Research Note 2. August 29 2021

The delta variant and the response to it by governments led me to continue working on this topic. Comments from two former UMD colleagues, P. Wonnacott and P. Cramton, suggested I read "The Premonition" by Michael Lewis. Following their suggestion confirmed the validity of continuing working on the topic. This book is useful in understanding various dimensions of this very dynamic ongoing process and of USA health bureaucracies' limitations in handling pandemics. Equally important, with country specific adaptations, these limitations easily extend to all bureaucracies and to all countries as they follow from collective action problems in providing public goods. Most directly, this book is an important reference for understanding the evolution of COVID-19 in the U.S in 2020 and early 2021. More indirectly, one can relate the issues highlighted by this book and brought out by the pandemic to Mancur Olson's "Rise and Decline of Nations". Finally, and more generally, the topics raised by Lewis generate issues known in the economics literature as principal- agent problems at several levels. At an initial level they arise between elected politicians (or authoritarian leaders pretending to embody the essence of the nation) as agents and citizens as principals. At a second level, they arise between elected politicians (or authoritarian leaders) as principals and professional bureaucrats as their agents. At the bureaucratic level, they also arise in two different ways. First, between centralized high- level administrators and their subordinates responsible for implementation. In decentralized systems, similar problem arise between federal or national coordinating authorities and the local ones dealing directly with the public. In all these settings, uncertainty issues leading to risks involving adverse selection and moral hazard emerge in a background of Knightian uncertainty provided by the pandemic.

For current purposes, I will simply review the new evidence on the biweekly spread of the delta variant using the same elementary statistics and vaccination rates as before from July 23 to August 20 for the same 40 spatial units used in the previous research note. Below, I present this information for the 20 original spatial units in Table 7A, which is comparable to Table 6A in Research Note 1, and for the subsequent 20 countries in Table 7B, which is comparable to Table 6B in Research Note 1. (Research Note 1 under the title "Understanding Elementary Statistics on COVID. Implications .Rev. July 28 2011" is available at http://econweb.umd.edu/~betancou/development.htm). Subsequently, I interpret this evidence, influenced by the literature mentioned in the previous paragraph, our earlier discussions and supplemented by other specific sources, which I note when introduced. The objective is the same as before, namely understand the relevance of different policy approaches in the context of the classification of spatial units as suppressors and mitigators.

IV. Are Earlier Conclusions Supported or Invalidated by the New July-August 2021 Evidence?

The main earlier conclusion in Research Note 1, item III, was that a combination of population- based policies (PBP) early with vaccination- based policies (VBP) later in the pandemic were complements and not substitutes in arriving at a long- term policy strategy (LTPS) for the pandemic.

A. *Suppressor Countries.*

The evidence for the suppressor countries not only confirms this conclusion, which I discuss first, but it provides an additional nuanced implication, which I introduce and discuss subsequently. Tables 7A and 7B identify eight suppressor countries. The first three in Table 7A (China, New Zealand and Australia) show no change at this level of aggregation with respect to the positivity rate, despite our knowledge

from journalistic sources that the spread of the delta variant violated the zero spread goal of their earlier PBP in 2020 during the period July-August 2021.

For instance, in China this spread started in Nanjing where it led to new dramatic lockdown restrictions in pursuit of the original goal (https://apnews.com/article/China-delta-variant-coronavirus-pandemic-lockdown-292b84b26eb41888c579a6460c2647c3). In terms of our data, it showed in an increase in the infection rate per million during the period from 64 to 66 but this had no impact on the positivity rate or the percentage change in the per capita death rate during any two- week period at this level of aggregation. What did change during the period was an increase in the vaccination rate, which was somewhat smaller in magnitude than during the June- July 2021 period reported in Research Note 1. New Zealand had a similar experience to China in that there was no change in either their positivity rate or their percentage change in the last two-weeks per capita death rate during this period. Yet, two cities have gone into temporary severe lockdowns in pursuit of the zero spread goal recently (https://www.reuters.com/world/asia-pacific/virus-free-new-zealand-investigating-new-community-covid-19-case-2021-08-17/). They also experienced a substantial increase in their vaccination rate compared to the Chinese, especially given their much lower stating base. Yet, the stress of the temporary lockdowns to fight community spread led a high- ranking health official to public confusion. He stated, much to the general amusement of audiences, that people want to go outside to spread their legs instead of to stretch their legs! In Australia, on the other hand, the impact of the delta variant spread was strong enough that it even showed in substantial increases for two biweekly periods during August in the percentage change of the last two-weeks per capita death rate. Their vaccination rates increased in magnitudes similar to New Zealand during the July-August period and complaints about new lockdown restrictions by citizens and politicians were widely reported in the press.

While all three countries experience continue to validate the general complementarity conclusion about policy strategy, questions posited in the China article above about the merits of the zero spread goal suggest fatigue with the goal's economic implications there. Namely, the economic costs imposed by limits on internal and external travel seemingly required in pursuit of the zero spread goal. Recently, even prominent politicians have started to question the zero spread goal in Australia (https://www.wsj.com/articles/delta-variant-foils-australias-zero-tolerance-strategy-for-covid-19-11629453402) and for similar economic reasons to those underlying China's fatigue. This questioning process has also started in New Zealand but seems far less advanced there at this time.

Of the remaining suppressor countries with PBP/PBP long-term strategies, one in table 7A and two in Table 7B, all experienced changes in their positivity rates (South Korea, Vietnam and Taiwan). The first two experienced increases in this rate due to the spread of the delta variant. This raises doubts about their ability to pursue a zero spread goal (https://www.gavi.org/vaccineswork/why-i-no-longer-think-we-can-eliminate-covid-public-health-expert). In South Korea's case, the increases are taking place at a decreasing rate. Thus, the possibility that South Korea can remain in the suppressor's category (POS < .015), regardless of whether or not it had or has given up on a zero spread strategy, is a sensible tentative conclusion at this point. Moreover, South Korea seems to have switched effectively to pursuing a VBP, since its vaccination rate is increasing during the period faster in absolute terms than the other four suppressors with vaccination rates below 100 and in percentage terms than the three with vaccination rates above 100. Vietnam, on the other hand, shows serious effects from the spread of the delta variant through their substantial increase in positivity rates and in its substantial increases in percentage changes of last two- weeks per capita death rates during each biweekly within the July

August 2021 dates. Moreover, their low but increasing vaccination rates suggest that they may be switching to a long-term strategy relying more heavily on vaccination rates. Indeed, officials have already acknowledged the impossibility of a zero spread goal as well as their need for additional vaccines (https://www.eastasiaforum.org/2021/08/02/vietnam-and-asias-pandemic-exit-strategy/).

Finally, the spread of the delta variant in Taiwan has been slower than in other countries, which is an important reason for their decreasing positivity rates not only during this six- week period but also during the earlier June- July period. Similarly, the decrease in the percentage change of the last two-weeks per capita death rate from early June to early July and from late July to late August is also indicative of their having it under control. Support for the latter assertion arises from its increased vaccination rates during the July-August period, which also suggests an eventual switch to a VBP as part of their new long-term policy strategy. Recently the official in charge of Taiwan's pandemic response has denied that Taiwan is pursuing a zero spread goal while admitting that their policies are oriented in that direction (https://www.taiwannews.com.tw/en/news/4275974). Indeed, we may characterize that attitude as the optimal one for suppressor countries that want to remain in the category due to the difficulty in implementing a 'perfect' zero spread goal as described, for example, in this roadmap (https://covidactiongroup.net/roadmap). More generally, the experience of these three countries during the July-August period also validates the complementarity conclusion about PBP and VCP policies as intertemporal and co-temporal complements in a LTPS.

With respect to the last two suppressor countries, Denmark and Singapore, they both have the same constant and very low transmission or positivity rate during the whole July- August period of 0.4 %. In both cases, the percentage change in the last two- weeks per capita death rate experiences substantial increases in the August biweekly periods while their vaccination rates as well as the patterns of their increase are very similar. The biggest difference in the two countries is in the intensity of their adoption of case-based policies relative to population- based policies. The testing rate per million persons in Denmark was 4.75 times that of the testing rate in Singapore, which suggests a much more intense adoption of CBP policies in Denmark. At the same time, around August 2020, per capita deaths in Denmark were about 441 per million persons whereas in Singapore they were about 8 per million persons. This substantial difference suggests a far greater reliance by Singapore on PBP with a consequent decline in transmission and subsequently in per capita deaths. Thus, this comparison confirms the complementarity between VCP and PBP policies as a Long Term Policy Strategy. Furthermore, the more important nuanced implication is **that the welfare objective of minimizing per capita deaths in a society arises far more efficiently from a combination of PBP early with VCP late than through a combination of CBP early with VCP late. Indeed, the efficiency ratio with this metric is over 55 in favor of the PBP/VBP combination!**

I have stressed conclusions in the discussion in this note, thus far, and the Denmark/Singapore comparison just yielded a new one for future consideration. Nevertheless**,** I conclude this discussion of suppressor countries with two relevant questions for future research. **How much consistency over time in attaining zero spread internally is necessary for a country remaining classified as a suppressor?** Additional observation and a detailed comparison of South Korea's experience with China, Denmark and Singapore should provide some answers. Finally, it is noteworthy that, despite its success, Singapore is beginning to question the merits of a zero spread goal due to the economic costs. This questioning enhances the importance of our distinction between suppressor and mitigator countries and suggests the formulation of another relevant question **– is it possible to be a suppressor country or area without**

a zero spread goal over a pandemic's evolution? Denmark and South Korea suggest a yes answer, China, New Zealand, Australia, Singapore and Vietnam suggest a no answer and Taiwan suggests a maybe answer!

[Insert Table 7A and 7B here.]

B. Mitigator Countries.

Just as in the case of Research Note 1, the discussion of mitigators requires obtaining additional information, which is available in Tables 7C1 and 7C2 below. The latter correspond to Tables 6C1 and 6C2 in the previous research note, respectively. We now have 32 mitigator spatial units, i.e., 30 countries since Thailand now classifies as a mitigator and 2 US states. Table 7C1 presents the data for the 10 mitigator countries that experienced a non-negative change in the last two- weeks per capita death rates during the three biweekly periods between June 11-July 09 2021. These countries were the ones, in principle, most likely to suffer most from the spread of the new delta variant. The data for July-August confirms that expectation in almost all cases and challenges it in at least one case.

[Insert Table 7C1 here]

One obvious challenge to the expectation is Chile, which experiences a substantial decrease in the last two- weeks per capita death rate change of 50 percent over the three biweekly periods in the July23 – August 20 2021 period. Moreover, this coincides with a 6 percent decrease in the positivity rate during the same period. The latter decrease also coincides with substantial increases in vaccination rates as well as an upgrading of vaccine quality by increasing the share of those that, indirectly , lower transmission the most through their effectiveness in preventing symptomatic illness from COVID-19 (https://www.reuters.com/business/healthcare-pharmaceuticals/sinovacs-covid-19-vaccine-585-effective-preventing-illness-chile-real-world-2021-08-03/). Incidentally, this period also coincides with the winter season in Chile. Thus, it is possible for aggressive increased vaccinations to coincide with lower transmission rates even in the presence of the delta variant, winter and with prior levels of high transmission rates. Of course, it is also noteworthy that Chile has pursued PBP policies that include very aggressive internal lockdowns (including substantial fines for violating mask-wearing mandates) tempered by some enforcement inconsistency, especially during the period coinciding with their summer between December 2020 and February 2021 (https://www.bmj.com/content/373/bmj.n1023).

A most obvious case confirming the expectation that high percentage increases in the last two weeks per capita death rate changes during the June-July period is a good predictor of suffering from the spread of the delta variant during the July-August period is Cuba. Most directly, the increases of changes in the last two-weeks per capita death rates during these three biweekly periods mushrooms to 718% in the July-August period, coinciding with a 49% increase in the positivity rate for the July-August period. In interpreting these numbers, note that the positivity rate relies on cumulative measures while changes during the last two- weeks per capita death rate relies, of course, on changes in changes. Hence, one would expect greater volatility in the latter measure. That is, a 49 % change in the lower volatility indicator is a much stronger signal than the same percentage change in the higher volatility indicator. This difference underlies the assertion that, given a substantial positive change in the last two-weeks per capita death rate during this period, Cuba provides the strongest case confirming the expectation of additional suffering from the spread of the delta variant, as measured by the substantial increase in the positivity rate (highest among the ten countries in Table 7C1). Thus, the coincidence between increases

in last two-weeks changes in per capita death rates and the positivity rates exhibited in June-July in creating human suffering takes place at higher values of both during the July- August period.

Moreover, if one were to measure the changes between July 09 and August 20, which covers 4 two-week periods rather than three, one finds a vaccination rate increase of 82% that coincides with an increase in the positivity rate of 90%. This 4 two-week period would include July 11. This day Cuba experienced the most intense and widespread protests against the government over the last 62 years, which may have contributed to a substantial spread of COVID 19. Nevertheless, even if you exclude the event by looking only at the three two- week period July 23- August 20, you still find that a 44% increase in vaccination rates is associated with a 49% increase in the positivity rate. Incidentally, Cuba's health regulator approved Emergency Use Authorization of their two vaccines in third stage trials in July (Abdala) and August (Soberana 2), respectively. Cuba claims about 92% efficacy in both cases but provides no support data for the claim. Indications of their effectiveness will take a while to materialize, since at best the third stage trials concluded by the end of May. Cuba first reported to our world in data by the end of May, having administered 17.99 doses per 100 persons in the population by May 31 2021. Given that these two vaccines are of a different type than Moderna and Pfizer, which have about 95% efficacy and drop to 66% effectiveness with respect to positivity rates in the general population, we would expect at best a similar drop with respect to vaccine effectiveness in the Cuban case.

Of the other eight countries in Table 7C1, five have nonnegative positivity rate changes during the July-August period (Botswana, Jamaica, UK, USA and El Salvador). Thus, confirming the expectation of further suffering due to the spread of the delta variant. Noteworthy here is that during the July-August period there is a crossing between the UK and the USA in terms of the level of per capita deaths favoring the UK (that is, lower levels for the UK after experiencing higher levels since the November 27 2020 biweekly period, Betancourt (April-June 2021, Appendix 1 Tables, available at http://econweb.umd.edu/~betancou/development.htm). Coinciding with this crossing in per capita deaths during the period is an increase in the absolute gap of administered vaccine doses per 100 persons in the population between the UK and the US. **These two facts illustrates two features of the pandemic for mitigator countries brought out by the delta variant. First, the value of lowering positivity rates over the duration of a pandemic with respect to this important metric of human welfare, regardless of whatever happened during the initial and intermediate stages of the pandemic. Second, the intertemporal and contemporary complementarity between PBP and effective VBP as elements of a long-term policy strategy towards a pandemic.** Two of the three remaining countries in this group (South Africa and Bangladesh) show decreases in the last two- weeks deaths per capita during the July-August period and increases in the positivity rate. While the former sign is a favorable one for the future, the latter sign is an unfavorable one especially given current high levels of POR in both countries. Thus, improved efforts in policy implementation make sense in these countries for two reasons: the lower volatility of the positivity rate compared to that of changes in the last two- weeks per capita death rate and the very low vaccination rates in these two countries. Finally, Nigeria shows a positive increase in the change of the per capita death rate with a decrease in the positivity rate at a very low vaccination rate as well as little change between the June-July and July-August periods. Hence, it seems wise to wait for further data accumulation in this case before assessing the impact of the delta variant.

[Insert table 7C2 here]

Turning to the remaining 22 countries in the mitigator category, which are included in Table 7C2, we find that 8 of them continue to have a negative change in the rate of change in per capita deaths over the last two-weeks and a non-positive change in the positivity rate. Four of them (Bahrain, Germany, India and Egypt) also have positivity rates below 10%. In addition, the first two countries in the group have vaccination rates over 100 doses per million persons and the other two have vaccination rates below 50 doses per million persons. These numbers are consistent with the respective policies (VBP and PBP) pursued by both sets of countries during 2021 and their standing as high income and low income countries, respectively. Moreover, they are suggestive of a capacity for addressing the challenges of the pandemic in the future with relative low levels of per capita deaths per million persons in the population. The remaining four countries (Peru, Costa Rica, Argentina and Colombia) have similar signs for the changes in the death rate per capita over the last two - weeks (negative) and in the positivity rate (negative). Nonetheless, they have middling vaccination rates (between 50 and 85 doses administered per million persons) and positivity rate levels higher than 10%. These two features suggests a high potential for continued failure against the main human welfare consequence of the pandemic, namely the level of deaths per capita in the population.

Of the 14 remaining spatial units, 7 experienced a positive change in the rate of change in the last two-weeks death rate per capita and a decrease in the positivity rate. Of these 7, 4 (Canada, Maryland, Italy and France) have positivity levels below 7% and 3 (Kenya, Thailand and Brazil) have positivity levels above 9.8%. The four units in the first group are high- income level with vaccination rates above 120 doses per million persons administered as of August 20 2021 while the three units in the second group are 1 low-income country (Kenya) and 2 middle- income countries with vaccination rates below 100 doses administered per million persons as of this date. Three of the four units in the first group LTPS consisted of CBP in 2020 with VBP in 2021. Canada is the exception having had a PBP in 2020 and adopting VBP in 2021 somewhat later than the other 3 units. By August 20 2021, however, the first group had levels of per capita deaths above 1,600 per million persons, except for Canada with 703 per million persons. Among the countries in the second group, the first two had PBP in both 2020 and 2021 and the third one (Brazil) as well during 2020, if ignoring the virus qualifies as a policy, and early in 2021 when it became a VBP. Not surprisingly, by August of 2021, the first two countries have less than 200 deaths per person similar to most mitigator countries in their respective regions (Africa) and South East Asia where as Brazil has more than 2,000, which is also similar to most mitigator countries in their region (South America).

In any event, the first group of units in this group is in a reasonable position to move in the direction of the suppressor upper limit of 1.5%. That is, in trying to bring the virus under control by increasing vaccinations as well as mask wearing and social distancing because their levels of positivity rates are not that far from the UK's peak values in January of 2021 when their vaccination campaign was getting off the ground. The latter was at .053 then and it is at .025 now despite the delta variant. Canada is in the best shape in terms of both having the highest vaccination rate (137.80) and the lowest positivity rate (.037) among the four on August 20 2021. On the other hand, the second group is in a far less advantageous position to move in the direction of suppressor status on this date than the first group. This conclusion is due to their having much lower vaccination rates than the UK's 130.54 (Brazil is the highest at 96.48 doses per 100 persons administered) and much higher transmission rates than the UK's .053 (Kenya is the lowest at .099).

Left for last is a group of 7 units experiencing nonnegative changes in the last two- weeks changes in death rates per capita during the three biweekly periods encompassed by July-August 2021 while also experiencing positive changes in their biweekly positivity rates during this six week period. These spatial units split into two easy to identify groups: those countries experiencing increases in their biweekly positivity rates of less than 5% over this six- week period (Israel, Pakistan, and Spain) and those spatial units experiencing increases over 13% in their biweekly positivity rates over the same period (Florida, Japan, Malaysia and Sri Lanka). Two of the three countries in the first group (Israel and Spain) are high-income countries experiencing setbacks in their ability to move toward the upper limit of suppressor countries due to the delta variant despite high levels of vaccination. They will have to increase their efforts to move in that direction, presumably by adopting more intense PBP since in both cases they relied on CBP policies in 2020 and VBP in 2021. PBP, as opposed to VBP, focuses directly on lowering transmission rather than per capita deaths. On the metrics for both dimensions, per capita deaths and POR, Israel has performed substantially better than Spain as of August 20 2021, i.e., 724/1792 and .054/.080. Pakistan, on the other hand, is a low- income country at very early stages of its vaccination campaign. This means it will have to improve aspects of PBP that affects transmission while waiting for COVAX, China and the U.S. to help with its vaccinations if it wants to keep is per capita deaths low.

Spatial units in the second group are in difficult conditions for moving toward the upper limit of suppressor status due to the delta variant. In the three countries, their percentage increases in positivity rates were 19% (Sri Lanka) 23% (Japan) and 25% (Malaysia). These three countries in Asia have high positivity rates, middling vaccination rates, and low per capita deaths as of August 20 2021: Sri Lanka (.082, 79.02 'doses', 123 'deaths'); Japan (.059 %, 91.51 'doses', 123 'deaths'); and Malaysia (.071, 92.34 'doses' and 411 'deaths'). It took the UK almost 8 months to move from a .053 positivity rate to its current .025. This halving of POR coincided with an increase in deaths per million persons from 1389 to 1924 and a vaccination increase from 9.32 doses per 100 persons to 130.54. Even if there are no further increases in the positivity rate due to the delta variant (or to the Olympics and Paralympics in Japan's case), how long would it take to cut in half the current positivity rates and at what cost in terms of increased vaccinations and deaths? Similarly, with respect to the remaining spatial unit, the US state of Florida, the same question arises. For, its positivity rate increase of 14% during the July-August period coincides with a current positivity rate of .088, a current vaccination rate of 102.74 per 100 persons and a current level of per capita of deaths of 1,953 per million. Note how Florida compares to the three Asian countries in terms of its current levels. With respect to transmissions (POR), it has a higher level, e.g., it is higher than the next best (Sri Lanka) by a ratio of 1.07. With respect to administered doses, it has a higher level, e.g., it compares to the next best (Malaysia) by a ratio of 1.11. Finally, and perhaps most importantly, with respect to per capita deaths, it has a much higher level, e.g., it compares to the next best (Malaysia) by a ratio of 4.75!

Concluding Remarks.

What have we learnt about the pandemic's evolution from the spread of the delta variant this summer?

For suppressor countries, doubts about the feasibility of a zero spread goal for COVID-19 exist now in all of them to some degree. One consequence of these doubts is a recent emphasis on vaccines to learn to live with the virus by all suppressor countries in order to avoid its worse consequences in terms of hospitalization and deaths this summer. For instance, by May 28 of 2021, the vaccination rate in six of the current suppressor countries was less than 50 doses administered per 100 persons. Only high

income Denmark and Singapore surpassed that rate at 56.36 and 69.19, respectively. By contrast, high-income mitigator countries such as the U.K. and Israel already were at 93.32 and 122.20 administered doses per 100 persons by that date, e.g., Betancourt (April-June 2021, Tables 3 and 5, available at http://econweb.umd.edu/~betancou/development.htm). The evidence for the new emphasis is that by August 20, 2021 vaccination rates for the four countries were 142.40, 146.10, 130.54 and 145.40, respectively. Thus, the rates of change, which are available from Tables 7A and 7B, had increased substantially for the two top suppressor countries in this dimension and, not coincidentally, decreased substantially for two of the top mitigator countries in this dimension.

Another consequence of these doubts about the zero spread goal's feasibility is a potential refining of their other COVID-19 policies (PBP and CBP) to deemphasize very restrictive lockdowns limiting internal and external mobility and emphasizing less costly aspects with other benefits. For instance, mask wearing and social distancing are far less costly in terms of resources and foregone economic benefits. The same is true of increased testing and contract tracing, which is more costly directly than mask wearing and social distancing but has lower foregone economic benefits directly. These policies aim directly at lowering transmissions, as opposed to vaccines, and are substitutes for very strict lockdowns limiting external and internal mobility, which also aim directly at transmission. Whether or not this refining takes place in repressor countries is likely to become visible during the remainder of this year when schools will be in operation everywhere.

What can we say about the impact of the delta variant on mitigator countries? Since they are at best failed suppressors, the zero spread goal either never was relevant or is no longer relevant in their case. A more realistic goal would be - can they even hope to become suppressor countries? At least they can hope to move in that direction and perhaps the most important lesson in the spread of the delta variant for these countries is that they should consider setting this goal as the more realistic objective during the rest of the pandemic for several reasons.

First, the Chilean example discussed in connection with Table 7C1 is the most encouraging evidence suggesting, in principle, the feasibility of that objective over time. Second, as noted at the beginning of this concluding section, the top mitigator countries that have pursued VCP successfully (UK and Israel) have slowed down considerably in the rate at which they have been able to administer vaccines per 100 persons in the population for a variety of reasons. Namely, 1) there are no available vaccines for children under 12. 2) Uptake by populations between 12 and 65 has been lower than in the over 65 cohort due to less exposure in time of availability of vaccines as well as probably inaccurate perceptions of risk with respect to serious consequences of COVID-19. 3) Vaccine hesitancy, nationalism and misinformation are present in all countries, regardless of platitudes to the contrary.

On the positive side, taking this goal seriously by mitigator countries removes obsession with vaccines as the sole essential input leading the pandemic to become endemic. It shifts focus somewhat to lowering transmissions and the instruments that do so directly. The latter have lower direct economic costs than vaccines and, thus, are more likely within the reach of all countries not just primarily developed ones. This does not mean ignoring vaccines, but stressing the contemporaneous complementarity between vaccines and other instruments that lower transmission directly, especially those without 'stop and go' features such as strong restrictions on internal and external mobility. Ironically, 'stop and go' approaches enhance the economically damaging, unpredictable uncertainty inherent in the pandemic.

Country/State	*Table 7A: Pandemic Response Original Countries, July-August 2021*									
	POR=IR/TR			%ΔDR (L2wks)/1000			Vaccination rate[1]			LTPS20/21
	07/23	08/06	08/20	07/23	08/06	08/20	07/23	08/06	08/20	
Suppressors:	**.000 < POR ≤ .015.**									
China	.001	.001	.001	.000	.000	.000	105.95	121.02	132.87	PBP/PBP
N. Zealand	.001	.001	.001	.000	.000	.000	32.21	41.91	54.12	PBP/PBP
Australia	.001	.001	.001	.000	.003	.056	42.55	51.10	63.53	PBP/PBP
Denmark	.004	.004	.004	.000	.005	.005	118.59	130.34	142.40	CBP/CBP
South Korea	.016	.017	.018	.000	.025	.049	44.05	52.52	67.85	PBP/PBP
Mitigators:	**POR > .015.**			**.001**						
UK	.024	.024	.025	.005	.001	.010	122.62	126.39	130.54	CBP/VBP
Cuba	.051	.063	.076	.050	.767	.359	75.46	92.50	108.48	PBP/VBP
Canada	.038	.037	.037	.004	.004	.006	124.90	132.80	137.98	PBP/VBP
Maryland	.042	.041	.041	.004	.004	.007	117.78	120.21	122.95	CBP/VBP
Japan	.048	.156	.059	.017	.008	.017	58.49	78.79	91.51	PBP/PBP
Germany	.057	.056	.056	.003	.003	.002	105.60	111.89	118.21	PBP/VBP
Italy	.057	.056	.055	.001	.002	.004	106.65	116.75	123.72	CBP/VBP
USA	.068	.067	.068	.006	.001	.017	101.77	104.34	107.53	CBP/VBP
Spain	.077	.080	.080	.002	.009	.013	114.32	124.27	134.00	CBP/VBP
El Salvador	.075	.076	.074	.043	.064	.046	60.71	71.91	84.94	PBP/PBP
France	.060	.058	.059	.002	.005	.009	100.73	112.30	121.95	CBP/VBP
Florida	.077	.082	.088	.014	.022	.064	102.74	106.54	111.24	CBP/VBP
Chile	.088	.086	.083	.038	.029	.019	130.81	134.38	144.52	CBP/VBP
Jamaica	.108	.107	.113	.051	.038	.108	10.16	10.16	13.21	PBP/PBP
Brazil	.356	.364	.362	.031	.025	.021	61.88	69.26	96.48	PBP/VBP

[1] Administered vaccine doses per 100 persons in total population; data available in (https://ourworldindata.org/covid-vaccinations

Country/State *Table 7B: Pandemic Response Classification: New Countries, July-August 2021*

Country/State	POR=IR/TR			%ΔDR (L2wks)/1000			Vaccination rate[1]			LTPS20/21
	07/23	08/06	08/20	07/23	08/06	08/20	07/23	08/06	08/20	
Suppressors: 0. < POR ≤ .015										
Vietnam	.006	.016	.020	3.000	6.000	1.607	4.60	8.28	16.36	PBP/PBP
Taiwan	.005	.004	.003	.100	.000	.061	26.25	37.26	42.05	PBP/PBP
Singapore	.004	.004	.004	.000	.167	.143	119.28	133.86	146.10	CBP/VBP
Mitigators: .015 < POR < 1.0										
Thailand	.056	.088	.122	.514	.584	.464	22.05	27.17	36.06	PBP/PBP
Sri Lanka	.069	.073	.082	.165	.217	.411	38.66	61.94	79.02	PBP/PBP
Bahrain	.050	.049	.047	.006	.001	.000	132.98	138.20	143.30	CBP/VBP
Malaysia	.057	.064	.071	.474	.341	.326	12.68	71.56	92.34	PBP/PBP
Botswana	.068	.080	.092	.144	.237	.220	13.22	15.53	81.69	PBP/PBP
Israel	.053	.053	.054	.003	.009	.037	127.64	133.35	145.40	CBP/VBP
India	.069	.067	.065	.034	.161	.016	31.01	35.89	41.06	PBP/PBP
Pakistan	.064	.067	.065	.020	.029	.038	10.91	15.98	20.25	PBP/PBP
Egypt	.093	.093	.093	.006	.006	.000	4.94	5.52	6.33	PBP/PBP
Nigeria	.071	.069	.069	.000	.000	.100	1.91	1.91	1.92	PBP/PBP
Kenya	.094	.096	.099	.029	.057	.081	2.91	3.29	4.13	PBP/PBP
Bangladesh	.155	.166	.169	.179	.188	.120	6.27	8.81	13.46	PBP/PBP
S. Africa	.162	.165	.168	.080	.076	.064	10.64	13.80	17.14	PBP/PBP
Peru	.139	.135	.132	.008	.006	.004	33.11	41.56	50.10	PBP/PBP
Colombia	.215	.211	.207	.060	.034	.016	48.22	57.02	63.80	PBP/PBP
Costa Rica	.235	.228	.227	.041	.037	.036	55.22	67.22	75.54	PBP/PBP
Argentina	.259	.251	.243	.053	.038	.026	64.33	74.64	83.99	PBP/PBP

[1]Administered vaccine doses per 100 persons in total population; data available in (https://ourworldindata.org/covid-vaccinations).

Country/State *Table 7C1: Non-Negative per Capita DR Δ, Mitigator Countries, July- August 2021*

Country/State	%Δ (% ΔDR)	% ΔPOR	DR08/20	POR08/20	Vaccination rate/08/20[1]	LTPS20/21
Botswana	52	+35	865	.092	81.69	PBP/PBP
Bangladesh	- 49	+ 9	149	.169	13.46	PBP/PBP
S. Africa	- 25	+ 4	1,308	.168	17.14	PBP/PBP
Cuba	718	+49	382	.076	108.48	PBP/VBP
Chile	- 50	- 6	1,083	.083	144.52	CBP/VBP
Jamaica	112	+ 5	451	.113	13.21	PBP/PBP
Nigeria	+ *	- 3	11	.069	1.92	PBP/PBP
UK	100	+ 4	1,924	.025	130.54	CBP/VBP
USA	183	0	1,930	.068	107.53	CBP/VBP
El Salvador	30	+ 7	432	.074	84.94	PBP/PBP

[1] Administered vaccine doses per 100 persons in total population; data available in (https://ourworldindata.org/covid-vaccinations.); *per capita deaths reported at 10 since April 30.)

*There was a positive change in the per capita death rate in Nigeria during this period from 10 to 11 but the earlier percentage change was zero. Hence, no percentage of the change in the change was calculated as division by zero makes no sense.

Table 7C2: Negative per Capita DR Δ, Mitigator Countries, July-august 2021

Country/State	%Δ(% ΔDR)	% ΔPOR	DR08/20	POR08/20	Vaccination rate/07/09[1]	LTPS20/21
Maryland	+75	- 2	1,640	.041	122.95	CBP/VBP
Japan	0	+ 23	123	.059	91.51	PBP/PBP
Bahrain	- 100	- 6	783	.047	143.30	CBP/VBP
Israel	+ 1133	+ 2	724	.054	145.40	CBP/VBP
Germany	- 33	- 2	1,099	.056	118.21	PBP/VBP
Italy	+ 300	- 4	2,131	.055	123.72	CBP/VBP
France	+ 350	- 2	1,728	.059	121.95	CBP/VBP
Pakistan	+ 90	+ 2	109	.065	20.25	PBP/PBP
India	- 53	- 6	311	.065	41.06	PBP/PBP
Florida	+ 357	+ 14	1,953	.088	102.74	CBP/VBP
Peru	- 50	- 5	5,902	.132	50.10	PBP/PBP
Costa Rica	- 12	- 3	1,029	.227	75.54	PBP/PBP
Argentina	- 51	- 7	2,405	.243	83.99	PBP/PBP
Canada	+ 50	- 3	703	.037	137.80	PBP/VBP
Spain	+ 550	+ 4	1,792	.080	134.00	CBP/VBP
Kenya	- 179	+3	80	.099	4.13	PBP/PBP
Thailand	-11	+ 117	123	.122	36.05	PBP/PBP
Sri Lanka	+149	+ 19	316	.082	79.02	PBP/PBP
Malaysia	- 312	+ 25	411	.071	92.34	PBP/PBP
Egypt	- 100	0	159	.093	6.33	PBP/PBP
Colombia	- 73	- 4	2,406	.215	63.80	PBP/PBP
Brazil	- 32	+ 2	2,673	.362	96.48	PBP/VBP

[1] Administered vaccine doses per 100 persons in total population; data available in (https://ourworldindata.org/covid-vaccinations.);