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9 May 2022

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May 9, 2022

"... there have they trembled for fear, where there was no fear."

Psalms 13:5

Abstract

The present research conducts a formal analysis of the interactive decisions concerning the enterprise of COVID-19 vaccination on the part of governments and citizens. It specifically constructs a non-cooperative static game with complete information between the citizen and the government encompassing the strategies of vaccination and no vaccination with regard to the former and the strategies of direct imposition, subsistence restrictions, luxury restrictions and no imposition with regard to the latter. On account of its payoff structure the present analysis finds that the game in question presents one sole and strict pure strategy Nash equilibrium, being that of strategies no vaccination and no imposition, respectively. The core rationale is that the citizen accepts COVID-19 vaccination only if his survival is placed at risk, because of the inherent unlawfulness presented by COVID-19 vaccination, itself due to foetal exploitation and potentially adverse effects, thereby prompting the government not to impose it, lest individual integrity and societal rights be violated as well. It furthermore shows that the exogenous elimination of the no imposition strategy on the part of the government transforms the Nash equilibrium into that of strategies vaccination and direct imposition, respectively, as materially come to pass. It finally determines that the unlikely addition of the revolution strategy on the part of the citizen in the presence of the elimination of the no imposition strategy on the part of the government likewise admits one sole and strict pure strategy Nash equilibrium, either in strategies vaccination and direct imposition or in strategies revolution and direct imposition, respectively.

MSC code: 91A05; 91A10; 91A35; 91A80; 91B06.
JEL classification code: C72; D74; I12; I18.
Keywords: citizen; COVID-19; equilibrium; game; government; imposition; pandemic; payoff; vaccination.

1. Introduction

1.1 COVID-19 and SARS-CoV-2. COVID-19 is an acronym for COrona VIrus Disease 2019, which originated from the Chinese city of Wuhan in late 2019 and which the World Health Organization (WHO) declared pandemic[1] on 11 March 2020.

About late January 2020 COVID-19 was related to have spread outside[2] of China. By late February 2020 the countries most affected[3] by it emerged as being Italy, South Korea, Iran and Japan, promoting infectious epicentres of their own. As of Spring 2020 the United States of America (USA) became the most prominent nation involved with the COVID-19 pandemic in the world.

The virus responsible for COVID-19 is the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 is described as being highly contagious[4]. Its symptoms[5] span those of the influenza,

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[1] https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020

[2] https://www.devex.com/news/covid-19-in-2020-a-timeline-of-the-coronavirus-outbreak-99634

[3] https://it.wikipedia.org/wiki/File:COVID-19-outbreak-timeline.gif

[4] https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-covid-19-how-is-it-transmitted

[5] https://www.who.int/health-topics/coronavirus#tab=tab_3

respiratory failures associated with severe pneumonia and even nothing at all (asymptomaticity). Cardiovascular[6] effects have moreover been examined, particularly at first. Those most at risk of contagion were initially identified with the elderly and other medically fragile subjects, but progressively came to entail middle aged individuals of either gender, young adults, adolescents, children, newborns and even pregnant women.

COVID-19 "variants of concern"[7] have thus far been dubbed Alpha, Beta, Gamma, Delta and Omicron, which respectively stemmed from the United Kingdom (UK) in September 2020, South Africa in May 2020, Brazil in November 2020, India in October 2020 and a variety of sources in November 2021. COVID-19 "variants of interest" have been correspondingly named Epsilon, Zeta, Eta, Theta, Iota, Kappa, Lambda and Mu, which respectively sprung from the USA in March 2020, Brazil in April 2020, multiple nations in December 2020, the Philippines in January 2021, the USA in November 2020, India in October 2020, Peru in December 2020 and Colombia in 2021.

1.2 COVID-19 vaccine and adverse effects. A COVID-19 vaccine was marketed in late 2020, which many prominent manufacturers have thus far deployed in three doses. Roughly 66% of the world's population has so far received[8] at least one dose of COVID-19 vaccine.

The most renowned types of COVID-19 vaccine, especially in the Western world, are the American German Pfizer-BioNtech or Comirnaty COVID-19 vaccine, the American Moderna or Spikevax COVID-19 vaccine, the American Johnson and Johnson or Janssen COVID-19 vaccine and the British Oxford-AstraZeneca, Covishield or Vaxzevria COVID-19 vaccine. Other common types of COVID-19 vaccine are: the Russian Sputnik V or Gam-COVID-Vac; the Chinese CoronaVac or Sinovac COVID-19 vaccine; the Chinese Sinopharm BIBP COVID-19 vaccine, also known as BBIBP-CorV; the Indian Covaxin, branded BBV152; the American Novavax COVID-19 vaccine, sold as Nuvaxovid or Covovax.

Reception[9] of COVID-19 vaccines is especially endorsed by both the WHO and the Centers for Disease Control and Prevention (CDC) and especially authorised by the European Medicines Agency (EMA) and the US Food and Drugs Administration (FDA).

The adverse effects of COVID-19 vaccines are however debated. Most deny them, others claim their minimality, yet others fear them by reason of their belaboured experiments and trials, not seldom regarded as unfinished, and others still, though few they be, emphasise their gravity and irreversibility.

In April 2021 Pfizer-BioNtech released ample documentation on its COVID-19 vaccine's adverse effects[10], including several autoimmune conditions, peculiar maladies, 270 "spontaneous abortions", incidences of herpes, epilepsy, heart failure and strokes and more. In March 2022 the European database of suspected drug reaction reports, named EudraVigilance and verified by the EMA, related 42,507 fatalities[11] and 3,984,978 injuries due to the reception of COVID-19 vaccines, subdivided between Pfizer-BioNtech, Moderna, Oxford-AstraZeneca and Johnson and Johnson. 1,843,512 of such injuries were described as serious.

The public health department of the Los Angeles (LA) county furthermore acknowledged that the COVID-19 vaccines occasionally exploited aborted foetal[12] cells.

1.3 COVID-19 vaccine imposition. Following the WHO, the CDC and other authoritative medical sources, governments around the world have been unanimously endorsing reception of COVID-19 vaccines, providing it free of charge, off their yearly budgets. Most governments around the world, particularly in the West, have in fact imposed it, to varying degrees. The imposition of a vaccine and of COVID-19 vaccines in particular can be therefore analysed as follows.

[6] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7556303/, https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD013879/full, https://www.ahajournals.org/doi/10.1161/CIRCRESAHA.121.317997

[7] https://www.who.int/en/activities/tracking-SARS-CoV-2-variants

[8] https://ourworldindata.org/covid-vaccinations

[9] https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-(covid-19)-vaccines, https://www.cdc.gov/coronavirus/2019-ncov/vaccines/facts.html, https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/covid-19-vaccines-authorised, https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/covid-19-vaccines

[10] https://phmpt.org/wp-content/uploads/2021/11/5.3.6-postmarketing-experience.pdf

[11] https://vaccineimpact.com/2022/42507-dead-3984978-injured-following-covid-vaccines-in-european-database-of-adverse-reactions/

[12] http://publichealth.lacounty.gov/media/Coronavirus/docs/vaccine/VaccineDevelopment_FetalCellLines.pdf

Vaccine imposition can be direct and indirect. Direct imposition is such that citizens are to be vaccinated by force, beginning with those more at risk and eventually covering the entire population. Indirect imposition is such that citizens are to face punitive restrictions, beginning with (i) luxury, passing through (ii) savings, healthcare, labour and income and ending with (iii) subsistence.

Levies on savings erode future subsistence. At zero savings, exclusion from the labour force, the mandated interruption of income perception or the outright interdiction of subsistence consumption at the expense of the non-vaccinated population plunges it into starvation. At the margin restrictions on savings, labour and income are thus binding restrictions on subsistence as are restrictions on subsistence itself. Restrictions on healthcare access are also binding on subsistence whenever they may concern life sustenance, being otherwise analogous to luxury restrictions. Healthcare restrictions, life threatening and not, are moreover contradictory inasmuch as they act as a collateral against the rejection of such a healthcare treatment as vaccination. In other words, the state is so concerned with citizens' health that it denies them access to healthcare, unless they accept the vaccination it has imposed. All such restrictions lastly contravene fundamental human dignity. Indirect imposition thus defined can be consequently deemed illegitimate.

The legitimacy of direct imposition is by contrast dependent on the absence of adverse effects on the part of the considered vaccine, be they (i) actual and total, (ii) actual and partial or even (iii) potential, for evil means cannot justify good ends, actually and potentially. Even if its adverse effects were ascertained to have concerned one sole individual, even if their existence were no more than estimated, the considered vaccine would remain prohibitive. Food and drugs are in fact regularly marketed on such an account, that is, on the estimated and continuously ascertained absence of any and all adverse effects upon their part. The requirements of legal immunity and disclaimers against COVID-19 vaccine injuries demanded from the beginning by vaccine producers and governments to the detriment of citizens receiving COVID-19 vaccines around the world, even under imposition, betrayed their potential for serious adverse effects.

1.4 SARS-CoV-2 mortality and isolation. Vaccine imposition additionally presumes pathogenic epidemic mortality and pathogenic isolation to begin with. SARS-CoV-2 enjoys unanimous consensus neither on the latter nor the former. Such an absence of consensus is particularly scientific.

The Case Fatality Rate[13] (CFR) of a disease is the quotient of confirmed deaths divided by confirmed cases thereof. Now, COVID-19 cases are focally ascertained through the Polymerase Chain Reaction (PCR) test, while COVID-19 deaths presume a nexus of axiomatic or at least statistical causality with SARS-CoV-2 (and SARS-CoV-2 isolation therewith). The PCR test is not quantitative[14], however, but qualitative, as confirmed by Doctor Kary Mullis, the biochemist who invented it in 1985 and won a Nobel Prize for it in 1993. A quantitative test identifies targeted genetic material, phenomenally, in an empirical fashion; a qualitative tests merely suggests its existence, which hinges upon its isolation. Until Spring 2022 PCR tests also failed[15] to report SARS-CoV-2 variants. Causality between SARS-CoV-2 and COVID-19 deaths is similarly unconvincing, especially because of the uncertainty around SARS-CoV-2 isolation[16].

Be that as it may, the CFR of COVID-19 across the world peaked at roughly 7% in May 2020, beginning to decrease thereafter and stabilising around 2% in February 2021. In February 2022 it further decreased to 1.5% or so and now orbits around 1.2%. Now, an epidemic is normally defined as a widespread infectious disease throughout a community at a given time period, but the quantitative determiner of an epidemic is undefined, even institutionally. The adjective "widespread" although speaks to the majority, envisaging a 50% threshold, but however relative the threshold may be required to be it could never be reduced to the scale of a single individual out of the ones considered, as COVID-19's CFRs have by contrast operated so far (not even one person in 10). Otherwise affirmed, relativity requires multiplicity, not singularity, at any scale, for however small a subset of the considered population may be relativity requires a relation between a subject and an object, which singularity excludes.

Such low CFRs do not thus merely compromise the presumption of SARS-CoV-2 epidemic mortality

[13] https://ourworldindata.org/mortality-risk-covid

[14] http://www.virusmyth.org/aids/hiv/jlprotease.htm

[15] https://www.elsevier.com/about/press-releases/research-and-journals/new-pcr-test-can-identify-all-sars-cov-2-variants-in-a-positive-patient-sample

[16] https://www.drug-dissolution-testing.com/blog/files/no-isolated-virus.pdf, https://andrewkaufmanmd.com/wp-content/uploads/2021/02/Statement-of-Virus-Isolation-SOVI-by-Morell-Cowan-and-Kaufman.pdf

but that of SARS-CoV-2 pandemic mortality as well. For such a reason does the Oxford English Dictionary (the moral authority of the means by which Anglophones communicate) now define[17] COVID-19 as "an acute disease in humans caused by a coronavirus, which is characterized mainly by fever and cough and is capable of progressing to severe symptoms and in *some* cases death, especially in older people and those with underlying health conditions."

The Infection Fatality Rate (IFR) of a disease is instead the quotient of total deaths divided by total cases thereof. Before the peak of an epidemic, for a given quantity of confirmed and total deaths, confirmed and total cases are underreported, for measurements are still very rough, overestimating both the CFR and the IFR. Before the peak of an epidemic, for a given quantity of confirmed and total cases, confirmed deaths are also underreported because of poor (causal) measurements, but total deaths are underreported both because of poor (causal) measurements and because deaths do not all unfold at once, underestimating the CFR and the IFR even more. After the peak of an epidemic, for a given quantity of confirmed and total cases, confirmed deaths converge towards total deaths; for a given quantity of confirmed and total deaths, confirmed cases similarly converge towards total cases; consequently, the CFR converges towards the IFR. The IFR speaks to the likelihood of dying from a contracted infection, of which the CFR is thus an imperfect statistic, though not unsatisfactory, with a particular application to COVID-19, whose peak occurred in Spring 2020.

In order to strengthen its analysis, at any rate, the present research presumes both SARS-CoV-2 pandemic mortality and SARS-CoV-2 isolation, abiding by the WHO and the CDC.

1.5 COVID-19 Medical CounterMeasures. The present research accordingly ignores the delicate issue of the COVID-19 Medical CounterMeasures (MCMs), lest its conclusions be outshone by a deductive impugnment of such measures.

For completeness, however, COVID-19 MCMs around the world have encompassed cancellation of public events and religious services, protest prohibitions, interdiction on travel and circulation, lockdowns, mask mandates, sanitation mandates, COVID-19 test mandates and COVID-19 vaccination mandates themselves. They have also been accompanied by bans on hospital and clinical access, food access and work, as well as by fines, work suspensions and dismissals and arrests. Such bans and provisions intersect with most of the applications of the vaccine imposition discussed above (luxury, savings, healthcare and labour), once again contravening fundamental human dignity and being thereby illegitimate.

Restrictions on luxury, savings, healthcare, labour, income and subsistence are unjustifiable. Paramountly, the preservation of the collective's health cannot be obtained through them. Precisely because they are envisaged as a collateral against the rejection of vaccination are such restrictions inherently inefficacious and thus gratuitous relative to the elimination of the pathogen. Safe and opportune vaccination calls for direct imposition to be in their stead.

The said COVID-19 MCMs are instead restrictions on association, movement and individual integrity. In the absence of an efficacious and safe medicament, prophylactic or therapeutic, such restrictions are potentially efficacious and thus debatably legitimate, but ever in the name of the collective's health and in accord with the severity of the pathogen's contagion and, in fact, with the non-internalisation of its disease, whereby the immune systems of the community's members have not become accustomed to it.

On the other hand, the only threshold which may characterise the collective is that of the majority, absolute or relative, but each human life is worth as much as all the others: provided gravity of contagion, why not impose the restrictions in question for lower thresholds of an infectable collective? Are such imperilled subjects not (collectively) worth as much as they would be if they were sided by further ones? Consequently, provided gravity of contagion, the extent to which part of a population be deemed expendable for the other is far from clear.

Risk aversion is nevertheless preferable to risk propensity in such events, even for minimal collectives, suggesting the legitimacy of the treated restrictions. Contemporary practice has tended to shun minimal collectives, perhaps on account of intuition with regard to the subsidence of the disease, but the contingent legitimacy of suchlike restrictions is the reason for which the non-internalisation of the disease, the severity of the pathogen's contagion, the competence and probity of the sources reporting them and the rationality and discernment of each individual emerge as discriminatory.

[17] https://www.oed.com

1.6 COVID-19 vaccination stances. The assumption of the present analysis is therefore that the government be capable of enacting and enforcing both kinds of vaccine imposition, direct and indirect, and all treated restrictions.

Applied to COVID-19 the reasoning proceeds as follows. If governments had enacted and enforced direct imposition then all citizens would have been eventually vaccinated against COVID-19, irrespective of their wills. If governments had enacted and enforced indirect imposition then citizens would have faced a moral dilemma. Specifically, given indirect imposition, should a citizen have received or rejected a COVID-19 vaccine? In fact, even if no vaccine imposition had been in place citizens would have still faced the same moral dilemma: if governments had enacted neither vaccine imposition then citizens would have been free to either accept or decline a COVID-19 vaccine, but on what grounds?

Some argued one should have never received a COVID-19 vaccine, even in view of restrictions on subsistence consumption. However deadly the COVID-19 pandemic may be COVID-19 vaccines are inherently unlawful, they underlined, at least because of their potentially adverse effects and their admitted exploitation of aborted foetal cells, no less than occasionally, not justifying the lawful end of survival. Such individuals could be termed COVID-19 vaccination rigourists.

Others argued one could have received a COVID-19 vaccine only in view of restrictions on subsistence consumption, might they be direct or indirect (income, labour, savings), but ever binding. By contraposition, they rejoined, self-starvation is inherently unlawful, for it is suicidal, not justifying the lawful end of rejecting unlawful COVID-19 vaccination. Formally: $(Survival \longrightarrow Vaccine) = (No\ Vaccine \longrightarrow No\ Survival)$. Between the syntactic implication and its contraposition the latter is thus morally preferable. Such individuals could be termed COVID-19 vaccination realists.

Yet others argued one could have received a COVID-19 vaccine even absent restrictions on subsistence consumption, but in the face of restrictions on luxury consumption. COVID-19 vaccination could even be inherently unlawful, they articulated, but there exist greater lawful ends (education, aid, apostolates) which warrant its induced reception, even if one's survival were not compromised. COVID-19 is also real, if not truly pandemic, some of them subjoined, and COVID-19 vaccination appears as an appropriate remedy for it after all, whose adverse effects and exploitation of aborted foetal cells are too remote (minimal and sunk) to regard it as an unlawful means. Such individuals could be termed COVID-19 vaccination subjectivists.

Spiritual welfare is certainly superior to temporal welfare, just as social welfare is superior to individual welfare therein, whereby aid and apostolates seemed to be warranted, but not education. The basis for its reception was in all events advocated as being subjective, that is, specific to each situation, but inasmuch as it might ignore the inherent unlawfulness of COVID-19 vaccination and fail to specify the subordination of the natural order to the supernatural it was ulteriorly subjectivistic.

More generally, unless the rejection of COVID-19 vaccination on the part of a person had outweighed the moral harm of its reception COVID-19 vaccination should have not been received, for its adverse effects and exploitation of aborted foetal cells were all too proximate (major and current), from the very beginning, to regard it as an unlawful means, whichever the lawful end. The advance exclusion of adverse effects on the part of COVID-19 vaccination was never clear and actual adverse effects were almost immediately verified; its exploitation of aborted foetal cells had instead been known all along. If lawful ends cannot justify unlawful means and such unlawful means can be avoided, unlike in the above event of restrictions on subsistence consumption and perhaps others, COVID-19 vaccination subjectivists were thus morally misleading: however great a lawful end may be an evil means cannot be *freely* employed in order to attain to it.

Others still advocated its outright acceptance. The COVID-19 pandemic is real and SARS-CoV-2 is truly at the root of it, they stated, consequently, COVID-19 vaccination saves one's own life as well as others', altruistically contributing to the destruction of the COVID-19 pandemic. Such individuals could be termed COVID-19 vaccination fundamentalists, who delineate the overwhelming majority of individuals. Aside from assuming SARS-CoV-2 pandemic mortality, whose dubiety was discussed above, COVID-19 vaccination fundamentalists did not only discount the exploitation of aborted foetal cells on the part of COVID-19 vaccination, together with the possibility of adverse effects, but also assumed COVID-19 vaccination efficacy against SARS-CoV-2, which to date, even after third doses thereof, is no more than potential.

The proximate blame is on SARS-CoV-2 variants and the remote blame on the non-vaccinated population.

COVID-19 vaccination fundamentalists specifically accused the non-vaccinated population of having corroded herd immunity, whose threshold became ever increasing, not for nothing. The corrosion of herd immunity was somehow presumed to have triggered the development of more SARS-CoV-2 variants. Infectious variants are nevertheless more likely to arise in view of greater herd immunity than lesser herd immunity and the first victims would be non-vaccinated citizens, provided comparable mortality, not vaccinated citizens. Vaccines for infectious variants would also render those for previous variants obsolete, revealing the illogic in requiring the non-vaccinated population to receive all doses available. In a closed community, through COVID-19 MCMs, if the non-vaccinated population carries a variant of SARS-CoV-2 then how did it become infected? The ordinary answer is through the vaccinated population alone, whose immunity triggered the development of more SARS-CoV-2 variants.

Moreover, while all viruses replicate themselves by the hundreds of thousands, causing mutations and variants to be more likely, coronaviruses[18] feature an error correction enzyme similar to that of deoxyribonucleic acid (DNA) viruses, which lowers the mutation rate in relation to other ribonucleic acid (RNA) viruses, such as those of influenzas. Consequently, SARS-CoV-2 was prone to developing less variants and was thus less likely to become endemic. Yet, even if SARS-CoV-2 had been prone to developing more variants as such other RNA viruses as those of the influenza then greater herd immunity would have effectively stimulated the creation of new variants, as with the influenza. In either case the vaccinated population would not have suffered significant losses of immunity on account of the non-vaccinated population: (i) if SARS-CoV-2 had been more prone to variants then greater herd immunity would have been counterproductive, the solution having truly been reliance upon hygiene and immune systems, and (ii) if SARS-CoV-2 had been less prone to variants then greater herd immunity would not have been required, COVID-19 vaccination having been socially unnecessary in turn.

If COVID-19 vaccines truly immunised individuals from SARS-CoV-2 then why should the vaccinated population have feared the non-vaccinated population and demanded its vaccination? The rational answer unsettlingly eluded medical purposes: because individuals were to be vaccinated anyway. The conventional answer, by COVID-19 vaccination fundamentalists, was because while COVID-19 vaccines might preserve an individual from being transferred into intensive care units, minimising his risk of dying of SARS-CoV-2, COVID-19 vaccines would not have immunised him. Such did not merely ignore contagion on the part of the vaccinated population too but it additionally begged an analogous question: if COVID-19 vaccines truly immunised individuals from being transferred into intensive care units, minimising their risk of dying of SARS-CoV-2, then why should the vaccinated population have feared the non-vaccinated population and demanded its vaccination? If the risk of death had been introduced into the answer, by linking it to wanting immunisation outside of intensive care units, then the risk of dying of SARS-CoV-2 would not have become so minimal after all and COVID-19 vaccines would have only solved part of the problem (immunisation from transfer into intensive care units), having become merely "better than nothing" and sufficient not to impose COVID-19 vaccination. The alternative answer remaining on the part of COVID-19 vaccination fundamentalists was therefore because the non-vaccinated population triggered SARS-CoV-2 variants, whose speciousness has been already exposed.

In sum, who was formally correct, amongst the four? Should governments have imposed COVID-19 vaccination after all? How, if so? Game theory, which is interactive decision theory, is to help discover the answers to all such questions.

2. COVID-19 vaccination game: building blocks

2.1 Game elements. A two player non-cooperative static game is now considered. The two players are the citizen and the government: $I = \{C,\ G\}$. They are assumed to be rational. Rationality itself is envisaged to be common knowledge, namely, transfinite knowledge of reciprocal rationality is also assumed.

The citizen's strategies are "Vaccination" and "No vaccination", in reference to that against COVID-19: $S_C = \{V,\ \neg V\}$. The government's strategies are "Direct imposition", "Subsistence restriction" and "Luxury restriction", under super-strategy "Indirect imposition", and "No imposition": $S_G = \{DI,\ II,\ \neg I\} = \{DI,\ SR,\ LR,\ \neg I\}$. Under strategy "Subsistence restriction" the non-vaccinated population faces luxury restrictions as well.

[18] https://now.tufts.edu/2021/06/09/how-viruses-mutate-and-create-new-variants

The strategy set product contains the combinations of all strategies, namely, all strategy profiles: $(s_C,\ s_G) \in \prod_{i=C}^{G} S_i = S_C \times S_G = \{(V,\ DI),\ (V,\ SR),\ (V,\ LR),\ (V,\ \neg I),\ (\neg V,\ DI),\ (\neg V,\ SR),\ (\neg V,\ LR),\ (\neg V,\ \neg I)\}$. The payoff function is a bijection of the strategy set product into the positive real line: $\pi : \prod_{i=C}^{G} S_i \to \mathbb{R}_{++}$. The pure strategy game is therefore a quadruple: $\Gamma_{PR} = \{I,\ \{S_i\}_{i=C}^{G},\ \pi\} = \{I,\ S_C,\ S_G,\ \pi\}$. The strategy profile payoffs are enunciated below.

2.2 Game nature. It must be noticed that a static game is one of simultaneity, whereby players do not know each other's actions, but only each other's strategies. The game consequently features imperfect information. In practice, however, the government plays before the citizen, who observes the government's actions, suggesting a dynamic game with perfect information, that is, one of sequentiality wherein secondary players know the actions played by primary players.

A static game is nevertheless preferable to the end of better modelling a theoretical scenario, one beginning from the very outset of the phenomenon at hand, that is to say, hereby being the COVID-19 pandemic. In other words, how should a foresighted citizen react to the outbreak of such a world pandemic as the COVID-19 pandemic? How should the selfsame governments and citizens have optimally reacted to the outbreak of the COVID-19 pandemic? Since citizens had intuitive knowledge of governments' macro-strategies in advance, that is, of direct, indirect and no COVID-19 vaccination imposition, and governments had trivial knowledge of those of citizens, being COVID-19 vaccination or no COVID-19 vaccination, the answer is best found within a static game.

The game's first fruits can be naturally extended to scenarios envisaging other vaccinations or pharmaceuticals by the more or less mandatory and questionable character, as well as to graver restrictions against individual integrity, such as (i) permanent food rationing, (ii) permanent movement limitation, (iii) mass sterilisation or (iv) mass euthanasia, possibly in the name of healthcare and environmental preservation.

2.3 Citizen payoffs. The citizen's payoff under strategy "Vaccination" always yields positive subsistence sub-payoff π_s, positive luxury sub-payoff π_l, to which luxury he gains or retains access, and positive sub-payoff $\pi_{\Diamond h}$ for potential health gains, by potentially acquiring immunity and aiding to destroy the COVID-19 pandemic. It correspondingly yields negative sub-payoff $-\pi_{\neg vC}$ for not having been able to avoid COVID-19 vaccination, on account of its abortive unlawfulness and potential health costs. Formally: $\pi_C(V,\ s_G) = \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$.

One must discern that luxury is hereby intended as non-subsistence, namely, all activities which pertain not to subsistence, including education and non-vital healthcare. Subsistence itself is not only intended to encompass direct subsistence, income, labour, savings and vital healthcare but even works of piety or charity, by virtue of the superiority of social welfare over individual welfare, both temporally and spiritually: $SW_S \succ IW_S \succ SW_T \succ IW_T$. The reception of COVID-19 vaccines cannot be numbered among works of piety or charity precisely because of their *ex ante* uncertain benefits, however honest might their endorsers be. In order to strengthen the propositions ensuing from the present analysis potential health gains sub-payoff $\pi_{\Diamond h}$ is in fact envisaged as being positive indeed, for COVID-19 vaccine reception was effectively expected to subject the organism to severe peril. The potential health gains from COVID-19 vaccination are thus assumed to outweigh its potential health costs.

The citizen's payoff from strategy profile "No vaccination, Direct imposition" is contradictory and does not therefore exist, for the citizen is subjected to COVID-19 vaccination by definition: $\nexists \pi_C(\neg V,\ DI)$. The citizen's payoff from strategy profile "No vaccination, Subsistence restriction" yields positive sub-payoff $\pi_{\neg vC}$ for having rejected COVID-19 vaccines and negative sub-payoffs $-\pi_s$, $-\pi_l$ and $-\pi_{\Diamond h}$ for having respectively lost access to subsistence, luxury and potential health gains, all else unchanged: $\pi_C(\neg V,\ SR) = \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$. The citizen's payoff from strategy profile "No vaccination, Luxury restriction" yields positive subsistence sub-payoff π_s, positive sub-payoff $\pi_{\neg vC}$ for having rejected COVID-19 vaccines and negative sub-payoffs $-\pi_l$ and $-\pi_{\Diamond h}$ for having respectively lost access to luxury and potential health gains, all else unchanged: $\pi_C(\neg V,\ LR) = \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$. The citizen's payoff from strategy profile "No vaccination, No imposition" yields positive sub-payoffs π_s, $\pi_{\neg vC}$ and π_l for subsistence, luxury and for having rejected COVID-19 vaccines, respectively, and negative sub-payoff $-\pi_{\Diamond h}$ for having lost access to potential health gains, all else unchanged: $\pi_C(\neg V,\ \neg I) = \pi_s + \pi_{\neg vC} + \pi_l - \pi_{\Diamond h}$.

Citizen sub-payoffs are consequently ordered thus, from the greatest to the smallest: subsistence; no vaccination; luxury; potential health gains. Formally: $\pi_s > \pi_{\neg vC} > \pi_l > \pi_{\Diamond h}$, $\Box(\pi_s,\ \pi_{\neg vC},\ \pi_l > 0)$ and $\not\Box(\pi_{\Diamond h} > 0)$, whence (i) $\pi_s + \pi_l + \pi_{\Diamond h} > \pi_{\neg vC} \longrightarrow \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} > 0$, (ii) $0 > \pi_{\neg vC} - \pi_s \longrightarrow 0 > \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$ and (iii) $\pi_s + \pi_{\neg vC} + \pi_l > \pi_{\Diamond h} \longrightarrow \pi_s + \pi_{\neg vC} + \pi_l - \pi_{\Diamond h} > 0$. The rationale is that at the margin the preservation of one's life is graver than the avoidance of the abortive unlawfulness and potential health costs of COVID-19 vaccination, which avoidance is itself albeit graver than the preservation of non-vital activities, in turn more certain and thereby of greater value than potential health gains, which are inherently uncertain, however likely. It must be noticed that in the face of a mandatory choice between (i) survival through COVID-19 vaccination and (ii) no COVID-19 vaccination through no survival jeopardising survival is hereby acknowledged as a graver *unintended* immorality than the reception of a COVID-19 vaccine, in line with COVID-19 vaccination realism, treated above.

The citizen sub-payoff difference between no vaccination and luxury $(\pi_{\neg vC} - \pi_l)$ cannot be finally expected to be compensated by the sub-payoff of potential health gains $(\pi_{\Diamond h})$, on account of their potentiality: $\pi_{\neg vC} - \pi_l > \pi_{\Diamond h} \longrightarrow \pi_{\neg vC} - \pi_l - \pi_{\Diamond h} > 0 \longrightarrow \pi_{\neg vC} > \pi_{\Diamond h} + \pi_l$, since $\Box(\pi_{\neg vC} > \pi_l > 0)$, but $\not\Box(\pi_{\Diamond h} > 0)$, by definition, thus, $\not\Box(\pi_{\Diamond h} \geq \pi_{\neg vC} - \pi_l > 0)$; it follows that $\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h} > 0$.

2.4 Government payoffs. The government's payoff from strategy profile "Vaccination, Direct imposition" yields positive sub-payoff π_{di} for direct imposition, potentially favouring the achievement of herd immunity and aiding to destroy the COVID-19 pandemic, and negative sub-payoff $-\pi_{\neg vG}$ for not having allowed citizens to properly decline COVID-19 vaccines, breaching individual independence, propagating the exploitation of aborted foetal cells and potentially causing genocide: $\pi_G(V,\ DI) = \pi_{di} - \pi_{\neg vG}$.

Indeed, the negativities associated with direct imposition are healthcare tyranny, social despotism and propagation of evil. Healthcare tyranny is connected with the violation of individual integrity. Social despotism is connected with the privation of societal rights, such as that to lawful labour, consumption and leisure. Propagation of evil is connected with the exploitation of aborted foetal cells. A further negativity is the genocide potentially resulting from COVID-19 vaccination. The negativity associated with the permission to decline COVID-19 vaccines would by contrast be the facilitation of the spread of the COVID-19 pandemic and of a correspondent genocide thereby.

The government's payoff from strategy profile "No vaccination, Direct imposition" is contradictory and does not therefore exist, for the citizen is subjected to COVID-19 vaccination by definition: $\nexists \pi_G(\neg V,\ DI)$. The government's payoff under strategy "Subsistence restriction" always yields positive sub-payoff π_{sr} for the restriction of subsistence, serving the same purposes of direct imposition, albeit less efficaciously, and negative sub-payoffs $-\pi_{di}$ and $-\pi_{\neg vG}$ for not having directly imposed COVID-19 vaccination, losing its benefits, and for not having allowed citizens to properly decline COVID-19 vaccines, respectively, all else unchanged: $\pi_G(s_C,\ SR) = \pi_{sr} - \pi_{di} - \pi_{\neg vG}$. The government's payoff under strategy "Luxury restriction" always yields positive sub-payoff π_{lr} for the restriction of luxury, serving the same purposes of direct imposition and of subsistence restriction, albeit with even less efficacy, and negative sub-payoffs $-\pi_{di}$, $-\pi_{sr}$ and $-\pi_{\neg vG}$ for not having directly imposed COVID-19 vaccination, for not having restricted subsistence, losing their benefits, and for not having allowed citizens to properly decline COVID-19 vaccines, respectively, all else unchanged: $\pi_G(s_C,\ LR) = \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$. The government's payoff under strategy "No imposition" always yields a positive sub-payoff $\pi_{\neg vG}$ for having allowed citizens to properly decline COVID-19 vaccines and negative sub-payoffs $-\pi_{di}$, $-\pi_{sr}$ and $-\pi_{lr}$ for not having directly imposed COVID-19 vaccination, for not having restricted subsistence and for not having restricted luxury, losing all of their benefits, all else unchanged: $\pi_G(s_C,\ \neg I) = \pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr}$.

Government sub-payoffs are consequently ordered thus, from the greatest to the smallest: no vaccination; direct imposition; subsistence restriction; luxury restriction. Formally: $\pi_{\neg vG} > \pi_{di} > \pi_{sr} > \pi_{lr}$, whence (i) $\pi_{\neg vG} + \pi_{di} > \pi_{sr} \longrightarrow 0 > \pi_{sr} - (\pi_{di} + \pi_{\neg vG})$ and (ii) $\pi_{\neg vG} + \pi_{di} + \pi_{sr} > \pi_{lr} \longrightarrow 0 > \pi_{lr} - (\pi_{di} + \pi_{sr} + \pi_{\neg vG})$. The rationale is that the negativities associated with the permission to decline COVID-19 vaccines are outweighed by those associated with direct imposition of COVID-19 vaccination, itself however preferable to subsistence restrictions, which include ones on luxury, and to luxury restrictions alone in turn, which are laxer. Otherwise expressed, healthcare tyranny, social despotism and propagation of evil are actual negativities, whereas the facilitation of the spread of the COVID-19 pandemic and of the attendant genocide is only potential, as well as offset by the potential genocide resulting from COVID-19 vaccination itself.

The government's payoff under strategy "No imposition" is lastly positive, for the positivities associated with the permission to decline COVID-19 vaccines outweigh those associated with direct imposition of

COVID-19 vaccination, subsistence restrictions and luxury restrictions. In other words, the avoidance of healthcare tyranny, social despotism, propagation of evil and of a potential genocide is graver than potentially limiting the spread of the COVID-19 pandemic and the attendant genocide: the two potential genocides annul each other, remaining there the actual negativities. Formally: $\pi_{\neg vG} > \pi_{di} + \pi_{sr} + \pi_{lr} \longrightarrow \pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr} > 0$.

2.5 Mixed strategies and best responses. John Nash[19] used the Kakutani fixed point theorem to prove that every game with multiple finite players and mixed strategies presents an equilibrium, eponymously termed Nash equilibrium. One must therefore discern that by contraposition a game bereft of a Nash equilibrium is one of pure strategies, provided finite players, but a pure strategy game can feature a Nash equilibrium: assuming finite players, $(Mixed\ strategy\ game \longrightarrow Nash\ equilibrium) = (No\ Nash\ equilibrium \longrightarrow Pure\ strategy\ game)$, but $Pure\ strategy\ game \not\longrightarrow No\ Nash\ equilibrium$.

Mixed strategies are continuous probability assignments to pure strategies, consequently, they are uncountably infinite: $\forall i \in I,\ p : S_i \to [0,\ 1] \subset \mathbb{R}_+$, where p is a probability density function, such that, $\forall j \in [1,\ n] \subset \mathbb{N}_+,\ p(s_{ij}) = p_{ij} \in [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{j=1}^{n} p_{ij} = 1$; $\forall i \in I,\ f : S_i \times [0,\ 1] \to \Sigma_i \subseteq \mathbb{R}_+$, where f is a probability assignment function, such that, $\forall j \in [1,\ n] \subset \mathbb{N}_+,\ f(s_{ij}p_{ij}) = \sigma_{ij} \in \Sigma_i \subseteq \mathbb{R}_+$ and $\sum_{j=1}^{n} s_{ij}p_{ij} = \sigma_i$. Mixed strategies are understood as randomisations over pure strategies. Alternatively, pure strategies are understood as mixed strategies wherein particular pure strategies are played with a probability of one.

The mixed strategy sets of the citizen and of the government are respectively denoted Σ_C and Σ_G. For notational simplicity, additionally: $p \equiv p_C$ and $q \equiv p_G$. The citizen's strategies are "Vaccination" and "No vaccination" and are respectively assigned probabilities p_1 and $p_2 = 1 - p_1$. The government's strategies are "Direct imposition", "Subsistence restriction", "Luxury restriction" and "No imposition" and are respectively assigned probabilities $q_1,\ q_2,\ q_3$ and $q_4 = 1 - \sum_{j=1}^{3} q_j$. The mixed strategy game is therefore a quadruple: $\Gamma_{MX} = \{I,\ \{\Sigma_i\}_{i=C}^{G},\ \pi\} = \{I,\ \Sigma_C,\ \Sigma_G,\ \pi\}$.

A best response function is a bijection of other players $\neg i$'s mixed strategy set into player i's mixed strategy set such that player i's mixed strategy is the best mixed strategy given other players $\neg i$'s mixed strategies, that is, a best response: $\forall i \in I,\ \rho_i : \Sigma_{\neg i} \to \Sigma_i$ such that $\sigma_i^* = \rho_i(\sigma_{\neg i}) = \sum_{j=1}^{n} s_{ij}p_{ij}^*$.

2.6 Nash equilibria. A Nash equilibrium is a strategy profile such that its payoff features player i's best response given other players $\neg i$'s best responses; it is thus a strategy profile of matching best responses: $\forall i \in I,\ NE := (\sigma_i^*,\ \sigma_{\neg i}^*)$ such that $\pi(\sigma_i^*,\ \sigma_{\neg i}^*)$. A weak Nash equilibrium is a Nash equilibrium in which player i's best response is one or more: $\forall i \in I,\ NE_{WK} := (\sigma_i^*,\ \sigma_{\neg i}^*)$ such that $\pi_i(\sigma_i^*,\ \sigma_{\neg i}^*) \geq \pi_i(\sigma_i,\ \sigma_{\neg i}^*)$, whereby $\sigma_i^* \neq \sigma_i$ or $\sigma_i^* = \sigma_i$. A strict Nash equilibrium is a Nash equilibrium in which player i's best response is one: $\forall i \in I,\ NE_{ST} := (\sigma_i^*,\ \sigma_{\neg i}^*)$ such that $\pi_i(\sigma_i^*,\ \sigma_{\neg i}^*) > \pi_i(\sigma_i,\ \sigma_{\neg i}^*)$, whereby $\sigma_i^* \neq \sigma_i$.

Strictly speaking, a Nash equilibrium in pure strategies is one in mixed strategies too, owing to its definition. For simplicity, however, a Nash equilibrium in mixed strategies is redefined such that all of its strategies are not pure: $\forall i \in I,\ NE_1 := (\sigma_i^*,\ \sigma_{\neg i}^*) \neq (s_i^*,\ s_{\neg i}^*)$, *ceteris paribus.* One must discern that whenever strategy profile $(s_{ij},\ s_{\neg ij})$ be played with probabilities p_{ij}^* and $p_{\neg ij}^* \in (0,\ 1) \subset \mathbb{R}_{++}$, that is, in an open real interval between zero and one, the mixed strategy Nash equilibrium is still delineated by strategy profile $(\sigma_i^*,\ \sigma_{\neg i}^*)$, wherein mixed strategies $\sigma_i^* = \sum_{j=1}^{n} s_{ij}p_{ij}^*$ and $\sigma_{\neg i}^* = \sum_{j=1}^{n} s_{\neg ij}p_{\neg ij}^*$. A Nash equilibrium in semi-mixed strategies is correspondingly defined such that at least one of its strategies is mixed and the others are pure: $\forall i \in I,\ NE_2 := (\sigma_i^*,\ \sigma_{\neg i}^*)$, $\exists \sigma_i^* \neq s_i^*$ and $\forall \sigma_{\neg i}^* = s_{\neg i}^*$, *ceteris paribus.* It must be once again noticed that whenever strategy profile $(s_{ij},\ s_{\neg ij})$ be played with probabilities $p_{ij}^* \in (0,\ 1) \subset \mathbb{R}_{++}$ and $p_{\neg ij}^* = 1$ the semi-mixed strategy Nash equilibrium is still delineated by strategy profile $(\sigma_i^*,\ \sigma_{\neg i}^*)$, wherein mixed strategies $\sigma_i^* = \sum_{j=1}^{n} s_{ij}p_{ij}^*$ and $\sigma_{\neg i}^* = s_{\neg ij}p_{\neg ij}^* = s_{\neg ij} = s_{\neg i}^*$. A Nash equilibrium in pure strategies is lastly defined such that all of its strategies are pure: $\forall i \in I,\ NE_3 := (\sigma_i^*,\ \sigma_{\neg i}^*) = (s_i^*,\ s_{\neg i}^*)$, *ceteris paribus.*

A Nash equilibrium in mixed or semi-mixed strategies is moreover possible only if the cardinality of player i's calculable probability set $\bar{P}_i$, representing unknowns, is no smaller than that of other players $\neg i$'s non-redundant strategy set $\bar{S}_{\neg i}$, representing equations, being itself no smaller than one, otherwise running into inconsistent overdetermination. In other words, the cardinality of other players $\neg i$'s non-redundant strategy

[19] John Forbes Nash Junior, *Equilibrium Points in N-Person Games,* Proceedings of the National Academy of Sciences 36(1): 48-49, 1950.

set $\bar{S}_{\neg i}$ is an element of the closed natural interval between one and the cardinality of player i's calculable probability set $\bar{P}_i$. Formally: $\forall i \in I,\ NE_{1,\,2} \longrightarrow n(\bar{P}_i) \geq n(\bar{S}_{\neg i}) \geq 1$ or $n(\bar{S}_{\neg i}) \in [1,\ n(\bar{P}_i)] \subset \mathbb{N}_+$, where $\bar{P}_i \subseteq P_i,\ n(P_i) = n(S_i),\ n(\bar{P}_i) = n(S_i \backslash \{s_{ij}\})$ and $\bar{S}_{\neg i} \subseteq S_{\neg i}$.

2.7 Dominant strategies. A weak dominant strategy is at least one mixed strategy such that its payoffs feature player i's best mixed strategy regardless of other players $\neg i$'s mixed strategies; in other words, player i's best mixed strategy can be one or more: $\forall i \in I,\ DS_{WK} := \tilde{\sigma}_i$ such that $\pi_i(\tilde{\sigma}_i,\ \sigma_{\neg i}) \geq \pi_i(\sigma_i,\ \sigma_{\neg i})$, whereby $\tilde{\sigma}_i \neq \sigma_i$ or $\tilde{\sigma}_i = \sigma_i$. A strict dominant strategy is a mixed strategy such that its payoffs feature player i's best mixed strategy regardless of other players $\neg i$'s mixed strategies; in other words, player i's best mixed strategy is exactly one: $\forall i \in I,\ DS_{ST} := \tilde{\sigma}_i$ such that $\pi_i(\tilde{\sigma}_i,\ \sigma_{\neg i}) > \pi_i(\sigma_i,\ \sigma_{\neg i})$, whereby $\tilde{\sigma}_i \neq \sigma_i$.

A weak dominant strategy equilibrium is the strategy profile of players i and $\neg i$'s weak dominant strategies: $\forall i \in I,\ DSE_{WK} := (\tilde{\sigma}_i,\ \tilde{\sigma}_{\neg i})$ such that $\pi_i(\tilde{\sigma}_i,\ \sigma_{\neg i}) \geq \pi_i(\sigma_i,\ \sigma_{\neg i})$ and $\pi_{\neg i}(\sigma_i,\ \tilde{\sigma}_{\neg i}) \geq \pi_{\neg i}(\sigma_i,\ \sigma_{\neg i})$. A strict dominant strategy equilibrium is the strategy profile of players i and $\neg i$'s strict dominant strategies: $\forall i \in I,\ DSE_{ST} := (\tilde{\sigma}_i,\ \tilde{\sigma}_{\neg i})$ such that $\pi_i(\tilde{\sigma}_i,\ \sigma_{\neg i}) > \pi_i(\sigma_i,\ \sigma_{\neg i})$ and $\pi_{\neg i}(\sigma_i,\ \tilde{\sigma}_{\neg i}) > \pi_{\neg i}(\sigma_i,\ \sigma_{\neg i})$.

If a strategy profile is a dominant strategy equilibrium then it is a Nash equilibrium, but not *vice versa.* The reason is that other players $\neg i$'s mixed strategies, relative to player i's best mixed strategy, can be best responses and player i's mixed strategy, relative to other players $\neg i$'s best mixed strategies, can be a best response, yielding a Nash equilibrium, but players $\neg i$ and i's best responses are not all their other mixed strategies, excluding a dominant strategy equilibrium. Formally: *ceteris paribus,* $\forall i \in I,\ (\tilde{\sigma}_i,\ \tilde{\sigma}_{\neg i}) \longrightarrow (\tilde{\sigma}_i,\ \tilde{\sigma}_{\neg i}) = (\sigma^*_i,\ \sigma^*_{\neg i})$, since $\Diamond\pi(\tilde{\sigma}_i,\ \sigma_{\neg i}) = \pi(\tilde{\sigma}_i,\ \sigma^*_{\neg i}),\ \Diamond\pi(\sigma_i,\ \tilde{\sigma}_{\neg i}) = \pi(\sigma^*_i,\ \tilde{\sigma}_{\neg i})$ and thus $\Diamond(\tilde{\sigma}_i,\ \tilde{\sigma}_{\neg i}) = (\sigma^*_i,\ \sigma^*_{\neg i})$, but $(\sigma^*_i,\ \sigma^*_{\neg i}) \not\longrightarrow (\sigma^*_i,\ \sigma^*_{\neg i}) = (\tilde{\sigma}_i,\ \tilde{\sigma}_{\neg i})$, since $\pi(\tilde{\sigma}_i,\ \sigma^*_{\neg i}) \neq \pi(\tilde{\sigma}_i,\ \sigma'_{\neg i})$ and $\pi(\sigma^*_i,\ \tilde{\sigma}_{\neg i}) = \pi(\sigma'_i,\ \tilde{\sigma}_{\neg i})$, respectively failing $\pi(\tilde{\sigma}_i,\ \sigma_{\neg i})$ and $\pi(\sigma_i,\ \tilde{\sigma}_{\neg i})$ for $(\tilde{\sigma}_i,\ \tilde{\sigma}_{\neg i})$.

3. Nash equilibrium: no COVID-19 vaccination

Table 1: Static COVID-19 vaccination game

		(q_1)	(q_2)	(q_3)	$(1 - \sum_{j=1}^{3} q_j)$
	$C \backslash G$	DI	SR	LR	$\neg I$
(p_1)	V	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{di} - \pi_{\neg vG})$	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{sr} - \pi_{di} - \pi_{\neg vG})$	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG})$	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr})$
$(1 - p_1)$	$\neg V$		$(\pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h},$ $\pi_{sr} - \pi_{di} - \pi_{\neg vG})$	$(\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h},$ $\pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG})$	$(\pi_s + \pi_{\neg vC} + \pi_l - \pi_{\Diamond h},$ $\pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr})^*$

Note. This is a static COVID-19 vaccination game between the citizen and the government. The citizen's strategies are "Vaccination" and "No vaccination". The government's strategies are "Direct imposition", "Subsistence restriction", "Luxury restriction" and "No imposition". The sole and strict pure strategy Nash equilibrium, marked by an asterisk, is strategy profile "No vaccination, No imposition": $(s^*_C,\ s^*_G) = (\neg V,\ \neg I)$. *There exist no Nash equilibria in mixed or semi-mixed strategies.*

Proposition 3.1 (Pure strategy Nash equilibria) *The game features one pure strategy Nash equilibrium, namely, strategy profile "No vaccination, No imposition". Formally:*

$$(s^*_C,\ s^*_G) = (\neg V,\ \neg I). \tag{1}$$

Proof. Best responses in pure strategies are elaborated in relation to both players. Their matches are subsequently acknowledged as the game's pure strategy Nash equilibria.

Lemma 3.1.1 The citizen's best responses are the following. If the government plays strategy "Direct imposition" the citizen's best response is necessarily strategy "Vaccination": $s_G = DI \longrightarrow s^*_C = V$, since $\nexists\pi(\neg V,\ DI)$.

If the government plays strategy "Subsistence restriction" the citizen's best response is strategy "Vaccination", his payoff being relatively higher thereby: $s_G = SR \longrightarrow s^*_C = V$, since $\pi_C(V,\ SR) > \pi_C(\neg V,\ SR)$, specifically, $\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} > \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h} \longrightarrow 2(\pi_s + \pi_l + \pi_{\Diamond h}) > 2\pi_{\neg vC} \longrightarrow \pi_s + \pi_l + \pi_{\Diamond h} > \pi_{\neg vC}$.

If the government plays strategy “Luxury restriction” the citizen’s best response is strategy “No vaccination”, his payoff being relatively higher thereby: $s_G = LR \longrightarrow s_C^* = \neg V$, since $\pi_C(\neg V,\ LR) > \pi_C(V,\ LR)$, specifically, $\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h} > \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} \longrightarrow 2(\pi_{\neg vC} - \pi_l) > 2\pi_{\Diamond h} \longrightarrow \pi_{\neg vC} - \pi_l > \pi_{\Diamond h}$.

If the government plays strategy “No imposition” the citizen’s best response is strategy “No vaccination”, his payoff being relatively higher thereby: $s_G = \neg I \longrightarrow s_C^* = \neg V$, since $\pi_C(\neg V,\ \neg I) > \pi_C(V,\ \neg I)$, specifically, $\pi_s + \pi_{\neg vC} + \pi_l - \pi_{\Diamond h} > \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} \longrightarrow 2\pi_{\neg vC} > 2\pi_{\Diamond h} \longrightarrow \pi_{\neg vC} > \pi_{\Diamond h}$.

Lemma 3.1.2 The government’s best responses are the following. If the citizen plays strategy “Vaccination” the government’s best response is strategy “No imposition”, his payoff being relatively higher thereby: $s_C = V \longrightarrow s_G^* = \neg I$, since $\pi_G(V,\ \neg I) > \pi_G(V,\ DI) > \pi_G(V,\ SR) > \pi_G(V,\ LR)$, specifically, $\pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr} > 0 > \pi_{di} - \pi_{\neg vG} > \pi_{sr} - \pi_{di} - \pi_{\neg vG} > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

If the citizen plays strategy “No vaccination” the government’s best response is strategy “No imposition”, his payoff being relatively higher thereby: $s_C = \neg V \longrightarrow s_G^* = \neg I$, since $\pi_G(s_C,\ \neg I) > \pi_G(s_C,\ SR) > \pi_G(s_C,\ LR)$ and $\nexists \pi(\neg V,\ DI)$, specifically, $\pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr} > 0 > \pi_{sr} - \pi_{di} - \pi_{\neg vG} > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

Lemma 3.1.3 The matches of the two players’ best responses in pure strategies yield strategy profile “No vaccination, No imposition”, being the game’s sole and strict pure strategy Nash equilibrium: $(s_C^*,\ s_G^*) = (\neg V,\ \neg I)$, since $s_C = V \veebar \neg V \longrightarrow s_G^* = \neg I$ and $s_G = \neg I \longrightarrow s_C^* = \neg V$. *QED*

Pure strategy Nash equilibrium “No vaccination, No imposition” is a resounding refutation of all COVID-19 vaccination fundamentalists, might be they citizens, governments or supranational institutions. So much for having peremptorily labelled those sceptical of or averse to COVID-19 vaccination irresponsible and selfish citizens, fit for that exclusion from society which was gradually accorded them, nay, criminals and terrorists. One could not help viewing such a conduct as a duplicitous attempt to intimidate and pressure persons into receiving COVID-19 vaccines, now being even more likely.

The best responses evaluated in the process are a further resounding refutation of COVID-19 vaccination subjectivists and rigourists. Specifically, the citizen’s best response to strategy “Luxury restriction” played by the government is strategy “No vaccination”, not “Vaccination”, as COVID-19 vaccination subjectivists would have by contrast accommodated, nor is it a mixed strategy, as to be seen. COVID-19 vaccination subjectivists could not have been wronger, for the sub-payoff yielded by no vaccination ultimately exceeds the sum of the sub-payoffs yielded by luxury and potential health gains: $\pi_{\neg vC} > \pi_l + \pi_{\Diamond h}$. The citizen’s best response to strategy “Subsistence restriction” played by the government is likewise strategy “Vaccination”, not strategy “No vaccination”, as COVID-19 vaccination rigourists would have by contrast stressed. They too could not have been wronger, for ineludible participation to evil is present either way (self-starvation or COVID-19 vaccination) and the sum of the sub-payoffs yielded by subsistence, luxury and potential health gains ultimately exceeds the sub-payoff yielded by no vaccination: $\pi_s + \pi_l + \pi_{\Diamond h} > \pi_{\neg vC}$.

Does the game albeit present any Nash equilibria in mixed or semi-mixed strategies? The answer is found in the proposition below.

Proposition 3.2 (Mixed and semi-mixed strategy Nash equilibria) *The game features no Nash equilibria in mixed and semi-mixed strategies, namely, it features Nash equilibria only in pure strategies, being strategy profile “No vaccination, No imposition”. Formally:*

$$(\sigma_C^*,\ \sigma_G^*) \stackrel{!}{=} (s_C^*,\ s_G^*) = (\neg V,\ \neg I). \tag{2}$$

Proof. Strategy expected payoffs are elaborated in relation to both players, feasibly solving for probabilities. Contingent on the obtainment of probabilities in relation to both players, best responses are subsequently elaborated. Their matches are finally acknowledged as the game’s Nash equilibria, in mixed, semi-mixed or pure strategies.

For notational simplicity: $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$; $d_C \equiv \pi_s + \pi_{\neg vC} + \pi_l - \pi_{\Diamond h}$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$; $d_G \equiv \pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr}$.

Lemma 3.2.1 The citizen’s expected payoff by playing strategy “Vaccination” is the probabilistic sum of his payoffs across the government’s pure strategies: $\mathbb{E}[\pi(V)] = a_C(q_1 + q_2 + q_3 + 1 - q_1 - q_2 - q_3) = a_C$. It is certainly payoff a_C, being the same across all government pure strategies.

The citizen's expected payoff by playing strategy "No vaccination" is the probabilistic sum of his payoffs across the government's pure strategies: $\mathbb{E}[\pi(\neg V)] = b_C q_2 + c_C q_3 + d_C(1 - q_1 - q_2 - q_3)$, where $q_1 = 0$.

The two expected payoffs are expressed in terms of probabilities, implicitly and explicitly, respectively. Such probabilities can be calculated by allowing the expected payoffs to equal zero, in correspondence: $\mathbb{E}[\pi(V)] = \mathbb{E}[(\neg V)] = 0 \longleftrightarrow a_C = b_C q_2 + c_C q_3 + d_C(1 - q_2 - q_3) = 0 \longrightarrow 0 = (b_C - d_C)q_2 + c_C q_3 + d_C(1 - q_3) \longrightarrow (d_C - b_C)q_2 = c_C q_3 + d_C(1 - q_3) \longrightarrow q_2 = \frac{c_C q_3 + d_C(1-q_3)}{d_C - b_C}$ such that $\{q_i\}_{i=1}^4 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{j=1}^4 q_j = 1$.

Lemma 3.2.2 The government's expected payoff by playing strategy "Direct imposition" is certainly payoff a_G, whereby probability p_1 is unitary, for strategy profile "No vaccination, Direct imposition" does not thereby exist: $\mathbb{E}[\pi(DI)] = a_G$ and $p_1 = 1$, since $\nexists \pi(\neg V,\ DI)$.

The government's expected payoff by playing strategies "Subsistence restriction", "Luxury restriction" and "No imposition" is the probabilistic sum of his respective payoffs across the citizen's pure strategies: $\mathbb{E}[\pi(SR)] = b_G(p_1 + 1 - p_1) = b_G$; $\mathbb{E}[\pi(LR)] = c_G(p_1 + 1 - p_1) = c_G$; $\mathbb{E}[\pi(\neg I)] = d_G(p_1 + 1 - p_1) = d_G$.

The four expected payoffs are expressed in terms of implicit probabilities. Probabilities $\{p_i\}_{i=1}^2$ therefore remain underdetermined: $\{p_i\}_{i=1}^2 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{j=1}^2 p_j = 1$.

Lemma 3.2.3 The citizen's conditional best responses are the following. If probability q_1 is greater than all other probabilities then probability p_1 is unitary. More clearly, the government would be more likely to play strategy "Direct imposition" and the citizen would necessarily respond by playing strategy "Vaccination": $q_1 > q_{\neg 1} \longrightarrow p_1 = 1$, *ceteris paribus,* since $\nexists \pi(\neg V,\ DI)$.

If probability q_2 is greater than all other probabilities then probability p_1 is unitary. More clearly, the government would be more likely to play strategy "Subsistence restriction" and the citizen would respond by playing strategy "Vaccination", for his payoff would thereby be greater: $q_2 > q_{\neg 2} \longrightarrow p_1 = 1$, *ceteris paribus,* since $\pi_C(V,\ SR) > \pi_C(\neg V,\ SR)$.

If probability q_3 is greater than all other probabilities then probability p_2 is unitary. More clearly, the government would be more likely to play strategy "Luxury restriction" and the citizen would respond by playing strategy "No vaccination", for his payoff would thereby be greater: $q_3 > q_{\neg 3} \longrightarrow p_2 = 1$, *ceteris paribus,* since $\pi_C(\neg V,\ LR) > \pi_C(V,\ LR)$.

If probability q_4 is greater than all other probabilities then probability p_2 is unitary. More clearly, the government would be more likely to play strategy "No imposition" and the citizen would respond by playing strategy "No vaccination", for his payoff would thereby be greater: $q_4 > q_{\neg 4} \longrightarrow p_2 = 1$, *ceteris paribus,* since $\pi_C(\neg V,\ \neg I) > \pi_C(V,\ \neg I)$.

Lemma 3.2.4 The government's conditional best responses are the following. If probability p_1 is greater than probability p_2 then probability q_4 is unitary. More clearly, the citizen would be more likely to play strategy "Vaccination" and the government would respond by playing strategy "No imposition", for his payoff would thereby be greater: $p_1 > p_2 \longrightarrow q_4 = 1$, *ceteris paribus,* since $\pi_G(V,\ \neg I) > \pi_G(V,\ DI) > \pi_G(V,\ SR) > \pi_G(V,\ LR)$.

If probability p_2 is greater than probability p_1 then probability q_4 is unitary. More clearly, the citizen would be more likely to play strategy "No vaccination" and the government would respond by playing strategy "No imposition", for his payoff would be thereby greater: $p_2 > p_1 \longrightarrow q_4 = 1$, *ceteris paribus,* since $\pi_G(s_C,\ \neg I) > \pi_G(s_C,\ SR) > \pi_G(s_C,\ LR)$ and $\nexists \pi(\neg V,\ DI)$.

Lemma 3.2.5 The matches of the two players' conditional best responses reveal the absence of Nash equilibria in mixed and semi-mixed strategies. Specifically, they yield strategy profile "No vaccination, No imposition", being the game's sole and strict pure strategy Nash equilibrium: $(\sigma_C^*,\ \sigma_G^*) \stackrel{!}{=} (s_C^*,\ s_G^*) = (\neg V,\ \neg I)$, since $p_2 > p_1 \longrightarrow q_4 = 1$ and $q_4 > q_{\neg 4} \longrightarrow p_2 = 1$. *QED*

Not only has a theoretical representation of the interactive decisions relative to COVID-19 vaccination fleshed out the strategic correctness of those sceptical of or averse to COVID-19 vaccination, not only has it thereby exposed COVID-19 vaccination fundamentalists as perilously illiberal and COVID-19 vaccination subjectivists and rigourists as severely confused, at best, not only has it unveiled all governmental measures of restriction, constriction and coercion towards the reception of COVID-19 vaccines adopted worldwide as profoundly flawed, but it especially dismantles the myth of COVID-19 vaccine reception as being a dominant strategy on the part of citizens and the myth of the existence of a dominant strategy equilibrium therewith, as to be seen, further refuting the illiberal COVID-19 vaccination fundamentalists. Indeed, COVID-19 vaccine reception on the part of citizens was transversally inculcated as citizens' best option irrespective of governmental decisions, as their panacea. It could not have been falser: it was a misconception and a most dangerous one too. The following proposition derives such a result.

Table 2: Static COVID-19 vaccination game with mixed strategies

$C\backslash G$	DI	SR	LR	$\neg I$	$DIq_1 + SRq_2 + LRq_3 + \neg I(1 - \sum_{i=1}^{3} q_i)$
V	$(a_C,\ a_G)$	$(a_C,\ b_G)$	$(a_C,\ c_G)$	$(a_C,\ d_G)$	$[a_C,\ a_Gq_1 + b_Gq_2 + c_Gq_3 +$ $+ d_G(1 - \sum_{i=1}^{3} q_i)]$
$\neg V$		$(b_C,\ b_G)$	$(c_C,\ c_G)$	$(d_C,\ d_G)$	
$Vp_1 + \neg V(1-p_1)$		$[a_Cp_1 + b_C(1-p_1),\ b_G]$	$[a_Cp_1 + c_C(1-p_1),\ c_G]$	$[a_Cp_1 + d_C(1-p_1),\ d_G]$	

Note. This is the static COVID-19 vaccination game between the citizen and the government with specified mixed strategies. Citizen mixed strategy $Vp_1 + \neg V(1-p_1) = Vp_1 + \neg Vp_2$ is such that probability $p_1 \in (0,\ 1) \subset \mathbb{R}_{++}$. Government mixed strategy $DIq_1 + SRq_2 + LRq_3 + \neg I(1 - \sum_{i=1}^{3} q_i) = DIq_1 + SRq_2 + LRq_3 + \neg Iq_4$ is such that sequence $\{q_i\}_{i=1}^{4} \subset (0,\ 1) \subset \mathbb{R}_{++}$ and sum $\sum_{i=1}^{4} q_i = 1$. Payoffs are denominated thus: $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$; $d_C \equiv \pi_s + \pi_{\neg vC} + \pi_l - \pi_{\Diamond h}$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$; $d_G \equiv \pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr}$. There exist no dominant strategy equilibria.

PROPOSITION 3.3 (Dominant strategy equilibria) *The game features no dominant strategy equilibria. Formally:*

$$\nexists(\tilde{\sigma}_C,\ \tilde{\sigma}_G). \tag{3}$$

Proof. Dominant strategies are elaborated in relation to both players. Their strategy profiles are then acknowledged as the game's dominant strategy equilibria.

For notational simplicity: $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$; $d_C \equiv \pi_s + \pi_{\neg vC} + \pi_l - \pi_{\Diamond h}$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$; $d_G \equiv \pi_{\neg vG} - \pi_{di} - \pi_{sr} - \pi_{lr}$.

Lemma 3.3.1 The citizen's mixed strategies are a probabilistic sum of his pure strategies: $\forall p_1 \in [0,\ 1] \subset \mathbb{R}_+,\ \sigma_C = Vp_1 + \neg V(1-p_1) = Vp_1 + \neg Vp_2$. Specifically, the citizen can play pure strategy "Vaccination", pure strategy "No vaccination" or a combination of the two: $\sigma_{C1} = V(1) + \neg V(1-1) = V,\ \sigma_{C2} = V(0) + \neg V(1-0) = \neg V$ or, $\forall p_1 \in (0,\ 1) \subset \mathbb{R}_{++},\ \sigma_{C3} = Vp_1 + \neg V(1-p_1)$.

The government's mixed strategies are a probabilistic sum of its pure strategies: $\forall \{q_i\}_{i=1}^{4} \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{i=1}^{4} q_i = 1,\ \sigma_G = DIq_1 + SRq_2 + LRq_3 + \neg I(1 - q_1 - q_2 - q_3) = DIq_1 + SRq_2 + LRq_3 + \neg Iq_4$.

Specifically, the government can play pure strategy "Direct imposition", pure strategy "Subsistence restriction", pure strategy "Luxury restriction", pure strategy "No imposition" or a combination of the four: $\sigma_{G1} = DI(1) + SR(0) + LR(0) + \neg I(1-1-0-0) = DI,\ \sigma_{G2} = DI(0) + SR(1) + LR(0) + \neg I(1-0-1-0) = SR,\ \sigma_{G3} = DI(0) + SR(0) + LR(1) + \neg I(1-0-0-1) = LR,\ \sigma_{G4} = DI(0) + SR(0) + LR(0) + \neg I(1-0-0-0) = \neg I$ or, $\forall \{q_i\}_{i=1}^{4} \subset (0,\ 1) \subset \mathbb{R}_{++}$ and $\sum_{i=1}^{4} q_i = 1,\ \sigma_{G5} = DIq_1 + SRq_2 + LRq_3 + \neg I(1 - q_1 - q_2 - q_3)$.

Lemma 3.3.2 The citizen's expected payoffs under mixed strategy σ_{C3} and pure strategies by the government are these: $\nexists\mathbb{E}[\pi_C(\sigma_{C3},\ DI)] = a_Cp_1$, since $p_1 = 1$ and thus $\nexists\mathbb{E}[\pi(\sigma_{C3},\ DI)]$; $\mathbb{E}[\pi_C(\sigma_{C3},\ SR)] = a_Cp_1 + b_C(1-p_1)$; $\mathbb{E}[\pi_C(\sigma_{C3},\ LR)] = a_Cp_1 + c_C(1-p_1)$; $\mathbb{E}[\pi_C(\sigma_{C3},\ \neg I)] = a_Cp_1 + d_C(1-p_1)$.

The government's expected payoffs under mixed strategy σ_{G5} and pure strategies by the citizen are these: $\mathbb{E}[\pi_G(V,\ \sigma_{G5})] = a_Gq_1 + b_Gq_2 + c_Gq_3 + d_G(1 - q_1 - q_2 - q_3)$; $\nexists\mathbb{E}[\pi_G(\neg V,\ \sigma_{G5})] = b_Gq_2 + c_Gq_3 + d_G(1 - q_1 - q_2 - q_3)$, since $q_1 = 0$ and $\nexists\mathbb{E}[\pi(\neg V,\ \sigma_{G5})]$.

The citizen's expected payoffs under pure strategies "Vaccination" and "No vaccination" and mixed strategy σ_{G5} by the government are these: $\mathbb{E}[\pi_C(V,\ \sigma_{G5})] = a_C(q_1 + q_2 + q_3 + 1 - q_1 - q_2 - q_3) = a_C$; / $\exists\mathbb{E}[\pi_C(\neg V,\ \sigma_{G5})] = b_Cq_2 + c_Cq_3 + d_C(1 - q_1 - q_2 - q_3)$, since $q_1 = 0$ and thus $\nexists\mathbb{E}[\pi(\neg V,\ \sigma_{G5})]$.

The government's expected payoffs under pure strategies "Direct imposition", "Subsistence restriction", "Luxury restriction" and "No imposition" and mixed strategy σ_{C3} by the citizen are these: $\nexists\mathbb{E}[\pi_G(\sigma_{C3},\ DI)] = a_Gp_1$, since $p_1 = 1$ and thus $\nexists\mathbb{E}[\pi(\sigma_{C3},\ DI)]$; $\mathbb{E}[\pi_G(\sigma_{C3},\ SR)] = b_G(p_1 + 1 - p_1) = b_G$; $\mathbb{E}[\pi_G(\sigma_{C3},\ LR)] = c_G(p_1 + 1 - p_1) = c_G$; $\mathbb{E}[\pi_G(\sigma_{C3},\ \neg I)] = d_G(p_1 + 1 - p_1) = d_G$.

The expected payoffs under strategy profile $(\sigma_{C3},\ \sigma_{G5})$ are finally these: $\nexists\mathbb{E}[\pi(\sigma_{C3},\ \sigma_{G5})] = \{a_Cp_1 + [b_Cq_2 + c_Cq_3 + d_C(1 - q_1 - q_2 - q_3)](1-p_1),\ [a_Gq_1 + b_Gq_2 + c_Gq_3 + d_G(1 - q_1 - q_2 - q_3)]p_1 + [b_Gq_2 + c_Gq_3 + d_G(1 - q_1 - q_2 - q_3)](1-p_1)\}$, since $p_1 = 1$ and $q_1 = 0$.

Lemma 3.3.3 If the government plays pure strategy "Direct imposition" the citizen's highest payoff is necessarily found in pure strategy "Vaccination": $s_G = DI = \sigma_{G1} \longrightarrow \pi_C(V,\ DI) = \pi_C(\sigma_{C1},\ DI) = a_C$ and $\nexists \pi_C(\neg V,\ DI) = \pi_C(\sigma_{C2},\ DI)$ and $\nexists \mathbb{E}[\pi_C(\sigma_{C3},\ DI)] = a_C$.

If the government plays pure strategy "Subsistence restriction" the citizen's highest payoff is found in pure strategy "Vaccination", relatively higher thereby, the threat of starvation being too great: $s_G = SR = \sigma_{G2} \longrightarrow \pi_C(V,\ SR) = \pi_C(\sigma_{C1},\ SR) > \mathbb{E}[\pi_C(\sigma_{C3},\ SR)] > \pi_C(\neg V,\ SR) = \pi_C(\sigma_{C2},\ SR)$, specifically, $a_C > a_C p_1 + b_C(1-p_1) > b_C$, whereby $a_C > a_C p_1 + b_C(1-p_1) \longrightarrow a_C(1-p_1) > b_C(1-p_1)$ and $a_C p_1 + b_C(1-p_1) > b_C \longrightarrow a_C p_1 > b_C p_1$, being all true.

If the government plays pure strategy "Luxury restriction" the citizen's highest payoff is found in pure strategy "No vaccination", relatively higher thereby, the risks from COVID-19 vaccination being too great: $s_G = LR = \sigma_{G3} \longrightarrow \pi_C(\neg V,\ LR) = \pi_C(\sigma_{C2},\ LR) > \mathbb{E}[\pi_C(\sigma_{C3},\ LR)] > \pi_C(V,\ LR) = \pi_C(\sigma_{C1},\ LR)$, specifically, $c_C > a_C p_1 + c_C(1-p_1) > a_C$, whereby $c_C > a_C p_1 + c_C(1-p_1) \longrightarrow c_C p_1 > a_C p_1$ and $a_C p_1 + c_C(1-p_1) > a_C \longrightarrow c_C(1-p_1) > a_C(1-p_1)$, being all true.

If the government plays pure strategy "No imposition" the citizen's highest payoff is found in pure strategy "No vaccination", relatively higher thereby, the risks from COVID-19 vaccination being again too great: $s_G = \neg I = \sigma_{G4} \longrightarrow \pi_C(\neg V,\ \neg I) = \pi_C(\sigma_{C2},\ \neg I) > \mathbb{E}[\pi_C(\sigma_{C3},\ \neg I)] > \pi_C(V,\ \neg I) = \pi_C(\sigma_{C1},\ \neg I)$, specifically, $d_C > a_C p_1 + d_C(1-p_1) > a_C$, whereby $d_C > a_C p_1 + d_C(1-p_1) \longrightarrow d_C p_1 > a_C p_1$ and $a_C p_1 + d_C(1-p_1) > a_C \longrightarrow d_C(1-p_1) > a_C(1-p_1)$, being all true.

If the government plays mixed strategy σ_{G5} the citizen's highest payoff is necessarily found as an expected payoff in pure strategy "Vaccination": $s_G = \sigma_{G5} \longrightarrow \mathbb{E}[\pi_C(V,\ \sigma_{G5})] = \mathbb{E}[\pi_C(\sigma_{C1},\ \sigma_{G5})] = a_C$ and $\nexists \mathbb{E}[\pi_C(\neg V,\ \sigma_{G5})] = \mathbb{E}[\pi_C(\sigma_{C2},\ \sigma_{G5})] = b_C q_2 + c_C q_3 + d_C(1-q_2-q_3)$ and $\nexists \mathbb{E}[\pi_C(\sigma_{C3},\ \sigma_{G5})] = a_C$. Consequently, the citizen features no dominant strategy and the game features no dominant strategy equilibria thereby: $\nexists \tilde{\sigma}_C$ and thus $\nexists(\tilde{\sigma}_C,\ \tilde{\sigma}_G)$.

Lemma 3.3.4 For completeness, if the citizen plays pure strategy "Vaccination" the government's highest payoff is found in pure strategy "No imposition", relatively higher thereby, the risks from COVID-19 vaccination being too great: $s_C = V = \sigma_{C1} \longrightarrow \pi_G(V,\ \neg I) = \pi_G(V,\ \sigma_{G4}) > \pi_G(V,\ DI) = \pi_G(V,\ \sigma_{G1}) > \pi_G(V,\ SR) = \pi_G(V,\ \sigma_{G2}) > \pi_G(V,\ LR) = \pi_G(V,\ \sigma_{G3})$ and $\pi_G(V,\ \neg I) = \pi_G(V,\ \sigma_{G4}) > \mathbb{E}[\pi_G(V,\ \sigma_{G5})]$, specifically, $d_G > a_G > b_G > c_G$ and $d_G > a_G q_1 + b_G q_2 + c_G q_3 + d_G(1-q_1-q_2-q_3) \longrightarrow 0 > (a_G - d_G)q_1 + (b_G - d_G)q_2 + (c_G - d_G)q_3$, being all true[20].

If the citizen plays pure strategy "No vaccination" the government's highest payoff is found in pure strategy "No imposition", relatively higher thereby, the risks from COVID-19 vaccination being again too great: $s_C = \neg V = \sigma_{C2} \longrightarrow \pi_G(\neg V,\ \neg I) = \pi_G(\neg V,\ \sigma_{G4}) > \pi_G(\neg V,\ SR) = \pi_G(\neg V,\ \sigma_{G2}) > \pi_G(\neg V,\ LR) = \pi_G(\neg V,\ \sigma_{G3})$ and $\nexists \pi_G(\neg V,\ DI) = \pi_G(\neg V,\ \sigma_{G1})$ and $\nexists \mathbb{E}[\pi_G(\neg V,\ \sigma_{G5})] = b_G q_2 + c_G q_3 + d_G(1-q_2-q_3)$; specifically, $d_G > b_G > c_G$[21].

If the citizen plays mixed strategy σ_{C3} the government's highest payoff is found as an expected payoff in pure strategy "No imposition", relatively higher thereby, the risks from COVID-19 vaccination being yet again too great: $s_C = \sigma_{C3} \longrightarrow \mathbb{E}[\pi_G(\sigma_{C3},\ \neg I)] = \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G4})] > \mathbb{E}[\pi_G(\sigma_{C3},\ SR)] = \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G2})] > \mathbb{E}[\pi_G(\sigma_{C3},\ LR)] = \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G3})]$ and $\nexists \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G1})] = \mathbb{E}[\pi_G(\sigma_{C3},\ DI)] = a_G$ and $\nexists \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G5})] = b_G q_2 + c_G q_3 + d_G(1-q_2-q_3)$; specifically, $d_G > b_G > c_G$[22]. Consequently, the government's dominant strategy is "No imposition": $\tilde{\sigma}_G = \neg I$.

Lemma 3.3.5 In sum, the game features no dominant strategy equilibria: $\nexists(\tilde{\sigma}_C,\ \tilde{\sigma}_G)$. *QED*

4. Despotic refinement and new Nash equilibrium: COVID-19 vaccination

The game is now nonetheless refined so as to eliminate strategy "No imposition" on the part of the

[20] For completeness, in accordance with $\{q_i\}_{i=1}^4 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^4 q_i = 1$: $\pi_G(V,\ DI) = \pi_G(V,\ \sigma_{G1}) \gtreqless \mathbb{E}[\pi_G(V,\ \sigma_{G5})] \longleftrightarrow a_G \gtreqless a_G q_1 + b_G q_2 + c_G q_3 + d_G(1-q_1-q_2-q_3) \longrightarrow 0 \gtreqless (a_G - d_G)q_1 + (b_G - d_G)q_2 + (c_G - d_G)q_3 + (d_G - a_G) \longrightarrow 0 \gtreqless (b_G - d_G)q_2 + (c_G - d_G)q_3 + (d_G - a_G)(1-q_1)$; $\pi_G(V,\ SR) = \pi_G(V,\ \sigma_{G2}) \gtreqless \mathbb{E}[\pi_G(V,\ \sigma_{G5})] \longleftrightarrow b_G \gtreqless a_G q_1 + b_G q_2 + c_G q_3 + d_G(1-q_1-q_2-q_3) \longrightarrow 0 \gtreqless (a_G - d_G)q_1 + (b_G - d_G)q_2 + (c_G - d_G)q_3 + (d_G - b_G) \longrightarrow 0 \gtreqless (a_G - d_G)q_1 + (c_G - d_G)q_3 + (d_G - b_G)(1-q_2)$; $\pi_G(V,\ LR) = \pi_G(V,\ \sigma_{G3}) \gtreqless \mathbb{E}[\pi_G(V,\ \sigma_{G5})] \longleftrightarrow c_G \gtreqless a_G q_1 + b_G q_2 + c_G q_3 + d_G(1-q_1-q_2-q_3) \longrightarrow 0 \gtreqless (a_G - d_G)q_1 + (b_G - d_G)q_2 + (c_G - d_G)q_3 + (d_G - c_G) \longrightarrow 0 \gtreqless (a_G - d_G)q_1 + (b_G - d_G)q_2 + (d_G - c_G)(1-q_3)$.

[21] For completeness, $\pi_G(\neg V,\ \neg I) = \pi_G(\neg V,\ \sigma_{G4}) > \mathbb{E}[\pi_G(\neg V,\ \sigma_{G5})]$ would be specified as $d_G > b_G q_2 + c_G q_3 + d_G(1-q_2-q_3) \longrightarrow 0 > (b_G - d_G)q_2 + (c_G - d_G)q_3$, which would be true, but $\nexists \mathbb{E}[\pi_G(\neg V,\ \sigma_{G5})] = b_G q_2 + c_G q_3 + d_G(1-q_2-q_3)$.

[22] For completeness, $\mathbb{E}[\pi_G(\sigma_{C3},\ \neg I)] = \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G4})] > \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G5})]$ would be specified as $d_G > b_G q_2 + c_G q_3 + d_G(1-q_2-q_3) \longrightarrow 0 > (b_G - d_G)q_2 + (c_G - d_G)q_3$, which would be true, but $\nexists \mathbb{E}[\pi_G(\sigma_{C3},\ \sigma_{G5})] = b_G q_2 + c_G q_3 + d_G(1-q_2-q_3)$.

government: $\hat{S}_G = \{DI,\ SR,\ LR\}$, *ceteris paribus,* such that $\hat{\Gamma}_{PR} = \{I,\ S_C,\ \hat{S}_G,\ \pi\}$ and $\hat{\Gamma}_{MX} = \{I,\ \Sigma_C,\ \hat{\Sigma}_G,\ \pi\}$.

Do the pure strategy Nash equilibria change? How, if so? Otherwise articulated, what if citizens around the world had discovered that their respective governments had never even considered the option of no COVID-19 vaccination imposition, if not as a diversion, in unison? How should have they pertinently reacted? The following proposition provides the answers.

Table 3: Static COVID-19 vaccination game refined for despotism

		(q_1)	(q_2)	$(1 - \sum_{j=1}^{2} q_j)$
	$C \backslash G$	DI	SR	LR
(p_1)	V	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{di} - \pi_{\neg vG})^*$	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{sr} - \pi_{di} - \pi_{\neg vG})$	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG})$
$(1 - p_1)$	$\neg V$		$(\pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h},$ $\pi_{sr} - \pi_{di} - \pi_{\neg vG})$	$(\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h},$ $\pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG})$

Note. This is the static COVID-19 vaccination game between the citizen and the government refined for despotism. The citizen's strategies are still "Vaccination" and "No vaccination". The government's strategies have become "Direct imposition", "Subsistence restriction" and "Luxury restriction", omitting "No imposition". The sole and strict pure strategy Nash equilibrium, marked by an asterisk, becomes strategy profile "Vaccination, Direct imposition": $(s_C^*,\ \hat{s}_G^*) = (V,\ DI)$. There exist no Nash equilibria in mixed or semi-mixed strategies.

PROPOSITION 4.1 (Despotic pure strategy Nash equilibria) *The despotic game features one pure strategy Nash equilibrium, namely, strategy profile "Vaccination, Direct imposition". Formally:*

$$(s_C^*,\ \hat{s}_G^*) = (V,\ DI). \tag{4}$$

Proof. Best responses in pure strategies refined for despotism are elaborated in relation to both players. Their matches are subsequently acknowledged as the despotic game's pure strategy Nash equilibria.

Lemma 4.1.1 The citizen's best responses refined for despotism are the following. If the government plays strategy "Direct imposition" the citizen's best response is necessarily strategy "Vaccination": $\hat{s}_G = DI \longrightarrow s_C^* = V$, since $\nexists \pi(\neg V,\ DI)$.

If the government plays strategy "Subsistence restriction" the citizen's best response is strategy "Vaccination", his payoff being relatively higher thereby: $\hat{s}_G = SR \longrightarrow s_C^* = V$, since $\pi_C(V,\ SR) > \pi_C(\neg V,\ SR)$, specifically, $\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} > \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h} \longrightarrow 2(\pi_s + \pi_l + \pi_{\Diamond h}) > 2\pi_{\neg vC} \longrightarrow \pi_s + \pi_l + \pi_{\Diamond h} > \pi_{\neg vC}$.

If the government plays strategy "Luxury restriction" the citizen's best response is strategy "No vaccination", his payoff being relatively higher thereby: $\hat{s}_G = LR \longrightarrow s_C^* = \neg V$, since $\pi_C(\neg V,\ LR) > \pi_C(V,\ LR)$, specifically, $\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h} > \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} \longrightarrow 2(\pi_{\neg vC} - \pi_l) > 2\pi_{\Diamond h} \longrightarrow \pi_{\neg vC} - \pi_l > \pi_{\Diamond h}$.

Lemma 4.1.2 The government's best responses refined for despotism are the following. If the citizen plays strategy "Vaccination" the government's best response is strategy "Direct imposition", his payoff being relatively higher thereby: $s_C = V \longrightarrow \hat{s}_G^* = DI$, since $\pi_G(V,\ DI) > \pi_G(V,\ SR) > \pi_G(V,\ LR)$, specifically, $0 > \pi_{di} - \pi_{\neg vG} > \pi_{sr} - \pi_{di} - \pi_{\neg vG} > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

If the citizen plays strategy "No vaccination" the government's best response is strategy "Subsistence restriction", his payoff being relatively higher thereby: $s_C = \neg V \longrightarrow \hat{s}_G^* = SR$, since $\pi_G(s_C,\ SR) > \pi_G(s_C,\ LR)$ and $\nexists \pi(\neg V,\ DI)$, specifically, $0 > \pi_{sr} - \pi_{di} - \pi_{\neg vG} > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

Lemma 4.1.3 The matches of the two players' best responses refined for despotism yield strategy profile "Vaccination, Direct imposition", being the despotic game's sole and strict pure strategy Nash equilibrium: $(s_C^*,\ \hat{s}_G^*) = (V,\ DI)$, since $s_C = V \longrightarrow \hat{s}_G^* = DI$ and $\hat{s}_G = DI \longrightarrow s_C^* = V$. *QED*

The Nash equilibria of dynamic games with perfect and thus complete information were termed sub-game perfect equilibria, by Reinhard Selten[23]. Complete information is such that all players know each other's

[23] Reinhard Selten, *Spieltheoretische Behandlung eines Oligopolmodells mit Nachfrageträgheit [Game Theory Treatment of an Oligopoly Model with Demand Inertia],* Zeitschrift für die Gesamte Staatswissenschaft 121: 301-24, 667-89, 1965.

types, being hereby unspecified and therefore void. Sub-game perfect equilibria also arise in static games with complete information: for a given game, the set of sub-game perfect equilibria is a subset of the set of Nash equilibria. Consequently, because the games at hand feature one sole and strict Nash equilibrium, in pure strategies, so do their dynamic representations with perfect information, which do not thus necessitate to be studied analytically, all the more.

Now, despotic Nash equilibrium "Vaccination, Direct imposition" is forcefully insightful as to contemporary events. Specifically, it is no coincidence that contemporary governments worldwide, state or federal, far from being benevolent, almost unanimously rushed to eliminate strategy "No imposition" from their strategy sets and strategy "Luxury restriction" forthwith. Indeed, governments around the world seem to have never even considered the selfsame luxury restrictions, if not as diversions. In brief, once strategy "No imposition" was no longer an option, for whatever reason (good or bad faith), all other factors constant (rationality, implementation, enforceability), COVID-19 vaccination mandates and spontaneous reception of COVID-19 vaccines internationally coincided.

It must be observed that even if the game were ulteriorly refined towards strategy "Direct imposition" the sole and strict pure strategy Nash equilibrium would not change. Indeed, under strategies "Subsistence restriction" and "Direct imposition" citizens' best responses are ever strategy "Vaccination". As a consequence, those countries which became for the most part vaccinated nations against COVID-19 before the introduction of restrictions on subsistence by their respective governments displayed irrationality, not because of nescience, but blindness, triggered by ill will and fomented by confusion and fear, themselves objectively actualised through brainwashing, through incessant misinformation (lies) and disorientating disinformation (terror), the reason for which is left to the critical thinker.

While citizens' best response to direct imposition and subsistence restrictions might be COVID-19 vaccination, necessarily and rationally, respectively, until subsistence restrictions were enacted one did not need to get vaccinated against COVID-19. In other words, the citizen's best response to strategy "Luxury restriction" is still strategy "No vaccination", even for the vaccinated population: new COVID-19 vaccine doses need not be wilfully received; so-called booster shots are to be avoided as much as possible.

Even so, does the despotic game present any Nash equilibria in mixed or semi-mixed strategies? The answer is found in the proposition below.

Proposition 4.2 (Despotic mixed and semi-mixed strategy Nash equilibria) *The despotic game features no Nash equilibria in mixed and semi-mixed strategies, namely, it features Nash equilibria only in pure strategies, being strategy profile "Vaccination, Direct imposition". Formally:*

$$(\sigma_C^*,\ \hat{\sigma}_G^*) \stackrel{!}{=} (s_C^*,\ \hat{s}_G^*) = (V,\ DI). \tag{5}$$

Proof. Strategy expected payoffs refined for despotism are elaborated in relation to both players, feasibly solving for probabilities. Contingent on the obtainment of probabilities in relation to both players, best responses refined for despotism are subsequently elaborated. Their matches are finally acknowledged as the despotic game's Nash equilibria, in mixed, semi-mixed or pure strategies.

For notational simplicity: $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

Lemma 4.2.1 The citizen's expected payoff by playing strategy "Vaccination" is the probabilistic sum of his payoffs across the government's pure strategies: $\mathbb{E}[\pi(V)] = a_C(q_1 + q_2 + 1 - q_1 - q_2) = a_C$. It is certainly payoff a_C, being the same across all government pure strategies.

The citizen's expected payoff by playing strategy "No vaccination" is the probabilistic sum of his payoffs across the government's pure strategies: $\mathbb{E}[\pi(\neg V)] = b_C q_2 + c_C(1 - q_1 - q_2)$, where $q_1 = 0$.

The two expected payoffs are expressed in terms of probabilities, implicitly and explicitly, respectively. Such probabilities can be calculated by allowing the expected payoffs to equal zero, in correspondence: $\mathbb{E}[\pi(V)] = \mathbb{E}[(\neg V)] = 0 \longleftrightarrow a_C = b_C q_2 + c_C(1 - q_2) = 0 \longrightarrow (c_C - b_C)q_2 = c_C \longrightarrow q_2 = \frac{c_C}{c_C - b_C}$ such that $\{q_i\}_{i=1}^3 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{j=1}^3 q_j = 1$.

Lemma 4.2.2 The government's expected payoff by playing strategy "Direct imposition" is certainly payoff a_G, whereby probability p_1 is unitary, for strategy profile "No vaccination, Direct imposition" does not thereby exist: $\mathbb{E}[\pi(DI)] = a_G$ and $p_1 = 1$, since $\nexists \pi(\neg V,\ DI)$.

The government's expected payoff by playing strategies "Subsistence restriction" and "Luxury restriction" is the probabilistic sum of his respective payoffs across the government's pure strategies: $\mathbb{E}[\pi(SR)] = b_G(p_1 + 1 - p_1) = b_G$; $\mathbb{E}[\pi(LR)] = c_G(p_1 + 1 - p_1) = c_G$.

The three expected payoffs are expressed in terms of implicit probabilities. Probabilities $\{p_i\}_{i=1}^2$ therefore remain underdetermined: $\{p_i\}_{i=1}^2 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{j=1}^2 p_j = 1$.

Lemma 4.2.3 The citizen's conditional best responses refined for despotism are the following. If probability q_1 is greater than all other probabilities then probability p_1 is unitary. More clearly, the government would be more likely to play strategy "Direct imposition" and the citizen would necessarily respond by playing strategy "Vaccination": $q_1 > q_{\neg 1} \longrightarrow p_1 = 1$, *ceteris paribus,* since $\nexists \pi(\neg V,\ DI)$.

If probability q_2 is greater than all other probabilities then probability p_1 is unitary. More clearly, the government would be more likely to play strategy "Subsistence restriction" and the citizen would respond by playing strategy "Vaccination", for his payoff would thereby be greater: $q_2 > q_{\neg 2} \longrightarrow p_1 = 1$, *ceteris paribus,* since $\pi_C(V,\ SR) > \pi_C(\neg V,\ SR)$.

If probability q_3 is greater than all other probabilities then probability p_2 is unitary. More clearly, the government would be more likely to play strategy "Luxury restriction" and the citizen would respond by playing strategy "No vaccination", for his payoff would thereby be greater: $q_3 > q_{\neg 3} \longrightarrow p_2 = 1$, *ceteris paribus,* since $\pi_C(\neg V,\ LR) > \pi_C(V,\ LR)$.

Lemma 4.2.4 The government's conditional best responses refined for despotism are the following. If probability p_1 is greater than probability p_2 then probability q_1 is unitary. More clearly, the citizen would be more likely to play strategy "Vaccination" and the government would respond by playing strategy "Direct imposition", for his payoff would thereby be greater: $p_1 > p_2 \longrightarrow q_1 = 1$, *ceteris paribus,* since $\pi_G(V,\ DI) > \pi_G(V,\ SR) > \pi_G(V,\ LR)$.

If probability p_2 is greater than probability p_1 then probability q_2 is unitary. More clearly, the citizen would be more likely to play strategy "No vaccination" and the government would respond by playing strategy "Subsistence restriction", for his payoff would be thereby greater: $p_2 > p_1 \longrightarrow q_2 = 1$, *ceteris paribus,* since $\pi_G(s_C,\ SR) > \pi_G(s_C,\ LR)$ and $\nexists \pi(\neg V,\ DI)$.

Lemma 4.2.5 The matches of the two players' conditional best responses refined for despotism reveal the absence of Nash equilibria in mixed and semi-mixed strategies. Specifically, they yield strategy profile "Vaccination, Direct imposition", being the despotic game's sole and strict pure strategy Nash equilibrium: $(\sigma_C^*,\ \hat{\sigma}_G^*) \overset{!}{=} (s_C^*,\ \hat{s}_G^*) = (V,\ DI)$, since $p_1 > p_2 \longrightarrow q_1 = 1$ and $q_1 > q_{\neg 1} \longrightarrow p_1 = 1$. *QED*

The meaning of the despotic pure strategy Nash equilibrium is that both citizens and governments find it optimal to embrace COVID-19 vaccination precisely owing to their knowledge of the despotic game's strategies. It explains the reason for which in the exogenous absence of no imposition governments around the world are to converge towards direct imposition, causing citizens to behave analogously, that is, to get vaccinated against COVID-19. Citizens should have although accounted and must yet account for luxury restrictions, be they out of sheer irrationality on the part of governments, be they out of prudence to avoid loss of power through revolutions or loss of influence through partial awakenings, because of their eliminations of no imposition. Citizens must thereby play their best responses, their strategies in accord with governments' played strategies, procrastinating the reception of COVID-19 vaccines whenever possible.

That clarified, the ineluctability of strategy profile "Vaccination, Direct imposition", throughout a worldwide convergence towards the elimination of strategy "No imposition", in spite of SARS-CoV-2's dubious pandemic mortality and isolation, deserves attention. In detail, despite it being obvious that COVID-19 vaccination is unwarranted the embracement of such an abortively unlawful and potentially catastrophic vaccination is becoming the most rational decision, the optimal decision. The world, Europe foremost, seems to be paying for its abandonment of perennial philosophy throughout the modern and postmodern age, having first returned to subjectivism and then fallen deeper into nihilism, structuralism and present trans-humanism: it is reaping that which it has sown.

The despotic game, in any event, fails to present a dominant strategy equilibrium as well, as the following proposition derives.

PROPOSITION 4.3 (Despotic dominant strategy equilibria) *The despotic game features no dominant strategy equilibria. Formally:*

$$\nexists(\tilde{\sigma}_C,\ \tilde{\hat{\sigma}}_G). \tag{6}$$

Proof. Dominant strategies refined for despotism are elaborated in relation to both players. Their strategy profiles are then acknowledged as the despotic game's dominant strategy equilibria.

For notational simplicity: $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

Lemma 4.3.1 The citizen's mixed strategies are a probabilistic sum of his pure strategies: $\forall p_1 \in [0,\ 1] \subset \mathbb{R}_+,\ \sigma_C = Vp_1 + \neg V(1-p_1) = Vp_1 + \neg Vp_2$. Specifically, the citizen can play pure strategy "Vaccination", pure strategy "No vaccination" or a combination of the two: $\sigma_{C1} = V(1) + \neg V(1-1) = V,\ \sigma_{C2} = V(0) + \neg V(1-0) = \neg V$ or, $\forall p_1 \in (0,\ 1) \subset \mathbb{R}_{++},\ \sigma_{C3} = Vp_1 + \neg V(1-p_1)$.

The government's mixed strategies are a probabilistic sum of his pure strategies: $\forall \{q_i\}_{i=1}^3 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{i=1}^3 q_i = 1,\ \hat{\sigma}_G = DIq_1 + SRq_2 + LR(1-q_1-q_2) = DIq_1 + SRq_2 + LRq_3$.

Specifically, the government can play pure strategy "Direct imposition", pure strategy "Subsistence restriction", pure strategy "Luxury restriction" or a combination of the three: $\hat{\sigma}_{G1} = DI(1) + SR(0) + LR(1-1-0) = DI,\ \hat{\sigma}_{G2} = DI(0)+SR(1)+LR(1-0-1) = SR,\ \hat{\sigma}_{G3} = DI(0)+SR(0)+LR(1-0-0) = LR$ or, $\forall \{q_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_{++}$ and $\sum_{i=1}^3 q_i = 1,\ \hat{\sigma}_{G4} = DIq_1 + SRq_2 + LR(1-q_1-q_2)$.

Lemma 4.3.2 The citizen's expected payoffs under mixed strategy σ_{C3} and pure strategies by the government are these: $\nexists\mathbb{E}[\pi_C(\sigma_{C3},\ DI)] = a_Cp_1$, since $p_1 = 1$ and thus $\nexists\mathbb{E}[\pi(\sigma_{C3},\ DI)]$; $\mathbb{E}[\pi_C(\sigma_{C3},\ SR)] = a_Cp_1 + b_C(1-p_1)$; $\mathbb{E}[\pi_C(\sigma_{C3},\ LR)] = a_Cp_1 + c_C(1-p_1)$.

The government's expected payoffs under mixed strategy $\hat{\sigma}_{G4}$ and pure strategies by the citizen are these: $\mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})] = a_Gq_1 + b_Gq_2 + c_G(1-q_1-q_2)$; $\nexists\mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})] = b_Gq_2 + c_G(1-q_1-q_2)$, since $q_1 = 0$ and $\nexists\mathbb{E}[\pi(\neg V,\ \hat{\sigma}_{G4})]$.

The citizen's expected payoffs under pure strategies "Vaccination" and "No vaccination" and mixed strategy $\hat{\sigma}_{G4}$ by the government are these: $\mathbb{E}[\pi_C(V,\ \hat{\sigma}_{G4})] = a_C(q_1+q_2+1-q_1-q_2) = a_C$; $\nexists\mathbb{E}[\pi_C(\neg V,\ \hat{\sigma}_{G4})] = b_Cq_2 + c_C(1-q_1-q_2)$, since $q_1 = 0$ and thus $\nexists\mathbb{E}[\pi(\neg V,\ \hat{\sigma}_{G4})]$.

The government's expected payoffs under pure strategies "Direct imposition", "Subsistence restriction" and "Luxury restriction" and mixed strategy σ_{C3} by the citizen are these: $\nexists\mathbb{E}[\pi_G(\sigma_{C3},\ DI)] = a_Gp_1$, since $p_1 = 1$ and thus $\nexists\mathbb{E}[\pi(\sigma_{C3},\ DI)]$; $\mathbb{E}[\pi_G(\sigma_{C3},\ SR)] = b_G(p_1+1-p_1) = b_G$; $\mathbb{E}[\pi_G(\sigma_{C3},\ LR)] = c_G(p_1+1-p_1) = c_G$.

The expected payoffs under strategy profile $(\sigma_{C3},\ \hat{\sigma}_{G4})$ are finally these: $\nexists\mathbb{E}[\pi(\sigma_{C3},\ \hat{\sigma}_{G4})] = \{a_Cp_1 + [b_Cq_2 + c_C(1-q_1-q_2)](1-p_1),\ [a_Gq_1 + b_Gq_2 + c_G(1-q_1-q_2)]p_1 + [b_Gq_2 + c_G(1-q_1-q_2)](1-p_1)\}$, since $p_1 = 1$ and $q_1 = 0$.

Lemma 4.3.3 If the government plays pure strategy "Direct imposition" the citizen's highest payoff is necessarily found in pure strategy "Vaccination": $\hat{s}_G = DI = \hat{\sigma}_{G1} \longrightarrow \pi_C(V,\ DI) = \pi_C(\sigma_{C1},\ DI) = a_C$ and $\nexists\pi_C(\neg V,\ DI) = \pi_C(\sigma_{C2},\ DI)$ and $\nexists\mathbb{E}[\pi_C(\sigma_{C3},\ DI)] = a_C$.

If the government plays pure strategy "Subsistence restriction" the citizen's highest payoff is found in pure strategy "Vaccination", relatively higher thereby, the threat of starvation being too great: $\hat{s}_G = SR = \hat{\sigma}_{G2} \longrightarrow \pi_C(V,\ SR) = \pi_C(\sigma_{C1},\ SR) > \mathbb{E}[\pi_C(\sigma_{C3},\ SR)] > \pi_C(\neg V,\ SR) = \pi_C(\sigma_{C2},\ SR)$, specifically, $a_C > a_Cp_1 + b_C(1-p_1) > b_C$, whereby $a_C > a_Cp_1 + b_C(1-p_1) \longrightarrow a_C(1-p_1) > b_C(1-p_1)$ and $a_Cp_1 + b_C(1-p_1) > b_C \longrightarrow a_Cp_1 > b_Cp_1$, being all true.

If the government plays pure strategy "Luxury restriction" the citizen's highest payoff is found in pure strategy "No vaccination", relatively higher thereby, the risks from COVID-19 vaccination being too great: $\hat{s}_G = LR = \hat{\sigma}_{G3} \longrightarrow \pi_C(\neg V,\ LR) = \pi_C(\sigma_{C2},\ LR) > \mathbb{E}[\pi_C(\sigma_{C3},\ LR)] > \pi_C(V,\ LR) = \pi_C(\sigma_{C1},\ LR)$, specifically, $c_C > a_Cp_1 + c_C(1-p_1) > a_C$, whereby $c_C > a_Cp_1 + c_C(1-p_1) \longrightarrow c_Cp_1 > a_Cp_1$ and $a_Cp_1 + c_C(1-p_1) > a_C \longrightarrow c_C(1-p_1) > a_C(1-p_1)$, being all true.

If the government plays mixed strategy $\hat{\sigma}_{G4}$ the citizen's highest payoff is necessarily found as an expected payoff in pure strategy "Vaccination": $\hat{s}_G = \hat{\sigma}_{G4} \longrightarrow \mathbb{E}[\pi_C(V,\ \hat{\sigma}_{G4})] = \mathbb{E}[\pi_C(\sigma_{C1},\ \hat{\sigma}_{G4})] = a_C$ and $\nexists\mathbb{E}[\pi_C(\neg V,\ \hat{\sigma}_{G4})] = \mathbb{E}[\pi_C(\sigma_{C2},\ \hat{\sigma}_{G4})] = b_Cq_2 + c_C(1-q_2)$ and $\nexists\mathbb{E}[\pi_C(\sigma_{C3},\ \hat{\sigma}_{G4})] = a_C$.

Consequently, the citizen features no dominant strategy refined for despotism and the despotic game features no dominant strategy equilibria thereby: $\nexists\tilde{\sigma}_C$ and thus $\nexists(\tilde{\sigma}_C,\ \tilde{\hat{\sigma}}_G)$.

Lemma 4.3.4 For completeness, if the citizen plays pure strategy "Vaccination" the government's highest payoff is found in pure strategy "Direct imposition" or mixed strategy $\hat{\sigma}_{G4}$, relatively higher thereby, in accordance with probabilities q_1 and q_2 : $s_C = V = \sigma_{C1} \longrightarrow \pi_G(V,\ DI) = \pi_G(V,\ \hat{\sigma}_{G1}) > \pi_G(V,\ SR) = \pi_G(V,\ \hat{\sigma}_{G2}) > \pi_G(V,\ LR) = \pi_G(V,\ \hat{\sigma}_{G3})$ and $\pi_G(V,\ DI) = \pi_G(V,\ \hat{\sigma}_{G1}) \gtreqless \mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})]$, specifically, $a_G > b_G > c_G$ and $a_G \gtreqless a_Gq_1 + b_Gq_2 + c_G(1-q_1-q_2) \longrightarrow 0 \gtreqless (a_G - c_G)q_1 + (b_G - c_G)q_2 + (c_G - a_G) \longrightarrow$

$0 \gtreqless (b_G - c_G)q_2 + (c_G - a_G)(1 - q_1)$, in accordance with $\{q_i\}_{i=1}^{3} \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^{3} q_i = 1$, being all true[24].

If the citizen plays pure strategy "No vaccination" the government's highest payoff is found in pure strategy "Subsistence restriction", relatively higher thereby, the COVID-19 vaccination incentives from luxury restrictions being too low: $s_C = \neg V = \sigma_{C2} \longrightarrow \pi_G(\neg V,\ SR) = \pi_G(\neg V,\ \hat{\sigma}_{G2}) > \pi_G(\neg V,\ LR) = \pi_G(\neg V,\ \hat{\sigma}_{G3})$ and $\nexists \pi_G(\neg V,\ DI) = \pi_G(\neg V,\ \hat{\sigma}_{G1})$ and $\nexists \mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})] = b_G q_2 + c_G(1 - q_2)$; specifically, $b_G > c_G$[25].

If the citizen plays mixed strategy σ_{C3} the government's highest payoff is found as an expected payoff in pure strategy "Subsistence restriction", relatively higher thereby, the COVID-19 vaccination incentives from luxury restrictions being too low: $s_C = \sigma_{C3} \longrightarrow \mathbb{E}[\pi_G(\sigma_{C3},\ SR)] = \mathbb{E}[\pi_G(\sigma_{C3},\ \hat{\sigma}_{G2})] > \mathbb{E}[\pi_G(\sigma_{C3},\ LR)] = \mathbb{E}[\pi_G(\sigma_{C3},\ \hat{\sigma}_{G3})]$ and $\nexists \mathbb{E}[\pi_G(\sigma_{C3},\ \hat{\sigma}_{G1})] = \mathbb{E}[\pi_G(\sigma_{C3},\ DI] = a_G$ and $\nexists \mathbb{E}[\pi_G(\sigma_{C3},\ \hat{\sigma}_{G4})] = b_G q_2 + c_G(1 - q_2)$; specifically, $b_G > c_G$[26].

Consequently, the government features no dominant strategy refined for despotism and the despotic game features no dominant strategy equilibria thereby: $\nexists \tilde{\hat{\sigma}}_G$ and thus $\nexists(\tilde{\sigma}_C,\ \tilde{\hat{\sigma}}_G)$.

Lemma 4.3.5 In sum, the despotic game features no dominant strategy equilibria: $\nexists(\tilde{\sigma}_C,\ \tilde{\hat{\sigma}}_G)$. *QED*

Table 4: Static COVID-19 vaccination game refined for despotism with mixed strategies

$C \backslash G$	DI	SR	LR	$DIq_1 + SRq_2 + LR(1 - \sum_{i=1}^{2} q_i)$
V	$(a_C,\ a_G)$	$(a_C,\ b_G)$	$(a_C,\ c_G)$	$[a_C,\ a_G q_1 + b_G q_2 + c_G(1 - \sum_{i=1}^{2} q_i)]$
$\neg V$		$(b_C,\ b_G)$	$(c_C,\ c_G)$	
$Vp_1 + \neg V(1 - p_1)$		$[a_C p_1 + b_C(1 - p_1),\ b_G]$	$[a_C p_1 + c_C(1 - p_1),\ c_G]$	

Note. This is the static COVID-19 vaccination game between the citizen and the government refined for despotism with specified mixed strategies. Citizen mixed strategy $Vp_1 + \neg V(1 - p_1) = Vp_1 + \neg Vp_2$ *is such that probability* $p_1 \in (0,\ 1) \subset \mathbb{R}_{++}$*. Government mixed strategy* $DIq_1 + SRq_2 + LR(1 - \sum_{i=1}^{2} q_i) = DIq_1 + SRq_2 + LRq_3$ *is such that sequence* $\{q_i\}_{i=1}^{3} \subset (0,\ 1) \subset \mathbb{R}_{++}$ *and sum* $\sum_{i=1}^{3} q_i = 1$*. Payoffs are denominated thus:* $a_C \equiv \pi_s + \pi_l + \pi_{\diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\diamond h}$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$*. There exist no dominant strategy equilibria.*

5. Resistance refinement and new Nash equilibrium: revolution

5.1 Resistance refinement. The elimination of strategy "No imposition" triggers an unavoidable convergence towards strategy profile "Vaccination, Direct imposition", notwithstanding all. Yet, an ordinary way out could be seen as possible, by means of the addition of strategy "Revolution" to the citizen's strategy set, in accordance with the Scholastic precept by which all positive law no longer participating of natural and eternal law in turn ceases to bind. Whenever widespread injustice become law, inimical to moral law, resistance becomes an obligation. The conditions laid out by Scholasticism for armed resistance against tyranny, to be otherwise tolerated for a greater cause, are in fact (i) consistent tyranny, (ii) its evaluation as such by the timocratic members of society, (iii) the probability of success in overturning it and (iv) the expectation of a superior outcome in relation to the extant situation.

Such would affect the game as follows: $\hat{S}_C = \{V,\ \neg V,\ R\}$, *ceteris paribus,* such that $\hat{\Gamma}_{PR} = \{I,\ \hat{S}_C,\ \hat{S}_G,\ \pi\}$ and $\hat{\Gamma}_{MX} = \{I,\ \hat{\Sigma}_C,\ \hat{\Sigma}_G,\ \pi\}$. How do the pure strategy Nash equilibria exactly change? Otherwise phrased, what if governments worldwide discovered that their respective citizens seriously considered the revolutionary option? How should they pertinently react? The upcoming proposition furnishes the answers.

5.2 Citizen payoffs under resistance. Before delving into said proposition, let the payoffs of the citizen and government under strategy "Revolution" be specified and illustrated. The citizen's payoffs from

24For completeness: $\pi_G(V,\ SR) = \pi_G(V,\ \hat{\sigma}_{G2}) \gtreqless \mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})] \longleftrightarrow b_G \gtreqless a_G q_1 + b_G q_2 + c_G(1 - q_1 - q_2) \longrightarrow 0 \gtreqless (a_G - c_G)q_1 + (b_G - c_G)q_2 + (c_G - b_G) \longrightarrow 0 \gtreqless (a_G - c_G)q_1 + (c_G - b_G)(1 - q_2)$, in accordance with $\{q_i\}_{i=1}^{3} \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^{3} q_i = 1$; $\mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})] > \pi_G(V,\ LR) = \pi_G(V,\ \hat{\sigma}_{G3}) \longleftrightarrow a_G q_1 + b_G q_2 + c_G(1 - q_1 - q_2) > c_G \longrightarrow (a_G - c_G)q_1 + (b_G - c_G)q_2 > 0$.

25For completeness, $\pi_G(\neg V,\ SR) = \pi_G(\neg V,\ \hat{\sigma}_{G2}) > \mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})]$ would be specified as $b_G > b_G q_2 + c_G(1 - q_2) \longrightarrow 0 > (b_G - c_G)q_2 + (c_G - b_G) \longrightarrow 0 > (c_G - b_G)(1 - q_2)$, which would be true, but $\nexists \mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})] = b_G q_2 + c_G(1 - q_2)$.

26For completeness, $\mathbb{E}[\pi_G(\sigma_{C3},\ SR)] = \mathbb{E}[\pi_G(\sigma_{C3},\ \hat{\sigma}_{G2})] > \mathbb{E}[\pi_G(\sigma_{C3},\ \hat{\sigma}_{G4})]$ would be specified as $b_G > b_G q_2 + c_G(1 - q_2) \longrightarrow 0 > (b_G - c_G)q_2 + (c_G - b_G) \longrightarrow 0 > (c_G - b_G)(1 - q_2)$, which would be true, but $\nexists \mathbb{E}[\pi_G(\sigma_{C3},\ \hat{\sigma}_{G4})] = b_G q_2 + c_G(1 - q_2)$.

strategy profiles “Revolution, Direct imposition”, “Revolution, Subsistence restriction” and “Revolution, Luxury restriction” are the same and yield positive sub-payoff π_r for the revolution: $\pi_C(R,\ DI) = \pi_C(R,\ SR) = \pi_C(R,\ LR) = \pi_r$. In detail, sub-payoff π_r from the revolution either exceeds, is exceeded by or amounts to zero, for the benefits from the revolution are such that subsistence, luxury and no vaccination net of potential health gains are guaranteed $(\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h})$ while bridging the societal justice gap at a risk of failure $(\varepsilon - \rho)$ whereby all would be lost, even one's life: $\forall \varepsilon,\ \rho \in \mathbb{R}_{++},\ \pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless 0$ in accordance with $\varepsilon \gtreqless \rho$; thus, (i) $\varepsilon \geq \rho \longrightarrow \pi_r > \pi_s > \pi_{\neg vC} > \pi_l > \pi_{\Diamond h}$, (ii) $\pi_s > \pi_{\neg vC} > \pi_l > \pi_{\Diamond h} > 0 > \pi_r \longrightarrow \rho > \varepsilon$ and (iii) $\pi_r = \pi_s,\ \pi_{\neg vC},\ \pi_l,\ \pi_{\Diamond h} \longrightarrow \rho > \varepsilon$.

5.3 Government payoffs under resistance. The government's payoff from strategy profile “Revolution, Direct imposition” yields positive sub-payoff π_{di} for direct imposition and negative sub-payoffs $-\pi_{\neg vG}$ and $-\pi_r$ for not having allowed citizens to properly decline COVID-19 vaccines and for the revolution, potentially stripping it of its power, respectively, all else unchanged: $\pi_G(R,\ DI) = \pi_{di} - \pi_{\neg vG} - \pi_r$. The government's payoff from strategy profile “Revolution, Subsistence restriction” yields positive sub-payoff π_{sr} for the restriction of subsistence and negative sub-payoffs $-\pi_{di},\ -\pi_{\neg vG}$ and $-\pi_r$ for not having directly imposed COVID-19 vaccination, for not having allowed citizens to properly decline COVID-19 vaccines and for the revolution, respectively, all else unchanged: $\pi_G(R,\ SR) = \pi_{sr} - \pi_{di} - \pi_{\neg vG} - \pi_r$. The government's payoff from strategy profile “Revolution, Luxury restriction” yields positive sub-payoff π_{lr} for the restriction of luxury and negative sub-payoffs $-\pi_{di},\ -\pi_{sr},\ -\pi_{\neg vG}$ and $-\pi_r$ for not having directly imposed COVID-19 vaccination, for not having restricted subsistence, for not having allowed citizens to properly decline COVID-19 vaccines and for the revolution, respectively, all else unchanged: $\pi_G(R,\ LR) = \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - \pi_r$.

It must be observed that if risk of revolution failure ρ is such that sub-payoff π_r from the revolution is negative then the government's sub-payoffs under strategy “Revolution” on the part of the citizen become higher than under strategy “Vaccination” played by the citizen: $\pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho < 0 \longrightarrow \rho > \varepsilon$ and (i) $\pi_G(R,\ DI) > \pi_G(V,\ DI) \longleftrightarrow \pi_{di} - \pi_{\neg vG} - \pi_r = \pi_{di} - \pi_{\neg vG} - (\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho) > \pi_{di} - \pi_{\neg vG}$, (ii) $\pi_G(R,\ SR) > \pi_G(V,\ SR) \longleftrightarrow \pi_{sr} - \pi_{di} - \pi_{\neg vG} - \pi_r = \pi_{sr} - \pi_{di} - \pi_{\neg vG} - (\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho) > \pi_{sr} - \pi_{di} - \pi_{\neg vG}$ and (iii) $\pi_G(R,\ LR) > \pi_G(V,\ LR) \longleftrightarrow \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - \pi_r = \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - (\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho) > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

Table 5: Static COVID-19 vaccination game refined for despotism and resistance

		(q_1)	(q_2)	$(1 - \sum_{j=1}^{2} q_j)$
	$C \backslash G$	DI	SR	LR
(p_1)	V	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{di} - \pi_{\neg vG})^*$	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{sr} - \pi_{di} - \pi_{\neg vG})$	$(\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC},$ $\pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG})$
(p_2)	$\neg V$		$(\pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h},$ $\pi_{sr} - \pi_{di} - \pi_{\neg vG})$	$(\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h},$ $\pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG})$
$(1 - \sum_{i=1}^{2} p_i)$	R	$(\pi_r,\ \pi_{di} - \pi_{\neg vG} - \pi_r)^*$	$(\pi_r,\ \pi_{sr} - \pi_{di} - \pi_{\neg vG} - \pi_r)$	$(\pi_r,\ \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - \pi_r)$

Note. This is the static COVID-19 vaccination game between the citizen and the government refined for despotism and resistance. The citizen's strategies have become “Vaccination”, “No vaccination” and “Revolution”. The government's strategies are still “Direct imposition”, “Subsistence restriction” and “Luxury restriction”. Revolution sub-payoff $\pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho,\ \forall \varepsilon,\ \rho \in \mathbb{R}_{++}$. The potential pure strategy Nash equilibria, marked by an asterisk, are strategy profiles “Vaccination, Direct imposition” and “Revolution, Direct imposition”: $(\hat{s}_C^*,\ \hat{s}_G^*) = (V,\ DI) \veebar (R,\ DI)$. There exist no Nash equilibria in mixed or semi-mixed strategies.

Proposition 5.3 (Warring pure strategy Nash equilibria) *The warring game features two potential pure strategy Nash equilibria, namely, strategy profiles “Vaccination, Direct imposition” and “Revolution, Direct imposition”. Formally:*

$$(\hat{s}_C^*,\ \hat{s}_G^*) = (V,\ DI) \veebar (R,\ DI). \tag{7}$$

Proof. Best responses in pure strategies refined for despotism and resistance are elaborated in relation to both players. Their matches are subsequently acknowledged as the warring game's pure strategy Nash equilibria.

Lemma 5.3.1 The citizen's best responses refined for despotism and resistance are the following. If the government plays strategy “Direct imposition” the citizen's best response is either strategy “Vaccination” or strategy “Revolution”, his payoffs being thereby either unequal or equal: $\hat{s}_G = DI \longrightarrow \hat{s}_C^* = V \veebar R$, since $\pi_C(V,\ DI) \gtreqless \pi_C(R,\ DI)$ and $\nexists \pi(\neg V,\ DI)$, specifically, $\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} \gtreqless \pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \longrightarrow 2(\pi_{\Diamond h} - \pi_{\neg vC}) \gtreqless \varepsilon - \rho$.

If the government plays strategy “Subsistence restriction” the citizen’s best response is either strategy “Revolution” or strategy “Vaccination”, in accordance with his determining payoffs: $\hat{s}_G = SR \longrightarrow \hat{s}_C^* = R \veebar V$, since (i) $\pi_C(R,\ SR) \gtreqless \pi_C(V,\ SR)$, (ii) $\pi_C(R,\ SR) \gtreqless \pi_C(\neg V,\ SR)$ and (iii) $\pi_C(V,\ SR) > \pi_C(\neg V,\ SR)$; specifically, (i) $\pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$, (ii) $\pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$ and (iii) $\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} > \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$, whereby (i) $\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} \longrightarrow \varepsilon - \rho \gtreqless 2(\pi_{\Diamond h} - \pi_{\neg vC})$, (ii) $\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h} \longrightarrow 2(\pi_s + \pi_l) + \varepsilon - \rho \gtreqless 0$ and (iii) $\pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} > \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h} \longrightarrow 2(\pi_s + \pi_l + \pi_{\Diamond h}) > 2\pi_{\neg vC} \longrightarrow \pi_s + \pi_l + \pi_{\Diamond h} > \pi_{\neg vC}$. More specifically, (i) $\pi_C(R,\ SR) > \pi_C(\neg V,\ SR) \longrightarrow \pi_C(R,\ SR) \gtreqless \pi_C(V,\ SR)$ and $\hat{s}_C^* = R \veebar V$ and (ii) $\pi_C(R,\ SR) \leq \pi_C(\neg V,\ SR) < \pi_C(V,\ SR) \longrightarrow \hat{s}_C^* = V$.

If the government plays strategy “Luxury restriction” the citizen’s best response is either strategy “Revolution” or strategy “No vaccination”, in accordance with his determining payoffs: $\hat{s}_G = LR \longrightarrow \hat{s}_C^* = R \veebar \neg V$, since (i) $\pi_C(R,\ LR) \gtreqless \pi_C(\neg V,\ LR)$, (ii) $\pi_C(R,\ LR) \gtreqless \pi_C(V,\ LR)$ and (iii) $\pi_C(\neg V,\ LR) > \pi_C(V,\ LR)$; specifically, (i) $\pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$, (ii) $\pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$ and (iii) $\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h} > \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$, whereby (i) $\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h} \longrightarrow 2\pi_l \gtreqless \rho - \varepsilon$, (ii) $\pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho \gtreqless \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} \longrightarrow \varepsilon - \rho \gtreqless 2(\pi_{\Diamond h} - \pi_{\neg vC})$ and (iii) $\pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h} > \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC} \longrightarrow 2(\pi_{\neg vC} - \pi_l) > 2\pi_{\Diamond h} \longrightarrow \pi_{\neg vC} - \pi_l > \pi_{\Diamond h}$. More specifically, (i) $\pi_C(R,\ LR) > \pi_C(V,\ LR) \longrightarrow \pi_C(R,\ LR) \gtreqless \pi_C(\neg V,\ LR)$ and $\hat{s}_C^* = R \veebar \neg V$ and (ii) $\pi_C(R,\ LR) \leq \pi_C(V,\ LR) < \pi_C(\neg V,\ LR) \longrightarrow \hat{s}_C^* = \neg V$.

Lemma 5.3.2 The government’s best responses refined for despotism and resistance are the following. If the citizen plays strategy “Vaccination” the government’s best response is strategy “Direct imposition”, his payoff being relatively higher thereby: $\hat{s}_C = V \longrightarrow \hat{s}_G^* = DI$, since $\pi_G(V,\ DI) > \pi_G(V,\ SR) > \pi_G(V,\ LR)$, specifically, $0 > \pi_{di} - \pi_{\neg vG} > \pi_{sr} - \pi_{di} - \pi_{\neg vG} > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

If the citizen plays strategy “No vaccination” the government’s best response is strategy “Subsistence restriction”, his payoff being relatively higher thereby: $\hat{s}_C = \neg V \longrightarrow \hat{s}_G^* = SR$, since $\pi_G(\hat{s}_C,\ SR) > \pi_G(\hat{s}_C,\ LR)$ and $\nexists \pi(\neg V,\ DI)$, specifically, $0 > \pi_{sr} - \pi_{di} - \pi_{\neg vG} > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$.

If the citizen plays strategy “Revolution” the government’s best response is strategy “Direct imposition”, his payoff being relatively higher thereby: $\hat{s}_C = R \longrightarrow \hat{s}_G^* = DI$, since $\pi_G(R,\ DI) > \pi_G(R,\ SR) > \pi_G(R,\ LR)$, specifically, $0 > \pi_{di} - \pi_{\neg vG} - \pi_r > \pi_{sr} - \pi_{di} - \pi_{\neg vG} - \pi_r > \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - \pi_r$.

Lemma 5.3.3 The matches of the two players’ best responses refined for despotism and resistance yield potential strategy profiles “Vaccination, Direct imposition” and “Revolution, Direct imposition”, being the warring game’s potential pure strategy Nash equilibria: $(\hat{s}_C^*,\ \hat{s}_G^*) = (V,\ DI) \veebar (R,\ DI)$, since $\hat{s}_C = V \longrightarrow \hat{s}_G^* = DI,\ \hat{s}_C = R \longrightarrow \hat{s}_G^* = DI$ and $\hat{s}_G = DI \longrightarrow s_C^* = V \veebar R$. *QED*

5.4 Luxury restriction prospects. Let one consider strategy “Luxury restriction” on the part of the government and let strategy “Revolution” present a greater payoff than strategy “Vaccination”, by which societal justice gap net of risk of revolution failure is greater than potential health gains net of no vaccination weighted by two $(\varepsilon - \rho > 2\pi_{\Diamond h} - 2\pi_{\neg vC}):\ \pi_C(R,\ LR) > \pi_C(V,\ LR) \longrightarrow \varepsilon - \rho > 2(\pi_{\Diamond h} - \pi_{\neg vC})$.

It follows that the citizen would have to choose between strategy “Revolution” and strategy “No vaccination”: $\hat{s}_C^* = R \veebar \neg V$, in accordance with $\pi_C(R,\ LR) \gtreqless \pi_C(\neg V,\ LR) \longrightarrow 2\pi_l \gtreqless \rho - \varepsilon$. Strategy “Revolution” is then played if the sum of double luxury $2\pi_l$ and societal justice gap ε is no smaller than risk of revolution failure $\rho:\ \pi_C(R,\ LR) \geq \pi_C(\neg V,\ LR) \longrightarrow 2\pi_l + \varepsilon \geq \rho \longrightarrow \hat{s}_C^* = R$. Strategy “No vaccination” is by contrast played if risk of revolution failure ρ is no smaller than the sum of double luxury $2\pi_l$ and societal justice gap $\varepsilon:\ \pi_C(\neg V,\ LR) \geq \pi_C(R,\ LR) \longrightarrow \rho \geq 2\pi_l + \varepsilon \longrightarrow \hat{s}_C^* = \neg V$. Consequently, the citizen is indifferent between playing strategy “Revolution” and strategy “No vaccination” if the sum of double luxury $2\pi_l$ and societal justice gap ε equals risk of revolution failure $\rho:\ \pi_C(R,\ LR) = \pi_C(\neg V,\ LR) \longrightarrow 2\pi_l + \varepsilon = \rho \longrightarrow \hat{s}_C^* = R \veebar \neg V$.

If strategy “Revolution” does not present a greater payoff than strategy “Vaccination” then the societal justice gap net of the risk of revolution failure is not greater than potential health gains net of no vaccination weighted by two ($\varepsilon - \rho \leq 2\pi_{\Diamond h} - 2\pi_{\neg vC}$) and strategy "No vaccination" is thereby played: $\pi_C(R,\ LR) \leq \pi_C(V,\ LR) \longrightarrow \varepsilon - \rho \leq 2(\pi_{\Diamond h} - \pi_{\neg vC}) \longrightarrow \hat{s}^*_C = \neg V$.

5.5 Direct imposition prospects. Let one consider strategy "Direct imposition" on the part of the government. Strategy "Vaccination" is played by the citizen if potential health gains net of no vaccination weighted by two are no smaller than the societal justice gap net of the risk of revolution failure ($2\pi_{\Diamond h} - 2\pi_{\neg vC} \geq \varepsilon - \rho$) : $\pi_C(V,\ DI) \geq \pi_C(R,\ DI) \longrightarrow 2(\pi_{\Diamond h} - \pi_{\neg vC}) \geq \varepsilon - \rho \longrightarrow \hat{s}^*_C = V$. Strategy "Revolution" is played by the citizen if the societal justice gap net of the risk of revolution failure is no smaller than potential health gains net of no vaccination weighted by two ($\varepsilon - \rho \geq 2\pi_{\Diamond h} - 2\pi_{\neg vC}$) : $\pi_C(R,\ DI) \geq \pi_C(V,\ DI) \longrightarrow \varepsilon - \rho \geq 2(\pi_{\Diamond h} - \pi_{\neg vC}) \longrightarrow \hat{s}^*_C = R$. Consequently, the citizen is indifferent between playing strategy "Vaccination" and strategy "Revolution" if potential health gains net of no vaccination weighted by two equal the societal justice gap net of the risk of revolution failure ($2\pi_{\Diamond h} - 2\pi_{\neg vC} = \varepsilon - \rho$) : $\pi_C(V,\ DI) = \pi_C(R,\ DI) \longrightarrow 2(\pi_{\Diamond h} - \pi_{\neg vC}) = \varepsilon - \rho \longrightarrow \hat{s}^*_C = V \veebar R$.

5.6 Subsistence restriction prospects. Let one consider strategy "Subsistence restriction" on the part of the government. If strategy "Revolution" presents a greater payoff than strategy "No vaccination" then double subsistence and double luxury are greater than the risk of revolution failure net of the societal justice gap ($2\pi_s + \pi_l > \rho - \varepsilon$) and strategy "Vaccination" or strategy "Revolution" is played by the citizen as under strategy "Direct imposition" on the part of the government: $\pi_C(R,\ SR) > \pi_C(\neg V,\ SR) \longrightarrow 2(\pi_s + \pi_l) > \rho - \varepsilon \longrightarrow \hat{s}^*_C = R \veebar V$, in accordance with $\pi_C(R,\ DI) \gtreqless \pi_C(V,\ DI) \longrightarrow \varepsilon - \rho \gtreqless 2(\pi_{\Diamond h} - \pi_{\neg vC})$.

If strategy "Revolution" does not present a greater payoff than strategy "No vaccination" then the citizen plays strategy "Vaccination" because double subsistence and double luxury are not greater than the risk of revolution failure net of the societal justice gap ($2\pi_s + 2\pi_l \leq \rho - \varepsilon$) : $\pi_C(R,\ SR) \leq \pi_C(\neg V,\ SR) \longrightarrow 2(\pi_s + \pi_l) \leq \rho - \varepsilon \longrightarrow \hat{s}^*_C = V$.

5.7 Revolution likelihood. Since the two potential pure strategy Nash equilibria concern strategy "Direct imposition" on the part of the government the determining element, indeed a necessary and sufficient condition, in the establishment of strategy profile "Revolution, Direct imposition" as the sole and strict pure strategy Nash equilibria is precisely the prevalence of the societal justice gap net of the risk of revolution failure over potential health gains net of no vaccination weighted by two ($\varepsilon - \rho > 2\pi_{\Diamond h} - 2\pi_{\neg vC}$) : $(\hat{s}^*_C,\ \hat{s}^*_G) \stackrel{!}{=} (R,\ DI) \longleftrightarrow \varepsilon - \rho > 2(\pi_{\Diamond h} - \pi_{\neg vC})$. Otherwise stated, if risk of revolution failure so offsets twice the sub-payoff from no vaccination and the societal justice gap as to cause twice the sub-payoff from potential health gains to outweigh them ($2\pi_{\neg vC} + \varepsilon - \rho < 2\pi_{\Diamond h}$) then the citizen had better not opt for a revolution, but for COVID-19 vaccination, however tragically, and *vice versa,* by which the sole and strict pure strategy Nash equilibrium would in the former case be strategy profile "Vaccination, Direct imposition" : $(\hat{s}^*_C,\ \hat{s}^*_G) \stackrel{!}{=} (V,\ DI) \longleftrightarrow 2\pi_{\neg vC} + \varepsilon - \rho < 2\pi_{\Diamond h}$.

Practically speaking, because barely any nation around the world presently features a society sufficiently trained, equipped and organised so much as to improvise the remotest form of armed resistance, let alone a revolution, on ultimate account of the subjectivistic, nihilistic and structuralistic spiral which has fatally enveloped the world throughout the past 60 odd years, the risk of revolution failure can be taken as ordinarily warranting the positive selection of strategy "Vaccination" on the part of worldwide citizens. In other words, the sole and strict pure strategy Nash equilibria appears to be, all else equal, none other than strategy profile "Vaccination, Direct imposition", again.

Does the warring game additionally present any Nash equilibria in mixed or semi-mixed strategies? The answer is found in the proposition below.

Proposition 5.8 (Warring mixed and semi-mixed strategy Nash equilibria) *The warring game features no Nash equilibria in mixed and semi-mixed strategies, namely, it features potential Nash equilibria only in pure strategies, being strategy profiles "Vaccination, Direct imposition" and "Revolution, Direct imposition". Formally:*

$$(\hat{\sigma}^*_C,\ \hat{\sigma}^*_G) \stackrel{!}{=} (\hat{s}^*_C,\ \hat{s}^*_G) = (V,\ DI) \veebar (R,\ DI). \tag{8}$$

Proof. Strategy expected payoffs refined for despotism and resistance are elaborated in relation to both players, feasibly solving for probabilities. Contingent on the obtainment of probabilities in relation to both players, best responses refined for despotism and resistance are subsequently elaborated. Their matches are finally acknowledged as the warring game's Nash equilibria, in mixed, semi-mixed or pure strategies.

For notational simplicity: $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$; $e_C \equiv \pi_r$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$; $e_G \equiv \pi_{di} - \pi_{\neg vG} - \pi_r$; $f_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG} - \pi_r$; $g_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - \pi_r$. Accordingly: $\forall \varepsilon,\ \rho \in \mathbb{R}_{++},\ \pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho$.

Lemma 5.8.1 The citizen's expected payoff by playing strategy "Vaccination" is the probabilistic sum of his payoffs across the government's pure strategies: $\mathbb{E}[\pi(V)] = a_C(q_1 + q_2 + 1 - q_1 - q_2) = a_C$. It is certainly payoff a_C, being the same across all government pure strategies.

The citizen's expected payoff by playing strategy "No vaccination" is the probabilistic sum of his payoffs across the government's pure strategies: $\mathbb{E}[\pi(\neg V)] = b_C q_2 + c_C(1 - q_1 - q_2)$, where $q_1 = 0$.

The citizen's expected payoff by playing strategy "Revolution" is the probabilistic sum of his payoffs across the government's pure strategies: $\mathbb{E}[\pi(R)] = e_C(q_1 + q_2 + 1 - q_1 - q_2) = e_C$. It is certainly payoff e_C, being the same across all government pure strategies.

The three expected payoffs are expressed in terms of probabilities, implicitly and explicitly. Such probabilities can be calculated by allowing the expected payoffs to equal zero, in correspondence: $\mathbb{E}[\pi(V)] = \mathbb{E}[\pi(R)] = \mathbb{E}[(\neg V)] = 0 \longleftrightarrow a_C = e_C = b_C q_2 + c_C(1 - q_2) = 0 \longleftrightarrow (c_C - b_C)q_2 = c_C \longrightarrow q_2 = \frac{c_C}{c_C - b_C}$ such that $\{q_i\}_{i=1}^3 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{j=1}^3 q_j = 1$.

Lemma 5.8.2 The government's expected payoff by playing strategy "Direct imposition" is the probabilistic sum of his respective payoffs across the government's pure strategies, whereby probability p_2 is null, strategy profile "No vaccination, Direct imposition" thereby existing not: $\mathbb{E}[\pi(DI)] = a_G p_1 + e_G(1 - p_1 - p_2)$ and $p_2 = 0$, since $\nexists \pi(\neg V,\ DI)$.

The government's expected payoff by playing strategies "Subsistence restriction" and "Luxury restriction" is the probabilistic sum of his respective payoffs across the government's pure strategies: $\mathbb{E}[\pi(SR)] = b_G(p_1 + p_2) + f_G(1 - p_1 - p_2)$; $\mathbb{E}[\pi(LR)] = c_G(p_1 + p_2) + g_G(1 - p_1 - p_2)$.

The three expected payoffs are expressed in terms of explicit probabilities. The resulting system features three non-redundant strategies or equations and two calculable probabilities or unknowns, therefore, calculable probabilities $\{p_i\}_{i=1}^2$ are inconsistently overdetermined and the warring game features no Nash equilibria in mixed and semi-mixed strategies: $\{p_i\}_{i=1}^2 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{j=1}^2 p_j = 1$ such that $n(\{p_1,\ p_2\}) = n(\bar{P}_C) < n(\{DI,\ SR,\ LR\}) = n(\bar{S}_G) \longrightarrow \neg NE_{1,\ 2}$.

Lemma 5.8.3 For completeness, the citizen's conditional best responses refined for despotism and resistance would be the following. If probability q_1 were greater than all other probabilities then probabilities p_1 and p_3 would either equal one half or be individually unitary. More clearly, the government would be more likely to play strategy "Direct imposition" and the citizen would respond by playing either strategy "Vaccination" or strategy "Revolution", his payoffs being either equal or unequal thereby: $q_1 > q_{\neg 1} \longrightarrow (p_1 = p_3 = \frac{1}{2}) \veebar (p_1 \veebar p_3 = 1)$, *ceteris paribus,* since $\pi_C(V,\ DI) \gtreqless \pi_C(R,\ DI)$ and $\nexists \pi(\neg V,\ DI)$.

If probability q_2 were greater than all other probabilities then probabilities p_3 and p_1 would either equal one half or be individually unitary. More clearly, the government would be more likely to play strategy "Subsistence restriction" and the citizen would respond by playing either strategy "Revolution" or strategy "Vaccination", his payoffs being either equal or unequal thereby: $q_2 > q_{\neg 2} \longrightarrow (p_3 = p_1 = \frac{1}{2}) \veebar (p_3 \veebar p_1 = 1)$, *ceteris paribus,* since (i) $\pi_C(R,\ SR) \gtreqless \pi_C(V,\ SR)$, (ii) $\pi_C(R,\ SR) \gtreqless \pi_C(\neg V,\ SR)$ and (iii) $\pi_C(V,\ SR) > \pi_C(\neg V,\ SR)$.

If probability q_3 were greater than all other probabilities then probabilities p_3 and p_2 would either equal one half or be individually unitary. More clearly, the government would be more likely to play strategy "Luxury restriction" and the citizen would respond by playing either strategy "Revolution" or strategy "No vaccination", his payoffs being either equal or unequal thereby: $q_3 > q_{\neg 3} \longrightarrow (p_3 = p_2 = \frac{1}{2}) \veebar (p_3 \veebar p_2 = 1)$, *ceteris paribus,* since (i) $\pi_C(R,\ LR) \gtreqless \pi_C(\neg V,\ LR)$, (ii) $\pi_C(R,\ LR) \gtreqless \pi_C(V,\ LR)$ and (iii) $\pi_C(\neg V,\ LR) > \pi_C(V,\ LR)$.

Lemma 5.8.4 The government's conditional best responses refined for despotism and resistance would be the following. If probability p_1 were greater than all other probabilities then probability q_1 would be unitary. More clearly, the citizen would be more likely to play strategy "Vaccination" and the government would respond by playing strategy "Direct imposition", for his payoff would be thereby greater:

$p_1 > p_{\neg 1} \longrightarrow q_1 = 1$, *ceteris paribus,* since $\pi_G(V,\ DI) > \pi_G(V,\ SR) > \pi_G(V,\ LR)$.

If probability p_2 were greater than all other probabilities then probability q_2 would be unitary. More clearly, the citizen would be more likely to play strategy "No vaccination" and the government would respond by playing strategy "Subsistence restriction", for his payoff would be thereby greater: $p_2 > p_{\neg 2} \longrightarrow q_2 = 1$, *ceteris paribus,* since $\pi_G(\hat{s}_C,\ SR) > \pi_G(\hat{s}_C,\ LR)$ and $\nexists \pi(\neg V,\ DI)$.

If probability p_3 were greater than all other probabilities then probability q_1 would be unitary. More clearly, the citizen would be more likely to play strategy "Revolution" and the government would respond by playing strategy "Direct imposition", for his payoff would be thereby greater: $p_3 > p_{\neg 3} \longrightarrow q_1 = 1$, *ceteris paribus,* since $\pi_G(R,\ DI) > \pi_G(R,\ SR) > \pi_G(R,\ LR)$.

Lemma 5.8.5 The hypothetical matches of the two players' conditional best responses refined for despotism and resistance, together with the inconsistent overdetermination of calculable probabilities $\{p_i\}_{i=1}^{2}$, reveal the absence of Nash equilibria in mixed and semi-mixed strategies.

Specifically, they yield potential strategy profiles "Vaccination, Direct imposition" and "Revolution, Direct imposition", being the warring game's potential pure strategy Nash equilibria: $(\hat{\sigma}_C^*,\ \hat{\sigma}_G^*) \stackrel{!}{=} (\hat{s}_C^*,\ \hat{s}_G^*) = (V,\ DI) \veebar (R,\ DI)$, since $(p_1 > p_{\neg 1}) \veebar (p_3 > p_{\neg 3}) \longrightarrow q_1 = 1$ and $q_1 > q_{\neg 1} \longrightarrow (p_1 = p_3 = \frac{1}{2}) \veebar (p_1 \veebar p_3 = 1)$, moreover, $\neg NE_{1,\ 2}$ such that $\nexists (p_1 = p_3 = \frac{1}{2})$. *QED*

The absence of mixed and semi-mixed strategy Nash equilibria in the warring game and the confirmation of potential pure strategy Nash equilibria "Vaccination, Direct imposition" and "Revolution, Direct imposition" calls for a final reflexion on the convergence towards COVID-19 vaccination, deployed by governments and enacted by citizens worldwide. Whether direct imposition or subsistence restrictions be the tool governments might have elected to cause citizens to embrace COVID-19 vaccination matters little, for the outcome would have been the same. Specifically, even if citizens had irrationally chosen self-starvation under subsistence restrictions, which most would have not, rationally primordial as survival is, they would have died, fulfilling that population reduction often publicly yearned by neo-Malthusians, if not its digital identification as well, under the banner of so-called neo-feudalism.

The following proposition lastly derives the warring game's failure to present a dominant strategy equilibrium.

Table 6: Static COVID-19 vaccination game refined for despotism and resistance with mixed strategies

$C\backslash G$	DI	SR	LR	$DIq_1 + SRq_2 + LR(1 - \sum_{i=1}^{2} q_i)$
V	$(a_C,\ a_G)$	$(a_C,\ b_G)$	$(a_C,\ c_G)$	$[a_C,\ a_G q_1 + b_G q_2 + c_G(1 - \sum_{i=1}^{2} q_i)]$
$\neg V$		$(b_C,\ b_G)$	$(c_C,\ c_G)$	
R	$(e_C,\ e_G)$	$(e_C,\ f_G)$	$(e_C,\ g_G)$	$[e_C,\ e_G q_1 + f_G q_2 + g_G(1 - \sum_{i=1}^{2} q_i)]$
$Vp_1 + \neg Vp_2 +$ $+R(1 - \sum_{i=1}^{2} p_i)$		$[a_C p_1 + b_C p_2 +$ $+e_C(1 - \sum_{i=1}^{2} p_i),$ $b_G(p_1 + p_2) +$ $+f_G(1 - \sum_{i=1}^{2} p_i)]$	$[a_C p_1 + c_C p_2 +$ $+e_C(1 - \sum_{i=1}^{2} p_i),$ $c_G(p_1 + p_2) +$ $g_G(1 - \sum_{i=1}^{2} p_i)]$	

Note. This is the static COVID-19 vaccination game between the citizen and the government refined for despotism and resistance with specified mixed strategies. Citizen mixed strategy $Vp_1 + \neg Vp_2 + R(1 - \sum_{i=1}^{2} p_i) = Vp_1 + \neg Vp_2 + Rp_3$ *is such that sequence* $\{p_i\}_{i=1}^{3} \subset (0,\ 1) \subset \mathbb{R}_{++}$ *and sum* $\sum_{i=1}^{3} p_i = 1$. *Government mixed strategy* $DIq_1 + SRq_2 + LR(1 - \sum_{i=1}^{2} q_i) = DIq_1 + SRq_2 + LRq_3$ *is such that sequence* $\{q_i\}_{i=1}^{3} \subset (0,\ 1) \subset \mathbb{R}_{++}$ *and sum* $\sum_{i=1}^{3} q_i = 1$. *Payoffs are denominated thus:* $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} - \pi_l - \pi_{\Diamond h}$; $e_C \equiv \pi_r$; $a_G \equiv \pi_{di} - \pi_{\neg vG}$; $b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG}$; $c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG}$; $e_G \equiv \pi_{di} - \pi_{\neg vG} - \pi_r$; $f_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG} - \pi_r$; $g_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - \pi_r$. *Revolution sub-payoff* $\pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho,\ \forall \varepsilon,\ \rho \in \mathbb{R}_{++}$. *There exist no dominant strategy equilibria.*

PROPOSITION 5.9 (Warring dominant strategy equilibria) *The warring game features no dominant strategy equilibria. Formally:*

$$\nexists (\tilde{\hat{\sigma}}_C,\ \tilde{\hat{\sigma}}_G). \tag{9}$$

Proof. Dominant strategies refined for despotism and resistance are elaborated in relation to both players. Their strategy profiles are then acknowledged as the warring game's dominant strategy equilibria.

For notational simplicity: $a_C \equiv \pi_s + \pi_l + \pi_{\Diamond h} - \pi_{\neg vC}$; $b_C \equiv \pi_{\neg vC} - \pi_s - \pi_l - \pi_{\Diamond h}$; $c_C \equiv \pi_s + \pi_{\neg vC} -$

$\pi_l - \pi_{\Diamond h};\ e_C \equiv \pi_r;\ a_G \equiv \pi_{di} - \pi_{\neg vG};\ b_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG};\ c_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG};\ e_G \equiv \pi_{di} - \pi_{\neg vG} - \pi_r;\ f_G \equiv \pi_{sr} - \pi_{di} - \pi_{\neg vG} - \pi_r;\ g_G \equiv \pi_{lr} - \pi_{di} - \pi_{sr} - \pi_{\neg vG} - \pi_r$. Accordingly: $\forall \varepsilon,\ \rho \in \mathbb{R}_{++},\ \pi_r = \pi_s + \pi_l + \pi_{\neg vC} - \pi_{\Diamond h} + \varepsilon - \rho$.

Lemma 5.9.1 The citizen's mixed strategies are a probabilistic sum of his pure strategies: $\forall \{p_i\}_{i=1}^3 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{i=1}^3 p_i = 1,\ \hat{\sigma}_C = Vp_1 + \neg Vp_2 + R(1 - p_1 - p_2) = Vp_1 + \neg Vp_2 + Rp_3$.

Specifically, the citizen can play pure strategy "Vaccination", pure strategy "No vaccination", pure strategy "Revolution" or a combination of the three: $\hat{\sigma}_{C1} = V(1) + \neg V(0) + R(1 - 1 - 0) = V,\ \hat{\sigma}_{C2} = V(0) + \neg V(1) + R(1 - 0 - 1) = \neg V,\ \hat{\sigma}_{C3} = V(0) + \neg V(0) + R(1 - 0 - 0) = R$ or, $\forall \{p_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^3 p_i = 1,\ \hat{\sigma}_{C4} = Vp_1 + \neg Vp_2 + R(1 - p_1 - p_2)$.

The government's mixed strategies are a probabilistic sum of his pure strategies: $\forall \{q_i\}_{i=1}^3 \subset [0,\ 1] \subset \mathbb{R}_+$ and $\sum_{i=1}^3 q_i = 1,\ \hat{\sigma}_G = DIq_1 + SRq_2 + LR(1 - q_1 - q_2) = DIq_1 + SRq_2 + LRq_3$.

Specifically, the government can play pure strategy "Direct imposition", pure strategy "Subsistence restriction", pure strategy "Luxury restriction" or a combination of the three: $\hat{\sigma}_{G1} = DI(1) + SR(0) + LR(1-1-0) = DI,\ \hat{\sigma}_{G2} = DI(0)+SR(1)+LR(1-0-1) = SR,\ \hat{\sigma}_{G3} = DI(0)+SR(0)+LR(1-0-0) = LR$ or, $\forall \{q_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_{++}$ and $\sum_{i=1}^3 q_i = 1,\ \hat{\sigma}_{G4} = DIq_1 + SRq_2 + LR(1 - q_1 - q_2)$.

Lemma 5.9.2 The citizen's expected payoffs under mixed strategy $\hat{\sigma}_{C4}$ and pure strategies by the government are these: $\nexists \mathbb{E}[\pi_C(\hat{\sigma}_{C4},\ DI)] = a_C p_1 + e_C(1 - p_1 - p_2)$, since $p_2 = 0$ and thus $\nexists \mathbb{E}[\pi(\hat{\sigma}_{C4},\ DI)];\ \mathbb{E}[\pi_C(\hat{\sigma}_{C4},\ SR)] = a_C p_1 + b_C p_2 + e_C(1 - p_1 - p_2);\ \mathbb{E}[\pi_C(\hat{\sigma}_{C4},\ LR)] = a_C p_1 + c_C p_2 + e_C(1 - p_1 - p_2)$.

The government's expected payoffs under mixed strategy $\hat{\sigma}_{G4}$ and pure strategies by the citizen are these: $\mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})] = a_G q_1 + b_G q_2 + c_G(1 - q_1 - q_2);\ \nexists \mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})] = b_G q_2 + c_G(1 - q_1 - q_2)$, since $q_1 = 0$ and $\nexists \mathbb{E}[\pi(\neg V,\ \hat{\sigma}_{G4})];\ \mathbb{E}[\pi_G(R,\ \hat{\sigma}_{G4})] = e_G q_1 + f_G q_2 + g_G(1 - q_1 - q_2)$.

The citizen's expected payoffs under pure strategies "Vaccination", "No vaccination" and "Revolution" and mixed strategy $\hat{\sigma}_{G4}$ by the government are these: $\mathbb{E}[\pi_C(V,\ \hat{\sigma}_{G4})] = a_C(q_1 + q_2 + 1 - q_1 - q_2) = a_C;\ \nexists \mathbb{E}[\pi_C(\neg V,\ \hat{\sigma}_{G4})] = b_C q_2 + c_C(1 - q_1 - q_2)$, since $q_1 = 0$ and thus $\nexists \mathbb{E}[\pi(\neg V,\ \hat{\sigma}_{G4})];\ \mathbb{E}[\pi_C(R,\ \hat{\sigma}_{G4})] = e_C(q_1 + q_2 + 1 - q_1 - q_2) = e_C$.

The government's expected payoffs under pure strategies "Direct imposition", "Subsistence restriction" and "Luxury restriction" and mixed strategy $\hat{\sigma}_{C4}$ by the citizen are these: $\nexists \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ DI)] = a_G p_1 + e_G(1 - p_1 - p_2)$, since $p_2 = 0$ and thus $\nexists \mathbb{E}[\pi(\hat{\sigma}_{C4},\ DI)];\ \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ SR)] = b_G(p_1 + p_2) + f_G(1 - p_1 - p_2);\ \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ LR)] = c_G(p_1 + p_2) + g_G(1 - p_1 - p_2)$.

The expected payoffs under strategy profile $(\hat{\sigma}_{C4},\ \hat{\sigma}_{G4})$ are finally these: $\nexists \mathbb{E}[\pi(\hat{\sigma}_{C4},\ \hat{\sigma}_{G4})] = \{a_C p_1 + [b_C q_2 + c_C(1 - q_1 - q_2)]p_2 + e_C(1 - p_1 - p_2),\ [a_G q_1 + b_G q_2 + c_G(1 - q_1 - q_2)]p_1 + [b_G q_2 + c_G(1 - q_1 - q_2)]p_2 + [e_G q_1 + f_G q_2 + g_G(1 - q_1 - q_2)](1 - p_1 - p_2)\}$, since $p_2 = 0$ and $q_1 = 0$.

Lemma 5.9.3 If the government plays pure strategy "Direct imposition" the citizen's highest payoff is found in either pure strategy "Vaccination" or pure strategy "Revolution", being thereby either unequal or equal: $\hat{s}_G = DI = \hat{\sigma}_{G1} \longrightarrow \pi_C(V,\ DI) = \pi_C(\hat{\sigma}_{C1},\ DI) = a_C \gtreqless \pi_C(R,\ DI) = \pi_C(\hat{\sigma}_{C3},\ DI) = e_C$ and $\nexists \pi_C(\neg V,\ DI) = \pi_C(\hat{\sigma}_{C2},\ DI)$ and $\nexists \mathbb{E}[\pi_C(\hat{\sigma}_{C4},\ DI)] = a_C p_1 + e_C(1 - p_1)$.

If the government plays pure strategy "Subsistence restriction" the citizen's highest payoff is found either in some pure strategy or as an expected payoff in the mixed strategy, in accordance with probabilities p_1 and p_2 : $\hat{s}_G = SR = \hat{\sigma}_{G2} \longrightarrow$ (i) $\pi_C(R,\ SR) = \pi_C(\hat{\sigma}_{C3},\ SR) \gtreqless \pi_C(V,\ SR) = \pi_C(\hat{\sigma}_{C1},\ SR)$, (ii) $\pi_C(R,\ SR) = \pi_C(\hat{\sigma}_{C3},\ SR) \gtreqless \pi_C(\neg V,\ SR) = \pi_C(\hat{\sigma}_{C2},\ SR)$, (iii) $\pi_C(V,\ SR) = \pi_C(\hat{\sigma}_{C1},\ SR) > \pi_C(\neg V,\ SR) = \pi_C(\hat{\sigma}_{C2},\ SR)$ and (iv) $\pi_C(V,\ SR) = \pi_C(\hat{\sigma}_{C1},\ SR),\ \pi_C(\neg V,\ SR) = \pi_C(\hat{\sigma}_{C2},\ SR),\ \pi_C(R,\ SR) = \pi_C(\hat{\sigma}_{C3},\ SR) \gtreqless \mathbb{E}[\pi_C(\hat{\sigma}_{C4},\ SR)]$; specifically, (i) $e_C \gtreqless a_C$, (ii) $e_C \gtreqless b_C$, (iii) $a_C > b_C$ and (iv) $a_C,\ b_C,\ e_C \gtreqless a_C p_1 + b_C p_2 + e_C(1 - p_1 - p_2)$, whereby (iv-a) $a_C \gtreqless a_C p_1 + b_C p_2 + e_C(1 - p_1 - p_2) \longrightarrow a_C(1 - p_1) \gtreqless b_C p_2 + e_C(1 - p_1 - p_2)$, (iv-b) $b_C \gtreqless a_C p_1 + b_C p_2 + e_C(1 - p_1 - p_2) \longrightarrow b_C(1 - p_2) \gtreqless a_C p_1 + e_C(1 - p_1 - p_2)$ and (iv-c) $e_C \gtreqless a_C p_1 + b_C p_2 + e_C(1 - p_1 - p_2) \longrightarrow e_C(p_1 + p_2) \gtreqless a_C p_1 + b_C p_2$, in accordance with $\{p_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^3 p_i = 1$, being all true. More specifically, (i) $\pi_C(R,\ SR) > \pi_C(\neg V,\ SR) \longrightarrow \pi_C(R,\ SR) \gtreqless \pi_C(V,\ SR) \longrightarrow \{\pi_C(R,\ SR) = \pi_C(V,\ SR) \gtreqless \mathbb{E}[\pi_C(\hat{\sigma_{C4}},\ SR)]\} \veebar \{\pi_C(V,\ SR) < \pi_C(R,\ SR) \gtreqless \mathbb{E}[\pi_C(\hat{\sigma_{C4}},\ SR)]\} \veebar \{\pi_C(R,\ SR) < \pi_C(V,\ SR) \gtreqless \mathbb{E}[\pi_C(\hat{\sigma_{C4}},\ SR)]\}$ and (ii) $\pi_C(R,\ SR) \leq \pi_C(\neg V,\ SR) < \pi_C(V,\ SR) \longrightarrow \pi_C(V,\ SR) \gtreqless \mathbb{E}[\pi_C(\hat{\sigma_{C4}},\ SR)]$.

If the government plays pure strategy "Luxury restriction" the citizen's highest payoff is found either in some pure strategy or as an expected payoff in the mixed strategy, in accordance with probabilities p_1 and p_2 :

$\hat{s}_G = LR = \hat{\sigma}_{G3} \longrightarrow$ (i) $\pi_C(R,\ LR) = \pi_C(\hat{\sigma}_{C3},\ LR) \gtreqless \pi_C(\neg V,\ LR) = \pi_C(\hat{\sigma}_{C2},\ LR)$, (ii) $\pi_C(R,\ LR) = \pi_C(\hat{\sigma}_{C3},\ LR) \gtreqless \pi_C(V,\ LR) = \pi_C(\hat{\sigma}_{C1},\ LR)$, (iii) $\pi_C(\neg V,\ LR) = \pi_C(\hat{\sigma}_{C2},\ LR) > \pi_C(V,\ LR) = \pi_C(\hat{\sigma}_{C1},\ LR)$ and (iv) $\pi_C(V,\ LR) = \pi_C(\hat{\sigma}_{C1},\ LR)$, $\pi_C(\neg V,\ LR) = \pi_C(\hat{\sigma}_{C2},\ LR)$, $\pi_C(R,\ LR) = \pi_C(\hat{\sigma}_{C3},\ LR) \gtreqless \mathbb{E}[\pi_C(\hat{\sigma}_{C4},\ LR)]$; specifically, (i) $e_C \gtreqless c_C$, (ii) $e_C \gtreqless a_C$, (iii) $c_C > a_C$ and (iv) $a_C,\ c_C,\ e_C \gtreqless a_C p_1 + c_C p_2 + e_C(1 - p_1 - p_2)$, whereby (iv-a) $a_C \gtreqless a_C p_1 + c_C p_2 + e_C(1 - p_1 - p_2) \longrightarrow 0 \gtreqless a_C(p_1 - 1) + c_C p_2 + e_C(1 - p_1 - p_2)$, (iv-b) $c_C \gtreqless a_C p_1 + c_C p_2 + e_C(1 - p_1 - p_2) \longrightarrow c_C(1 - p_2) \gtreqless a_C p_1 + e_C(1 - p_1 - p_2)$ and (iv-c) $e_C \gtreqless a_C p_1 + c_C p_2 + e_C(1 - p_1 - p_2) \longrightarrow e_C(p_1 + p_2) \gtreqless a_C p_1 + c_C p_2$, in accordance with $\{p_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^3 p_i = 1$, being all true. More specifically, (i) $\pi_C(R,\ LR) > \pi_C(V,\ LR) \longrightarrow \pi_C(R,\ LR) \gtreqless \pi_C(\neg V,\ LR) \longrightarrow \{\pi_C(R,\ LR) = \pi_C(\neg V,\ LR) \gtreqless \mathbb{E}[\pi_C(\widehat{\sigma_{C4}},\ LR)]\} \veebar \{\pi_C(\neg V,\ LR) < \pi_C(R,\ LR) \gtreqless \mathbb{E}[\pi_C(\widehat{\sigma_{C4}},\ LR)]\} \veebar \{\pi_C(R,\ LR) < \pi_C(\neg V,\ LR) \gtreqless \mathbb{E}[\pi_C(\widehat{\sigma_{C4}},\ LR)]\}$ and (ii) $\pi_C(R,\ LR) \leq \pi_C(V,\ LR) < \pi_C(\neg V,\ LR) \longrightarrow \pi_C(\neg V,\ LR) \gtreqless \mathbb{E}[\pi_C(\widehat{\sigma_{C4}},\ LR)]$.

If the government plays mixed strategy $\hat{\sigma}_{G4}$ the citizen's highest payoff is found in either pure strategy "Vaccination" or pure strategy "Revolution", being thereby either unequal or equal: $\hat{s}_G = \hat{\sigma}_{G4} \longrightarrow \mathbb{E}[\pi_C(V,\ \hat{\sigma}_{G4})] = \mathbb{E}[\pi_C(\hat{\sigma}_{C1},\ \hat{\sigma}_{G4})] = a_C \gtreqless \mathbb{E}[\pi_C(R,\ \hat{\sigma}_{G4})] = \mathbb{E}[\pi_C(\hat{\sigma}_{C3},\ \hat{\sigma}_{G4})] = e_C$ and $\nexists \mathbb{E}[\pi_C(\neg V,\ \hat{\sigma}_{G4})] = \mathbb{E}[\pi_C(\hat{\sigma}_{C2},\ \hat{\sigma}_{G4})] = b_C q_2 + c_C(1 - q_2)$ and $\nexists \mathbb{E}[\pi_C(\hat{\sigma}_{C4},\ \hat{\sigma}_{G4})] = a_C p_1 + e_C(1 - p_1)$.

Consequently, the citizen's potential dominant strategy refined for despotism and resistance is either "Vaccination", "Revolution" or void and the warring game potentially features no dominant strategy equilibria thereby: $(\tilde{\hat{\sigma}}_C = V \veebar R) \veebar (\nexists \tilde{\hat{\sigma}}_C)$ and thus $\Diamond\ \nexists(\tilde{\hat{\sigma}}_C,\ \tilde{\hat{\sigma}}_G)$.

Lemma 5.9.4 For completeness, if the citizen plays pure strategy "Vaccination" the government's highest payoff is found in either pure strategy "Direct imposition" or mixed strategy $\hat{\sigma}_{G4}$, being thereby either unequal or equal, in accordance with probabilities q_1 and q_2 : $\hat{s}_C = V = \hat{\sigma}_{C1} \longrightarrow \pi_G(V,\ DI) = \pi_G(V,\ \hat{\sigma}_{G1}) > \pi_G(V,\ SR) = \pi_G(V,\ \hat{\sigma}_{G2}) > \pi_G(V,\ LR) = \pi_G(V,\ \hat{\sigma}_{G3})$ and $\pi_G(V,\ DI) = \pi_G(V,\ \hat{\sigma}_{G1}) \gtreqless \mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})]$, specifically, $a_G > b_G > c_G$ and $a_G \gtreqless a_G q_1 + b_G q_2 + c_G(1 - q_1 - q_2) \longrightarrow 0 \gtreqless (a_G - c_G)q_1 + (b_G - c_G)q_2 + (c_G - a_G) \longrightarrow 0 \gtreqless (b_G - c_G)q_2 + (c_G - a_G)(1 - q_1)$, in accordance with $\{q_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^3 q_i = 1$, being all true[27].

If the citizen plays pure strategy "No vaccination" the government's highest payoff is found in pure strategy "Subsistence restriction", relatively higher thereby, the vaccination incentives from luxury restrictions being too low: $\hat{s}_C = \neg V = \hat{\sigma}_{C2} \longrightarrow \pi_G(\neg V,\ SR) = \pi_G(\neg V,\ \hat{\sigma}_{G2}) > \pi_G(\neg V,\ LR) = \pi_G(\neg V,\ \hat{\sigma}_{G3})$ and $\nexists \pi_G(\neg V,\ DI) = \pi_G(\neg V,\ \hat{\sigma}_{G1})$ and $\nexists \mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})] = b_G q_2 + c_G(1 - q_2)$; specifically, $b_G > c_G$[28].

If the citizen plays pure strategy "Revolution" the government's highest payoff is found in either pure strategy "Direct imposition" or mixed strategy $\hat{\sigma}_{G4}$, being thereby either unequal or equal, in accordance with probabilities q_1 and q_2 : $\hat{s}_C = R = \hat{\sigma}_{C3} \longrightarrow \pi_G(R,\ DI) = \pi_G(R,\ \hat{\sigma}_{G1}) > \pi_G(R,\ SR) = \pi_G(R,\ \hat{\sigma}_{G2}) > \pi_G(R,\ LR) = \pi_G(R,\ \hat{\sigma}_{G3})$ and $\pi_G(R,\ DI) = \pi_G(R,\ \hat{\sigma}_{G1}) \gtreqless \mathbb{E}[\pi_G(R,\ \hat{\sigma}_{G4})]$, specifically, $e_G > f_G > g_G$ and $e_G \gtreqless e_G q_1 + f_G q_2 + g_G(1 - q_1 - q_2) \longrightarrow 0 \gtreqless (e_G - g_G)q_1 + (f_G - g_G)q_2 + (g_G - e_G) \longrightarrow 0 \gtreqless (f_G - g_G)q_2 + (g_G - e_G)(1 - q_1)$, in accordance with $\{q_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^3 q_i = 1$, being all true[29].

If the citizen plays mixed strategy $\hat{\sigma}_{C4}$ the government's highest payoff is found as an expected payoff in pure strategy "Subsistence restriction", relatively higher thereby, the vaccination incentives from luxury restrictions being too low: $\hat{s}_C = \hat{\sigma}_{C4} \longrightarrow \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ SR)] = \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ \hat{\sigma}_{G2})] > \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ LR)] = \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ \hat{\sigma}_{G3})]$ and $\nexists \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ \hat{\sigma}_{G1})] = \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ DI] = a_G p_1 + e_G(1 - p_1)$ and $\nexists \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ \hat{\sigma}_{G4})] = [b_G q_2 + c_G(1 - q_2)]p_1 + [f_G q_2 + g_G(1 - q_2)](1 - p_1)$; specifically, $b_G(p_1 + p_2) + f_G(1 - p_1 - p_2) > c_G(p_1 +$

[27] For completeness: $\pi_G(V,\ SR) = \pi_G(V,\ \hat{\sigma}_{G2}) \gtreqless \mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})] \longleftrightarrow b_G \gtreqless a_G q_1 + b_G q_2 + c_G(1 - q_1 - q_2) \longrightarrow 0 \gtreqless (a_G - c_G)q_1 + (b_G - c_G)q_2 + (c_G - b_G) \longrightarrow 0 \gtreqless (a_G - c_G)q_1 + (c_G - b_G)(1 - q_2)$, in accordance with $\{q_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^3 q_i = 1$; $\mathbb{E}[\pi_G(V,\ \hat{\sigma}_{G4})] > \pi_G(V,\ LR) = \pi_G(V,\ \hat{\sigma}_{G3}) \longleftrightarrow a_G q_1 + b_G q_2 + c_G(1 - q_1 - q_2) > c_G \longrightarrow (a_G - c_G)q_1 + (b_G - c_G)q_2 > 0$.

[28] For completeness, $\pi_G(\neg V,\ SR) = \pi_G(\neg V,\ \hat{\sigma}_{G2}) > \mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})]$ would be specified as $b_G > b_G q_2 + c_G(1 - q_2) \longrightarrow 0 > (b_G - c_G)q_2 + (c_G - b_G) \longrightarrow 0 > (c_G - b_G)(1 - q_2)$, which would be true, but $\nexists \mathbb{E}[\pi_G(\neg V,\ \hat{\sigma}_{G4})] = b_G q_2 + c_G(1 - q_2)$.

[29] For completeness: $\pi_G(R,\ SR) = \pi_G(R,\ \hat{\sigma}_{G2}) \gtreqless \mathbb{E}[\pi_G(R,\ \hat{\sigma}_{G4})] \longleftrightarrow f_G \gtreqless e_G q_1 + f_G q_2 + g_G(1 - q_1 - q_2) \longrightarrow 0 \gtreqless (e_G - g_G)q_1 + (f_G - g_G)q_2 + (g_G - f_G) \longrightarrow 0 \gtreqless (e_G - g_G)q_1 + (g_G - f_G)(1 - q_2)$, in accordance with $\{q_i\}_{i=1}^3 \subset (0,\ 1) \subset \mathbb{R}_+$ and $\sum_{i=1}^3 q_i = 1$; $\mathbb{E}[\pi_G(R,\ \hat{\sigma}_{G4})] > \pi_G(R,\ LR) = \pi_G(R,\ \hat{\sigma}_{G3}) \longleftrightarrow e_G q_1 + f_G q_2 + g_G(1 - q_1 - q_2) > g_G \longrightarrow (e_G - g_G)q_1 + (f_G - g_G)q_2 > 0$.

$p_2) + g_G(1 - p_1 - p_2) \longrightarrow (b_G - c_G)(p_1 + p_2) + (f_G - g_G)(1 - p_1 - p_2) > 0$[30].

Consequently, the government features no dominant strategy refined for despotism and resistance and the warring game features no dominant strategy equilibria thereby: $\nexists \tilde{\hat{\sigma}}_G$ and thus $\nexists(\tilde{\hat{\sigma}}_C,\ \tilde{\hat{\sigma}}_G)$.

Lemma 5.9.5 In sum, the warring game features no dominant strategy equilibria: $\nexists(\tilde{\hat{\sigma}}_C,\ \tilde{\hat{\sigma}}_G)$. *QED*

The salient conclusion of the above analysis is such that the administration of COVID-19 vaccines characterises an optimal condition for both citizens and governments if and only if governments refuse to contemplate the option of no imposition of COVID-19 vaccination, notwithstanding its inherent unlawfulness, and that unless citizens be likely to resist the imposition of COVID-19 vaccination on the part of governments such an oxymoronically optimal condition cannot change. Accordingly, the administration of COVID-19 vaccines is suboptimal for both citizens and governments if and only if governments do contemplate the option of no imposition of COVID-19 vaccination. Now, such is in patent contrast with the advice offered by such authoritative medical sources as the WHO, CDC, EMA and FDA, surveyed above. As a consequence, a reflexion on authoritative reliance is lastly in order.

Unknown events, which are fundamentally all past (history), and personally unverifiable facts (existence of things) are believed or disbelieved on account of the credibility and therefrom the authority proper to the party relating them. Thence the assessment of credentials for court witnesses, for instance. The canon for or the measure of such a credibility proximately depends on individual norms and remotely depends upon societal norms, which do not albeit always coincide with their natural and eternal counterparts (nowadays foremost). Thence the necessity of prophecies and miracles for the religious fact. Now, notions whereof one is nescient are subject to a slightly different paradigm. As awareness of one's nescience is acquired such a nescience is replaced either by pertinent knowledge, though imperfect, or by proper ignorance. The motive is that all rational men are capable of sufficient ratiocination in order to attain to their final good, be it subsistence, in an evolutionary orbit, be it salvation, in a retributive orbit. The scientists and experts elected by the professed nescient are so elected through a substantially equal science and expertise. At core authoritative reliance on third parties as regards a man's convictions and decisions on notions of logic and ontology is consequently fideistic.

Yet, even if one were to grant individuals the benefit of the doubt, whereby the scrupulous insecurity in having acquired sufficient understanding upon having discovered their nescience were to prompt them to rely on a third party anyway, even if one were to grant them outright reliance on a third party irrespective of the underlying motivations, the case at hand is such that the objective concessions by the third parties on which most citizens rely, as concerns their substance (admission of foetal exploitation, confusion on adverse effects, dubious pandemic mortality and isolation, disclaimers), not their accidents (endorsement), rationally warranted the decline of COVID-19 vaccines. In a word, COVID-19 vaccination was (i) unlawful, for it could have still exploited aborted foeti, (ii) potentially costly, wreaking even death, (iii) directed at a dubiously identified virus by the minimal alleged mortality and (iv) transmissive of legal immunity in the regard of vaccine producers and governments. No more can be added.

6. Conclusion

The present research conducted a formal analysis of the interactive decisions concerning the enterprise of COVID-19 vaccination on the part of governments and citizens. It specifically constructed a non-cooperative static game with complete information between the citizen and the government encompassing the strategies of vaccination and no vaccination with regard to the former and the strategies of direct imposition, subsistence restrictions, luxury restrictions and no imposition with regard to the latter.

Its payoff structure was founded upon the citizen's concatenated preference of subsistence to no vaccination, luxury and potential health gains and the government's concatenated preference of no vaccination to direct imposition, subsistence restrictions and luxury restrictions. The core rationale was that the citizen accepts COVID-19 vaccination only if his survival is placed at risk, because of the inherent unlawfulness presented by COVID-19 vaccination, itself due to foetal exploitation and potentially adverse effects, thereby prompting the government not to impose it, lest individual integrity and societal rights be violated as well.

[30]For completeness, $\mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ SR)] = \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ \hat{\sigma}_{G2})] \gtreqless \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ \hat{\sigma}_{G4})]$ would be specified as $b_G(p_1 + p_2) + f_G(1 - p_1 - p_2) \gtreqless [b_G q_2 + c_G(1 - q_2)]p_1 + [f_G q_2 + g_G(1 - q_2)](1 - p_1 - p_2) \longrightarrow b_G p_2 \gtreqless [b_G(q_2 - 1) + c_G(1 - q_2)]p_1 + [f_G(q_2 - 1) + g_G(1 - q_2)](1 - p_1 - p_2) \longrightarrow b_G p_2 \gtreqless (c_G - b_G)(1 - q_2)p_1 + (g_G - f_G)(1 - q_2)(1 - p_1 - p_2)$, which would be true, but $\nexists \mathbb{E}[\pi_G(\hat{\sigma}_{C4},\ \hat{\sigma}_{G4})] = [b_G q_2 + c_G(1 - q_2)]p_1 + [f_G q_2 + g_G(1 - q_2)](1 - p_1 - p_2)$.

On such an account the present analysis found that the game in question presents one sole and strict pure strategy Nash equilibrium, being that of strategies no vaccination and no imposition, respectively. It furthermore showed that the exogenous elimination of the no imposition strategy on the part of the government transforms the Nash equilibrium into that of strategies vaccination and direct imposition, respectively, as materially come to pass. It finally determined that the unlikely addition of the revolution strategy on the part of the citizen in the presence of the elimination of the no imposition strategy on the part of the government likewise admits one sole and strict pure strategy Nash equilibrium, either in strategies vaccination and direct imposition or in strategies revolution and direct imposition, respectively.

Appendix

Psalms 13: *"[1] Unto the end, a psalm for David. The fool hath said in his heart: There is no God, They are corrupt, and are become abominable in their ways: there is none that doth good, no not one. [2] The Lord hath looked down from heaven upon the children of men, to see if there be any that understand and seek God. [3] They are all gone aside, they are become unprofitable together: there is none that doth good, no not one. Their throat is an open sepulchre: with their tongues they acted deceitfully; the poison of asps is under their lips. Their mouth is full of cursing and bitterness; their feet are swift to shed blood. Destruction and unhappiness in their ways: and the way of peace they have not known: there is no fear of God before their eyes. [4] Shall not all they know that work iniquity, who devour my people as they eat bread? [5] They have not called upon the Lord: there have they trembled for fear, where there was no fear. [6] For the Lord is in the just generation: you have confounded the counsel of the poor man, but the Lord is his hope. [7] Who shall give out of Sion the salvation of Israel? when the Lord shall have turned away the captivity of his people, Jacob shall rejoice and Israel shall be glad".* [Source: http://www.drbo.org/cgi-bin/s?q=psalm+13&b=drb&t=0]