THE COSTS AND BENEFITS OF A COVID-19 LOCKDOWN

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1. Introduction

As with most other countries, the New Zealand government recently implemented a substantial curtailment of normal activities in order to reduce the death toll from Covid-19 ("lockdown"). Since then, curtailments have been lessened but still substantial, most particularly in restricting foreign visitors. This paper attempts to estimate the cost of such a policy (especially in in terms of the GDP losses) relative to the additional lives saved, so as to compare this to currently employed ratios for guiding public policy in general.

2. Analysis

To date, the New Zealand death toll from Covid-19 has been 22, and there have been no deaths since May 28.[1] The justification for the lockdown was the likelihood that the death toll would have otherwise been considerably larger. The first estimates of this type were presented for the UK by Ferguson et al (2020), who estimated that a China style "suppression" policy (which might have to be maintained for several months) would yield about 20,000 deaths in the UK (ibid, Table 4) whilst that from a much milder "mitigation" policy (involving isolation of only high risk groups and suspect cases) would yield about 250,000 deaths (ibid, page 16). Ferguson et al therefore recommended suppression, and their recommendation appears to have significantly influenced UK government policy. However, and remarkably, the paper contains no information on the costs of adopting a suppression rather than a mitigation policy. Implicitly, their goal seems to be to minimize the number of deaths regardless of the cost. This is not a rational policy, and could involve inflicting on a country a 'cure that was worse than the disease'.

[1] See https://www.worldometers.info/coronavirus/country/new-zealand/.

Turning to New Zealand, Ferguson et al's (2020) expected saving in lives from a suppression policy rather than a mitigation policy (of 230,000) would translate into 17,000 lives for New Zealand if the results here were proportional to the difference in populations (5m for NZ and 68m for the UK). These 17,000 people would be mostly old and almost all would be suffering from pre-existing conditions.[2] Ferguson et al (2020, page 7) also estimate the casualties at 510,000 from no control measures, implying a worst case saving in lives from a suppression strategy over (totally ineffective) mitigation efforts at 490,000, implying a saving in lives in New Zealand of 36,000.

Subsequent estimates for New Zealand come from Blakely et al (2020), who estimated the deaths from an "eradication" policy (akin to suppression) at 500 and those from a mitigation policy at 6,500-13,000. The expected saving in lives from eradication rather than mitigation is therefore 6,000-12,500. Blakely et al (2020) also estimated the average residual life expectancy of the victims sans Covid-19 at five years, implying the number of life years saved at 6,000*5 = 30,000 to 12,500*5 = 62,500. Because of their existing medical conditions, such people would also have subnormal life quality. Applying a 50% discount for this, the saving in Quality Adjusted Life Years (QALYs) would range from a lower bound of 6,000*5*0.5 = 15,000 to an upper bound of 12,500*5*0.5 = 37,500.[3]

Since New Zealand has suffered only 22 deaths to date, and none since 28 May, Blakely et al's (2020) estimate of 500 deaths from an eradication policy would seem to be far too high. Accordingly, their estimates of 6,500 – 13,000 deaths from a mitigation policy are also likely to be too high. To better estimate this, it is desirable to locate a country otherwise identical to New Zealand but which pursued a mitigation rather than a suppression strategy. No such country seems to exist but Sweden appears to be the best available alternative because it adopted a mitigation strategy and is similar to New Zealand is many relevant ways. In particular, both countries are largely populated by Caucasians emanating from or native to Northern Europe, with similar population density, living standards and the quality of their

[2] In respect of those dying in New York City up to May 13, 96% were at least 45, and 74% at least 65. Furthermore, in those cases where the existing medical condition of the patient was known (no underlying condition or at least one underlying condition), 99% had at least one underlying condition. See https://www.worldometers.info/coronavirus/country/new-zealand/.

[3] Blakely et (2020) do not apply any discount to reflect the imperfect health of the victims pre Covid-19. This was presumably an oversight.

health care systems. To date Sweden has suffered 570 deaths per 1m of population and the increase in the rate is tailing away to zero.[4] All countries that have experienced higher death rates (Belgium, Spain, Italy, UK, and Peru) engaged in some form of lockdown, and therefore are not suitable estimators for the death rate under a mitigation strategy.[5] So, using Sweden's death rate of 570 per 1m, New Zealand's population of 5m implies 2,850 deaths under a Sweden-style mitigation policy. The QALYs saved would then be (2,850 – 22)*5*0.5 = 7,070.

Even this figure is likely to be too high because, if New Zealand suffered the same death rate as Sweden under a mitigation policy, Sweden's Nordic neighbours (Denmark, Norway and Finland, who like New Zealand all locked down) would be expected to have had the same death rate as New Zealand, but instead have much higher rates (107, 47 and 60 versus 4 for New Zealand). A plausible explanation for this difference is the proximity of these Nordic nations to other nations with large numbers of victims coupled with land access from those other nations. So, a more reasonable estimate for New Zealand would be well below Sweden's 570 per 1m. Using 300 per 1m of population, this would imply 1,500 deaths and the QALYs saved would then be (1,500 – 22)*5*0.5 = 3,695.

Even this figure is likely to be too high because most claimed victims of Covid-19 suffered from at least one serious existing condition and some of these deaths might have occurred at the same time even in the absence of Covid-19. Similarly, if a person is shot in the heart and then the head, one cannot attribute the death to the latter. A test for this issue would be to estimate the number of deaths that would have occurred in the absence of Covid-19 and the number truly attributable to it is then the actual deaths in 2020 less the predicted number sans Covid-19. The Euromomo Network has done so and estimated the number of deaths across 18 European countries progressively through 2020, 2019 and 2018 relative to a baseline. The excess deaths in 2020 to date relative to 2019 at the same point is about 90,000 and that relative to the 2018/2019 average at the same point is about 115,000.[6] By contrast, the deaths

[4] See https://www.worldometers.info/coronavirus/country/sweden/.

[5] See https://www.worldometers.info/coronavirus/ for the death rates, and Wikipedia pages for the policies pursued by their governments.

[6] See https://www.euromomo.eu/graphs-and-maps#excess-mortality.

attributed to Covid-19 across these 18 countries were 170,457.[7] Thus, the deaths attributed to Covid-19 seem to have been in excess of the true number by 50-90%. Using the lower figure of 50%, the expected death toll for New Zealand under a mitigation policy would then be 200 per 1m, which implies 1,000 deaths and the QALYs saved would then be (1,000 – 22)*5*0.5 = 2,445.

Turning now to the costs of the policy, this principally takes the form of lost GDP. Shortly before the pandemic arose, in December 2019, The Treasury (2019, page 3) forecasted New Zealand's real GDP growth rates for 2020-2024 at the rates shown in the first row of Table 1. This is a lower bound on growth under the pandemic but with *no* curtailment of economic activity, because the pandemic would have increased health care expenditures. More recently, in May 2020, these forecasts have been revised as shown in the third row of the table (The Treasury, 2020, page 3). Arbitrarily designating 2019 GDP as 100, the GDP results under these two paths are as shown in Table 1.

Table 1: GDP Forecasts

	2020	2021	2022	2023	2024	Sum
Dec 2019 Forecasts	2.2%	2.8%	2.7%	2.5%	2.4%	
Implied GDP	102.2	105.1	107.9	110.6	113.3	539.1
May 2020 Forecasts	-4.6%	-1.0%	8.6%	4.6%	3.6%	
Implied GDP	95.4	94.4	102.6	107.3	111.1	510.8

The aggregate difference in these two paths is 539.1 – 510.8 = 28.3, which represents 28% of New Zealand 2019 GDP. Since New Zealand's 2019 GDP was $311b, this is $87b.[8] Even this may be too low for two reasons. Firstly, the 2024 GDP level under the curtailment scenario is below that from the no-curtailment scenario (111.1 versus 113.3) and such GDP losses relative to the counterfactual would continue until these levels were equal. Secondly, New Zealand has just experienced new cases after a hiatus of 107 days, leading to the partial

[7] The countries are Austria, Belgium, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK. For the deaths, see https://www.worldometers.info/coronavirus/.

[8] The GDP figure comes from Table M5 on the website of the RBNZ (www.rbnz.govt.nz).

reinstatement of restrictions (including a lockdown in Auckland), which will presumably further reduce GDP forecasts.

In summary, the QALYs saved by locking down rather than mitigating has been about 2,500 to date whilst the GDP losses from the curtailment of economic activity are expected to be at least $87b. Some of these GDP losses would have arisen without any government-imposed restrictions, because some people would have reduced their interactions with others anyway; for example, a foreigner electing not to make a trip to New Zealand that they would otherwise have made. Further losses would have arisen due to the additional actions of foreign governments; for example, foreign governments preventing their citizens from making foreign trips. Further losses would have arisen if the New Zealand government had followed merely a mitigation strategy. Further losses would have arisen from the New Zealand government instead following a suppression strategy. It is only the last of these losses that can be attributed to the New Zealand government choosing to lockdown rather than mitigate. Estimating this residue is problematic but it helps to know that its upper bound is $87b (subject to the caveats noted in the preceding paragraph).

Suppose the residue due to New Zealand locking down rather than mitigating was 25% of this $87b, i.e., $21.75b. The cost per QALY saved would then be $21.175b/2,500 = $8.5m per QALY saved. By contrast, the pre Covid-19 value of a QALY in New Zealand was about $45,000 (Kvizhinadze et al, 2015, page 3).[9] Thus, with Covid-19, the cost of adopting a suppression rather than a mitigation policy per additional QALY saved would be at least 190 times the pre Covid-19 value for a QALY. This is an extraordinary difference. Consistency would require spending $21.175b to extend the lives of 1,000 people suffering from heart disease, cancer or diabetes, which is more than the entire annual spending on health care in New Zealand.

Furthermore, the $22b loss (or whatever it is) may not be 'evenly' shared (through the tax system in the usual way with medical expenditures to extend lives). It may fall largely on two groups. The first own businesses and would suffer a loss in profits. The second would lose their jobs and remain unemployed for some period. By adopting a suppression rather

[9] Blakely et al (2020) uses the same figure. A related concept is the "Value of a Statistical Life", which values all lost years of an average aged person's life. Such estimates are accordingly much larger than the value of a QALY. Conducting the analysis at the QALY level is superior because the likely fatalities from covid-19 have very low residual life spans.

than a mitigation policy, in order to moderately extend the lives of 1,000 largely old and sick people, these two other groups might suffer substantial financial losses. The extent to which this actually occurs will depend upon the extent to which the government compensates them for these losses. Furthermore, even if the government does intervene in an attempt to protect some vulnerable groups, other vulnerable groups may be inadvertently hurt. For example, if rent payments are suspended by government for some period, landlords will suffer and some of them will be retired people who derive a considerable proportion of their modest incomes from this source. In addition, prospective landlords will not rent out their properties, to the disadvantage of both parties.

The parameters used in this analysis are debatable. The death rate under a mitigation policy may be much larger than estimated here. If it is doubled, the cost per QALY saved would halve to $4.25m, but would still be 94 times the usually accepted figure. The GDP loss from the current path relative to that if there is no curtailment in economic activity could be smaller. If it were halved, in addition to the death rate being doubled, the cost per QALY saved would fall further to $2.12m but this would still be 47 times the usually accepted figure. The remaining parameter is the proportion of the GDP loss due to lockdown rather than mitigation, which is unknown. However, any reasonable proportion will produce a cost per QALY saved well in excess of the usual figure of $45,000. To produce a cost per QALY saved equal to the usual figure of $45,000, this proportion would have to be p as follows:

$$\frac{p\$87b}{2{,}500} = \$45{,}000$$

The solution is p = .0013, i.e., 0.13%. So, if the proportion of the GDP loss due to lockdown rather than mitigation was at least 0.13%, lockdown was unwarranted. Obviously, this minimal percentage must apply. Focusing just on entertainment, the cumulative economic effect of every such human interaction with economic consequences that did not occur because of the mandatory lockdown restrictions (flights, visits to hotels, sports events, cinemas, restaurants and cafes) must have easily exceeded the 0.13% figure.

This analysis omits many relevant features, but the huge excess in the cost per QALY saved from a suppression rather than a mitigation policy over currently accepted values for a QALY provides considerable scope for such additional features without changing the fundamental

conclusion. For example, with a mitigation rather than a suppression policy, the health system may be so overwhelmed by Covid-19 cases that many other people may die from lack of care. However, even if the number of these extra deaths were as large as those from a mitigation rather than a suppression policy (Boyd, 2020, page 4), it merely halves the cost per QALY in the above analysis, still leaving the cost per QALY well in excess of currently accepted values for a QALY. In addition, there are direct medical costs of dealing with the demand surge from a mitigation rather than a suppression policy. However, any reasonable estimate of these costs has no material impact on the result. For example, if these extra medical costs were as much as $2b (Boyd, 2020, page 4), the cost of a suppression rather than a mitigation policy would then be $20b rather than $22b, which only trivially lowers the cost per QALY saved. In addition, some Covid-19 survivors may experience long-term adverse consequences.[10] Ferguson et al (2020) and Blakely et al (2020) do not comment on this, and I cannot therefore address it. However it might be recognized by adding some multiple to the QALYs saved from a suppression policy. Clearly, there is room for a large such multiple before suppression involves a cost per QALY saved no higher than generally employed figures on the value of a QALY.

In addition, the appropriate cost from the GDP losses is not the GDP losses themselves but the "economic surplus", which is the consumer surpluses (the aggregate amount consumers are willing to pay in excess of the amounts actually paid for all goods and services) plus the producer surpluses (the aggregate amounts received by producers less the amounts they would be willing to accept to produce at this level), and this sum could be more or less than the GDP losses. Again, there is considerable room for large adjustments before suppression involves a cost per QALY saved no higher than generally employed figures on the value of a QALY. In addition, there are other costs of a lockdown, in the form of increased addiction, crime, mental health problems, and premature death attendant on large scale unemployment. These raise the cost per QALY saved.

All of this suggests that the cost per QALY saved of a suppression rather than a mitigation approach by the New Zealand government is dramatically inconsistent with long-established views on the value of a QALY. This holds even if the actions of foreign governments, most of whom adopted some variant of temporary lockdown, are taken as given.

[10] See https://www.businessinsider.com.au/coronavirus-survivors-lung-damage-ards-fcim-intensive-care-research-2020-3?r=US&IR=T.

3. Conclusions

World-wide, many governments have implemented substantial curtailments of normal economic activity in order to reduce the expected death toll from Covid-19. This paper considers the effect of the New Zealand government adopting a suppression policy versus a milder mitigation policy, with the actions of other governments taken as given. The cost per QALY saved from doing so would seem to have been vastly in excess of the currently used value for a QALY of $45,000. Consideration of alternative parameter values and recognition of factors omitted from the analysis would not likely reverse this imbalance in cost per QALY saved versus currently accepted figures for the value of a QALY. The suppression policy was therefore dramatically inconsistent with long-established views about the value of a QALY.

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