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COVID-19 Resilience Analysis: Are the competitive sub-national economies of India resilient?*

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May 25, 2021

Abstract

The on-going second wave of the COVID-19 pandemic in India is one of the worst that the world has seen. The country has been reeling under the devastation caused by crumbling healthcare system and lack of medical and oxygen supplies. That said, the dire situation is not uniform in all parts of the country with certain sub-national economies emerging as more resilient to the second wave. In this study, we rank the Indian sub-national economies on the basis of COVID-19 resilience index scores constructed using Bloomberg methodology. We find that the more competitive sub-national economies are less resilient to the second wave. We argue that such an anomaly rises because these economies have *"inherent vulnerabilities"* of low standard of living, ageing population and inadequate public healthcare infrastructure.

1 Introduction

The calamitous surge of the COVID-19 infections in India has made the country suffer from one of the world's worst coronavirus crises. On 8^{th} May 2021, India recorded more than 400,000 cases in a single day - a new global record. According to experts,[1] the actual number would be far higher than the official figures.

There is a lot of debate on whether India could have been more ***"resilient"*** to the second wave. The country was doing well up until February 2021 (at least in accordance with official figures, see Fig. 1). It locked down in the past year, almost crushed the first wave and then opened up. The country maintained a low death rate and returned to a sense of normalcy in winter 2020. It seemed as though India had a grip to handle the looming second wave. But then, the opposite happened and questions arose on the reasons for the country's low resilience to the second wave.

The poorly implemented vaccination drive was a major impediment to India's resilience to the second wave. Despite being the world's leading producer of vaccines, a mere 10% of India's population has been fully or partially vaccinated.[2] Fig. 2.a shows that India's total vaccines per hundred population is lower than other BRICS counterparts (except for South Africa). The vaccination diplomacy stance of the Indian government was a major contributor to such low vaccination rates. While Western nations were preoccupied with inoculating their own populations, India competed with China to be a world player in donating and exporting medical supplies and vaccine to the rest of the world (Dhume, 2021).

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[1] See Jameel (2021).

[2] Source: Our World in Data.

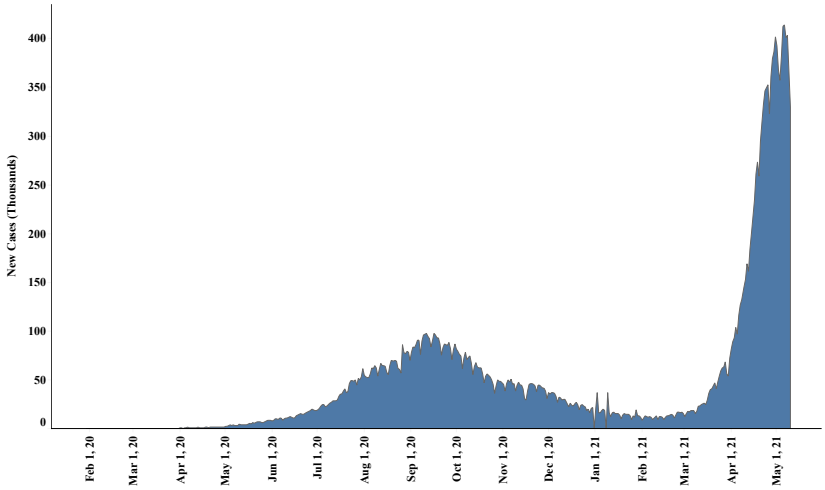
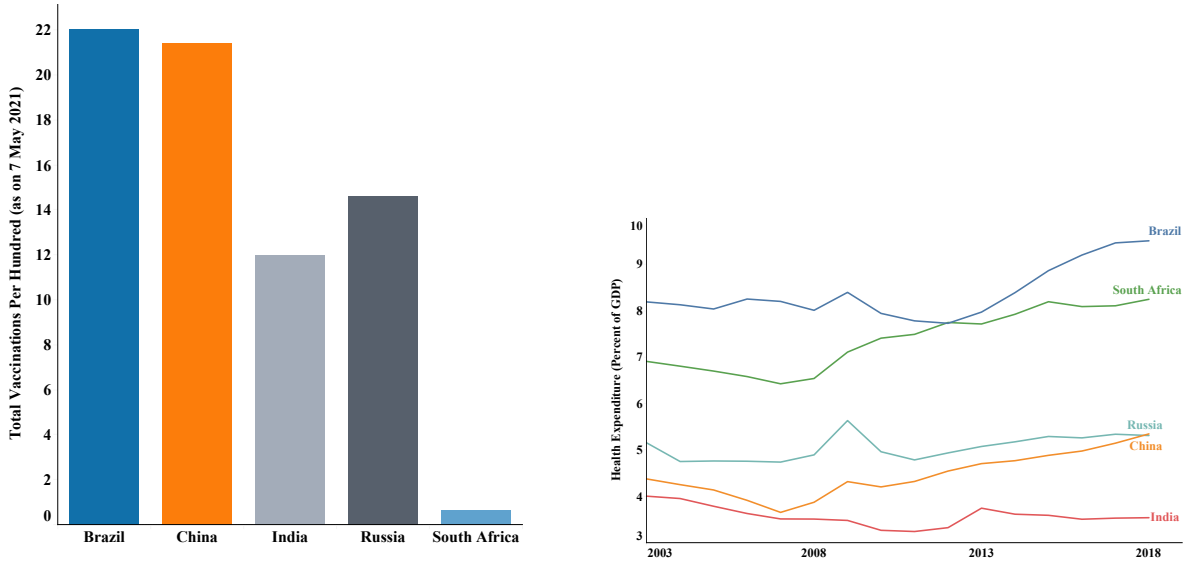


Figure 1: New COVID-19 cases in India
Source: Our world in data



(a) Vaccination rate

(b) Health expenditure

Figure 2: Vaccination rate and Healthcare Spending in BRICS nations
Source: Our World in Data and World Bank

Coupled with low vaccination rates, the tumultuous second wave of the COVID-19 infections was further fuelled by the B.1.617 variant, which has recently been declared as a "variant of concern" by the World Health Organization. Studies like Yadav et al. (2021); Edara et al. (2021) find reduced efficiency of Pfizer and Moderna vaccines against this new variant. The transmission of this new variant was also propelled by mass social gatherings, religious events and election rallies with negligible social distancing (Slater and Masih, 2021).

The infections have spread so fast across the country that it has led crippled the health infrastructure. In contrast to the first wave where the infections were limited to urban regions, the second wave has witnessed the disease infecting even remote rural areas. There is an acute shortage of medicine supply which has forced people turn to the black market to purchase the required COVID-19 drugs and oxygen

supplies at exorbitant prices. The situation is so dire that the sick have been left stranded in interminable lines at hospital gates or at home. The devastation has more or less exposed the neglect of India's public healthcare system. Even patients who can afford the private hospitals are unable to receive the required treatment due to capacity shortages in the private hospitals. In short, India's resilience to the second COVID-19 wave has also been mired by its meagre spending on healthcare. India's healthcare spending has been around 3.6% of GDP for the past six years which is the lowest among the BRICS countries (see Fig. 2.b).

Although the national level indicators point to a low resilience to the second wave of COVID-19 infections, the picture is varied for different sub-national economies. For example, Delhi and Maharashtra faced the heaviest burden of the second wave with high infection rates and fatalities. On the other hand, North-eastern sub-national economies such as Arunachal Pradesh and Assam have remained largely resilient to the COVID-19 second wave. In light of this regional heterogeneity, this study constructs a COVID-19 resilience ranking for each Indian sub-national economy using the Bloomberg COVID-19 resilience index methodology. We also compare the COVID-19 resilience ranking with the competitiveness ranking of the sub-national economies by the Asia Competitiveness Institute (ACI). Interestingly, we find the competitive sub-national economies to be less resilient to the second wave of the COVID-19 pandemic.

The remainder of the paper is organised as follows. Section 2 discusses the methodology and the data used in constructing the COVID-19 resilience ranking. Section 3 analyses the COVID-19 resilience ranking *vis-à-vis* the ACI competitiveness ranking of the Indian sub-national economies. Section 4 delves deeper into the potential reasons responsible for making the more competitive sub-national economies more vulnerable to COVID-19. Section 5 concludes with policy recommendations.

2 Data and Methodology

Our methodology largely follows the Bloomberg methodology, which assesses how well 53 of the largest countries around the world are dealing with the COVID-19 pandemic. The COVID Resilience Rankings are calculated using a set of indicators related to COVID-19 and quality of life.[3] The 'max-min' methodology is used to score 10 indicators on a scale of 0-100, with 0 indicating the worst performance and 100 the best. Their final scores are based on the average of the performance across all the indicators weighted equally.

Our analysis broadly is in line with the Bloomberg methodology, where the indicators used to measure the COVID-19 status are largely identical. However, our study differs from it with respect to two criteria: a) our focus is on assessing the sub-national level COVID-19 resilience for India; and b) we use sub-national level specific quality of life indicators based on data availability. The time period taken into consideration is from April to May 2021, which covers the onset of the second COVID-19 wave in India. The complete list of indicators used is presented in Table 1 and the list of our sub-national level COVID-19 resilience rankings is presented in Appendix A.

Table 1: List of COVID-19 Resilience Ranking Indicators

Indicator	Definition	Source
1-Month Confirmed Cases per 100000	Confirmed COVID-19 cases per 100000 people from 4 April to 4 May 2021	CEIC
1-Month Fatality Rate	COVID-19 deaths as a proportion of confirmed cases for the period 4 April to 4 May 2021	CEIC
Total Deaths per 1 Million	Total COVID-19 deaths per one million people since the start of the pandemic until 4 May 2021	CEIC
Positive Test Rate	Number of confirmed COVID-19 cases as a share of total tests administered on 4 May 2021	CEIC Database & COVID19 India API
Doses per 100 persons	Total number of vaccination doses administered per 100 people	Ministry of Health and Family Welfare, Government of India
Mobility 30-day average	Movement of people to retail, recreation and workplaces compared to pre-pandemic baseline	Google COVID-19 Community Mobility Reports
Gross State Domestic Product Growth Rate for 2021	The projected nominal growth rate for 2021 [4]	State Bank of India Ecowrap, Issue No.83 for Financial Year 2021
Adequacy of Hospital	Population per 10000 people served per public hospital	ACI 2021 India Competitiveness Study based on National Health Profile 2019
Population per Hospital Bed	Population per 10000 people served per public hospital bed	ACI 2021 India Competitiveness Study based on National Health Profile 2019
Population per Medical Personnel	Population per 10000 people served per public hospital medical personnel	ACI 2021 India Competitiveness Study based on National Health Profile 2019

[3] For more details about the methodology refer to Chang and Hong (2020).

The sub-national economies of Dadra and Nagar Haveli, Daman and Diu and Lakshadweep are excluded from the analysis due to data constraint. For Jammu and Kashmir, the mobility data provided by the Google COVID-19 Community Mobility Reports could not be used as the the region was going through prolonged periods of internet blackouts, curfews and travel restrictions (Ellis-Peterson, 2020) during baseline time period considered for the mobility data. To avoid bias in the data, we dropped Jammu and Kashmir from the analysis as well.

In Fig. 3, the scores for the indicators directly related to the impact of COVID-19, such as 1-month confirmed cases per 100000, 1-month fatality rate, total deaths per one million, positive test rate and adequacy of hospitals are presented. The lower the score, the darker is the colour, indicating bad performance. Largely, it can be seen that Delhi, Goa, Chhattisgarh, Chandigarh and Maharashtra have the worst performance across the board. The virus has been multiplying at an exponential rate, overwhelming the healthcare infrastructure and the people of Maharashtra, Delhi and Chhattisgarh (Agarwal, 2021). A higher number of persons as a proportion of the population have also lost their lives due to COVID-19 in Delhi, Goa, Maharashtra and Puducherry as compared to the other sub-national economies. The overall high concentration of cases and deaths in these economies maybe attributed to the fact that they are largely urbanised and have a very high population density.

In terms of the recent fatality rate, Punjab, Jharkhand, Manipur and Himachal Pradesh are the worst impacted. The positive test rate, which is measured as the number of confirmed cases over the number of tests administered on a given date, is the highest for Nagaland, Goa, West Bengal and Karnataka. Lastly, the public healthcare infrastructure (adequacy of hospital) is the weakest in Andhra Pradesh, Madhya Pradesh, Maharashtra, Delhi and Gujarat leading to these economies being crippled by the second COVID-19 wave. Instances of shortages of critical-care bed and oxygen, delay in testing and turning away of critically ill patients by hospitals are testaments to the under equipped and inadequate healthcare infrastructure in the country (Sharma, 2021).

Fig. 4 focuses on the scores pertaining to vaccine doses per 100 persons, expected economic growth rate at sub-national level for 2021 and the movement of people to and fro retail, recreation and work places. The higher the score, the darker is the colour, indicating good performance. The Northern-eastern sub-national economies of Tripura, Sikkim and Himachal Pradesh and the federal territory of Andaman and Nicobar Islands have the highest number of vaccine doses administered per 100 people, which maybe attributed to the low population density. On the other hand, Uttar Pradesh, Bihar, Andhra Pradesh, Tamil Nadu and Assam seem to be performing poorly in this regard. The expected economic growth rate for the financial year of 2021 is the highest for Nagaland and Uttar Pradesh and the lowest for Maharashtra and Himachal Pradesh. Lastly, the average mobility for the month of April 2021 and the beginning of May 2021 seemed to be returning to that of the baseline period for Andaman and Nicobar Islands, Sikkim and Tripura, the sub-national economies which are not badly affected by the second COVID-19 wave as seen in Fig. 3. On the contrary, Maharashtra and Delhi, which are among the worst affected sub-national economies, witness very restricted mobility during this period.

[4]Proxy for sub-national economies with missing data is done using the average growth rate of the other sub-national economies.

Sub-National Economies	1-Month Confirmed Cases per 100000	1-Month Fatality Rate	Total Deaths per 1 Million	Positive Test Rate	Adequacy of Hospital
Andaman & Nicobar Islands	92.2	60.0	81.0	96.7	97.1
Andhra Pradesh	91.7	83.5	91.2	71.7	0.0
Arunachal Pradesh	97.6	98.4	97.5	94.8	100.0
Assam	97.5	67.8	97.0	89.6	89.5
Bihar	95.1	75.1	98.9	81.2	50.5
Chandigarh	47.7	62.3	52.9	46.7	37.9
Chhattisgarh	51.9	30.7	66.5	49.1	34.4
Delhi	0.0	33.6	0.0	54.7	15.3
Goa	6.7	29.4	2.5	17.5	85.7
Gujarat	86.6	40.8	88.9	87.5	25.3
Haryana	73.0	68.1	83.5	59.3	82.1
Himachal Pradesh	81.2	25.2	76.9	71.5	99.1
Jharkhand	90.4	9.2	92.5	65.9	69.3
Karnataka	67.8	71.3	74.4	44.4	91.8
Kerala	44.1	97.9	83.1	67.6	90.2
Madhya Pradesh	89.2	67.6	93.5	67.6	14.3
Maharashtra	47.7	55.1	37.3	63.4	15.5
Manipur	98.8	10.2	86.9	75.5	50.2
Meghalaya	98.6	45.9	95.7	84.1	92.5
Mizoram	96.4	89.1	100.0	95.1	96.7
Nagaland	98.2	37.9	94.6	0.0	76.0
Odisha	91.9	100.0	96.4	62.9	90.9
Puducherry	53.8	56.2	38.5	81.9	50.7
Punjab	84.6	0.0	66.0	84.9	81.4
Rajasthan	87.8	69.6	94.8	69.5	89.9
Sikkim	89.8	64.8	75.5	100.0	93.7
Tamil Nadu	86.9	75.1	81.0	74.9	70.7
Telangana	87.3	75.8	94.0	86.3	81.8
Tripura	100.0	87.0	90.3	96.4	90.7
Uttar Pradesh	90.8	67.0	94.9	77.0	79.1
Uttarakhand	72.0	27.7	72.8	76.4	91.2
West Bengal	91.6	79.2	88.3	41.4	71.6

Figure 3: COVID-19 Indicators at the Sub-National Level
Source: CEIC, COVID19 India API, Authors' own calculation

3 Have the competitive sub-national economies of India proven to be resilient to COVID-19?

At ACI, we publish the sub-national level competitiveness rankings and scores for India annually.[5] ACI classifies the sub-national economies of India into Top, Middle and Bottom based on the competitiveness rankings. Analogously, for the COVID-19 Resilience rankings, the first 10 sub-national economies constitute the Top group, the next 13 form the Middle group and the last nine form the Bottom group (see Appendix A).

In Fig. 5, the left axis represents the Top, Middle and Bottom groups for the competitiveness ranking and the right axis represents the same groups for the COVID-19 resilience rankings. The 'flows' indicate the change in a given sub-national economy's competitiveness ranking *vis-à-vis* its COVID-19 resilience ranking. Some very interesting inferences can be drawn from Fig. 5. Only a small fraction of the Top competitive sub-national economies prove to be among the Top COVID-19 resilient economies. A majority of the Top competitive economies are extremely vulnerable to the COVID-19 pandemic as indicated by the rank flow from the Top competitive to the Bottom resilience. For the Middle competitive economies, most of them continue to be in the Middle COVID-19 resilience category. Another interesting trend can be seen in the case of the Bottom competitive economies, most of which prove to be highly resilient to COVID-19 and move to the Top resilience and Middle resilience groups.

[5] For more details about the methodology refer to Tan et al. (2020).

Sub-National Economies	Vaccine Doses per 100 Persons	Gross State Domestic Product Growth Rate for 2021	Mobility 30-Day Average
Andaman & Nicobar Islands	82.7	38.4	100.0
Andhra Pradesh	6.8	38.4	47.6
Arunachal Pradesh	36.6	38.4	40.9
Assam	8.3	38.4	49.7
Bihar	0.8	50.0	48.0
Chandigarh	50.3	38.4	26.7
Chhattisgarh	50.2	36.4	0.0
Delhi	46.6	38.4	6.8
Goa	70.5	38.4	34.5
Gujarat	50.0	31.8	23.0
Haryana	29.4	18.2	39.7
Himachal Pradesh	75.8	4.5	45.5
Jharkhand	9.7	13.6	33.2
Karnataka	33.9	54.5	21.1
Kerala	63.6	9.1	43.4
Madhya Pradesh	15.7	50.0	6.9
Maharashtra	28.4	0.0	1.2
Manipur	12.2	38.4	36.2
Meghalaya	11.3	38.4	45.1
Mizoram	57.1	38.4	46.7
Nagaland	20.2	100.0	37.6
Odisha	27.5	18.2	43.5
Puducherry	29.2	38.4	41.0
Punjab	22.9	54.5	39.6
Rajasthan	42.2	9.1	26.8
Sikkim	99.7	38.4	57.4
Tamil Nadu	7.8	50.0	42.1
Telangana	27.9	31.8	28.5
Tripura	100.0	38.4	50.9
Uttar Pradesh	0.0	95.5	34.9
Uttarakhand	48.4	38.4	47.6
West Bengal	21.6	63.6	41.4

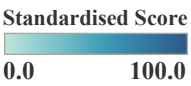


Figure 4: Vaccination Doses, Future Growth Expectation and Mobility at the Sub-National Level
Source:Ministry of Health and Family Welfare Government of India, Google COVID-19 Community Mobility Reports, State Bank of India, Authors' own calculation

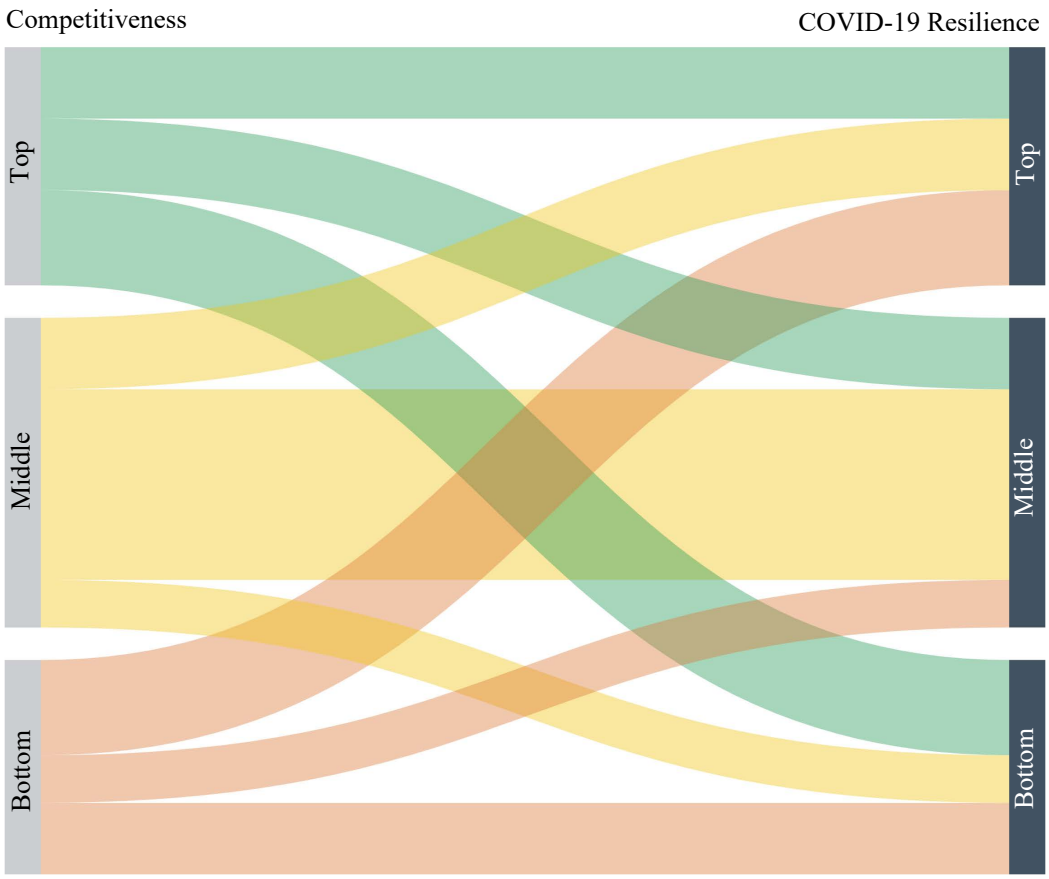


Figure 5: Competitiveness Vs. COVID-19 Resilience for Top, Middle and Bottom Sub-National Economies

Source:Authors' own calculation

To get a microscopic understanding of this anomalous finding in which majority of the Top competitive sub-national economies are least resilient to the pandemic and vice-versa for the Bottom competitive economies, we focus on Fig. 6. Since our competitiveness ranking analysis had 36 sub-national economies and the COVID-19 resilience ranking analysis has 32 economies, we plot a vertical and a horizontal line at the 18^{th} and the 16^{th} ranks respectively to mark the midpoints of both the rankings in order to bifurcate the economies into well performing and poor performing groups.

More competitive and more COVID-19 resilient: The top-right region of Fig. 6 showcases the sub-national economies which are highly competitive and also resilient to the COVID-19 pandemic. The North-eastern economies of Sikkim and Arunachal Pradesh, the Southern economies of Tamil Nadu, Kerala and Telangana and the Northern economies of Uttar Pradesh and Rajasthan fall within this category. The healthcare infrastructure in these sub-national economies is largely better than that of the others. We would like to highlight the case of Kerala which is one of the few sub-national economies that is the most competitive and also the most resilient. Its proactive response to the pandemic can be attributed to its successful handling of three crises during 2018 and 2019 and its robust healthcare infrastructure which provides free access to all (Chathukulam and Tharamangalam, 2021).

Figure 6: Competitiveness Vs. COVID-19 Resilience Rankings at the Sub-National Level
Source:Authors' own calculation

Less competitive and more COVID-19 resilient: The top-left region, which consist of the least competitive but most resilient economies, is dominated by the North-eastern and Eastern economies such as Tripura, Mizoram, Assam, Meghalaya, Andaman and Nicobar Islands and Odisha.

Less competitive and less COVID-19 resilient: The bottom-left region of Fig. 6 features the economies which are the least competitive and also the most vulnerable to the pandemic. The Eastern economies of Jharkhand, Bihar and Chhattisgarh and the Northern economies of Uttarakhand and Punjab are a part of the group.

More competitive and less COVID-19 resilient: Lastly, the bottom-right region comprises the economies which although highly competitive are very vulnerable to the pandemic. The Western economies - Maharashtra, Gujarat and Goa, the Northern economies - Delhi, Haryana and Chandigarh and the Southern economies - Karnataka and Andhra Pradesh form a part of this group. Maharashtra and Karnataka accounted for the highest number of active COVID-19 cases and deaths at the time of the study while Delhi had the second highest number of deaths despite having a moderate number of active cases. This indicates that although these Top competitive sub-national economies have very well-established economic systems and infrastructure in place, there exist certain vulnerabilities in their systems because of which they were under-equipped and unable to respond to the massive surge of cases

in the second wave.

4 Which vulnerabilities cause the competitiveness-resilience anomaly?

According to the sub-national level competitiveness analysis conducted by ACI annually, most competitiveness economies face a trade-off. The analysis that includes four environments; (1) Macroeconomic Stability, (2) Government and Institutional Setting, (3) Financial, Businesses and Manpower Conditions and (4) Quality of Life and Infrastructure Development, finds the Top competitive sub-national economies to perform well across the first three environments but fall short in the environment of Quality of Life and Infrastructure Development. The Top economies are found to provide ample economic growth opportunities that attract businesses and manpower while not addressing the concomitant quality of life externalities.

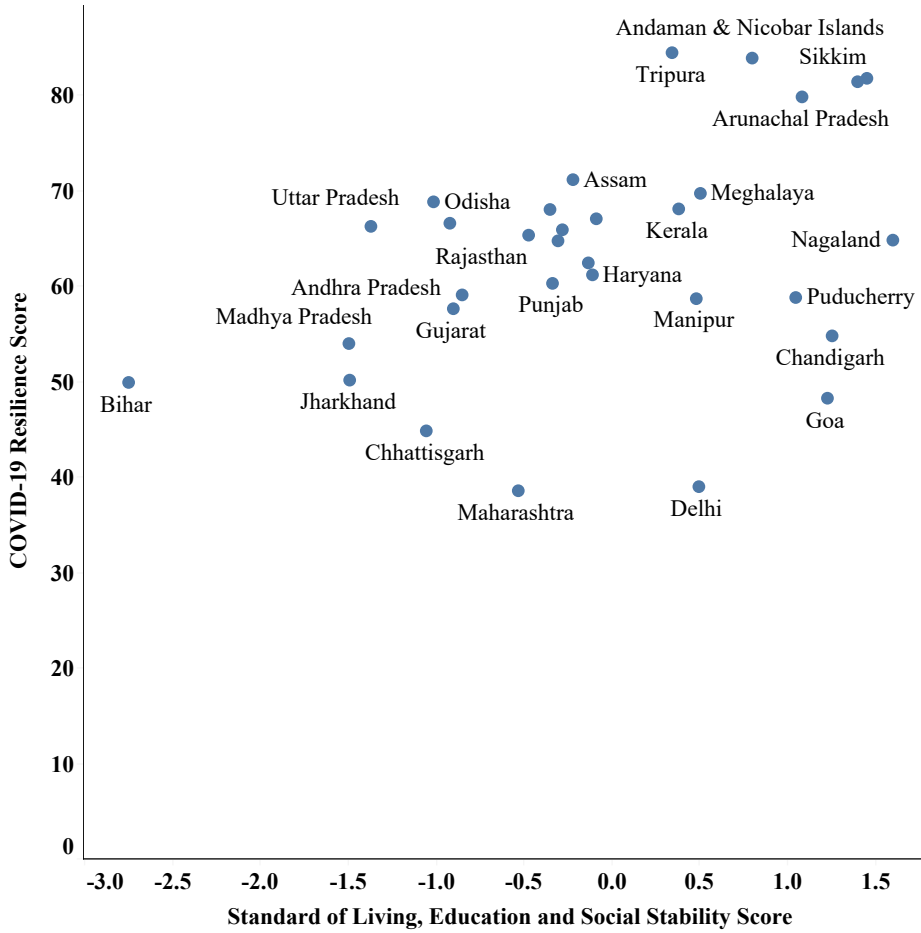


Figure 7: COVID-19 Resilience and Standard of Living, Education and Social Stability
Note:The names of some sub-national economies are not shown in the graph but are available on request
Source:Authors' own calculation

To understand how an external shock such as the second wave of the COVID-19 pandemic brought the inherent vulnerabilities of the Top competitive sub-national economies to the forefront, we delved deeper into the three sub-environments pertaining to Quality of Life and Infrastructure Development;

(1) Physical Infrastructure, (2) Technological Infrastructure and (3) Standard of Living, Education and Social Stability.

We identified an interesting trend with respect to the sub-environment of Standard of Living, Education and Social Stability (see Fig. 7). Sub-national economies with a better performance in terms of standard of living, showed higher resilience to the second COVID-19 wave. On probing further into the indicators within this sub-environment, we recognised that the sub-national economies with a higher resilience score also have a favourable ageing profile, old age dependency ratio and better healthcare infrastructure. On the contrary, the Top competitive sub-national economies have a larger number of people over 60 years of age (who are more vulnerable to the pandemic) and also a lack of healthcare infrastructure to serve their densely populated cities. This is evident by the fact that in April 2021 the country's hospitals started running out of oxygen, beds and requisite drugs, with the national capital, Delhi, having less than 100 critical care beds at one point of time (Bhardwaj and Kalra, 2021).

Healthcare infrastructure inadequacy of the Top competitive economies is evident from the bottom-right quadrant of Fig. 8 where darker colour represents inadequacy of public hospitals.[6] The sub-national economies that are more competitive and less resilient to COVID-19 suffer from public hospital inadequacy as compared to the more resilient and less competitive sub-national economies (top-left quadrant).

5 Policy implications and concluding remarks

The inherent vulnerabilities in the fundamentals of the most competitive sub-national economies of India have been brought to the forefront in the context of the second COVID-19 wave. COVID-19 has been highly concentrated in metropolitan cities with high population density, elderly population and migration rate and with lack of basic amenities (Pandey et al., 2021). These cities include Mumbai, Thane and Nagpur from Maharashtra, Chennai from Tamil Nadu, Kolkata from West Bengal, Hyderabad from Telangana, Thiruvananthapuram from Kerala, Bengaluru from Karnataka, Gurugram and Faridabad from Haryana and Delhi. The findings from our study also echo this narrative as we find the Top competitive sub-national economies (which largely comprise the afore-mentioned metropolitan cities) to be less resilient to COVID-19 second wave. Our analysis leads to an intriguing policy implication that the Top competitive sub-national economies could have weathered the COVID-19 second wave with more resilience had they addressed the challenges of healthcare infrastructure inadequacy and standard of living externalities during the pre-pandemic period.

Given the havoc caused by the COVID-19 second wave, the possible solutions advocated by experts include imposing nation wide lockdown, enhancing vaccine production capacity and pursuing an efficient and fastidious vaccination drive as possible solutions to contain the second wave. The Indian SARS-CoV-2 Genetics Consortium, forum of scientific advisers established by the central government to detect genomic variants of the coronavirus, had issued warnings about the new virus variant in early March 2021 itself (Ghoshal and Das, 2021). However, the central government failed to respond proactively. This lackadaisical attitude exacerbated the situation throughout the country, eventually leading the sub-national level governments to implement fragmented lockdowns. As the country continues to weather the crisis, the advice of the top health experts, including Dr Anthony Fauci's to impose nationwide lockdown, expedite the inoculation drive and construct a large number of makeshift hospitals should be taken very seriously (Jha, 2021). Policymakers should pay heed to the concerns raised by the experts

[6] For our study, we focused only on the public healthcare infrastructure as there is no official source providing the data on the private healthcare system.

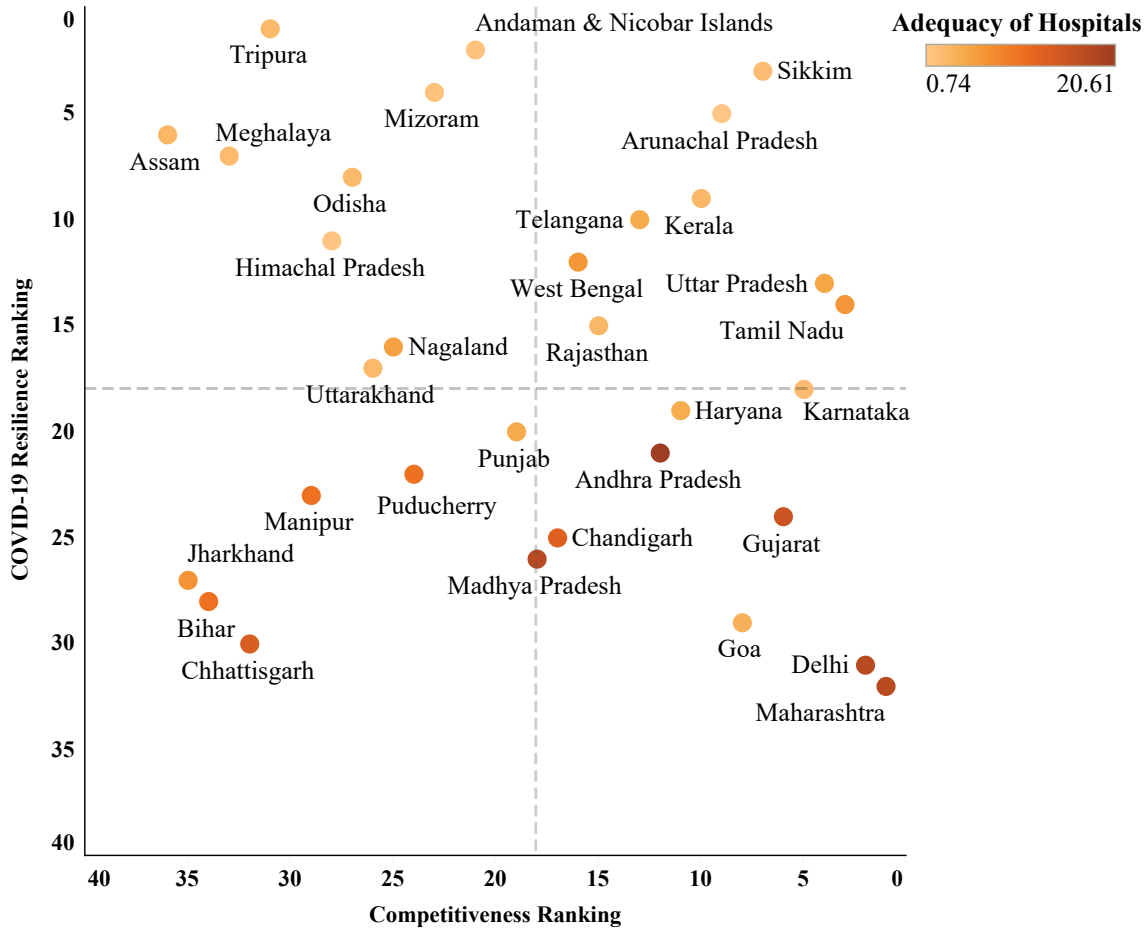


Figure 8: Competitiveness Vs. COVID-19 Resilience Rankings with respect to Adequacy of Hospitals
Source:Authors' own calculation

and take the required steps to tackle these extraordinary challenges. Without a science-led approach from the government (both central and sub-national level), the successful containment of the COVID-19 pandemic will continue to be a looming challenge for India.

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A Appendix

Table A.1: COVID-19 Resilience Ranking for the Sub-National Economies of India

Sub-National Economies of India	**COVID-19 Resilience Ranking**	**COVID-19 Resilience Classification**
Tripura	1	
Andaman & Nicobar Islands	2	
Sikkim	3	
Mizoram	4	
Arunachal Pradesh	5	Top
Assam	6	
Meghalaya	7	
Odisha	8	
Kerala	9	
Telangana	10	
Himachal Pradesh	11	
West Bengal	12	
Uttar Pradesh	13	
Tamil Nadu	14	
Rajasthan	15	
Nagaland	16	
Uttarakhand	17	Middle
Karnataka	18	
Haryana	19	
Punjab	20	
Andhra Pradesh	21	
Puducherry	22	
Manipur	23	
Gujarat	24	
Chandigarh	25	
Madhya Pradesh	26	
Jharkhand	27	
Bihar	28	Bottom
Goa	29	
Chhattisgarh	30	
Delhi	31	
Maharashtra	32	