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by

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A Sectoral View of Lifting the Lockdown and the Use of Sample-based Random Testing

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In a previous paper¹, we made the point that lockdown restrictions should be lifted gradually and selectively, in lockstep with the preparedness of the health system to face the flow of cases that will continue even after the lockdown.²

We described a gradual, selective approach along two lines. **On the one hand, restrictions on mobility could be lifted, first, within barangays, then within cities/municipalities, and then between cities/municipalities** – the pacing of which should be informed by both public health indicators and the readiness of localized systems to ‘quarantine-test-isolate’. Thus, improvements in the capacity of and ability to respond by localized systems would be the crucial determinant of whether a lockdown in specific catchment areas can be relaxed. Mayors and governors would be given additional authorities, provisions and funding so that minimum capacities for quarantining, testing and isolating can be made available for the barangays and municipalities/cities in their jurisdictions.³

On the other hand, a revival of economic activity could be phased-in similarly and would depend on an adherence to, and enforcement of, public health protocols, including social distancing and/or use of personal protective equipment as well as testing protocols, such as random testing of high contact personnel, by and among private establishments. We suggested that given the imperative of delivering food and essential goods to quarantined households, establishments involved in these supply chains should immediately be allowed to operate freely, restoring their operations to as full a capacity as possible while complying with recommendations for personal hygiene, use of personal protective equipment (PPE), workplace modification,

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¹ Monsod et. al. “Surviving the Lockdown and Beyond”, UPSE DP 2020-04
(<https://www.econ.upd.edu.ph/dp/index.php/dp/article/view/1527/1010>)

² Conversely, that the health system should be immediately and adequately provisioned so that lockdown restrictions can be lifted as quickly as possible.

³ For instance, barangays can have the capacity to quarantine and isolate, but would require outside assistance for testing. Such assistance can be provided proximately by cities/municipalities through their health system. But cities/municipalities would also need assistance in testing when dealing with many barangays; developing capacity for testing using local health staff might take time. Thus, special action testing teams organized by the province, which might have better capacity for scale-up organization, could be considered (A.N. Herrin, notes, unpublished.)

environmental disinfection and social distancing, among others.⁴ To minimize the risk of the virus spreading, random testing for possible ‘super spreader’⁵ occupations (such as postal and courier services, transport workers, food vendors, personnel of food delivery establishments and bulk food transport services) was a condition for continued operation.

The former, a geographical approach, is the default approach and seems to be slowly gaining ground.⁶ The latter, sectoral approach, has yet to be detailed and is the focus of this paper. Here we propose principles and parameters for how supply chains can be unbundled and organized by sector and quarantine restrictions lifted accordingly, at the same time providing authorities with regular and reliable information on the behavior of the disease on the ground. We assume that, in the best case, a stable long-term scenario may come about only 18 months⁷ from now when a vaccine is expected to be available that can protect the population in the same way the flu vaccine is regularly administered.⁸ Until then, intermittent but limited lockdowns will remain a policy tool for local and national public health authorities to wield when necessary. Our proposal includes a mechanism by which these decisions can be made based on more rigorous information.⁹

Organization by sector

We identify sectors along two dimensions. **First, by how important the sector is to sustaining the economy over the next 18 months**, classifying each simply as ‘high’ or

⁴ https://www.osha.gov/Publications/influenza_pandemic.html

⁵ The term “super spreader” refers to infected individuals that unusually transmit the disease to many other individuals. Factors such as congestion, be it in the workplace or community, increase the risk for “super spreaders” of COVID-19. In the previous paper, we used the term to apply to occupations that have high human-to-human interaction or reach.

⁶ Although the IATF continues to control the ECQ, city mayors in NCR have been managing within-city movement and have imposed stricter restrictions on barangays when they have deemed it necessary. The April 21 announcement of the PNP, that it will begin to arrest lockdown violators without warning, may be a step back however (see <https://www.rappler.com/nation/258570-pnp-begins-arrest-coronavirus-lockdown-violators-without-warning>.) Better information delivered at the barangay level might be more effective than fear tactics.

⁷ <https://www.livescience.com/coronavirus-covid-19-vaccine-timeline.html>

⁸ Alternatively, a drug (antiviral) or therapy may be developed that can combat the virus directly or improve management or treatment of the disease (as opposed to making one immune), or the population may achieve sufficient “herd immunity” for the virus to stop spreading further. In the former, even if an already existing drug (e.g., chloroquine) is used, proper scientific testing and approval of these typically takes time, e.g., 1-4 years; whether Philippine authorities will be willing to grant provisional permission to use some drugs widely before then is not clear. The latter happens when enough of the population has contracted the disease and has recovered. (E. de Dios, “Covexit”, 19 April 2020, unpublished)

⁹ The proposals here also assume that protocols for the testing and care of health care personnel, military, police and others in the frontlines are in place and will continue. As such, these sectors and occupations are not discussed in this paper.

‘low’. Goods and services involved in the supply chains for food and essential goods would be classified as ‘high’; occupations involved in public works¹⁰, private construction and BPOs may also be considered “high”.¹¹ Others, including schools and other educational institutions, would be classified as ‘low’.

Second, by the potential contribution of occupations to the spread of the virus, i.e., whether they involve extensive client contact or not. ‘High-risk’ spreader occupations would include those involved in logistics and transportation networks, food distribution and retail networks, hotel and restaurant and other entertainment/retail networks (malls, theaters, casinos). Other occupations would be ‘low-risk’ spreaders.

Combining the two dimensions results in four economic clusters as illustrated in the Figure below. In three out of four clusters – A, B and D – restrictions on movement can be lifted, with just basic safety measures in place for those in A and additional requirements, specifically, sample-based random testing for B and D respectively. **That is, restrictions can be lifted across many sectors for as long as sample-based random testing is introduced.**¹² The rationale and design principles for random testing are described in the next section.

It is important to note that, as a rule, workers in clusters A, B and D who can be placed on work-from-home arrangements should maintain such arrangements until a vaccine or cure is available, and in no case should restrictions be lifted for workers of ages 60 and above and/or with comorbidities; work-at-home arrangements should be required for them. In all cases, young adult workers should also be given specific instructions on how to prevent the possible spread of infection if they live with vulnerable family members (e.g. elderly, with comorbidities).

It is also important to note that except for Cluster A, where place of work and place of residence are more or less the same, the other economic clusters have an important ‘place of residence’ dimension.¹³ Workers in Clusters B and D can be monitored and can be safe at place of work with proper measures, but if their area of residence is infected, their mobility is affected; they cannot travel to their place of work if they are home quarantined. Infections can also happen en route while commuting from one place to the other.

¹⁰ This includes the construction, repair and maintenance of public infrastructure including buildings, bridges, flood control works, MRT/LRT, among others.

¹¹ Construction is a high-employment activity. BPOs was a high growth sector within the services sector, the fastest growing component of GDP, pre-covid, and already uses non-contact technology.

¹² This is in contrast to what some have proposed, e.g. where sectors/firms are allowed to open with 100 percent of workers, with 50 percent of workers on site and 50 percent at-home, with 50 percent of workers, or 0% of workers.

¹³ For this and the next key point, our thanks to A.N. Herrin.

Hence, of prior importance is ensuring that the spread of the virus can be controlled at the barangay level, so restrictions on mobility can be lifted for workers in those barangays in order for them to join activities in Cluster B and D, as well as on mass public transportation systems. The former implies that the geographical approach precedes the sectoral approach. The latter implies that a sequence even within Clusters B and D will be needed, where health protocols for the operation of mass public transport facilities (in cluster D) have to be implemented first.¹⁴

Restrictions on movement would not be lifted for establishments in Cluster C.

However, establishments may continue to operate by modifying business models as many are now doing (e.g. remote learning, virtual concerts, take-out and delivery services). Moreover, **where the larger geographical unit – namely, the province or highly urbanized city – has no reported case yet, Cluster C establishments may open and could be treated like Cluster B firms, with periodic sample-based testing.**

The matrix can also be used to classify exporting firms who continue to service foreign clients or who are able to pivot their operations to serve the domestic market. Along with BPOs, exporters (in PEZA, etc.) are currently considered “essential”, i.e. they are allowed to operate using skeletal workforces under the ECQ. Presumably this enabled them to continue fulfilling contractual obligations made prior to the ECQ. While it is expected that foreign demand will be muted in the immediate aftermath of the lockdown, exporting firms may be able to reconfigure their operations to respond to domestic demand, in which case they will likely fall under cluster B or D.

¹⁴ It also means that protocols for the identification of workers who can move under the sectoral approach need to be very clear and well-coordinated among the IATF, the PNP and the LGUs. Otherwise enforcement costs can be prohibitive.

		Importance to sustaining the economy for the next 18 months*	
		<i>Low</i>	<i>High</i>
Extent of client contact (i.e. potential contribution to spreading the virus)*	<i>Low-risk spreaders</i>	A = family subsistence agriculture workers Action: Lift restriction on movement, excluding ≥ 60 yrs and/or with comorbidities. Minimum requirements: basic safety measures (social distancing, face masks, coughing manners, handwashing)	B = Workers in food and agricultural production, banking and finance institutions, telecoms, BPOs Action: Lift restriction on movement, excluding ≥ 60 yrs and/or with comorbidities Minimum requirements: basic safety measures. Implement periodic sample-based random testing.
	<i>High-risk spreaders</i>	C = Workers in malls, theaters, bars, resorts, casino. Schools & educational institutions Action: Do not lift restrictions on movement. Online and other work-at-home arrangements can be pursued. If located in provinces with no reported case, Cluster B actions/rules may apply.	D = Workers in logistics & transport networks, food distribution & retail networks including public markets and restaurants; private security workers; public works/ construction workers. Action: Lift restriction on movement, excluding ≥ 60 yrs and/or with comorbidities. Dine-in services remain prohibited. Minimum requirements: Basic safety measures; additional PPE where necessary. Implement regular sample-based random testing**

Figure. Classification of sectors/occupations and pre-requisites for lifting lockdown restrictions

[Notes: * This matrix does not include health and medical services and workers, military and police, and others in the frontlines, who are already covered by existing safety and care protocols; ** If the total costs of testing are low (see Box in next section), then a higher level of scrutiny can be adopted for some very select subgroups of D such as those in food preparation, i.e. they be treated as health workers and other front liners and be subjected to regular tests.]

Sample-based random testing: rationale and design principles

There are three reasons why random testing is preferred. **First, it is a feasible and economical way to surveil SARS-CoV-2¹⁵ infections, providing an adequate level of safety and assurance within and among firms and LGUs.** By definition, sample-based random testing schemes by sector or industry, or among neighborhood enterprises and local service providers (tricycle drivers, informal workers), could cost a fraction of mass testing schemes yet still provide statistically reliable information.¹⁶ It would be particularly useful for LGUs as part of their efforts to develop local strategies to combat the virus.

Second, it is a feasible and economical way to generate the numbers needed to truly understand and monitor the dynamics of COVID-19, i.e. to gauge whether the curve is indeed flattening and anticipate whether and when second or third waves of infection may occur. The fact is that the data available at this time are limited and compromised by selection problems;¹⁷ only those with symptoms are currently prioritized for testing. This approach is unable to provide an estimate of how many are actually infected (especially those who are asymptomatic but who are spreading the virus) as well as disease transmission rates and other indicators required to design policy (e.g. when and how to lift the ECQ, deployment of health resources across localities). As it is, little is known about whether, when, and where surges of new cases may happen.

Third, it is a feasible and economical way to monitor and gauge the extent of ‘herd’ or community immunity, i.e. when a large part of the population of an area is immune to a specific disease. If enough people are resistant to the cause of a disease, such as a virus, the

¹⁵ We thank Dr. M.A. Lansang for pointing out the difference between SARS-CoV-2 infections (which includes asymptomatic) and COVID-19 (those with the disease/symptoms.)

¹⁶ Here we refer to the common notion of mass-testing which is to test entire populations. Clearly, this will be prohibitive in terms of costs. This is not to be confused with government’s current notion of “mass testing”, which actually refers to testing activities targeted only to those manifesting symptoms, health workers and close contacts. This targeted approach is largely due to limited testing capacity but also runs the risk of being incomplete and biased given that roughly half of COVID-19 cases are asymptomatic. The need to further expand the testing coverage should differentiate objectives between diagnostic testing meant to identify people to be treated as opposed to a statistical tool meant to discover disease prevalence among the population. The latter is an informative approach intended for planning. (E. de Dios, “Covexit”, 19 April 2020, unpublished, and C. Panelo)

¹⁷ A ‘selection problem’ or selection bias refers to a bias introduced by the selection of individuals or groups or data for analysis in such a way that proper randomization is not achieved. Consequently, the sample obtained is not representative of the population intended to be analyzed, and population estimates arising from that sample are likely to be unreliable or spurious.

group as a whole has protection even if not every single individual may be immune; infection rates drop, and the disease peters out.¹⁸

Suggestions have been made for the Department of Health (DOH) to test for surveillance purposes apart from testing to *diagnose* and confirm cure in symptomatic individuals. Such suggestions have thus far not gained traction, perhaps, owing to budgetary constraints and capacity problems.

Alternatively, the DOH can share costs and capacities for surveillance testing with LGUs, who can set-up their own testing facilities (City of Marikina) or obtain equipment and then enter into partnerships with accredited laboratories (City of Baguio), as well as with **the private sector, which could partner with LGUs and laboratories** for the same purpose. If large conglomerates or private associations of firms have the capacity to organize themselves for periodic sample-based random testing, they may be allowed to go ahead as long as they are coordinated with local and national authorities so that testing samples and/or results are submitted and consolidated.

The cost of running a sector-based random sample testing for COVID 19 will depend on both the sample design and on the type of test. The gold standard, which is the RT-PCR test, is estimated to cost ₱8150 per test.¹⁹ The rapid antibody-based test is estimated to cost ₱1930 per test.²⁰ Apart from costs however, there are important trade-offs that need to be considered. The RT-PCR test gives the best estimate of the true prevalence of COVID 19²¹, but there is limited testing capacity throughout the country. Test results take approximately around a week to obtain as there are only 17 authorized testing centers operating to date.²² However, the DOH aims to reach a testing capacity of 8,000 to 10,000 tests per day by end of April 2020.²³ Setting up a testing lab is also costly. The PCR machine alone can cost between ₱2.3M to ₱8M²⁴

¹⁸ Current rapid test kits can detect the presence of IgG which is indicative of previous SARS-CoV-2 infection (and therefore, assumed immunity). However, it has yet to be established that IgG antibodies detected are truly neutralizing, i.e. that people are truly immune. The specificity of existing rapid test kits is also known to vary widely across available brands.

¹⁹ Based on case rate for COVID-19 testing as per PhilHealth Circular No. 2020-0010.

²⁰ The highest known price of a test procured by an LGU is ₱1900. With the cost of a test tube (₱5) and salary of med tech equivalent for 10 minutes (₱25), the total estimated cost per test is ₱1930.

²¹ While RT-PCR is considered the gold standard, it is not a perfect test. Test performance is influenced by many factors, which include type of specimen used, viral load at timing of collection, lab technique, among others.

²² <https://www.doh.gov.ph/covid19tracker?fbclid=IwAR3UvmRe-eaQ3IdeHcOPn7Ux5a4NQFx07q5RSz3-yElz6T0sWOCY72R9r4o>

²³ <https://news.abs-cbn.com/video/news/04/17/20/philippines-24-hour-covid-19-coronavirus-testing-10000-tests-daily>

²⁴ According to various key informants and suppliers canvassed

depending on the brand and machine capacity, not counting the cost of other equipment, supplies, staffing and laboratory space.²⁵

With the widely publicized delays encountered by the City of Marikina, one bottleneck to expanding testing capacity would seem to be the DOH certification and licensing process for Biosafety Level (BSL) 2 laboratories. The City of Baguio was able to avoid going through the certification and licensing process by buying its own PCR machine and placing it with the Baguio General Hospital and Medical Center which is an accredited BSL 2 laboratory.²⁶

All the above considered, a feasible sector-based random sample testing scheme could have the following features.

1. Two-level design: (i) a random sample of firms; and (ii) a random sample of employees within the selected firms. The random sample of firms would be drawn from lists formulated by the Department of Trade and Industry (DTI) and the Philippine Statistics Authority (PSA)²⁷, which should be able to identify firms by sector and across locations; firms which operate strictly within one LGU – such as local service providers or neighborhood retail outlets – would be included in a separate, LGU listing. The size of the random sample of employees per selected firm would depend on the size of the firm – with more than 100 workers, with 31-100 workers, and with 30 or less workers – and the physical location of (or nature of) workers within a firm.
2. Representativeness of the overall sample in each sector can be approximated by the number of workers tested multiplied by the number of firms sampled multiplied by the frequency of testing. As a rule of thumb, the product of these three elements must approximate a sample size of 1,000 per month.

²⁵ Another type of PCR-based test exists, which runs on GEnEXpert machines currently used for TB diagnoses and surveillance, and which can be a game changer for the country (https://cnnphilippines.com/news/2020/4/13/DOH-awaits-3,000-cartridges-COVID-19-test-.html?fbclid=IwAR3fyx4QAmq3DyLjVrnR_DvvaXlcExnHx2beeEyhRcQzYsxiXWzexfCDc-A).

However, supply may be limited <https://www.theguardian.com/world/2020/apr/01/absolutely-wrong-how-uk-coronavirus-test-strategy-unravelling>

²⁶ <https://www.baguioheraldexpressonline.com/baguio-not-ready-for-mass-testing/>

²⁷ The PSA maintains and updates a register of businesses (called the List of Establishments or LE) that contains basic information such as industrial classification (using Philippine Standard Industrial Code), geographical location, employment, legal organization, and economic organization. Despite best efforts to categorize firms by PSA, however, caveats remain. It is possible that firms can change their industrial classification over time and not inform PSA. Further, firms can engage in multiple activities of equal weighing but still declare only one activity under the LE. All these might have an effect on sampling.

3. The frequency with which tests are done is also integral to the sampling design. Workers in Cluster D firms might have to be tested on a weekly basis to allow for close to real-time monitoring. Workers in Cluster B might be tested less frequently – say, every two weeks.
4. To illustrate, a back of the envelope sample size estimate would be roughly 10 to 20 firms, depending on the size of the sector, and 2 to 10 workers per week depending on the size of the firm. For instance, assuming all workers are in one location with the same degree of mobility, a random sample of 10 employees could suffice if workers are > 100, 5 employees if workers number from 31 to 100, and 2 employees if workers number 30 and below.
5. As to the type of test, the rapid antibody-based test (@ ₹1930 per test) can be administered to all employees selected as samples for the week. **If a sampled worker tests positive, then a RT-PCR testing protocol – by individual or pooled – would commence for the entire shift of workers that were exposed to the infected individual.** We endorse the pooled approach, given the substantial difference in costs, all else held fixed.²⁸ An example of this costing is provided in the Box below.
6. Additionally, once any of the workers test positive for COVID-19 using the RT-PCR test, three actions will be necessary: **1) bring all workers to a certified quarantine facility (or hospital if symptomatic); 2) disinfect the workplace; and 3) trace close contacts in the community where the infected worker resides.**

It should be clear from the example in the Box, that the burden of sector-based testing is the actual cost incurred if and when a sampled worker is tested positive. For firms, this is the opportunity cost of missing out on firm level preventive measures - among others, the practice of social distancing, the use of face masks and other more elaborate PPE if social distancing is difficult, the practice of proper cough manners and hand washing, etc. The provision of nearby housing for employees could also be a justifiable preventive measure if reckoned against the possibility of infections that may occur when staff is in transit or at home. A study in Singapore reported that surveillance and segregation of work units into smaller working subgroups had

²⁸ Pooling of samples is done for many diagnostic testing protocols such as for HIV (up to 100 samples) and influenza (10 samples). See https://journals.lww.com/aidsonline/Fulltext/2000/12010/Feasibility_of_pooling_sera_for_HIV_1_viral_RNA_to.15.aspx, and <https://jcm.asm.org/content/50/3/891>, respectively. For COVID-19 testing, guidance from India is recommending no more than 5 samples per pooled specimen, in order to optimize accuracy (<https://www.mohfw.gov.in/pdf/letterregguidanceonpoolingsamplesfortesting001.pdf>).

significantly lower serologically confirmed infections compared with subgroups using the standard pandemic plan (17% vs 44%).²⁹

It should also be clear that even under pooled testing, the capacity of current RT-PCR testing will be overrun. **Expansion of DOH capacity to accredit private and LGU laboratories is urgent.** Existing testing facilities could be deputized to accredit other facilities. Firms, in partnership with private hospitals can also be allowed to build their own testing capabilities, and then themselves become accreditation agents.

Example: Expected cost of a firm in Cluster D who is randomly selected for the week.

If < 31 workers, (i) the antibody-based rapid test for 2 workers (@ ₱1930/test) = ₱3,860. If a sampled worker tests positive, and all are in one contiguous location, then (ii) administering RT-PCR test for all 30 workers, @ ₱8150/test) = ₱244,500. (This assumes that all exposed workers will be taken off the line and quarantined for 14 days. DOH DM 2020-0151 does not require another RT PCR test if the suspected, probable or confirmed case improves and is not symptomatic at the end of the 14- day quarantine period.)

If between 31 to 100 workers, (i) antibody-based rapid test for 5 workers (@ ₱1930/test) = ₱9,650. If a sampled worker tests positive, and assuming workers are in one contiguous location, then (ii) administering at least one RT-PCR test for all workers would cost between ₱252,650 (31 workers) to ₱815,000 (100 workers).

If > 100 workers, (i) antibody-based rapid test for 10 workers (@ ₱1930/test) = ₱19,300. If a sampled worker is tested positive, then one confirmatory RT-PCR tests for, say 200 workers identified as vulnerable (within the same contiguous location, etc.) would cost ₱1.63M.

The above assumes individual-level RT-PCR testing. However, to cut down on RT-PCR testing costs if and when a sampled employee is tested positive, another approach would be to pool blood samples or swabs from employees of the firm into groups or batches of, say 5, so that only 20 RT-PCR tests will be processed for a hundred workers. Only those batches that show positive results will be subjected to individual worker tests. For example, a firm of 100 workers that has to undertake RT-PCR testing will have employees' blood or swab samples grouped into 20 batches. This will bring the initial RT-PCR testing cost down to ₱163,000 (= ₱8150 X 20 batches). If, for example, four batches are found to have a positive sample, then all employees belonging to these two batches will have to be individually tested, i.e. 4 batches x 5 employees x one confirmatory RT-PCR tests = ₱163, 000.

For a firm with 100 workers, the RT-PCR protocol would therefore cost ₱163,000 (initial RT-PCR test) + ₱163,000 (if 4 batches are positive) = ₱326,000, substantially lower than ₱815,000 under a regular protocol where all 100 employees undergo RT PCR testing at least once.

²⁹ Lee V, Yap J, Cook AR, Chen M, Tay J, Barr I, et al. Effectiveness of public health measures in mitigating pandemic influenza spread: a prospective sero-epidemiological cohort study. J Infect Dis. 2010;202:1319–26. PubMed <https://doi.org/10.1086/656480>

As indicated in #1 above, **the DTI, PSA and LGUs would play key roles in a sectoral approach - in tandem with the DOH, which would have to aggregate and analyze surveillance data in real time.** DTI/PSA would be responsible for identifying firms per sector – particularly firms whose operations cut across city/municipality lines, and shared facilities such as ports, common food terminals, inter-city/province transportation and delivery networks (e.g., inter-city/province bus franchises, LBC) – and selecting a random sample per week. City/municipal LGUs would be responsible for the same but limited to firms whose operations are confined to within their borders, e.g. neighborhood/city markets, retail stores and service centers, local transportation providers, and the like. The design of testing and sampling protocols to be used by DTI and LGUs shall be based on these lists and be in accordance with COVID-19 testing guidelines used by various health authorities worldwide, subject to the approval of DOH.

Note that the geographic and sectoral approaches can be decoupled. A city/municipal LGU may be ready to implement the geographical approach – determining when and to what extent in-city movement can be permitted, and implementing targeted barangay lockdowns when warranted – but may not be ready to implement a sectoral approach at the local level, even if DTI is ready to implement the approach at the regional level. If this is the case, the enterprises that operate strictly within that city/municipality may remain closed, while enterprises whose operations traverse jurisdictions may start to operate.

In any event, the role of LGUs in lifting the current ECQ and managing responses on the ground moving forward, cannot be overstated. All forms of support, from both the national government and the private sector, should be provided to LGUs.