# ESTIMATION METHOD OF PRELIMINARY QUARTERLY GDP (QE) (The 4th Edition)


**(Revised in January 2005)**
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# I. Concept of the new estimation method of preliminary quarterly GDP (QE) (disclosed in August 2002)

## (1) New QE method

The Japanese government introduced a new method to estimate the Apr-Jun 2002 preliminary quarterly GDP, which was released on August 30, 2002. The new method employs the supply-side statistics to achieve the following purposes:

- **To identify economic trends more accurately by properly coping with ever-changing statistical environments and by incorporating much more statistical data, especially supply-side data, for estimating QE.**

  "Ever-changing statistical environments" include:
  - Supply-side statistics have been getting more sophisticated (e.g., the service statistics now covers increased number of sectors); and
  - The conventional estimation methods chiefly based on demand-side statistics do not correctly illustrate economic trends (e.g., low-frequency purchase behaviors, such as consumption of high-priced products, becomes more important; households have been more "individualized"; and corporate activities are also getting more diversified.)

  Examples of demand-side statistics:
  "Family Income and Expenditure Survey" (Ministry of Internal Affairs and Communications), "Quarterly Financial Statements Statistics of Corporations" (Ministry of Finance), etc.
  Examples of supply-side statistics:
  "Current Survey of Production" and "Survey of Selected Service Industries" (Ministry of Economy, Trade and Industry), "Monthly Economic Report on Land, Infrastructure and Transport" (Ministry of Land, Infrastructure and Transport), etc.

- **To release the first preliminary estimates a month and two weeks after the end of each quarter like other major developed countries in order to quickly identify the economic trends.**

  The government will release the QE data five business days after releasing "Family Income and Expenditure Survey (all households)."

- **To improve consistency with the annual accounts estimation method.**

The new QE method also aims to identify the economic trends more precisely by improving the following elements:

- **Incorporating the estimation method that focuses on comparison with the preceding quarter;**
- **Flexibly revising past QE data retroactively; and**
- **Changing the seasonal adjustment approach (including recalculation of the most recent QE data).**

## (2) Main points of the new QE approach

### 1) Problems in the older QE approach

The conventional estimation approach up until the Jan-Mar 2002 preliminary quarterly GDP is as follows:

- Calendar year-based revised annual accounts are estimated based on the commodity-flow method using supply-side statistics (e.g., "Census of Manufactures," "Census of Commerce," "Establishment and Enterprise Census," etc.); and
- QE is estimated by extrapolating quarterly breakdown of calendar-year-based revised annual accounts using year-to-year comparison of demand-side statistics (e.g., "Family Income and Expenditure Survey," "Quarterly Financial Statements Statistics of Corporations," etc.).

The following problems have been pointed out regarding the conventional estimation approach:

- QE sometimes has a large gap with revised annual estimates because the revised annual estimates use supply-side statistics, while QE is based on demand-side statistics;
- Estimation accuracy may be insufficient due to the sampling nature of the demand side statistics; and
- Japan releases GDP data slower than other major developed nations.

**2) Introduction of supply-side estimation**

In order to address these problems, the government has introduced a new estimation method (the supply-side estimation) that uses monthly- or quarterly-based supply-side statistics, such as Current Survey of Production, Survey of Selected Service Industries, based on the basic idea of annual estimation. The new approach is summarized as follows:

a) **Auxiliary series for shipment:** In line with the yearly shipment value as defined in the commodity-flow method's 90-commodity classification(*) for revised annual accounts, the QE team creates auxiliary series that indicate quarterly shipment trend, using monthly- or quarterly-based source statistics.
b) **Quarterly values of revised annual accounts:** Paying attentions to quarterly pattern of these auxiliary series, the QE team divides the yearly shipment values into quarterly shipment data.
c) **Extrapolation based on period-over-period comparison:** The QE team calculates preliminary quarterly shipment values by extrapolating the latest data of b) based on period-over-period comparison of the auxiliary series. This yields the quarterly shipment value in line with the 90-commodity classification of the commodity-flow method.
d) **Estimation of domestic aggregate supply:** After taking into consideration the freight/transport margins and "net imports," the QE team estimates domestic aggregate supply data by subtracting net increase in distributors' inventory and net increase in raw material inventory.
e) **Estimation of demand-side components:** The QE team calculates domestic household final consumption expenditure and gross fixed capital formation by multiplying domestic aggregate supply by applicable allocation ratio, which is calculated from the latest annual estimates.

By integrating demand-side data with the domestic household final consumption expenditure and gross fixed capital formation calculated above, the QE team calculates the overall estimates.

* Subcategories of estimated products/goods

For QE purpose, some categories in the 90-commodity classification ("31. Petroleum products," "51.

Electronic and Communication Equipment," and "67. Insurance") have their subcategories since Jan-Mar 2001. (The QE team traditionally used the 90-commodity classification to estimate QE in the past, but the team modified the products/goods classifications when calculating the Jul-Sep 2003 second QE.) See Reference #2.

**3) Estimation approach for each demand-side component**

While the QE team basically uses the conventional methods when estimating demand-side components (except for domestic final consumption expenditure of households and private non-residential investment), converting into real values or seasonally adjusting statistics, the team has introduced the new approaches as stated in II (4) below. To release QE data as early as possible, the QE team has significantly modified the approach for estimate the private inventory increase.

## II. Summary of the new estimation method of preliminary quarterly GDP (QE)

### (1) Method of estimating nominal value per demand component

**Table 1: Summary of estimation method for nominal value for each demand component**

| |
|---|
| **Final consumption expenditure of households**<br>Final consumption expenditure of households takes into consideration the supply-side estimates as well as the demand-side estimates derived from "Family Income and Expenditure Survey" etc. The final consumption expenditure of households represents the weighed average of demand-side and supply-side estimates. The weight is calculated based on estimation accuracy (i.e., relative standard error). |
| **Private housing investment**<br>Total residential investment is estimated by converting "Building Construction Started" into the progress-based value, taking into consideration the average construction schedule. The fluctuation in the average construction schedule is also incorporated. |
| **Private non-residential investment**<br>For the first QE, the private non-residential investment basically represents "supply-side estimates of gross fixed capital formation (*)" less "public fixed capital formation". For the second QE, the private non-residential investment represents takes into accounts the two components: The supply-side estimates (calculated in the same manner as the first QE); and the demand-side estimates derived from "Quarterly Financial Statements Statistics of Corporations." It is the weighted average of the demand-side and supply-side estimates. The weight is calculated based on estimation accuracy (i.e., relative standard error).<br>(*) Private housing investment and the non-residential investment of private non-profit institutions serving households are deducted. |
| **Private inventory increase**<br>For the first QE, the finished goods inventory represents the (year-end) inventory stock in "Census of Manufactures" multiplied by the inventory index of the "Indices of Industrial Production (IIP)." The distributors' inventory is calculated by extrapolating the inventory stock of "Census of Commerce," using the on-hand commodity data in "Current Survey of Commerce." For the second QE, the work-in-process inventory and raw material inventory are estimated by using "Quarterly Financial Statements Statistics of Corporations." |
| **Government final consumption expenditure**<br>Each component for government final consumption expenditure is estimated by using budget statistics or other quarterly source statistics data. |
| **Public fixed capital formation**<br>Basically, the public fixed capital formation is estimated by year-on-year comparison of the "Public Sector" section in "Integrated Statistics on Construction Works (on a progressive basis)." (The QE team traditionally calculated annual public investments, using budget information, and then, estimated the quarterly trend by using "Integrated Statistics on Construction Works" and past quarterly patterns.) |
| **Public inventory**<br>The QE team holds hearing sessions for stakeholders to collect related data. |
| **Exports and imports**<br>The QE team calculates exports/imports based on the goods/services trade data in "Balance of Payments Statistics." Since the first QE does not incorporate the data for the final month, the QE team estimates it based on related data such as "Trade Statistics." |

### (2) Method of converting into real values

When releasing the FY2003 revised annual accounts and the Jul-Sep 2004 second QE (on December 8, 2004), the QE team started using the chain-linking method for converting nominal values into real values. (As a result, the QE team has designated the traditional real values (calculated in line with the fixed-base year approach) as reference series. The team intends to release the traditional real values about two weeks after announcing the second QE data.) The chain-linking method is applicable for real value data for Jan-Mar 1994 and subsequent quarters. In this sense, the fixed-reference-year-based real values (released in December 2003) represent the official series from Jan-Mar 1980 to Oct-Dec 1993. The new chain-linking method uses the year 2000 as its reference year (i.e., chain price index of the calendar year 2000), while the traditional fixed-base year approach employs the year 1995 as its reference year.

### (3) Published items

**Table 2. List of items released in QE**

**1. GDP-related components (nominal values, real values, deflators; except for some components)**

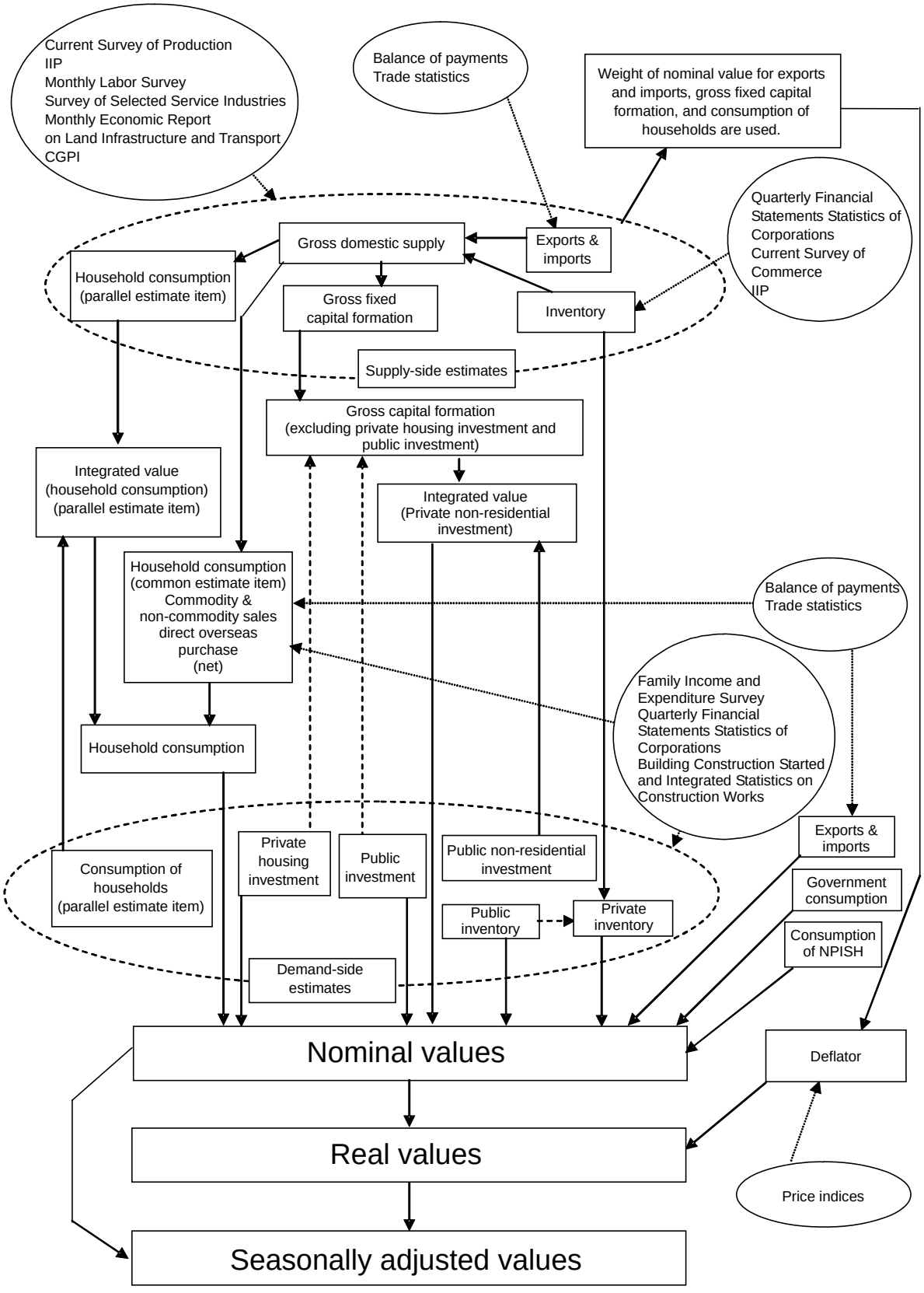
| |
|---|
| Gross domestic expenditure (GDE = GDP) |
| Domestic demand |
| Private demand |
| Private final consumption expenditure |
| Final consumption expenditure of households |
| Final consumption expenditure of households (except imputed rent) |
| Private housing investment |
| Private non-residential investment |
| Private inventory increase **(Note 1)** |
| Public demand |
| Government final consumption expenditure |
| Public fixed capital formation |
| Public inventory increase **(Note 1)** |
| Gross fixed capital formation (re-grouped) **(Note 2)** |
| Net export of goods and services (nominal and real values only) **(Note 3)** |
| Export of goods and services |
| Import of goods and services |
| Gross domestic income (GDI) (real values only) |
| Gross national income (GNI) |

Note 1: Deflator: Calendar-year average deflator
Note 2: Gross domestic fixed capital formation = private housing investment + private non-residential investment + public fixed capital formation
Note 3: The real-based net export of goods and services is defined as "export less import."

**2. Compensation of employees (nominal and real values)**

| |
|---|
| Compensation of employees |

## Chart 1. Image of new QE estimation method



### (4) Other characteristics

**1) Extrapolation approach for QE**

- QE is calculated by distributing the latest (annual-based) revised data into quarterly values, and then taking into consideration the quarter-over-quarter comparison of source statistics' original series.
- The traditional QE calculation approach (i.e., a year-on-year comparison approach) has a problem because quarterly pattern fluctuations in the preceding year would affect the quarter-on-quarter comparison in QE. However, the new approach would remove such problem.

**2) Quarterly distribution of the revised annual accounts**

- As underlying data for QE, the new estimation approach in principle divides the revised annual accounts into quarterly data, taking into consideration the auxiliary series quarterly pattern. (A new approach is employed for domestic final consumption expenditure of households, private non-residential investment and private inventory increase.)
- The new estimation approach is better at incorporating source statistics and identifying economic trends than the conventional estimation approach because the conventional approach divides the annual accounts into quarterly data by using the QE quarterly pattern derived from the demand-side statistics. (In the conventional approach, some series are divided into quarterly data by using special techniques.)

**3) Seasonal adjustment**

- Seasonal adjustment is recalculated every quarter inclusive of the most recent estimate. (On the other hand, the conventional approach seasonally adjusts the latest revised annual accounts, while employing the pre-calculated seasonal index in estimating QE.)
- In this new approach, the QE team has to revise the seasonally adjusted series retroactively for each quarter, but the new approach would incorporate the most recent quarter's seasonal pattern much better than the conventional approach.
- If original series have a different seasonal pattern gap between the primary QE and the secondary QE, it is necessary to prevent adverse impacts on the seasonal pattern series.

**4) Retroactive revision rule**

To address annual revisions in the source statistics, the QE team will retroactively revise the estimated data if deemed necessary. (In principle, the conventional estimation approach did not require modifying the past data from releasing the second QE information to publicizing the finalized GDP data.) In addition, since the newly-introduced chain-linking method requires benchmarking quarterly real GDP in line with annual-based real GDP, the retroactive revision will cover up until the first quarter of the calendar year on which the revised annual GDP data is available.

**5) Others**

- In estimating final consumption expenditure of households, the QE team will stop using the single-person household data in "Family Income and Expenditure Survey" of MIC (Ministry of Internal Affairs and Communications).
- When estimating private non-residential investment based on "Quarterly Financial Statements Statistics of Corporations," the QE team will correct problems resulting from sample discontinuity.
- In estimating private inventory, the QE team will basically use relevant source statistics. However, the team will also minimize statistical errors because these source statistics are sample surveys.
- The QE team will employ the trend extrapolation approach when calculating NPISH's final consumption expenditure. (This feature has already been applied in the conventional approach.)
- In estimating the housing investment, the team will review feasibility in progress-rate calculation criteria (i.e., average construction schedule).
- The team will estimate the public fixed capital formation data, using "Integrated Statistics on

Construction Works (on progressive basis, public)" available from MLIT (Ministry of Land, Infrastructure and Transport).

- The QE team will incorporate the current products/goods information when estimating related deflators for fixed capital formation.

### (5) Timing for QE publication

- Because the new estimation approach employs the supply-side statistics to calculate QE, the QE team will be able to release the first QE information almost a month earlier than in the past. In this sense, Japan will be able to provide QE data at almost the same timing as other major developed nations. The Japanese government plans to provide the first QE data about a month and two weeks after the applicable quarter, while disclosing the second QE data about two months and 10 days later than the applicable quarter. In principle, the government intends to release QE data in the following timing.

  The first QE: 5 business days after releasing "Family Income and Expenditure Survey (all households)"

  The second QE: 5 business days after releasing "Quarterly Financial Statements Statistics of Corporations"

**<Reference> How long does it take for major nations to release (the first) QE data after the applicable quarter is over?**

| | |
|---|---|
| UK | Almost a month |
| USA | Almost a month |
| Japan (new QE approach) | About a month and two weeks |
| France | About a month and two weeks |
| Germany | About a month and two weeks |
| Italy | About a month and two weeks |
| Canada | Nearly two months |

(*) Under the conventional approach (applicable until August 2002), the Japanese government released the first QE data about two months and seven days later than the end of applicable quarter, and the second QE data four months and ten days after the applicable quarter. Analysts have been recommending the government to release QE data at a quicker timing from the viewpoint of timely evaluation of economic trends.

### (6) New QE method: Covered period and related remarks

#### 1) Applicable quarters for new estimation approach

**(a) Method of dividing annual estimation into quarter-based data**

<Original series>

- The QE team will employ the new approach when calculating quarterly estimates for the Jan-Mar 1994 and subsequent quarters. (In calculating the nominal compensation of employees, the team will use the new estimation approach to estimate the quarterly estimates for the Jan-Mar 1980 and subsequent quarters.)
- As for the Oct-Dec 1993 and preceding quarters, the official data shall be the finalized quarterly data that are calculated in line with the quarterly allocation approach in a similar

manner to the new estimation approach. (For more information, see the section 4.(2) in the instruction manual "National Accounts for FY2002.")

<Seasonally adjusted series>

- The seasonal adjustment is applicable for the data from the Jan-Mar 1994 (or Jan-Mar 1980 in case of compensation of employees) to the latest quarter. Because the QE team will add or revise these data (original series) when estimating the first QE and the second QE, these data are subject to retroactive revision.
- As for the seasonally adjusted estimates for the periods up to the Oct-Dec 1993 quarter, the official series are the seasonally adjusted series of the already published original series, with the seasonal adjustment periods Jan-Mar 1980 to Oct-Dec 1993. (These series will not be modified unless the original series are modified).
- The quarters up until Oct-Dec 1993 have different seasonal patterns from the Jan-Mar 1994 and subsequent quarters. Employing different seasonal adjustment factors for these quarters will prevent adverse impacts resulting from the seasonal pattern gap.

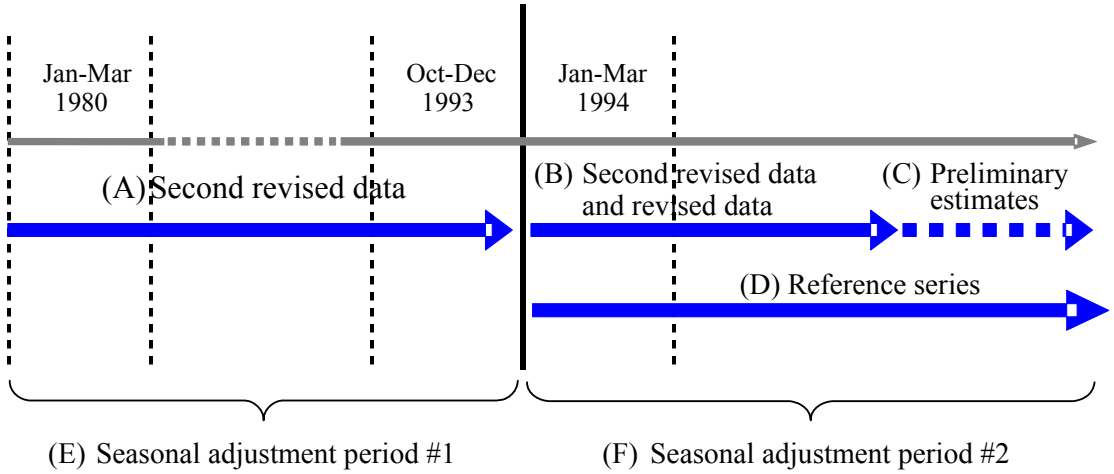
**(b) Coexistence of series with different quarterly patterns**

- As a result, the quarters up to Oct-Dec 1993 have different quarterly allocation criteria from the Jan-Mar 1994 and subsequent quarters in terms of private non-residential investment, private inventory increase, etc. In this sense, it is necessary to pay due attentions when using the following data.
  i) Original series: the year-on-year comparison factor and the contribution ratio for each quarter from Jan-Mar 1994 to Oct-Dec 1994;
  ii) Seasonally adjusted series: the quarter-over-quarter comparative data and the contribution ratio for the Jan-Mar 1994 quarter; and
  iii) Yearly series: FY1993 GDP and composition ratio, the year-on-year comparison data for FY1993 and FY1994, and the contribution ratio for FY1993 and FY1994.
- The conventional quarterly allocation approach has yielded the following calculation results in terms of FY1993 and FY1994 GDP.

| (Reference) | Actual GDP (base year: 1995) | | Nominal GDP | |
|---|---|---|---|---|
| | GDP | Growth rate from the preceding FY | GDP | Growth rate from the preceding FY |
| FY1993 | 482,226.8 | (0.2) | 484,787.4 | 0.2 |
| FY1994 | 487,844.6 | 1.2 | 489,837.4 | 1.0 |

(¥1 billion, %)

**Chart 2. Applicable quarters for the new estimation method**




(A) The conventional quarterly allocation approach (Jan-Mar 1980 to Oct-Dec 1993). The QE team calculates real GDP based on the 1995 price level.

(B) The new estimation approach is applicable for allocating the revised final data and finalized data into quarterly data. The QE team calculates real GDP based on the 2000 chain price index.

(C) Quarterly preliminary estimates by the new approach. The QE team calculates real GDP based on the 2000 chain price index.

(D) Represents only the real GDP based on the 1995 price level. The same approach as (B) and (C) shall be applicable for quarterly allocation approach and other calculation, except for real value calculation.

(E) The seasonal adjustment is applicable from the Jan-Mar 1980 quarter to the Oct-Dec 1993 quarter.

· The seasonally adjusted series for these quarters will not be modified unless the original series are retroactively revised.

(F) Seasonal adjustment is applicable from the Jan-Mar 1994 quarter to the latest quarter.

· These quarters are subject to repeated seasonal adjustment when estimating GDP.

· As a result, the seasonal adjustment series are retroactively revised when estimating GDP.

## 2) Annual revisions, etc.

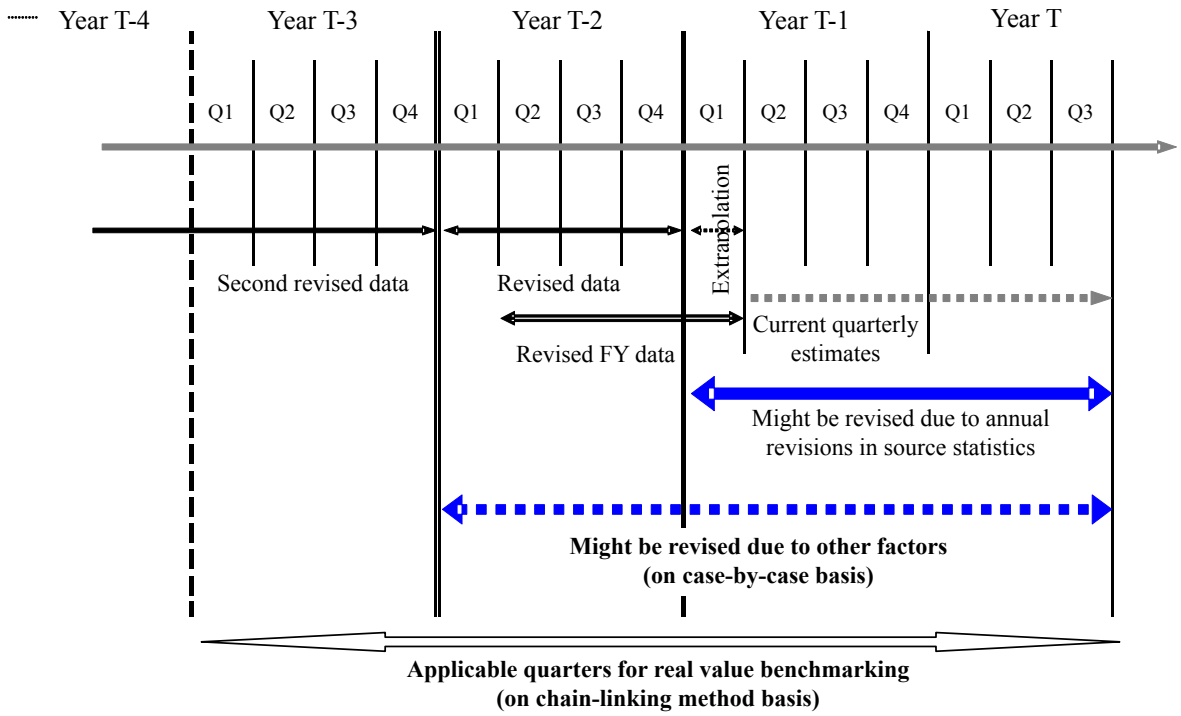
**(Nominal values)**

- The QE team retroactively revises nominal value of GDE components if source statistics are subject to annual revision. (If the current year is the year T, the QE team will retroactively revise these nominal values for up until the Jan-Mar quarter of the year T-1. As a result, the revised data of the year T-2 will be revised before it turns into the final revised data.)
- If series appear only in annual accounts, these series are revised in the process of next annual estimation.
- If source statistics have changed due to other factors than stated above (e.g., changing a questionnaire format, or revising standard year), the corresponding estimates will be revised by using a proper calculation approach on a case-by-case basis. However, the first annual accounts are retroactively revised, but the second (final) annual accounts will not be revised in principle.

**(Real values)**

- If source statistics are retroactively revised, the real values of GDE components (on chain-linking method basis) are also retroactively revised up until the Jan-Mar quarter of the year T-2. In this case, it is necessary to recalculate quarterly real values into yearly real values. However, the QE team will retroactively recalculate the quarterly data up until the Jan-Mar quarter of the year T-3. (In other words, even if applicable source statistics are not revised, the QE team might retroactively revise quarterly real values for the year T-3.)

**Chart 3. Image of retroactive revision**



## III. Method of supply-side estimation

### (1) Basic idea

Based on the commodity-flow method used in the annual estimates, the QE team also employs supply-side source statistics to calculate domestic household final consumption expenditure and the gross fixed capital formation in nominal terms. However, since the calculation approach used for annual estimates is not technically feasible for estimating quarterly data, a simpler calculation approach is employed.

The commodity-flow method for annual estimates has detailed distribution channel categories for some 2000 goods/services and estimates the allocation amount to each of these goods/services (see the annexed chart in Reference #1). The QE team estimates supply-side data for the 90 commodities listed in the commodity-flow method(*), while simplifying distribution channels to a certain extent. The supply-side estimation approach is summarized below (see Reference #1):

1) In line with the yearly shipment value as defined in the commodity-flow method's 90-commodity classification* for revised annual accounts, the QE team creates the auxiliary series that indicates quarterly shipment trend, using monthly- or quarterly-based source statistics.
2) Paying attentions to quarterly pattern of this auxiliary series, the QE team divides the yearly shipment values into quarterly shipment data.
3) Based on the latest data of 2) above, the QE team estimates preliminary quarterly shipment values, paying attentions to the period-over-period comparative data of the auxiliary series. This yields the quarterly shipment value in line with the 90-commodity classification of the commodity-flow method.
4) After taking into consideration the freight/transport margins and "net imports," the QE team estimates domestic aggregate supply data by subtracting net increase in distributors' inventory and net increase in raw material inventory.
5) The QE team calculates domestic household final consumption expenditure and gross fixed capital formation by multiplying the domestic aggregate supply by applicable allocation ratio, which is calculated from the latest annual estimates.

By integrating demand-side data with the domestic household final consumption expenditure and gross fixed capital formation derived from the supply-side estimation above, the QE team calculates the overall estimates.

* Subcategories of estimated products/goods

For QE purpose, some categories in the 90-commodity classification ("31. Petroleum products," "51. Electronic and Communication Equipment," and "67. Insurance") have their subcategories since Jan-Mar 2001. (The QE team traditionally used the 90-commodity classification to estimate QE in the past, but the team modified the products/goods classification when calculating the Jul-Sep 2003 second QE.)

Hereinafter, the term “the 90-commodity classification” includes these subcategories. (For more information on commodity categories, see Reference #2.)

### (2) How to create auxiliary series

Paying attentions to source statistics, the QE team creates auxiliary series that indicate quarterly

shipment trends.

1) An auxiliary series derived entirely from a single data

If a series falls under the 90-commodity classification of the commodity-flow method, the series will be used as an auxiliary series.

2) An auxiliary series created by totaling two or more series

If a product or service falls under more than one product categories in the 90-commodity classification, the QE team sums up the shipment values of these product categories and creates a shipment series as close as possible to the 90-commodity classification.

3) An auxiliary series created by "quantity * price (index)"

If only shipment volume data is available, the QE team chooses or estimates the closest price index as close as possible, multiplies it by the shipment volume, and calculates an (nominal-based) auxiliary series that represents the trend of shipment value.

4) Wholesale and retail businesses

The QE team calculates the wholesale/retail margin (equal to their shipment value) by multiplying sales data (derived from "Current Survey of Commerce") by margin rate (calculated from "Basic Survey on Commercial and Manufacturing Structure and Activity" and "Quarterly Financial Statements Statistics of Corporations".)

Wholesaling and retailing margin =

{(Sales - cost of sales) / sales + differential margin (note)} * sales

(Note) Differential margin adjusts a gap between the margin rate derived from "Basic Survey on Commercial and Manufacturing Structure and Activity" and the margin rate from "Quarterly Financial Statements Statistics of Corporations."

Because the data on "Quarterly Financial Statements Statistics of Corporations" is not available for the first QE, the QE team extrapolates the wholesale/retail margin by using the average margin rate for the latest year (four quarters). As for estimating the second QE, the team uses the same data as the first QE due to time constraints. (The team uses the data in "Quarterly Financial Statements Statistics of Corporations" when calculating the first QE for the following quarter.)

5) An auxiliary series derived from demand-side estimates

If supply-side statistics does not provide any auxiliary series, the team uses "Family Income and Expenditure Survey" and other demand-side statistics to identify the trend of shipment value.

6) Others

The QE team sometimes utilizes multiple approaches as stated above when estimating an auxiliary series.

See Reference #7 for more information on a list of statistics actually used for the 90-commodity classification, how to employ the approaches 1) to 6), and the extrapolation approach for the latest quarter.

### (3) Method of dividing annual shipment data into quarterly data

Using the quarterly pattern of the auxiliary series derived from (2) above, the QE team creates quarterly shipment data by allocating the annual shipment data to quarters.

| | |
|---|---|
| Auxiliary series for the calendar year t | $A_t$ |
| Auxiliary series for the quarter i in the calendar year t | $a_{t,i}$ (i=1,2,3,4) |
| | ($A_t=a_{t,1} + a_{t,2} + a_{t,3} + a_{t,4}$) |
| Revised annual shipment value | |

| | |
|---|---|
| under the 90-commodity classification | $Q_t$ |
| Revised quarterly shipment value | |
| under the 90-commodity classification | $q_{t,i}=Q_t\times(a_{t,i}/A_t)$ |

**(4) Method of extrapolating preliminary shipment data**

Based on the latest quarterly shipment data derived from (3) above, the QE team extrapolates preliminary shipment data, using quarter-over-quarter comparison of auxiliary series.

| | |
|---|---|
| The latest quarterly shipment data | |
| under the 90-commodity classification | $q_{t,4}$ |
| Auxiliary series for the same quarter | $a_{t,4}$ |
| Preliminary quarterly shipment value | |
| under the 90-commodity classification | $q_{t+1,1} = q_{t,4} \times (a_{t+1,1} / a_{t,4})$ |
| | $q_{t+1,2} = q_{t+1,1} \times (a_{t+1,2} / a_{t+1,1})$ |
| | ▪ |
| | ▪ |

**(5) Method of estimating demand components**

1) Adjustment to exports and imports

The domestic supply is estimated by adding the shipment value in (4) above and imports, and then subtracting exports. The QE team calculates the exports and imports by reorganizing the trade statistics' export/import data and the BOP statistics service balance data in line with the 90-commodity classification.

2) Converting into purchasers' price

The QE team calculates purchasers' price-based value by adding the values of 1) above and freights/margins (Commodity #1-58 in the 90-commodity classification). In the case of commerce (wholesale and retail), the QE team excludes cost-type commercial sales portion (e.g., secondhand goods trading within the same sector) and allocates the reminder as the freight/margins incidental to other commodities. As for transportation, the team excludes cost-type freights (e.g., transportation activities as a part of production process) and passenger-related transportation activities and then allocates the remainder as the freights/margins incidental to other goods.(*)

3) Estimating domestic aggregate supply (adjusting net inventory increase)

The QE team calculates the domestic aggregate supply (exclusive of inventory increase) by deducting distributors' inventory net increase and raw material inventory net increase from the purchasers' price-based domestic supply derived from 2) above.

The team estimates the distributors' inventory net increase, using the inventory data in "Commercial Census" and the on-hand commodities data in "Current Survey of Commerce." On the other hand, the raw material inventory net increase is calculated, using the inventory (materials and supplies) data in "Quarterly Financial Statements Statistics of Corporations." (For more information on how to calculate the inventory net increase, see the section "IV.4. Private Inventory Increase.")

4) Estimating demand components

The QE team estimates the nominal values of domestic household final consumption expenditure and gross fixed capital formation by multiplying the domestic aggregate supply in 3) above by the allocation ratio derived from the latest annual estimates. (For more information on the allocation ratio, see Reference #2.)

Allocation ratio of domestic household final consumption expenditure
= Domestic household final consumption expenditure / domestic aggregate supply

Allocation ratio of gross fixed capital formation
= Gross fixed capital formation / domestic aggregate supply

(*) New approach for estimating freights and wholesale/retail margins

When allocating the freight and wholesale/retail margins in line with the 90-commodity classification, the QE team employed the composition ratio in revised annual GDP data. However, in order to address possible shipment fluctuations, the QE team is now using new composition ratio calculation approach, which multiplies the domestic supply (as calculated for each of the 90 commodities) by applicable freight rate or wholesale/retail margin rate. (The QE team retroactively applies this approach up to the Jan-Mar 1994 quarter.)

### (6) How to estimate output in the construction industry

Unlike other industries, construction companies usually yield value by procuring construction materials and processing these materials for relatively longer term. In this sense, it is not technically difficult to identify the output level on a progress basis. From this viewpoint, the QE team estimates the output level in the construction industry by calculating the industry's input materials in line with the commodity-flow method, and then incorporating the separately-calculated value added, such as employees' compensation and operating surplus. This approach is called "Construction commodity-flow method."

In relation with QE, the team extrapolates the construction industry's output level, using the auxiliary series as follows:

Auxiliary series = (Input materials + value added) / (1 - intermediate input ratio for sectors where the commodity-flow method is not applicable)

Input materials represents the domestic aggregate supply of (5) multiplied by the construction material input ratios (as stated in the latest annual estimates). The value added is extrapolated from the construction industry's total value-added (in the annual estimates), taking into consideration "Contractual cash earnings (establishments with 5 or more employees) of 'Monthly Labor Survey' multiplied by Number of employees of 'Labor Force Survey.'" In order to incorporate the output level in the sectors where the commodity-flow method is not applicable (e.g., construction repair works), the QE team divides the value added by the coefficient as stated in the above formula's latter half.

The QE team allocates the construction industry's quarterly output level into the two portions (i.e., the construction industry's intermediate demand portion and the gross fixed capital formation portion), and incorporates the latter portion to gross fixed capital formation.

# IV. Method of estimating nominal value per demand component

## 1. Private final consumption expenditure

### (1) Final consumption expenditure of households

#### 1) Domestic final consumption expenditure of households

The QE team estimates the domestic household final consumption expenditure by summing up the following three components: (a) the goods/services listed in the 87-purpose classification and calculated in parallel from the supply-side and demand-side perspectives (parallel estimate items); (b) the goods/services directly calculated from various statistics (common estimate items); and (c) commodity/non-commodity sales estimated from their trends.

**(a) Parallel estimate items**

**Demand-side estimates**

By using the auxiliary series (i.e., total household consumption) derived from "Family Income and Expenditure Survey," "Survey of Household Economy," [(Note)] the number of households and other data sources, the QE team allocates the annual estimates into quarterly data and also extrapolates preliminary quarterly data in line with the 87-purpose classification. When extrapolating preliminary quarterly data, the QE team uses a quarter-to-quarter comparative data of the auxiliary series. Electricity and water supply as estimated in this approach are regarded as common estimate items.

The auxiliary series (the total household consumption) represents per-household consumption expenditure (reorganized in line with the purpose classification) for 1) two-or-more-person nonagricultural household, 2) single-person nonagricultural households in "Family Income and Expenditure Survey" (families of two or more members) or 3) agricultural households in "Statistical Research on the Farm Economy (monthly report)" multiplied by the number of households derived from "Population Census" or "Monthly Report on Current Population Estimates." The resultant household expenditures are summed up in line with the 87-purpose classifications.

As for single-person nonagricultural households, the QE team uses the "Family Income and Expenditure Survey" data (families of two or more members) after making some adjustments in line with single-person household consumption expenditure data of "National Survey of Family Income and Expenditure."

**Supply-side estimates**

The QE team recalculates the household final consumption expenditure (derived from supply-side calculation) in line with the 87-purpose classification, using the commodity weight calculated from revised annual estimates.

**Method of integration**

The QE team integrates the demand-side and supply-side data in the following formula ($C_d$ represents demand-side data; while $C_s$ is supply-side data). The integration process goes in line with the purpose classification of domestic household final consumption expenditure (a portion that falls under Parallel Estimate Items). (See Reference #3 for more information on weight k; and also see Reference #6 for the formula's concepts and the weight k calculation approach).

Integrated value of domestic household final consumption expenditure (Parallel Estimate Items) = $kC_d + (1-k)C_s$

[(Note)] In estimating demand-side auxiliary series for household final consumption expenditure, the QE team started using the "Survey of Household Economy" data in the Jan-Mar 2002 quarter if the survey provides substitutive data for "Household Income and Expenditure Survey." The QE team currently uses the "Survey of Household Economy" data for 19 consumption purposes out of the total 87. (On the average in 2002, the "Survey of Household Economy" data account for some 17% of the consumption expenditure in the demand-side auxiliary series.)

## Table 3. List of 87-purpose classification applicable to domestic household final consumption expenditure

| | |
|---|---|
| **1. Food and non-alcoholic beverages** | **7. Transport** |
| 1101 Bread and cereals | 7101 Automobiles |
| 1102 Meat and meat substitute products | 7102 Motorcycles |
| 1103 Fish and marine products | 7103 Bicycles and other vehicles |
| 1104 Milk, cheese and eggs | 7201 Spare parts and accessories |
| 1105 Oil and fats | 7202 Fuels and lubricants |
| 1106 Fruit | 7203 Maintenance and repair of personal transport equipment |
| 1107 Vegetables | 7204 Other services |
| 1108 Sugar, chocolate and confectionery | 7301 Passenger transport by railway |
| 1109 Other foodstuff | 7302 Passenger transport by road |
| 1201 Coffee, tea and cocoa | 7303 Passenger transport by air |
| 1202 Other non-alcoholic beverages | 7304 Passenger transport by sea and inland waterway |
| **2. Alcoholic beverages and tobacco** | 7305 Other transportation services |
| 2100 Alcoholic beverages | **8. Communications** |
| 2200 Tobacco | 8100 Postal service |
| **3. Clothing and footwear** | 8201 Domestic telephone and telegraph services |
| 3101 Clothing materials | 8202 International telephone and telegraph services |
| 3102 Garments | 8203 Other communication services |
| 3103 Other clothes and clothing accessories | **9. Entertainment, leisure services and culture** |
| 3104 Cleaning and clothing repair costs | 9101 Radio, TV and video equipment |
| 3201 Shoes and other footwear | 9102 Photographic/cinematographic equipment and optical instruments |
| 3202 Footwear repair cost | 9103 Information processing equipment |
| **4. Gross rent, water, electricity, gas and other fuels** | 9104 Recording media |
| 4100 Gross rent | 9105 Repair of audio-visual, photographic and information processing equipment |
| 4201 Water supply | 9201 Musical instruments |
| 4202 Waste disposal | 9202 Repair of musical instruments |
| 4301 Electricity | 9301 Games, toys, etc. |
| 4302 Gas | 9302 Sporting goods |
| 4303 Liquid fuels | 9303 Garden-, plant- and pets-related goods/services |
| 4304 Solid fuels | 9401 Recreational and sports services |
| 4305 Heat energy | 9402 Cultural services |
| **5. Furnishing, household equipment and homemaking services** | 9403 Gambling |
| 5101 Furniture and furnishings | 9501 Books |
| 5102 Carpets and other floor coverings | 9502 Newspapers and periodicals |
| 5103 Repair of furniture, furnishings and floor coverings | 9503 Other printed matter |
| 5200 Household textiles | 9504 Stationeries and painting goods |
| 5301 Household appliances | 9600 Package tour |
| 5302 Repair of household appliances | **10.Education** |
| 5400 Glassware, tableware and household utensils | 10100 Education |
| 5500 Tools and equipment for house and garden | **11.Restaurant and hotels** |
| 5601 Non-durable household goods | 11100 Wining/dining service |
| 5602 Home services and homemaking services | 11200 Accommodation service |
| **6. Health and medical care** | **12.Miscellaneous goods and services** |
| 6101 Medicines and other medical goods | 12101 Hair salon and beauty salon services |
| 6102 Therapeutic equipment | 12102 Personal care tools and goods |
| 6200 Outpatient services | 12201 Jewelry, clocks and watches |
| 6300 Hospital stay services | 12202 Other personal effects |
| 6400 Nursing care services | 12301 Life insurance |
| | 12302 Non-life insurance |
| | 12400 Financial services |
| | 12500 Other services |

**<Supplementary information> Detailed explanation on how to estimate demand-side auxiliary series**

For QE purpose, households consist of plural-person nonagricultural households, single-person nonagricultural households and agricultural households. In the formula stated below, the QE team estimates per-household consumption expenditure for each commodity category and calculates the aggregate data in line with the 87 consumption purposes in terms of Parallel Estimates.

It should be noted that the following items in "Family Income and Expenditure Survey" are excluded as they do not belong to the parallel estimate items:

"School lunch," "Rents," "Repairs & maintenance" (except for gardening), "Health and medical care services," "Automobile purchase," "Automobile insurance premium," "Tuition," "Religious contribution" and "Non-life insurance premium," "Housing-related expenditures."

The transfer expenditures shown below are also excluded since they do not fall under consumption expenditure in SNA:

"Membership dues," "Donation," "Money gifts," "Other obligation fees" and "Remittance."

Estimated consumption expenditure of plural-person nonagricultural households

= Per-household itemized consumption expenditure of all plural-member households as described in MIC, "Family Income and Expenditure Survey" or "Survey of Household Economy"
  × Correction factor of "National Survey of Family Income and Expenditure" (Two or more person households)
  × Adjustment factor for number of household members
  × Number of plural-person nonagricultural households

Estimated consumption expenditure of single-person nonagricultural households

= Per-household itemized consumption expenditure of all plural-member households as described in MIC, "Family Income and Expenditure Survey" or "Survey of Household Economy"
  × Correction factor of "National Survey of Family Income and Expenditure" (single-person households)
  × Adjustment factor for number of household members
  × Number of single-person nonagricultural households

Estimated consumption expenditure of agricultural households

= Per-agricultural household consumption expenditure as described in MAFF, "Statistical Research on the Farm Economy (monthly report)"
  × Adjustment factor for all agricultural households
  × Adjustment factor for number of household members
  × Number of agricultural households

1. Plural-member nonagricultural households

- Per-household itemized consumption expenditure:

  The QE team employs the per-household itemized consumption expenditure data for all plural-member households, which is available in "Family Income and Expenditure Survey" or "National Survey of Family Income and Expenditure." In this context, "Pocket money" and "Social expenses" are allocated to relevant categories in light of "Personal Income and Expenditure Table" in "National Survey of Family Income and Expenditure."

- Correction factor of "National Survey of Family Income and Expenditure" (Two or more person households):

  In order to correct sampling errors resulting from sampling in "Family Income and Expenditure Survey" (about 8,000 households surveyed) or "Survey of Household Economy" (about 27,000 households surveyed), the QE team modifies the itemized consumption expenditure in line with MIC's quinquennial survey, "National Survey of Family Income and Expenditure" (about 54,000 households surveyed). After dividing "per-household consumption expenditure in National Survey of Family Income and Expenditure" by "per-household consumption expenditure in Family Income and Expenditure Survey" or "Survey of Household Economy'" at the time of "National Survey of Family Income and Expenditure," the QE team multiplies the resultant value by per-household consumption expenditure as stated in the monthly version of "Family Income and Expenditure Survey" or "Survey of Household Economy."

- Adjustment factor for number of household members

  There is a gap between the per-household family member data in "Family Income and Expenditure Survey" (or "Survey of Household Economy") and the per-household non-agricultural family member data derived from estimated household numbers. To adjust data in line with the latter data, the QE team adjusts per-household itemized consumption expenditure, using the family member adjustment factor and then reorganizes it in line with the purpose classification. The following formula shows how to calculate the family member adjustment factor:

$$
\begin{aligned}
P &= (CXk) / (CXh) \\
&= \{(4-XK)\,C3+(XK-3)\,C4\} / \\
&\quad \{(4-XH)\,C3+(XH-3)\,C4\}
\end{aligned}
$$

  (This formula is applicable if average number of per-household members stands between 3 and 4)

P: Adjustment factor for number of household members
CXh: Consumption expenditure if XH persons belong to a household
CXk: Consumption expenditure if XK persons belong to a household
XH: Per-household members of "Family Income and Expenditure Survey" or "Survey of Household Economy"
XK: Per-household members estimated from "Population Census," etc.
C3: Consumption expenditure of 3-member households as stated in "Family Income and Expenditure Survey" or "Survey of Household Economy"
C4: Consumption expenditure of 4-member households of "Family Income and Expenditure Survey" or "Survey of Household Economy"

- Number of agricultural households:

  The number of households is estimated in the formula: "population / per-household family members". Population data come from "Total population (from "Monthly Report on Current Population Estimates") less agricultural population less number of single-person non-agricultural households". The data on per-household family members come from quinquennial "Population Census," while the QE team interpolates linearly or extrapolates the data for intermediate years.

2. Number of single-person nonagricultural households

- Per-household itemized consumption expenditure

  The QE team now uses the per-household itemized consumption expenditure data for all plural-member families, rather than using the single-person household data in "Family Income and Expenditure Survey" or "Survey of Household Economy." (The QE team handles "Pocket money" and "Social expenses" in the same manner as plural-member nonagricultural households.)

- Correction factor for "National Survey of Family Income and Expenditure" (single-person households):

  After dividing "single-person per-household consumption expenditure in National Survey of Family Income and Expenditure" by "per-household consumption expenditure in 'Family Income and Expenditure Survey' or 'Survey of Household Economy'" at the time of "National Survey of Family Income and Expenditure," the QE team multiplies the resultant value by per-household consumption expenditure (for plural-member households) as stated in the monthly version of "Family Income and Expenditure Survey" or "Survey of Household Economy."

- Adjustment factor for number of household members:

  The QE team employs the household member adjustment factor in the same manner as 1. above in order to align the plural-member household consumption expenditure data (in "Family Income and Expenditure Survey" or "Survey of Household Economy") with the above-mentioned household data as of "National Survey of Family Income and Expenditure."

- Number of households:

  For QE purpose, " single-person general households" and "institutional household members" in "Population Census" are regarded as representing single-person households. The QE team calculates the single-person household percentage for each age bracket (intermediate years are linear-interpolated or extrapolated), and multiplies the percentage by age-bracket-based population as stated in "Monthly Report on Current Population Estimates." As the resultant figure would include single-person agricultural household data, the QE team multiplies the single-person agricultural household percentage (derived from "World Census of Agriculture and Forestry" and "Census of Agriculture") by the number of agricultural households and, then, deducts the resultant figure to estimate the number of single-member nonagricultural households.

3. Agricultural households

- Per-household consumption expenditure:

  (Until the year 1999)

  The QE team estimates consumption expenditure, using the household expenditures statement (for all agricultural households) in MAFF, "Monthly Statistics on Trend of Farm Management and Economy." After allocating "extraordinary expenses" to other applicable expense categories, the team distributes the remainder to relevant expenditure components in line with the average household's consumption expenditure percentage for each commodity as stated in MIC, "Family Income and Expenditure Survey."

  (From 2000 to 2003)

  The QE team estimates consumption expenditure by deducting "Consumption of self-supplied" and "Depreciation" from the per-family "household expenditure" (for all agricultural households) in MAFF, "Monthly Statistics on Trend of Farm Management and Economy." Then, the team distributes the remainder to relevant commodity categories in line with the average household's consumption expenditure percentage for each commodity as stated in MIC, "Family Income and Expenditure Survey." (In this context, the term "average household" includes agricultural, forestry and fishery two-or-more-person households).

  (Since 2004)

  (i) The QE team creates regression formula, using "Monthly Statistics on Trend of Farm

Management and Economy" and MIC's "Family Income and Expenditure Survey (including agricultural, forestry and fishery households)" released from January 2000 to December 2003.
(ii) From the relationship in (i) above, the team calculates monthly per-family-member consumption expenditure, using the data from "Family Income and Expenditure Survey (including agricultural, forestry and fishery households)" data.
(iii) The team calculates the per-agricultural-household consumption expenditure by multiplying the resultant figure in (ii) by the number of per-household family members. The number of per-household family member primary comes from the per-agricultural-household family member data in quinquennial "Population Census," but the team also interpolates linearly or extrapolates the data for intermediate years.
The QE team distributes the resultant consumption expenditure data to each commodity category in line with two-or-more-person household's consumption expenditure percentage for each commodity as stated in "Family Income and Expenditure Survey" or "Survey of Household Economy." (In this context, the term "household" includes agricultural, forestry and fishery households.)

(Adjusting "Pocket money," etc.)
Using the weight as shown in the "Personal Income Statement" section of "National Survey of Family Income and Expenditure," the QE team allocates "Pocket money" and "Social expenses" to relevant categories.

- Estimating adjustment rate for all agricultural households (since 2000):

  In terms of the year 2000 and subsequent years, "Monthly Statistics on Trend of Farm Management and Economy" does not provide expenditure statement data on all agricultural households. Consequently, in order to convert the commercial agricultural household's data into the total agricultural household data, the QE team adjusts the per-household consumption expenditure data in line with the total-agricultural-household adjustment rate.

  There are two approaches to calculate the 1999 per-agricultural-household consumption expenditure for each commodity: the "pre-1999" estimation approach that employs the total agricultural household data; and "post-2000" estimation approach that utilizes the commercial agricultural household data. The adjustment rate for all agricultural households is defined as the calculation result of the former approach divided by the figure derived from the latter approach.

- Adjustment factor for number of household members

  In order to align the per-household consumption expenditure data (of Monthly Statistics on Trend of Farm Management and Economy) into per-household family-member-based data as shown below, the QE team adjusts the applicable data in the same manner as two-or-more-person nonagricultural households.

- Number of agricultural households:

  The QE team calculates the quinquennial benchmark from "World Census of Agriculture and Forestry" and "Census of Agriculture" and then interpolates or extrapolates intermediate years' quarterly data, using the data from annual edition of "Agricultural Survey." The number of per-household family members mainly comes from the agricultural household-related data in quinquennial "Population Census," while the QE team interpolates linearly or extrapolates the data for intermediate years.

### (b) Common estimate items

**Rents**

The QE team calculates rents (excluding boarding house fee) principally based on the overall house rent data derived from the gross floor area and unit house rent in "Housing and Land Survey." The team also extrapolates the increased floor area by looking at "Statistics on Building Construction Starts," while extrapolating the decreased floor area, using "Building Loss Statistics." The QE team estimates the rent unit price data based on "Consumer Price Index." When estimating the boarding house fees, the QE team quadrisects the latest annual survey data.

When estimating the imputed rent for owner-occupied houses, the QE team uses the owned/rented house's floor area data in "Housing and Land Survey," extrapolates the owned house floor area percentage by using "Statistics on Dwelling Construction Starts" and "Building Loss Statistics," and then multiplies it by the rent (except for the boarding house fees).

**Medical and nursing care services**

As components for domestic household final consumption expenditure, the QE team calculates the medical care services and nursing care insurance services by estimating the total value of each service and deducting government-side insurance payment portion, which belongs to government final consumption expenditure.

When estimating the total medical care service data for the annual estimate purpose, the QE team uses "Input-Output Table" as the benchmark, takes into consideration the national medical expenses growth rate, and divides the annual estimates into quarterly data in the same manner as government-side insurance payments. As for preliminary quarterly estimates, the team extrapolates the total medical expenditure data based on a quarter-to-quarter comparison of the government-side insurance payments, assuming that the total medical service expenditure would increase at the same rate as the government-side medical insurance payment. This approach is applicable, as long as the government does not modifies the current medical insurance framework. (For more information, see the section "5. Government final consumption expenditure.") If the government modifies the current framework, the QE team would take into consideration the government-side medical insurance payment fluctuations, such as a change in government-side medical insurance payment ratio.

When calculating the total nursing care insurance service expenditure, the team adds the nursing care expenses (from All-Japan Federation of National Health Insurance Organizations, "Survey on Nursing Care Insurance Benefits") and 10/9 times of welfare equipment purchase cost and house repair cost as described in Ministry of Health, Labour and Welfare (MHLW), "Report on Nursing Care Insurance Operations."

**Water supply and electricity**

The QE team uses the related data, which are derived from the demand-side parallel estimation process in (a) above.

**Automobile, insurance, financial services and real estate brokerage/management**

The team uses the service-based data, which are derived from supply-side estimation process.

### (c) Commodity/non-commodity sales

Commodity/non-commodity sales refer to services that households would purchase from the public sector or nonprofit organizations (e.g., tuition or public facility's admission fee). In SNA, these services are included in the domestic household final consumption expenditure.

The QE team calculates the quarterly commodity/non-commodity sales data by extrapolating the annual data for each commodity/service from their trend or budget growth, and then dividing it by the preceding year’s quarterly allocation percentage.

## 2) Resident households' direct overseas purchase and non-resident households' direct domestic purchase

Household final consumption expenditure is obtained in the following formula:

Domestic final consumption expenditure of households as estimated in 1)
+ resident households' direct overseas purchase
- non-resident households' direct domestic purchase.

The QE team estimates this data by reclassifying "Balance of Payments Statistics." However, as the last month's data are not available for the first QE, the QE team extrapolates it based on the

year-on-year comparison of the preceding two months.

**(2) Final consumption expenditure of NPISH (private non-profit institutions serving households)**

When estimating the revised annual GDP data, the QE team calculates NPISH's output level (i.e., the sum of employees compensation and intermediate input, etc.) and commodity/non-commodity sales (non-profit organization's services purchased by households, etc.) in the two purpose categories (i.e., "education" and "others"), using "Survey on Private Non-Profit Institutions" and other source documents. NPISH's final consumption represents their output level less their commodity/non-commodity sales. If an estimated component (e.g., employees' compensation in the "education" category) has close relationships with the source statistics, the QE team takes account of its seasonal patterns when allocating the annual data to quarterly data. (In this context, the QE team uses the education/service sector's wage index for employers with five or more employees as described in MHLW, "Monthly Labour Survey.") If not, the team simply divides the annual data by four.

When estimating preliminary quarterly data, the QE team estimates the current fiscal year data in line with the preceding year's level, and then divides it by quarterly allocation ratios of the preceding fiscal year. The team calculates the annual output level, paying attentions to its past trend. When estimating the "education" data, the team conducts a trend estimation, paying attentions to private school's teaching staff data of "School Basic Survey." In estimating the commodity/non-commodity sales, the team calculates its percentage to overall output level and multiplies the resultant percentage by the output level.

## 2. Private housing investment

When calculating private housing investment, the QE team deducts the public housing investment from estimated overall housing investment. The team estimates the overall housing investment by converting the residential buildings construction costs (total cost) and residential-commercial dual-purpose buildings construction costs (70% of total cost) into work-progress-based data in line with the average construction schedule(*) for building structure types, residential buildings or residential-commercial dual-purpose buildings, and then multiplying it by applicable correction factor in order to eliminate a possible error on construction work unit price or housing starts. (The above-mentioned construction cost data comes from "Statistics on Building Construction Starts.") It should be noted that the building structure types include the following categories: Wooden structure, steel-framed reinforced-concrete structure, reinforced concrete structure, steel-framed structure, concrete block structure and others.

In terms of the average construction schedule for structure types, residential buildings and residential-commercial dual-purpose buildings, the team in principle estimates applicable data every five years based on the construction schedule data in "Annual Statistical Construction Report," while the team also interpolates the data for intermediate quarters.

(*) The team estimates the average construction schedule by using the structure-based or floor-area-based construction schedule pattern data for all buildings, which is illustrated in "Annual Statistical Construction Report." This survey covers buildings other than residential buildings; however, the team adopts as the approximate value the average construction schedule for the residential building's average floor area.

## 3. Private non-residential investment

As for private non-residential investment, the QE team estimates the supply-side factors and demand-side factors in parallel and, then, integrates these two factors at level of aggregative values (i.e., parallel estimate items). Then, the team adds two more factors: the private sector's portion of the software new orders (i.e., a common estimate item derived from the supply-side estimation); and NPISH's capacity investments (estimated from its trend).

**(1) Parallel estimate items**

**1) Demand-side estimates**

Demand-side estimates are created in and after the second QE. The QE team allocates annual estimates into quarterly data or extrapolates preliminary estimates by using the auxiliary series of Non-Residential Investment derived from "Financial Statements Statistics of Corporations by Industry" (non-financial corporations), "Business and Investment Survey of Incorporated Enterprises" (financial institutions) and "Unincorporated Enterprise Survey" (unincorporated enterprises). The team divides the annual estimates into quarterly data in line with the auxiliary series' quarterly ratios, while extrapolating the preliminary estimates based on a quarter-to-quarter comparison of the auxiliary series.

The auxiliary series are estimated as follows:

**(a) Non-residential investment of private non-financial corporations**

The data is estimated from Non-Residential Investment data (new investment in tangible fixed assets) in "Quarterly Financial Statements Statistics of Corporations by Industry". In this process, the team adjusts the data in order to mitigate errors due to yearly change in sample firms for quarterly reports or negative impacts arising from each quarter's respondent enterprises gap. To be more specific, the QE team multiplies the non-residential investment by the adjustment factor, which is estimated from the fixed assets data in "Quarterly Financial Statements of Corporations by Industry" in the following manner:

"Quarterly Financial Statements of Corporations by Industry" does not successfully provide coherent time-series data on tangible fixed assets because the closing value in the current quarter has some gaps with the initial value for the following quarter. From this viewpoint, the QE team designates a proper past quarter as the benchmark (say, the Apr-Jun 1990 quarter) and creates a stock series by successively multiplying the stock series by the closing stock level as a percentage to the initial stock level in the same period. This stock series may take different levels, depending upon the benchmark quarter; however, if the benchmark is proper enough, the estimated stock series would exceed or underrun the actually observed stock level at almost the same probability. Then, the team estimates a regression formula (with the least square method with no constant term), which has the explaining variable of the stock level (benchmark: the Apr-Jun 1990 quarter) as well as the explained variable of the actually observed stock level (at the quarter end). Then, the team multiplies the explaining variable by the regression coefficient to calculate the average benchmark series. Assuming that the flow and the stock have a proportionality relation each other, the QE team is able to calculate time-series-comparable capacity investment level by multiplying the observed non-residential investment by the average benchmark stock series' percentage to the observed level.

On the other hand, "Quarterly Financial Statements Statistics of Corporations by Industry" does not cover corporations with less than ¥10 million capital base. To estimate the capacity investment level for these smaller corporations, the QE team calculates the percentage relation between these smaller corporations and the corporations with larger capital base from "Annually Financial Statements Statistics of Corporations by Industry" and multiplies this percentage by new investment level (after modifying above-mentioned “faults”). As this percentage relation would fluctuate every year, the team employs the Lisman-Sandee method to allocate it into each quarter and calculate a smoothly connecting capacity investment level. (In other words, the QE team estimates the current year’s quarterly data from the data in the preceding, current and next fiscal years.) If this percentage relation data were unavailable for a certain year, the team would use the percentage data in the latest fiscal year.

**(b) Non-residential investment by financial institutions**

This investment is estimated using non-residential investment in the financial/insurance

industries as stated in "Business and Investment Survey of Incorporated Enterprises." However, as this survey does not provide capacity investment data at the time of the second QE, the team calculates the preceding quarter's estimated data, using the percentage relation between the estimated investment level and the actual investment level in the financial/insurance industry as stated in the said survey." When estimating the first QE for the following quarter, the team again estimates the investment level by replacing the estimated investment data with the actual investment data.

**(c) Non-residential investment by households (unincorporated enterprises)**

(Agriculture)

The QE team multiplies per-agricultural-household capacity investment by the number of agricultural households. To estimate the per-agricultural-household capacity investment, the team first converts the agricultural sector's estimated personal commercial-use construction costs (from MLIT, "Statistics on Building Construction Starts") into progress-based data and then uses it to extrapolate annual capacity investment portion from the per-agricultural-household fixed asset purchase amount as stated in "Statistical Research on Farm Economy." The number of agricultural households is estimated by extrapolation using "Census of Agriculture" as the benchmark.

(Manufacturing industry, wholesale/retail industries)

To estimate machinery/equipment portions other than buildings, the QE team multiplies per-company machinery/equipment purchase amount (from "Unincorporated Enterprise Survey") by the number of unincorporated enterprises, which is primarily estimated from the unincorporated enterprises data (in "Establishment and Enterprise Census") and extrapolated from a quarter-to-quarter comparison of the number of self-employees (from "Labor Force Survey"). As for estimating the buildings portion, the QE team collects applicable personal building owner data from the building owner's purpose category table in "Statistics on Building Construction Starts" and converts it into progress-based data.

(Service industry)

Basically, the QE team estimates the service industry's capacity investments in the same manner as manufacturing and wholesale/retail industries. However, when estimating the per-company investment data (used for estimating the machinery/equipment portion other than buildings), the QE team primarily uses the per-unincorporated-enterprises investment amount data (in "Survey on Service Industries") and makes adjustments in line with a quarter-to-current comparison of per-company machinery/equipment purchase amount data (from "Unincorporated Enterprise Survey").

(Other industries)

The team collects applicable data on personal commercial-use estimated construction costs from "Statistics on Building Construction Starts" and converts it into progressive-based data.

**2) Supply-side estimates**

The QE team uses the gross fixed capital formation data calculated at the section, "III. Supply-side estimates."

**3) Method of integration**

The team calculates the integrated data for the second QE's private non-residential investment level in the following formula (See Reference #3 for specific figure of weight k; also see Reference #6 for more information on calculation concepts and calculation approach for weight k):

Integrated value of Private Non-Residential Investment = $kI_p + (1-k)(I_t - I_g)$

$I_p$: Private non-residential investment estimated from demand-side statistics
$I_t$: Gross fixed capital formation from supply-side data (excluding private housing investment and non-profit institution investment)
$I_g$: Public fixed capital formation estimated from "Integrated Statistics on Construction Works" (on a progress basis, public)

As demand-side estimates do not include new orders for software, the QE team deducts the software new orders portion from the gross fixed capital formation data in order to secure data coherency.

As for private non-residential investment, source statistics are different between the 1st and the 2nd QE. Since this source data incoherency might lead to a seasonal pattern gap in original series for first and second QE, it is necessary to avoid possible adverse impacts on movements in seasonally adjusted series (for further information, see the section (4) in "VII. Method of Seasonal Adjustment").

In addition to the private non-residential investment, the QE team also examined technical feasibility in integrating data for gross fixed capital formation or public fixed capital formation, using the weight calculated from a sample-theoretic approach (see Reference #3). In our opinion, such approach would contribute to minimizing observation errors. However, when the QE team examined a gap between the actual annual data in the past and the estimated annual data (i.e., the annual data calculated from preliminary quarterly data in line with the integration approach), the gap became even larger than the preliminary quarterly data estimated from "Integrated Statistics on Construction Works" (on a progress basis, public) without employing the integration approach. This suggests that the integrated values would generate considerable distortion in dividing the annual estimates into quarterly data, which in turn would distort preliminary estimates through the seasonal adjustment process. From this viewpoint, in relation with public fixed capital formation, the QE team decided to choose the pre-integration data estimated from "Integrated Statistics on Construction Works."

In order to secure additive consistency, the team also defined the gross fixed capital formation as the sum of private non-residential investment data (before integration) and public fixed capital formation (after integration). (Also see Reference #3.)

### (2) Common estimate items

#### (a) New orders for software

In supply-side estimates, software new orders belong to the category, "81. Advertising, Research and Information Services". However, as this item needs to be taken out as a common estimate item, the QE team separately estimates the software new orders data. To be more specific, the QE team collects software shipment data from annual estimates, divide it into, or extrapolates, the quarterly data by using the auxiliary series (i.e., the software sales data in "Current Survey of Selected Service Industries"), and calculates the gross fixed capital formation portion in line with applicable allocation rate under the commodity flow method used for estimating annual data. When estimating the private non-residential investment portion, the QE team employs a pro-rata calculation approach in line with the software industry's private sector percentage data in the input-output table's fixed capital matrix, in the same manner as annual estimates.

#### (b) Non-residential investment of private non-profit institutions serving households (exclusive of software new orders)

At the time of preliminary estimates, the QE team estimates annual data based on trend analysis on "Survey on the Private Non-profit Institutions" and divides the estimated annual data by 4.

## 4. Private inventory increase

When estimating private inventory increase, the QE team sums up the four inventory component data: Finished goods inventory, work-in-progress inventory, raw material inventory and distributors' inventory.

If a fiscal year has the finalized annual data, the QE team estimates the finalized quarterly data in the following process: a) Estimating quarterly inventory net increase from source statistics; b) calculating a gap between total annual data for the same calendar year and the finalized annual data (estimated in the commodity-flow method); and c) then, adding the quarterly data estimated in a) and 1/4 of the gap calculated in b). If the finalized annual data is unavailable, the team estimates the quarterly data by adding the two factors: a) the quarterly inventory net increase data estimated from source statistics; and b) the additional factor that are added when estimating the latest finalized quarterly data. The aforementioned calculation approach may include public inventory in its estimation results, in which case adjustment is made by subtracting the public inventory that was separately estimated (see 7).

- If the finalized annual data is available...

| | |
|---|---|
| Inventory net increase in calendar year t, as estimated from source statistics | $B_t$ |
| Inventory net increase in the quarter i, calendar year t, as estimated from source statistics | $b_{t,i}$ (i=1,2,3,4) ($B_t=b_{t,1}+b_{t,2}+b_{t,3}+b_{t,4}$) |
| Finalized inventory net increase in calendar year t | $Q_t$ |
| Finalized inventory net increase in the quarter i, calendar year t | $q_{t,i}=b_{t,i}+(Q_t-B_t)/4$ |

- QE periods

| | |
|---|---|
| Inventory net increase in calendar year t, as estimated from source statistics | $B_t$ |
| Inventory net increase in the quarter i, calendar year t, as estimated from source statistics | $b_{t,i}$ (i=1,2,3,4) ($B_t=b_{t,1}+b_{t,2}+b_{t,3}+b_{t,4}$) |
| Finalized inventory net increase in calendar year t-n | $Q_{t-n}$(n=1or 2) |
| Finalized inventory net increase in the quarter i, calendar year t-n | $q_{t-n,i}=b_{t-n,i}+(Q_{t-n}-B_{t-n})/4$ |
| QE inventory net increase in the quarter i, calendar year t | $q_{t,i}=b_{t,i}+(Q_{t-n}-B_{t-n})/4$ |

**(1) Idea of estimating inventory increase**

National accounting adopts the principle of accrual basis, which stipulates that any change in inventory should be evaluated at the price prevalent at the time of increase/decrease of such inventory. However, available inventory data describe the inventory balance in line with business accounting where the inventory is evaluated by various valuation methods, including LIFO (last-in, first-out method) and FIFO (first-in, first-out method). Consequently, the increase/decrease calculated by deducting the initial inventory from the closing inventory will include a gap attributable to the evaluation price difference at the beginning and end of the period.

For this reason, when estimating an inventory increase based on inventory balance data from the business accounting, it is necessary to adjust an evaluation gap between national accounting and business accounting. This approach is called inventory valuation adjustment.

The inventory valuation adjustment has the following steps:

1. Calculate nominal inventory balance from business-accounting-based source data;
2. Create commodity-specific deflators, and calculate commodity-specific inventory balance deflators that are compatible with the inventory valuation approach and the inventory turnover rate;
3. Calculate the real closing and initial inventory balance by dividing the nominal inventory balance by "inventory balance deflator," and calculate the real inventory increase from the difference between these two inventory values;

4. Obtain the mean inventory deflator of the period by taking the average value of the inventory deflator during the period, multiply real inventory increase by the mean inventory deflator to calculate the nominal inventory increase after inventory valuation adjustment.

When calculating the commodity-specific inventory balance deflator (stated in 2. above), the QE team collects information on inventory valuation corporate practices (from corporate financial data prepared by Development Bank of Japan) and employs the weight-average of commodity-specific deflators.

**(2) Net increase in finished goods inventory**

The net increase in the manufacturing industry is calculated as follows:

1. Extrapolate the inventory balance (year-end) of "Census of Manufactures (Report by Commodity)" compatible with the commodity flow method's 90-commodity classification by using the nominal index, which represents "Indices of Producers Inventories * price indices (price indices are estimated by Cabinet Office)." Then, create the series for quarterly nominal inventory balance;
2. Calculate the real inventory balance by dividing the quarterly nominal inventory balance series in 1) by applicable commodity-specific inventory balance deflator;
3. Divide and extrapolate the shipment value (annual) in "Census of Manufactures (Report by Commodity)" compatible with the commodity flow method's 90-commodity classification by the nominal index, which is created in the following formula:
   "Indices of Producers Shipments" × price indices
   (price indices are estimated by Cabinet Office)
   Then, create the quarterly series of the shipment value;
4. Calculate inventory fluctuation rate (i.e., inventory fluctuation as a percentage to shipment value) in the following formula:
   Inventory fluctuation rate =
   ((real inventory balance at the current term-end
   - real inventory balance at the preceding term-end)
   × commodity-specific average inventory deflator during the term)
   / shipment value calculated in 3; and
5. Net increase in finished goods inventory =
   shipment value from supply-side estimates × inventory fluctuation rate calculated in 4 above.

Indices of Producers Inventories (term-end) are not available in time for the first QE. After identifying how much percentage the indices in the third month of the same quarter a year ago have increased from the second month in the same quarter, the QE team extrapolates such missing data by multiplying the second month's data by the said percentage.

As for agricultural, forestry and fishing industries, the inventory net increase are estimated and added in the following manner:

- As for rice and wheat (commodity category #1), net increase in finished goods inventory is defined as an increase in current producer's brown rice inventory (flow value) multiplied by the national average price.
- As for livestock farming (commodity category #3), net increase in finished goods inventory shall be 1/4 of the latest finalized annual data calculated in line with the commodity flow method.

**(3) Net increase in work-in-progress inventory**

The QE team estimates net increase in work-in-progress inventory in the following steps: Collecting the industry-specific work-in-progress inventory data (except for construction and real estate industries) from "Financial Statements Statistics of Corporations by Industry"(*);

reorganizing it into commodity-specific inventory balance data (in line with the 90-commodity classification) by using the V-matrix (output table by industry) used for the latest annual estimates; and recalculating the reorganized data in line with the inventory valuation adjustment.

Quarterly version of "Financial Statements Statistics of Corporations by Industry" only covers corporations with capital base of 10 million yen or more. Therefore, the QE team estimates the closing inventory balance for each period. In this case, the team uses the closing inventory data in the annual version of the said statistics (which covers corporations of all sizes), paying attentions to how much the closing inventory in the quarterly edition has increased/decreased from the initial inventory.

To avoid influence of sampling errors, the increase/decrease rate of inventory balance during term (used for extrapolation) is derived from the regression formula that explains the entire inventory balance increase/decrease rate, using inventory movements of corporations with capital base of ¥1 billion or more. (See Reference #4 for more information on the regression formula.)

As for other crop farming (commodity category #2), livestock farming (commodity category #3), forestry (commodity category #5) and fisheries (commodity category #6), the team estimates their inventory net increase separately.

Data from quarterly version of "Financial Statements Statistics of Corporations by Industry" are not available in time for the first QE. Therefore, the QE team uses the seasonal adjustment factor of the preceding quarter, while using an original value that incorporates the preceding term's seasonal adjustment factor and the current term's projected seasonal factors. (As a result, contribution of seasonally adjusted values stands at zero.)

**(4) Net increase in distributors' inventory**

The QE team estimates nominal distributors' inventory balance based on the inventory balance data, which is reorganized into the 90-commodity classification from the 1997 "Census of Commerce." For the periods before or after that quarter, the team extrapolates it based on the increase/decrease rate for on-hand commodity data in "Current Survey of Commerce." (Assuming that the industry classification in "Census of Commerce" (i.e., 18 sectors for wholesale, and 3 for retail) would represent the commodity classification for QE purpose, the QE team reorganizes the increase/decrease rate data in line with the commodity-flow method's 90-commodity classification.)

"Current Survey of Commerce" only provides the on-hand commodity data of large-size stores; therefore, if such increase/decrease rate is employed for extrapolating the entire distributors' inventory, a particular behavior of a large-sized store might have significant adverse impacts on overall calculation result. On the other hand, quarterly reports of "Financial Statements Statistics of Corporations by Industry" does provide information on distributors' inventory (i.e., products/commodities inventory data of wholesale/retail industries); however, the report is not available in time for the 1st QE, and further, its quarterly fluctuations might include some noises because the statistics is a sampling survey. For this reason, the QE team uses the increase/decrease rate estimated from the regression formula, which explains the latter from the on-hand commodity fluctuation data in "Current Survey of Commerce." The regression formula makes estimates for wholesale and retail industries separately and applies commonly to the commodity categories that correspond to both of them. (See Reference #4 for more information on the regression formula.)

"Commercial Statistical Research" does not provide sector-specific on-hand commodity data in time for the 1st QE; therefore, sector-specific on-hand commodity is estimated extendedly, using the growth rate of the overall value.

After calculating the nominal inventory balance data in this way, the QE team conducts inventory valuation adjustment to estimate net increase in distributors' inventory.

For agriculture/forestry/fishery and mining industries, the team estimates the data in the following manner:

- For rice and wheat (commodity classification #1), net increase in distributors' inventory of rice is used.
- For crude petroleum and natural gas (commodity classification #10), the team multiplies an increase in government's oil stockpiling by applicable crude oil unit price. In this context, the crude oil unit price represents the import amount/imported volume (from Trade Statistics)

multiplied by the pre-calculated import duties adjustment rate.

**(5) Net increase in raw material inventory**

The QE team estimates net increase in raw material inventory in the following steps: Collecting the raw material inventory data (except for real estate industry) from "Financial Statements Statistics of Corporations by Industry"(*); reorganizing it into commodity-specific inventory balance data (in line with the 90-commodity classification) by using the U-matrix (commodity input table by industry) used for the latest annual estimates; and recalculating the reorganized data in line with the inventory valuation adjustment.

In the same manner as the work-in-progress inventory data, the QE team estimates the closing inventory balance for each period. In this case, the team uses the closing inventory data in the said statistics annual version (which covers corporations of all sizes), paying attentions to how much the closing inventory in the quarterly edition has increased/decreased from the initial inventory. This increase/decrease rate is derived from the regression formula that would explain the entire inventory balance increase/decrease rate, using inventory movements of corporations with capital base of ¥1 billion or more. (See Reference #4 for more information on the regression formula.)

For crude petroleum and natural gas (commodity classification #10), the team multiplies an increase in crude oil inventory (except for government's oil stockpiling) by applicable crude oil unit price. In this context, the crude oil unit price is calculated in the same manner as mentioned in the "(4) distributors' inventory" section.

Data from "Financial Statements Statistics of Corporations by Industry" are not available in time for the first QE. Therefore, the QE team uses the preceding quarter's seasonal adjustment factor as it is. The team uses an original value that incorporates the preceding term's seasonal adjustment factor and the current term's projected seasonal factors; however, such values are not reflected in the domestic aggregate supply estimation process. (As a result, contribution of seasonally adjusted values would stand at zero.) They are estimated for the 2nd QE in the above manner, but are not reflected either in the domestic aggregate supply estimation process due to time constraints (they are reflected in the preceding term's values at the following term’s 1st QE).

(*) Reclassified industry categories in "Financial Statements Statistics of Corporations by Industry" (the source material for estimating work-in-progress inventory and raw material inventory)

In its April-June 2004 version, Ministry of Finance reclassified the industry categories of "Financial Statements Statistics of Corporations by Industry" in line with Japan Standard Industry Classification (last update in March 2002; hereinafter, referred to as "new JSIC"). The ministry released the new industry categories in September 2004. Because SNA has its sector classification in accordance with the older JSIC (revised in October 1993), the QE team has converted the new JSIC data into the older JSIC-based data.

## 5. Government final consumption expenditure

In the same manner as annual estimates, government final consumption expenditure in QE is estimated for each component. (The government final consumption expenditure = compensation for employees + intermediate consumption + consumption of fixed capital + taxes imposed on production and imports + social benefit in kind - commodity/non-commodity sales.) Due to limited availability of document materials, the QE team estimates it based on the budget data, hearings, etc. How to estimate each component is as follows.

"Compensation of employees" is estimated based on the number of public employees and the payroll cost per head. Regarding the number of public employees, the QE team holds quarterly hearing sessions to collect information on the workforce size at Self Defense Forces, public schools, police force and Tokyo Metropolitan Government, and estimates overall trend of public employees. If data are not available for the third month of a quarter, data for the third month will be estimated extendedly by the year-on-year comparison of the preceding two months' data. When estimating the

per-head payroll cost, the QE team collects the preceding year's per-head payroll cost from "Statistical Report of Payroll Payment" and calculates the quarterly data, taking into account NPA (National Personnel Authority) recommendations as well as actual bonus payments.

When estimating "intermediate consumption" or "commodity/non-commodity sales (deductible items)," the team calculates the central government's annual portion based on budget data. As for local government portion, the team estimates the annual level, using its trend (for the 1st QE) as well as the trend and the "Special Survey on Expenditure of Local Governments" data (for the 2nd QE). Then, the resultant preliminary annual data are divided into quarters in line with past quarterly patterns.

As for "consumption of fixed capital," source data are unavailable for QE estimates. The QE team estimates preliminary annual values from their trend, and then basically divides it by 4 to provide quarterly values.

Regarding "taxes imposed on production and imports," preliminary annual values are estimated from the budget data, etc. and quadrisected for allocation to quarters.

"Social Benefit in Kind" is made up of medical care, nursing care and others (school textbooks expenses, child custody cost subsidy, contribution for free train/boat ride for war-injured/diseased). Medical care is roughly divided into the three categories (persons employed, persons not employed, and the elderly). These three categories are extrapolated, using the source documents: "Payment by Social Insurance" of Social Insurance Medical Care Fee Payment Fund; "Survey on Medical Expense of National Health Insurance" of All-Japan Federation of National Health Insurance Organizations; and "Monthly Report on Workers' Accident Insurance" of MHLW. Regarding nursing care, the QE team collects welfare equipment purchase cost data and house repairs cost data from "Payment by Nursing Care Insurance" of MHLW, while estimating the other cost data from "Payment by Social Insurance" of National Health Insurance Central Society. Regarding "others" (school textbooks expenses, child custody cost subsidy, contribution for free train/boat ride for war-injured/diseased), preliminary fiscal year values are estimated from the trend in applicable budget amount, and allocated to each quarter. If applicable data is not available for a certain month, the QE team will estimate such monthly data on a year-on-year comparison of the preceding month's data.

## 6. Public fixed capital formation

When estimating public fixed capital formation, the QE team first divides it (except for software new orders) into two categories (i.e., "public housing investment" portion and "others"). The team sums up the two components: a) the figure calculated from a year-on-year comparison of the residential buildings and other buildings (as stated in "Integrated Statistics on Construction Works" (on a progress basis, public); and b) the public sector portion of the software new orders (calculated on a pro rata basis from the supply-side statistics).

As for estimating public fixed capital formation other than residential buildings, the QE team first calculates the preceding year's gap between the year-on-year comparison result in "Integrated Statistics on Construction Works" and that in annual estimates of public fixed capital formation. Then, the team multiplies the calculated gap's inverse number by the current term's year-on-year comparison result. This calculation approach would mitigate the gap between preliminary estimates and annual estimates. The team estimates the applicable data based on the adjusted year-on-year comparison result.

As for the first QE, "Integrated Statistics on Construction Works" does not provide the data for the third month of a quarter. For this reason, the QE team extrapolates it in line with the year-on-year comparison of the preceding two months' data. As for public fixed capital formation other than residential buildings, the team creates a regression formula that explains the relationship between the two factors: a) "public works' 5-month moving average in the third month / sum of such moving averages in the preceding two months" calculated from "Statistics on Public Works Advance Payment Guarantee"; and b) the same ratio from "Integrated Statistics on Construction Works." Using this regression formula, the data for the third month will be extrapolated.

## 7. Public inventory increase

By holding hearing sessions to stakeholders, the QE team estimates the major public inventory data other than cultivated assets. These data include rice/wheat inventory of Special Account for Foodstuff Control; stockpiled crude oil and rare metals of JOGMEC (Japan Oil, Gas and Metals National Corporation); reserve for coins issued and gold inventory of Japan Mint; and raw silk inventory of Agriculture and Livestock Industries Corporation. Cultivated assets such as stumpage are assumed to take the same value as in the preceding year. Increases in other inventories are assumed to be zero.

## 8. Exports and imports

The QE team estimates exports/imports after rearranging the trade/service balance data in "Balance of Payments Statistics." However, since the data for the last month in a quarter are not available for the 1st QE, the QE team estimates it by multiplying the last month's exports/imports of "Trade Statistics" by the ratio of the preceding two months' exports/imports of "Balance of Payments" to those of "Trade Statistics." As for services trade, the QE team calculates the last month's data based on a year-on-year comparison of the preceding two months' data.

## V. Method of converting into real values

### 1. Chain-linking method

(Basic formula for chain-linking method)

As for the chain-linking method, the following sections employ the basic formula as stated below. In addition, chain index calculation process uses the same data as the fixed-base year approach.

Calendar year deflator : $CP_t = \dfrac{\sum_i P_t^i \cdot Q_t^i}{\sum_i P_{t-1}^i \cdot Q_t^i} \times CP_{t-1}$

Quarterly deflator : $CP_{t,k} = \dfrac{\sum_i P_{t,k}^i \cdot Q_{t,k}^i}{\sum_i P_{t-1}^i \cdot Q_{t,k}^i} \times CP_{t-1}$

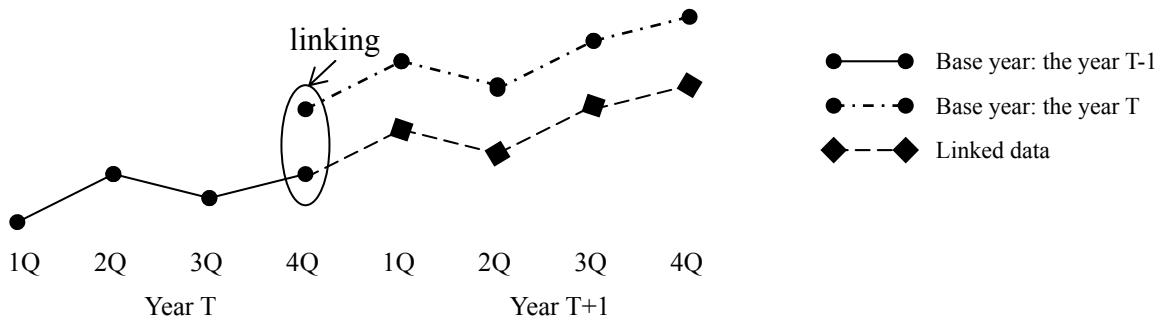
Calendar year real value : $CV_t = \dfrac{\sum_i P_{t-1}^i \cdot Q_t^i}{\sum_i P_{t-1}^i \cdot Q_{t-1}^i} \times CV_{t-1}$

Quarterly real value : $CV_{t,k} = \dfrac{\sum_i P_{t-1}^i \cdot Q_{t,k}^i}{\sum_i P_{t-1}^i \cdot Q_{t-1}^i} \times CV_{t-1}$

$CP_{t,k}$ : Deflator for the quarter k, year t (chain-linking method)
$CV_{t,k}$ : Real value for the quarter k, year t (chain-linking method)
$P_{t,k}^i$ : Price index of commodity i for the quarter k, year t;
$Q_{t,k}^i$ : Real value of commodity i for the quarter k, year t

(Forth quarter overlapping approach)

If the Oct-Dec quarter in year T and the Jan-Mar quarter in the following year have different base years each other, the growth rate data might have a "fault" in the Jan-Mar quarter on a quarter-to-quarter comparison basis. When calculating real values, the QE team employs "fourth quarter overlapping approach" (see the chart below) to link the data in every fourth quarter, aiming at avoiding such data fault.



This approach will yield a gap between the annual total of (real) quarterly values (derived from quarterly data) and the annual (real) value derived from applicable calendar year deflator (in other words, the data will lost time-series additive consistency). For this reason, it is necessary to divide (benchmark) the annual data in accordance with quarterly data. For benchmarking, the QE team employs the proportional Denton method. When estimating preliminary data for each quarter, the QE team will retroactively revise the quarterly data up to the Jan-Mar term in the calendar year that has the final revised annual data.

$$\min \sum_{t=2}^{T} \left[ \frac{X_t}{I_t} - \frac{X_{t-1}}{I_{t-1}} \right]^2 \quad \text{s. t.} \quad \sum_{t=4y-3}^{4y} X_t = A_y \, (y = 1, \cdots, \beta)$$

t: Quarter t; "4y-3" represents the Q1 in the year y, while "4y" means the Q4 in the year y
$X_t$: Quarterly value to be calculated
$I_t$: Underlying quarterly data
$A_y$: Annual data for the benchmark year y
β: The latest year y in which the benchmark Ay exists
T: The latest quarter t in which $I_t$ exists

## 2. Final consumption expenditure of households

First of all, in line with the 87-purpose classification for household final consumption expenditure, the QE team calculates the purpose-specific chain deflator by using commodity-specific deflator that corresponds to commodity-based nominal value (i.e., this nominal value represents the quarterly nominal value divided by the annual accounts weight).

Then, the nominal household final consumption expenditure for each purpose category is divided by applicable purpose-specific deflator, and per-purpose real value is found. The nominal value of household final consumption expenditure is calculated by integrating demand-side and supply-side estimates for each purpose category, and therefore, the real value for each purpose category will be calculated by dividing the per-purpose integrated values by applicable deflators. For common estimate items, the QE team calculates their real values by dividing the nominal values (as estimated on the supply-side and the demand-side) by corresponding purpose-specific deflators. As for commodity/non-commodity sales, the team converts into real values by using applicable indexes (such as CPI) for each commodity category, and then classifies and sums up these real values in accordance with purpose classification. Regarding deflators applicable to resident household's direct overseas purchase and nonresident household's domestic purchase, see “6. Exports and Imports.” The real value for overall household final consumption expenditure is obtained by integrating the following factors in the chain-linking method: the above-mentioned purpose-specific real values, the purpose-specific deflators, the real value and deflators for common estimate items, the real value and deflators for commodity/non-commodity sales, and the real value and deflators for direct purchases.

The deflator for overall household final consumption expenditure is obtained, ex post, by dividing the above-mentioned nominal value of household final consumption expenditure by its real

value.

### 3. Final consumption expenditure of private non-profit institutions serving households

The real value of NPISH's final consumption expenditure is calculated by subtracting the real value of commodity/non-commodity sales from the real value of the output calculated with the chain-linking method (See the formula described below). For converting the output and commodity/non-commodity sales into real values, applicable annual implicit deflator is extrapolated with trend analysis at the time of preliminary estimates, and real annual data are calculated by dividing nominal annual values by each corresponding deflator. Then, each of these real annual data is divided by the preceding year's quarterly percentage to give real quarterly values.

$$CV_{t,k} = \frac{P_{t-1} \cdot Q_{t,k} - p_{t-1} \cdot q_{t,k}}{P_{t-1} \cdot Q_{t-1} - p_{t-1} \cdot q_{t-1}} \times CV_{t-1}$$

$CV_{t,k}$: NPISH's final consumption in the quarter k, year t

$P_{t,k}, Q_{t,k}$: Deflator and real value for non-profit output level in the quarter k, year t

$p_{t,k}, q_{t,k}$: Deflator and real value for non-profit commodity/non-commodity sales in the quarter k, year t

### 4. Government final consumption expenditure

When converting government final consumption expenditure into its real value, the QE team estimates the data for each component, such as compensation of employees, intermediate consumption, consumption of fixed capital, taxes imposed on production and imports, commodity/non-commodity sales (deductible item) and benefit in kind. With the chain-linking method, the QE team integrates these component data into the entire real value of government final consumption expenditure, using the component-specific real values and applicable deflators. The method of estimating the deflator for each component is described below.

Regarding the deflator for employees compensation, the annual deflator is extrapolated in line with average public employees' wage hike as recommended by the National Personnel Authority, and then converted into quarterly data taking into consideration the bonus payments.

The intermediate consumption deflator is created by reorganizing the input-output table data in line with the commodity flow method's 400 commodity categories, and integrating intermediate consumption deflators in line with applicable weight.

Regarding the fixed capital consumption deflator, the fixed capital formation deflator for the general government sector (estimated from the fixed capital formation matrix) is used.

For taxes imposed on exports/imports, the intermediate consumption deflator is used.

For the commodity/non-commodity sales deflator, applicable deflator for household final consumption expenditure is used.

Regarding the benefit in kind, the QE team calculates the medical care deflator by multiplying CPI's health/medical care services by the weight used in CPI; however, for medical care fees, change in service user payment portion will be deducted.

For the nursing care deflator, the QE team allocates the nominal value of nursing care services into "home care," "medical facilities" and "welfare facilities" categories by using "Survey on Nursing Care Insurance Benefits," converts them into real value with applicable deflators, and sums up these real values to yield the real value of overall nursing care services. Then, the nominal value is divided by the real value to give the nursing care deflator. For the dividing weight, the value of each calendar year is used. For preliminary estimates purpose, the weight of the latest annual estimates (calendar year basis) is used. For the "home care" deflator, CPI (home nursing care fee) is used. In calculating the "medical facilities" and "welfare facilities" deflators, the QE team estimates input cost-type deflators that correspond to the input structure as seen in the input-output table's "medical service" and "social insurance and welfare" sections.

## 5. Gross fixed capital formation

### (1) Method of converting gross fixed capital formation into real value

The real value of gross fixed capital formation is calculated as the nominal value (for a sector category or residential/non-residential investment category) divided by applicable deflator. Summing up these data in line with the chain-linking method will yield the real value data for each published item. The deflator for each published item is calculated as the nominal value divided by the corresponding real value.

Gross fixed capital formation deflators (for sector categories or residential/non-residential investment categories) are estimated by assigning the commodity-flow method's 400-commodity-related gross fixed capital formation deflators in the case of machinery, while attributing the construction deflators (for wooden houses, non-residential wooden buildings, non-wooden houses, non-residential non-wooden buildings and other buildings) in the case of the construction industry; and then, by integrating these deflators in line with applicable sector- or commodity-specific weights estimated in the following process.

#### (a) Method of creating construction deflators

Construction deflators are used for converting the construction sector's output, intermediate consumption and gross fixed capital formation (construction portion) data into real values. Deflators are estimated for wooden/non-wooden residential houses, wooden/non-wooden non-residential buildings, construction repair works and other construction activities.

Construction deflators are estimated as input cost-type deflators. Based on the detailed input materials data and the value added data (as estimated by the Construction commodity flow method), the QE team prepares the construction matrix as shown in Chart 4 and calculates deflators in line with this matrix. As the construction commodity-flow method does not provide the detailed input data for wooden/non-wooden residential houses or wooden/non-wooden non-residential buildings, the QE team calculates such detailed data in accordance with the RAS method by using the input-output table. The construction matrix is created for each quarter.

**Chart 4. Quarterly Construction Matrix**

| | Wooden | | | Non-wooden | | | Construction repair | Other buildings |
|---|---|---|---|---|---|---|---|---|
| | Residential | Nonresidential | Total | Residential | Nonresidential | Total | | |
| Commodity-flow method's 6-digit commodities | RAS (2) | | | RAS (2) | | | | |
| Total of Input materials | RAS (1) | | | RAS (1) | | | | |
| Value added | | | | | | | | |
| Output | | | | | | | | |

(Remarks)

1. Light shaded columns: Quarterly data are available from the construction commodity-flow method.
2. Dark shaded columns: Output data are calculated by dividing the output level (calculated from the construction commodity-flow method) by the progress-based data from MLIT, "Survey of Construction Work Started."
3. RAS(1) represents the columns where the total input materials and the value added data will be allocated to residential or non-residential portion in line with RAS method.
4. RAS(2) represents the columns where the input materials will be allocated to residential or non-residential portion in line with RAS by using the total input materials data calculated in the "RAS(1)" column.

Construction deflators are calculated in the following formula by using the quarterly construction matrix as weight (after RAS method is applied). However, in the case of value added portion, the employees' compensation data will be deflated with applicable regular salary index. (When allocating the employees compensation data to residential or non-residential column, the QE team uses the percentage data for RAS-applied total value-added.)

$$D_{ct} = \frac{\sum M_{it} + A_t}{\sum \frac{M_{it}}{D_{it}} + \frac{At}{D_{at}}}$$

$D_{ct}$: construction deflator
$A_t$: compensation of employees in the year t
$M_{it}$: input materials of the commodity i under the construction commodity flow method
$D_{it}$: intermediate consumption deflator for commodity i
$D_{at}$: regular salary index for the construction industry in year t (for employers with 5 or more employees)

**(b) Method of creating deflator for gross fixed capital formation**

**Gross fixed capital formation matrix**

A fixed capital matrix is created as a part of the input-output table preparation process. After aligning this matrix with SNA concepts, the QE team prepares the gross fixed capital formation matrix as shown in Chart 5 every quarter in line with RAS method.

Summing up this matrix's data vertically will yield the supply-side-based quarterly gross fixed capital formation divided by the sector-specific weight in the preceding annual accounts. On the other hand, the total of the row will represent the commodity-specific gross fixed capital formation

derived from quarterly supply-side estimation as well as the 5-category-based construction output level.(*)

(*) In this context, "5 categories" refer to wooden houses, non-wooden houses, non-residential wooden buildings, non-residential non-wooden buildings and other buildings.

**Chart 5. Matrix of gross fixed capital formation**

| | Private | | | | | Public | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Non-financial non-residential | Residential | Financial non-residential | Non-profit non-residential | Non-financial non-residential | Residential | Financial non-residential | General government | |
| Commodity-flow method's 6-digit commodities | (Allocated with RAS method) | | | | | | | | Commodity-flow method |
| Wooden residential<br>Non-wooden residential<br>W. non-residential<br>Non-w. non-residential<br>Other buildings | | | | | | | | | Construction commodity-flow method<br>+<br>Construction work started |
| | | | | | | | | | |

**Estimating gross fixed capital formation deflator**

In line with the above-mentioned factors in the quarterly gross fixed capital formation matrix, the QE team calculates the gross fixed capital formation deflator by integrating commodity-specific gross fixed capital formation deflators and construction deflators (compatible with commodity-flow method's 400 products) based on the chain-linking method.

### (2) Points to remember when converting gross fixed capital formation data into real value

As already explained in (1) above, the QE team calculates the fixed capital formation deflators by estimating "sector-based commodity composition ratio for fixed capital formation" in line with two types of information: "Goods/services allocated for fixed capital formation (commodity-specific information)" and "Sector-based value, such as private non-financial investment, private housing investment and general government investment (sector-specific information)"; and then integrating the deflators in accordance with applicable weight. When estimating these data for each quarter, the QE team employs the quarterly "commodity-specific information," while using annual data in the case of "sector-specific information." The team handles these data in the following manner.

When calculating quarterly deflators for the period when annual estimates exists, the QE team first estimates the quarterly "sector-based commodity composition ratio" in line with the corresponding quarter's data (in the case of "commodity-specific information") or the same year's annual data(*) (in the case of "sector-specific information") and then integrates quarterly deflators using these information as weight.

Deflators for preliminary estimate are calculated by estimating "sector-based commodity composition ratio" in line with the corresponding quarter's data (in the case of "commodity-specific information") or the preceding year's annual data(*) (in the case of "sector-specific information") and then integrates quarterly deflators using these information as weight.

(*) Reason why the QE team does not use the same quarter's data for "Sector-specific Information"

"Output in the construction industry" as estimated from supply-side data (= intermediate consumption of construction materials + value added in construction industry) do not necessarily coincide with the sector-specific fixed capital formation data, such as "private housing investment" and "public fixed capital Formation," which are estimated from "Survey of Construction Work Started." The QE team calculated the fixed capital formation deflators in line with quarterly "commodity-specific information" and quarterly "sector-specific information." Although these two data are not necessarily coherent, the team's attempts to match the resultant data have led to distortion in the calculation results, causing greater variation in quarterly deflators. Basically, quarterly "commodity-specific information" (as derived from supply-side statistics) should be incorporated when estimating deflators; therefore, the QE team decided to choose the (preceding) calendar year's data for "sector-specific information."

## 6. Exports and Imports

First of all, the deflator for entire goods/services trade is calculated. Then, the team calculates the real value of quarterly nominal exports/imports data at the lowest level (i.e., the 400-commodity level: The quarterly balance of payment table is sorted out with the commodity-flow method's 400-commodity information (in the case of goods trade) or the base year's information (in the case of service trade)), by using applicable commodity-specific deflator. After that, the team combines this real value with the said deflator to calculate the (chain-based) real value for entire exports/imports.

The team calculates the real value for entire exports/imports by integrating the above-mentioned goods/services trade volume (chain-based real value), applicable implicit deflator as well as real value and deflator for direct purchase.

The deflator for direct purchase is as follows.

For nonresident households' domestic direct purchase, consumer price index (national, overall except for imputed rent) is used. For resident households' overseas direct purchase, consumer price indices (overall) in the most popular 4 nations among Japanese tourists will be Paasche-integrated, using the number of annual travelers visiting these nation as weight.

## 7. Gross domestic expenditure

Real gross domestic expenditure is obtained by adding up real values of GDE components, which are calculated in the above-mentioned processes. Dividing this real GDE by nominal GDE will yield GDE deflator. To be more specific, the following formula illustrates the real GDP calculation

process.

$$GDP_{t,k} = \frac{\sum P_{t-1} \cdot Q_t + \sum D_{t-1} \cdot \Delta INV_t}{\sum P_{t-1} \cdot Q_{t-1} + \sum D_{t-1} \cdot \Delta INV_{t-1}} \times GDP_{t-1}$$

$P_t$ : Demand component's deflator in the year t

$Q_t$ : Demand component's real value in the year t

$D_t$ : Calendar year average inventory deflator in the year t

$\Delta INV_t$ : Real inventory net increase in the year t

**8. Real inventory net increase under the chain-linking method**

Since the inventory net increase might take zero or negative value, the QE team first calculates (chain-based) real values of the pattern-level inventory volume (in the case of the private inventory) or the sector-level inventory volume (for public inventory) and then converts the real values into the flow-based data. Private inventory is integrated (on a chain-linking method basis) from the 90-commodity classification level, while public inventory is integrated from the individual commodity level. The inventory data table describes the calendar-year average inventory deflator, which is implicitly calculated for entire inventory both in the private and public sectors.

(1) Inventory balance : $INV_t = INV_{t-1} \times \frac{\sum \overline{D}_{i,t-1} Q_{i,t}}{\sum \overline{D}_{i,t-1} Q_{i,t-1}}$

$\overline{D}_{i,t}$ (Calendar year annual average inventory deflator) represents annual average of closing deflators for commodity i

$\overline{D}_{i,t} = \frac{\sum D_{i,t}^k Q_{i,t}^k}{\sum Q_{i,t}^k}$

*k* represents the quarter *k* in year *t*

Closing deflator（$D_i$）: Deflator at the quarter ends

(e.g., end of March = the average of inventory in March and that in April)

(2) Inventory flow : $\Delta INV_t = INV_t - INV_{t-1}$

**9. Method of extrapolating basic statistics**

If the latest month's data are not available, at the time of processing QE, of the various price indices that serve as basic statistics for deflators, the average value in the first and second months is deemed as the value of the entire quarter. (If only the first month's data are available, such month's data are regarded as the data for entire quarter.)

## VI. Method of estimating compensation of employees

Nominal value for original series is estimated on a quarter-to-quarter comparison of source statistics.

Real value for original series is calculated by dividing the employees compensation (original series, nominal) by the household final consumption expenditure deflator (except for imputed rent).

Regarding the seasonally adjusted value, the nominal value (for wage/salaries, employer's actual social contribution, and employer's imputed social contribution) is obtained by conducting seasonal adjustment with X-12-ARIMA; however, the real value is calculated by dividing the seasonally adjusted nominal value (except for imputed rent) by the household final consumption expenditure's seasonally adjusted deflator (calculated as "seasonally adjusted nominal value / seasonally adjusted real value").

### 1. Wages and salaries

To estimate the quarterly wage and salary levels, the QE team uses as the basis the total wage/salaries in the Jan-Mar quarter (as mentioned in the latest annual estimation) derived from "Annual Report on the Labor Force Survey," "Annual Report on the Monthly Labour Survey" and various financial statements, and grasps the increase/decrease in employees (from "Monthly Report on the Labour Force Survey") and the wage/salaries per employee from "Monthly Labour Survey"; and then, conducts a quarter-to-quarter ratio comparison of wages/salaries as obtained by adjusting the coverage difference between "Annual Report" and "Monthly Report."

### 2. Employer's actual social contribution

Employer's actual social contribution is made up of "compulsory actual social contribution" (welfare pension, welfare insurance special account, health insurance by private mutual association, employers' contribution to each mutual benefit society) obligated by law or regulation, and voluntarily-borne "voluntary actual social contribution" (employers' contributions to pension fund (welfare pension fund, etc)).

To estimate the compulsory actual social contribution, the QE team uses as the basis the Jan-Mar quarter value (as mentioned in the latest annual estimates) and collects information on applicable insurance premium rates and basic materials relating to various insurance systems and mutual aids (amount and rate of employers' contribution), such as "Monthly Report on the Labor Force Survey" and "Monthly Labour Survey." Based on these materials and data, the value for the quarter corresponding to the QE is estimated.

To estimate voluntary actual social contribution, the QE team uses the Jan-Mar quarter value (as mentioned in the most recent annual estimation) as the basis, and collects information from basic materials of various pension funds, including "Monthly Report on the Labor Force Survey" and "Monthly Labour Survey." Based on these materials and data, the QE team estimates the value for the quarter corresponding to the QE.

### 3. Employer's imputed social contribution

Regarding lump-sum retirement allowances that occupy a significant portion of employer's imputed social contribution, the QE team uses as the basis the Jan-Mar value (as mentioned in the latest annual estimation derived from "Annual Statistical Report of the National Tax Administration," financial statements of central and local governments and the number of displaced workers data in "Monthly Labour Survey"), estimates the number of displaced workers from the job separation rate data in "Monthly Labour Survey," and conducts a quarter-to-quarter comparison of the number of dispatched workers to calculate the QE quarterly value.

Other categories of employer's imputed social contribution would include public service-related

accidents, liability insurance for workers' accidents, etc. The QE team uses as the basis the Jan-Mar value as mentioned in the latest annual estimation, and estimates quarterly preliminary values by collecting data from source materials: "Monthly Report on the Labour Force Survey" and "Monthly Labour Survey."

# VII. Method of seasonal adjustment

When evaluating the economy trend using quarterly statistics, seasonal variations arising from climate, social practices and the like must be eliminated. For seasonal adjustment of QE, Census Bureau Method "X-12-ARIMA" of the Census Bureau of Dept. of Commerce, USA, has been used for the national accounting purpose since the "Revised National Account on the Basis of 1995" (Oct. 2000).

When selecting ARIMA model for seasonal adjustment with X-12- ARIMA, the QE team determines applicable regression variables for adjusting outliers and level shift on each nominal or real value, and picks up a model that would minimize AIC (Akaike Information Criteria). After that, an ARIMA model of a type that serves equally for both nominal value and real value is applied. Concretely, an ARIMA model is selected in the following process (non-seasonal difference and seasonal difference of the ARIMA model are both assumed to be 1). As for the reference series under the fixed-base year approach (effective from the Jan-Mar 1994 quarter onward), the QE team uses the same model as the official series.

### (1)-1 Adjustment of outliers and level shift

If it is desirable to adjust outliers or level shift for a certain quarter from the viewpoint of economic conditions, regression variables for adjustment will be established.

<Examples>

- Domestic final consumption expenditure of households (except for imputer rent): Period of the last-minute demand due to the consumption tax rise of April 1997 (the Jan-Mar 1997) and its reactionary period (the Apr-Jun 1997). For these quarters, the QE team set up a regression variable that would work quantitatively conversely for the last-minute demand period and the reactionary period.
- Government individual consumption expenditure: with the introduction of the public nursing care insurance system in FY2000, the government budget started to include the nursing care insurance payments in the Apr-Jun 2000. Therefore, level shift adjustment variables were set up from the Apr-Jun 2000 quarter onward.

### (1)-2 Adjustment for leap years

Relating to domestic final consumption expenditure of households (except for imputed rent), the QE team has been considering the technical feasibility in leap-year adjustment (LPYEAR). As a result, the team conducted the leap-year adjustments on the quarterly series (fixed-base year: 1995) from the Jan-Mar 1980 quarter to Oct-Dec 1993 quarter. As the team has not been seeing the significance of the regression variable on the quarterly series (both of official series and reference series) since the Jan-Mar 1994 quarter, there is no leap-year adjustment.

### (2) Selection of ARIMA model to minimize AIC

If a series would require the adjustment mentioned in (1), the QE team would incorporate various regression variables and choose an ARIMA model that will minimize AIC both for nominal and real values. In this case, degrees of AR part and MA part relating to the non-seasonal portion and seasonal portion of ARIMA models are assumed to be 0 to 2 (Consequently, selection is made from the total 81 models from (0 1 0)(0 1 0) to (2 1 2)(2 1 2)).

**(3) Final selection of ARIMA models**

If the ARIMA model selected in (2) is the same for both nominal and real values, it may be adopted. If models are different for the nominal value and the real value, the movement of the deflators that are calculated implicitly from seasonally adjusted nominal and real values will include variations arising from the gap in ARIMA models. Such variations do not necessarily represent actual economic conditions and therefore should be mitigated as much as possible. For this reason, ARIMA models used for nominal and real values should have the same model type for effecting seasonal adjustment.

Concretely speaking, after examining seasonal adjustment performance (e.g., movements of deflators calculated implicitly from a pre-adjusted original series derived from ARIMA models), the QE team will choose an ARIMA model type that would work in the same manner both for nominal and real values (however, estimated parameters would be different).

Seasonal adjustment is made with X-12-ARIMA, using the ARIMA model selected in the above process. Described below are the details of setting.

The period of seasonal adjustment (SPAN) shall be from the Jan.-Mar. 1994 (or the Jan-Mar 1980, in the case of nominal value for employees' compensation)to the most recent quarter. Thus, seasonal adjustment is repeatedly applied, causing seasonally adjusted values to be modified each time retroactively. The period applicable to the data for estimating ARIMA models (MODEL SPAN) shall be in principle the same as the period of seasonal adjustment, that is, from the Jan-Mar 1994 (or the Jan-Mar 1980, in the case of nominal value for employees compensation) to the latest quarter (thus, the parameter of each degree will vary each time although the ARIMA model remains unchanged).

The periods of forecast by the ARIMA model are the following:

- Future forecast (MAXLEAD) period shall be for 8 quarters in principle because ARIMA model settings might have some impacts on seasonal adjustment indices. However, as the private work-in-progress inventory series would see improved stability in its seasonally adjusted series, the applicable future forecast period shall be 12 quarters long (effective on the first QE for the Oct-Dec 2004 quarter).
- As quarterly data estimated with the current approach are only available only for 1994 onward, retracing forecast (MAXBACK) shall be made from the viewpoint of stability in seasonally adjusted values. The periods of MAXBACK shall be 20 quarters long (5 years) based on its settings' impacts on the seasonal adjustment index. (As for nominal value for employees' compensation, as the QE team has the quarterly data for more than 15 years, MAXBACK shall not be applied.)

See Table 4 for more information on seasonal adjustment levels. For information on applicable ARIMA model types, see Reference #5.

## Table 4. List of method for creating seasonal adjustment series for each component

Shaded column: direct seasonal adjustment with X-12-ARIMA
White column: seasonally adjusted values are calculated with the definition equation from seasonally adjusted values of component

### 1. GDP-related components (commonly applicable to nominal and real values)

| | |
|---|---|
| Gross domestic expenditure (GDE = GDP) | 1+29 |
| 1 Domestic demand | 2+18 |
| 2 Private demand | 3+11+12+13 |
| 3 Private final consumption expenditure | 4+10 |
| 4 Final consumption expenditure of households | 5+9 |
| 5 Final consumption expenditure of households (except for imputed rent) | 6+7-8 |
| 6 Domestic final consumption expenditure of households (except for imputed rent) | |
| 7 Direct overseas purchase by resident households | |
| 8 (deducted) Direct domestic purchase by nonresident households | |
| 9 Imputed rent | |
| 10 Final consumption expenditure of non-profit institutions serving households (Note 1) | |
| 11 Private housing investment | |
| 12 Private non-residential investment (Note 2) | |
| 13 Private inventory increase | 14+15+16+17 |
| 14 Private finished goods inventory increase | |
| 15 Private work-in-progress inventory increase | |
| 16 Private distributors' inventory increase | |
| 17 Private raw material inventory increase | |
| 18 Public demand | 19+22+26 |
| 19 Government final consumption expenditure | 20+21 |
| 20 Government individual consumption expenditure | |
| 21 Government collective consumption expenditure | |
| 22 Public fixed capital formation | 23+24+25 |
| 23 Public housing investment | |
| 24 Public non-residential investment | |
| 25 General government fixed capital formation | |
| 26 Public inventory | 27+28 |
| 27 Public enterprises inventory increase | |
| 28 General government inventory increase | |
| Gross fixed capital formation | 11+12+22 |
| 29 Net exports of goods and services | 30-32 |
| 30 Exports of goods and services | 31+8 |
| 31 Exports of goods and services (except for direct domestic purchase by nonresident households) | |
| 8 Direct domestic purchase by non-resident households (re-listed) | |
| 32 (deducted) Imports of goods and services | 33+7 |
| 33 Imports of goods and services (except for direct overseas purchase by resident households) | |
| 7 Direct overseas purchase by resident households (re-listed) | |

| | |
|---|---|
| 34 Gross domestic income (GDI) <only real value> | 35+36 |
| 35 Gross domestic production (GDP) (re-listed) | 1+29 |
| 36 Trading gains/losses <only real value> 29(nom)/((30(nom)+32(nom))/(30(real)+32(real))*100)*100-29(real) | |
| 37 Income from the rest of the world | |
| 38 (deducted) Payment to the rest of the world | |
| Gross national income (GNI) | 34+37-38 |

(Note 1) See the section "(5) Seasonal adjustment of final consumption expenditure of non-profit institutions serving households" in this chapter.

(Note 2) As for the nominal value of private non-residential investment, the QE team has calculated the seasonally adjusted values both for demand-side and supply-side estimates (except for software new orders and NPISH's portion) because they are necessary for calculation purpose. (Refer to "(4) Seasonal adjustment of the 1st QE" in this chapter)

## 2. Compensation of employees

| | |
|---|---|
| Compensation of employees (nominal) | 1+2+3 |
| 1 Wages, salaries | |
| 2 Employers' actual social contribution | |
| 3 Employers' imputed social contribution | |
| Compensation of employees (real) (Note 3) | |

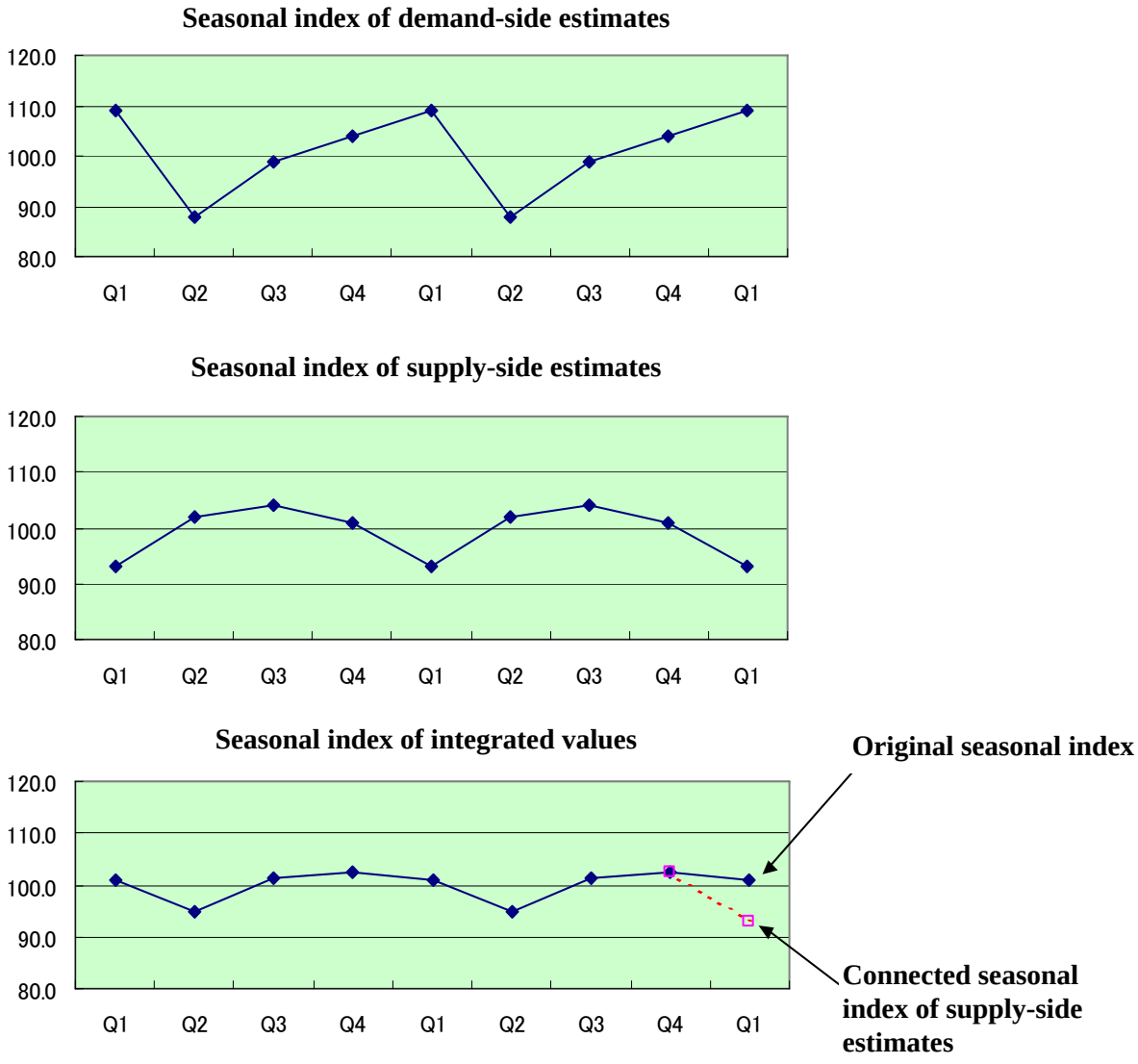
(Note 3) Calculated as seasonally adjusted employees compensation (nominal) divided by the seasonally adjusted deflator (computed by "seasonally adjusted nominal value / seasonally adjusted real value) of household final consumption expenditure (except for imputed rent).

### (4) Seasonal adjustment of the 1st QE

If the 1st QE and 2nd QE use different source statistics on private non-residential investment, this data source gap might cause a seasonal patterns gap in the original series between these two types of QE. Therefore, if seasonal adjustment is made, at the time of the 1st QE, by simply connecting new estimates to the 2nd QE of the previous quarters, a difference in seasonal patterns may distort the performance of the seasonally adjusted values.

Demand-side estimates may not be created for the 1st QE. However, assuming that their seasonally adjusted values would increase/decrease on a quarter-on-quarter comparison basis at the same rate as their applicable supply-side estimates, the QE team creates the demand estimates as well as the original value ($I_p$) that is divided back by the assumed seasonal index of the demand-side estimates. Then, the demand-side estimates and the supply-side estimates are integrated in the same manner as the 2nd QE (computed by: integrated value $= kI_p + (1-k)(I_t - I_g)$. See IV. 3.(1) for more information).

**Chart 6. Image of "distortion" in seasonally adjusted values**



### (5) Seasonal adjustment of final consumption expenditure of private non-profit institutions serving households

Regarding the seasonal adjustment series of NPISH's final consumption expenditure, the nominal and real annual data on NPISH's final consumption (the sum of "education" and "others") are divided with a mechanical approach (Lisman-Sandee Method) to yield a smooth quarterly series; and then the value obtained above shall be the quarterly series without seasonal variation factors ("seasonal adjustment series").

Regarding the preliminary estimates, the extrapolated nominal and real annual data are divided with Lisman-Sandee method in the same manner. (See IV.1. (2) for more information on how to extrapolate the data; and see V.3. for details on how to convert into real values.)