Structural Change in Nominal State Domestic Product in India: A Segmented-Trend Analysis, 2012-13 to 2023-24.

Abstract

India's aggregate nominal GSDP growth was statistically unchanged on average before and after 2020-21 (10.9% vs 11.0%), yet its trend broke sharply at that year. Using Gross State Domestic Product at current prices for 30 states and union territories (MoSPI series, base year 2011-12) over 2012-13 to 2023-24, we estimate a log-linear segmented-trend model with a level shift and a slope shift at 2020-21. The joint test of no break is rejected for the aggregate ($F(2,8) = 23.7$, $p < 0.001$) and for 28 of 31 series. The level fell about 12% below the pre-break trend in 2020-21, and the post-break slope is 3.2 percentage points steeper ($p = 0.003$), so GSDP had returned to within about 2% of the old trend by 2023-24. A sup-F search over candidate break years independently selects 2020-21. Re-estimating on real GSDP shows the same V-shape, but real output remained about 9% below its pre-break trend in 2023-24, so much of the nominal catch-up reflects higher prices. With only 12 annual observations and 4 post-break points, the results are exploratory.

Keywords:structural break, Chow test, nominal GSDP, Indian states, COVID-19, segmented regression, regional growth

1. Introduction

The nominal GDP trend of Indian states changed significantly at 2020-21, but the change is a shock-and-rebound, not a durable shift in average growth. This article tests that claim with a segmented regression on state-level data and asks whether the pattern is common to all states or driven by a few.

Structural change matters for economists because a trend estimated across a break gives misleading forecasts, growth rankings and convergence results. Between 2012-13 and 2023-24 Indian states faced several candidate disruptions: demonetization (November 2016), the Goods and Services Tax (July 2017), a slowdown in 2019-20, and the COVID-19 lockdown that began in March 2020. Each could have altered the level or slope of nominal output. The analysis uses 2020-21 as the break year because it is the only candidate with a clear theoretical justification as a nationwide, simultaneous shock.

Research question-Did the state's nominal GDP trend change significantly during the study period?

Hypothesis

- H0: the log-linear trend of nominal GSDP has no level shift ($\beta_2 = 0$) and no slope shift ($\beta_3 = 0$) at 2020-21.
- H1: at least one of β_2 or β_3 differs from zero.
- H2: mean annual nominal growth differs before and after 2020-21.

Contribution-The paper (i) applies a fixed-date and an unknown-date break test to 30 states and UTs at once, (ii) shows that a significant trend break coexists with an unchanged mean growth rate, and (iii) separates the real and price components of the break.

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2. Background and conceptual framework

The econometric literature offers two approaches to breaks. When the break date is known on theoretical grounds, the Chow (1960) test compares a pooled regression with separate pre- and post-break regressions. When the date is unknown, Andrews (1993) shows that the maximum of the sequence of F statistics must be compared with non-standard critical values, and Bai and Perron (1998) extend this to multiple breaks. Perron (1989) cautions that a level shift can be mistaken for a unit root, which is relevant because nominal GSDP is a trending series.

A nominal break can arise from real output, from prices, or from both. Nominal GSDP growth equals real growth plus change in the implicit deflator, so a pandemic contraction followed by a post-lockdown price surge produces a V-shaped nominal path. Three mechanisms are therefore examined:

1. **Demand and supply disruption.** Lockdowns cut activity in services, construction and trade, lowering the level in 2020-21.
2. **Rebound and base effects.** Growth measured from a depressed base overstates the recovery in 2021-22, steepening the post-break slope.
3. **Price effects.** Input-cost and commodity inflation raises the deflator, lifting nominal values without raising real output.

Measurement is a fourth candidate: the series uses the 2011-12 base year throughout, so no base-year splice falls inside the window, but later-year figures may still be provisional.

3. Data and Methodology

The data are annual GSDP at current prices (₹ crore) for 30 states and UTs from the Ministry of Statistics and Programme Implementation (MoSPI) state-wise SDP release dated 15 April 2026 (base year 2011-12). The estimation window is 2012-13 to 2023-24 (T = 12). 2011-12 is dropped so that the window holds twelve complete observations and so that 2024-25 and 2025-26, which are missing for several states, are excluded. An all-states aggregate is the sum of the 30 entities. Real GSDP (constant 2011-12 prices) from the same file is used in robustness checks, and the implicit deflator is nominal divided by real.

The suggested level specification is estimated in logs, because nominal GSDP grows roughly exponentially and log-differences read as growth rates:

$$\ln GSDP_t = \beta_0 + \beta_1 t + \beta_2 D_t + \beta_3 (t \cdot D_t) + \varepsilon_t$$

Here t = 1 in 2012-13, and $D_t = 0$ before 2020-21 and 1 from 2020-21 (t = 9). β_1 is the pre-break trend, $\beta_1 + \beta_3$ the post-break trend, and β_2 the intercept shift at t = 0. Because the interaction uses t rather than t minus the break date, the actual level gap at the break is:

$$\text{Gap}_{2020\text{-}21} = \beta_2 + 9\beta_3, \qquad \text{Gap}_{2023\text{-}24} = \beta_2 + 12\beta_3$$

The tests are:

- **Chow-type joint F-test** of $\beta_2 = \beta_3 = 0$, with (2, 8) degrees of freedom.
- **t-tests** on β_2 and β_3, with Newey-West (1987) HAC standard errors (one lag) as a check against serial correlation.
- **Durbin-Watson** statistic of the residuals.
- **sup-F (Andrews, 1993)** over break years 2015-16 to 2021-22, trimming three observations at each end.
- **Welch t-test** of mean annual growth, 2013-14 to 2019-20 (7 years) against 2020-21 to 2023-24 (4 years).

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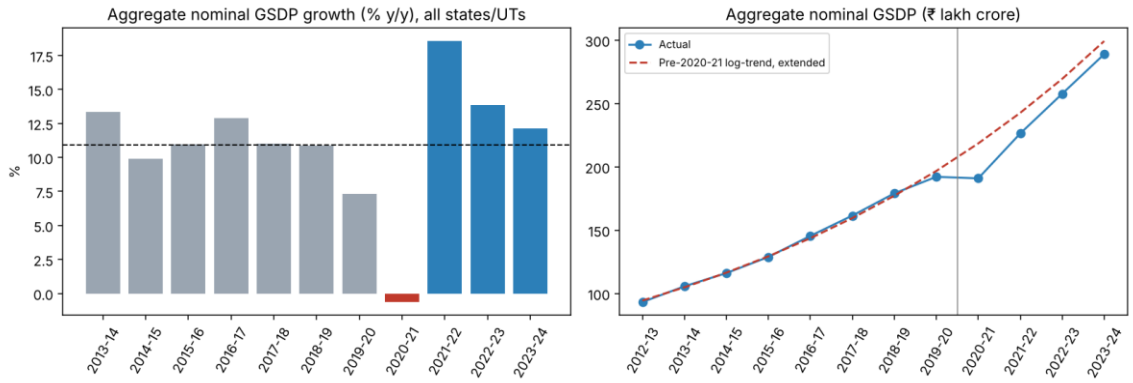
With 12 observations and 4 parameters the model has 8 residual degrees of freedom, so p-values are approximate and the analysis is exploratory.

4. Results

4.1 Growth rates and the turning point

Aggregate nominal growth fell from 13.3% in 2013-14 to 7.3% in 2019-20, collapsed to -0.6% in 2020-21, then jumped to 18.6%, 13.9% and 12.1%. Fig. 1 shows the growth bars and the pre-break trend extended through the sample; actual GSDP sits clearly below that line in 2020-21 and approaches it by 2023-24.



The heat map in Fig. 2 shows that the 2020-21 contraction was nearly universal: 28 of 30 states and UTs recorded growth of 3% or less in that year, and the strongest rebounds came in 2021-22. The pre-break years show no comparable simultaneous break.

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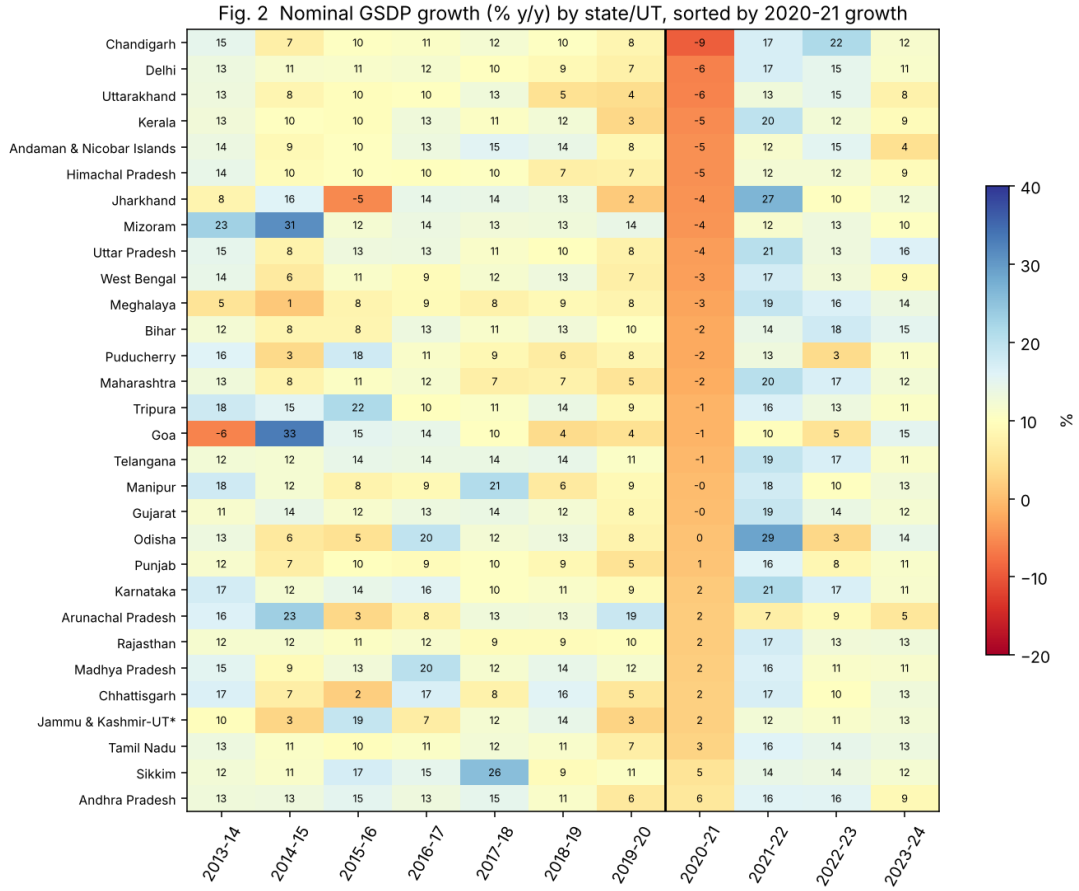
Fig. 2 Nominal GSDP growth (% y/y) by state/UT, sorted by 2020-21 growth



4.2 Aggregate regression

The joint test rejects no break for the aggregate, and both the level shift and the slope shift are individually significant.

Parameter	Estimate (%)	p-value
β_1 pre-break trend (per year)	10.49	n/a
β_2 level shift at t = 0	-41.20	0.001
β_3 change in trend	+3.25	0.003 (HAC 0.003)
Post-break trend, $\beta_1 + \beta_3$	13.73	n/a
Level gap at 2020-21, $\beta_2 + 9\beta_3$	-11.98	n/a
Level gap at 2023-24, $\beta_2 + 12\beta_3$	-2.24	n/a
Joint F(2, 8), $\beta_2 = \beta_3 = 0$	23.68	< 0.001
R^2 / Durbin-Watson	0.999 / 1.82	n/a

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The high R^2 mainly reflects the shared trend in logs, so the F-test and gap estimates carry the evidence, not R^2. A Durbin-Watson value of 1.82 gives no sign of first-order autocorrelation, and Newey-West errors leave the β_3 p-value at 0.003.

Average growth is a different story. Mean nominal growth was 10.9% in 2013-14 to 2019-20 and 11.0% in 2020-21 to 2023-24, and the Welch test cannot distinguish them ($p = 0.99$). The two results are consistent: the post-break window combines a -0.6% year with three years above 12%, so the average is unchanged while the path is not.

4.3 Unknown break date

The sup-F statistic over 2015-16 to 2021-22 peaks at 2020-21 ($F = 23.7$). Every other candidate year gives a much smaller F, below about 3.4 (the next highest is 2019-20). The fixed date is therefore supported by the data and not only by prior reasoning, although the exact Andrews critical value for $T = 12$ with this trimming is not tabulated here, so only the size of the gap should be read as informative.

4.4 Cross-state evidence

The joint test rejects no break at the 5% level for 28 of 31 series (30 states/UTs plus the aggregate); Chhattisgarh, Jharkhand and Odisha are the exceptions. Of the 30 states and UTs, 26 have a negative level shift, 22 have a positive slope change, and 24 of the 31 series choose 2020-21 as the best-fitting break year in the sup-F search.

Fig. 3 shows how far each state sat from its own extended pre-break fit in the break year and in 2023-24. Every state sat below trend in 2020-21 (mean gap -13.0%, range -5.6% to -23.8%). By 2023-24 the median gap had narrowed to -6.6%: 13 units were within 5% of trend or above it, but 22 of 30 were still below it and 10 remained more than 10% below.

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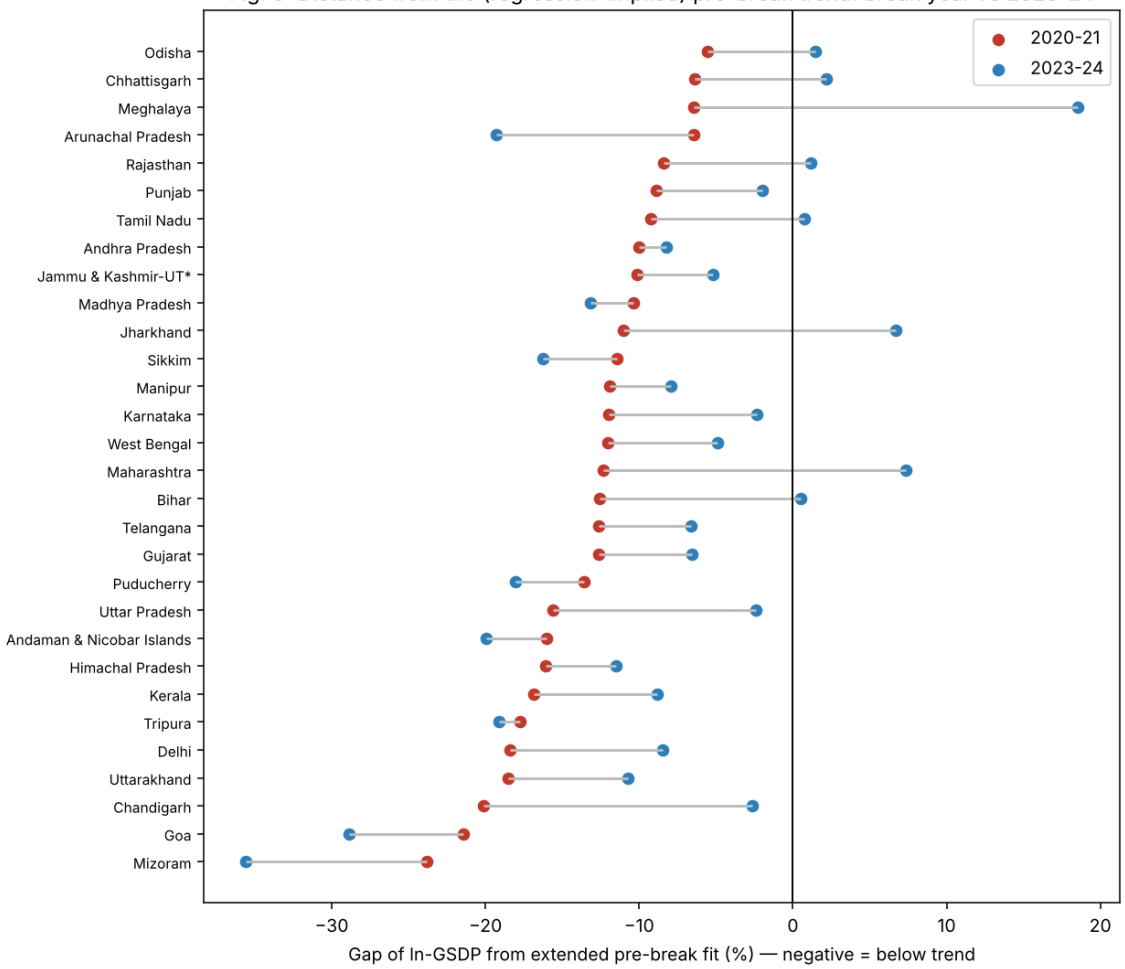
Fig. 3 Distance from the (regression-implied) pre-break trend: break year vs 2023-24



State/UT	Gap 2020-21 (%)	Gap 2023-24 (%)	Mean growth before / after (%)
Mizoram	-23.8	-35.6	17.1 / 7.7
Goa	-21.5	-28.9	10.7 / 7.0
Andaman & Nicobar Islands	-16.0	-19.9	12.0 / 6.6
Arunachal Pradesh	-6.4	-19.3	13.4 / 5.8
Tripura	-17.7	-19.1	14.1 / 9.8
Maharashtra	-12.3	+7.3	9.0 / 11.9
Jharkhand	-11.0	+6.7	8.8 / 11.2
Meghalaya	-6.4	+18.6	6.9 / 11.6

The table lists the five states furthest below trend in 2023-24 and three that overshot it. For the five, a lasting slowdown, not a rebound, is the better description.

Across the 30 units, mean nominal growth fell by 1.35 percentage points after 2020-21 (paired t = -2.52, p = 0.017; Wilcoxon p = 0.014), with 20 of 30 below their earlier average. This contrasts with the flat aggregate because the aggregate is weighted by output and dominated by large states whose growth held up, while the simple average gives small states equal weight.

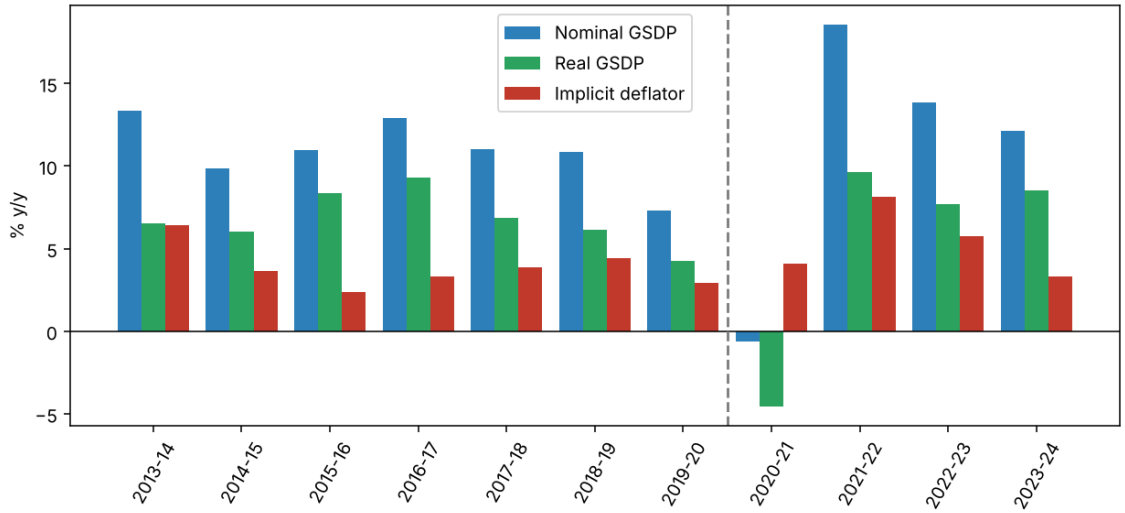
5. Robustness: real output and prices

The real-GSDP regression shows the same V-shape, but real output recovered much less than nominal output; the difference is the price level. The identity ln(nominal) = ln(real) + ln(deflator) means the three gaps in the table add up.

Aggregate series	Pre-break trend (%/yr)	β_3 trend change (pp)	p(β_3)	Gap 2020-21 (%)	Gap 2023-24 (%)	Joint F(2, 8)
Nominal GSDP	10.49	+3.25	0.003	-12.0	-2.2	23.7
Real GSDP (2011-12 prices)	6.88	+1.31	0.062	-13.2	-9.3	42.2
Implicit deflator	3.61	+1.94	0.007	+1.3	+7.1	9.3

In real terms the 2020-21 shortfall is slightly larger (-13.2%) and GSDP was still 9.3% below its pre-break trend in 2023-24. The deflator ran about 7% above its old trend by then, which is what closed the nominal gap. The real slope change is only marginally significant (p = 0.062), whereas the price slope change is clearly significant (p = 0.007).

Fig. 4 Decomposing nominal growth into real growth and price change (aggregate)



The 2021-22 deflator rise of 8.1% is the largest in the window, against a pre-break range of 2.4% to 6.4%. The Durbin-Watson statistic for the real series is 1.50, which is inconclusive at this sample size, so the real-series p-values should be treated cautiously.

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Fig. 5 Pre- vs post-break mean nominal growth
(dashed = no change)

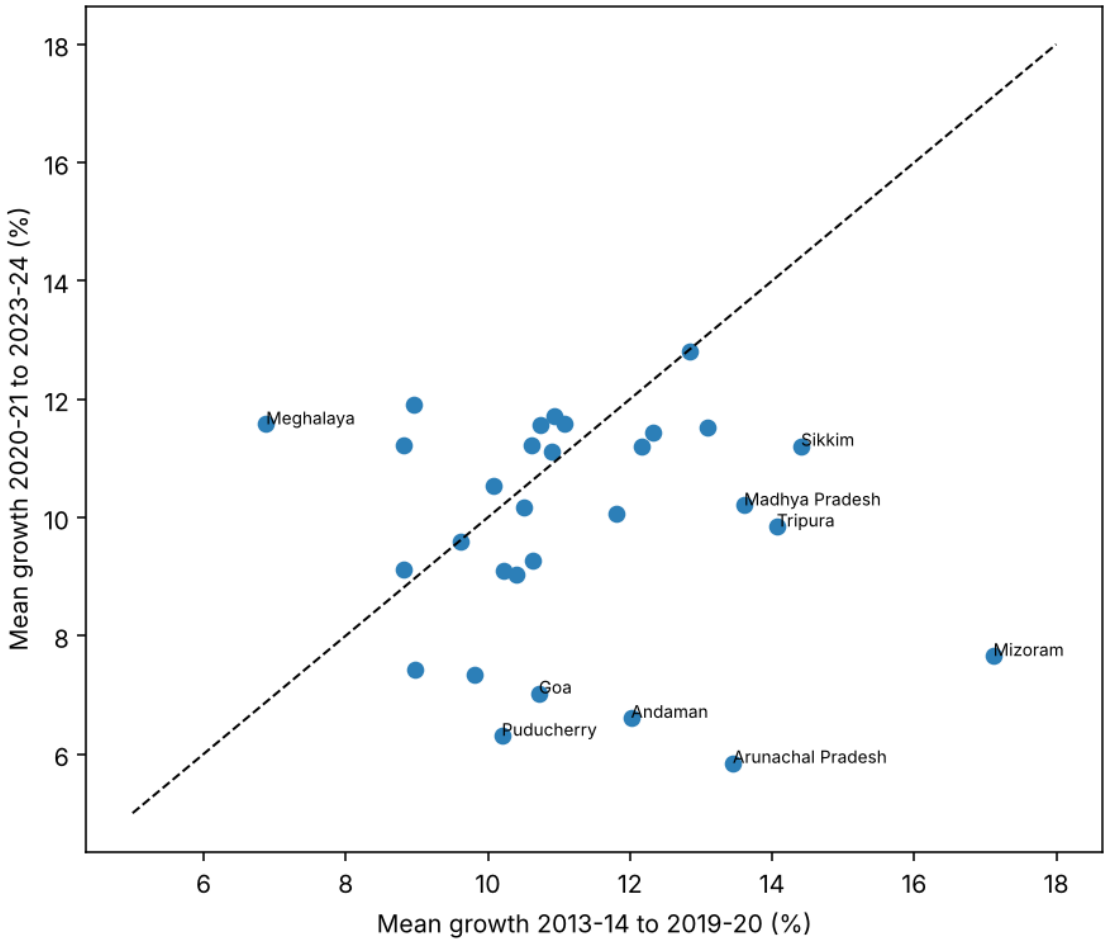

Fig. 5 plots each unit's mean growth before and after 2020-21; units below the dashed line grew more slowly afterwards. Labelled points are those whose mean growth changed by more than 3 points; they are mainly small economies, whose growth rates are volatile.

7. Conclusion

Nominal GSDP in Indian states did experience a statistically significant trend break at 2020-21 (aggregate joint $F = 23.7$, $p < 0.001$; 28 of 31 series), so the null of a stable trend is rejected. The break is a level drop of about 12% followed by a steeper recovery slope (+3.2 percentage points), which brought the aggregate back to within about 2% of its old trend by 2023-24. Average nominal growth did not change in the aggregate (10.9% vs 11.0%), but fell by 1.35 points on average across the 30 units. Real output remained about 9% below trend, so higher prices explain much of the nominal recovery. Given 12 observations and 4 post-break years, these results are exploratory and should be confirmed with a state panel, sectoral data and further years as they are finalized.

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