

Understanding societal responses to policies undertaken during emergencies: Lessons from COVID-19's Second Wave in Maharashtra

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Abstract

Maharashtra, one of India's wealthiest and most populous states, was among the worst hit by the second wave of COVID-19 in 2021. The state government was responsible for enacting emergency policies to curb the transmission and reduce the economic shock of the virus. This paper investigates the societal response to such restrictions using alternative data. It employs anonymized smartphone location data to furnish a sense of movement between state districts as well as satellite imagery to understand changes in industrial economic activity. Our analysis of this data shows how residents and industries reacted to rapidly changing directives enforced by the government. It also highlights the efficacy of utilising such high-frequency datasets to provide officials with the impact of policies made during an emergency. This paper finds that the mobility of people changed in anticipation of a policy, not when the policy itself was enforced whereas industrial activity required a one to two-week lag to react to policy changes.

Introduction

Maharashtra, one of the wealthiest states in India, was the worst hit by the COVID-19 pandemic, alongside other economic powerhouses such as Kerala and Karnataka (Kar et.al., 2021). The state was ill-prepared to handle the emergency, with haphazard policies undertaken without a solid evidence base as well as weak health infrastructure that was unable to provide a systematic response to the outbreak (Kodge, 2021). As a result, it became a hotbed for the disease, registering nearly 140,000 COVID-19 deaths since the start of the pandemic.

India cannot afford Maharashtra being ill-prepared for future disasters due to its economic and social importance. The state contributed around 14.2% of India's GDP in 2021-22 (Maharashtra Economic Survey 2021-22) in addition to housing close to 112 million residents (9.3% of India's population) as per Census 2011, making it the second-most populous state with a size comparable to the current population of Mexico. Going forward, policies need to be informed through data that is readily available and accurate. However, collecting data using traditional methods (sample surveys, census, administrative data, etc.) to direct policy is difficult during an emergency due to the inherent lag present in those methods coupled with the rapidly changing nature of the situation. Hence, using alternative datasets that capture frequent, granular data could help measure the impact of policy actions, especially ones enacted during emergencies, in real-time.

To that end, this paper presents a methodology using anonymized smartphone data and satellite imagery that measures the real-time societal response to policies undertaken by the Maharashtra

government during the second wave of COVID-19. By developing this case study, we hope to highlight the potency of utilising such high-frequency datasets to provide officials with the impact of policies made during an emergency.

The rest of the paper is structured as follows: first, we outline the research objectives of the paper, followed by defining the questions to be answered. Second, we walk through the different datasets chosen and the policies analysed for this case study. Third, using the datasets, we show how the methodology was developed to understand the response of people and industry to the rapidly changing policies during the pandemic. Finally, we provide our main findings and discuss their policy implications and use in future research.

Research Objectives

This paper has a three-fold objective. First, it aims to fill a gap in research on the impact of the second wave in India. During the first wave of the pandemic, the national government imposed an India-wide lockdown on March 25, 2020, and during the entirety of the first wave, policy actions were centralised with New Delhi making decisions and the different state governments implementing the directives (FirstPost, 2020).

This structure changed during the second wave. One of the main drivers behind this could be the fact that as per India's constitution, health is primarily a state subject, meaning that state governments should be allowed to make independent decisions on COVID-19 response, rather than the central government crossing boundaries and imposing centralised lockdowns (Kar et.al, 2021).

With power being transferred back to the states, during the second wave, officials in Maharashtra decided policies for each district within the state regarding containment, testing, etc. To the best of our knowledge, there is a dearth of literature on the impact of state directives and general policies, both on inter-district movement and economic activity during this time, which this paper hopes to address using alternative data.

Second, this paper aims to chart out the movement and economic impact of COVID-19 on sectors and industrial districts wherein working remotely/from home was not an option during the pandemic. This is particularly true in Maharashtra, where services are the dominant sector, but close to 30% of the workforce is employed in industrial activity, making the state a major hub.

The Manufacturing and Construction sectors were hit hardest by COVID-19 and as a result, grew at (-)13.3 percent and (-)11.0 percent respectively, because of which overall industrial growth was estimated to be (-)10 percent in the 2021-22 financial year (Maharashtra Economic Survey 2021-22). An overview of some of the key industries in the state is provided in Table 1.

Selected Industries in Maharashtra

Industry	Geography (Districts)	Notes
Automobiles	Pune and Aurangabad	Accounted for 10.2% of total value of output (2017-18)
Food Processing	Solapur, Pune, Ahmednagar, Nashik, and Nagpur	Contribute around 13.5% of total value of output (2017-18)
Electronics	Pune	-
Textiles	Solapur, Pune, Nagpur, and Amravati	188 spinning & 36 composite textile mills in Maharashtra as well as 13 Textile Parks
Pharmaceuticals & Chemicals	Mumbai, Thane, Aurangabad, and Pune	Contribute 13.0% of total value of output (2017-18)

Source: Economic Survey of Maharashtra 2021 • Created with Datawrapper

Table 1: Selected Industries in Maharashtra

As expected, these industries are clustered in specific districts of the state that contribute vastly to the overall state gross value added (GVA). Hence, measuring inter-district movement and the economic impact on these industries because of state governments' directives is useful to understand the lags between the enacting of a policy, its impact on mobility and the closing/opening of activities taking place in these industries.

Third, this paper aims to showcase the potency of having frequent, granular data to measure the impact of policy actions, especially ones enacted during emergencies, in real-time. This can bridge the dearth of information that currently hampers data-driven decision making by government officials due to the lag in obtaining data through traditional sources. While the use of such alternative data for tracking movement and economic activity does not provide causal inferences, it does showcase the direction of travel of decisions made, which are particularly useful in making fast decisions during emergencies.

Research Questions

This paper investigates two research questions:

1. How did residents of Maharashtra's districts react to policy directives curbing their movement during the second wave of COVID-19?
2. What was the impact on general industrial activity (labour-intensive sectors that require on-site presence) due to the pandemic and the subsequent policy directives?

Data

Choosing the districts within Maharashtra

We identified the top ten districts of Maharashtra based on their contribution to the state's industrial GVA in 2019-20. We sourced district level Gross Domestic Product (GDP) data from the Directorate of Economics and Statistics, Government of Maharashtra. The ten districts outlined below contributed 71.5% of state GVA in 2019-20 (Table 2).

Top 10 industrial districts of Maharashtra

These districts contributed 71.5% of state GVA in 2019-20.

S. No	District	Contribution to Maharashtra GVA
1	Mumbai (Mumbai City + Mumbai suburban)	19.8%
2	Thane (includes Palghar)	14.6%
3	Pune	11.8%
4	Nagpur	5.0%
5	Nashik	5.0%
6	Kolhapur	3.4%
7	Solapur	3.3%
8	Ahmednagar	3.2%
9	Aurangabad	2.7%
10	Raigad	2.6%

Source: Government of Maharashtra • Created with Datawrapper

Table 2: Top 10 Industrial Districts in Maharashtra

Movement Data (Outlogic): Daily, anonymized smartphone location data for Maharashtra

Outlogic (previously X-Mode) collects anonymised smartphone location data, providing an unfiltered stream of location and proximity data that it has aggregated from its data suppliers. These suppliers are applications or SDKs that capture the latitude and longitude of a device at a given time. Upon this event, the recorded location of the device and the time it was captured are provided to Outlogic. All such locations are then aggregated and anonymised to protect personal privacy.

For this study, we received daily aggregated datasets from Outlogic for India between December 2020 to July 2021, with a total estimated size of 160GB. We also obtained data for three months (May, July, and August) of 2019, using which we formed a baseline for pre-COVID-19 data.

Economic Activity (SpaceKnow Indices)

SpaceKnow, a satellite imagery company, aims to ‘index the physical world’ and provides ultra-large-scale planetary analysis via indexes on satellite activity, activity structure and pollution indices.

There were two types of indices that were of interest to us. The first one is the Satellite Activity Index (SAI) which measures the level of economic activity in specific industries as compared to a baseline. Each SAI contains daily data points but revisits per location are between 6-12 days and the final index is aggregated to 12, 24 and 30 days. The second index, Activity Structure Indexes (ASI), is a qualitative metric that highlights the number of firms— aggregated to 12, 24 and 30 days— that are displaying higher, normal, or lower than normal levels of activity. Using these two indices in conjunction allows a daily estimation of the level of economic activity taking place in a particular industry and any changes over time can be mapped. These indices are available for the entire period of our study (December 2020-July 2021), in line with Outlogic data.

Policy Directives by the Maharashtra government during the second wave of COVID-19

The COVID-19 second wave hit Maharashtra from the period of February-July 2021, with deaths due to the disease peaking in April and May 2021. As a result of the surge during the second wave, various policy directives and measures to curb the virus were imposed by the government of Maharashtra. These are provided below in Figure 1 (timeline of the wave) with Figure 2 highlighting the major policy directives undertaken during April-May 2021.

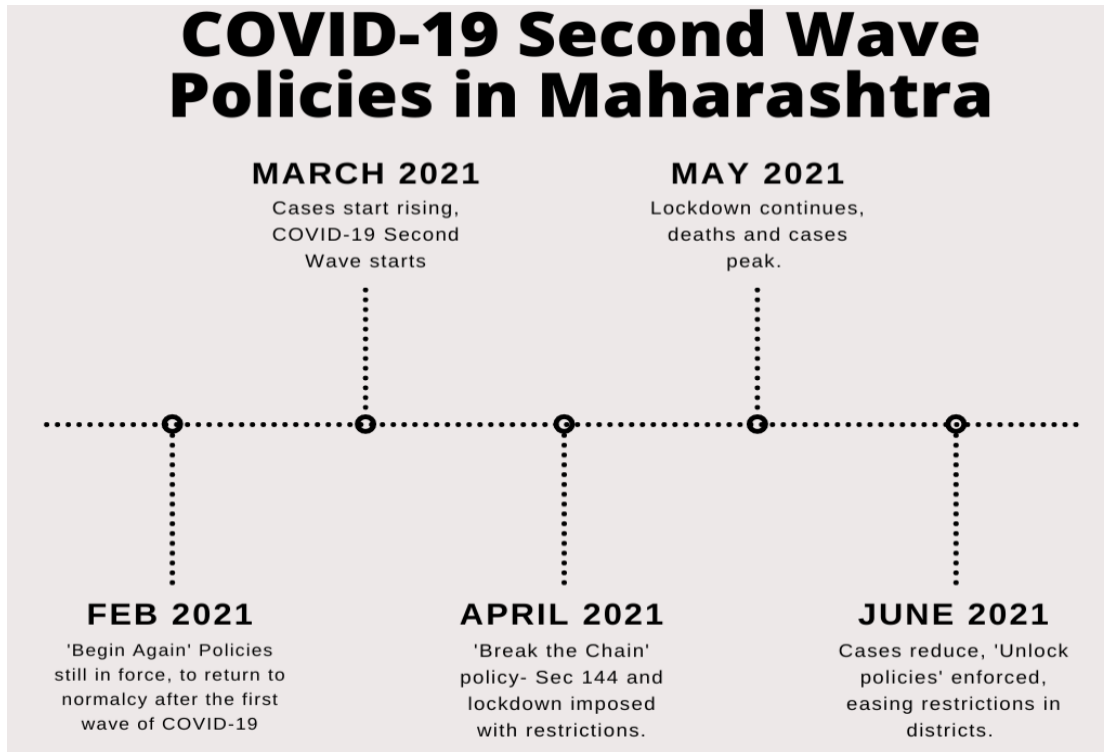


Figure 1: Timeline of the second wave of COVID-19 in Maharashtra

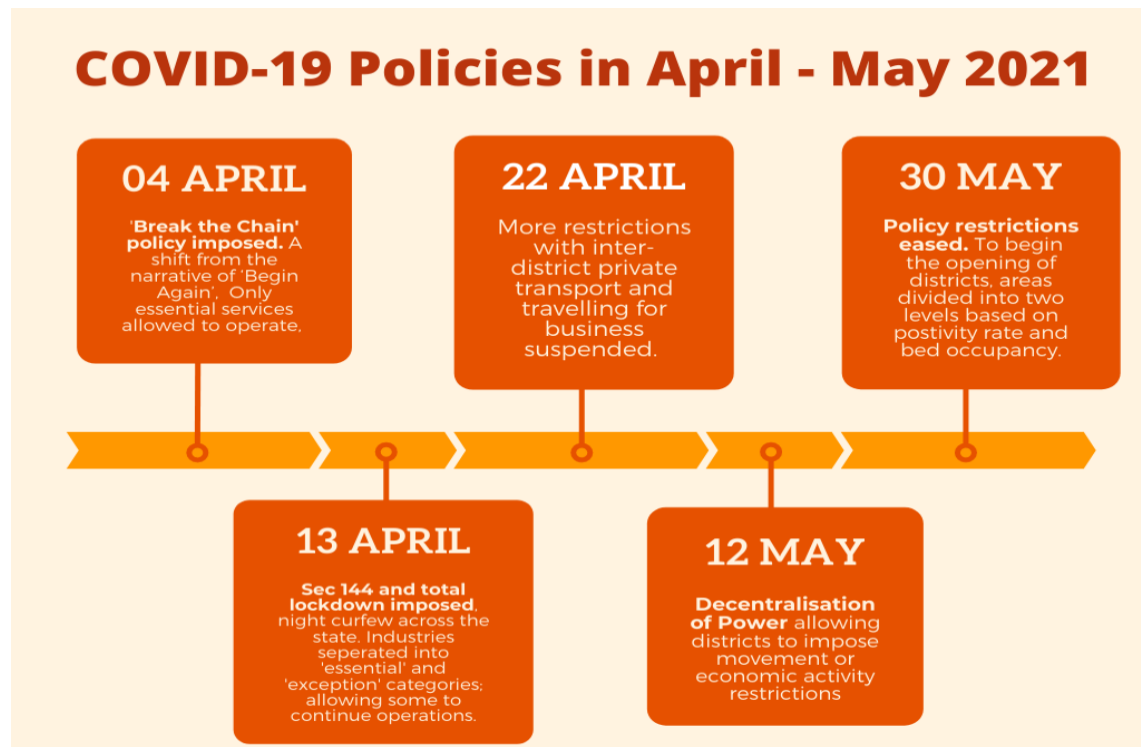


Figure 2: Policy directives during the peak of the COVID-19 second wave in Maharashtra

In June 2021, the economy was 'unlocked' after the peak of the second wave subsidised. The government reduced restrictions in a decentralised, phased manner, based on the weekly case positivity rate and percentage of oxygen beds occupied within each district. There were five levels of restrictions, with more curbs at higher levels. Please refer to the [appendix](#) for a detailed overview of all policy directives undertaken by the government during the second wave.

By overlaying these policy directives onto our anonymized smartphone location data (Outlogic) and economic indices (SpaceKnow) for the peak of the second wave of COVID-19, we were able to develop a methodology to understand the societal response to the enforced policies.

Methodology

1. Tracking movement by filtering location, not devices

We narrowed down the dataset to location pings and unique devices emerging only from the selected districts (using district boundaries shapefiles) for the period. Since we were concerned only with the inter-district changes over time for this study, we aggregated the pings and unique devices from each district for each day to obtain our final dataset.

After filtering the dataset by location (i.e., district), we tracked the percentage increase and decrease month-on-month in the number of unique devices for each district within the study. Using this

process, we get consistent pings over time and avoid the hassle of obtaining origin-destination matrices for specific devices. This allows us to obtain a sense of movement between these districts by seeing the change in the absolute number of pings and devices that arise in a district across different periods.

2. Choosing relevant economic activity indicators and industries

To get a sense of the predominant industrial economic activity undertaken in the chosen districts, we analysed the Annual Survey of Industries (ASI), a source of industrial statistics for the registered manufacturing sector of the economy. We also looked at the annual Economic Survey of Maharashtra as well as the locations of deployed investments by the Maharashtra Industrial Development Corporation.

Through this process, we determined general economic activity could be measured by tracking manufacturing, industrial activity, and construction. In terms of specific sectors, we decided to follow automobiles, food processing, textiles, and electronics.

The industries that we focus upon, unlike services, are labour intensive and require some amount of on-site presence and physical movement. As a result, working from home is not an option for the large workforce employed in these industries, making analyses of movement and economic activity particularly relevant.

While SpaceKnow Indices is at the country (India) level, approximately 400 locations out of 2400, i.e., 17% of all locations captured in India are in Maharashtra. This is relatively proportional to the overall GDP contribution (14.2%) of Maharashtra to the Indian economy, allowing us to use the national level indices for our state-level analysis. It is not a perfect estimate but suffices for this study.

To map out the impact of the second wave on general economic activity, we looked at ‘Aggregated Industrial’, ‘Aggregated Manufacturing’, and ‘Aggregated Construction’ SpaceKnow indices. For Maharashtra-specific industries, we chose the following indexes: ‘Car Factory’ and ‘Car Distribution’ (Automobiles), ‘Electronics’ (Electronics), and ‘Food’ (Food Processing). While industries such as textiles are critical to Maharashtra, due to the lack of a SpaceKnow index for the sector, it was not possible to include it in the analysis. Further, since the 30-day daily aggregated indices had the highest coverage in terms of satellite imagery and confidence, we used them to track changes in day-to-day economic activity.

3. Final Methodology

After gathering cleaned data on inter-district movement (Outlogic), economic activity in labour-intensive industries (SpaceKnow), and the policy directives undertaken, we overlaid them on each other to carry out three specific analyses. These are outlined below:

Movement and Economic Activity as compared to pre-COVID levels:

- Movement: We aggregated the number of unique devices in each district to get a monthly percentage change in inward and outward movement as compared to the baseline 2019 data (pre-COVID-19).
- Economic Activity: We used the 30-day aggregated indices for each industry analysed and calculated the monthly percentage change in economic activity as compared to the baseline 2019 data (pre-COVID-19).

Month on-month change in movement and economic activity during COVID-19 second wave:

- Movement: We aggregated the number of devices in each district to get a monthly percentage change for inward and outward movement from January-July 2021.
- Economic Activity: We used the 30-day aggregated indices for each industry analysed and calculated the monthly percentage change in economic activity from January-July 2021.

Weekly impact on movement and economic activity of the policies undertaken during the peak of the second wave:

- Movement: We aggregated the number of pings in each district to get a weekly percentage change for inward and outward movement from the week starting 22 March 2021 to the week starting 04 July 2021.
- Economic Activity: We used the 30-day aggregated indices for each industry analysed and calculated the weekly percentage change in economic activity from the week starting 22 March 2021 to the week starting 04 July 2021.
- Policy Directives: We overlaid the dates and content of different policy directives that were imposed during the COVID-19 second wave in Maharashtra to investigate the effects they would have on inter-district mobility and economic activity.

By combining the datasets, we can see the effects of rapidly changing policy directives on movement and economic activity weekly, highlighting the efficacy of using such high frequency, granular data.

Findings

General Findings

Trends regarding movement and economic activity between districts during COVID-19's second wave (as compared to regular times)

We compared inward and outward resident flows (into/from districts) to the baseline numbers from the average of three months from 2019 (pre-pandemic levels). We see a general trend of people moving into the industrialised districts between December 2020 to February 2021, with policy directives at the time focused on 'Begin Again' and restarting Maharashtra's economy following the 2020 national lockdown.

While still lower than the baselines of 2019, these industrial hubs seemed to be on an upward trajectory in early 2021 with more people moving into them. This can be seen when comparing December 2020 to January-February 2021. The average number of devices in each district (apart from Kolhapur and Solapur) was 52% lower than baseline in December 2020 and only 40.82% lower in January-February 2021, an 11.18 percentage point (pp) average increase, signalling inward movement.

However, with the onset of the second wave, the scenario seems to have rapidly changed. When compared to 2019 baseline data, outward flows started to rise. This escalated during the peak of COVID-19's second wave with the average number of devices within the districts 60% lower as compared to the 2019 baseline. In July 2021, this came down to 55.49% lower than the baseline, an increased inflow of ~5pp, seemingly as more residents returned to their districts following the worst of the second wave.

Economic activity across industries took less of a shock during COVID-19's second wave, possibly due to the more business-friendly policies adopted with no industry going lower than -25% when compared to baseline (i.e., normal) activity.

The way that industries were classified by the government (essential, exception, etc.) also seems to have played its part. For instance, construction was the most affected by the second wave, possibly since it was not considered an essential or exception activity. On the other hand, food processing continued as is, being classified as an exception category by the government, dipping only around 10% during the peak of the second wave compared to normal activity.

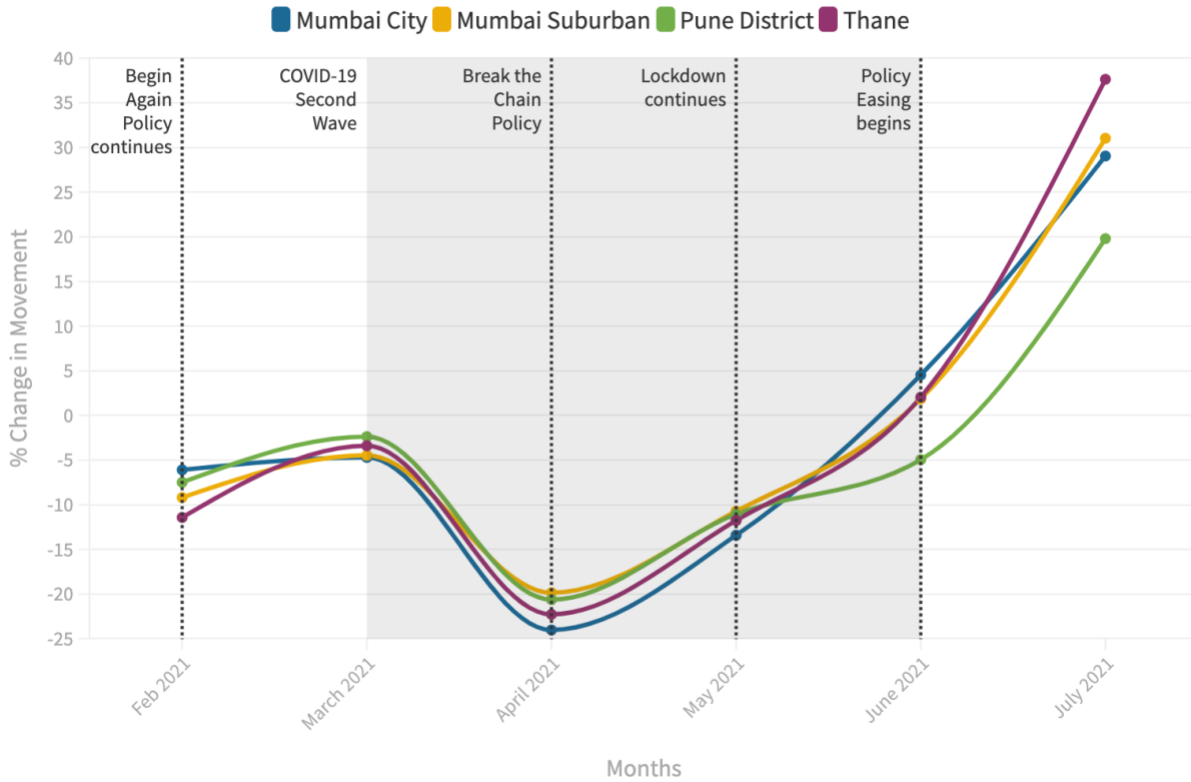
Monthly changes in economic activity and movement patterns during the COVID-19 second wave

Like the trend seen when comparing with baseline data, between February and March 2021, there is an increase in movement into the industrial districts with Begin Again policy directives still in force, signalling a supposed return to normalcy.

However, this changed in April 2021, with the onset of the second wave as well as the Break the Chain movement restrictions to curb the outbreak. Outward flows from industrial districts shot up, with major cities Mumbai and Pune suffering the worst, seeing a 20% and 18% increase in residents leaving the cities, respectively.

There seems to have been a gradual increase in inward movement with most districts seeing a 5-9pp increase in people coming back to the cities and districts in June 2021, following the peak of the second wave. By July 2021, there is a massive surge in movement into the districts (especially cities) with both Mumbai and Pune seeing a 25% inflow. The journey of Maharashtra's major cities is outlined in Figure 3 below.

Changes in movement patterns for Maharashtra's major cities



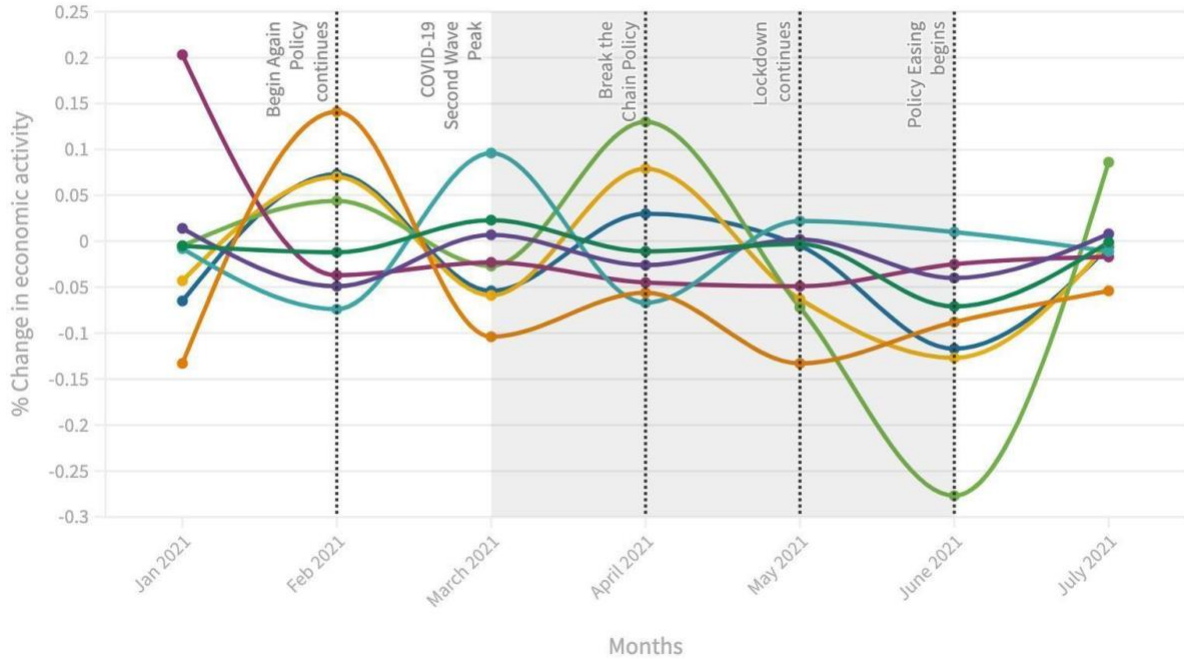
Data Source: Outlogic • Positive Change == Inward Movement into district

Figure 3: Changes in the movement for Maharashtra's major cities

The business-friendly nature of Break the Chain policies ensured that the economy took less of a shock with the second wave. Most industries had a monthly change in activity ranging between an increase/decrease of 10pp as compared to the previous month. As the baseline, construction activities were the most affected by the second wave, possibly because it was not considered an essential activity. The monthly changes in the state's economic activity are outlined in Figure 4.

Monthly changes in economic activity

■ Agg Industrial
 ■ Agg Manufacturing
 ■ Agg Construction
 ■ Car Factory
 ■ Car Distribution
 ■ Food
 ■ Electronics
 ■ Electronics Parking



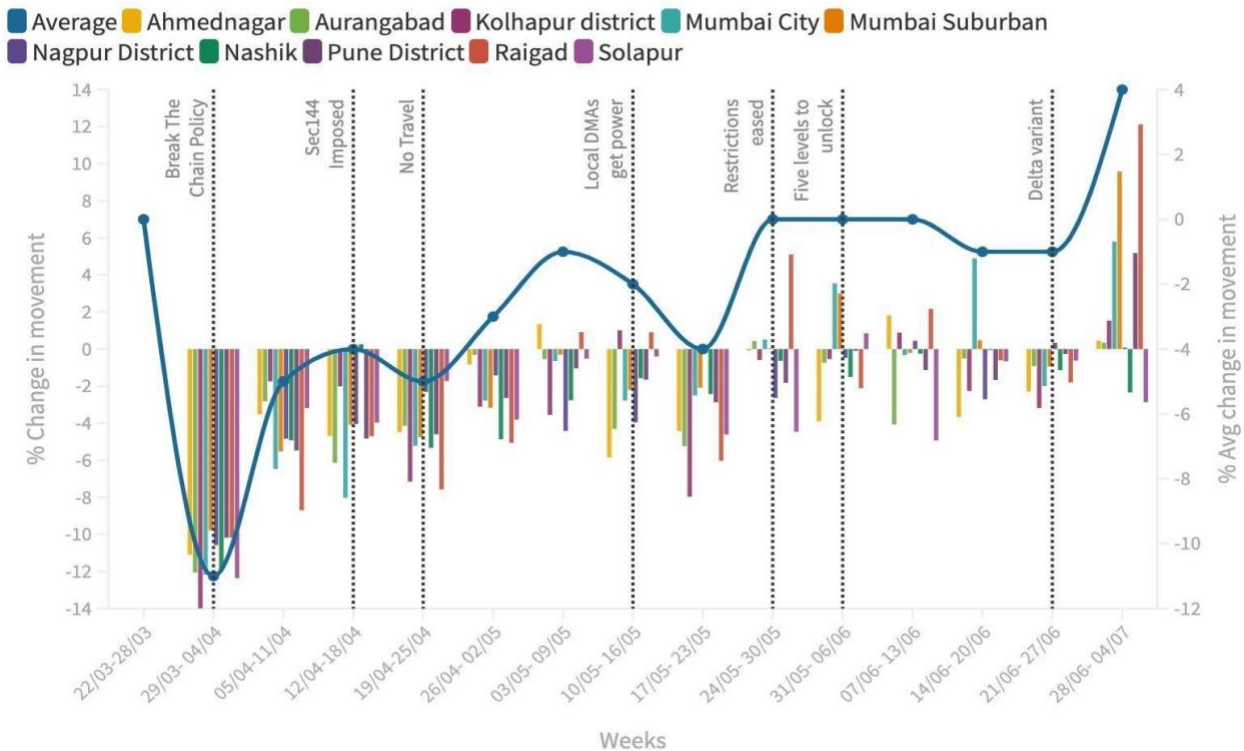
Source: Spaceknow Indices

Figure 4: Monthly Changes in Maharashtra’s economic activities

Weekly impact on movement and economic activity of policies undertaken during the peak of the second wave

We undertake a week-by-week analysis (15 weeks from end-March to the start-July 2021) to understand the change in movement and economic activity on a granular basis during the peak of COVID-19’s second wave.

Weekly changes in movement patterns across selected districts

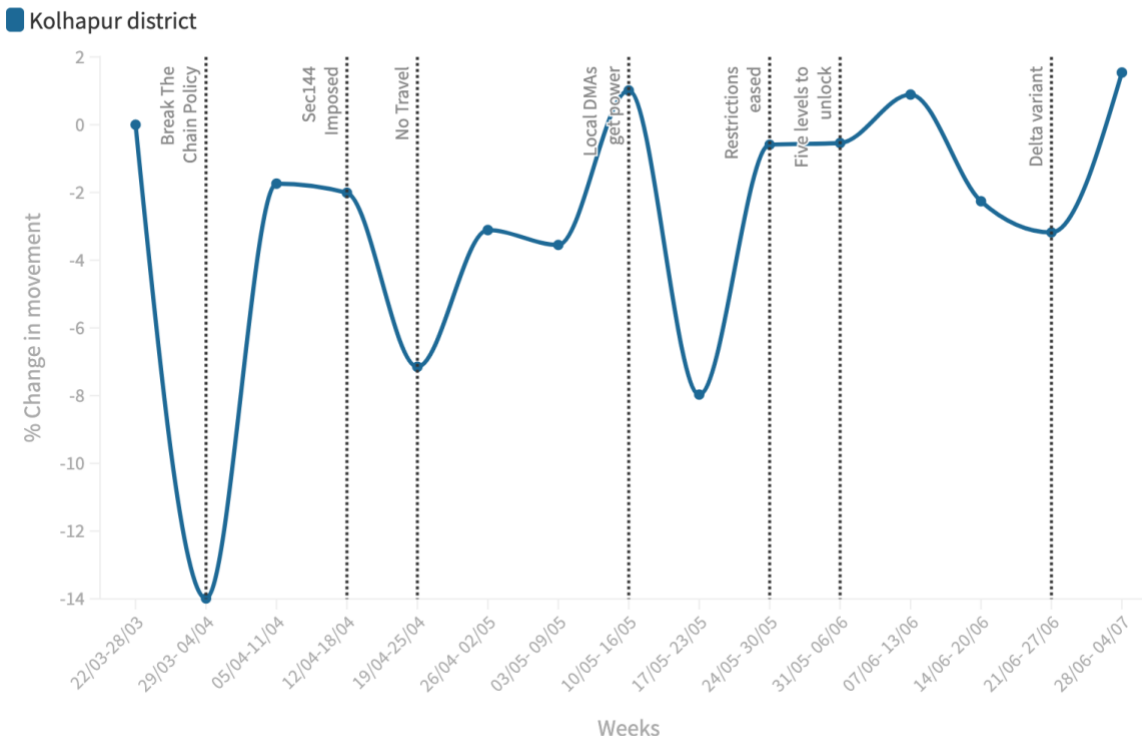


Source: Outlogic • Positive Change == Inward Movement into district
 Figure 5: Weekly changes in movement patterns across districts (average of districts== line)

Movement Patterns

We find that the **mobility of people changed in anticipation of a policy, not when the policy itself was enforced** (Figure 5). If residents felt that lockdowns/restrictions were about to be imposed, they tended to move out of the district. This can be seen in the week of 22-28 March 2021, where all districts saw an increase in outward movement as compared to the previous week (Figure 5). Following the first round of Break the Chain restrictions on April 4, which signalled the official recognition of the second wave by the government, people ended up returning to their districts, with an increase in movement into each district.

Weekly changes in movement patterns for Kolhapur

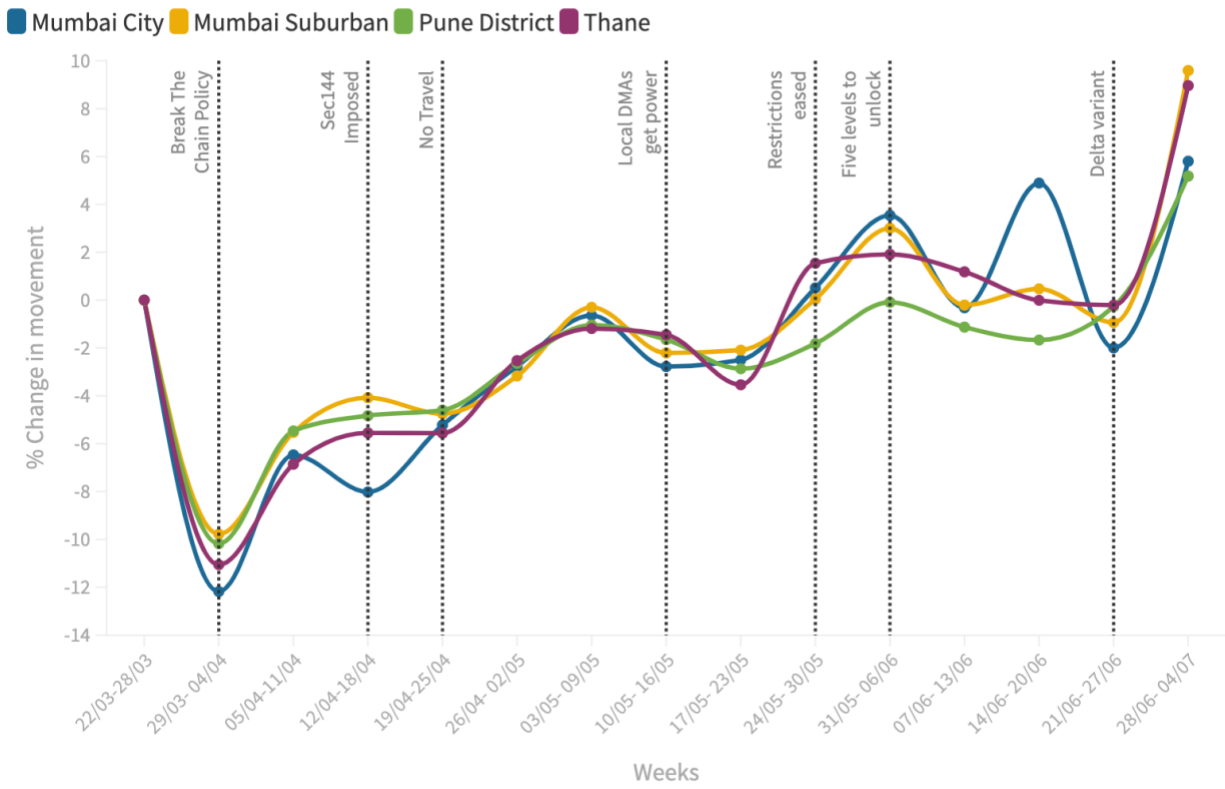


Source: Outlogic • Positive Change == Inward Movement into district
 Figure 6: Weekly changes in the movement for the Kolhapur district

The district of Kolhapur seems to have been most hit by COVID-19. It sees the biggest outflow, with a 14% increase in people leaving the district (Figure 6). Interestingly, when local disaster management agencies were given more power in May 2021, it is one of the few districts in which people continue to move out with most other districts seeing an inflow of residents. This could be a result of Kolhapur being the worst-hit district in terms of COVID-19 cases, with the district always remaining at Level 3 or 4 in terms of lockdown restrictions. Being at a higher level of containment, inflows into Kolhapur remain low throughout this period.

However, seasonal migration flows to and from Kolhapur are a caveat to this finding. While data on them is limited, Shinde (2015) did surmise—based on qualitative analysis—that Kolhapur’s seasonal migrants work between September-May and head back to their native place between June-August. As a result, some of the outward flows during May 2021 might be a result of regular seasonal migration.

Weekly changes in movement patterns for Maharashtra's cities

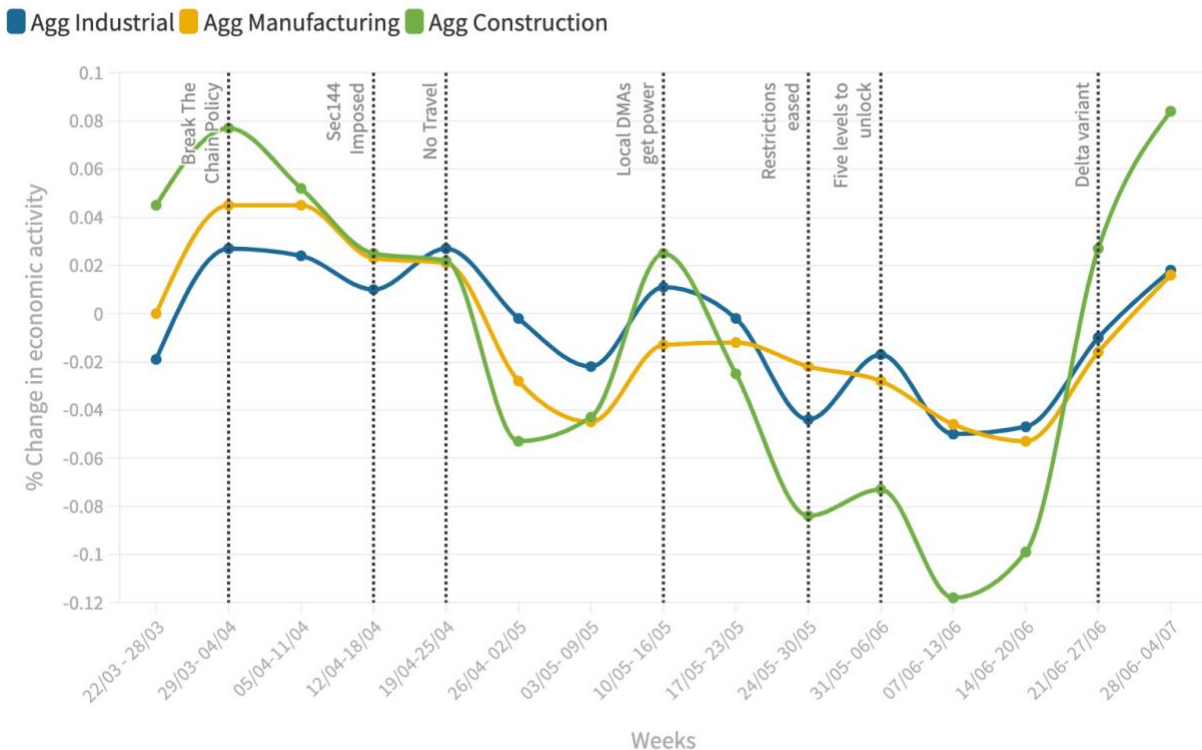


Source: Outlogic • Positive Change == Inward Movement into district
 Figure 7: Weekly changes in movement patterns for Maharashtra's cities

The major cities in the state (Mumbai and Pune) also see a massive exodus at the start of the second wave, with outward movement increasing by 12% in Mumbai and 10% in Pune (Figure 7). However, following an initial outflow, the cities see a gradual inflow over most of the remaining period.

Economic Activity

Weekly changes in economic activity



Source: Spaceknow Indices

Figure 8: Weekly changes in economic activity

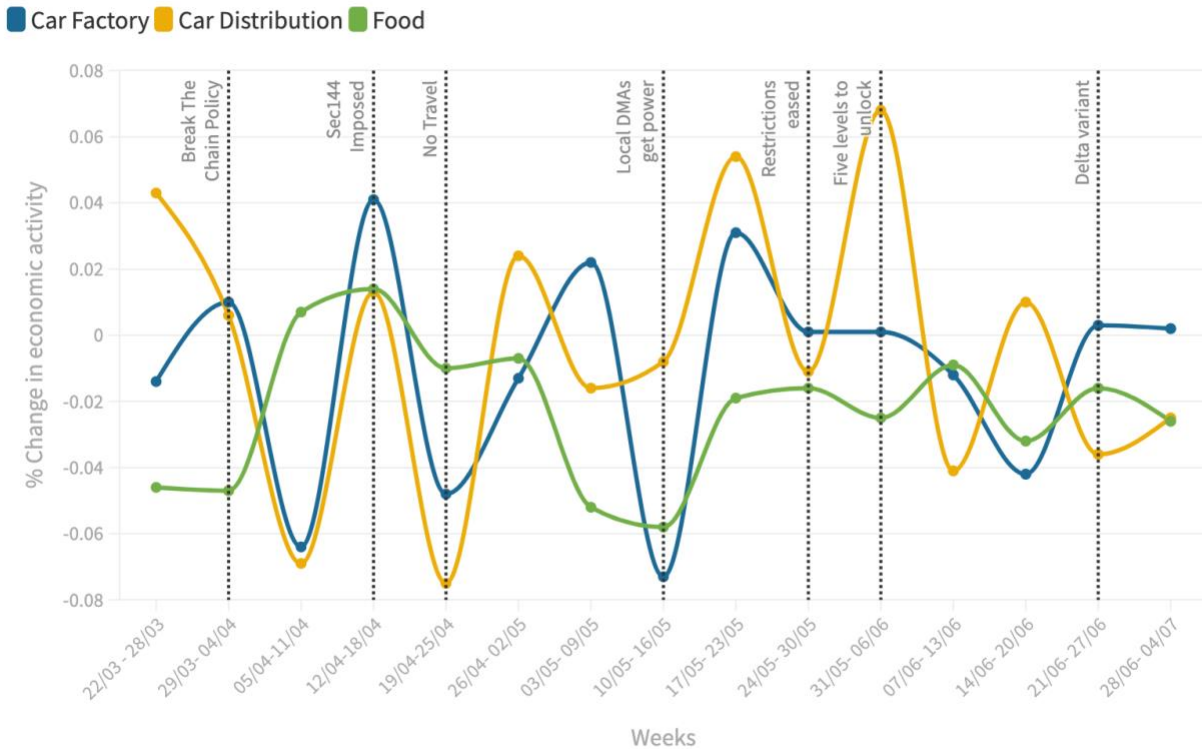
We find that **industrial, construction and manufacturing indices always took a week or two to react to a change in policy** (Figure 8).

The **construction industry seems to have been the worst affected** when policy restrictions were enacted, with activity declining with the imposition of Section 144 and travel restrictions being imposed in April 2021. It seems to hit a trough during the start of June 2021 and then improved rapidly with the state easing lockdown through five levels of restrictions by the start of July. This pattern is confirmed by SpaceKnow's ASI indices wherein a lot more construction facilities perform higher than usual around the time when more economic activity is allowed. Further, there is an increase in the number of factories operating at a normal level at the start of July, signalling a return to normalcy.

General industrial and manufacturing activity both follow the pattern of taking a week or two in reacting to policy changes and adapting their activity. We see this a week after the first Break the Chain policy which was followed by a massive drop-in activity after Section 144 was imposed across the state. Both bottom out around the time when Maharashtra is about to start the unlock procedure (with five levels of containment) and kick start activity post these directives. Once restarted, they start improving operations by July. Such a pattern is confirmed by SpaceKnow's ASI data which follows a

similar pattern.

Weekly changes in activity of specific industries



Source: Spaceknow Indices

Figure 9: Weekly changes in specific industries

Individual industries such as food processing and automobiles reacted differently depending on policies. Automobiles did not seem to be affected with both car factory and car distribution indices seeing a -0.04 and + 0.04 change week on week with no discernible pattern visible (Figure 9). Food, listed as an essential service, was initially protected but took a hit after the imposition of Section 144 and no travel, and then slowly came back to normal.

Finally, the **emergence of the Delta variant across the state in end-June 2021** (which prompted the state to declare each district at Level 3 or higher of containment) **did not seem to have much of an effect on inward movement or economic activity**. Residents seemed to have flocked into the districts despite the threat posed by the variant.

Discussion

The outflow of residents from districts in anticipation of restrictive policies being imposed could be a result of residents expecting national, extremely restrictive lockdown measures to be implemented, as was the case in March 2020. During the first wave, the central government treated COVID-19 as a

national emergency, despite health being a state subject, but this changed during the second wave. With people often basing their individual decisions on past experiences, these pre-emptive outflows are justified with uncertainty over the future. Residents also seem to have decided to return to the industrial districts after the imposition of the lighter-than-expected restrictions.

The lag in how general economic activity responded to a policy directive is also understandable. Firm-level decisions, especially ones that drastically change operations such as shutting/restarting a factory do require time since there are a plethora of variables (managing labour and capital) that need to be figured out.

At the same time, economic activity (at least according to satellite imagery) was not as heavily affected. This could be a result of the government's wish to minimise the impact on the economy, at the risk of an increased caseload. There is an open question on whether it was the correct approach: i.e., choosing to reduce the number of restrictions in favour of allowing more economic activity to happen. As we now know, Maharashtra state recorded most of its fatalities (64%) during the second wave of the disease. Looser restrictions combined with its poor healthcare infrastructure might have caused more harm than good when we look at the health of its residents, and not just its economy (Chandra, 2021). However, we cannot say so conclusively given that it requires further research.

We also see a mini case study of decentralisation of power with districts being given autonomy to choose levels of restrictions. For instance, Mumbai, India's financial capital, chose to stay at Level 3 of containment, even when based on the state guidelines, it could have operated at Level 2 with fewer restrictions, prioritising containment of the virus over economic benefits (Thakkar, 2021).

The developed method highlights the efficacy of using alternative, granular and fast frequency data from smartphones and satellite imagery to provide policymakers with real-time analysis which is often not available during an emergency. Quantifying the effects of government directives on movement and economic activity provides an understanding of future state interventions in similar situations.

Another stakeholder that could potentially benefit from this kind of study are epidemiologists studying pandemics since it provides a case study of mobility changes in India during an outbreak, highlighting societal response at the beginning of an epidemic.

While such data and methods can help bridge gaps, we are cognisant that their benefits are limited when utilised independently of other data sources. It can only provide possible explanations for situations that take place. As such, it highlights *an* explanation, not *the* explanation. Hence, while it can give policymakers an overall direction and picture of the possible impact of their policies, it cannot accurately predict the ultimate impact. In an ideal scenario, such data should be used in conjunction with data from more traditional sources and backed up with qualitative interviews and pulse polling.

Another restriction of using such private datasets is that the methodology of the calculation of indices

(based on proprietary algorithms) such as SpaceKnow Indices is unknown to researchers, which causes us to pause in providing recommendations when such data is used independently of other checks and balances.

With these limitations acknowledged, the method developed in this study attempted to make use of alternative data and found a question that can be answered using such information. Moreover, it showed the potency of such alternative, big data to provide highly granular and frequent patterns on how a society responds to policies undertaken during an emergency, something that is currently not possible with traditional data sources in India.

To further build on this work, qualitative research on the impact of the second wave on mobility and economic activity within Maharashtra is needed. Ultimately, this methodology is scalable and should be tested and replicated within other states in India and countries wherein similar data is available.

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Appendix: Detailed policy directives by the Maharashtra government during the second wave of COVID-19

March 2021: Cases and deaths start rising with expectations of a lockdown looming, with articles circulating that the Maharashtra government will be imposing restrictions to curb the spread of COVID-19. Till then, the economy was opening, and the policy narrative was focused on 'Begin Again' as the slogan of policy directives.

April 2021

04 April 2021:

The government imposed restrictions on movement and economic activity to curb the spread of the disease. The policy was entitled 'Break the Chain' (BTC), a shift from the narrative of 'Begin Again', recognising the second wave of COVID-19. The directive allowed only essential services to operate and certain organisations to operate during the day. Travel between districts could still take place and industrial workers were allowed to travel from 2000 to 0700 if they had their ID cards.

13 April 2021:

The government increased restrictions due to the rising cases, such as the imposition of Section 144 across the state along with a night curfew. However, with the cardinal principle of these guidelines being that "essential for essential is essential", it allowed a lot of economic activity to continue.

The activity was separated into two: essential and exception categories. Essential services could carry on as is whereas services in the exceptions category could work from 0700-2000 with no movement restrictions. This classification was critical due to its idiosyncratic impact on industries. For instance, pharmaceuticals were regarded as an essential service whereas the textiles industry was not allowed to operate. On the other hand, food processing and packaging was classified as essential service, allowing for a continuation of business operations.

Moreover, manufacturing units, if they could "provide accommodation to their labour, working either in the same campus or in an isolated facility from where movement can happen" would be allowed to continue work. Doing so allowed workers living in the same district to continue work.

A point of note in these guidelines was that "Units of a continuous nature (that cannot be stopped immediately and cannot restart without considerable time requirement), were allowed to continue with max 50% capacity." Such a policy could have potentially allowed industries such as automobiles to take advantage and continue operations.

22 April 2022:

The government imposed further movement restrictions to curb the outbreak with government offices now only allowed to operate at 15% capacity due to the continuously rising caseload and

overburdened healthcare infrastructure. Inter-district private transport and travelling for business were suspended, with only emergency travel being permitted. Passengers travelling between districts on buses would also be stamped for a 14-day quarantine, a move that would have discouraged inter-district movement.

May 2021

12 May 2021:

With the state still at the peak of the second wave, the government continued restrictions on movement and economic activity till June 2021. The guidelines were revised to decentralise power and allow districts to have more control over curbing the spread. In particular, the local disaster management agency was given the power to impose further restrictions generally or on specific sectors with intimation to the state government with at least 48 hours of public notice before enacted.

30 May 2021:

With the caseload reducing, the government decided to start an easing of restrictions, with two levels of ‘unlocking’ the districts approved. They were divided into the following:

- A: If the positivity rate was equal to or less than 10% in the district and the occupancy of beds was less than 40%, the following could be eased:
 1. All essential establishments could operate in the morning.
 2. The decision of opening non-essential shops was left up to the local DMA.
 3. Delivery of non-essential goods was restarted.
 4. Government offices could now operate at 25% attendance.
- B: If the positivity rate was more than 20% or where occupancy of beds was more than 75%, the restrictions from 12 May 2021 were augmented to include the sealing of the district border with no inflow or outflow of people allowed (i.e., no inter-district movement permitted).

June 2021

04 June 2021:

With caseload and doubling rates reducing, the government presented a detailed plan to reopen districts with the two levels proposed earlier moving to five levels of restrictions based on case positivity rate and percentage of oxygen beds occupied. These are outlined in Table 3 below.

Conditions of Unlock Levels | June 2021

5 levels of restrictions based on case positivity rate (CPR) and percentage of oxygen beds occupied.

Level of Restriction	Conditions	What should happen?
1	CPR < 5% AND beds occupancy < 25%	Get back to normal economic activity with minimal restrictions.
2	CPR < 5% AND beds occupancy is 25-40%	Minimise attendance in closed spaces and public places.
3	CPR 5-10% OR beds occupancy > 40%	Minimise movement post 1700 hours on weekdays and on weekends.
4	CPR 10-20% OR beds occupancy is > 60%	No movement past 1700 hours on weekdays and no movement on weekends, without emergency reasons.
5	CPR > 20% OR beds occupancy is > 75%	No movement in the district at all without emergency reason.

Source: Government of Maharashtra • Created with Datawrapper

Table 3: Conditions of Unlock Levels in Maharashtra

The level assignment changed every week, with the state public health department announcing the CPR and occupancy rate for each district on Thursday with the new restrictions to be imposed the following Monday. The kind of restrictions present at each level is outlined in Table 4.

Unlock Levels | Easing Restrictions by District (June 2021)

The level assignment changed on a weekly basis, with the state public health department announcing the CPR and occupancy rate for each district on Thursday with the new restrictions to be imposed the following Monday.

Level of Restriction	Opening of private offices	Office Attendance	Construction	Public Transport running	Inter-district Movement	Manufacturing
Level 1	All	100	Regular	Regular	Regular	Regular
Level 2	All	100	Regular	100%- no standing	Regular	Regular
Level 3	All (till 1600 hours)	50	Only on-site labour or workers leave the site by 1600 hours.	50%- no standing	Regular	50% staff movement, within a transport bubble (travelling together)
Level 4	Only exempted industries	25	Only onsite labour.	50%- no standing	Regular	50% staff movement, within a isolation bubble (onsite accommodation)
Level 5	Only exempted industries	15	Only onsite labour/only essential workers.		Only with E-Pass	50% staff movement, within a isolation bubble (onsite accommodation)

Source: Government of Maharashtra • Created with Datawrapper

Table 4: Unlock restrictions for districts in Maharashtra (June 2021)

25 June 2021:

Due to the sudden emergence of the Delta variant of COVID-19, the state government takes a unilateral call to move all districts of the state to Level 3 of restrictions until further notice.