Case 1 — Real GVA extrapolated using a volume indicator

Think of an industry where quarterly real GVA is estimated using a **physical-production or volume indicator** such as IIP, tonnes produced, passenger-km, electricity generated, etc.

1. Scenario setup

We start with the same base economy:

Variable	Y0 Values
Real output	100
Real intermediate consumption	60
Real GVA	**40**
Output price index	100
Input price index	100
Nominal output	100
Nominal IC	60
Nominal GVA	**40**

So:

$$GVA_0 = 100 - 60 = 40$$

Now suppose the quarterly statistical system does **not** observe output and IC separately in real terms.

Instead, it has a volume indicator.

Suppose the indicator says:

$$Production\ volume\ growth = 10\%$$

The estimation method therefore assumes:

$$Real\ GVA\ growth \approx 10\%$$

and calculates:

$$GVA_1^{estimated} = 40 \times 1.10 = 44$$

That is the basic estimation mechanism.

2. First Y1: everything moves proportionately

Let us first create a situation where the volume indicator is a very good proxy.

Assume:

Variable	Y0	Y1 change	Y1
Output volume	100	+10%	110
IC volume	60	+10%	66
Output price index	100	+5%	105
Input price index	100	+20%	120

Notice that prices are diverging substantially:

- output prices: **+5%**
- input prices: **+20%**

But physical input and output volumes both grow 10%.

Nominal values in Y1

Nominal output:

$$110 \times 1.05 = 115.5$$

Nominal IC:

$$66 \times 1.20 = 79.2$$

Therefore:

$$Nominal\ GVA_1 = 115.5 - 79.2 = 36.3$$

Nominal GVA has actually fallen from 40 to 36.3.

If we looked only at nominal GVA, we might incorrectly think economic activity contracted.

3. What does double deflation give us?

Under double deflation, we deflate the two components separately.

Output

$$Real\ Output_1 = \frac{115.5}{1.05} = 110$$

Intermediate consumption

$$Real\ IC_1 = \frac{79.2}{1.20} = 66$$

Therefore:

$$Real\ GVA_1 = 110 - 66 = 44$$

Hence:

$$Real\ GVA\ growth = \frac{44}{40} - 1 = 10\%$$

So the **correct real growth is 10%**.

4. What does the volume-indicator method give us?

The production indicator also increased by 10%.

So:

$$Estimated\ Real\ GVA_1 = 40 \times 1.10 = 44$$

Therefore:

Measure	Y1 real GVA	Growth
Double-deflated GVA	44	+10%
Volume-indicator estimate	44	+10%

They agree perfectly.

Why?

Because the relationship between output and intermediate consumption has remained unchanged.

In Y0:

$$\frac{IC}{Output} = \frac{60}{100} = 60\%$$

In Y1:

$$\frac{66}{110} = 60\%$$

So if output volume rises 10%, GVA volume also rises 10%.

The fact that input inflation was **20% while output inflation was only 5%** does not hurt the volume-indicator estimate.

Why?

Because the method essentially **bypasses prices altogether**.

5. Now change Y1: input use grows faster

This is the more interesting situation.

Keep:

$$Output\ volume: +\ 10\%$$

But now suppose intermediate-input volume rises **20%**.

Perhaps the industry became less efficient, had to use more fuel/raw materials, or shifted toward more input-intensive production.

Our economy becomes:

Variable	Y0	Y1 change	Y1
Output volume	100	+10%	110
IC volume	60	**+20%**	72
Output price index	100	+5%	105
Input price index	100	+20%	120

Nominal values

Output:

$$110 \times 1.05 = 115.5$$

IC:

$$72 \times 1.20 = 86.4$$

Nominal GVA:

$$115.5 - 86.4 = 29.1$$

6. True GVA under double deflation

Output:

$$\frac{115.5}{1.05} = 110$$

IC:

$$\frac{86.4}{1.20} = 72$$

Therefore:

$$Real\ GVA_1 = 110 - 72 = 38$$

Compared with Y0:

$$\frac{38}{40} - 1 = - 5\%$$

So **true real GVA falls 5%**.

This may initially look strange because production itself increased 10%.

But remember:

$$GVA = Output - IC$$

Output increased:

$$100 \rightarrow 110$$

but IC increased much faster:

$$60 \rightarrow 72$$

Therefore:

$$40 \rightarrow 38$$

Value added actually fell.

7. But what does our quarterly volume indicator say?

Suppose IIP or the physical-production indicator only sees:

$$Output\ volume: + 10\%$$

The quarterly methodology extrapolates GVA:

$$40 \times 1.10 = 44$$

So it reports:

$$+ 10\%$$

while double deflation gives:

$$- 5\%$$

Now we have a large difference.

	Double deflation	Volume extrapolation
Real output	110	—

Real IC	72	—
Real GVA	**38**	**44**
Real GVA growth	**−5%**	**+10%**

8. What exactly went wrong?

The volume-indicator method implicitly assumed something like:

$$GVA\ volume\ growth \approx Output\ volume\ growth$$

That is reasonable only if the **input-output relationship is reasonably stable**.

In our first example:

$$100 - 60 = 40$$

became:

$$110 - 66 = 44$$

Everything scaled 10%.

But in the second example:

$$100 - 60 = 40$$

became:

$$110 - 72 = 38$$

Production increased, but the amount of intermediate inputs required increased even more.

The simple output-volume indicator cannot see this.

9. So where does double deflation matter here?

This distinction is important.

Price divergence itself

Suppose:

- output inflation = 5%
- input inflation = 20%

but output and IC **volumes both grow 10%**.

The volume-indicator method is still fine.

So:

$$Different\ output/input\ inflation\ alone\ need\ not\ distort\ a\ good\ volume\ proxy$$

because prices are not being used to derive the real-growth estimate.

Volume divergence

The real problem appears when:

$$Output\ volume\ growth \neq IC\ volume\ growth$$

Double deflation can capture this because it separately produces:

$$Real\ Output$$

and

$$Real\ IC$$

whereas direct GVA extrapolation from an output indicator cannot.

Case 1 — final takeaway

The logic can be summarized as:

$$GVA_t^{real} \approx GVA_0^{real} \times Output\ volume\ index$$

This works well when the industry's **input-output coefficient is stable**.

But if intermediate consumption behaves differently from output:

$$Output\ indicator\ growth \neq true\ GVA\ growth$$

Double deflation is conceptually superior because it calculates:

$$Real\ GVA = Real\ Output - Real\ IC$$

rather than assuming output-volume growth is also GVA-volume growth.

So for Case 1, the major potential benefit of double deflation is capturing changes in input intensity/productivity—not simply correcting for divergent output and input prices.

Case 2 — Nominal corporate results are used to estimate real GVA

This is the case where the quarterly estimator observes **nominal corporate financial data**—for example, sales, expenses, profits, compensation, etc.—rather than a clean physical volume indicator.

The important difference from Case 1 is:

We begin with **current-price rupee values**, so the way we remove inflation becomes crucial.

1. Scenario setup

We keep exactly the same base economy.

Variable	Y0 Values
Real output	100
Real intermediate consumption	60
Real GVA	**40**
Output price index	100
Input price index	100
Nominal output	100
Nominal IC	60
Nominal GVA	**40**

So:

$$GVA_0 = 100 - 60 = 40$$

Now assume corporate results for Y1 tell us nominally:

- sales/output value
- intermediate costs

But we want **real GVA growth**.

2. Start with the simple Y1 case

First let both output and IC volumes rise by 10%.

But prices behave differently:

Variable	Y0	Y1 change	Y1 real/price level
Output volume	100	+10%	110

IC volume	60	+10%	66
Output prices	100	+5%	105
Input prices	100	+20%	120

Therefore, nominal corporate numbers become:

Nominal output

$$110\times1.05 = 115.5$$

Nominal IC

$$66\times1.20 = 79.2$$

So nominal GVA is:

$$115.5 - 79.2 = 36.3$$

Thus the corporate accounts would show:

	Y0	Y1
Nominal output	100	115.5
Nominal IC	60	79.2
Nominal GVA	**40**	**36.3**

Nominal GVA appears to have fallen by:

$$\frac{36.3}{40} - 1 =- 9.25\%$$

But physically both output and IC increased 10%.

So clearly:

$$- 9.25\%\neq real\ GVA\ growth$$

The fall is caused by **input prices rising much faster than output prices**.

3. Double-deflation result

Here we separately deflate output and IC.

Output

$$Real\ Output_1 = \frac{115.5}{1.05} = 110$$

Intermediate consumption

$$Real\ IC_1 = \frac{79.2}{1.20} = 66$$

Therefore:

$$Real\ GVA_1 = 110 - 66 = 44$$

Hence:

$$Real\ GVA\ growth = \frac{44}{40} - 1 = 10\%$$

So the correct result is:

$$+\ 10\%$$

4. What happens under single deflation?

Now suppose instead of separately deflating output and IC, the statistical system calculates nominal GVA first:

$$Nominal\ GVA = 36.3$$

and then deflates that entire GVA using **one price index**.

Suppose it uses the output-price index:

$$P = 105$$

Then:

$$Real\ GVA^{single} = \frac{36.3}{1.05} = 34.57$$

Therefore estimated real growth is:

$$\frac{34.57}{40} - 1 = -\ 13.6\%$$

So:

Method	Real GVA	Growth
Double deflation	44.0	+10.0%

Single deflation using output price	34.6	−13.6%

That is a massive difference.

5. Why did single deflation fail?

Because nominal GVA was:

$$115.5 - 79.2 = 36.3$$

The two parts contain **different inflation rates**:

$$Output: \; + 5\%$$

but

$$IC: \; + 20\%$$

When we first subtract them in nominal terms, the high input-price inflation has already pushed nominal GVA down.

Then dividing the whole ₹36.3 by an output-price index of 1.05 cannot undo the 20% inflation embedded inside IC.

Mathematically, single deflation effectively does:

$$\frac{Nominal\ Output - Nominal\ IC}{P}$$

while double deflation does:

$$\frac{Nominal\ Output}{P_O} - \frac{Nominal\ IC}{P_{IC}}$$

And generally:

$$\frac{O - IC}{P} \neq \frac{O}{P_O} - \frac{IC}{P_{IC}}$$

when:

$$P_O \neq P_{IC}$$

6. Now change Y1: input volumes also behave differently

Let's use the more difficult economy from Case 1.

Output volume rises 10%, but IC volume rises 20%.

Variable	Y0	Y1 change	Y1
Output volume	100	+10%	110
IC volume	60	**+20%**	72
Output prices	100	+5%	105
Input prices	100	+20%	120

Nominal corporate results now show:

Output

$$110\times1.05 = 115.5$$

IC

$$72\times1.20 = 86.4$$

Therefore:

$$Nominal\ GVA = 115.5 - 86.4 = 29.1$$

7. Double-deflation result

Separately deflate:

$$Real\ Output = \frac{115.5}{1.05} = 110 Real\ IC = \frac{86.4}{1.20} = 72$$

Therefore:

$$Real\ GVA = 110 - 72 = 38$$

Hence:

$$Real\ GVA\ growth = \frac{38}{40} - 1 =- 5\%$$

So the true real economy has contracted:

$$- 5\%$$

8. Single-deflation result

Suppose again we deflate nominal GVA using the output-price index.

$$Real\ GVA^{single} = \frac{29.1}{1.05} = 27.71$$

Growth:

$$\frac{27.71}{40} - 1 = -\ 30.7\%$$

So:

Method	Real GVA Y1	Growth
Double deflation	38.0	−5.0%
Single deflation	27.7	−30.7%

Again, single deflation badly exaggerates the fall.

9. Why Case 2 is fundamentally different from Case 1

This is the important comparison.

Case 1: volume indicator

We started directly from something like:

$$Production\ volume: +\ 10\%$$

So price changes were largely bypassed.

The key risk was:

$$Output\ volume\ growth \neq IC\ volume\ growth$$

Case 2: nominal corporate results

We start from:

$$₹\ sales,\ ₹\ costs,\ ₹\ GVA$$

Those rupee values contain both:

$$volume\ change\ +\ price\ change$$

Therefore we must somehow separate the two.

Here divergent output and input prices become **directly important**.

10. ANOTHER USEFUL WAY TO SEE IT

Suppose nothing changes physically at all.

Keep:

$$Output\ volume\ =\ 100IC\ volume\ =\ 60$$

Therefore true real GVA remains:

$$40$$

and true growth is:

$$0\%$$

But now let:

- output prices rise 5%
- input prices rise 20%

Nominal values become:

$$Output\ =\ 105IC\ =\ 72$$

Nominal GVA:

$$105\ -\ 72\ =\ 33$$

Nominal GVA appears to fall:

$$40 \rightarrow 33$$

or:

$$-\ 17.5\%$$

even though **nothing whatsoever changed physically**.

Double deflation

$$105/1.05\ =\ 10072/1.20\ =\ 60$$

Therefore:

$$Real\ GVA\ =\ 100\ -\ 60\ =\ 40$$

Correct:

$$0\%$$

Single deflation using output price

$$33/1.05 = 31.43$$

implying:

$$\frac{31.43}{40} - 1 = - 21.4\%$$

So single deflation would show a large real contraction where **there was literally zero volume change**.

That is probably the cleanest illustration of why double deflation matters for nominal corporate data.

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11. Case 1 vs Case 2

	Case 1: Volume indicator	Case 2: Nominal corporate results
Starting information	Physical/volume growth	Current-price ₹ values
Prices directly affect starting indicator?	No	**Yes**
Need to remove inflation?	Usually already a volume measure	**Yes**
Divergent output/input prices important?	Less directly	**Very important**
Different output/IC volume growth important?	Yes	Yes
Double deflation advantage	Captures changing input intensity	**Separates both different prices and different volumes**

Core takeaway

For corporate-result-based estimation:

$$Double\ deflation\ matters\ much\ more\ directly$$

because the starting data are **nominal**.

If input prices rise much faster than output prices, nominal corporate GVA can collapse even when real production is flat or increasing.

Double deflation disentangles:

$$Output\ volume\ from\ Output\ prices$$

and separately:

$$IC\ volume\ from\ Input\ prices$$

before calculating GVA.

That is precisely what single deflation cannot fully do.

Case 3 — Annual estimate is available, then quarterised

This is different from Cases 1 and 2 because the quarterly estimate is **not built independently from current-quarter output and IC data**.

Instead, the statistical system first has an **annual estimate** and then distributes, or quarterises, that annual estimate using some quarterly indicator or seasonal pattern.

Think of activities such as livestock, forestry, or other areas where a strong annual estimate exists but quarterly measurement is weaker.

1. Scenario setup

We keep the same base economy:

Variable	Y0 Values
Real output	100
Real intermediate consumption	60
Real GVA	**40**
Output price index	100
Input price index	100
Nominal output	100
Nominal IC	60
Nominal GVA	**40**

So:

$$GVA_0 = 100 - 60 = 40$$

Now suppose the annual estimation system concludes that **full-year real GVA is 10% higher**.

So annual real GVA becomes:

$$40 \times 1.10 = 44$$

The quarterly problem is now:

How much of this annual ₹44 of real GVA should be assigned to Q1, Q2, Q3 and Q4?

2. Simple annual quarterisation

Suppose the historical seasonal distribution is:

Quarter	Share of annual GVA
Q1	20%
Q2	25%
Q3	25%
Q4	30%
Total	**100%**

In Y0, annual real GVA = 40.

So quarterly GVA was:

Quarter	Y0 real GVA
Q1	8
Q2	10
Q3	10
Q4	12
Annual	**40**

Now annual Y1 GVA is estimated at 44.

If the same seasonal shares are used:

Quarter	Share	Y1 estimated real GVA
Q1	20%	8.8
Q2	25%	11.0
Q3	25%	11.0
Q4	30%	13.2
Annual	**100%**	**44.0**

Every quarter therefore shows approximately +10% growth.

So at the quarterly stage, we are essentially doing:

$$Quarterly\ GVA_t = Annual\ GVA \times quarterly\ share$$

There is no separate quarterly calculation of:

$$Output_q - IC_q$$

3. Where does double deflation enter?

Here we need to separate **two stages**.

Stage A — estimating annual real GVA

If the annual estimate itself is constructed from:

$$Output - IC$$

then double deflation can matter substantially at the **annual estimation stage**.

For example, suppose annual nominal data show:

- output prices +5%
- input prices +20%

Then ideally we calculate:

$$Real\ Output^{annual} = \frac{Nominal\ Output}{P_O}$$

and:

$$Real\ IC^{annual} = \frac{Nominal\ IC}{P_{IC}}$$

and then:

$$Real\ GVA^{annual} = Real\ Output - Real\ IC$$

So double deflation may determine whether the annual GVA estimate is 44, 38, or something else.

Stage B — distributing that annual GVA across quarters

Once annual real GVA is already estimated, quarterisation itself usually does **not** require double deflation.

It is simply:

$$Annual\ real\ GVA \rightarrow Q1, Q2, Q3, Q4$$

using quarterly indicators or seasonal weights.

That distinction is the most important part of Case 3.

4. Now create a more interesting Y1

Suppose the true annual economy is:

Variable	Y0	Y1 change	Y1 real
Output volume	100	+10%	110
IC volume	60	+20%	72
Output prices	100	+5%	105
Input prices	100	+20%	120

Exactly the same difficult scenario as before.

Nominal annual output:

$$110 \times 1.05 = 115.5$$

Nominal annual IC:

$$72 \times 1.20 = 86.4$$

Nominal annual GVA:

$$115.5 - 86.4 = 29.1$$

5. Correct annual GVA under double deflation

Separately deflate output and IC:

$$Real\ Output\ = \frac{115.5}{1.05} = 110 Real\ IC\ = \frac{86.4}{1.20} = 72$$

Therefore:

$$Real\ annual\ GVA\ = 110\ -\ 72\ =\ 38$$

So actual annual real GVA growth is:

$$\frac{38}{40} - 1 =-\ 5\%$$

Thus our annual benchmark should be:

$$38$$

not 44.

6. Quarterise the correct annual GVA

Using the same seasonal shares:

Quarter	Share	Y0 GVA	Y1 GVA
Q1	20%	8.0	7.6
Q2	25%	10.0	9.5
Q3	25%	10.0	9.5
Q4	30%	12.0	11.4
Annual	**100%**	**40.0**	**38.0**

Every quarter shows:

$$-\ 5\%$$

because we assumed the seasonal structure did not change.

So here:

$$Double\ deflation\ affected\ the\ annual\ level$$

and the quarterisation simply passed that result into the quarters.

7. What if annual GVA was single-deflated incorrectly?

Suppose instead we first calculate nominal annual GVA:

$$29.1$$

and single-deflate using the output price index of 1.05:

$$Real\ GVA^{single} = \frac{29.1}{1.05} = 27.71$$

That implies annual growth of:

$$\frac{27.71}{40} - 1 = -30.7\%$$

Then the quarterisation process distributes **27.71** across the year:

Quarter	Share	Double-deflation GVA	Single-deflation GVA
Q1	20%	7.60	5.54
Q2	25%	9.50	6.93
Q3	25%	9.50	6.93
Q4	30%	11.40	8.31
Annual		**38.00**	**27.71**

So the quarterly results become badly distorted.

But notice:

The error did **not arise because quarterisation itself was wrong**.

It arose because the **annual real GVA supplied to the quarterisation process was wrong**.

The quarterisation simply propagated the error.

8. There is a second source of error: quarterisation pattern

Now suppose annual GVA is correctly estimated at:

But economic activity did not decline uniformly across quarters.

Suppose the true quarterly GVA was actually:

Quarter	True Y1 GVA
Q1	9
Q2	10
Q3	9
Q4	10
Total	**38**

Compare with Y0:

Quarter	Y0	True Y1	Growth
Q1	8	9	+12.5%
Q2	10	10	0%
Q3	10	9	−10%
Q4	12	10	−16.7%
Annual	**40**	**38**	**−5%**

But our simple historical-share quarterisation gave:

Quarter	Estimated Y1
Q1	7.6
Q2	9.5
Q3	9.5
Q4	11.4

So annual GVA is perfectly correct:

but individual quarterly estimates can still be wrong. This has nothing to do with double deflation. It is a **quarterisation problem**.

9. So there are really two independent questions

For this method:

Question 1: Is annual real GVA measured correctly?

This is where double deflation matters.

$$Nominal\ Output \to Real\ Output Nominal\ IC \to Real\ IC Real\ GVA = Real\ Output - Real\ IC$$

Question 2: Is annual GVA distributed correctly across quarters?

This depends on:

- quarterly production indicators,
- seasonal patterns,
- livestock/harvest cycles,
- administrative data,
- trend extrapolation,
- etc.

Double deflation cannot fix a poor quarterisation indicator.

10. Compare Cases 1–3

	Case 1: Volume indicator	Case 2: Nominal corporate data	Case 3: Annual estimate → quarterisation
Starting point	Quarterly volume indicator	Quarterly nominal ₹ data	**Annual estimate**
Quarterly GVA estimated directly?	Yes, via proxy	Yes	**Not necessarily**
Price effects important?	Limited directly	**Very important**	Important mainly in annual estimate

Double deflation applied at quarterly stage?	Usually no	Potentially yes	**Usually no**
Double deflation may matter elsewhere?	Benchmarking	—	**Yes, annual GVA estimation**
Main quarterly risk	Output ≠ GVA volume	Wrong deflator	**Wrong quarterisation pattern**

Case 3 — final takeaway

For annual-quarterised industries:

$$Annual\ real\ GVA\ estimation \rightarrow Quarterisation$$

Double deflation mainly affects the **first arrow's starting value**.

If annual GVA is incorrectly deflated:

$$all\ four\ quarters\ inherit\ that\ error$$

But even with perfect double deflation at the annual level:

$$quarterly\ GVA\ can\ still\ be\ wrong\ if\ the\ quarterisation\ indicator\ is\ poor$$

So Case 3 introduces a new issue that Cases 1 and 2 did not have: **temporal allocation error** in addition to the measurement/deflation problem.

Case 4 — Output and Intermediate Consumption are estimated separately

This is the case that is **closest to the textbook production approach**:

$$GVA = Output - Intermediate\ Consumption$$

Here, unlike Case 1, we are not simply extrapolating GVA from an output indicator. And unlike Case 3, we are not just distributing an annual GVA estimate across quarters.

Instead, we try to estimate **output and IC separately** for the current quarter.

This is exactly the setting where **double deflation is most naturally applied**.

1. Scenario setup

Same base economy:

Variable	Y0 Values
Real output	100
Real intermediate consumption	60
Real GVA	**40**
Output price index	100
Input price index	100
Nominal output	100
Nominal IC	60
Nominal GVA	**40**

So:

$$GVA_0 = 100 - 60 = 40$$

Now suppose in Y1 we can estimate current-price output and current-price IC separately.

2. First Y1: same volume growth, different prices

Assume:

Variable	Y0	Y1 change	Y1
Output volume	100	+10%	110
IC volume	60	+10%	66
Output prices	100	+5%	105
Input prices	100	+20%	120

So nominal output becomes:

$$110\times1.05 = 115.5$$

Nominal IC becomes:

$$66\times1.20 = 79.2$$

Therefore nominal GVA is:

$$115.5 - 79.2 = 36.3$$

Again, nominal GVA appears to fall from 40 to 36.3.

But physically, output and IC both grew 10%.

3. Double deflation

Because output and IC are separately available, we can deflate them using their own price indices.

Output

$$Real\ Output_1 = \frac{115.5}{1.05} = 110$$

IC

$$Real\ IC_1 = \frac{79.2}{1.20} = 66$$

Therefore:

$$Real\ GVA_1 = 110 - 66 = 44$$

Hence:

$$Real\ GVA\ growth = \frac{44}{40} - 1 = 10\%$$

This exactly recovers the underlying real economy.

4. Why this method is conceptually strong

Because we are doing:

$$Real\ GVA = Real\ Output - Real\ IC$$

rather than trying to construct a deflator for GVA itself.

That matters because **GVA does not really have one natural observable price**.

Output has output prices.

Intermediate consumption has input prices.

But:

$$GVA = Output - IC$$

is a residual.

So when output and input prices move differently, defining a single appropriate GVA deflator becomes difficult.

Double deflation avoids this problem.

5. Now make the economy harder

Use our second scenario:

Variable	Y0	Y1 change	Y1
Output volume	100	+10%	110
IC volume	60	**+20%**	72
Output prices	100	+5%	105
Input prices	100	+20%	120

Nominal values:

$$Nominal\ Output\ =\ 110\times1.05\ =\ 115.5 Nominal\ IC\ =\ 72\times1.20\ =\ 86.4$$

Therefore:

$$Nominal\ GVA\ =\ 115.5\ -\ 86.4\ =\ 29.1$$

6. Double-deflated GVA

Output:

$$\frac{115.5}{1.05} = 110$$

IC:

$$\frac{86.4}{1.20} = 72$$

Therefore:

$$Real\ GVA\ =\ 110\ -\ 72\ =\ 38$$

Growth:

$$\frac{38}{40} - 1 =- 5\%$$

So the method correctly captures both:

- output volume rising 10%
- input use rising 20%

and therefore correctly concludes:

$$Real\ GVA =- 5\%$$

7. Compare with a fixed-IC-ratio approach

Now suppose we estimate output separately, but instead of actually estimating IC volume we assume that IC remains a fixed proportion of output.

In Y0:

$$\frac{IC}{Output} = \frac{60}{100} = 60\%$$

So if real output becomes 110, we might estimate:

$$Real\ IC^{estimated} = 110\times60\% = 66$$

Then estimated GVA would be:

$$110 - 66 = 44$$

or:

$$+ 10\%$$

But the actual IC volume was 72.

Therefore true GVA was:

$$110 - 72 = 38$$

or:

$$- 5\%$$

So even though the methodology **looks like Output − IC**, it only captures the advantage of double deflation if IC is actually estimated independently enough to reflect changing input intensity.

That is an important nuance.

8. There are therefore two versions of Case 4

Version A — genuinely separate estimation

We estimate:

$$Nominal\ Output$$

and:

$$Nominal\ IC$$

using separate data sources, then separately deflate them.

This gives:

$$true\ double\ deflation$$

and can capture:

- different output and input prices,
- different output and input volume growth,
- changing input intensity.

Version B — IC is mechanically linked to output

For example:

$$IC_t = \alpha \times Output_t$$

where αis taken from a benchmark year.

Then:

$$GVA_t = Output_t(1 - \alpha)$$

In practice, this starts looking very similar to direct GVA extrapolation.

If output rises 10%:

$$GVA\ also\ rises\ 10\%$$

regardless of whether actual IC volume rose 10%, 20%, or 30%.

So:

$$Separate - lookingestimation \neq genuinelyindependentestimation$$

9. What about single deflation here?

Suppose we first calculate nominal GVA:

$$29.1$$

and then divide by output prices:

$$\frac{29.1}{1.05} = 27.71$$

This implies:

$$-\ 30.7\%$$

versus the correct:

$$-\ 5\%$$

So once again:

Method	Real GVA	Growth
Double deflation	**38.0**	**−5.0%**
Fixed IC ratio	44.0	+10.0%
Single deflation using output price	27.7	−30.7%

This table is useful because it shows **three completely different errors**.

10. What each method is assuming

Double deflation

Uses:

$$O_{real} = \frac{O_{nominal}}{P_O}$$

and:

$$IC_{real} = \frac{IC_{nominal}}{P_{IC}}$$

No assumption that output and IC behave proportionately.

Fixed IC ratio

Assumes:

$$\frac{IC}{Output} = constant$$

So:

$$IC\ volume\ growth \approx Output\ volume\ growth$$

This can miss productivity/input-intensity changes.

Single deflation

Effectively assumes one price index can adequately remove the price movements embedded in:

$$Output - IC$$

This becomes problematic when:

$$P_O \neq P_{IC}$$

11. Why Case 4 is the benchmark against which the others are judged

Conceptually, if we had perfect quarterly information, we would ideally want:

$$Real\ GVA_q = Real\ Output_q - Real\ IC_q$$

with both independently measured.

So Case 4 is almost the **ideal benchmark**.

Cases 1, 2, 3 and 5 largely exist because quarterly statistical systems often **do not have enough timely information to do this perfectly**.

For example:

- Case 1 uses a production-volume proxy because quarterly IC data are unavailable.
- Case 2 uses corporate financial results because direct physical measures may be unavailable.
- Case 3 uses annual estimates because quarterly information is weak.
- Case 5 uses other proxy indicators because direct output/IC information may not exist.

Case 4 — final takeaway

If output and IC can genuinely be measured separately:

$$Double\ deflation = \frac{Nominal\ Output}{Output\ deflator} - \frac{Nominal\ IC}{Input\ deflator}$$

This is the cleanest way to measure real GVA.

It can simultaneously handle:

$$P_O \neq P_{IC}$$

and:

$$\Delta Q_O \neq \Delta Q_{IC}$$

But the practical benefit disappears partially if IC is merely estimated as a **fixed ratio of output**.

So the key question is not just:

"Are output and IC shown separately?"

It is:

"Are output and IC independently estimated enough that both their price and volume movements can differ?"

If yes, Case 4 is where double deflation provides the fullest benefit.

Case 5 — GVA extrapolated using another proxy indicator

This is the broad residual case: the statistical system does **not** directly observe quarterly output and IC, and it may not even have a clean physical production indicator like IIP.

Instead, it uses some other indicator that is believed to move with activity.

Examples could be things like credit growth, deposits, freight traffic, passenger traffic, employment, tax collections, communication usage, etc., depending on the industry.

The basic idea is:

$$Real\ GVA_t \approx Real\ GVA_0 \times\ Proxy\ Indicator\ Growth$$

So conceptually, this is similar to Case 1, but the proxy may be **further removed from actual output volume**.

1. Scenario setup

Same base economy:

Variable	Y0 Values
Real output	100

Real intermediate consumption	60
Real GVA	**40**
Output price index	100
Input price index	100
Nominal output	100
Nominal IC	60
Nominal GVA	**40**

So:

$$GVA_0 = 100 - 60 = 40$$

Suppose the available quarterly proxy rises by 10%.

The estimator therefore calculates:

$$Estimated\ Real\ GVA_1 = 40 \times 1.10 = 44$$

So estimated growth is:

$$+ 10\%$$

Now we ask whether that proxy really tracks GVA.

2. First Y1 — proxy moves perfectly with actual activity

Suppose the true economy is:

Variable	Y0	Y1 change	Y1
Output volume	100	+10%	110
IC volume	60	+10%	66
Output prices	100	+5%	105
Input prices	100	+20%	120
Proxy indicator	100	+10%	110

Nominal output:

$$110 \times 1.05 = 115.5$$

Nominal IC:

$$66 \times 1.20 = 79.2$$

Nominal GVA:

$$115.5 - 79.2 = 36.3$$

Double deflation gives:

$$Real\ Output = 110 Real\ IC = 66$$

and therefore:

$$Real\ GVA = 44$$

or:

$$+10\%$$

The proxy method also gives:

$$40 \times 1.10 = 44$$

So:

Method	Real GVA	Growth
Double deflation	44	+10%
Proxy extrapolation	44	+10%

Perfect agreement.

Again, divergent prices are not a problem because the proxy route is already trying to measure real activity directly.

3. Now suppose input intensity changes

Keep the proxy at +10%, but let IC volume rise 20%.

Variable	Y0	Y1 change	Y1
Output volume	100	+10%	110

IC volume	60	**+20%**	72
Output price index	100	+5%	105
Input price index	100	+20%	120
Proxy indicator	100	+10%	110

Double deflation gives:

$$Real\ GVA = 110 - 72 = 38$$

So:

$$Real\ GVA\ growth = -5\%$$

But the proxy method still says:

$$40 \times 1.10 = 44$$

or:

$$+10\%$$

So:

Method	Real GVA	Growth
Double deflation	38	−5%
Proxy extrapolation	44	+10%

This is already the same weakness we saw in Case 1.

But Case 5 has an additional problem.

4. The proxy itself may diverge from output

Suppose the actual economy is unchanged:

$$Output\ volume = 100 IC\ volume = 60$$

so true real GVA remains:

$$40$$

and true growth is:

$$0\%$$

But suppose our proxy rises 10%.

Why could that happen?

Imagine a banking-type proxy where credit outstanding rises because:

- borrowers draw more working capital because prices rose,
- loan maturities increase,
- firms accumulate inventories,
- nominal ticket sizes rise,
- financial deepening occurs,

without a corresponding 10% rise in the underlying volume of value added.

The estimation method would nevertheless produce:

$$40 \times 1.10 = 44$$

or:

$$+\ 10\%$$

while true real GVA is:

$$40$$

or:

$$0\%$$

So:

$$Proxy\ growth \neq Output\ volume\ growth$$

is an additional source of error.

5. This gives Case 5 two separate assumptions

When we say:

$$GVA\ growth \approx Proxy\ growth$$

we are effectively making two links:

$$Proxy \longrightarrow Output \longrightarrow GVA$$

For the estimate to work well:

Assumption 1

$$Proxy\ growth \approx Output\ volume\ growth$$

Assumption 2

$$Output\ volume\ growth \approx GVA\ volume\ growth$$

If either link breaks, the estimate can be wrong.

Case 1 mainly depended on the second assumption.

Case 5 can depend on **both**.

6. Example where both assumptions fail

Let's make it more extreme.

Suppose:

Variable	Change
Proxy indicator	+15%
Actual output volume	+5%
IC volume	+15%
Output prices	+5%
Input prices	+20%

Base:

$$Output = 100,\ IC = 60,\ GVA = 40$$

Actual real output:

$$105$$

Actual real IC:

$$60 \times 1.15 = 69$$

Therefore true real GVA:

$$105 - 69 = 36$$

Growth:

$$\frac{36}{40} - 1 = -10\%$$

But the proxy method says:

$$40 \times 1.15 = 46$$

Growth:

$$+15\%$$

So we can get:

$$Estimated: +15\%$$

versus:

$$True: -10\%$$

The problem here is not deflation at all.

It is that the proxy is a weak representation of underlying value-added volume.

7. Where does double deflation matter?

Just as in Case 1, divergent prices alone are not the central issue if the proxy is genuinely a real-volume indicator.

If:

- proxy growth = true output volume growth,
- input-output structure stays stable,

then the proxy can give a good answer even when:

$$P_O \neq P_{IC}$$

because price changes are bypassed.

Double deflation becomes superior when we have enough information to separately recover:

$$Real\ Output$$

and:

$$Real\ IC$$

But if those data are unavailable—which is precisely why a proxy is being used—then double deflation may not be operationally feasible at the quarterly stage.

8. Case 1 versus Case 5

They look similar, but there is an important distinction.

Case 1 — direct volume indicator

Example:

$$IIP,\ tonnes,\ electricity\ generated$$

The indicator is reasonably close to actual output.

So the main assumption is:

$$Output\ volume\ growth \approx GVA\ growth$$

Case 5 — indirect proxy

Example:

$$credit,\ deposits,\ traffic,\ employment,\ etc.$$

Now we first assume:

$$Proxy \approx Output$$

and then:

$$Output \approx GVA$$

So Case 5 has a **longer inference chain**.

That generally makes it potentially less robust.

9. Final comparison across all five cases

Now the full structure becomes clearer:

Case	Starting information	Main quarterly mechanism	Where double deflation matters
1. Volume indicator	Physical/volume measure	Extrapolate GVA directly	Mainly if output and IC volumes diverge

2. Nominal corporate results	Nominal ₹ values	Deflate nominal information	**Very directly; output/input price divergence matters**
3. Annual estimate → quarterisation	Annual GVA + quarterly pattern	Allocate annual GVA across quarters	Mainly in constructing the annual real GVA
4. Output and IC separately estimated	Output + IC	$Real\ O\ -\ Real\ IC$	**This is the natural double-deflation case**
5. Indirect proxy extrapolation	Proxy indicator	Proxy growth applied to GVA	Double deflation mostly unavailable; proxy error is key

The single most useful way to remember all five is:

$$How\ close\ are\ we\ to\ actually\ observing\ Output\ -\ IC?$$

At one end is Case 4:

$$Output\ and\ IC\ separately$$

which is the ideal environment for double deflation.

At the other end is Case 5:

$$Proxy \rightarrow GVA$$

where we are furthest away from directly measuring value added.

And Cases 1–3 sit in between.

SUMMARY

Here is the table I would keep in your notes.

GVA group	Typical closest case from our 5 cases	What works well	Main potential error	Quarterly real-GVA risk
Agriculture, forestry & fishing	Cases 1, 3 & 4	Physical crop/fish quantities	IC ratio assumptions; forecasts; quarterisation	**Medium**
Mining & quarrying	Cases 1 & 4	Strong physical production data	IC intensity, product mix	**Low–Medium**
Manufacturing	Cases 2 & 4	Corporate accounts + production data	Input/output price divergence; corporate sample; IC changes	**Medium–High**
Electricity, gas, water	Cases 1 & 4	Excellent physical output indicators	Fuel/input mix and prices	**Medium**
Construction	Case 5 / indirect Case 4	Material/project indicators	No clean output quantity; material mix; price divergence	**High**
Trade, hotels, transport, communication	Cases 1, 2 & 5	Some strong traffic/telecom indicators	Trade margins, quality, heterogeneous services	**Medium–High**
Financial, real estate & professional	Cases 2 & 5 + specialised	Rich nominal/admin data in parts	No obvious quantity/price; imputation; coverage	**High**
Public administration, defence & other services	Case 3 / input-based specialised	Government expenditure/payroll observable	Output quantity/productivity difficult; quarterisation	**Medium–High / High**

And there is an important pattern

You can mentally arrange the eight sectors on a spectrum.

Easier: physical quantities exist

$$Mining \rightarrow Agriculture \rightarrow Electricity$$

We can actually observe things like:

- tonnes,
- kWh,
- barrels,
- crops.

The main issue becomes:

$$Output\ volume\ growth GVA\ growth$$

because IC may behave differently.

Middle

$$Manufacturing \rightarrow Transport/Trade/Hotels$$

We have significant data, but:

- IC matters enormously,
- nominal corporate numbers require deflation,
- quality/product mix matters,
- coverage may be incomplete.

Harder

$$Construction \rightarrow Financial/Professional \rightarrow Government/nonmarket\ services$$

Here we increasingly struggle even to define or observe a clean:

$$quantity\ of\ output$$

So proxies, imputations and input-based methods become more important.

One final insight tying this back to double deflation

There are actually **three different kinds of uncertainty**, and it's useful not to call all of them “deflation problems.”

A. Price-measurement error

$$P_O \neq P_{IC}$$

Single deflation can give wrong real GVA.

Most important: manufacturing, construction, utilities.

B. Input-volume error

We observe output volume but assume IC moves with it:

$$Q_{IC} \propto Q_O$$

when it doesn't.

Relevant: agriculture, mining, manufacturing, utilities.

C. Proxy/output-measurement error

We don't observe output itself:

$$ProxyOutputGVA$$

Most important: construction, trade/services, finance, professional services.

And government adds a fourth:

D. Output itself has no market price

So:

$$real\ output\ is\ partly\ constructed\ from\ inputs\ rather\ than\ directly\ observed$$

That is why **"use double deflation everywhere" would improve only one part of the problem**. It can address A and, if IC data are genuinely separate, some of B. It cannot magically solve C or D.