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Pandemic threat, Ostrom Threshold and pre-emptive public goods: why East Asia performed better in the COVID-19 crisis

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The COVID-19 pandemic is an eminent threat posed by nature to the survival of the whole community. The cost X it imposes upon the community can be mitigated by the community's pre-emptive public goods: an early warning system, capacity for monitoring, contact tracing and isolating infected persons, the strength of its public health system and the cultivated readiness to cooperate with anti-COVID protocols. The community provides these public goods in a nonstrategic game *N* (Nature) where the probability of a "bad outcome" (being symptomatically infected) falls with the total spending on pre-emptive public goods. Aside from *N*, members of the community play an Economic Dilemma Game (*EDG*), a symmetric Prisoner's Dilemma Game (*PDG*) with strategy set (*C*, *D*), where the community earns its economic income which in turn provides the financing of the pre-emptive public goods. Games *EDG* and *N* are fused into a composite game *N*+*EDG* by defining the probability of a good outcome as increasing with the level of public goods financing. *N*+*EDG* has the same strategy set (*C*, *D*) as *EDG* but the payoffs of players are composite: the payoff from *EDG* less the expected share of the pandemic cost to the members. We show that there is a threshold pandemic cost X_0 (Ostrom threshold) so that if $X \geq X_0$, the *N*+*EDG* has dominant strategy in *C*. At the cooperative equilibrium, the community is at its peak strength: economic output from *EDG* is largest and the contribution to pre-emptive public good is highest. A severe-enough cost of the pandemic threat as perceived by the group (i) causes players to exhibit an altruistic phenotype (choosing *C* every time) and (ii) leads to the lowest probability of a bad outcome. We argue that previous experience with pandemics in the last two decades on top of a higher tendency to follow authority in East Asia supported both the provision of better pre-emptive public goods and the higher abidance with anti-COVID protocols. These explain better performance.

JEL Classification: C72, D01, D02
Key Words: Pandemic cost, Ostrom threshold, COVID-19, Pre-emptive public goods, Altruistic behavioral phenotype

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1. Introduction

The world of 2021 is still viciously beset by the Coronavirus 2019 pandemic. What is slowly coming out is that some countries are more successful at handling the pandemic, incurring less toll in morbidity and mortality than others. The East Asian countries China, Taiwan Province of China, South Korea, Singapore, Hongkong and Vietnam appear to be consensus top anti-COVID performers. Many affluent western countries Belgium, Italy, Spain, the United Kingdom, Russia and the USA fared relatively worse. Why did some countries respond like coiled springs to the emerging threat - detecting infections early and resolutely containing (testing, tracking, isolating and social distancing) while others waffled until it was too late?

Ma, Wang, and Wu [2021] have documented the comparative performance of select East Asian countries versus select Western countries. We quote their reading: "Our analysis shows that East Asia's success, compared with the six selected Western societies, can be attributed to stronger and more prompt government responses, as well as better civic cooperation… In addition to rapid and systematic government responses, citizens in East Asia… were generally more compliant with government mandates for mask-wearing, improving personal hygiene, and maintaining physical distance than citizens in the selected Western countries". They also attribute the latter to a stronger cultural adherence to state-issued protocols among East Asians than counterparts in the West.

The issue of how culture may affect the responses to severe natural threats like COVID-19 has been lately explored. Van Babel et al. [2020] identify important insights from social and behavioral science to guide public decision makers for effective response to COVID-19. Gelfand et al. [2020] has shown using data up to April 4, 2020 that the interaction between "cultural tightness" and "government effectiveness" correlates highly and robustly with lower growth of infection and lower death rate from COVID-19 pandemic. They define cultural tightness to be the society's capacity to adhere to norms and obey mandates from the center. To model the emergence of cultural tightness, they employ numerical Evolutionary Game Theory (EGT) model to simulate the comparative success of two populations, one culturally tight and another culturally loose, in forging cooperation and coordination in social dilemma games. Detecting and containing the spread of pandemics such as the COVID-19 is one such dilemma game. Social dilemma games like the Prisoner's Dilemma Game (*PDG*) are those strategic games where the players' pursuit of their individual self-interest leads to the sacrifice of community interests; for example, members who insist on accustomed physical proximity and intimacy interactions become spreaders and raise the transmission rate of the COVID-19 virus thus harming the community. Roos et al. [2015] has shown how groups that face high degree of threats develop stronger norms for social interaction, higher capacity for norm abidance and penalty for deviance using numerical EGT modelling. Smaldino et al. [2013] used agent-

based simulation to demonstrate that in the long-run, harsh environments select for cooperative phenotypes but in the short-run, selfish phenotypes may thrive because the sudden loss of resources lead to demise. All this is in agreement with the variability selection hypothesis (Potts [1996;1998], Potts and Faith [2015]), which finds that changes in hominin morphology and advances in primitive tool technology seemed most rapid when climate fluctuation is most severe which in turn inspire rapid adaptations. Adaptability to extreme changes in the environment is the by-word in variability selection hypothesis. Indeed, many hominin groups may have become extinct for failure to adapt to severe climate fluctuation which supports the alternative adage "survival of the most adaptable". The most employed adaptation is genetic adaptation where climate change favor one allele that is better adapted. Allele (gene form) adaptation however happens across many generations and presupposes that remnants of the species survive. The latter means the current generation adapt well-enough to enable a viable remnant to survive and procreate.

To ensure that some members of the species survive to pass on the gene pool requires a coping mechanism employed by the current population; one is to evolve new institutional structures and behaviors that conduce towards stronger and wider cooperation among the extant population to outlast the changed environment [Smithsonian National Museum of Natural History 2018]. The threatened population itself responds directly exploiting the innate malleability of the species rather indirectly through gene selection which is anyway impossible if none of present population survives. *Homo sapiens* survived because, through innumerable climate distresses, the remnants of the current generation survived by cultural and institutional innovation. One such monumental innovation is cooperation on a much larger scale. Cooperation among larger and larger number of individuals and groups was the root cause of why *homo sapiens* survived while other hominids such as the Neanderthals and Denisovans did not. It allowed *homo sapiens* to occupy more and more diversified environments and geographies that act as insurance against climate stresses. This is the celebrated thesis of historian Juval Harari in the bestselling volume *Sapiens* [Harari 2014].

Elinor Ostrom and her group (Ostrom [1990; 2000], Ostrom et al. [1994]) have amply demonstrated that the failure of cooperation called "tragedy of the commons" in the management of a common resource need not always be the fate of collectives. There are exceptions to the so-called "zero contribution hypothesis" of Olson [1964]. The Ostrom group has identified the conditions that make for collective action success: small communities, face-to-face repeated interactions, relative homogeneity of members, limited exit possibility, an evolved regime that punishes deviance, and finally the salience of the threat and cost of failure (Ostrom [1990; 1999; 2007]). Ostrom salience is the the severity of the harm to the well-being of the community and thus of members in case of failure to respond cooperatively. To mitigate the likelihood of failure, the community evolves

institutions of norms and enforcement for deviance. Ostrom [2000] and others (e.g. Fehr and Fischbacher [2002]) favor some pro-social tendencies, say, strong reciprocity or conditional cooperation, to explain the emergence of cooperation in common pool resource management. Conditional cooperation could be viewed as a behavioral phenotype springing from the same basic genotype that also supports self-oriented behavior.

In this paper, we enquire how cooperation, the anchor of, as it were, a coiled spring community response to threats, can be attained even in the absence of pro-social tendencies. We are especially interested in the role of the Ostrom salience in making cooperation the best reply to itself even among intrinsically selfish agents. Our interest revolves around short-horizon cooperative response by the threatened generation rather than the long-horizon cross-generation response implied in allele selection. The overwhelming imperative is for a viable remnant of the current threatened population to survive to pass on the gene pool.

The common model to generate cooperative outcomes is evolutionary game theory (EGT). The EGT models employs Malthusian replication and Darwinian selection and thus require long time horizons to bear fruit - the slow recession through non-replication of the non-cooperative gene. To survive as a species, the currently threatened generation has to ensure that a viable remnant of the group outlasts the climate distress to pass on the gene pool. The model offered here dispenses with such baggage as allele selection and replication.

The following story reveals that perhaps the same human agents can manifest self-regarding or group-regarding behavior depending upon which best equips the agent for survival in the surrounding physical or social milieu. In other words, the ambient environment dictates the behavioral phenotypes that get expressed.

Previous to 458 BC, Roman society, after a period of relative external success and peace, turned inwards, as it were, and was rent by an ideological conflict. One party, the Plebians, was beginning to demand expanded rights from the ruling party, the Patricians. Lucius Quinctus Cincinnatus, a citizen of recognized military prowess and the leader of the Patricians, opposed the demands. When the Patricians lost, Cincinnatus was deprived of wealth and influence and forced into self-exile on the other side of the Tiber River where he lived as a humble farmer. In Darwin's words, the early Romans after early success had become a "selfish and contentious people" and Roman society became socially incoherent. In 458 BC, Rome became severely threatened by an invasion from neighboring tribes/groups, the Aequi and Sabines. The Roman Senate, in the face of the eminent threat of possible subjugation and slavery for all, set aside ideological differences and hurriedly offered Cincinnatus the dictatorship of Rome (*Magister Populi*) for a period of six months on condition that he raises and leads an army in defense of Rome. Cincinnatus accepted the commission, raised an army and repulsed the invasion in 17 days. Having done so, he promptly resigned his commission and returned to his farm. He repeated the feat years later (468 BC) when Rome was

once more threatened by a social disorder stemming from a conspiracy to install a king. Cincinnatus became an icon of civic virtue for the world then and now. This oscillation between behavioral phenotypes occurred within one generation. But the capacity to set aside selfish differences and re-cohere in the face of an eminent threat, was the true seed of the future Roman Empire. This empire however collapsed a thousand years later when Romans lost, what historian Edward Gibbons (1776-79) called "civic virtue". After a thousand years luxuriating in wealth and a sense of invincibility, the threat of the barbarians knocking at the door lost its sting. The defense of the realm was increasingly entrusted to paid mercenaries and conscripted former barbarians rather than to citizen-soldiers. Rome fell in 458 BC.

In this paper, we investigate how a heightened awareness of a severe exogenous natural threat, in this case a pandemic, whose ravages can be mitigated by pre-emptive public goods, can (i) make agents switch from selfish behavior to a cooperative behavior, increasingly identifying individual well-being with group well-being and in so doing (ii) help the community attain its peak strength in terms of pre-emptive public goods.

In Section 2, we fuse the Economic Dilemma Game (*EDG*), a symmetric *PDG*, and a non-strategic game *N* pitting the community against a Nature instanced here by a pandemic. The community can mitigate the harm of the pandemic by arming itself with pre-emptive public goods (*PEPG*). Failure to be adequately armed results in a higher probability of a "bad outcome" (everyone gets a symptomatic infection). The probability of the good outcome (either nobody gets infected or everyone gets only asymptomatic infection) rises with the resources, assessed from members' payoffs in the *EDG*, to finance the pre-emptive public goods. Free riding in *EDG* results not only in paltry economic payoffs but paltry contribution to and inadequate *PEPG* resulting in a higher probability of a bad outcome. The composite game is called the *"N+EDG"*.

We ask what threat level makes cooperation in the *N-EDG* a dominant strategy. We introduce the concept of the "Ostrom threshold", the cost of the pandemic in excess of which cooperation is the best reply to itself. The Ostrom threshold demarcates the social space: on one side, selfishness is king and on the other cooperation is king. A large enough cost of the pandemic can make every member a "critical" decision maker rendering *free riding* an inferior strategy and cooperation the dominant strategy. In Section 4, we conclude.

2. The Economic Dilemma Game

Players *A* and *B* are self-interested members of a group, who play an economic dilemma game, exemplified by the Humean Farmer Dilemma Game. This is a social dilemma game where two farmers face the strategy set (*C*, *D*); "*C*" stands for "Cooperate, that is, help harvest the other farmer's crop" and "*D*" means

"Don't help". If they manage to cooperate, they thrive; if they do not, they languish. We label this game the Economic Dilemma Game (*EDG*). *EDG* is a symmetric Prisoner's Dilemma Game as shown in Table 1 below, with $a > b > c > d$. With both A and B being self-interested maximizers, the Nash equilibrium of the *EDG* is (D, D). The pursuit of myopic selfish interest leads to a non-cooperative and a welfare-inferior outcome payoff profile (c, c). The symmetric nature of the game is just for convenience; non-symmetric *PDG* can be accommodated trivially.

TABLE 1. Payoff matrix of *EDG*

B / A	C	D
C	b, b	d, a
D	a, d	c, c

3. The Non-strategic Pandemic Game *N*

The community is threatened by a deadly pandemic. For simplicity let A and B be the only members of the community. The entry of the pandemic into the community cannot be stopped. But the damage caused by the pandemic can be mitigated by the resources the community is able to deploy for *PEPG* (pre-emptive public goods): a well-funded early-warning system, ample hospital facilities, strong monitoring, contact-tracing and isolation of infected persons, a culture of affinity to comply with government protocols. *PEPG* have to be financed by contribution from community members.

Let P be the probability of a good outcome of a pandemic, and $(1 - P)$ the probability of a bad outcome. By "good outcome" we mean "no infection for all or only asymptomatic infection for all". By "bad outcome" we mean "symptomatic infection for all". Good or bad outcome applies equally to everyone. The cost of the pandemic to the community (and indeed all the identical communities) is fixed $X > 0$ times the probability of a bad outcome; we assume that the cost of the community is born equally by A and B, i.e., the cost to each of two members is half the cost to the community. Ostrom's condition of membership homogeneity makes this assumption plausible. Likewise, no member can evade this exaction simply by exiting the group's jurisdiction following Ostrom's no exit condition. Resources to build and upkeep the pre-emptive public goods is raised through a contribution rate t, $0 < t < 1$, assessed against individual member payoff in the economic game *EDG*. This is a fully symmetric information game.

The aggregate contribution R for the pre-emptive public goods increases the probability P of a good outcome. Letting R_0 be a fixed parameter representing the

"fury of the pandemic", say, the transmission rate of the virus, its mortality per infection rate or the duration at which those infected remain spreaders. We adopt a simple Tullock structure for the probability of success:

$$P = R / [R + R_0]. \quad (1)$$

The collection $\{P, X, R, R_0, t\}$ we call N a game played by the community against Nature, in this case, manifested as COVID-19 pandemic. Since Nature does not respond to the community's action, N is a non-strategic game. From (1) we know that the community's spending R for pre-emptive public goods raises the probability of a good outcome P; R_0 represents the pandemic's fury and is a *black swan* event. Each farmer pays the expected amount [(X/2) × the likelihood of a bad outcome] which neither A nor B can escape by simply exiting the group.

The punishment for shirking one's obligation in *EDG* comes not from other members but from a third party, Nature, that visits the community. N is the type of game that the people of Netherlands ("Nederlanders" literally means "lowlanders") have been playing for centuries against the North Sea. The Dutch have been farming and prospering under the shadow of the dikes they built to reduce the damage from the fury of the North Sea.

4. The Composite Game

We can fuse the *EDG* and N into a single composite game, *N+EDG*, by defining the total *PEPG* contribution R collected from all members as assessments against the payoffs in the *EDG*:

$$R(i, j) = t(U_A(i, j) + U_B(i, j)),\ i, j = C, D \quad (2)$$

$U_A(i, j)$ and $U_B(i, j)$ are the fitness of A and B, respectively which are identical to payoffs of A and B, in the *EDG* under strategy profile (i, j) in Table 1. For example, from Table 1, we have $U_A(C,C) = b = U_B(C, C)$, $U_A(C, D) = d$, $U_B(D, D) = c$. Likewise, we have $R(C, C) = t(b + b)$ for (C, C) and $R(C, NC) = t(d + a)$, etc. The probability of the good outcome is:

$$P(i, j) = R(i, j)/[R(i, j) + R_0]. \quad (3)$$

Definition 1: The Ostrom Threshold of the *N+EDG* is the pandemic cost X_0, $0 \le X_0 < \infty$, such that if $X \ge X_0$, C is a best reply to C for both players and strictly so if $X > X_0$.

Remark 1: Ostrom's "salience" resonates with the Ostrom threshold, X_0, beyond which behavior becomes cooperative.

Remark 2: The Ostrom threshold demarcates the social space where cooperation is the dominant strategy. The lower is the Ostrom threshold X_0, the easier it is for cooperation to be attained in *N+EDG*. Indeed if *A* and *B* happen to be blood brothers, X_0 may be zero.

The expected utility of *A* under (*C*, *C*) in the *N+EDG* is:

$$EU_A(C, C) = U_A(C, C)(1 - t) - (X/2)\,[1 - P(C, C)]. \tag{4}$$

Now $P(C, C) = t(2b)/[t2b + R_0]$. Thus, substituting the corresponding payoffs from Table 1, the expected fitness of *A* can be written as:

$$EU_A(C) = b(1 - t) - (X/2)[1 - (2bt/(2bt + R_0))]. \tag{5}$$

Equation 5 says that by choosing *C*, the expected fitness of *A* consists of $b(1 - t)$ (*A*'s fitness with cooperation in non-pandemic times) less his share in the expected cost of the pandemic. *A*'s individual fitness (5) is now intimately related to how the group performs against the pandemic. This echoes the concept of "inclusive fitness" in evolutionary biology [Bowles 2004; Wilson and Wilson 2008]. With *D*, *A*'s expected fitness is thus:

$$EU_A(D) = a(1 - t) - (X/2)[1 - (t(d + a)/(t(d + a) + R_0)]. \tag{6}$$

Note that *A*'s expected fitness in (5) and (6) is in each case a composite of the individual payoff in *EDG* and his share of the group's expected loss. Equating (5) and (6), we have:

$$(X/2)\{t(d + a)[t(d + a) + R_0]^{-1} - t(b + b)[b + b) + R_0]^{-1}\} = (1 - t)(a - b). \tag{7}$$

This equality condition ensures that *C* is a weakly best reply to *C* or (*C*, *C*) is a weakly dominant Nash equilibrium of the *N+EDG*.

Remark 3: The Ostrom Threshold is that level of pandemic cost X_0 such that (7) holds.

The main result concerns the condition for the existence of the Ostrom Threshold for the game in question:

Proposition: (Existence of the Ostrom Threshold) The composite game *N+EDG* has an Ostrom threshold if and only if $(b+b) > (a+d)$ in the original *EDG*.

Proof: (if) Suppose $(b+b) > (a+d)$, Consider the following:

$$X_0 = -\,2(1 - t)(a - b)[H_2/H_1], \tag{8}$$

where $H_1 = tR_0[(a + d) - (b + b)] < 0$ and $H_2 = (t(d + a) + R_0)(t(b + b) + R_0)$ is clearly positive but less than ∞, since $(1 - t) > 0$ and $(a - b) > 0$ by *N+FDG*. So $X_0 > 0$ but less than ∞, as required for an Ostrom threshold. Now X_0 solves (7) which ensures that C is weakly best reply to C for A. By symmetry, it also does the same for B. Furthermore, for every $X > X_0$, $EU_A(C, C) > EU_A(NC, C)$ or C is strictly best reply to C for all players. Thus, X_0 is clearly the Ostrom threshold for the *N+EDG*. (Only if) Suppose the inequality condition $(b+b) < (a+d)$ instead holds for the *N+EDG*. The $H_1 > 0$ and $X_0 < 0$ violating the condition for the Ostrom threshold.

Remark: The condition $[(b+b) > (a+d)]$ is of some interest. The economic dilemma game should be such that the cooperative solution rewards the whole community better than if at least one player reneges. Note that the *EDG* can be a proper dilemma game even if the condition does not hold, that is, when $(d > (b+b-a)$ while $a < b)$ resulting in $(b+b) < (a+d)$. In this case, the opportunist (one who plays D when the other plays C) is very highly rewarded. Thus, cultures that highly reward opportunism may not exhibit Ostrom thresholds and may not attain the coiled spring feature. Cultures that highly reward cooperativism may attain the coiled spring feature. Cultures which privilege the group over the individual would naturally be more in tune with $(b+b) > (a+d)$. The proof can be trivially tweaked to accommodate a non-symmetric game.

We have shown that when the community faces the cost X of the pandemic in excess of the Ostrom threshold, the *N+EDG* transforms into a game with cooperation as the dominant strategy. The necessary and sufficient condition is that the Utilitarian social welfare at (C, C) exceeds those at (C, D) or (D, C) in the original *EDG*.

The community is at its peak strength at (C, C): its economic output is at its highest and it is contributing the largest to its anti-COVID insurance. At (C, C) the community becomes as if it were a "coiled spring" ready to pounce on pandemic intrusion. This state of readiness is attained and sustained by a threat level in excess of the Ostrom threshold. At this point, every member though inherently self-regarding acts "as if" altruistic as a way to advance his/her own personal welfare.

Note that the size of X can be a shared subjective valuation in the mind of the public. This subjective valuation depends in part on past experience with pandemics which gives an idea of how likely and how severe they will be. Likewise, trusted leadership can stoke the citizenry's subjective valuation to levels exceeding X_0 thus enabling stronger government actions that drive government effectiveness in Gelfand et al [2020]. Consequently, government effectiveness may itself be just reflecting the anti-COVID frenzy in the polity. The combination of effective government and a citizenry primed by past experience and trust of authorities results in what Gelfand et al. [2020] calls culturally "tight societies". Members of culturally tight societies submit better to harsher measures than members of looser societies. Of course, the coiled spring feature of tight societies can also be used by a demagogue for anti-social ends like making war.

The Romans in 450 BC formed one such coiled spring or tight societies forged by a heightened sense of identity and vulnerability that allowed them to coalesce to repulse eminent threats from other tribes despite previous fractious internal state of affairs. The Romans of 450 AD by contrast, having experienced centuries of peace and luxury coupled with an increasingly confused identity in a diverse multi-ethnic society, could not maintain the same sense of urgency and vulnerability. This in turn resulted in crumbling pre-emptive public goods. Such was instantiated by the defense of the realm being increasingly entrusted to paid mercenaries or conscripted barbarians rather than to citizen-soldiers. A thousand years of the *Pax Romana*, of luxury and a sense of invincibility may also have selected the sterner martial spirit of previous generations for Darwinian extinction. By 450 AD, the Roman society had become absorbed more by infighting for bigger shares in the imperial pie (rent-seeking) [Olson 1983] rather than by outfighting and bringing the barbarians to heel.

It is now a widely documented fact that East Asian countries fared better sometimes than Western countries in managing the COVID-19 Crisis. The question is why? Ma et al. [2021] documents which responses were stronger; a more timely government response combined with better civic cooperation was found in their list of East Asian countries (Hong Kong, Taiwan, China, South Korea, Singapore and Vietnam) than in their list of Western countries (UK, Italy, France Spain, Belgium, Germany, USA, Sweden, Denmark). They also resort to East Asian culture in the form of civic cooperation within communities, a culture as well more in tune with the authorities. Our take is that these East Asian societies apart from having a culture that is more in tune with its leadership also had a greater exposure to the ravages of pandemics of the last two decades leading to a more heightened sense of vulnerability making the sacrifice of personal comfort associated with protocol abidance more acceptable. It was a marriage between Nietszche ("What doesn't kill you makes you stronger") and Confucius (*Song* or loyalty to the state).

5. Summary

The model on offer here differs decidedly from the more long-run *EGT* models which depends on Malthusian replication and allele selection to explain the emergence of "tight societies" consisting of cooperators. Rather than just produce offspring more adapted allele-wise to the new difficult environmental situation, in our model, the current population itself employs species behavioral malleability by changing its behavior and institutions. Under duress, agents discard the selfish behavior and adopt the cooperative behavior. Some may call this "as if" altruism especially if the subjects revert back to self-seeking after the threat is lifted. If the threat is perceived to be long-lasting or recurrent, this "as if" altruism may become institutionalized and normalized.

The model features a community with two initially self-interested agents *A* and *B* normally interacting in an economic game characterized by a social dilemma where the Nash equilibrium delivers an inferior welfare outcome. The pandemic threatens to impose a cost $X > 0$ upon the community. The community cannot stop the spread of the pandemic *per se* but it can erect pre-emptive public goods that mitigate the damage caused by the pandemic. In other words the pre-emptive public goods can result in a "good outcome" defined as "no infection or asymptomatic infection for all"; the bad outcome is "symptomatic infection for all". The community thus plays a non-strategic game *N* against Nature by erecting such pre-emptive public goods.

Spending for pre-emptive public goods reduces the probability of the bad outcome of the pandemic having to be financed from revenues assessed upon the individual payoffs in the *EDG*. Thus, free riding in *EDG* incurs the additional cost of the risk of getting the bad outcome of the pandemic. Fusing together the *EDG* and *N* results in a game we call *N+EDG* where players face the strategy set (*C, D*) as in the *EDG* but the payoffs are each a composite as it accounts for the expected cost of the pandemic. The assumptions employed in the *N+EDG* echo the Ostrom assumptions for successful avoidance of the tragedy of the commons. For instance, the assumptions of equal sharing of the cost of the pandemic echoes relative homogeneity and difficulty of exit in Ostrom. Punishment for deviance exists but is now meted by Nature rather than by members themselves.

We introduce the concept of the "Ostrom threshold" which is the cost of the pandemic in excess of which cooperation in the *N+EPD* is a best reply to itself. The cost of the pandemic in excess of the Ostrom threshold transforms the *N+EPG* from a simple *PDG* to a game where cooperation is the dominant strategy. We give the necessary and sufficient condition for the existence of the Ostrom threshold for the *N+EPG*: that the utilitarian welfare is highest under full cooperation than under some free riding. Note that agents still exhibit selfish phenotype below the Ostrom threshold; and the cooperative phenotype above the threshold. The model can easily be generalized to more than two agents and for other eminent threats.

Why do some societies respond to an eminent threat like coiled springs while others dilly-dally until it's too late? The coiled spring feature towards a threat comes from the heightened sense of vulnerability to and immediacy of the threat. This feature is not costless since members of the community contribute to the provision of the pre-emptive public goods sacrificing present consumption and accustomed comfort in the process. Political consensus towards the provision of pre-emptive public goods is easier to reach and government anti-COVID protocols tend to be effective with the strong tailwind of civic cooperation.

Since four of the six pandemics in the last two decades originated and did most damage in East Asia, the heightened anxiety they left behind among East Asians combined with a more developed cultural tendency to cooperate with the authorities partly explains why the best performers against COVID-19 in deaths per million population are East Asian [Ma, Wang, and Wu 2021].

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