



Lecture 4. GDP at Constant Price

What are the ways to value GDP?

- **GDP at current price** - the value of production of goods and services using prices of the period
- **GDP constant price** - the value of GDP using fixed prices of a fixed period (called base period)
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How to distinguish the two

- GDP at current price is represented as

$$P_t Q_t$$

P_t = price at the period t

Q_t = volume or quantity at period t

t = reference period of the estimates

How to distinguish..

GDP constant price is represented as

$$P_0 Q_t$$

P_0 = price at the base period 0

Q_t = volume or quantity at period t

Example: Gross Output of fish at current price

Item	2000	2001	2002	2003	2004
fish caught (ton)	100	120	126	145	200
price (th \$/ton)	5	6	6	9	12
$P_t Q_t$ (th \$)	500	720	756	1305	2400

Example: Gross Output of fish at constant 2000 price

Item	2000	2001	2002	2003	2004
fish caught (ton)	100	120	126	145	200
price (th \$/ton)	5	6 5	6 5	9 5	12 5
P_0Q_t (th \$)	500	720 600	756 630	1305 725	2400 1000

What is the use of GDP at constant price ?

GDP constant price represented a measure of volume of production

$$\frac{P_0 Q_t}{P_0 Q_{t-1}} = \frac{\cancel{P_0} Q_t}{\cancel{P_0} Q_{t-1}} = \frac{Q_t}{Q_{t-1}} = 1 + q$$

q is the growth rate between $t-1$ to t

Example: Estimating annual growth rate (q) of fish output

Item t	2000 0	2001 1	2002 2	2003 3	2004 4
$P_0 Q_t / P_0 Q_{t-1}$	500/ 500	600/ 500	630/ 600	725/ 630	1000/ 725
$1+q$	1.000	1.200	1.050	1.151	.3793
q_t		20%	5%	15.1%	37.9%

How to estimate growth rate q

$$q = \frac{725 - 630}{630} = \frac{95}{630}$$

$$q = 0.1508 \text{ or } 15.08 \%$$

$$1+q = \frac{725}{630} = \frac{630 + 95}{630} = \frac{630}{630} + \frac{95}{630}$$

$$1+q = 1 + 0.1508$$

$$q = 0.1508 \text{ or } 15.08 \%$$

How to estimate average annual growth rate *avg q*

average annual growth rate = geometric mean =

$$= \sqrt[t]{(1+q_1) * (1+q_2) \dots (1+q_{t-1}) * (1+q_t)} - 1$$

$$= \sqrt[4]{1.2 * 1.05 * 1.151 * 1.379} - 1$$

$$= \sqrt[4]{1.9999} - 1 = 1.1892 - 1 = 0.1892 \text{ or } 18.92\%$$

How to estimate ... *avg q*

average annual growth rate = geometric mean =

$$= \sqrt[t]{\frac{Vt}{V0}} - 1 = \sqrt[4]{\frac{1000}{500}} - 1$$

$$= \sqrt[4]{2.00} - 1 = 1.1892 - 1 = 0.1892 \text{ or } 18.92\%$$

How to estimate GO at constant prices

GO at current price

$$GO_t = P_t Q_t$$

Q_t = quantity or volume at time t

P_t = price at time t

GO at constant price at 0

$$GO_{0,t} = P_0 Q_t$$

Q_t = quantity or volume at time t

P_0 = price at time 0

How to estimate GO at constant prices

- **Revaluation** = multiply the quantity or volume of t by price at time 0
- **Deflation** = divide the GO at current price by price relative or price index with base 0
- **Extrapolation** = multiply the value at time 0 with volume relative or volume index

How to estimate.. constant prices

- **Revaluation** = multiply quantity at time t by price at time 0

$$GO_{0,t} = Q_t P_0$$

	2000	2001	2002	2003
Qt	100	120	126	145
Pt	5	6	6	9
P₂₀₀₀Qt	500	600	630	725

How to estimate.. constant prices

- Price deflation - divide current price estimate by price relative/price index

$$GO_{0,t} = Q_t P_t / (P_t / P_0)$$

	2000	2001	2002	2003
$Q_t P_t$	500	720	756	1305
P_t	5	6	6	9
P_t/P_0	5 / 5	6 / 5	6 / 5	9 / 5
$Q_t P_t / (P_t/P_{2000})$	500	600	630	725

How to estimate.. constant prices

- **Volume extrapolation** - multiply base year value by volume relative or volume index

$$GO_{0,t} = Q_0 P_0 * Q_t / Q_0$$

	2000	2001	2002	2003
Q_t P_t	500	720	756	1305
Q_t	100	120	126	145
Q_t/Q₀	120 / 100	120 / 100	126 / 100	145 / 100
Q₂₀₀₀ P₂₀₀₀* (Q_t/Q₂₀₀₀)	500	600	630	725

Gross Value Added

- Value added is the difference between value of output of goods and services less value of intermediate input

$$GVA_t = GO_t - IC_t$$

$$= \sum P_t Q_t - \sum p_t q_t$$

How to estimate GVA at constant price

Double deflation (double indicator):

Value added = output at t with prices at base year 0 - intermediate consumption at t at base year prices 0

$$GVA_{0t} = GO_{0t} - IC_{0t} = \sum P_0 Q_t - \sum p_0 q_t$$

Volume measure of output and intermediate consumption are estimated either by revaluation, price deflation or quantity extrapolation

How to estimate GVA at constant price

Single indicator

1. when GO at constant price is available

$$GVA_{0,t} = GO_{0,t} * gvar_0$$

gross output is valued at constant price multiplied by gross value added ratio of base period (takes the base year technology)

How to estimate GVA at constant price

Single indicator

2. when GVA at current price and price index are available

$$GVA_{0,t} = GVA_t / PI_{0,t}$$

GVA_t = gross value added at current price

$PI_{0,t}$ = price index with same base year 0

How to estimate GVA at constant price

Single indicator

3. when GVA at base year is available and volume index are available at base year 0

$$GVA_{0,t} = GVA_0 * QI_{0,t}$$

GVA_0 = GVA at base year 0

$QI_{0,t}$ = volume index at base year 0

How to estimate GVA at constant price

Single indicator

4. when GVA at constant price of previous period and volume index are available

$$GVA_{0,t} = GVA_{0,t-1} * (QI_{0,t} / QI_{0,t-1})$$

$GVA_{0,t-1}$ = GVA at constant price of time t-1

$QI_{0,t}$ = volume index for time t

$QI_{0,t-1}$ = volume index for time t-1

Change in Value Added

- Measure change in value added of industry

$$\frac{GVA_{0t} - \sum p_0 Q_t}{GVA_{00} - \sum p_0 Q_0} = 1 + q$$

In the formula q represent the growth rate of gross value added from base year period 0 to current period t .

How to estimate other transactions of GDP

Revaluation

Price deflation

Volume extrapolation

Data for estimation

Value data

- gross receipts, sales, value of export, value of imports, etc..

Price data

- unit value of export or import, consumer price index, tuition fees, etc...

Volume data

- fish catch, tourist, hotel guest nights, enrollment, quantity of imports, etc..

Types of Price Indices

- Price indices of *output of the industry*
- Price indices of *output of similar industry*
- Price indices of *all or major intermediate consumption goods and services*
- Price indices of *component of value added*

Types of Price Indices

- Price indices of *same commodity groups from CPI, WPI or other existing indices* (although not very appropriate because these are generally Laspeyre's type)
- General price index
- GDP deflators ($\text{GDP at current} / \text{GDP at constant}$)

Assumption in Deflation of Value Added

Single indicator- (single deflator)

1. No change in production technology
2. Where Laspeyres type of price indices are used, composition of industry production remain the same as base year

Assumption in Deflation of Value Added

3. Same rate of change in prices of output and intermediate consumption
4. When CPI, WPI or other price indices on final demand are used for deflation, rate of change in trade mark up, product taxes and transport prices is assumed to be the same as producers price.

Types of Volume Indicators

- Volume index of output of industry (production index)
- Volume index of factor of production (employment, vehicles, etc.)
- Volume index of use of goods and services (exports, tourist arrivals, etc..)

Assumption in Extrapolation of Value Added

1. No change in production technology
2. No change in composition of goods and services
3. Indicator used is approximate measure of volume of goods and services

Base Period for Volume Measure

1. Fixed based - $\sum P_0 Q_t$

The price is fixed for period 0

2. Chain based - $\sum P_{t-1} Q_t$

The price of the volume measure is based on the previous period t-1

Types of Indices

Laspeyres index : base year is past year

Price index

$$L_p = \frac{\sum P_t Q_0}{\sum P_0 Q_0}$$

The quantity or volume is fixed for period 0

Volume index

$$L_q = \frac{\sum P_0 Q_t}{\sum P_0 Q_0}$$

The price is fixed for period 0

Types of Indices

Paasche index : base year is current year

Price index

$$P_p = \frac{\sum P_t Q_t}{\sum P_0 Q_t}$$

The quantity or volume is period t

Volume index

$$P_q = \frac{\sum P_t Q_t}{\sum P_t Q_0}$$

The price is period t

Types of Indices

Fishers index : base year is current year

Price index

$$F_p = \left\{ \left(\frac{\sum P_t Q_0}{\sum P_0 Q_0} \right) * \left(\frac{\sum P_t Q_t}{\sum P_0 Q_t} \right) \right\}^{1/2}$$
$$= (L_p * P_p)^{1/2}$$

Volume index

$$F_q = \left\{ \left(\frac{\sum P_0 Q_t}{\sum P_0 Q_0} \right) * \left(\frac{\sum P_t Q_t}{\sum P_t Q_0} \right) \right\}^{1/2}$$
$$= (L_q * P_q)^{1/2}$$



Thank you