CHAPTER 7: CHANGE IN PRIVATE INVENTORIES

Change in private inventories (CIPI), or inventory investment, is a measure of the value of the change in the physical volume of the inventories—additions less withdrawals—that businesses maintain to support their production and distribution activities.

Inventory investment is one of the most volatile components of gross domestic product (GDP), giving it an important role in shortrun variations in GDP growth. Moreover, inventory movement plays a key role in the timing, duration, and magnitude of business cycles, as unanticipated buildups in inventories may signal future cutbacks in production, and unanticipated shortages in inventories may signal future pickups in production.

The CIPI estimates are the building blocks for BEA's estimates of inventory stocks. These stock estimates, coupled with BEA's estimates of final sales, form inventory-sales ratios that can be used to assess the likelihood that businesses will add to, or reduce, inventories in response to changes in demand.

The CIPI estimates are an integral part of the U.S. national income and product accounts (NIPAs), a set of accounts that provide a logical and consistent framework for presenting statistics on U.S. economic activity (see "Chapter 2: Fundamental Concepts").

Definitions and Concepts

CIPI is the NIPA measure of the flow (or change) in the stock of inventories held by private business over a specified period.[1] The stock of inventories is the value of the goods owned by private business at the end of a specified period, whether the goods were produced or acquired in that period or in previous periods.

Inventories are maintained by business in order to facilitate the production and distribution of goods or services. The items held in inventory may be in the form of goods ready for sale (finished goods), of goods undergoing production (work in process), or of goods acquired for use in the production process (materials and supplies) (table 7.1). For example, an auto dealer keeps a variety of makes, models, and parts on hand to meet the varied requirements and preferences of potential customers; an auto manufacturer keeps supplies of inputs, such as steel, on hand for use in manufacturing new vehicles.

Table 7.1—Content of Change in Private Inventories

Category of inventory	Comments
Finished/ready-for-sale goods inventory	The value of produced goods held for future sale. Applies to most industries.
Work-in-process inventory	The value of goods still in the process of production. Applies to manufacturing and publishing industries.
Materials and supplies inventory	The value of natural resources and basic manufactured goods that are acquired by business for use as inputs to the production process. Applies to manufacturing, mining, construction, utilities, and publishing industries.

A general principle underlying NIPA accounting is that production should be recorded at the time it occurs. In the measurement of GDP, the other product-side components, such as personal consumption expenditures (PCE) and fixed investment, record final sales in the current period, but these sales may involve goods that were produced—or at least partially produced—in earlier periods. The recording of movements of goods in inventory—materials and supplies, work-in-process, and finished goods—and from inventories to final sales provides the means to allocate production to the period in which it actually occurred (see the box on the next page for a simple example of the allocation).

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[1] In the NIPAs, private business consists of all private entities that produce goods and services for sale at a price intended to at least approximate production costs and of certain other private entities that are treated as business in the NIPAs. These other entities include mutual financial institutions, private noninsured pension funds, cooperatives, and nonprofit organizations that primarily serve business (that is, entities classified as nonprofit by the Internal Revenue Service in determining income tax liability), federal reserve banks, and federally sponsored credit agencies.

Simple Example of CIPI Role in Calculating GDP

	[Billions of dollars]				
	Auto Manufacturer		Auto dealer		GDP
	Materials and supplies	Finished goods	Goods ready for sale	Sales	
I	-10,000	+20,000	…..	…..	+10,000
II	…..	-20,000	+20,000	…..	0
III	…..	…..	+20,000	+22,000	+2,000

- At the beginning of period I, an auto manufacturer has in inventory $10,000 of steel and other materials and supplies that it will use as inputs to produce an automobile.
- In period I, the manufacturer uses the materials and supplies from inventory and its own resources (such as labor) to produce the automobile. The value of the materials and supplies used ($10,000) is subtracted from those inventories, and the value of the produced automobile ($20,000) is added to the finished goods inventory. Thus, total change in inventories is +$10,000, and this amount— which represents production, or value added, in this period—is added to GDP.
- In period II, the manufacturer ships the finished auto to an auto dealer. The value of the manufacturer's finished goods inventory decreases by $20,000, and the value of the dealer's inventory of autos ready for sale increases by $20,000. GDP is not affected.
- In period III, the dealer sells the auto to a consumer for $22,000. The dealer's inventory declines by $20,000. GDP increases by $2,000 (PCE of $22,000 plus CIPI of –$20,000), which represents the value added by the dealer in the form of retail margin.

As a result of this accounting for inventories, the process of assembling the materials and supplies into a finished automobile is recorded in period I, when it actually occurred, rather than in period III, when the final sale occurred. Similarly, the value added by steel manufacturers and other producers of the materials and supplies that were used as inputs in period I would have been recorded in earlier periods when those goods were produced.

In measuring the level of GDP, the change in, not the level of, inventories provides the appropriate measure of the flow of economic activity that is consistent with that measured by the other GDP components. A positive CIPI indicates that total production (GDP) exceeded the sum of the final sales components of GDP in the current period and that the excess production was added to inventories. A negative CIPI indicates that final sales exceeded production in the current period and that the excess sales were filled by drawing down inventories. CIPI is valued in the average prices for the period because units move in and out of inventories continuously over the course of the period.

In measuring the change in GDP, the change in CIPI (or the change in inventory investment) is the relevant measure. For example, inventories may contribute to an increase in GDP (1) by accumulating in the current period after decumulating in the preceding period, (2) by accumulating more in the current period than in the preceding period, or (3) by decumulating less in the current period than in the preceding period (table 7.2).

Table 7.2—Effects of Change in CIPI on Change in GDP
[Billions of dollars]

	Inventory level [stock]			CIPI [flow]		Contribution of change in CIPI to change in GDP
	I	II	III	II	III	III
(1)	500	495	500	-5	5	10
(2)	500	510	530	10	20	10
(3)	500	485	480	-15	-5	10

Most of the CIPI estimates are derived from information recorded in business-accounting statements. For an illustration of the relationships between business-accounting practices and the principles of national accounting and their varying impacts on the measurement of inventories, cost of goods sold, and profits, see appendix A to this chapter.

In business accounting, the change in the book value of inventories is the measure of the difference between inventory acquisitions and inventory withdrawals during the accounting period. Generally, when a good is placed in inventory, it is valued on a firm's books at the price prevailing when the good enters into inventory; this is sometimes referred to as "acquisition" or "historical" cost. However, there are a number of different accounting methods—such as "last in, first out" (LIFO) and "first in, first out" (FIFO)—that can be used in determining the value of the goods that are withdrawn from inventories and of the goods that remain in inventories over time.[2]

Another general principle underlying NIPA accounting is that (a) production should be valued at the price prevailing when it occurs, regardless of whether the good is sold immediately or it is entered into inventory for sale at a later time, and (b) a good that is withdrawn from inventory must be valued at the price prevailing when it is withdrawn, so holding gains or losses do not affect the measure of production in the current period. In business accounting, a good leaving inventory is valued at historical cost—that is, at the price that prevailed when it entered inventory (see appendix A). The difference

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[2] LIFO is a method of accounting valuation of inventories that assumes the goods acquired most recently are used up first, so that withdrawals from inventory are primarily valued at recent acquisition costs. FIFO is a method that assumes the oldest stock in inventories is used up first, so withdrawals from inventory are primarily valued at earlier acquisition costs. Other valuation methods include "average cost," "market cost," and "standard cost."

between the business-accounting measure of change in the book value of inventories and the NIPA measure of CIPI is the gain or loss from holding goods in inventory; it is termed the *inventory valuation adjustment* (IVA) (see the section "Overview of Source Data and Estimating Methods").

Recording in the NIPAs

As described above, CIPI provides a bridge between final sales in the current period and production in the current period. It is one of the few NIPA components that can be negative. In the seven summary accounts of the NIPAs, CIPI appears in the Domestic Income and Product Account (account 1) as a component of gross private domestic investment and in the Domestic Capital Account (account 6) as a component of gross domestic investment.

In the NIPAs, the inventory estimates are generally shown by industry classification, using the North American Industry Classification System, rather than by type of product classification (see chapter 2). Thus, for example, "wholesale trade durable goods inventories" signifies "inventories held by industries engaged in the wholesale trade of durable goods." CIPI by industry is presented in NIPA table group 5.6. Stocks of private inventories, along with the corresponding aggregate estimates of final sales and inventory-sales ratios, are shown in table group 5.7.

The following is a list of the principal NIPA tables that present the inventory estimates:
5.6.5B Change in Private Inventories by Industry
5.6.6B Change in Real Private Inventories by Industry, Chained Dollars
5.7.5B Private Inventories and Domestic Final Sales by Industry
5.7.6B Real Private Inventories and Real Domestic Final Sales by Industry, Chained Dollars
5.7.9B Implicit Price Deflators for Private Inventories by Industry
In addition, estimates of change in motor vehicle inventories are shown in tables 7.2.5B and 7.2.6B, and estimates of change in farm inventories are shown in tables 7.3.5 and 7.3.6.

BEA also prepares "Underlying Detail" tables for the estimates shown in NIPA table group 5.6, including detail for change in the book values and for IVA by industry, at a greater level of detail than is shown in the published estimates.[3]

In addition, BEA publishes estimates of real inventories, sales, and inventory-sales ratios for the manufacturing and trade industries each quarter in the *Survey of Current Business* (generally in the January, April, July, and October issues). BEA also prepares "Underlying Detail" tables for these estimates.

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[3] Go to www.bea.gov/national/nipa_underlying/Index.asp.

Overview of Source Data and Estimating Methods

As described earlier in this handbook, the NIPA estimates, including those for CIPI, are prepared using a wide variety of source data (see "Chapter 3: Principal Source Data") and using estimating methods that adjust the source data to the required NIPA concepts and that fill in gaps in coverage and timing (see chapter 4).

For farm inventories, the estimates of crop and of livestock inventory change are prepared as the product of the change in the physical volume and of the average price, based on data from the U.S. Department of Agriculture (USDA). For example, changes in stocks of wheat on the farm are calculated as wheat harvested and available for sale less wheat sold, valued at average market prices. The estimates of farm inventories include materials and supplies—such as feed, fertilizer, and purchased seed—that are used as inputs to farm production. For crops, the estimates also take into account Commodity Credit Corporation (CCC) loans to producers who use agricultural commodities as collateral.[4] Because the estimates of farm inventories are prepared using data on quantities and current prices rather than business-accounting data, an IVA is not calculated.

For nonfarm industries, the estimates of inventory change are generally prepared by beginning with data on the end-of-period book value of inventories, as reported by private business using a variety of accounting methods.[5] The inventory data are then adjusted—annually for 417 detailed industries and monthly for 82 aggregated industries—to value the inventories at a uniform set of prices and to remove holding gains or losses.

More specifically, for manufacturing and trade industries, data on the book value of inventory stocks, inventory turnover, and on the methods of inventory valuation are collected in economic censuses and annual surveys conducted by the Census Bureau. Businesses that use LIFO accounting also provide the Census Bureau with an estimate of the "LIFO reserve," an adjustment for converting their inventories to a non-LIFO valuation. Data on inventory stocks at the end of the month (and quarter) are collected in the Census Bureau's monthly surveys. In the Census Bureau's published reports of manufacturing and trade inventories, all inventories are valued on a "non-LIFO basis."[6]

For most other nonfarm industries, annual data on the book value of inventory stocks are available from Internal Revenue Service (IRS) tabulations of business tax

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[4] Placement of crops as collateral for CCC loans is treated as an addition to farm inventories. Redemption of the crop after loan repayment or forfeiture of the crop after loan default are each treated as a withdrawal from farm inventories. The data on the physical quantities of crops placed, redeemed, and forfeited are from USDA and are valued using average market prices.

[5] As a practical matter, the end-of period inventory data reflect losses that result from damage, theft, and other causes, as well as business withdrawals.

[6] The Census Bureau reports inventories on a non-LIFO basis because during periods of rising inventories and prices, LIFO accounting may result in stock estimates that are considerably undervalued (see appendix A).

returns. The data include information on inventory stocks, the proportions of those stocks that are valued on a LIFO basis, and inventory turnover.

For most nonfarm industries, the principal price data used in estimating NIPA inventories are producer price indexes (PPIs) and import price indexes, both from the Bureau of Labor Statistics (BLS). For the manufacturing and publishing industries, the prices for work-in-process and finished goods inventories consist of a combination of the following: the cost of materials and supplies, based on PPIs; labor costs, based on BEA-constructed unit labor cost indexes; and overhead costs—including rent, depreciation charges, and repair costs—primarily based on PPIs. The BEA labor cost indexes cover compensation of production workers, supervisors, and nonproduction personnel working at the plant and are based on BEA wage data.

At the most detailed level for which BEA prepares estimates, the procedure for nonfarm inventories generally consists of the following steps that yield current-dollar and constant-dollar estimates for CIPI and for the stocks of goods held in inventory. For an illustration of the estimation procedure, see appendix B to this chapter.

1. Separating Census Bureau published inventories (which are on a non-LIFO basis) into those that were reported on a LIFO basis and those that were reported using other accounting methods.
2. Construction of current-period inventory price indexes for each industry, and for manufacturing and for publishing, each stage of fabrication.
3. Construction of monthly cost indexes for each industry, and for manufacturing and publishing, each stage of fabrication.
4. Revaluation of the book-value inventories to yield constant-dollar and current-dollar change in inventories.
5. Calculation of the IVA.
6. Calculation of current-dollar and constant-dollar stocks.

As noted earlier, the IVA is the measure of the holding gains or losses that are removed from the business-accounting measure of inventory change. It is calculated for all inventory-accounting methods, regardless of whether inventories are accumulating or decumulating over the recording period. However, under LIFO accounting, if inventories are accumulating, withdrawals are already valued at current-period prices; thus, CIPI and change in the book value are equal, and the IVA is zero (see appendix A).

In the NIPAs, the IVA is also shown on the income side of the accounts in order to exclude the inventory holding gains (or losses) from business income in the calculation of corporate profits and of nonfarm proprietors' income.[7] Since profit and income data come from IRS tabulations, the product-side IVA must be adjusted for any accounting-basis differences between the IRS data and the Census Bureau data. (The estimates for nonfarm industries other than manufacturing and trade are already based on IRS data, so in most cases no adjustment is needed for those industries.)

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[7] See NIPA table 6.14D, "Inventory Valuation Adjustment to Nonfarm Incomes by Legal Form of Organization and by Industry."

In estimating the stocks of private inventories, the constant-dollar estimates are derived first, using the perpetual inventory method—that is, by adding the change in real private inventories during the period to the real stocks at the end of the preceding period (see "perpetual inventory method" in "Chapter 4: Estimating Methods"). The end-of-period current-dollar estimates of the stock of private inventories are then derived by "reflation"—that is, by multiplying estimates of the end-of-period real-stocks by appropriate price indexes.

Table 7.A at the end of this chapter summarizes the source data and estimating methods that are used to prepare the benchmark-year, nonbenchmark-year, current quarterly, and quantity (inflation-adjusted) estimates for the CIPI categories that are shown by industry in NIPA table group 5.6.

Benchmark-year estimates

For manufacturing, data on the book value of inventory stocks and on the methods of inventory valuation are available from the Census Bureau's economic census. Manufacturing establishments report their end-of-year inventory levels and their inventories by stage of fabrication (finished, work-in-process, and materials and supplies). Information on the distribution of costs in the manufacturing sector among materials, labor, and overhead is used in the calculation of cost of goods sold and of inventory turnover ratios (see appendix B). The commodity composition of materials held in inventory is assumed to be the same as that for materials purchased by the industry, which, in turn, is derived from BEA's benchmark input-output accounts, based on information from the economic censuses on materials "consumed" by industry. This information is used in the calculation of materials held in inventory.

For wholesale trade, data on the book value of inventory stocks are available from the annual wholesale trade survey and data on the methods of inventory valuation are available from the economic census. For retail trade, the data on the book value of inventory stocks and on inventory valuation are available from the annual retail trade survey. Retail and wholesale trade establishments report their inventories of goods for sale at the end of the year.[8] LIFO users also report the LIFO reserve and the LIFO value after adjustment for the reserve. For wholesale and retail trade, data on purchases from the annual surveys are used in the calculation of cost of goods sold and of inventory-turnover ratios. In addition, data on product-line sales by industry are used in the calculation of commodities held in inventory.

For the mining and construction industries, the inventory estimates for benchmark years are based on information from the economic census. For the publishing industry, the inventory estimates are based on information from the services annual survey. For all

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[8] The inventory data published by the Census Bureau include inventories that are owned by U.S. establishments but are held abroad. BEA adjusts these data in order to exclude those inventories.

other nonfarm industries, the estimates for all years except the most recent year are based on IRS tabulations of income tax returns for corporations and for sole proprietorships and partnerships.

For farm inventories, the estimates for all years (benchmark and nonbenchmark) are based on USDA annual reports. Annual changes in farm inventories of crops are estimated as crops harvested in the period and available for sale (that is, not including crops retained for personal consumption) less crops sold in the period plus net CCC loan transactions. The annual quantity changes for each crop are valued at average market prices received by farmers during the calendar year. Annual changes in farm inventories of livestock are estimated from USDA surveys of inventory stocks on farms. For each livestock commodity, annual quantity changes are valued at average market price per head.

Nonbenchmark-year estimates

For years other than benchmark years and the most recent year, the inventory estimates for the manufacturing, trade, and publishing industries are primarily based on the Census Bureau's annual survey of manufactures, annual wholesale trade survey, annual retail trade survey, and service annual survey. Respondents to these surveys report LIFO, LIFO reserve, and non-LIFO valuations separately. In addition, respondents in the manufacturing sector report information on the distribution of costs among materials, labor, and overhead and those in retail and wholesale report purchases; this information is used in the calculation of cost of goods sold and of inventory-turnover ratios.

For the mining, utilities, and construction industries, as well as for other nonfarm industries, the estimates for all nonbenchmark years except the most recent year are based on IRS tabulations of income tax returns for corporations and for sole proprietorships and partnerships.

The sources and methods for deriving the nonbenchmark-year estimates of farm inventories are the same as those for the benchmark estimates (see above).

Most-recent-year and current-quarterly estimates

The inventory estimates for the most recent year and for the current quarters for the manufacturing and trade industries (except those for retail auto dealers) are based on the following Census Bureau surveys: monthly survey of manufacturers' shipments, inventories, and orders; monthly wholesale trade survey; and monthly retail trade and food services survey. The data for manufacturing, wholesale trade, and retail trade are summarized in the Census Bureau's monthly "Business Sales and Inventories" release. The quarterly estimates for the manufacturing and trade industries are calculated as end-of-month inventories for the final month of the quarter less end-of-month inventories for the final month of the preceding quarter.

For retail auto dealers, inventory estimates for the most recent year and for the current quarters are primarily based on a reconciliation with BEA's unit-based estimates, which are based on the monthly unit data from *Wards' Automotive Reports* and on average price data from J.D. Power and Associates.

For utilities, the quantity estimates are prepared first, using data on changes in the physical stocks of coal, petroleum, and natural gas and on base-year prices from the Energy Information Administration. The current-dollar estimates are then derived by "reflation"—that is, by multiplying the quantity estimates by appropriate price data from the Bureau of Labor Statistics (BLS).

For all other nonfarm industries, estimates for the most recent year and for the current quarters are prepared by starting with the previous annual level and by assuming that inventories move proportionately with certain other indicator series chosen for each industry or by judgmental trend. The indicator series include inventory information from the Census Bureau's quarterly financial reports and monthly measures of activity from the Census Bureau's construction statistics and from BLS industry wage data.

For farm inventories, quarterly estimates of crop inventories, which are calculated only for total crops, are based on a BEA quarterly allocation of USDA annual projections of crop output and cash receipts. Quarterly estimates of livestock inventories are based on USDA data by type of livestock.

Quantity and price estimates

The quantity estimates for the detailed inventory components are primarily derived by deflation, as shown in appendix B. (For a general description of the deflation method, see "Estimates for detailed components" in chapter 4.)

In the NIPAs, the aggregate measures for most of the components of real GDP are calculated from the detailed components as chain-type quantity and price indexes (see "Estimates for NIPA aggregates" in chapter 4). However, the detailed CIPI estimates may contain negative values (which could require the Fisher formula to take the square root of a negative number).[9] Therefore, the end-of period, chain-weighted estimates of inventory stocks are calculated first, and the CIPI chained-dollar estimates are then calculated as the differences between these estimates. Under this procedure, inventory stocks are used as weights for inventory flows, though the composition of the stocks may differ from the composition of the inventory investment flows.

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[9] The inability to calculate Fisher quantity indexes for CIPI does not extend to higher level aggregates (such as gross private domestic investment and GDP) that include CIPI as a component, because the negative values of CIPI are small relative to the levels of the other components of those aggregates.

Appendix A: Illustration of LIFO and FIFO Accounting Methods and Their Relationship to NIPA Accounting

This appendix illustrates the basic aspects of last-in-last-out (LIFO) and first-in-first-out (FIFO) inventory accounting and their relationship to NIPA inventory accounting. The illustration is based on one retail establishment that holds only one type of good in inventory. The unit cost and the sales price increase over time, but they are equal to each other in each period, so any profit (or loss) made by the establishment is solely the result of changes in the prices of goods held in inventory.

Exhibit 1 provides information on goods purchased by the establishment in periods 0 to 3; these goods then were sold in that same period or were added to inventory. It also provides information on goods sold by the establishment in periods 1 to 3; these goods were purchased in that same period or were withdrawn from the inventory of goods that were purchased in earlier periods.

Exhibit 1— Purchases and Sales

	Purchases			Sales		
Period	Quantity	Unit cost	Book value	Quantity	Price	Revenue
0	100	$1	$100	…..	…..	…..
1	10	$2	$20	10	$2	$20
2	10	$3	$30	5	$3	$15
3	10	$4	$40	20	$4	$80

Exhibit 2 presents the LIFO-accounting treatment for the cost of goods sold (COGS), the book value of inventories, and the resulting measure of profit for the establishment.

Exhibit 2—Inventory Accounting on a LIFO Basis

Period	Book value at beginning of period	Purchases	Cost of goods sold (COGS)	Quantity in inventory	Book value at end of period	Change in book value	Recorded profit (revenue minus COGS)
0	$0	$100	$0	100	$100	…..	…..
1	$100	$20	$20	100	$100	0	$0
2	$100	$30	$15	105	$115	$15	$0
3	$115	$40	$60	95	$95	–$20	$20

- In period 1, the beginning inventory consists of 100 units at $1 each = $100; 10 units are sold at $2 each = $20; under LIFO, these 10 units are the most recent goods acquired, so COGS is 10 units at $2 each = $20; recorded profit is $20 – $20 = $0; and inventory at end of period 1 (and at beginning of period 2) consists of 100 units at $1 each = $100.
- In period 2, 5 units are sold at $3 each = $15; COGS is 5 units at $3 each = $15; recorded profit is $15 – $15 = $0; and inventory at end of period 2 (and at beginning of period 3) consists of 100 units at $1 each + 5 units at $3 each = $115.
- In period 3, 20 units are sold at $4 each = $80; COGS is 10 units at $4 each + 5 units at $3 each + 5 units at $1 each = $60; recorded profit is $80 – $60 = $20; and inventory at end of period 3 consists of 95 units at $1 each = $95.

Exhibit 3 presents the FIFO-accounting treatment for the COGS and the book value of inventories for the establishment.

Exhibit 3—Inventory Accounting on a FIFO basis

Period	Book value at beginning of period	Purchases	Cost of goods sold (COGS)	Quantity in inventory	Book value at end of period	Change in book value	Recorded profit (revenue minus COGS)
0	$0	$100	$0	100	$100	…..	…..
1	$100	$20	$10	100	$110	$10	$10
2	$110	$30	$5	105	$135	$25	$10
3	$135	$40	$20	95	$155	$20	$60

- In period 1, the beginning inventory consists of 100 units at $1 each = $100; 10 units are sold at $2 each = $20; under FIFO, these 10 units are the earliest goods acquired, so COGS is 10 units at $1 each = $10; recorded profit is $20 – $10 = $10; and inventory at end of period 1 (and at beginning of period 2) consists of 90 units at $1 each + 10 units at $2 each = $110.
- In period 2, 5 units are sold at $3 each = $15; COGS is 5 units at $1 each = $5; recorded profit is $15 – $5 = $10; and inventory at end of period 2 (and at beginning of period 3) consists of 85 units at $1 each + 10 units at $2 each + 10 units at $3 each = $135.
- In period 3, 20 units are sold at $4 each = $80; COGS is 20 units at $1 each = $20; recorded profit is $80 – $20 = $60; and inventory at end of period 3 consists of 65 units at $1 each + 10 units at $2 each + 10 units at $3 each + 10 units at $4 each = $155.

Exhibit 4 illustrates the concepts that the NIPAs attempt to capture in inventory accounting. The change in private inventories (CIPI) in each period is equal to the change

in the quantity of inventory times the current price in that period. The inventory valuation adjustment (IVA) is equal to CIPI minus the change in the book value of inventory. Note that when prices are rising from period to period, as in this illustration, the FIFO IVA is negative. Note also that when inventories are unchanged or increasing from period to period, the LIFO IVA is equal to $0, and when prices are rising and inventories are decreasing, the LIFO IVA is negative.

Exhibit 4—NIPA Accounting Concept

Period	Quantity in inventory	Change in quantity in inventory	Price	Change in private inventories	Inventory valuation adjustment (LIFO basis)	Inventory valuation adjustment (FIFO basis)
0	100	…..	…..	…..	…..	…..
1	100	0	$2	0	$0	–$10
2	105	5	$3	$15	$0	–$10
3	95	–10	$4	–$40	–$20	–$60

- In period 1, the quantity of goods held in inventory is unchanged, so CIPI is $0. Under LIFO, the change in the book value is $0, and the LIFO IVA is $0 (see exhibit 2). Under FIFO, the change in the book value is $10, and the FIFO IVA is $0 – $10 = –$10 (see exhibit 3).

- In period 2, the quantity of goods held in inventory increases by 5 units, and the price is $3 per unit, so CIPI is $15. Under LIFO, the change in the book value is $15, and the LIFO IVA is $15 – $15 = $0. Under FIFO, the change in the book value is $25, and the FIFO IVA is $15 – $25 = –$10.

- In period 3, the quantity of goods held in inventory decreases by 10 units, and the price per unit is $4, so CIPI –$40. Under LIFO, the change in the book value is –$20, and the LIFO IVA is –$40 – (–$20) = –$20. Under FIFO, the change in the book value is $20, and the FIFO IVA is –$40 – $20 = –$60.

For the purposes of this illustration, information on physical quantities and on prices is provided for the individual good held in inventory. However, data on the physical quantities of goods moving through inventory are generally not available, and the NIPA estimates are derived using data on book values from the Census Bureau or from the IRS. For an illustration of the actual method used in accounting for inventories in the NIPAs, see appendix B.

Appendix B: Illustration of NIPA Inventory Calculations

   This appendix illustrates the basic steps in preparing end-of-quarter inventory estimates for an industry using the following assumptions.

- Last-in, first-out (LIFO) and first-in, first-out (FIFO) are the only accounting methods used in this industry.
- The Census Bureau published value of non-LIFO inventories (that is, the value of inventories without using LIFO accounting) for this industry is $110 in May and $130 in June.
- The percentage of inventories for this industry that are accounted for on a LIFO basis is 10 percent, and the LIFO reserve (the adjustment that converts a LIFO valuation to a non-LIFO valuation) is $10.
- The FIFO turnover ratio (ending inventory divided by monthly cost of goods sold), which is used in deriving the turnover period and the turnover pattern for this industry, is 1.4. The turnover period (the average time a good is held in inventory), which is used in deriving the monthly cost index, is 4 months. The turnover pattern (the pattern of how goods are withdrawn from inventory), is also used in deriving the monthly cost index. The pattern, starting with the most recent month, is 0.23, 0.62, 0.14, and 0.01.
- The inventory composition for this industry is 40 percent of commodity A and 60 percent of commodity B. The monthly producer price indexes (PPIs) for each of these commodities are shown in the first two columns of exhibit 2.

Step 1: Separating Census Bureau published inventories into those that were reported on a LIFO basis and those that were reported using other accounting methods

Exhibit 1

Time period	Census Bureau non-LIFO inventories	LIFO reserve	Book value of inventories	LIFO inventories	FIFO inventories
May	110	10	100	10	90
June	130	10	120	12	108

   <u>Book value of inventories</u>. Calculated as Census Bureau non-LIFO inventories minus LIFO reserve: for June, $130 – $10 = $120. Of this $120, $12 is valued on a LIFO-accounting basis ($120 x 0.10), and the remaining $108 is valued on a non-LIFO (FIFO) accounting basis.

Step 2: Construction of current-period inventory price indexes for each industry, and for manufacturing and publishing, each stage of fabrication

Exhibit 2

Time period	PPI for com-modity A	PPI for com-modity B	Monthly price index	End-of-month price index	Average monthly price index	Monthly cost index
January	108.0	109.0	108.6	109.3	….	
February	110.0	110.0	110.0	111.3	110.30	
March	115.0	111.0	112.6	113.6	112.45	
April	120.0	111.0	114.6	115.3	114.45	
May	122.0	112.0	116.0	117.9	116.60	114.623
June	130.0	113.0	119.8	120.8	119.35	116.880
July	132.0	115.0	121.8	….	….	

Monthly price index. Calculated as the weighted average of the commodity PPIs: for June, (130.0 x 0.4) + (113.0 x 0.6) = 119.8.[10]

End-of-month price index. Calculated as a 2-month forward moving average of the monthly price index: for June, (119.8 + 121.8) / 2 = 120.8.

Average monthly price index. Calculated as a 2-month average of the end-of-month price index: for June, (117.9 + 120.8) / 2 = 119.35.

Step 3: Construction of monthly cost indexes for each industry, and for manufacturing and publishing, each stage of fabrication

Monthly cost index (acquisition cost). Calculated as the average of the monthly price indexes for the turnover period weighted by the turnover pattern: for June, (112.45 x 0.01) + (114.45 x 0.14) + (116.60 x 0.62) + (119.35 x 0.23) = 116.880.[11]

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[10] In the NIPA calculations, industry-based PPIs rather than commodity-based PPIs are used for some industries. In calculating the average price at the detailed industry level, BEA applies a fixed-weight aggregation structure, based on weights from the economic censuses, when combining specific commodities held within an industry rather than a Fisher aggregation.

[11] This illustrated calculation is that used under FIFO accounting. BEA has a specific methodology for constructing the cost indexes under each of the inventory-accounting methods.

Step 4: Revaluation of the book-value inventories to yield constant-dollar and current-dollar change in inventories

Exhibit 3

Time period	Current-dollar change in inventories	Constant-dollar change in inventories	Change in book value of inventories	IVA	Constant-dollar stocks	Current-dollar stocks
June	18.57	15.56	20	−1.43	95.56	115.44

Change in FIFO inventories. Constant-dollar change is calculated as the difference between the FIFO book values for each month deflated by the monthly cost index: for June, ($108 / 1.16880) – ($90 / 1.14623) = $13.88. Current-dollar change is then calculated by reflating the constant-dollar change using the average monthly price index: for June, $13.88 x 1.1935 = $16.57.

Change in LIFO inventories. Because LIFO inventories increased from May to June, current-dollar change is equal to change in LIFO book value: for June, $2.00 (see appendix A). Constant-dollar change is calculated by deflating the change in LIFO book value by the average monthly price index: for June, ($2.00 / 1.1935) = $1.68.

Current-dollar change in inventories. Calculated as the sum of the current-dollar change in FIFO inventories and the current-dollar change in LIFO inventories: for June, $16.57 + $2.00 = $18.57.

Constant-dollar change in inventories. Calculated as the sum of the constant-dollar change in FIFO inventories and the constant-dollar change in LIFO inventories: for June, $13.88 + $1.68 = $15.56.

Step 5: Calculation of the Inventory Valuation Adjustment (IVA)

Change in the book value of inventories. Calculated as the difference in the Census Bureau non-LIFO inventory levels: for June, $130 – $110 = $20.

IVA. Calculated as the difference between current-dollar change in inventories and change in the book value of inventories: for June, $18.57 – $20.00 = –$1.43. (Note that because LIFO inventories increased during this period, the IVA for the LIFO portion of inventory change is $0, and the IVA for the FIFO portion is $16.57 – $18.00 = –$1.43.)

Step 6: Calculation of current-dollar and constant-dollar stocks

Constant-dollar stocks. Calculated by adding constant-dollar change in inventories to the previous month's constant-dollar stock: assuming a constant-dollar inventory level of $80 for May, the constant-dollar stock of inventories for June is $80 + $15.56 = $95.56.

Current-dollar stocks. Calculated by reflating constant-dollar stocks using end-of-month prices: for June, $95.56 x 1.208 = $115.44.

Note that while the difference between the constant-dollar stocks for May and June ($15.56) is equal to constant-dollar CIPI,[12] the difference between the current-dollar stocks for May and June ($19.88) is not equal to current-dollar CIPI ($18.57). This is because the current-dollar stocks are valued at end-of-period prices, while CIPI is valued using average prices for the period.

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[12] Because quarterly and monthly estimates in the NIPAs are expressed at annual rates, it is necessary to divide the CIPI estimates by 4 and by 12, respectively, to observe the equality.

Table 7.A—Summary of Methodology Used to Prepare Estimates of Change in Private Inventories					
Line in NIPA table group 5.6	Component	Current-dollar estimates			Quantity and price estimates (quantity estimate prepared by deflating with the price index unless otherwise indicated)
		Benchmark year	Indicator series used to interpolate and extrapolate		
			Nonbenchmark years except the most recent year	Most recent year	Current quarterly estimates	
2	Farm	USDA change in inventories adjusted to exclude Commodity Credit Corporation (CCC) forfeitures and to include net CCC loans at market value.	Same as for benchmark year.	Same as for benchmark year.	Crops: BEA quarterly allocations of USDA annual projections of crop output and cash receipts. Livestock: USDA quarterly data.	USDA average market prices.
3	Mining, utilities, and construction					
	Mining	Inventories from EC, revalued to current replacement cost using EC information on accounting methods, commodity composition, and turnover and using information on prices, primarily PPIs.	Inventories from IRS tabulations of business tax returns, revalued to current replacement cost based on IRS LIFO valuation proportions and turnover and using information on prices, primarily PPIs.	Census Bureau quarterly financial report survey of mining corporations, revalued as in nonbenchmark years	For third and second estimates, same as for most recent year; for advance estimate, judgmental trend.	PPI for coal mining, PPI for nonmetallic mineral mining and quarrying, PPI for metal ore mining, PPI for oil and gas extraction, PPI for petroleum refinery primary products, PPI for parts and attachments for mining, machinery, and equipment, and PPI for mining machinery and equipment.
	Utilities	Inventories from IRS tabulations of business tax returns, revalued to current replacement cost based on IRS LIFO valuation proportions and turnover and using information on prices, primarily PPIs.	Same as for benchmark year.	Monthly physical quantities and base-year prices from Energy Information Administration (EIA) combined with PPIs for electric utilities.	Same as for most recent year.	For annual except most recent year, deflation using PPI for coal, PPI for natural gas, and PPI for heavy fuel oils; for most recent year and current quarterly, direct valuation, using quantities and prices of stocks of coal, petroleum, and natural gas from EIA.
	Construction	Inventories from EC, revalued to current replacement cost using IRS information on accounting methods and EC information	Inventories from IRS tabulations of business tax returns, revalued to current replacement cost based on IRS LIFO valuation	Judgmental trend.	Same as for most recent year.	PPI for construction materials.

Table 7.A—Summary of Methodology Used to Prepare Estimates of Change in Private Inventories					
Line in NIPA table group 5.6	Component	Current-dollar estimates			Quantity and price estimates (quantity estimate prepared by deflating with the price index unless otherwise indicated)
		Benchmark year	Indicator series used to interpolate and extrapolate		
			Nonbenchmark years except the most recent year	Most recent year	Current quarterly estimates	
		on turnover and using information on prices, primarily PPIs.	proportions and turnover and using information on prices, primarily PPIs.			
4	Manufacturing:					
5	Durable goods industries	Inventories from EC, revalued to current replacement cost using EC information on accounting methods, commodity composition, and turnover and using information on prices, primarily PPIs and BEA unit labor costs.	Inventories from ASM, revalued to current replacement cost based on ASM LIFO proportions and turnover and using information on prices, primarily PPIs and BEA unit labor costs.	Inventories from Census Bureau monthly surveys of manufacturers' shipments, inventories, and orders, revalued as in nonbenchmark years.	Same as for most recent year.	Various PPIs.
6	Nondurables goods industries	Inventories from EC, revalued to current replacement cost using EC information on accounting methods, commodity composition, and turnover and using information on prices, primarily PPIs and BEA unit labor costs.	Inventories from ASM, revalued to current replacement cost based on ASM LIFO proportions and turnover and using information on prices, primarily PPIs and BEA unit labor costs.	Inventories from Census Bureau monthly surveys of manufacturers' shipments, inventories, and orders, revalued as in nonbenchmark years	Same as for most recent year.	Crude petroleum: composite price from Energy Information Administration. Other components: various PPIs.
7	Wholesale trade:					
8	Durable goods industries	Inventories from EC and AWTS, revalued to current replacement cost using EC information on accounting methods, commodity composition, and turnover and using information on prices, primarily PPIs and	Inventories from AWTS, revalued to current replacement cost based on AWTS LIFO proportions and turnover and using information on prices, primarily PPIs and IPIs.	Merchant wholesale: inventories from MWTS, revalued as in nonbenchmark years. Nonmerchant wholesale: estimated CIPI based on manufacturing finished goods CIPI and on	Same as for most recent year.	Various PPIs and IPIs.

		Table 7.A—Summary of Methodology Used to Prepare Estimates of Change in Private Inventories				
Line in NIPA table group 5.6	Component	Current-dollar estimates				Quantity and price estimates (quantity estimate prepared by deflating with the price index unless otherwise indicated)
		Benchmark year	Indicator series used to interpolate and extrapolate			
			Nonbenchmark years except the most recent year	Most recent year	Current quarterly estimates	
		IPIs.		judgmental trend.		
9	Nondurable goods industries	Inventories from EC and AWTS, revalued to current replacement cost using EC information on accounting methods, commodity composition, and turnover and using information on prices, primarily PPIs and IPIs.	Inventories from AWTS, revalued to current replacement cost based on AWTS LIFO proportions and turnover and using information on prices, primarily PPIs and IPIs.	Merchant wholesale: inventories from MWTS, revalued as in nonbenchmark years. Nonmerchant wholesale: estimated CIPI based on manufacturing finished goods CIPI and on judgmental trend.	Same as for most recent year.	Various PPIs and IPIs.
10	Retail trade:					
11	Motor vehicle and parts dealers	Inventories from ARTS, revalued to current replacement cost using ARTS information on accounting methods and turnover, EC information on commodity composition, and using information on prices, primarily PPIs and IPIs.	Inventories from ARTS, revalued to current replacement cost based on ARTS LIFO proportions and turnover and using information on prices, primarily PPIs and IPIs.	New motor vehicles: based on reconciliation with BEA unit-based motor vehicle estimates. Other components: inventories from MRTS, revalued as in nonbenchmark years.	Same as for most recent year.	New motor vehicles: for annual, deflation using PPI for new autos, PPI for light trucks, PPI for parts, IPI for new autos and light trucks, and CPI for used motor vehicles; for quarterly, based on reconciliation with BEA unit-based motor vehicle estimates. Other components: PPI for boats, PPI for motor cycles, PPI for RVs, PPI for other transportation equipment, PPI for parts and accessories, IPI for parts and accessories, and IPI other transportation equipment.
12	Food and beverage stores	Inventories from ARTS, revalued to current replacement cost using ARTS information on	Inventories from ARTS, revalued to current replacement cost based on ARTS LIFO proportions and	Inventories from MRTS, revalued as in nonbenchmark years.	Same as for most recent year.	Various PPIs and IPIs.

Table 7.A—Summary of Methodology Used to Prepare Estimates of Change in Private Inventories					
Line in NIPA table group 5.6	Component	Current-dollar estimates				Quantity and price estimates (quantity estimate prepared by deflating with the price index unless otherwise indicated)
		Benchmark year	Indicator series used to interpolate and extrapolate			
			Nonbenchmark years except the most recent year	Most recent year	Current quarterly estimates	
		accounting methods and turnover, EC information on commodity composition, and using information on prices, primarily PPIs and IPIs.	turnover and using information on prices, primarily PPIs and IPIs.			
13	General merchandise stores	Inventories from ARTS, revalued to current replacement cost using ARTS information on accounting methods and turnover, EC information on commodity composition, and using information on prices, primarily PPIs and IPIs.	Inventories from ARTS, revalued to current replacement cost based on ARTS LIFO proportions and turnover and using information on prices, primarily PPIs and IPIs.	Inventories from MRTS, revalued as in nonbenchmark years.	Same as for most recent year.	Various PPIs and IPIs.
14	Other retail stores	Inventories from ARTS, revalued to current replacement cost using ARTS information on accounting methods and turnover, EC information on commodity composition, and using information on prices, primarily PPIs and IPIs.	Inventories from ARTS, revalued to current replacement cost based on ARTS LIFO proportions and turnover and using information on prices, primarily PPIs and IPIs.	Inventories from MRTS, revalued as in nonbenchmark years.	Same as for most recent year.	Various PPIs and IPIs.
15	Other industries	Publishing: inventories from SAS, revalued to current replacement cost based on IRS LIFO proportions and SAS turnover and using information on prices, primarily PPIs and BEA unit-labor costs. Other components: inventories from IRS	Same as for benchmark year.	Judgmental trend.	Same as for most recent year.	Various PPIs.

Line in NIPA table group 5.6	Component	Current-dollar estimates				Quantity and price estimates (quantity estimate prepared by deflating with the price index unless otherwise indicated)
		Benchmark year	Indicator series used to interpolate and extrapolate			
			Nonbenchmark years except the most recent year	Most recent year	Current quarterly estimates	
		tabulations of business tax returns, revalued to current replacement cost based on IRS LIFO valuation proportions and turnover and using information on prices, primarily PPIs.				

Table 7.A—Summary of Methodology Used to Prepare Estimates of Change in Private Inventories

ARTS Annual Retail Trade Survey, Census Bureau
ASM Annual Survey of Manufactures, Census Bureau
AWTS Annual Wholesale Trade Survey, Census Bureau
BLS Bureau of Labor Statistics
EC Economic Census, Census Bureau
IPI Import Price Index, BLS
IRS Internal Revenue Service
LIFO Last In, First Out
PPI Producer Price Index, BLS
MRTS Monthly Retail Trade Survey, Census Bureau
MWTS Monthly Wholesale Trade Survey, Census Bureau
SAS Services Annual Survey, Census Bureau
USDA U.S. Department of Agriculture