

Bridging Data Gaps: Nowcasting State-Level GDP Growth in India with Geospatial Data

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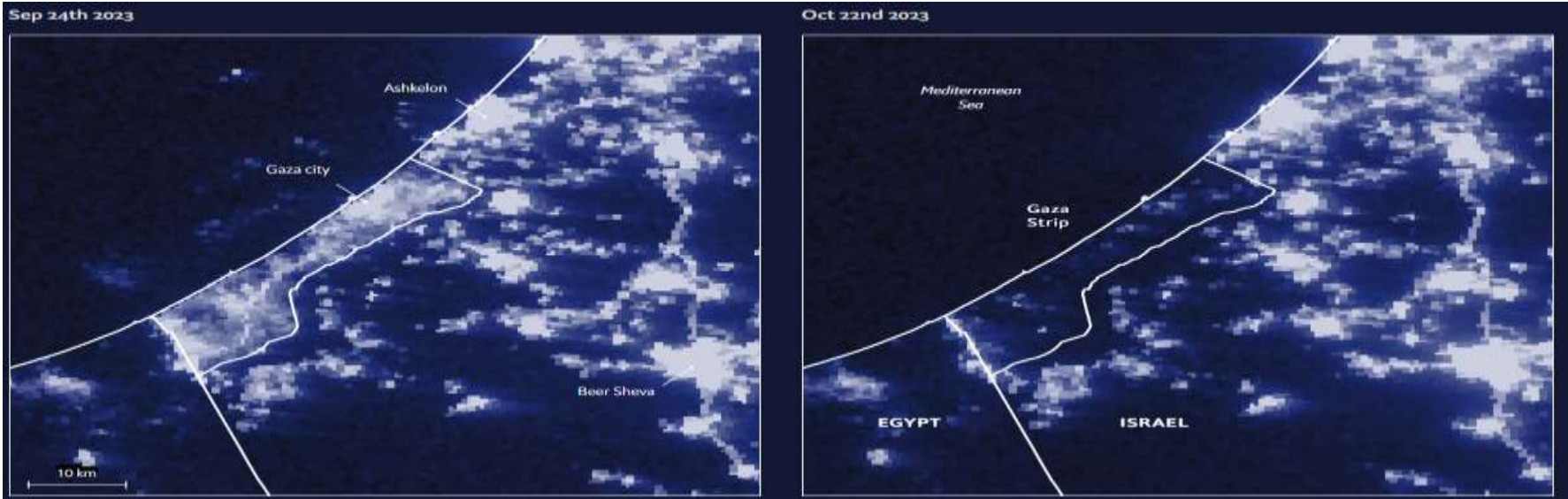


**Data Sciences Lab
Reserve Bank of India**

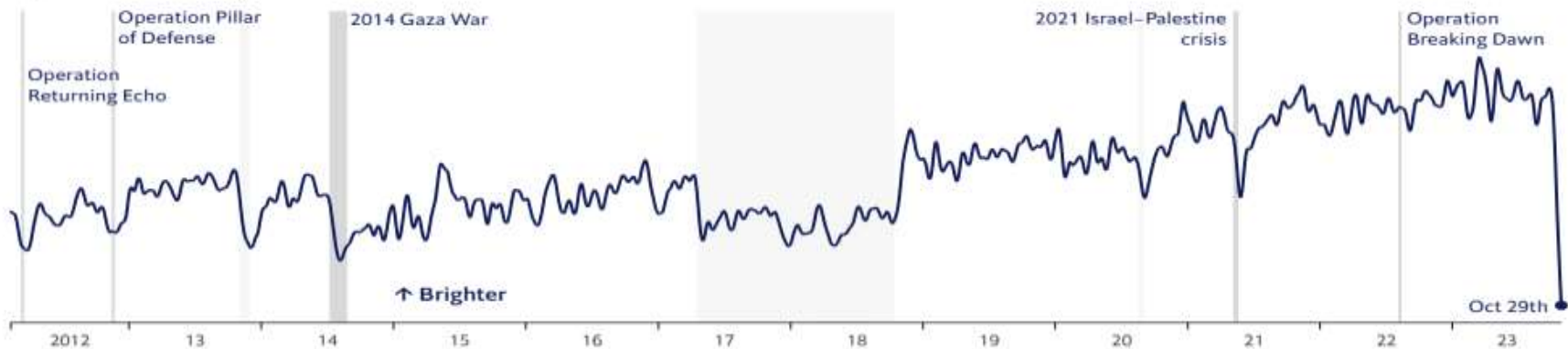
Gaza's darkest nights

The enclave is operating on one-tenth of its normal power supply

Nov 9th 2023



Night-time luminosity in Gaza



Background and Motivation

Problem

- National GDP available quarterly since 1996–97
- State GDP published annually with 18 months delay

Relevance of This Study

- Necessitates high frequency state level economic growth data to support decision making at state level
- Useful for disaster response planning and infrastructure prioritization

Objective: Estimate state-level GDP at quarterly frequency using non-traditional data sources (night light, Google Trends)

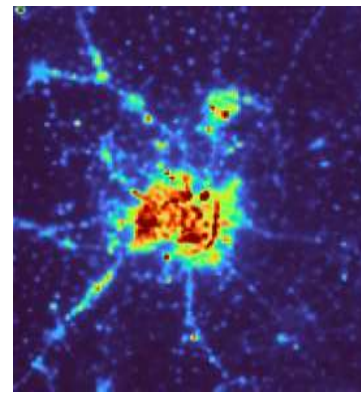
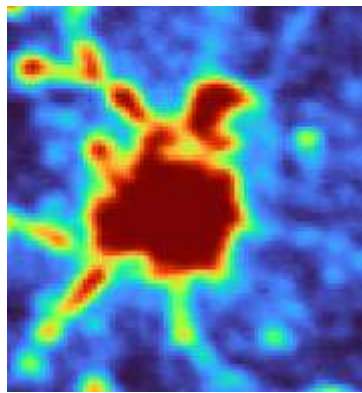
Novelty

First attempt in India to estimate quarterly state-level economic activity using night-time lights and Google Trends

Satellite Night Light Datasets

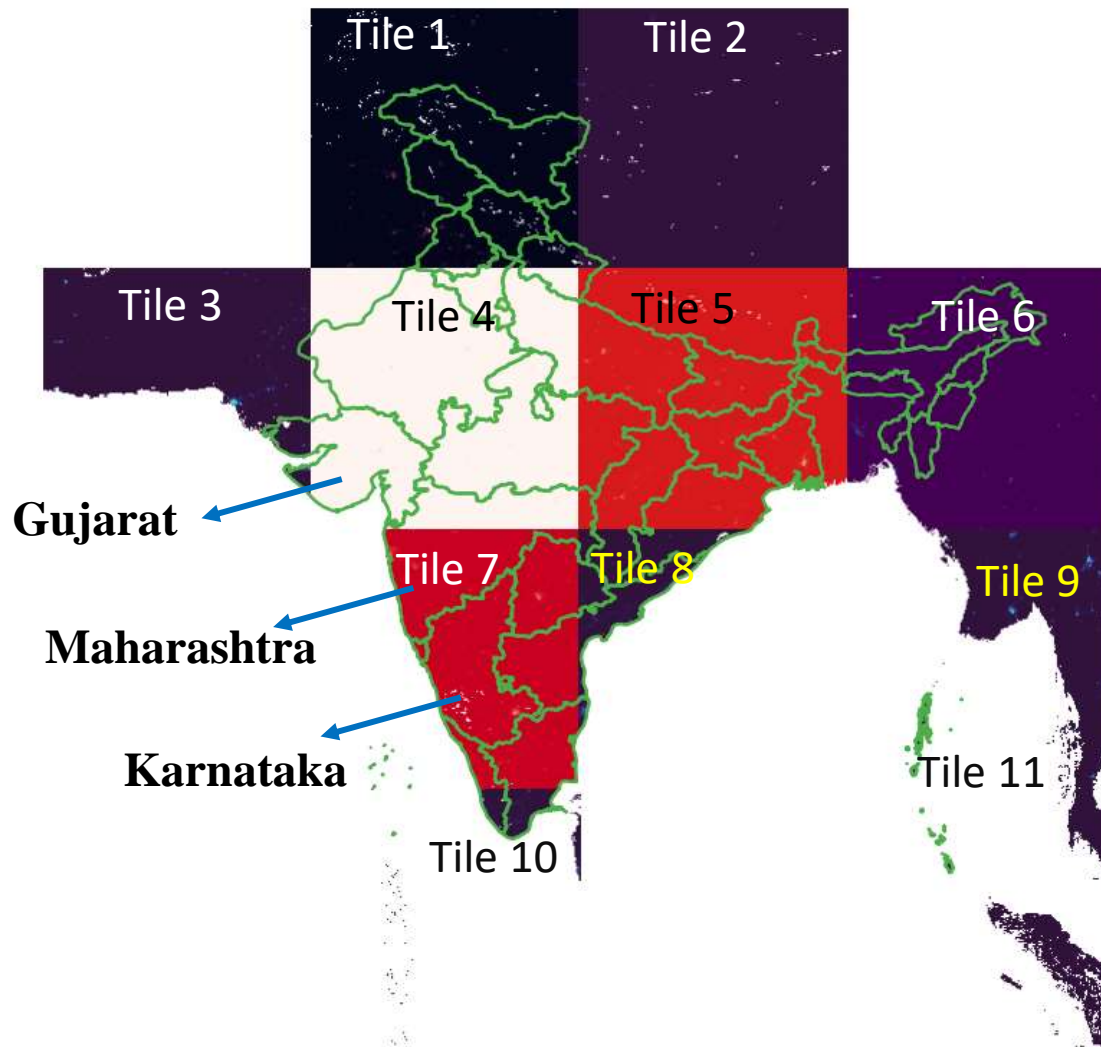
Specifications	DMSP/OLS (Old)	S-NPP VIIRS (New) 1. VIIRS V1 2. NASA: Black Marble
Time span	1992–2013	2012–present
Resolution	~1 km	~500 m
Bit depth	6-bit (0–63)	14-bit (0–16,383)
Saturation	Severe in cities	Minimal
Calibration	No	Yes
Blooming effect	Significant	Much reduced
Strength	Long historical record	High accuracy, finer details
Time span	1992–2013	2012–present

Ahmedabad City

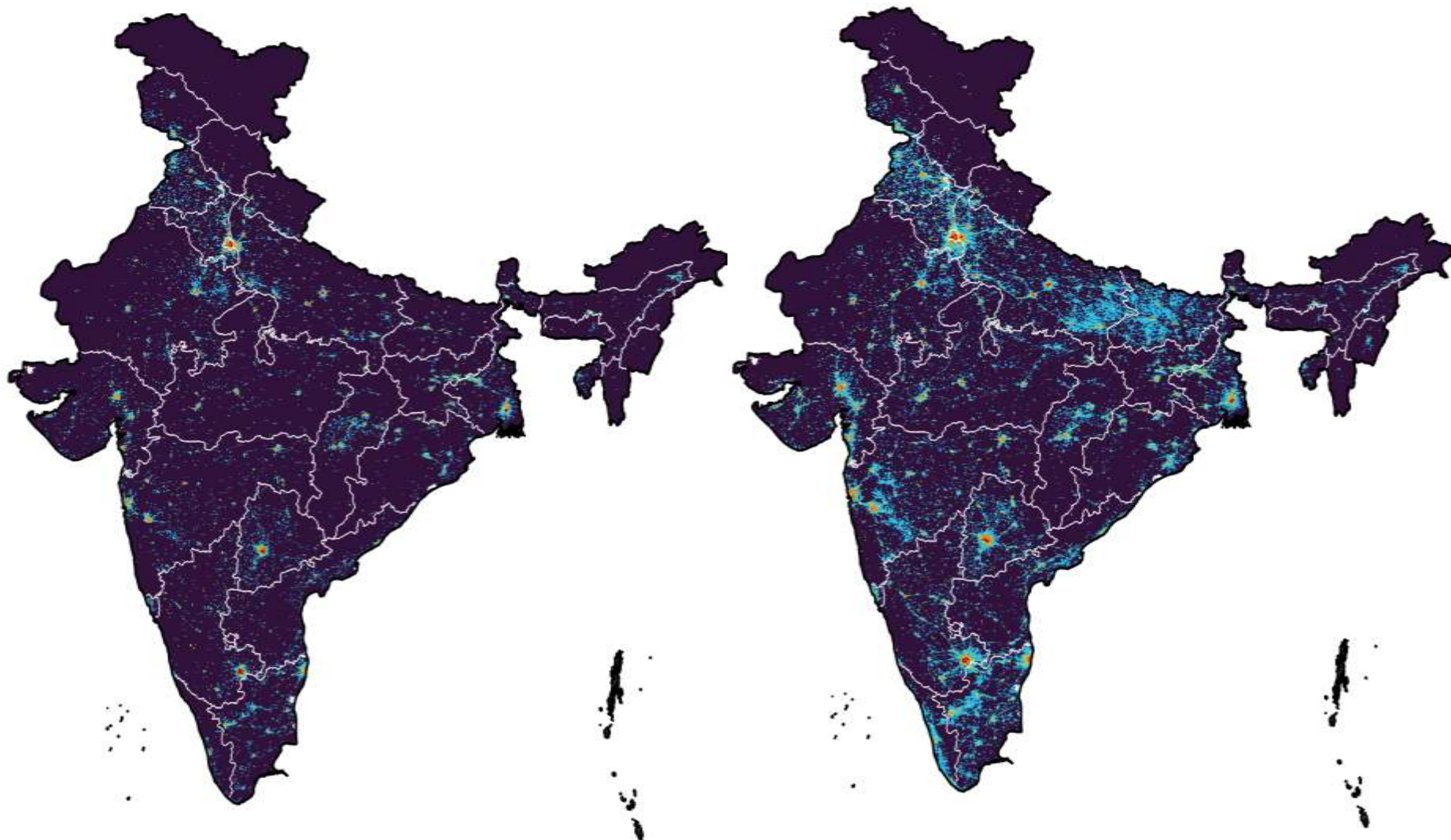


Study Area

- Need 11 tiles to cover whole India
- 1 tile = $10^0 \times 10^0 = 1113 \times 1113$ km
- States selected based on higher industrial activity and data quality



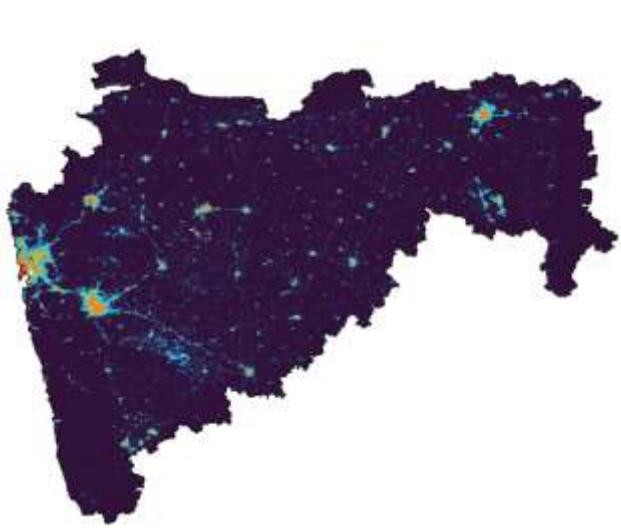
Spatio-Temporal Patterns in Night Lights



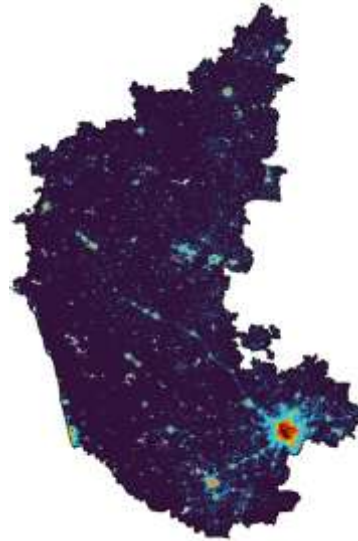
India: 2012-13Q1

India: 2024-25Q4

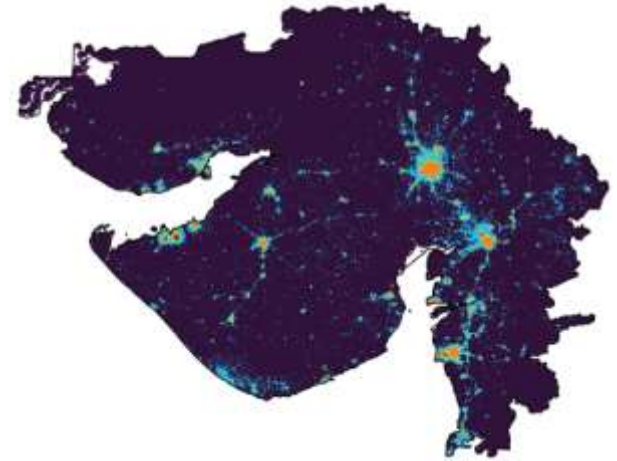
Spatio-Temporal Patterns in Night Light over States



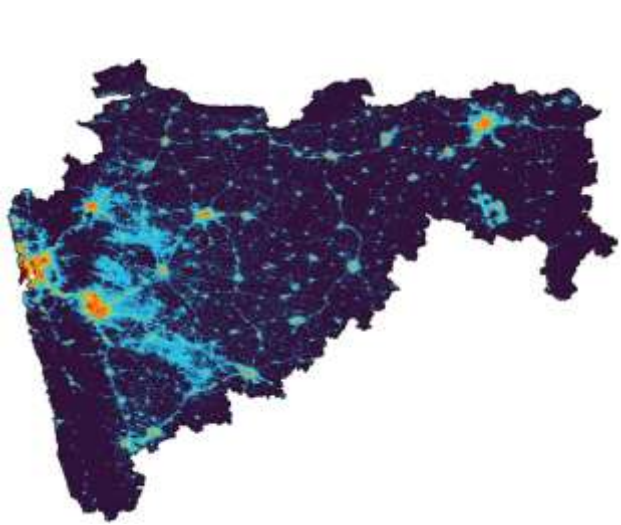
Maharashtra: 2012-13Q1



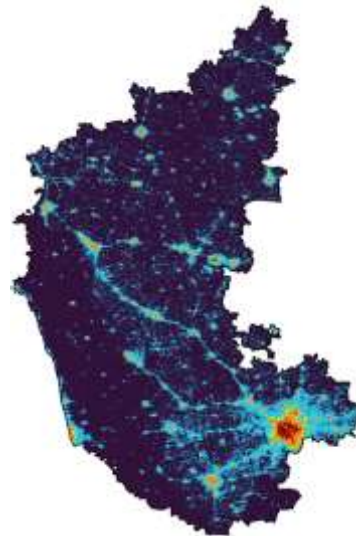
Karnataka: 2012-13Q1



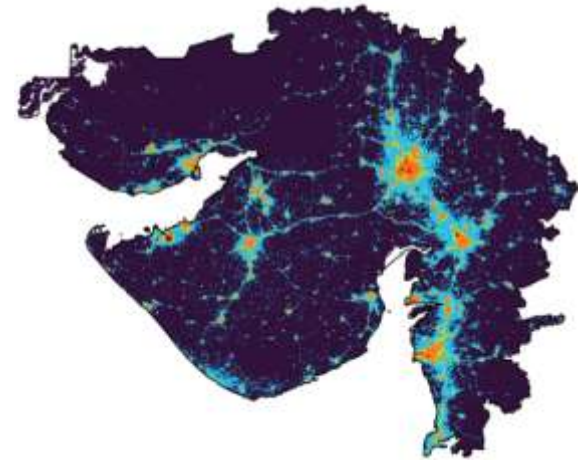
Gujarat- 2012-13Q1



Maharashtra: 2024-25Q1



Karnataka: 2024-25Q1



Gujarat- 2024-25Q1

Google Trends Data

Availability

- Publicly available since **2004**
- Updated in near real-time

Structure

- ~25 broad categories (Jobs, Finance, Travel, etc.)
- Data reported as **Search Volume Index (SVI: 0–100)**
- Relative measure, not absolute search counts

Methodological Changes

- **2011**: Transition to Google Trends platform, improved categorization
- **2016**: Expanded sampling, real-time updates, normalization changes

Sampling & Normalization

- Based on a **sample of total searches**, not full universe
- Values normalized to the peak within time/region
- Different downloads may yield slightly different values

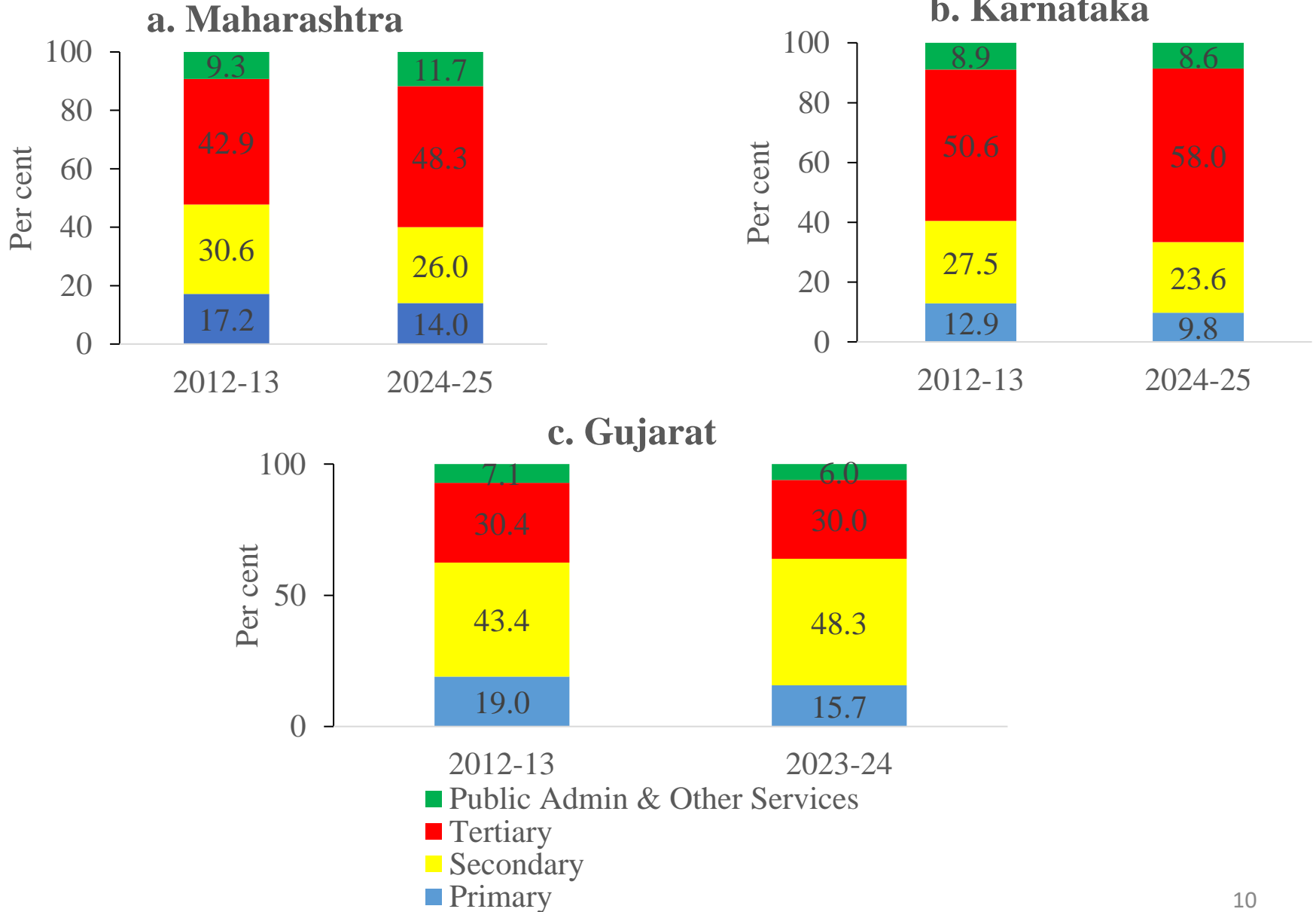
Selected Google Trend Categories and Principal Components

S.No.	Maharashtra	Karnataka	Gujarat
1	Travel	Travel	Travel
2	Sports	Jobs & Education	Shopping
3	Real Estate	Beauty & Fitness	Real Estate
4	Jobs & Education	Real Estate	Beauty & Fitness
5	Shopping	Shopping	Autos & Vehicles
6	Beauty & Fitness	Business & Industrial	Law & Government
7	Autos & Vehicles	Autos & Vehicles	Home & Garden
8	Home & Garden	Law & Government	People & Society
9	Business & Industrial	Games	Business & Industrial
10		Arts & Entertainment	Jobs & Education
11		Finance	Hobbies & Leisure
12		Computers & Electronics	
13		People & Society	
14		Online Communities	

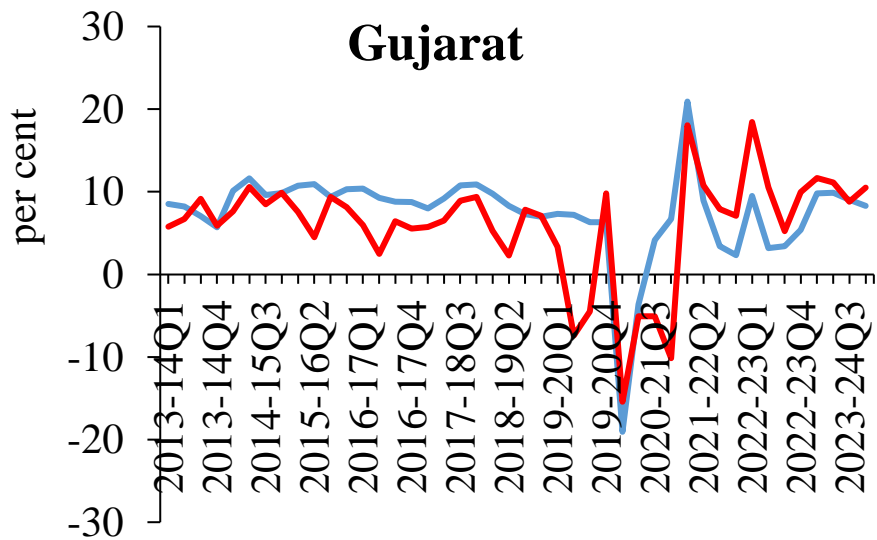
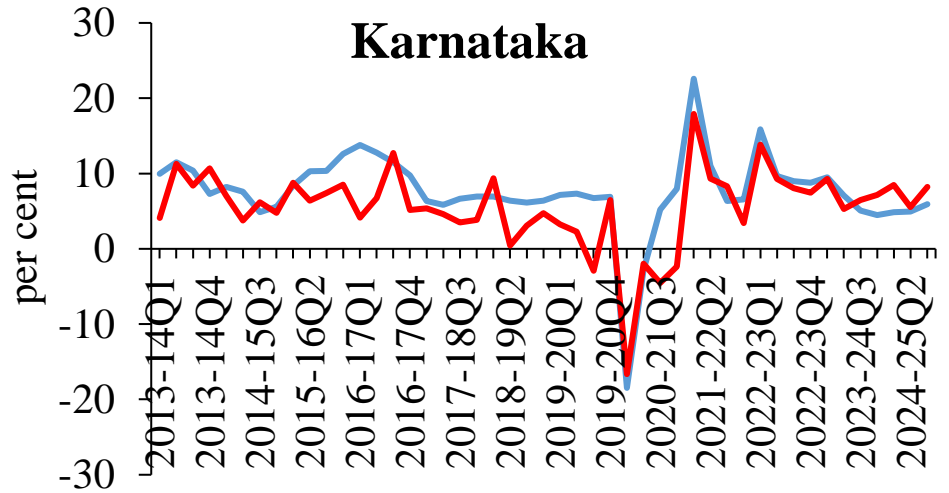
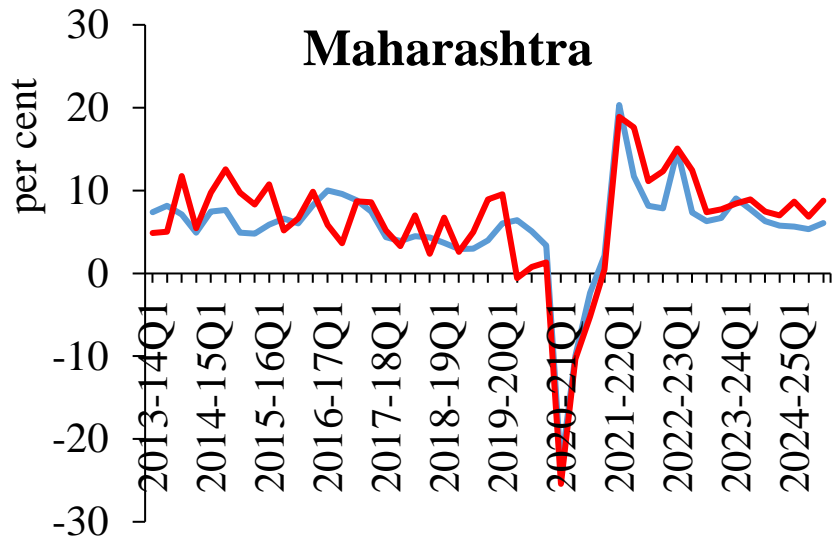
Principal Components

States	No. of Principal Components
Maharashtra	3
Karnataka	2
Gujarat	2

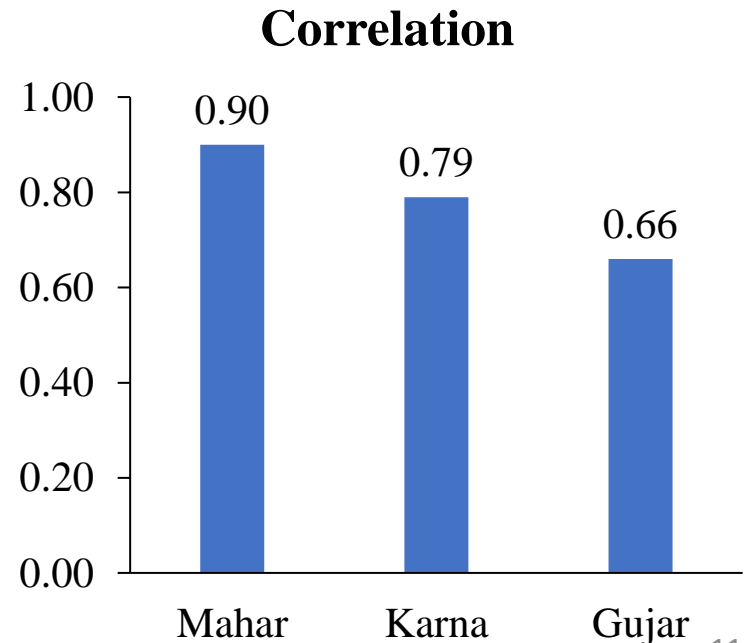
Sector-wise Share of GSVA for States



GSVA and Night Light Growth: Correlation

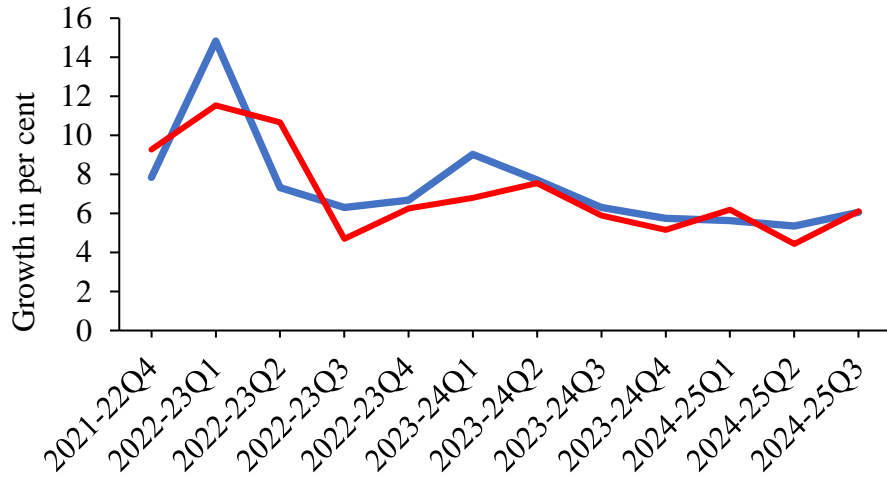


— Total GSVA Growth — Night Light Growth

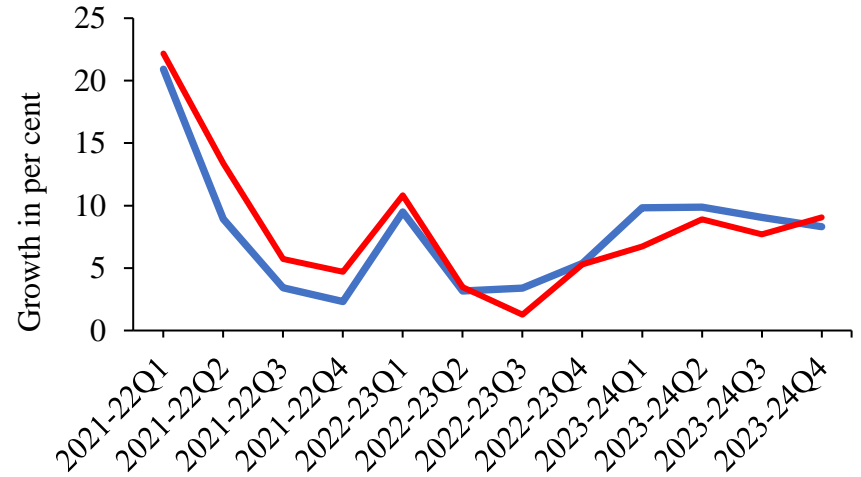


Test Data: Model Tracks Turning Points Well Across States: Actual vs. Predicted

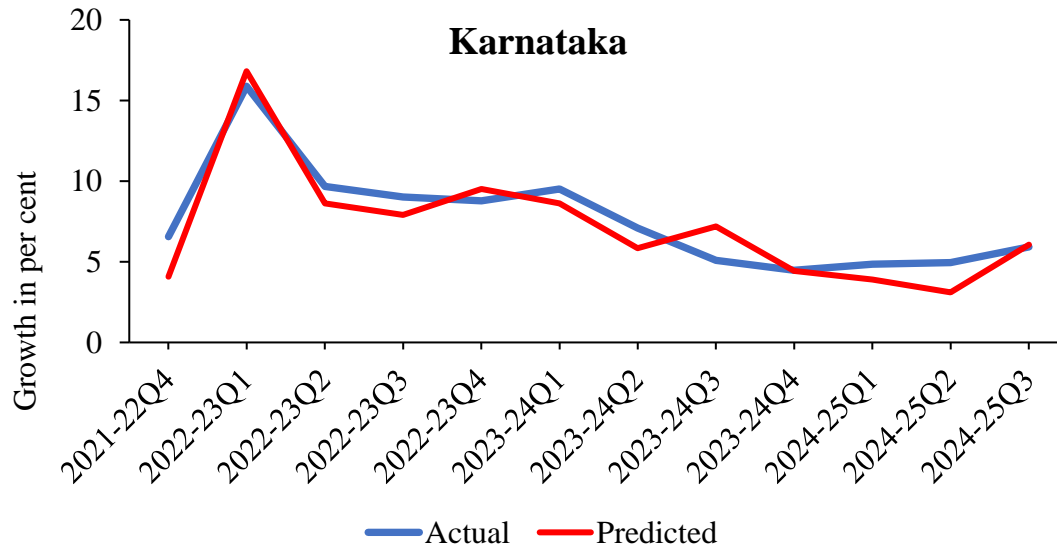
Maharashtra



Gujarat

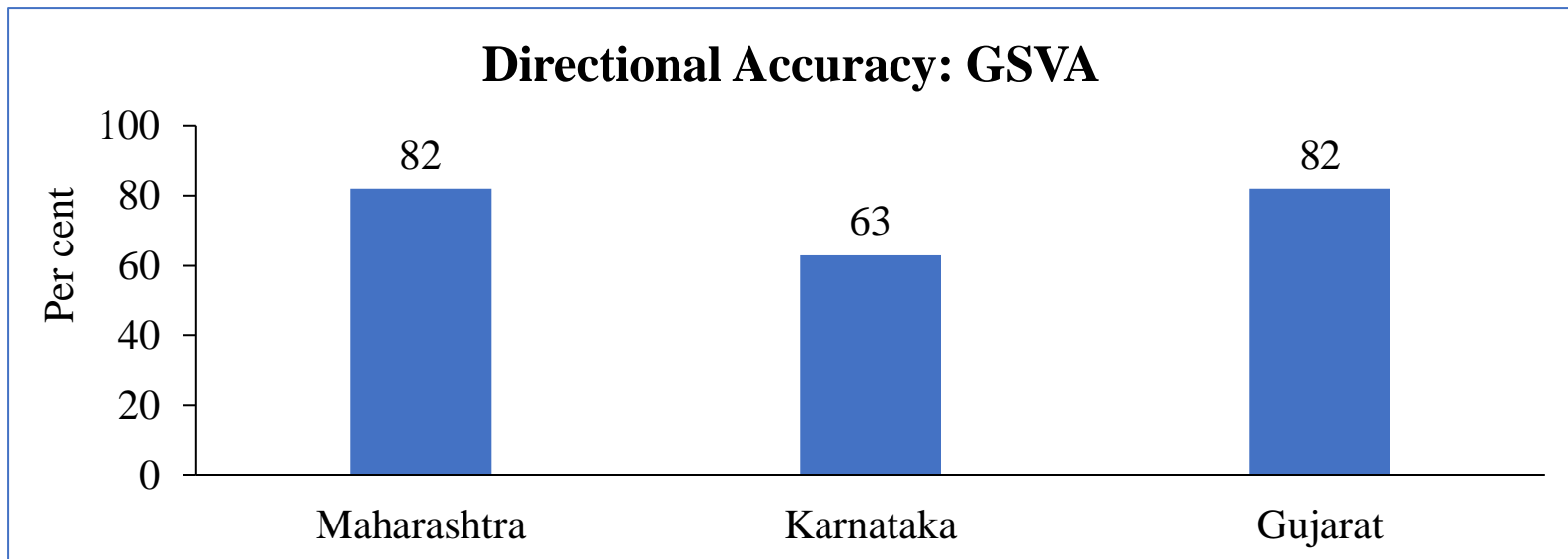
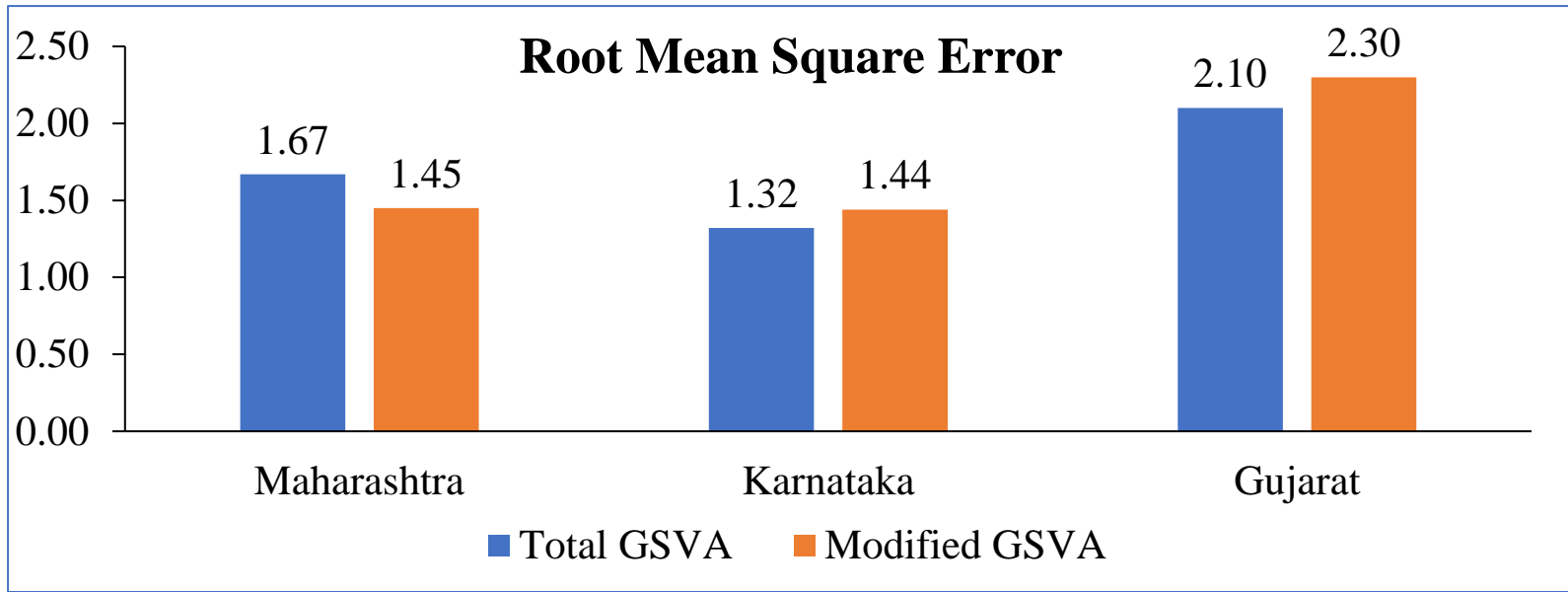


Karnataka



— Actual — Predicted

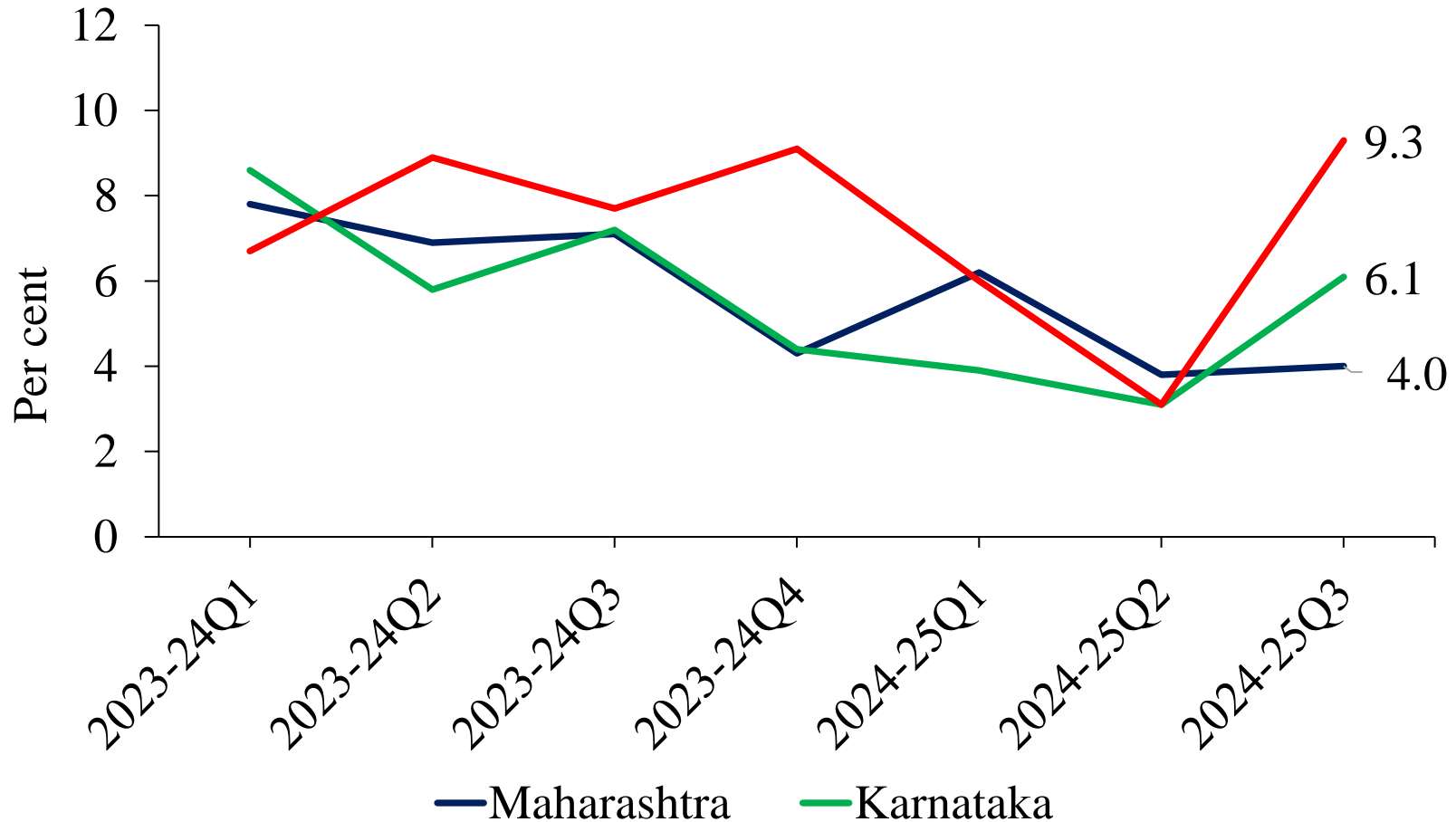
Model Performance



Modified GSVA excludes Primary, Public Administration & Other Services

Nowcasted State GSVA Growth Rates (2023–2025)

Gujarat shows robust acceleration; Karnataka stabilizes; Maharashtra faces moderation



Conclusions

- **Proof of Concept:** Demonstrated feasibility of nowcasting state GVA for three major states using non-traditional, publicly available data.
- **Scalability:** Framework can be extended to other states and South Asian and African countries where quarterly GDP unavailable
- **Novelty:** To the best of our knowledge, this is the first state-level nowcasting exercise for India using night-time lights and Google Trends.

