Spread of Covid-19 in India: A preamble to subsequent reports [13.4.20]

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We have been deafeningly silent for a week. We apologize for that (we can give quite a few excuses, but not too many good reasons). We reiterate that in writing our reports, we have aimed to: (*a*) document the spatial and temporal spread of Covid-19 in India, and (*b*) interpret the data with the hope of generating some sensible policy recommendations. We admit that we have been slow regarding the former, and sporadic with respect to the latter. In order to be able to do a slightly better job in our subsequent reports, we plan to present data on Covid-spread in India in a way that it feeds appropriately into the policy debate of the day – how to structure (and possibly lessen) the social and economic restrictions in future lock-downs across the country. The aim of this preamble is to describe how we plan to go about achieving this objective in our future reports.

But before we do that, we want to briefly discuss the following issues: [1] What are the principal stylized facts regarding the spread of Covid between late March and early April in India? [2] Given the lack of adequate testing in India that has many people so concerned, can we claim to have uncovered anything substantial about the true nature of Covid spread in India?

Of course, it makes more sense to address the second question first. So here goes. We agree that testing has not been adequate in India. [Whether that is necessarily a bad thing given genuine resource scarcity, and whether some suggested creative ways of increasing testing rates make a lot of sense, is a discussion we do not get into here (but we do here).] In order to proceed with our analysis, we have decided to hold on to the following "working hypotheses": (i) Each Indian state has a specified set of testing criteria (e.g., travel from infected countries, known contact with an infected person, etc.) which – though not as inclusive as one might want – do identify a "population to be tested", and (ii) while the testing criteria have differed across states, there hasn't been systematic differences in implementing these criteria in the different *districts* of a state.

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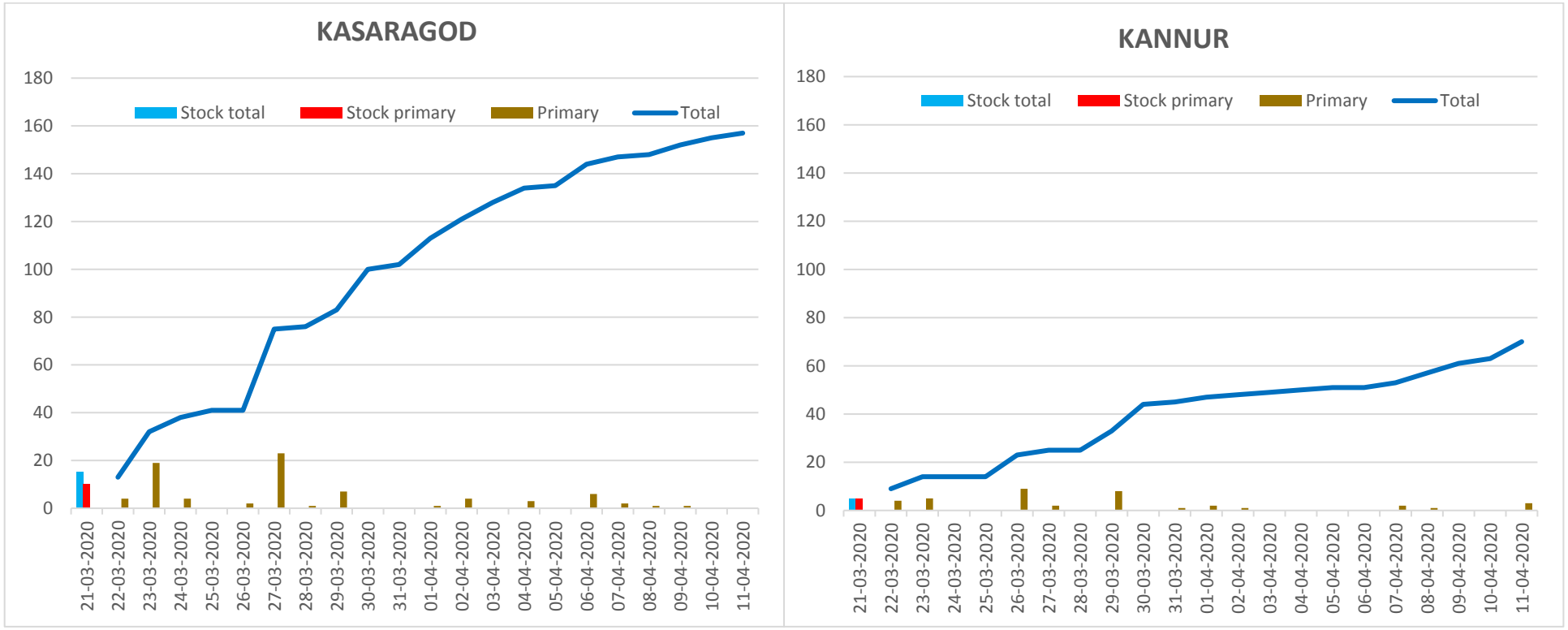
Consequently, we believe that while testing rates have been different in different states (and all inadequate to different extents), they have not been systematically different *in different districts of the same state*. This immediately implies: (*a*) our available infection data are indeed likely to provide a reasonably correct picture of Covid-spread *within* each state; while (*b*) we might not be quite justified in comparing propagation rates *across* different states. In order to address the latter concern, we are collecting data on test rates in the different states (again, primarily from covid19india.org), so that we can "appropriately deflate" the infection numbers in the different states and thus make more sensible inter-state comparisons. [Regarding ever being successful in determining the total number of infections in each state in India, our only hope is to locate epidemiological conclusions that will tell that given the testing criteria in a state, if X people were tested and Y people were found infected, then the best guess is that $Z > Y$ people were truly infected in the population.]

To the extent that we haven't yet carried out the appropriate state-deflation, our stated stylized facts about Covid-spread across Indian states do have to be taken as only being suggestive, while we are on surer ground as far as within-state spreads are concerned. As our previous four reports have highlighted, we believe that the following claims do constitute a valid set of stylized facts about disease-spread in India:

- The spread of Covid-19 has been uneven, initially affecting a set of western and southern states more than the rest of the country.
- Over time, the number of "primary cases" – mainly Indians returning from disease-loaded foreign countries have decreased significantly, while the number of "transmitted cases" have grown.
- Metropolitan (and other densely-populated) areas have been, and continue to be, much more heavily affected than rural areas.
- Paradoxically, since the beginning of the 21-day lock-down, two things have happened over time: (i) disease spread (generally at low rates) has occurred in "new" districts, and (ii) some districts in some states (which did not have that bad initial conditions) have suffered significant worsening of disease load. The reasons for these developments are likely to be a combination of the following factors: (*a*) asymmetric impact of certain one-off congregations, (*b*) significant movements of migrant labour, (*c*) violations of lock-down restrictions, (*d*) and idiosyncratic high local transmissions. Serious econometric work, if at all possible with available data, will be needed to distinguish between these causes.

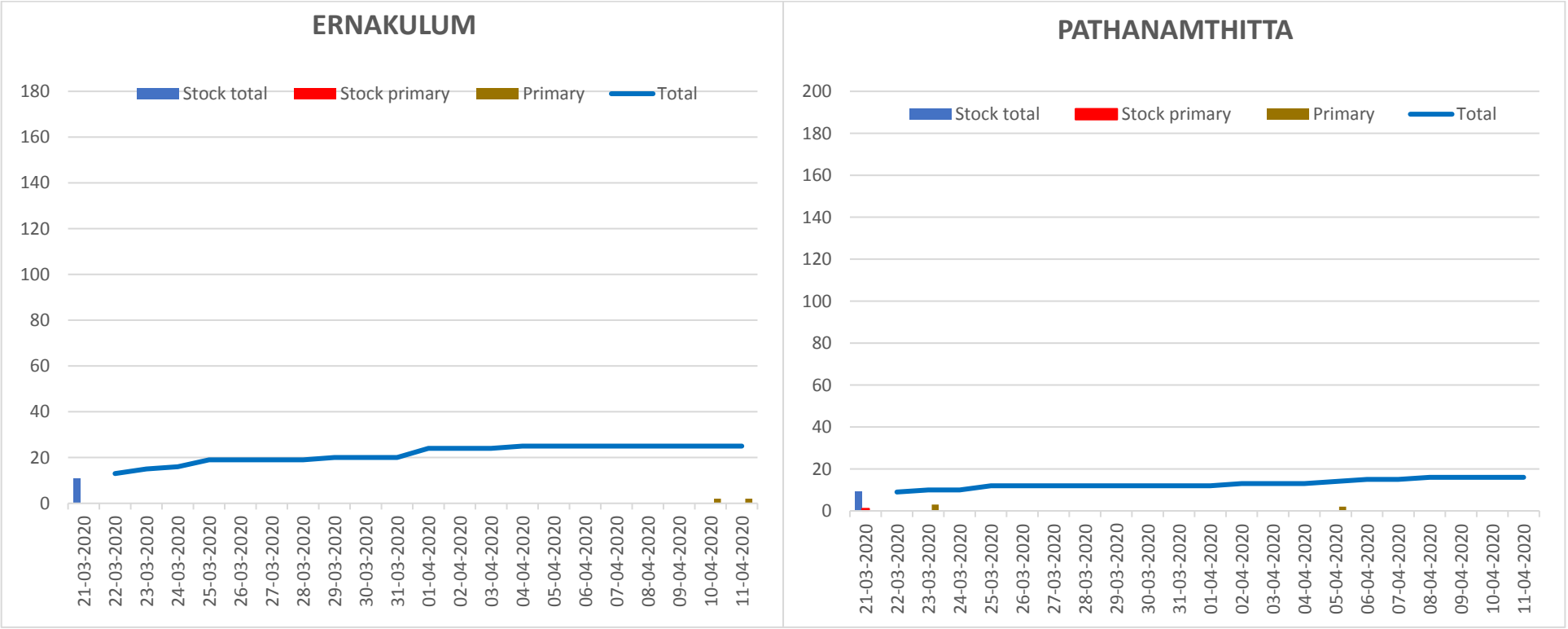
Presentation of district-wise data

We now present data on the spread of Covid-19 in four districts of Kerala that have experienced different levels of intertemporal disease load. As we explain below, this is how we plan to present the evolving district-level data in our future reports (rather than using tables and maps,).



The chart for each district has dates on the horizontal axis, running from 21st March (the day before India's first "locked-down Sunday") to a recent cut-off date – in this case, 11th April. The blue bar (respectively, the red bar) on the initial date informs us about the total stock of cases (respectively, the stock of "primary cases") as they had accumulated up to March 21 in the district. Then, from March 22 onwards, the blue line shows how the (cumulated) total stock of cases has increased (or remained constant) over the 22 days (from March 22 and April 11). Finally, in the span of the 22 day-interval, the intermittent brown bars show the *addition* of new primary cases in the relevant dates.

The logic of such a chart for each district of a state is as follows. We posit that for most districts, the disease originated with a primary case (for some districts, a primary case infected someone in the district and then moved on to another district to be identified and treated), and then spread over the district by contact transmission as well as by arrival of additional primary cases. Given such a propagation mechanism, our chart for a district starts at the initial date by depicting the two stocks – total and primary cases – at that date, and then tracks how the



aggregate disease load increased over time, and if (and how) additional new primary cases "pinged" the evolution of total district disease-load over time. We do expect such "primary pings" to have the potential of increasing the spread of Covid-19 in a district. Further, we consider the temporal rise (or lack thereof) in district disease load following a significant number of primary pings to be a reflection of the administrative and medical success in disease control in the district.

From the above charts, note that one explanation of the heavy disease spread/load in Kasaragod is the large number of primary pings that the district has received. Even then, the growth in total disease stock in Kasaragod is not currently exploding (the total disease stock is not quite increasing at an increasing rate between April 5 and 11). In contrast, the current disease growth in Kannur is worse (with accelerated increase in total stock between April 7 and 11), even though the district has endured fewer primary pings. Ernakulum and Pathanamthitta have received virtually no primary pings, and have consistently carried a significantly smaller cumulated disease load. Furthermore, the disease

stock has not grown in Ernakulum after 4th April, and in Pathanamthitta after 8th April, suggesting that Covid-19 spread might have been successfully arrested in these districts (at least for now).

In our future reports, we intend to present such district-level charts (for increasing date intervals, all starting from March 21) for all infected districts of India for which we have complete infection information.

Debating Lock-downs

As we have mentioned in our earlier reports, we believe that India will benefit by designing district-specific lock-down policies (we are encouraged to note that the central government is also thinking along these lines). We also believe that two sets of data: (1) data on temporal disease spread and current disease load, and (2) data on economic benefits (respectively, costs) of relaxing (respectively, strengthening) lock-down, should be studied in conjunction in order to determine district-specific lock-down policies. With regard to (1), recognize that district-level charts of the above kind should go a long way in determining the anticipated medical challenges in relaxing lock-downs. At an intuitive level, a district with a small stock of current infections (and small numbers of currently quarantined people, if this information is available) and with negligible recent growth of disease stock (especially, even if it has received recent primary pings) should be a prime contender for lock-down relaxation. [Lock-down policies for predominantly rural districts must be very different from those for urban districts].

In our future reports, we intend to elaborate on the possible ways to combine the district-level economic data with its disease data to come up with sensible recommendations about changes in continuing lock-down policies. Our initial idea is that the following economic variables should play an important role in these policy decisions – the relative economic value of a district's output, and the extent of economic activity that can be revived without significantly altering minimal social distancing requirements (and without necessitating much travel). In this context, information on a district's share in state GDP, the importance of agriculture in the district, and general work environments of the informal and formal manufacturing sectors in the district will be of much relevance.

Finally, in this policy design exercise, we will try to internalize the concrete positive experiences of different districts and states of India – like the district of Bhilwara in Rajasthan, the districts of Ladakh, and the states of Kerala and Orissa.