

Chapter 10 Investment in inventories

Introduction

10.1 In the Income and Expenditure Accounts, investment in inventories is estimated for the agricultural and non-agricultural business sector and for the government sector.

10.2 Inventory fluctuations essentially represent the gap between aggregate production and final demand in any given period. Inventories can play a crucial role in generating swings in economic activity despite the fact that changes in inventories are a relatively small component of GDP. However, their importance stems from the fact that they typically fluctuate to a substantially greater extent than other GDP components—and can either be strongly positive or strongly negative. The average absolute quarterly contribution of inventory movements to quarterly growth can be large, sometimes making it a major factor in GDP growth.

10.3 Changes in inventories have always had a major influence on business cycles. However, the role of inventories is evolving, as indicated in the article *The Changing Role of Inventories in the Business Cycle*.¹ The article deals specifically with non-farm inventories and concludes that the economy benefits when businesses manage their inventories better. Changes in farm inventories can have a significant effect on changes in the gross domestic product. Changes in such inventories are caused by developments in the global economy as well as by weather conditions or, as has been the case more recently, by national and international events such as the mad cow crisis.

Concepts and definitions

10.4 Investment in inventories, commonly referred to as the value of physical change in inventories or as changes in inventories in the international system, includes the following:

- changes in stocks of outputs that are still being held by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways;
- changes in stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing; they are measured by the value of the entries into inventories less the value of withdrawals, less the value of any recurrent losses of goods held in inventories;²
- changes in work in progress inventories.

10.5 In the Canadian System of National Accounts (CSNA), business inventory investment is subdivided into farm inventories and non-farm inventories. Estimates of business investment in farm inventories fall under three major headings: grain,³ other farm-held inventories,⁴ grain in commercial channels.⁵ Non-farm inventories are estimated at a very detailed level and are published for five main categories:

- Manufacturing (durable and non-durable goods);
- Retail trade (durable and non-durable goods);
- Wholesale trade (durable and non-durable goods);
- Non-monetary gold; and
- Other non-farm inventories.⁶

1. Cross, P. and Salvatore, G. 2003; “*The Changing Role of Inventories in the Business Cycle*”. Canadian Economic Observer, catalogue no. 11-010.

2. This definition has been taken from *System of National Accounts 1993*, paragraphs 10.7 and 10.28 and glossary, under changes in inventories.

3. Grain includes eight components: wheat, oats, barley, rye, flax, canola, soybeans and corn.

4. Other inventories have eight components: potatoes, tobacco, special crops, cattle, calves, hogs, sheep and lambs, and poultry.

5. Grain in commercial channels is grain held by the Canadian Wheat Board or by private traders.

10.6 Work in progress for uncompleted structures is not treated as part of inventories in the CSNA.

10.7 Manufacturing, retail trade, and wholesale trade comprise the major categories of non-farm inventories. The manufacturing industries encompass 23 categories of goods, while retail trade has 19 and wholesale trade, 16. Table 10.2 provides a complete list of these categories.

10.8 Aside from the classification of goods by category, inventories in the manufacturing industries can also be classified according to the product's state of development. First are finished goods, that is, the goods an industry produces. Next are goods purchased for resale, meaning goods purchased by the industry to be resold without any processing taking place. Third, there are goods in process,⁷ or goods that have not been completed and which must undergo further processing before they can be sold. Finally, raw materials include goods that a business owns and intends to use in the production of other goods. Raw materials include both the "nuts and bolts" and the goods used indirectly in production, such as fuel oil and paper for administrative purposes. Inventories of raw materials differ from gross fixed capital formation in that the goods are incorporated into the finished products rather than used⁸ in the production process. In addition, the goods in question are used during a relatively short period (generally less than a year).

10.9 All gold bullion, including that held by individuals, is included in gold inventories since it can be resold for use in the production process. Gold coins are excluded from inventories since they are considered to be finished products. The only gold coins included in inventories are those classified as goods in process that are produced by coin manufacturers. Monetary gold (a financial asset in the financial account) and gold held in Canada by non-residents are also excluded from inventories.

10.10 The last category is that of other non-farm inventories, which includes six categories of goods—logging, mining, finance and services, transportation and construction. For these goods, inventory estimates pertain to finished products only.

Presentation: Income and Expenditure Accounts and Input-Output Tables

10.11 The investment in inventories that appears in the Income and Expenditure Accounts (IEA) is not formally reconciled with the estimates that appear in the Input-Output Tables (IOT) for Canada, as is the case for all other GDP expenditure items.

10.12 This is because the IEA statistical discrepancy is implicitly included in the investment in inventories in the IOT (Table 10.1).

6. Inventories of natural resources (minerals in the ground or forests), are not included in inventories of raw materials. Stocks of natural resources, such as timber and subsoil minerals, are included in the economy-wide measures of non-financial non-produced tangible assets in the *National Balance Sheet Accounts* (catalogue no. 13-214). These are not treated as inventories in the national accounts.

7. According to the *System of National Accounts 1993*, goods in process should include housing under construction (par. 10-102). However, in the Income and Expenditure Accounts, the latter are included with gross fixed capital formation in residential buildings (see Chapter 9).

8. This is referred to as "wear and tear", known as "depreciation of capital assets" or "rate of depreciation of fixed capital".

Table 10.1 Investment in inventories in the Input-Output Tables and in the Income and Expenditure Accounts, 2000

	CANSIM	Millions of dollars
Input-Output Tables¹ final demand categories		
Inventories: Value of physical change		12,277
Additions	V29346714	21,506
Withdrawals	V29346743	-9,229
Income and Expenditure Accounts²: Expenditure-based GDP categories		
Investment in inventories and statistical discrepancy		12,278
Government investment in inventories	V498094	24
Business investment in inventories	V498100	11,505
Statistical discrepancy	V498109	749

1. Input-Output Tables are published in the *Input-Output Structure of the Canadian Economy*, catalogue no. 15-201.

2. Income and Expenditure Accounts estimates are published in *National Income and Expenditure Accounts*, catalogue no. 13-001. Provincial and territorial estimates appear in *Provincial Economic Accounts*, catalogue no. 13-213.

Business investment in non-farm inventories

Estimation methods, benchmark years and non-benchmark years

10.13 For manufacturing, retail trade and wholesale trade industries, the annual surveys are extensions of the monthly surveys; they provide more detail and cover a broader universe. They are used to calibrate the monthly or quarterly information. However, the estimation method is still monthly, and quarterly and annual figures are derived by adding up the sub annual estimates.

10.14 Annual data for the logging industry are obtained from the *Annual Survey of Forestry* and those for the mining industry from the Annual Census of Mines, conducted by Natural Resources Canada.

10.15 For other non-farm inventories categories (construction, mining, finance, insurance and real estate, transportation and utilities) the monthly or quarterly approach for manufacturing and retail and wholesale trade, described below, is applied annually.

Estimation methods, monthly and quarterly

10.16 For each of the 128 categories of goods for which business investment in non-farm inventories is measured (see Table 10.2), a 10-step approach is used. The inventory valuation adjustment item, an aggregate that is part of the calculation of income-based gross domestic product, is estimated as part of the same process.⁹

9. For further details on concepts, see the inventory valuation adjustments section of Chapter 4. Calculation methods are described in this chapter.

Table 10.2 Series and deflators used in the calculation¹ of business investment in non-farm inventories, 2000

Component ²	Deflator ³	Millions of dollars
Manufacturing		4,848
Durable goods		4,479
Electrical and electronic (4 stages)	IPPI	
Furniture and fixtures (4 stages)	IPPI	
Machinery (non-electrical) (4 stages)	IPPI	
Fabricated metal (4 stages)	IPPI	
Other (4 stages)	IPPI	
Motor vehicles (4 stages)	IPPI	
Non-metallic mineral (4 stages)	IPPI	
Other transportation (4 stages)	IPPI	
Motor vehicles parts (4 stages)	IPPI	
Primary metals (4 stages)	IPPI	
Wood (4 stages)	IPPI	
Non-durable goods		369
Beverages (4 stages)	IPPI	
Chemicals (4 stages)	IPPI	
Food (4 stages)	IPPI	
Clothing (4 stages)	IPPI	
Leather (4 stages)	IPPI	
Paper (4 stages)	IPPI	
Refined petroleum (4 stages)	IPPI	
Plastic (4 stages)	IPPI	
Printing (4 stages)	IPPI	
Rubber (4 stages)	IPPI	
Textiles (4 stages)	IPPI	
Tobacco (4 stages)	IPPI	
Trade		7,903
Retail		5,649
Durable goods		5,332
Motor vehicles		2,284
New car dealers	CPI	
Used and recreational motor vehicle and parts dealers	CPI	
Furniture stores	CPI	
Home furnishings stores	CPI	
Computer and software stores	CPI	
Home electronics and appliance stores	CPI	
Home centres and hardware stores	CPI	
Specialized building material and garden stores	CPI	
Pharmacies and personal care stores	CPI	
Non-durable goods		317
Supermarkets	CPI	
Convenience and specialty food stores	CPI	
Beer, wine and liquor stores	CPI	
Gasoline stations	CPI	
Clothing stores	CPI	
Shoe, clothing accessories and jewellery stores	CPI	
Sporting goods, hobby, music and book stores ⁴	CPI	
Department stores ⁴	CPI	

Table 10.2 Series and deflators used in the calculation¹ of business investment in non-farm inventories, 2000

Component ²	Deflator ³	Millions of dollars
Other general merchandise stores ⁴	CPI	
Miscellaneous store retailers ⁴	CPI	
Wholesale		2,254
Durable goods		1,830
Household and personal products	IPPI and import price index	
Pharmaceuticals	IPPI and import price index	
Motor vehicles	IPPI and import price index	
Motor vehicle parts and accessories	IPPI and import price index	
Building supplies	IPPI and import price index	
Metal products	IPPI and import price index	
Lumber and millwork	IPPI and import price index	
Machinery and equipment	IPPI and import price index	
Computers and other electronic equipment	IPPI and import price index	
Office and professional equipment	IPPI and import price index	
Non-durable goods		424
Farm products	IPPI and import price index	
Food products	IPPI and import price index	
Alcohol and tobacco	IPPI and import price index	
Apparel	IPPI and import price index	
Other products	IPPI and import price index	
Petroleum products	IPPI and import price index	
Gold	Price in US\$ per ounce from Platts Metals Week converted to Canadian dollars	-117
Other non-farm inventories		-1,279
Construction	Construction implicit price index from the gross fixed capital formation section of the Income and Expenditure Accounts	
Finance, insurance and real estate	CPI - services	
Logging	RMPI - logs	
Mining	RMPI metals and MEPI mines	
Transportation and communication	IPPI - transportation equipment	
Utilities	Uranium price, RMPI - coal, natural gas, MEPI electrical utilities	
Total		11,355

1. Calculation includes finished goods, goods bought for resale, goods in progress and raw materials.

2. The series having numeric values correspond to published levels. They appear in tables 28 and 29 of *National Income and Expenditure Accounts*, catalogue no. 13-001.

3. IPPI: *Industrial Product Price Index*; CPI: *Consumer Price Index*; RMPI: *Raw Materials Price Index*; MEPI: *Machinery and Equipment Price Index*.

4. This category appears in both non-durable goods and durable goods in retail trade. Half of it is allocated to non-durables the other half to durables.

10.17 Estimates of business investment in inventories are produced monthly for the manufacturing, retail trade and wholesale trade industries. The quarterly data are obtained by adding up the monthly figures. For gold and other sectors, estimates are produced on a quarterly basis.

10.18 The following data are needed for the calculations:

- the value of sales and shipments;
- the book value of inventories as reported by businesses;
- the accounting method used by businesses to arrive at the book value; and
- price indexes that, to the extent possible, reflect purchase costs rather than selling prices.

10.19 Each of these datasets is explored in the sections below. A description of the 10-step calculation method follows (paragraphs 10.38 to 10.50).

Sales and shipments

10.20 Sales and shipments for manufacturing are derived from the *Monthly Survey of Manufacturing (MSM)*.¹⁰ For the wholesale industry, monthly sales and shipments data are provided by the *Wholesale Trade Survey (Monthly)*.¹¹ For the retail industry, the data are taken from the *Monthly Retail Trade Survey (Department Store Organizations)* and the *Retail Trade Survey (Monthly)*.¹²

10.21 For gold, a supply and demand model is used as a quarterly distributor of the annual benchmarks provided by the Input-Output Tables. The same model is used to produce the current estimates; it relies on the Industry Accounts Division's estimates of gold production, gold exports and imports from the International Trade Division, and the Balance of Payments Division's surveys for the Bank of Canada's activities in managing gold reserves and sales of gold coins.

10.22 For construction, the benchmark data are projected using information from the *Survey of Employment, Payrolls and Hours*¹³ and the *Survey of Employment, Payrolls and Man-hours*. The same approach is followed for financial services, except that the projectors are taken from personal expenditure on consumer financial services.

10.23 For the logging industry, a supply and demand model is used. The information is provided by the Industry Accounts Division and the International Trade Division.

10.24 For the mining industry and the transportation and telecommunications industry, quarterly information is available from the *Quarterly Survey of Financial Statistics for Enterprises*.¹⁴

10.25 For electric utilities, information is provided by the Public Institutions Division. For gas utilities, it is supplied by the Manufacturing, Construction and Energy Division.

Book value stocks

10.26 The book values of inventory stocks for the manufacturing, wholesale, retail, gold and other industries are derived from the same sources as sales and shipments.

Accounting method

10.27 The accounting method refers to the LIFO (last in first out) and FIFO (first in first out) methods of booking inventories. The FIFO assumes for costing purposes that the goods are charged to production or sales in order of their acquisition. The LIFO method assumes that the goods charged out first are the goods last acquired.

10. Survey no. 2101, published in *Monthly Survey of Manufacturing*, catalogue no. 31-001.

11. Survey no. 2401, published in *Wholesale Trade*, catalogue no. 63-008.

12. Survey no. 2406, published in *Retail Trade*, catalogue no. 63-005.

13. Survey no. 2612, published in *Employment, Earnings and Hours*, catalogue no. 72-002.

14. Survey no. 2501, published in *Quarterly Financial Statistics for Enterprises*, catalogue no. 61-008.

10.28 Since the accounting method used for inventories is not captured in surveys, the Income and Expenditure Accounts Division assumes that the FIFO method is used.¹⁵ The exception is inventories of petroleum for both the wholesale and the manufacturing industries. In that case, producers specified that they were using the LIFO method.

Price indexes for deflation and revaluation

10.29 Price indexes are used twice in the calculation of business investment in inventories. In one case, they are used to deflate the book values of inventories reported by businesses. In the other, they are used to revalue the physical change in inventories at average quarterly prices (revaluer price indexes).

10.30 While deflators and revaluer price indexes are constructed from the same price indexes, they are distinct because of differences in weighting. For details on the indexes used, see Table 10.2. In general, the manufacturing series use industrial product price indexes¹⁶ while consumer price indexes¹⁷ are used to construct the deflators for retail trade, and a combination of industry product price indexes and import price indexes¹⁸ (from the *International Trade Price Indexes*) are used to produce the deflators and revaluer price indexes for the wholesale sector. For gold and other commodities, raw materials price indexes¹⁹ and other specific price indexes are used.

Book value deflators

10.31 The price indexes used to deflate the book values of inventories reported by businesses have to reflect the accounting method used.²⁰ In the IEA, it is assumed that businesses use the FIFO (first in, first out) method. In this case, each commodity included in the inventories has its own turnover rate, which is the average time that the commodity remains in inventory. One way of understanding the turnover rate is to look at the number of production days, months or years that a business holds a commodity in inventory. Thus, the book value of inventories reported by businesses for the reference period is the sum of the costs of the commodities that entered inventory during the reference period.

10.32 Table 10.3 provides an example of how to calculate a turnover rate; in this case, the rate is based on the inventories-to-sales ratios reported by the *Wholesale Trade Survey (Monthly)* for two trade groups, food products and machinery and equipment. The turnover rate is less than one month for food products and over two months for machinery and equipment.

Table 10.3 Example of turnover calculation using wholesale trade data, November 2004 to February 2005

		2004		2005	
		November	December	January	February
Food products					
Inventories (seasonally adjusted)	millions of dollars	4,269	4,167	4,306	4,413
Sales (seasonally adjusted)	millions of dollars	6,435	6,480	6,370	6,538
Turnover period expressed as:					
Months of sales held in inventories (monthly inventories divided by monthly sales)	months	0.66	0.64	0.68	0.67
Days of sales held in inventories (monthly inventories divided by monthly sales times number of days in month)	days	19.9	19.9	21.0	18.9

15. Two studies provided information on the accounting method. According to the 1975 study, 35% of manufacturers were using the FIFO method and 31% the average cost method. In 1990, a small study with retailers and wholesalers indicated that 68% of them were using the specific cost method, confirming the increasing role of computer in the control of inventories.

16. *Industrial Product Price Index*, survey no. 2318, published in *Industry Price Indexes*, catalogue no. 62-011.

17. *Consumer Price Index*, survey no. 2301, published in *Consumer Price Index*, catalogue no. 62-001.

18. Estimates from this survey are published in *Canadian International Merchandise Trade*, catalogue no. 65-001.

19. Estimates from this survey are published in *Industry Price Indexes*, catalogue no. 62-011.

20. Financial information reported to Statistics Canada are those that appear in the financial statements of businesses. This Statistics Canada policy was established to reduce the response burden of businesses.

Table 10.3 Example of turnover calculation using wholesale trade data, November 2004 to February 2005

Machinery and equipment						
Inventories (seasonally adjusted)	millions of dollars	8,687	8,803	8,753	8,777	
Sales (seasonally adjusted)	millions of dollars	3,522	3,427	3,529	3,681	
Turnover period expressed as:						
Months of sales held in inventories (monthly inventories divided by monthly sales)	months	2.47	2.57	2.48	2.38	
Days of sales held in inventories (monthly inventories divided by monthly sales times number of days in month)	days	74.0	79.6	74.4	73.9	

Source: *Wholesale Trade*, February 2005, catalogue no. 63-008, tables 1.1 and 4.1.

10.33 To deflate the book values of inventories reported by businesses, the deflator must reflect price movements during the turnover period. Hence, the deflator is calculated as the weighted average of the price indexes during the turnover period. For example, for machinery and equipment and food products in Table 10.3, the inventory book value deflator for February 2005 is computed as follows:

Examples of the calculation of inventory book value deflators, February 2005

Deflator food products (turnover rate of 0.67) = Combination of the IPPI index and import index of February.

Deflator machinery and equipment (turnover rate 2.38) = ((Combination of the IPPI index and import index of February)
 + (combination of the IPPI index and import index of January)
 + (0.38 × combination of the IPPI index and import index of December))
 ÷ 2.38

10.34 When the turnover rate is less than a month, the index of the last month is used as the deflator.

10.35 For the manufacturing sector, the turnover rates are an average of the turnover for the last four years, based on manufacturing shipments and inventories data from the *Annual Survey of Manufactures and Logging*. For gold and other stocks, the ratio is determined yearly based on data from various annual surveys. For retail and wholesale trade, the turnover rates are estimated monthly using the sales and inventories series (see Table 10.3). This information is provided by the surveys of retail and wholesale sales (see paragraph 10.20).

Revaluer price indexes

10.36 Like book value deflators, revaluers are price indexes, but they have a different purpose. They are used to revalue the volume of business investment in inventories at average prices for the reference period in order to make the series comparable with other aggregates of final expenditure. The aim is to reflect the average cost of inventories during the current period. For the monthly estimates, the revaluers are simply the price indexes reported in the price surveys (see paragraph 10.30). For the quarterly estimates, an average of the monthly indexes is used.

10.37 It is important to note that the method described above applies to the most detailed components of the estimate. The implicit indexes used at aggregate levels (ratio of current dollars to volumes) can be quite different from the component indexes.

Ten-step calculation process

10.38 Table 10.4 summarizes the calculation method used at the most detailed level. The first six steps show the calculation of business investment in non-farm inventories in current dollars, which appears in the IEA's expenditure-based gross domestic product table.²¹ Lines 7 and 8 show the derivation of the inventory valuation

21. *National Income and Expenditure Accounts*, catalogue no. 13-001, Table 2, line 15.

adjustment item that appears in the IEA's income-based gross domestic product table.²² Lines 9 and 10 contain the equations for calculating the inventory level used to produce volume estimates under the chain Fisher formula (see paragraphs 10.69 to 10.81).

Table 10.4 The ten step calculation for investment in non-farm inventories and inventory valuation adjustment

A. The 6 steps for calculating investment in non-farm inventories

1. CBV_e	Reported current dollar book values of inventories at the end of the period.
2. DEF_e	Deflator of book values at the end of the period.
3. $KBV_e = CBV_e / DEF_e$	Constant dollar book values of inventories at the end of the period.
4. $KVPC_t = KBV_e - KBV_{e-1}$	Constant dollar value of physical change for period t .
5. REV_t	Revaluer of the value of physical change for period t .
6. $VPC_t = KVPC_t \times REV_t$	Current dollar value of physical change for period t .

B. The 2 steps for the calculating inventory valuation adjustment

7. $\Delta CBV_t = CBV_e - CBV_{e-1}$	Change in reported closing book value of inventories in current dollar for period t .
8. $IVA_t = VPC_t - \Delta CBV_t$	Inventory valuation adjustment in current dollar for period t .

C. The 2 steps for the calculating volume estimates of investment in inventories using the Chain-Fisher method

9. $RBV_e = KBV_e \times REV_t$	Value of inventories at the end of the period, in current dollars, estimated at average prices of the period.
10. $RBV_b = RBV_e - VPC_t$	Value of inventories at the beginning of the period, in current dollars, estimated at average prices of the period.

10.39 **Step 1.** Obtain the end-of-period inventory book values reported by businesses. These are the reported book values. The code for this is CBV_e , the e indicating that it is the end-of-period value.

10.40 **Step 2.** Create a weighted price index for deflation of inventory book values. This implies knowledge of the composition of inventories, their turnover period, changes in the prices of goods in inventory, and the various methods of valuing them. These series are known as book value deflators. The code is DEF_e , the e indicating that it is the end-of-period inventory composition.

10.41 **Step 3.** Deflating the book values ($CBV_e \div DEF_e$) produces the end-of-period inventory book value at constant prices. The code is KBV_e , the e indicating that it is the end-of-period volume measure.

10.42 **Step 4.** Taking the first difference of the end-of-period inventory book value obtained in Step 3 yields a measure of the change in inventory volume between the beginning and end of a period. This concept is also referred to as the value of physical change in inventories at constant prices. The code is $KVPC_t$; the t indicates that the physical change in inventories is being measured for a particular period (e.g., the first quarter of 2001), whereas e indicates that the series reflect the situation at the end of a period (e.g., KBV_e would be the volume of inventories on March 31, 2001, and KBV_{e-1} would be the volume on February 28, 2001).

10.43 **Step 5.** A revaluer price index is introduced in this step, reflecting the composition of inventories and the average value of inventories during the current period. The code is REV_t , the t indicating that it is an index that reflects the average price of inventories during the period.

22. *National Income and Expenditure Accounts*, catalogue no. 13-001, Table 1, line 7.

10.44 **Step 6.** Compute the value of physical change in inventories at current prices. The calculation involves multiplying the value of physical change in inventories at constant prices from Step 4 by the revaluer price index from Step 5. Using an average quarterly price to estimate the value of physical change in inventories at current prices makes the investment in inventories estimates comparable to other GDP aggregates.

10.45 The next two steps compute the inventory valuation adjustment item and have no effect on the business investment in inventories aggregate.

10.46 **Step 7.** Calculate the change in inventory book value reported by businesses, compiled in Step 1. The code is ΔCBV_t ; the t indicates that the change in inventory book value is being measured for a particular period (e.g., the first quarter of 2001), whereas e indicates that the series reflect the situation at the end of a period (e.g., CBV_e could be the inventory book value on March 31, 2001, and CBV_{e-1} could be the value on February 28, 2001).

10.47 **Step 8.** The inventory valuation adjustment is the difference between the physical change in inventories at current prices (Step 6) and the value of change in inventory book value (Step 7). This adjustment, usually negative because of ongoing inflation, is a distinct entry on the income side of the GDP ledger. This entry amounts to an ex-post correction to the profits of corporations and government enterprises and the net income of unincorporated businesses for the net capital gains or losses that businesses incur on their inventories as a result of price changes. Those gains or losses must be eliminated before the value of current dollar output can be measured.

10.48 Steps 9 and 10 compute the value of inventories held at the start and end of a period. The estimates obtained are used in the chain Fisher formula that calculates volume estimates of investment in inventories aggregates.

10.49 **Step 9.** To obtain Fisher volume estimates of investment in inventories, we need to measure the end-of-period inventory value at current prices for the quarter. This is done by multiplying the inventory value in constant dollars (KBV_e) by the average price of inventories during the period (REV_t). The code for the series is RBV_e , the e indicating that it is the end-of-period value; for monthly estimates, for example, it could be the value of inventories in current dollars on March 31, 2001, the inventories having been evaluated at the average prices for March 2001.

10.50 **Step 10.** To produce the Fisher volume estimates of investment in inventories, we also need to measure the start-of-period inventory value at current prices for the quarter. This is done by subtracting the value of physical change in inventories at current prices from the end-of-period inventory value computed in Step 9. This method of calculating the start-of-period inventory value is equivalent to multiplying the start-of-period inventory values in constant dollars (KBV_{e-1}) by the average price of inventories during the period (REV_t). The code for the series is RBV_b , the b indicating that it is the start-of-period value. For monthly estimates, for example, it could be the value of inventories in current dollars on March 1, 2001, the inventories having been evaluated at the average prices for March 2001. In mathematical terms it is expressed as follows:

$$RBV_b = RBV_e - VPC_t \text{ Step 10 equation}$$

$$RBV_b = (KBV_e \times REV_t) - (\Delta KPC_t \times REV_t), \text{ substitution of Step 9 equation and Step 6 equation}$$

$$RBV_b = (KBV_e - \Delta KPC_t) \times REV_t$$

$$RBV_b = (KBV_e - (KBV_e - KBV_{e-1})) \times REV_t, \text{ substitution of Step 4 equation}$$

$$RBV_b = (KBV_e - KBV_e + KBV_{e-1}) \times REV_t$$

$$RBV_b = KBV_{e-1} \times REV_t$$

Estimation methods, provinces and territories

10.51 For most series, the national estimates of business investment in non-farm inventories are distributed by region on the basis of the reported book values for each province and territory. The exceptions are:

- Gold;
- finance, insurance and real estate; and
- construction.

10.52 For finance, insurance and real estate, the provincial or territorial distribution is based on household expenditure on legal and financial services, reported in *Detailed Average Household Expenditure for Canada, Provinces/Territories and Selected Metropolitan Areas*.

10.53 For construction, the provincial or territorial distribution of national data is based on the value of building permits for each province and territory, published in *Building Permits*.

10.54 For gold, the provincial or territorial breakdown is based on the distribution of families with incomes over \$60,000. This information is taken from *Income in Canada*.

10.55 For inventory valuation adjustment, the 10-step method is followed using provincial or territorial book values and national price indexes.

Business investment in farm inventories

10.56 Business investment in farm inventories can be broken down into three main categories: grain, other farm-held inventories and grain in commercial channels. Table 10.5 shows the levels of publication, the level of analysis and their values for 2000. The source data are quarterly and come from the Agriculture Division, the Canadian Wheat Board and the Canadian Grain Commission.

Table 10.5 Business investment in farm inventories, 2000

	Table ¹	Line ¹	Millions of dollars
Business investment in farm inventories	Table 2	Line 16	150
Grain	Table 28	Line 16	-244
Wheat (including durum)			83
Oats			-36
Barley			15
Flaxseed			-48
Canola			-66
Soybeans			-22
Corn			-162
Rye			-8
Other farm-held inventories	Table 28	Line 17	322
Potatoes			50
Tobacco			-138
Special crops			47
Cattle			302
Calves			-45
Hogs			73
Sheep and lambs			31
Poultry			2
Grain in commercial channels	Table 28	Line 18	72

1. Refers to table and line numbers in the *National Income and Expenditure Accounts*, catalogue no. 13-001.

Estimation methods, non-benchmark years

10.57 For business investment in farm inventories, the annual estimates represent the sum of the quarterly estimates. Levels for benchmark years are established following annual revisions conducted by the Agriculture Division in November of each year.

Estimation methods, quarterly estimates

10.58 Quarterly estimates of business investment in farm inventories in Canada are obtained by summing the quarterly provincial estimates.

Estimation methods, provincial estimates

10.59 The Agriculture Division provides quarterly estimates of market prices and farm-held inventories. This information is available by province.²³ For grain in commercial channels, information on prices and level of inventories is available from the Canadian Wheat Board and the Canadian Grain Commission.

10.60 Following are descriptions of the estimation methods for crops, livestock and poultry and grain in commercial channels. In each case, estimates are produced by product and by province. Aggregates at current prices are obtained by summation. Aggregates in chained dollars are obtained using the Fisher formula.

Crops

10.61 This method applies to grain, potatoes, tobacco and special crops. To obtain the value of the business investment in farm inventories (or the value of physical change (VPC)), the value of production (VP) and the value of depletion of inventories (VDI) are calculated, on a quarterly basis, from the quantities multiply by the average quarterly prices as shown in the following equation:

$$VPC_t = VP_t + VDI_t$$

where,

$VP_t = P_t \times PR_t$, where value of production = production in metric tonnes x average quarterly prices;

$DI_t = I_e - I_b - P_t$, where depletion in metric tons = end-of-quarter inventories - beginning-of-quarter inventories - production during the period;

$VDI_t = DI_t \times PR_t$, where value of depletion = depletion in metric tonnes x average quarterly prices.

10.62 Business investment in farm inventories is equal to the change in inventories in volume multiplied by the average price during the period. The calculation is equivalent to the method referred to in the following Livestock and poultry section (paragraph 10.64). However, both estimates of the value of production and the value of depletion are prepared, as the value of production is provided to the Industry Accounts Division for use in calculating the monthly GDP.

10.63 For seasonally adjusted estimates, the annual value of production is distributed among the quarters using a minimum sum-of-squared-changes criterion.²⁴ This procedure minimizes the breaks between the fourth quarter of a year and the first quarter of the following year. The technique also gives special treatment to years with bumper crops or droughts by reflecting most of the production excess or shortfall in the harvest quarter. Industry Accounts Division makes this adjustment for its estimates of the monthly GDP at basic prices. Since production is

23. There is no information available for farm inventories in the territories. It should be noted that agricultural activity is very limited in the northern part of Canada.

24. For further details, see the technical paper *Treatment of Grain Production in the Quarterly Income and Expenditure Accounts*, catalogue no. 13-604, no. 2.

concentrated in the third and fourth quarters, harvests are evaluated using the prices for those periods. In contrast with production, withdrawals on inventories are distributed throughout the entire year and are seasonally adjusted using the X-11 ARIMA method.

Livestock and poultry

10.64 The estimates of livestock and poultry inventories (number of head) and the average market price during the quarter are obtained from Agriculture Division's *Livestock Survey*.²⁵ To obtain the value of business investment in farm inventories in current prices, which corresponds to the value of physical change (VPC) for non-seasonally adjusted series, the calculation consists of simply taking the difference between inventories at the end (I_e) and at the beginning (I_b) of the quarter and multiplying it by the average price (PR) for the period, as illustrated by the following equation:²⁶

$$VPC_t = (I_e - I_b) \times PR_t$$

10.65 Seasonally adjusted series are obtained using the X-11 ARIMA method.

Grain in commercial channels

10.66 This method applies to grain held off-farm in commercial channels.²⁷ The calculation of investment in farm inventories is done using the same method as the one described in the section livestock and poultry except that the quantities are expressed in metric tonnes. Information on inventories and market prices comes from the Canadian Wheat Board and the Canadian Grain Commission. Seasonally adjusted series are obtained using the seasonal movements of grain exports and grain withdrawals from inventories.

Government investment in inventories

10.67 Government investment in inventories includes only changes in the inventory of industrial milk and milk products held by the Canadian Dairy Commission (CDC). Estimates are based on the figures from the CDC's quarterly financial statements. The provincial distribution is also based on the CDC's reports.

10.68 Two industrial price indexes, for butter and for powdered milk, are used for the deflation of government investment in inventories.

Calculating volume aggregates with the chain Fisher formula for investment in inventories

10.69 Like other expenditure-based gross domestic product aggregates, real investment in inventories is estimated by means of the chain Fisher formula. However, this formula cannot be used directly for investment in inventories aggregates because the series can take positive or negative values. To avoid the problems created by sign changes, the estimates are produced using inventory levels, which always take a positive value. Essentially, the indirect approach to estimating real investment in inventories involves estimating real inventory levels at the start and end of the period using the Fisher formula and subtracting one from the other.

25. Survey no. 3460, published in *Cattle Statistics*, catalogue no. 23-012; *Hog Statistics*, catalogue no. 23-010; *Livestock Statistics*, catalogue no. 23-603; and *Sheep Statistics*, catalogue no. 23-011.

26. This calculation corresponds to steps 4 to 6 of the 10-step method used to estimate business investment in non-farm inventories (see Table 10.4). The only difference between the non-farm and the farm inventories calculations is that for farm inventories, beginning and end of period inventories are expressed in terms of units and prices in terms of dollars per unit, whereas for non-farm inventories they are expressed in constant dollars.

27. Grain in commercial channels estimates are compiled for wheat, oats, barley, rye, flaxseed and canola.

Calculation formulas

10.70 The Fisher formula used to compute non-chained volume indexes²⁸ is

Equation 10.1

$$FV_t = \sqrt{\frac{\sum P_t Q_t}{\sum P_t Q_{t-1}} \times \frac{\sum P_{t-1} Q_t}{\sum P_{t-1} Q_{t-1}}}$$

10.71 In practice, this formula is not useful because the quantities would have to be observed directly. Consequently, the formula is transformed to include only current dollars (C_t and C_{t-1}) and prices (P_t and P_{t-1}), two kinds of data that are available to statisticians. Equation 10.1 becomes

Equation 10.2

$$FV_t = \sqrt{\frac{\sum C_t \times (P_{t-1}/P_t)}{\sum C_{t-1}} \times \frac{\sum C_t}{\sum C_{t-1} \times (P_t/P_{t-1})}}$$

10.72 Equation 10.2 produces a non-chained volume index. To obtain estimates in chained dollars, the non-chained indexes must be added together from a particular starting point (CFV_0). For us, the starting point is 2002, the reference period for which the real and nominal estimates of the aggregates are equal. The formula used is:

Equation 10.3

$$CFV_t = CFV_0 \times FV_1 \times FV_2 \dots \times FV_t$$

10.73 For example, to calculate real personal expenditure on consumer goods and services in millions of chained (2002) dollars, the current value and the price index for each of the 130 categories of goods and services that make up the aggregate for all periods since 2002 are used.

Using the formula for investment in inventories

10.74 In the case of investment in inventories, the non-chained Fisher index (FV_t) cannot be used because of sign changes. It is impossible to take the square root of a negative number. The solution is to compute two “real” estimates using the chain Fisher formula for each period (t), one for the inventory level at the end (e) of period t (e.g., March 31, 2005) and the other for the inventory level at the beginning (b) of period t (e.g., January 1, 2005). As a result, investment in inventories for period t will be written as:

Equation 10.4

$$CFV_t = CFV_e - CFV_b$$

10.75 As in the case of any aggregate, the data needed to calculate the end component (CFV_e) and the start component (CFV_b) are current dollar series and component prices series.

28. Unchained indexes means that the index represents the growth relative to the preceding period. In other words, it is as if the preceding period value was always “1” or “100”.

Components of the calculation of investment in non-farm inventories

10.76 The current dollar series for each basic component are evaluated in Steps 9 and 10 (see paragraphs 10.49 to 10.50) of the 10-step method (see Table 10.4). The end-of-period inventory value is estimated by multiplying end-of-period inventory quantities by the average price for the quarter. By the same logic, the start-of-period inventory value is computed by multiplying start-of-period inventory quantities by the same average price for the quarter.

10.77 The price series corresponding to the current-dollar series are simply the revaluation price indexes (Step 5 of the 10-step method). For a description of these prices, see paragraphs 10.29 to 10.37. The prices are used for both the start-of-period estimates and the end-of-period estimates.

Components of the calculation of investment in farm inventories

10.78 The calculation of real investment in farm inventories is also based on start-of-period and end-of-period inventory levels expressed in terms of the average prices of goods sold during the estimation period. The average prices are the same as those used in estimating investment in inventories at current prices. Inventory levels in current dollars are calculated in two steps: first, the inventory level is estimated in constant dollars, and then inventory value is computed at current prices.

10.79 Real end-of-period inventory levels (KBV_e) are estimated for each of the 17 basic farm components (see Table 10.5). To estimate the inventories at constant prices, a starting point is needed; the fourth quarter of 2001 was chosen. By performing the calculation for the periods before and after the fourth quarter of 2001, we can obtain the inventories at constant prices. This calculation involves adding business investment in inventories at constant prices for the period (i.e., the value of physical change at constant prices (KVPC)) to inventories for the previous period (KBV_{e-1}). This is shown in Equation 10.5 below.

Equation 10.5

$$KBV_e = KBV_{e-1} + KVPC$$

10.80 The end-of-quarter inventories at current prices (RBV_e) are obtained by multiplying the end-of-quarter inventories at constant prices (KBV_e) by the average price²⁹ of the current period (REV_t) for each of the 17 basic components. This calculation is shown in Equation 10.6, (Step 9 of the 10-step method used for non-farm inventories).

Equation 10.6

$$RBV_e = KBV_e \times REV_t$$

10.81 As in non-farm inventories, the start-of-quarter inventories at current prices (RBV_b) are obtained by subtracting the value of physical change in inventories at current prices (VPC) from the end-of-period inventory value (RBV_e) given by Equation 10.6. This calculation is shown in Equation 10.7, which is identical to Step 10 of the 10-step method used for non-farm inventories. This method of calculating the start-of-period inventory value is equivalent to multiplying the start-of-period inventory values in constant dollars by the average price of inventories during the period (see paragraph Table 10.50).

Equation 10.7

29. As noted, the same prices are used to revalue the level of farm inventories as are used in the investment in farm inventories at current prices. However, the seasonally adjusted version is used in the form of a price index since real inventory levels are estimated on a seasonally adjusted basis and in constant dollars rather than on a non-seasonally adjusted basis and in quantity terms, as is the case for investment in inventories.

$$RBV_b = RBV_e - VPC$$

Investment in inventories, level of aggregation

10.82 Real business investment in non-farm inventories is published for 14 aggregates while real business investment in farm inventories is published for four aggregates (Table 10.6). The estimates for these aggregates are produced using the chain Fisher formula.

10.83 It is important to note that the 38 basic components of business investment in non-farm inventories and the 17 basic components of business investment in farm inventories are included in the calculation of real GDP. Also included are start-of-quarter and end-of-quarter inventories.

Table 10.6 Business investment in inventories, 2000

	Table ¹	Line ¹	Millions of chained (2002) dollars
Business investment in non-farm inventories	Table 3	Line 15	13,708
Manufacturing	Table 29	Line 2	6,067
Durable goods	Table 29	Line 3	5,128
Non-durable goods	Table 29	Line 4	770
Trade	Table 29	Line 5	8,675
Retail	Table 29	Line 6	6,177
Durable goods	Table 29	Line 7	5,704
of which: motor vehicles	Table 29	Line 8	2,356
Non-durable goods	Table 29	Line 9	358
Wholesale	Table 29	Line 10	2,533
Durable goods	Table 29	Line 11	2,001
Non-durable goods	Table 29	Line 12	444
Gold	Table 29	Line 13	-149
Other non-farm inventories	Table 29	Line 14	-1,561
Business investment in farm inventories	Table 3	Line 16	775
Grain	Table 29	Line 16	-85
Other farm-held inventories	Table 29	Line 17	560
Grain in commercial channels	Table 29	Line 18	99

1. Refers to table and line numbers in the *National Income and Expenditure Accounts*, catalogue no. 13-001.