income, the statistical discrepancy, gross national income, national income, personal income, disposable personal income, personal saving, gross (national) saving, compensation, and gross product of corporate business. Other components that are closely linked to wages and salaries, such as personal current taxes and employer contributions for government social insurance, are also revised. Product-side series, including GDP, are not affected.

Source Data and Key Assumptions for the Advance Estimates of GDP for the First Quarter of 2014

The advance estimates of many components of GDP are based on 3 months of source data, but the estimates of some components are based on only 2 months of data. For the following items, the number of months for which source data are available is shown in parentheses.

Personal consumption expenditures: sales of retail stores (3), unit auto and truck sales (3), consumer' shares of auto and truck sales (2), motor vehicle fuels data (2), and electricity and gas usage and unit-value data (2);

Nonresidential fixed investment: unit auto and truck sales (3), construction spending (value put in place) (2), manufacturers' shipments of machinery and equipment (3), and exports and imports of machinery and equipment (2);

Residential fixed investment: construction spending (value put in place) (2), single-family housing starts (3), sales of new homes (3), and sales of existing houses (3);

Inventory investment: trade and nondurable-goods manufacturing inventories (2), durable-goods manufacturing inventories (3), and unit auto and truck inventories (3);

Net exports of goods and services: exports and imports of goods and services (2) and values of quantities of petroleum imports (2);

Government consumption expenditures and gross investment: federal government outlays (3), state and local construction spending (value put in place) (2), and state and local government employment (3);

Compensation: employment, average hourly earnings, and average weekly hours (3); and

Prices: consumer price indexes (3), producer price indexes (3), and values and quantities of petroleum imports (2).

Unavailable source data

When source data were unavailable, BEA made various assumptions for March, including the following:

- An increase in nonresidential structures,
- An increase in residential structures,
- A decrease in nondurable-goods manufacturing inventories,
- An increase in exports of goods excluding gold,
- A decrease in imports excluding gold, and
- An increase in state and local government structures.

Note. This box was adapted from the one published on page 5 of the August 2007 issue of the *Survey of Current Business*.

Source data for successive vintages

For the advance GDP estimates, indirect indicator data account for 34 percent of the source data used to calculate the estimates. Comprehensive data account for over 25 percent. Trend-based data account for 28 percent, and direct indicator data account for the remainder. (See chart 3.1 on the next page).

For the advance GDP estimates, indirect indicator and trend-based data together account for almost two-thirds of the source data used to calculate the estimates; for the third estimate, the two together account for only one-third-. Conversely, the share for the more-accurate comprehensive and direct indicator data, combined, increases from just over one-third to about two-thirds from the advance to the third estimate.

For estimates of GDI, there is a slower progression from less-comprehensive to more-comprehensive source data. Indirect indicator data account for 56 percent of the source data used to calculate the estimates for both the second and third estimates (as noted above, there is no advanced estimate for GDI). Trend-based data account for 31 percent of the source data in the second estimate, and 30 percent in the third. Direct indicator data make up only 12 and 13 percent of the second and third estimates respectively, and comprehensive data accounts for less than 1 percent in both estimates. However, the revision of the previous-quarter estimates at the time of the second release of GDP brings the use of comprehensive data up to 34 percent, and the use of indirect indicator and trend-based data down to 23 and 30 percent, respectively.

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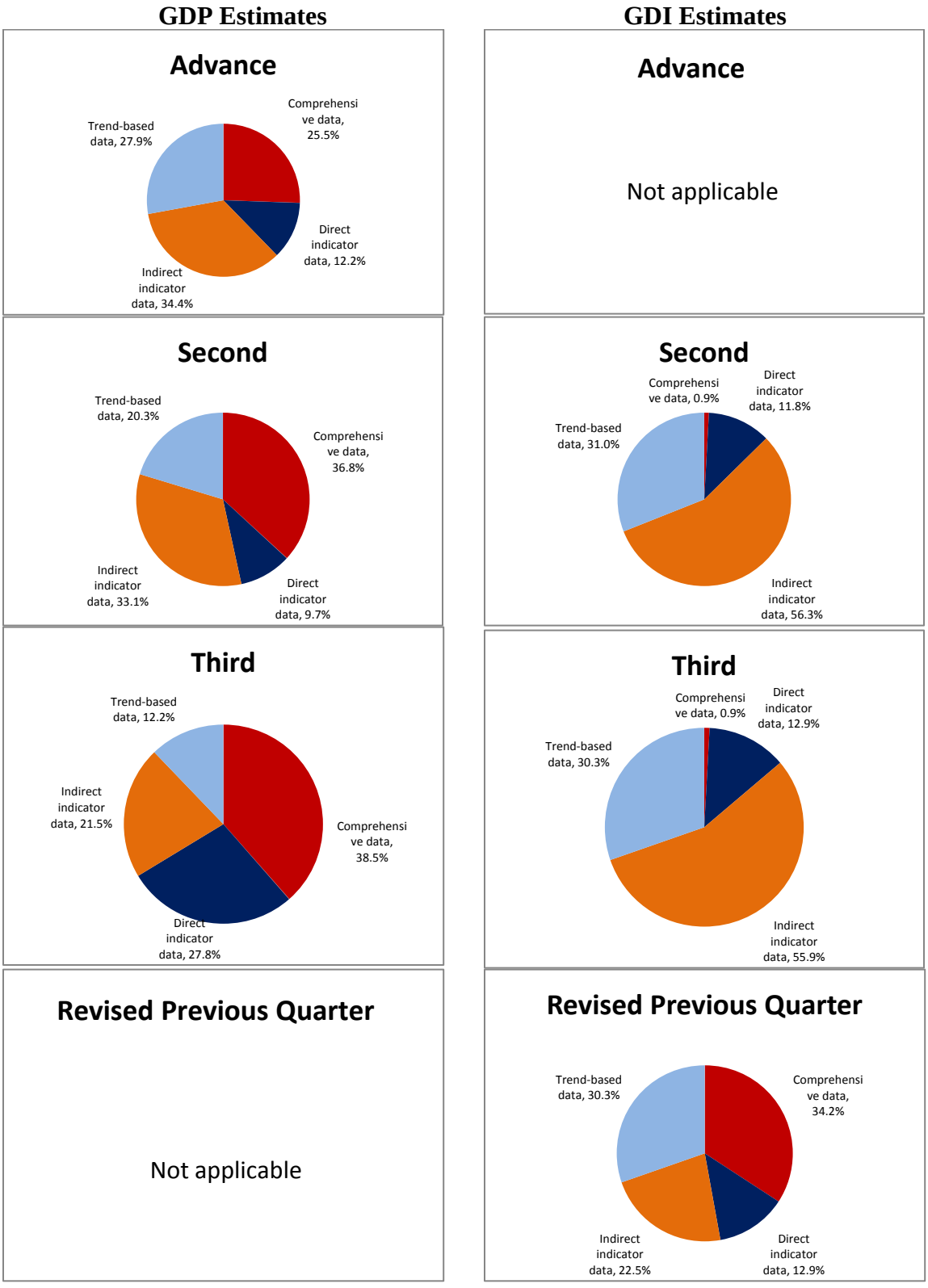
Chart 3.1— Shares of Source Data for the Quarterly GDP and GDI Estimates



Source data for the annual updates

Annual updates of the NIPAs are usually released in July and cover the months and quarters of the most recent calendar year and of the 2 preceding years.[12] The NIPA estimates for the most recent calendar year are revised to incorporate revisions that result from annual benchmarking of some of the principal monthly or quarterly source data. The NIPA estimates for all 3 years are revised to incorporate a broad range of newly available and revised annual source data (table 3.2). For the expenditures components, the newly available source data include annual surveys conducted by the Census Bureau. For the income components, the newly available source data include IRS tabulations of income tax returns and BLS tabulations of employment and wage information.

Table 3.2—Principal Newly Available Sources for NIPA Annual updates

Source	Agency
Annual survey of manufactures	Census Bureau
Annual wholesale trade survey	Census Bureau
Annual retail trade survey	Census Bureau
Service annual survey	Census Bureau
Annual surveys of state and local government finances	Census Bureau
Annual revision of the international transactions accounts	Bureau of Economic Analysis
Annual farm statistics	Agriculture Department
Quarterly census of employment and wages	Bureau of Labor Statistics
Tabulations of tax returns	Internal Revenue Service
Federal government annual budget	Office of Management and Budget

The first four sources listed in table 3.2 are the annual counterparts of the Census Bureau monthly surveys used for the current quarterly estimates. The more extensive annual survey samples are from companies listed in the Business Register, and the recipients are selected by stratified probability sampling. Response to these surveys is mandatory. New samples are usually selected after each economic census, and the samples are updated periodically to reflect business "births" and "deaths."

Annual Survey of Manufactures (ASM) is a Census Bureau survey of manufacturing establishments with paid employees. The ASM is conducted in the years between economic censuses—that is, in all years not ending in 2 or 7. Data are collected on employment, payroll, value added by manufacture, materials consumed, value of shipments, detailed capital expenditures, supplemental labor costs, fuels and electric energy used, and inventories by stage of fabrication. These source data are primarily used in estimating private investment in equipment, change in private inventories, and

[12] Starting in 2010, BEA instituted a "flexible" approach to annual updates that allows for the incorporation of improvements in methodology and for the extension of the 3-year revision period to earlier periods; see "BEA Briefing: Improving BEA's Accounts Through Flexible Annual Revisions," *Survey* 88 (June 2008): 29–32.

nonfarm proprietors' income. The ASM data are published about 11 months after the close of the reference year.

Annual Wholesale Trade Survey (AWTS) is a Census Bureau survey of companies that have significant activity in wholesale trade. These companies include wholesalers that take title of the goods they sell—such as jobbers, industrial distributors, exporters, importers, and manufacturer sales branches and offices (MSBOs)—and, beginning in 2007, wholesalers that do not take title—such as agents, merchandise and commodity brokers, commission merchants, and electronic business-to-business marketers. Merchant wholesalers excluding MSBOs provide data on sales, inventories, inventory valuation, purchases, and gross margin. MSBOs provide data on sales, inventories, inventory valuation, and operating expenses. The wholesalers that do not take title provide data on sales, commissions earned, gross selling value of sales conducted for others, and operating expenses. The AWTS data are primarily used in estimating change in private inventories and nonfarm proprietors' income. The statistics for all wholesalers are normally published about 15 months following the close of the reference year.

Annual Retail Trade Survey (ARTS) is a Census Bureau survey of retail companies with one or more establishments that sell merchandise and associated services to final consumers. The survey is sent to a sample of retail establishments with paid employees, and the data collected are supplemented by administrative data to account for businesses without paid employees (typically self-employed individuals or unincorporated partnerships). The ARTS collects data on the dollar value of retail sales, sales taxes collected, inventories, inventory valuation, cost of purchases, and accounts receivables balances. These source data are primarily used in estimating PCE and change in private inventories. The statistics are normally published about 15 months following the close of the reference year.

Service Annual Survey (SAS) is a Census Bureau survey of companies that provide services to individuals, businesses, and governments. The survey is sent to selected businesses with paid employees, and the data collected are supplemented by administrative data or imputed values to account for businesses without paid employees. The data collected include operating revenue for both taxable and tax-exempt firms and organizations, sources of revenue, exports, and inventories for selected industries, and selected industry-specific items. The SAS has been expanded over time in order to improve the coverage of the service industries in the U.S. economy.[13] The SAS data are primarily used in estimating PCE and private investment in intellectual property products. The statistics are normally published about 12 months after the close of the reference year.

Annual surveys of state and local government finances, prepared by the Census Bureau, provide data on the financial activities of state governments and of local governments, including counties, municipalities, townships, special districts, and school

[13] For a discussion of the most recent expansion of the SAS, see Eugene P. Seskin and Alyssa E. Holdren, 24.

districts. The data are compiled from three sources: an enumeration of all 50 states, a probability sample survey of local governments, and data from federal government agencies. Reported data are for each government's annual accounting period (fiscal year) that ends on or before June 30 of the survey year. Data are obtained for revenue, expenditure, debt, and financial assets. These source data are primarily used in estimating state and local government spending, employee compensation, and taxes on production and imports. The data are available about 12 months after the close of the survey year.

Annual revision of the international transactions accounts (ITAs), prepared by BEA, incorporates newly available annual source data and statistical, methodological, and presentational improvements into the accounts, which may result in revisions that extend back for a number of years.[14] (The ITAs were described in the preceding section on sources for the current quarterly estimates.) These source data are primarily used in estimating exports of goods and services, and imports of goods and services. The annual revision of the ITAs is released in mid-June.

Annual farm statistics are collected in the Agricultural Resource Management Survey (ARMS), which is sponsored jointly by the Economic Research Service and the National Agricultural Statistics Service of the U.S. Department of Agriculture. The ARMS starts in the fall with the collection of data on crop production and costs and finishes in the spring with the collection of data on whole farm and livestock production practices and costs. The data, which underpin USDA's annual estimates of net farm income, cover virtually every aspect of U.S. agriculture, including production and supplies, prices paid and received, farm labor and wages, and farm finances. These source data are primarily used in estimating change in private inventories and farm proprietors' income. The ARMS data are available in the fall following the close of the reference year.

Quarterly Census of Employment and Wages (QCEW) is a cooperative program (also known as the ES-202 program) involving BLS and the state employment security agencies. The QCEW produces a comprehensive tabulation of employment and wage information for workers who are covered by state unemployment insurance programs or by the unemployment insurance program for federal employees; as such, the QCEW is a virtual census of nonagricultural employment and wages. These source data are primarily used in estimating PCE, wages and salaries, and nonfarm proprietors' income. The QCEW data are usually released to the public 6 to 7 months after the close of the reference quarter.[15]

Tabulations of tax returns, prepared by the IRS Statistics of Income program, are compilations of information from the tax returns of corporations and of sole proprietorships and partnerships. The aggregate data are compiled based on stratified probability samples of tax or information returns. The data collected include by-industry

[14] For a description of an annual revision of the ITAs, see the most recent July issue of the *Survey*.
[15] As noted in footnote 9, some preliminary information from the QCEW is incorporated into the quarterly estimates on a delayed basis. However, the annual NIPA revision provides the opportunity for a more complete incorporation of these data.

information on assets, business receipts and deductions, and net income. The source data are primarily used in estimating corporate profits and nonfarm proprietors' income. The data for nonfarm sole proprietorships and partnerships are released to the public about 1 ½–1 ¾ years after the end of the tax year, and the data for corporations are released to the public about 1 ¾ years after the end of the tax year.[16]

Federal government annual budget, a report prepared by the Office of Management and Budget, presents preliminary estimates of U.S. Government receipts and expenditures for the current fiscal year (October 1 through September 30) and revised data for the preceding fiscal year, as well as the President's proposed budget for the upcoming fiscal year. Data are provided on budget receipts by source, such as individual and corporate income taxes, and on budget outlays by function, such as national defense and Medicare. These source data are primarily used in estimating federal government spending and wages and salaries. The report is usually released in early February.

Source data for the comprehensive updates

Comprehensive updates of the NIPAs are carried out about every 5 years, and they may result in revisions that extend back for many years. These revisions are timed to incorporate the infrequent but most comprehensive source data, and they also provide the opportunity to incorporate definitional, statistical, and presentational improvements to the accounts. Generally, comprehensive updates replace the annual update that would normally take place in that year, and so they also incorporate the source data that would normally be incorporated in the annual update. The most important source for the comprehensive update is BEA's benchmark input-output tables, which, in turn, are primarily based on the detailed information collected in the economic census conducted by the Census Bureau (table 3.3).

Table 3.3—Principal Newly Available Sources for NIPA Comprehensive updates

Source	Agency
Benchmark input-output accounts	Bureau of Economic Analysis
Economic census	Census Bureau
Census of governments	Census Bureau

Benchmark Input-Output (I-O) Accounts, prepared by BEA, are U.S. economic accounts that provide detailed statistics on economic processes and the relationships between various industries in the U.S. economy. The core of the I-O accounts consists of the "make" table, which shows the value of each commodity produced by each industry, and the "use" table, which shows the consumption of each commodity by each industry

[16] For corporations, the tax year covers tax returns that are filed for accounting periods ending in July of one year through June of the following year; for most corporations, the accounting period coincides with the calendar year.

or final user. The benchmark I-O accounts, which are prepared at about 5-year intervals, incorporate a vast amount of source data, the most important of which are data from the economic census. The I-O account estimates are used extensively as benchmarks for many of the corresponding NIPA estimates, but I-O accounts also directly incorporate some of the NIPA estimates, such as the estimates for owner-occupied housing and for motor vehicles. The benchmark I-O accounts are usually released about 5 years after the reference year for the economic census.[17]

Economic Census conducted by the Census Bureau, is a mandatory census that provides a detailed portrait of the nation's economy once every 5 years.[18] The economic census consists of several censuses that cover nearly all private industries, including manufacturing, wholesale and retail trade, construction, transportation, information, services, and finance and insurance.[19] In the 2007 Economic Census, report forms were sent to the establishments of all large employers (all multi-establishment firms and all firms with a payroll above a specified cutoff) and to a stratified sample of small employers (single-establishment firms with payroll below the cutoff). Statistics for selected small employers (for example, those with fewer than 10 employees) and all firms without employees were compiled from administrative records of the IRS and other federal government agencies. The economic census is the most important data source for the benchmark I-O accounts. Results from the economic census are released over a period of several years.

Census of Governments, which is conducted by the Census Bureau in the same years as the economic census, is a voluntary census that provides periodic and comprehensive statistics about governments and governmental activities. The census covers all state and local governments, including counties, cities, townships, special districts, and school districts. Data are collected on revenues, expenditures, debt, assets, employees, payroll, and benefits for the individual fiscal year that ended prior to July 1 of the census year. These source data are primarily used in estimating state and local government spending. The financial data are released beginning about 16 months after the close of the census year, and the employment data are released beginning about 12 months after the close of the census year.

[17] Effective with the 2013 cycle of comprehensive updates of the NIPAs and releases of the benchmark I-O accounts, the two sets of accounts are fully integrated—that is, the results of the 2013 comprehensive NIPA revision are released before publication of the 2007 benchmark I-O accounts. Previously, benchmark I-O accounts were released first, and thus they were not fully consistent with the revised NIPA estimates. For more information, see Erich H. Strassner and David B. Wasshausen, "Preview of the 2013 Comprehensive Revision of the Industry Economic Accounts," *Survey* 93 (June 2013): 19–33.
[18] See "Economic Census" at www.census.gov/econ/census02.
[19] Prior to the 1997 Economic Census, these censuses were referred to in the plural—that is, as "economic censuses"—because they were considered to be compilations of distinct censuses for each major industry.

CHAPTER 4: ESTIMATING METHODS

(Updated: November 2017)

Current-Dollar Estimates
- Adjustments to the source data
- Seasonal adjustment
- Moving average
- Best level and best change
- Interpolation and extrapolation using an indicator series
- Three special estimation methods
  - Commodity-flow method
  - Retail control method
  - Perpetual inventory method

Quantity and Price Estimates
- Estimates for detailed components
- Estimates for NIPA aggregates
- Properties of chain-type measures

Appendix to Chapter 4
- Calculation of Output and Price Indexes
  - Adjusting for quality change
- Statistical Tools and Conventions
  - Chained-dollar measures
  - Contributions to percent change
  - Annual rates
  - Growth rates
  - Rebasing an index

The NIPA measures are built up from a wide range of source data using a variety of estimating methods. Each NIPA component is derived using a specific methodology—that is, source data and estimating methods—that progresses from the advance quarterly estimate through the comprehensive NIPA revision.

The methodologies used to prepare the various NIPA estimates are periodically changed in order to incorporate improvements in the source data or in the estimating methods.[1]

- Over time, source data may emerge or disappear, so new source data must be identified and evaluated, and estimating methods must be adapted accordingly.
- Advances in statistical techniques or in other aspects of estimation must be evaluated for adoption into the methodology.

[1] Substantive changes to NIPA methodologies are documented in BEA's monthly *Survey of Current Business*.

- As the U.S. economy evolves, the methodologies must be updated to ensure that the estimates continue to provide a reliable and relevant picture of transactions and transactors in the economy.

The examples provided in this chapter are simplified in order to illustrate the basic estimating concepts and calculations. In practice, the procedures used for deriving the NIPAs involve complex statistical techniques that are designed to ensure consistency across the entire time series for a given estimate and between interrelated estimates.

Current-Dollar Estimates

For most NIPA components, the current-dollar, or nominal, estimates are derived from source data that are "value data," which reflect the product of quantity and price. For the estimates that are not derived from value data, separate quantity data and price data must be combined. For example, an estimate of expenditures on new autos may be calculated as the number of autos sold times expenditure per auto (at transaction prices—that is, the average list price with options adjusted for transportation charges, sales taxes, dealer discounts, and rebates). An estimate of wages may be calculated as employment times average hourly earnings times average hours worked, and an estimate of interest received may be calculated as the stock of interest-bearing assets times an effective interest rate. (The NIPA current-dollar estimates are expressed at annual rates; see the appendix to this chapter.)

Adjustments to the source data

BEA makes three general types of adjustments to the source data that are incorporated into the NIPA estimates. The first consists of adjustments that are needed so that the data conform to appropriate NIPA concepts and definitions. For example, Internal Revenue Service data from corporate tax returns include estimates of depreciation, but these estimates are based on historical-cost valuation and on tax service lives. BEA must adjust these estimates to the NIPA definition of depreciation—consumption of fixed capital—which is based on current-cost valuation and economic service lives.

The second type of adjustment involves filling gaps in coverage. For example, one of the primary sources for the quarterly estimates of the change in private inventories component of GDP is the Census Bureau's monthly survey of wholesale trade. However, this source does not cover inventories of nonmerchant wholesalers (wholesalers that do not take title to the goods they sell). Thus, the survey data must be augmented by separate BEA estimates for the change in the inventories of these wholesalers.

The third type of adjustment involves time of recording and valuation. For example, in the NIPAs (as in BEA's international transactions accounts), imported goods are valued at "foreign port value"—that is, the value at the point of exportation to the

United States. The source data on imports of goods from Canada, which the Census Bureau receives in a bilateral data exchange with Canada, are often valued at the point of manufacture; thus, BEA must adjust these data to foreign port value by adding the cost of transporting these goods within Canada from the point of manufacture to the point of export to the United States.

In addition, source data must occasionally be adjusted to account for special circumstances that affect the accuracy of the data. For example, the monthly current employment statistics are collected in the middle of the month, which is assumed to represent conditions during the entire month. Thus, these source data may need to be adjusted if a significant event, such as a blizzard that blankets much of the eastern United States, occurs during that period.

Seasonal adjustment

Quarterly and monthly NIPA estimates are seasonally adjusted at the detailed-series level when the series demonstrate statistically significant seasonal patterns. For most of the series that are seasonally adjusted by the source agency, BEA adopts the corresponding seasonal adjustment factors. Seasonal adjustment removes from the time series the average effect of variations that normally occur at about the same time and in about the same magnitude each year—for example, the effect of weather or holidays. After seasonal adjustment, trends, business cycles, and other movements in the time series stand out more clearly.

Many of the data used by BEA to estimate GDP are seasonally adjusted by the source data agencies, and BEA seasonally adjusts some of those that are not; other source data cannot be seasonally adjusted with conventional methods, such as the X-12 ARIMA process, until the time series is sufficiently long (that is, at least 5 years) to adequately capture seasonal trends.[2]

In general, the seasonal adjustment techniques used by BEA and its source data agencies successfully remove seasonal patterns from the estimates.[3] However, for a variety of reasons, including differences between monthly and quarterly seasonal patterns and the aggregation of data from different sources, residual seasonality may remain. BEA and its source data agencies regularly review and update seasonal adjustment procedures to adjust any source data not previously adjusted and to address residual

[2] X-12 ARIMA is a software program developed by the Census Bureau to identify and remove seasonal effects from a time series; for more information, see the Census Bureau website at www.census.gov. In cases where the series lacks a sufficient time span to derive seasonal factors, BEA often uses smoothing techniques such as moving averages to reduce seasonality in the data.

[3] This is evident in the strong seasonality apparent in the non-seasonally adjusted estimates that were produced by BEA until they were discontinued in 2008.

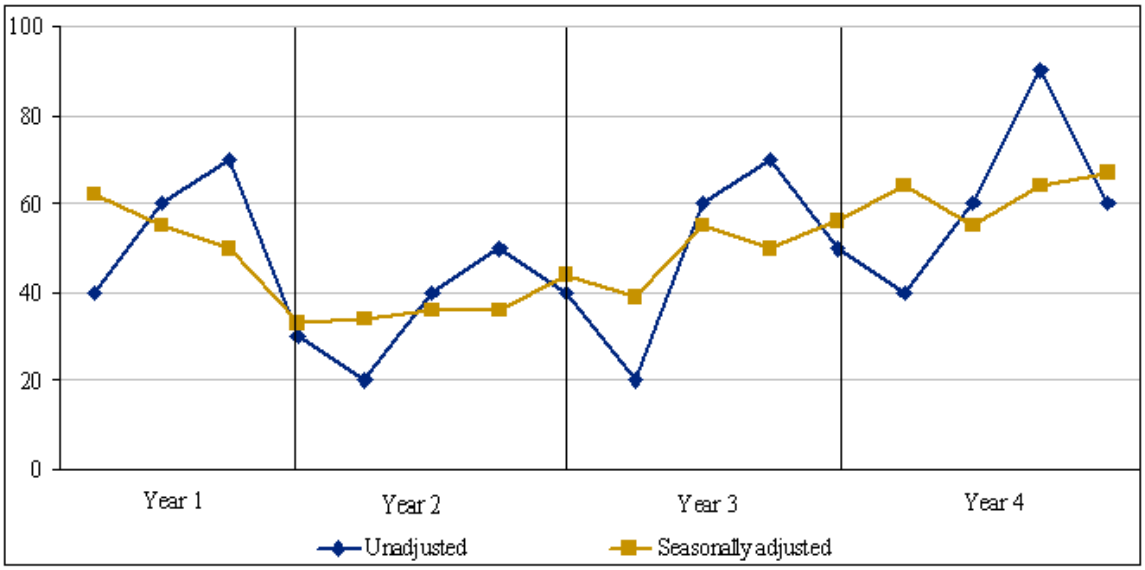
seasonality emerging over time, and BEA is engaging in research to identify and address additional sources of residual seasonality.[4]

Table 4.1 and chart 4.1 illustrate the effects of seasonally adjusting a series that has a significant seasonal pattern. The unadjusted series shows a pattern of consistent strength in the second and third quarters and corresponding weakness in the first and fourth quarters. The series is adjusted by calculating seasonal adjustment factors and dividing them into the unadjusted values for the appropriate quarter. As necessary, further adjustments are then made to ensure that the seasonally adjusted quarterly values sum to the annual total for that year.

Table 4.1—Simplified Example of Seasonal Adjustment

	Unadjusted					Seasonally adjusted			
Quarter	I	II	III	IV	Total	I	II	III	IV
Year									
1	40	60	70	30	200	62	55	50	33
2	20	40	50	40	150	34	36	36	44
3	20	60	70	50	200	39	55	50	56
4	40	60	90	60	250	64	55	64	67

Chart 4.1—Illustration of Seasonal Adjustment



[4] For more information on residual seasonality and BEA's associated research agenda, see Brent R. Moulton, "Residual Seasonality in GDP and GDI: Findings and Next Steps," *Survey of Current Business* 96 (July 2016): 1-6 and see Stephanie H. McCulla and Shelly Smith, "The 2016 Annual Update of the National Income and Product Accounts," *Survey of Current Business* 96 (August 2016): 1-31.

Two seasonal adjustment strategies are commonly used: Regular seasonal adjustments use seasonal factors that are based on the factors for prior years, and concurrent seasonal adjustments are redone each period (quarter or month) using all the estimates up to and including the current period to calculate the seasonal factor. Because seasonal patterns may change over time, complex statistical techniques have been developed to seasonally adjust time series data. The most widely used method is the Census Bureau's X-12 ARIMA program, which uses a statistical analysis to calculate how the seasonal pattern of a time series has changed recently and how it might be expected to change further over the coming year.

Moving average

A moving average is a calculation that is used to smooth a data series that is characterized by volatile short-term fluctuations. As a result, trend and cyclical movements in the smoothed series will be more apparent, and the series can be better used as an indicator for interpolation and extrapolation (see below).

Table 4.2 illustrates the smoothing effects of a three-quarter moving average on a volatile series. The simple moving average is calculated by summing the value in a given quarter and in the preceding two quarters and dividing by 3 (in year 1:III, (90.0 + 120.0 + 100.0)/3 = 103.3). A weighted moving average is calculated by assigning greater weight to the time periods that are deemed more relevant. In this example, the weighted moving average is calculated by weighting the current quarter at 50 percent, and the two preceding quarters at 25 percent each (in year 1:III, ((90.0 × 0.50) + (120.0 × 0.25) + (100.0 × 0.25) = 100.0).

Table 4.2—Example of Moving-Average Calculation

Time period	Original series	Simple moving average	Weighted moving average
Year 1:I	100.0	…..	…..
Year 1:II	120.0	…..	…..
Year 1:III	90.0	103.3	100.0
Year 1:IV	150.0	120.0	127.5
Year 2:I	170.0	136.7	145.0
Year 2:II	100.0	140.0	130.0
Year 2:III	150.0	140.0	142.5
Year 2:IV	120.0	123.3	122.5

Alternatively, a "centered" three-quarter moving average could be calculated, in which the quarterly value is the average of the value in the current quarter and the values in the preceding quarter and in the following quarter. This would have the effect of shifting the moving-average series back one quarter (in the example, the value of the centered moving average would be 103.3 in year 1:II, and so forth through 123.3 in year 2:III).

Best level and best change

Source data are incorporated into the NIPA estimates on either a "best-level" or a "best-change" basis. Best level provides the most accurate value for an economic statistic at a specified point in time using the best available source data. For example, in a comprehensive update of the NIPAs, data from the quinquennial economic census are incorporated into the estimates on a best-level basis.

However, it is not practical to revise the entire NIPA time series every time new or revised source data become available. Thus, these data are often initially introduced into the estimates on a best-change basis. Best change provides the most accurate measure of the period-to-period movement in an economic statistic using the best available source data. In an annual update of the NIPAs, data from the annual surveys of manufacturing and trade are generally incorporated into the estimates on a best-change basis. In the current quarterly estimates, most of the components are estimated on a best-change basis from the annual levels established at the most recent annual update.

In table 4.3, the original series of source data (column 1) has been revised as shown by the best-level series (column 3). In the example, the level of the series has been revised up in all years, perhaps reflecting a change in definition, and the percent changes in the series have been revised to incorporate new statistical information. In an annual NIPA revision, the revised levels of the source data cannot be fully incorporated, because

annual updates only cover the 3 most recent years.[5] As can be seen in this example, incorporating the revised best-level series only for years 2–4 would result in a discontinuity between the unrevised estimate for year 1 (100.0) and the revised estimate for year 2 (115.0) (a 15.0-percent increase rather than the 10.6-percent increase indicated by the source data). To avoid this problem, the revised source data are instead incorporated on a best-change basis—that is, a new best-change series is created by beginning with the value in the unrevised year 1 (100.0) and applying the percent changes in the best-level series (column 4). As a result, the level of the new series (column 5) is kept consistent with the level of the earlier nonrevised year, while the percent changes in the new series (column 6) fully reflect the new statistical information that was incorporated into the source data. In the next comprehensive update, the revised best-levels would be incorporated into the NIPA estimates.

Table 4.3—Simplified Example of "Best Level" and "Best Change"

Year	Original series [billions of dollars] (1)	Percent change in original series (2)	Revised ("best-level") series [billions of dollars] (3)	Percent change in best-level series (4)	Revised ("best-change") series [billions of dollars] (5)	Percent change in best-change series (6)
1	100.0	…..	104.0	…..	100.0	…..
2	110.0	10.0	115.0	10.6	110.6	10.6
3	120.0	9.1	124.0	7.8	119.2	7.8
4	130.0	8.3	136.0	9.7	130.8	9.7

Interpolation and extrapolation using an indicator series

Generally, monthly or quarterly source data are not as comprehensive or as reliable as annual source data (and, similarly, annual source data are not as comprehensive or as reliable as quinquennial source data). Thus, for some estimates, the more frequent but less comprehensive source data may be used as an indicator of the movements of the component series rather than as a measure of the absolute levels of the series. Specifically, for the periods for which annual estimates are available and the quarterly estimates must be forced to average to these annual totals, the quarterly pattern is estimated by *interpolation*. For the periods not yet covered by annual estimates (such as the current quarter), the quarterly estimates are made by *extrapolation*.

[5] Starting in 2010, BEA instituted a "flexible" approach to annual updates that allows for the incorporation of improvements in methodology to be introduced and for the extension of the 3-year revision period to earlier periods; see "BEA Briefing: Improving BEA's Accounts Through Flexible Annual Revisions," *Survey* 88 (June 2008): 29–32.

The use of an indicator series to estimate a component is illustrated in table 4.4. We begin with a value of $200 (annual rate) for the fourth quarter of year 1 (this value was determined by the preceding year's calculation) and a value of $220 for the year 2 (this value was determined from an annual data source). Because the detailed source data are not available on a quarterly basis, the estimates for the quarters of year 2 are interpolated using an indicator series whose movements are deemed to approximate those of the component series. In this simplified example, the interpolation of the quarterly values is accomplished by calculating a time series that begins with the established value ($200) for the fourth quarter of year 1 and progresses through the four quarters of year 2 at the same rate of change as the indicator series: for year 2:I, $200 + ($200 × 0.20) = $240; for year 2:II, $240 + ($240 × –0.167) = $200; and so forth. As necessary, the calculated series is then adjusted to ensure that the average for the four quarters of year 2 is equal to the established annual value for year 2: for year 2:I, $240 × ($220/$240) = $220; for year 2:II, $200 × (220/$240) = $183.3; and so forth.

Similarly, the estimates for the quarters of the current year, year 3, can be calculated by extrapolating the value for the fourth quarter of year 2 using the percent change in the values for the indicator series as they become available: for year 3:I, $256.7 + ($256.7 × 0.20) = $308.0.

Table 4.4—Simplified Example of Estimation Using an Indicator Series

Time period	Established value	Indicator series	Percent change in indicator series	Calculated value	Adjusted series
Year 1:IV	200	25	…..	…..	
Year 2:I		30	20.0	240	220.0
Year 2:II		25	–16.7	200	183.3
Year 2:III		30	20.0	240	220.0
Year 2:IV		35	16.7	280	256.7
Year 2: Total	220			240	220.0
Year 3:I		42	20.0		308.0

Over time, BEA has used a number of different statistical techniques for interpolation of NIPA time series. Currently, BEA is using a procedure known as the "proportional Denton method" or "quadratic minimization." In its most common application, this approach interpolates series by minimizing the sum of the squared differences of the ratios of the interpolated series and the indicator series. Formally, the interpolation is estimated by the following optimization problem:

$$\min_{x_t} \sum_{t=2}^{4N} \left(\frac{x_t}{z_t} - \frac{x_{t-1}}{z_{t-1}} \right)^2, \qquad s.t. \sum_{t=1}^{4} x_t = A_1, \ldots \sum_{t=4N-3}^{N} x_t = A_N$$

,

where z is the indicator series, x is the interpolated series, A are the annual controls that the interpolated series must sum to, and N is the number of years for the interpolation. This example shows an annual-to-quarterly interpolation. The same method can also be used for annual-to-monthly and quarterly-to-monthly interpolation.[6]

Three special estimation methods

In certain cases where primary source data are not available, one or more of the following special methods—commodity flow, retail control, or perpetual inventory—may be used to estimate values.

Commodity-flow method

The commodity-flow method is generally used to derive estimates in economic census years for various components of consumer spending, equipment and software, and the commodity detail for state and local government consumption expenditures and gross investment. An abbreviated form of this method is used to prepare estimates of investment in equipment in nonbenchmark years, and an even more abbreviated form is used to prepare the current quarterly estimates of investment in equipment.[7]

The commodity-flow method begins with estimates of the domestic output or domestic sales of a commodity valued in producers' prices.[8] Then, estimates of the domestic supply of that commodity—the amount that is available for domestic consumption—are prepared by adding imports and by subtracting exports and inventory change. Next, the domestic supply of the commodity is allocated among domestic purchasers—that is, persons, business, and government. Finally, the estimates are converted to purchasers' prices.[9]

The commodity-flow method is illustrated in table 4.5. First, domestic shipments—the value of shipments of the commodity produced by domestic firms at producers' prices—are converted to net supply, by adding imports and subtracting exports, government purchases, and change in inventories (a positive change in inventories reduces net supply and a negative change in inventories raises net supply) (in

[6] See Baoline Chen and Stephen H. Andrews, "An Empirical Review of Methods for Temporal Distribution and Interpolation in the National Accounts," *Survey* 88 (May 2008): 31–37.
[7] For more information on using the commodity-flow method to prepare the estimates of investment in equipment, see "Chapter 6: Private Fixed Investment," pages 10–11.
[8] Producers' prices are the prices received by producers for the goods and services they sell. These prices include sales and excise taxes but exclude domestic transportation costs and trade margins. Trade margins, or markups, reflect the value added by wholesalers and retailers in the distribution of a commodity from producers to final purchasers.
[9] Purchasers' prices are the prices paid by intermediate and final purchasers for the goods and services they buy. These prices are equal to producers' prices plus domestic transportation costs and trade margins.

the example, $100 + $40 – $10 – $5 – $5 = $120). Portions of the net supply are then allocated among business intermediate purchases and consumer spending. This allocation may be based on relationships from the most recent economic census or on information from other sources (such as spending by consumers as determined by the retail control method). In this example, it is assumed that one-fourth of net supply is allocated to business intermediate purchases and one-sixth to personal consumption expenditures. Investment in equipment (prior to adjustments for transportation costs and wholesale and retail trade margins) is then computed as net supply less business intermediate purchases and consumer spending (in the example, $120 – $30 – $20 = $70). This estimate is then converted to purchasers' prices by adding domestic transportation costs and trade margins ($70 + $5 + $10 = $85).

Table 4.5—Simplified Example of Commodity-Flow Calculation

Factors for commodity flow	Values
Output (shipments)	100
Plus: Imports	40
Less: Exports	10
Government purchases	5
Inventory change	5
Equals: Net supply	120
Less: Business intermediate purchases	30
Personal consumption expenditures	20
Equals: Private fixed investment (producers' prices)	70
Plus: Domestic transportation costs	5
Trade margins	10
Equals: Private fixed investment (purchasers' prices)	85

Retail control method

The retail control method uses retail sales data, compiled by the Census Bureau, to estimate annual, quarterly, and monthly consumer spending on most consumer goods in nonbenchmark years. In these years, the estimate of total personal consumption expenditures (PCE) on most goods is derived by extrapolation from the benchmark year using a retail control total of sales by most kinds of business from the Census Bureau's monthly and annual surveys.

In general, product-based data on consumer spending are not available in nonbenchmark years, so the estimates for the detailed PCE categories are prepared by extrapolation using estimates of retail sales by corresponding product lines that, in turn, are based on retail sales by kind of business and on commodity sales data from the most

recent quinquennial economic census.[10] Then, the extrapolated estimates are adjusted proportionately so that their sum is equal to that for total PCE.[11]

The retail control method is illustrated in table 4.6. First, the PCE control total for year 2 is derived by extrapolation, using the change in the retail control total from year 1 to year 2 ($89 \times (120 / 100) = 106.8$).

In year 1, a benchmark year, information from the economic census is available to break sales down into product lines (and to corresponding PCE categories) for each kind of business (such as "grocery stores"). In year 2, the annual survey of retail sales provides data on sales by kind of business but not on sales by individual product lines. In order to estimate sales by product line for year 2, the product-line distribution of sales from year 1 is applied to the sales by kind of business for year 2 (for kind of business A, $0.2 \times 60 = 12$ for product line 1, and $0.8 \times 60 = 48$ for product line 2). Total sales for each product line are then computed by summing across all kinds of business (for product line 1, $12 + 36 = 48$; and for product line 2, $48 + 24 = 72$).

The retail sales product lines in the Census Bureau's data and the PCE categories in the NIPAs do not always match (in the example, product line 1 at 44 is larger than PCE category 1 at 33). Thus, the retail sales data are used to extrapolate the PCE estimates for year 2 (for product line 1, $33 \times (48 / 44) = 36$). Finally, the PCE category estimates must be adjusted so they sum to the PCE control total for year 2 (for product line 1, the adjusted estimate for year 2 is $36 \times (106.8 / 108) = 35.6$).

[10] The estimates for some PCE categories, such as consumer purchases of new and used motor vehicles and of motor vehicle fuels, are prepared independently.

[11] For more information on using the retail control method to prepare the PCE estimates, see "Chapter 5: Personal Consumption Expenditures," page 9.

Table 4.6—Simplified Example of Retail Control Calculation

	Year 1 (economic census)	Product ratios in year 1	Year 2 (annual survey)	Year 2 (calculated values)
Retail control total	100		120	
PCE control total	89			106.8
Retail sale data:				
Kind of business A	40		60	
Product line-1	8	0.2		12
Product line-2	32	0.8		48
Kind of business B	60		60	
Product line 1	36	0.6		36
Product line 2	24	0.4		24
Product-line sales:				
Line 1	44			48
Line 2	56			72
PCE sales data:				
Category 1	33			
Category 2	56			
PCE (summed by category)				108
Category 1				36
Category 2				72
PCE adjusted				106.8
Category 1				35.6
Category 2				71.2

Perpetual inventory method

The perpetual inventory method is used to indirectly derive historical-cost and constant-dollar estimates of net stocks of fixed assets, which, in turn, are used in deriving the NIPA estimates of consumption of fixed capital.[12] 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 (in order to capture shifts in ownership across NIPA sectors)—less the cumulative value of depreciation through that year. A variation of this method that omits depreciation is used to calculate the stocks of private inventories.

[12] Current-cost net stocks and current-cost depreciation (consumption of fixed capital) are derived by converting the corresponding constant-dollar estimates to the prices of the current period.

The perpetual inventory method is illustrated in table 4.7 (in this example, it is assumed that asset prices do not change over the course of the year). In year 1, the estimates of the beginning-of-year stocks for two types of assets, A and B, are equal to the end-of-year stocks for the preceding year.[13] For asset A, the end-of-year stock in year 2 is equal to the beginning-of-year stock in year 2 plus the value of investment in asset A during the year minus the value of depreciation during that year ($110 + $20 – $11 = $119).

Table 4.7—Simplified Example of Perpetual Inventory Calculation

	Asset A	Asset B	Total capital stock
Year 1:			
Beginning-of-year stock	100	50	150
Plus: Investment	20	10	
Minus: Depreciation	10	10	
Equals: End-of-year stock	110	50	160
Year 2:			
End-of-preceding-year stock	110	50	160
Plus: Investment	20	5	
Minus: Depreciation	11	10	
Equals: End-of-year stock	119	45	164

[13] The estimates of capital stock are very long time series, so virtually all assets currently in existence have been valued since they were produced.

Quantity and Price Estimates

Estimates for all of the NIPA aggregates and components are presented in current dollars. Changes in current-dollar estimates measure the changes in the market values of goods or services that are produced or sold in the economy. For many purposes, it is necessary to decompose these changes into price and quantity components. In the NIPAs, prices and quantities are expressed as index numbers with the reference year—at present, the year 2009—equal to 100. For selected series, quantities—or "real" (inflation adjusted) measures—are also expressed in chained (2009) dollars. (Period-to-period changes in quantities and prices are expressed as percent changes at annual rates; see "Statistical Tools and Conventions" in the appendix to this chapter.)

BEA prepares quantity estimates for GDP and its product-side components and for a few other aggregates and components. (For an illustration of the calculation of these estimates from a set of quantity and price information, see "Calculation of Output and Price Indexes" in the appendix to this chapter.)

Estimates for detailed components

For the detailed NIPA components, the quantity estimates are prepared using one of three methods—deflation, quantity extrapolation, or direct valuation—depending on the availability of source data. The quantity estimates are expressed as real values with 2009 (at present) as the reference year.

Deflation. Because the source data available for most components of GDP are measured in dollars rather than in units, the quantities of most of the detailed components are obtained by deflation. For deflation, quantities are calculated by dividing the current-dollar value of the component by an "appropriate" price index (with the reference-year value set to 100).[14]

$Q_t = (p_t q_t) / (p_t / p_o)$, where p_t and q_t are observed prices and quantities in the current year and p_o is the observed price in the reference year.

Thus, for example, if the current-dollar value for the component series is \$14 in 2010 and the appropriate price index is 112 in 2010, then the quantity estimate for the component series in 2010 is (\$14 ⁄ (112 ⁄ 100)), or \$12.50.

The price indexes used for deflation are generally adjusted for changes in characteristics or quality as described in the appendix to this chapter.

Quantity extrapolation. The other two methods are similar in that they both are derived using quantity data. Quantity extrapolation is used when a quantity indicator series is available that approximates the movements of the component series. In this

[14] A price index is appropriate if its definition and coverage closely match those of the series being deflated.

method, the quantity estimate is obtained by using the indicator series to extrapolate from the reference-year value.

$Q_t = p_o q_o + ((p_o q_o) \times ((q_t' - q_o')/q_o'))$, where q' represents the quantity indicator series.

For example, if the dollar value of the component series is $10 in 2009 and the quantity indicator series shows an increase of 25 percent in 2010, then the quantity estimate for the component series in 2010 is ($10 + ($10 × 25/100)), or $12.50.

Direct valuation. Direct valuation is used when physical quantity data and price data are available. In this method, the quantity estimate is obtained by multiplying the reference-year price by the actual quantity data for the current year.

$Q_t = p_o q_t$.

For example, if the price of the detailed component is $.50 per unit in 2009 and the quantity measure is 20 units in 2009 and 25 units in 2010, then the quantity estimate for the component series in 2010 is ($.50 × 25), or $12.50.

Estimates for NIPA aggregates

The fundamental problem confronting the efforts to adjust GDP and other aggregates for inflation is that there is not a single inflation number but rather a wide spectrum of goods and services with prices that are changing relative to one another over time. The index numbers for the individual components can be combined statistically to form an aggregate index, but the method of aggregation that is used affects the movements of the resulting index.

In the NIPAs, the annual changes in quantities and prices are calculated using a Fisher formula that incorporates weights from 2 adjacent years.[15] For example, the 2011–2012 change in real GDP uses prices for 2011 and 2012 as weights, and the 2011–2012 change in prices uses quantities for 2011 and 2012 as weights. These annual changes are "chained" (multiplied) together to form time series of quantity and price indexes. Quarterly changes in quantities and prices are calculated using a Fisher formula that incorporates weights from two adjacent quarters; quarterly indexes are adjusted for consistency to the annual indexes before percent changes are calculated.

The Fisher index (Q_t^F) for calculating real GDP (and other aggregate measures of output and expenditures) in year *t* relative to its value in the previous year *t-1* is

[15] This formula is named after Irving Fisher, who originally developed this index to more accurately measure quantity and price changes over time.

$$Q_t^F = \sqrt{\frac{\sum p_{t-1} q_t}{\sum p_{t-1} q_{t-1}} \times \frac{\sum p_t q_t}{\sum p_t q_{t-1}}},$$

where the *p*'s and *q*'s represent prices and quantities of detailed components in the 2 years.

Because the first term in the Fisher formula is a Laspeyres quantity index (Q_t^L), or

$$Q_t^L = \frac{\sum p_{t-1} q_t}{\sum p_{t-1} q_{t-1}},$$

and the second term is a Paasche quantity index (Q_t^P), or

$$Q_t^P = \frac{\sum p_t q_t}{\sum p_t q_{t-1}},$$

the Fisher formula can also be expressed for year *t* as the geometric mean of these indexes as follows:

$$Q_t^F = \sqrt{Q_t^L \times Q_t^P}.$$

The percent change in real GDP (and in other measures of output and expenditures) from year *t-1* to year *t* is calculated as

$$100(Q_t^F - 1.0).$$

Similarly, price indexes are calculated using the Fisher formula

$$P_t^F = \sqrt{\frac{\sum p_t q_{t-1}}{\sum p_{t-1} q_{t-1}} \times \frac{\sum p_t q_t}{\sum p_{t-1} q_t}},$$

which is the geometric mean of a Laspeyres price index (P_t^L) and a Paasche price index (P_t^P), or

$$P_t^F = \sqrt{P_t^L \times P_t^P} .$$

The chain-type quantity index value for period *t* is $I_t^F = I_{t-1}^F \times Q_t^F$, and the chain-type price index is calculated analogously. Chain-type real output and price indexes are presented with the reference year (*b*) equal to 100; that is, $I_b = 100$.

The current-dollar change from year *t-1* to year *t* expressed in the form of a ratio is equal to the product of the changes in the Fisher price and quantity indexes:

$$\frac{\sum p_t q_t}{\sum p_{t-1} q_{t-1}} = \sqrt{\frac{\sum p_t q_{t-1}}{\sum p_{t-1} q_{t-1}} \times \frac{\sum p_t q_t}{\sum p_{t-1} q_t}} \times \sqrt{\frac{\sum p_{t-1} q_t}{\sum p_{t-1} q_{t-1}} \times \frac{\sum p_t q_t}{\sum p_t q_{t-1}}} = P_t^F \times Q_t^F .$$

The same formulas are used to calculate the quarterly (and for some components, monthly) chain-type indexes. All quarterly chain-type indexes for completed years that have been included in an annual or comprehensive update are adjusted so that the quarterly indexes average to the corresponding annual index. When an additional year is completed between annual updates, the annual index is computed as the average of the quarterly indexes, so no adjustment is required to make the quarterly and annual indexes consistent. For example, until the 2012 annual update was released, the chain-type indexes for the year 2011 were computed as the average of the four quarterly indexes for 2011.

Properties of chain-type measures

The chain-type indexes based on the Fisher formula have several advantages over the fixed-weighted indexes that BEA used before 1996.[16]

- They produce percent changes in quantities and prices that are not affected by the choice of the reference period.
- They eliminate the substitution bias in measures of real GDP growth that are derived using fixed-weighted indexes. This bias tends to cause an understatement

[16] For information on BEA's introduction of chain-type indexes as its featured measure of real output and prices, see J. Steven Landefeld and Robert P. Parker, "Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA's New Featured Measures of Output and Prices," *Survey* 75 (July 1995): 31–38. See also J. Steven Landefeld and Robert P. Parker, "BEA's Chain Indexes, Time Series, and Measures of Long-Term Economic Growth," *Survey* 77 (May 1997): 58–68; and J. Steven Landefeld, Brent R. Moulton, and Cindy M. Vojtech, "Chained-Dollar Indexes: Issues, Tips on Their Use, and Upcoming Changes," *Survey* 83 (November 2003): 8–16.

of growth for periods before the reference year and an overstatement of growth for periods after the reference year.

- They eliminate the distortions of growth in components and in industries that result from the fixed-weighted indexes.
- They eliminate the anomalies that arise from using recent-period weights to measure periods in the past when a far different set of prices prevailed. For example, the prices of defense equipment in the 2000s are not appropriate for measuring the real changes in defense spending in the 1940s.
- They eliminate the inconvenience and confusion associated with BEA's previous practice of updating weights and years—and thereby rewriting economic history—about every 5 years.

Despite the greater accuracy provided by the chain-type indexes, users of macroeconomic statistics need more than index numbers and percent changes. The earlier fixed-weighted estimates were denominated in constant dollars, and the real levels for the components of GDP added up to total GDP. Because the system was additive, the shares of the real components reflected their relative importance in total GDP. Similarly, in decomposing total GDP growth by component, the change in constant-dollar values measured the component's contribution to the change in the fixed-weighted aggregate. For GDP and most of its components, BEA prepares estimates in chained dollars as well as chain-type indexes (see the appendix to this chapter). However, because these chained-dollar measures are not based on a single set of weights, they are not additive and thus do not yield accurate measures of shares and contributions to growth.

For real GDP and its major components, BEA provides tables that present accurate estimates of contributions to growth rates that are based on chain-type quantity indexes rather than on the chained-dollar estimates (see the appendix). In addition, BEA provides measures of percentage shares that are based on current-dollar values. Because current-dollar values provide the weights for the chain-type indexes, shares calculated from these estimates rather than from the chained-dollar estimates should be used to indicate the relative importance of components.

APPENDIX

Calculation of Output and Price Indexes

The market (and nonmarket) values used to measure GDP and the other NIPA estimates are in current dollars—that is, they represent the values of transactions taking place in the current time period. In turn, these transactions reflect a combination of physical quantities and prices. As shown in exhibit 4.1, in year 1, 10 apples at a price of $0.20 per apple can be purchased for $2.00. If the transactions in a given time period are compared with those in another time period, the differences in the current-dollar values can be attributed to differences in quantities and to differences in prices. In year 2, 20 apples at a price of $0.25 per apple can be purchased for $5.00. The increase in expenditures from $2.00 to $5.00, or 150 percent, can be separated into quantity and price elements. The quantity of apples purchased increased from 10 to 20, or 100 percent, and the price of apples increased from $0.20 to $0.25 or 25 percent.

Exhibit 4.1

Year 1			
	Expenditures	Quantity	Price
Apples	$2.00	10	$0.20
Oranges	$3.00	30	$0.10
Total fruit	$5.00		
Year 2			
Apples	$5.00	20	$0.25
Oranges	$4.00	20	$0.20
Total fruit	$9.00		

For most NIPA components, estimates of physical quantities are not available. Instead, "real" estimates—that is, estimates that exclude the effects of price change—are derived by "deflating" (dividing) the current-dollar value by appropriate price indexes. In order to prepare such estimates, a statistical application must be used that establishes a common unit price as the basis for comparison. For exhibit 4.1, one way to accomplish this is to value the second-period transaction in the price of the first period: 20 apples at the year 1 price of $0.20 is equal to $4.00, and so the real estimate increases from $2.00 in year 1 to $4.00 in year 2, or 100 percent. Alternatively, the first-period transaction could have been valued in second-period prices: 10 apples at the year 2 price of $0.25 is equal to $2.50, and so the real estimate increases from $2.50 in year 1 to $5.00 in year 2, or 100 percent.

Thus, the separation of current-dollar change into price and quantity elements for a single, detailed component is straightforward. However, for an aggregation of detailed components, price changes and quantity changes cannot be observed directly in the economy. Thus, the partitioning of the current-dollar change into price- and quantity-change elements becomes an analytic process. The price and quantity changes must be calculated, and the calculation method is determined by analytic requirements. Because of the complexity of the interactions of prices and quantities, the method of calculating real estimates for the NIPAs has evolved over time.

Estimates of real GNP and other components were introduced into the NIPAs in the early 1950s as a supplement to the current-dollar estimates. These measures were calculated by specifying a single base period set of prices and then valuing the output of all periods using those prices.

As shown in calculation 1 in exhibit 4.2 (page 4–19), which uses year 1 for valuation, the real estimate for the change in fruit from year 1 to year 2 is 20 percent. This approach, in which the real estimates are calculated moving forward from the base period, is called a "Laspeyres" quantity index. However, the results of the calculation are dependent on the choice of the base year for valuation. In calculation 2, which uses year 2 for valuation, the real estimate for the change in fruit from year 1 to year 2 is 6 percent. This approach, in which the estimates are calculated moving backward from the current period, is called a "Paasche" quantity index. Corresponding calculations can be made to produce Laspeyres and Paasche price indexes.

Before 1996, the real estimates in the NIPAs were calculated as Laspeyres quantity indexes, and the price estimates were calculated as implicit price deflators.[17] In calculation 4, the estimate for the change in the price of fruit from year 1 to year 2 is 50 percent. Note that one property of these estimates is that the index for total expenditures on fruit in year 2 ($9.00 / $5.00, or 1.800) is equal to the Laspeyres quantity index for year 2 multiplied by the Paasche price index for year 2: 1.200 × 1.500 = 1.800.

In 1996, BEA introduced chain-weighted indexes as its featured measure of the change in real GDP and in prices. These indexes, which are based on weights that are more appropriate to the time period being measured, significantly improved the accuracy of the NIPA estimates. The weights for these measures are calculated as the geometric mean of the calculations for the Laspeyres index and the Paasche index (in exhibit 4.1, as the square root of 1.200 × 1.059, or 1.127). Similarly, price measures are computed using weights calculated as the geometric mean of the calculations for the Laspeyres index and the Paasche index (in exhibit 1, as the square root of 1.700 × 1.500, or 1.597). Note that for the chain-type measures, the Fisher quantity index for year 2 multiplied by the Fisher price index for year 2 is also equal to the index for total expenditures on fruit in year 2: 1.127 × 1.597 = 1.800.

Note. The material presented in this section is based on the box "Note on Calculating Output and Prices" written by Jack E. Triplett and published in the article "Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA's New Featured Measures of Output and Prices," *Survey of Current Business* 75 (July 1995): 32–33.

[17] In the exhibit, all calculations involve only 2 years, so the Paasche price index and the implicit price deflator are equivalent.

Exhibit 4.2

Calculation 1: Laspeyres Quantity Index

Year 1 weighted quantity change measure for fruit: hypothetical expenditure on fruit in year 2 using year 1 prices, divided by actual expenditure on fruit in year 1

$$[(20 \times \$0.20) + (20 \times \$0.10)] / [(10 \times \$0.20) + (30 \times \$0.10)]$$

$$= \$6.00 / \$5.00 = 1.200$$

Calculation 2: Paasche Quantity Index

Year 2 weighted quantity change measure for fruit: actual expenditure on fruit in year 2, divided by hypothetical expenditure on fruit in year 1 using year 2 prices

$$[(20 \times \$0.25) + (20 \times \$0.20)] / [(10 \times \$0.25) + (30 \times \$0.20)]$$

$$= \$9.00 / \$8.50 = 1.059$$

Calculation 3: Laspeyres Price Index

Year 1 weighted price change measure for fruit:

$$[(10 \times \$0.25) + (30 \times \$0.20)] / [(10 \times \$0.20) + (30 \times \$0.10)]$$

$$= \$8.50 / \$5.00 = 1.700$$

Calculation 4: Paasche Price Index

Year 2 weighted price change measure for fruit:

$$[(20 \times \$0.25) + (20 \times \$0.20)] / [(20 \times \$0.20) + (20 \times \$0.10)]$$

$$= \$9.00 / \$6.00 = 1.500$$

Adjusting for quality change

Accurate price indexes are crucial for preparing accurate estimates of real GDP as well as corresponding productivity measures. The illustrations shown above assume that there are changes only in the prices and quantities of the goods or services being measured. The development of a price index becomes more complicated when the characteristics or quality of the goods or services are also changing. In these cases, the price index must isolate and measure only the price change and not the impacts of these other changes. There are several methods used to construct price indexes, and while most of these are designed to measure price change while holding quality constant, no method

is perfect in every situation.[18] Traditional matched model indexes, which hold quality constant by specifying each variety in the sample and ensuring that exactly the same variety of product is sampled each period, work well with relatively standardized products. However, these indexes are less accurate when the characteristics, quality, market shares, and prices are changing rapidly. In such cases, alternative methods for quality adjustment may yield more accurate measures. The attribute-cost adjustment method, adopted recently by the Bureau of Labor Statistics (BLS) to construct the consumer price index (CPI) for computers, uses monetary values of the attributes that affect price, obtained from the original equipment manufactures or from price compiler websites, to determine appropriate quality adjustments.[19] The hedonic method uses regression analysis to determine statistical relationships between observed price changes and changes in the characteristics and qualities of the products, and these relationships are used to hold quality constant; this method is used by BLS in many of its producer and consumer price indexes and by the Census Bureau in its housing construction and sales price indexes. Both techniques have been shown to produce price indexes that are more accurate than traditional matched model indexes in cases of rapid change.[20] BEA's primary source of indexes to deflate GDP and its components is BLS, which provides detailed price indexes—including consumer price indexes, producer price indexes, and international price indexes. These indexes, as well as other indexes from BLS, the Census Bureau, and other federal agencies, all employ methodologies to adjust for quality change. In cases where quality-adjusted indexes have not been available, BEA has developed its own indexes. For example, for a number of years in the 1980s and early 1990s, BEA produced hedonic indexes for computers; as BLS began publishing quality-adjusted PPIs for computers and peripheral equipment in the 1990s, BEA adjusted its methodologies to incorporate them. In the late 1990s, BEA introduced quality-adjusted price indexes for semiconductors, for digital telephone switching equipment, and for computer software; more recently, BEA has introduced a hedonic price index for photocopying equipment.[21]

[18] An exception is a unit value index, which measures the change in the value of items without holding characteristics, quality, or even the mix of items constant.

[19] For more information on how BLS calculates the CPI for computers, see http://www.bls.gov/cpi/cpifaccomp.htm.

[20] For more information on the hedonic method underlying producer and consumer price indexes, see http://www.bls.gov/ppi/ppicomqa.htm and http://www.bls.gov/cpi/cpihqaitem.htm and http://www.bls.gov/cpi/cpihqaitem.htm. For more information on the hedonic method underlying housing price indexes, see http://www.census.gov/construction/cpi.

[21] For more information these quality-adjustment techniques, see "Prices and Output for Information and Communication Technologies," on BEA's Website at http://www.bea.gov/national/info_comm_tech.htm.

Statistical Tools and Conventions

This section describes some of the statistical tools and conventions that BEA uses in preparing and presenting the NIPA estimates. In general, these statistical operations are used to transform the estimates into alternative formats that facilitate analytical or presentational uses.

Chained-dollar measures

As a supplement to its chain-type quantity indexes, BEA prepares measures of real GDP and its components in a dollar-denominated form, designated "chained (2009) dollar" estimates. For GDP and most other series, the chained-dollar value CD_t^F is calculated by multiplying the reference year current-dollar value $\sum p_b q_b$) by the chain-type Fisher quantity index (I_t^F) and dividing by 100. For period *t*,

$$CD_t^F = \sum p_b q_b \times I_t^F / 100 .$$

Thus, for example, if a current-dollar GDP component is equal to $200 in 2009 and if the quantity index for this component increased 15 percent by 2012, then the chained (2009) dollar value of this component in 2012 would be $200 x 115⁄100, or $230.

The chained (2009) dollar estimates provide measures to calculate the percent changes for GDP and its components that are consistent with those calculated from the chain-type quantity indexes; any differences are small and due to rounding. For most components of GDP, the chained-dollar estimates also provide rough approximations of their relative importance and of their contributions to real GDP growth for years close to 2009. However, for components—such as computers and other high-tech equipment—with rapid growth in real output and sharply falling prices, the chained-dollar levels (as distinct from chain-weighted indexes and percent changes) will overstate their relative importance to GDP growth.

In addition, chained-dollar values for the detailed GDP components will not necessarily sum to the chained-dollar estimate of GDP (or of any intermediate aggregate), because the relative prices used as weights for any period other than the reference year differ from those used for the reference year. BEA provides a measure of the extent of such differences by showing a "residual" line on chained-dollar tables that indicates the difference between GDP (and other major aggregates) and the sum of the most detailed components in the table.

For periods close to the reference year, when there usually has not been much change in the relative prices that are used as the weights for calculating the chain-type index, the residuals tend to be small, and the chained (2009) dollar estimates can be used to approximate the contributions to growth and to aggregate the detailed estimates.

However, it is preferable to use estimates of exact contributions, which are described in the next section.

Some exceptions to the above methodology are made for a few components of GDP. For cases in which the components of an aggregate include large negative values, the Fisher formula cannot be used because it would require taking the square root of a negative number. In such cases, one of two other methods is used.

- Quantity estimates are calculated as the sum of, or as the difference between, chained-dollar series that measure flows. For example, real net exports is derived as the difference between real exports and real imports.
- Quantity estimates are calculated as the difference between measures of chain-weighted stocks. For example, the real annual change in private inventories is derived as the difference between real beginning-of-year inventories and real end-of-year inventories.

The inability to calculate a particular Fisher quantity index (for example, for change in private inventories) because of negative values usually does not extend to the calculation of higher level aggregates (for example, quantity indexes for gross private domestic investment and for GDP can be computed). The calculation of contributions to percent change is not affected by negative values, so they can be calculated for all components.

The chain-dollar estimates are used in the calculation of another price index, the *implicit price deflator* (IPD). The IPD_t^F for period *t* is calculated as the ratio of the current-dollar value to the corresponding chained-dollar value, multiplied by 100, as follows:

$$IPD_t^F = \frac{\sum p_t q_t}{CD_t^F} \times 100 .$$

For all aggregates and components and for all time periods, the value of the IPD is very close to the value of the corresponding chain-type price index. Note that this definition of the IPD differs from that used before the introduction of chain-type measures in1996, when the IPD was defined as the ratio of the current-dollar value to the corresponding constant-dollar value.

Contributions to percent change

As one moves further away from the reference year, the residual tends to become larger, and the chained-dollar estimates are less useful for analyses of contributions to growth. For this reason, BEA also shows contributions of major components to the percent change in real GDP (and to the percent change in other major aggregates) that use exact formulas for attributing growth.

The contributions to percent change in a real aggregate, such as real GDP, provide a measure of the composition of growth in the aggregate that is not affected by the nonadditivity of its components. This property makes contributions to percent change a valuable tool for economic analysis. The contribution to percent change ($C\%\Delta_{i,t}$) in an aggregate in period *t* that is attributable to the quantity change in component *i* is defined by the formula

$$C\%\Delta_{i,t} = 100 \times \frac{((p_{i,t} / P_t^F) + p_{i,t-1}) \times (q_{i,t} - q_{i,t-1})}{\sum_j ((p_{j,t} / P_t^F) + p_{j,t-1}) \times q_{j,t-1}},$$

where

P_t^F is the Fisher price index for the aggregate in period *t* relative to period *t-1*;
$p_{i,t}$ is the price of the component *i* in period *t*; and
$q_{i,t}$ is the quantity of the component *i* in period *t*.

The summation with subscript *j* in the denominator includes all the deflation-level components of the aggregate. Contributions of subaggregates (such as PCE goods) to the percent change of the aggregate (say, PCE or GDP) are calculated by summing the contributions of all the deflation-level components contained in the subaggregate.[22]

For annual estimates, no adjustments are required for the contributions to sum exactly to the percent change in the aggregate. For quarterly estimates, adjustments are required to offset the effects of adjustments that were made to equate the average of the quarterly estimates to the corresponding annual estimate and to express the percent change at annual rate. The same formula is used for both annual and quarterly estimates of contributions to percent change in all periods. The only variation in the method of calculation is that the annual contributions for the most recent year are based on a weighted average of the quarterly contributions until the next annual update.

Annual rates

Quarterly and monthly NIPA estimates in current and chained dollars are presented at annual rates, which show the value that would be registered if the level of activity measured for a quarter or for a month were maintained for a full year. Annual rates are used so that periods of different lengths—for example, quarters and years—may be easily compared. These annual rates are determined simply by multiplying the estimated rate of activity by 4 (for quarterly data) or by 12 (for monthly data).

[22] See Marshall B. Reinsdorf, W. Erwin Diewert, and Christian Ehemann, "Additive Decompositions for Fisher, Tornqvist, and Geometric Mean Indexes," *Journal of Economic and Social Measurement* 28 (2002): 51–61, www.econ.ubc.ca/diewert/additive.pdf.

Growth rates

In general, percent changes in the NIPA estimates are also expressed at annual rates, which show the value that would be registered if the pace of activity measured for a time period were maintained for a full year.[23] Calculating these changes requires a variant of the compound interest formula,

$$r = \left[\left(\frac{GDP_t}{GDP_0} \right)^{m/n} - 1 \right] \times 100,$$

where

r is the percent change at an annual rate;
GDP_t is the level of activity in the later period;
GDP_0 is the level of activity in the earlier period;
m is the periodicity of the data (for example, 1 for annual data and 4 for quarterly data); and
n is the number of periods between the earlier and later periods (that is, t-0).

Thus, for example, if a component increases from $100 in the first quarter to $105 in the second quarter (5 percent at a quarterly rate), the annual rate of increase is (($105/$100)$^{4/1}$ – 1) x 100 = 21.6 percent.

Rebasing an index

In the NIPAs, quantities and prices are generally expressed as index numbers with a reference year—at present, the year 2009—equal to 100. These indexes can easily be rebased to a different reference year without changing the relationship between the series values. To rebase, divide the entire index by the index value of the desired reference year. As illustrated in table 4.8, the original index is rebased from year 1 to year 2 by dividing each of the original index values by the index value in year 2 (for year 1, 100.0⁄110.0 = 90.9). Note that the year-to-year percent changes are unaffected by the rebasing.

Table 4.8—Example of Index Rebasing

Year	Original index	Percent change	Rebased index	Percent change
1	100.0	…..	90.9	…..
2	110.0	10.0	100.0	10.0
3	120.0	9.1	109.1	9.1
4	130.0	8.3	118.2	8.3

[23] The growth rates in the NIPA monthly series, such as personal income, are not expressed at annual rates.