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PONAŠANJE U SKLADU S PROPISIMA U EUROPI U RANOJ FAZI COVID-19 PANDEMIJE: ŠTO MOŽEMO NAUČITI IZ TEORIJE IGARA I EKSPERIMENTALNE EKONOMIJE?

COMPLIANCE BEHAVIOUR IN EUROPE IN THE EARLY STAGES OF THE COVID-19 PANDEMIC: WHAT CAN WE LEARN FROM GAME THEORY AND EXPERIMENTAL ECONOMICS?

SAŽETAK: Studije diljem Europe pokazale su da se ljudi u ranim fazama pandemije COVID-19 nisu u potpunosti pridržavali preventivnih mjera i preporuka koje su dale vlasti. Kao što je vidljivo, stope usklađenosti mogu ovisiti o mnogim različitim čimbenicima, uključujući osobine ličnosti, spol, dob, pa čak i iracionalno vjerovanje u teorije zavjere. Ovi nalazi naglašavaju heterogenost među ljudima i, u kombinaciji s uvidima iz teorije igara i eksperimentalne ekonomije, sugeriraju da bi bilo teško održati visoke stope usklađenosti i spriječiti širenje smrtonosnog virusa bez uvođenja strožih mjera koje su kasnije usvojene.

KLJUČNE RIJEČI: ponašanje u skladu s propisima, COVID-19, Europa, eksperimentalna ekonomija, teorija igara

ABSTRACT: Studies across Europe have shown that in the early phases of the COVID-19 pandemic people did not fully comply with preventive measures and recommendations given by the authorities. As evidenced, compliance rates may depend on many different factors, including personality traits, gender, age, and even irrational beliefs in conspiracy theories. These findings highlight heterogeneity among people and, in combination with insights from game theory and experimental economics, suggest that it would be difficult to sustain high compliance rates and prevent the spread of the deadly virus without imposing stricter measures that were adopted later.

KEY WORDS: compliance behaviour, COVID-19, Europe, experimental economics, game theory

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UVOD

Godina 2020. ući će u povijest kao godina u kojoj smo svjedočili novootkrivenom koronavirusu, teškom akutnom respiratornom sindromu koronavirusa 2 (SARS-CoV-2), koji se širi svijetom. U 2022. godini koronavirus je i dalje prisutan i negativno utječe ne samo na naše zdravlje, nego i na naše gospodarstvo i turizam. Potonje je posebno teško pogođeno u početnim fazama izbijanja pandemije, kada turisti nisu mogli slobodno putovati u inozemstvo (vidi, npr., Gössling i sur., 2021, i reference u njima). Osobit problem u ranim fazama bilo je samo djelomično pridržavanje savjeta nadležnih tijela o ponašanju koje je omogućilo brže širenje virusa.

Budući da se ljudi redovito susreću i komuniciraju s drugima, njihove odluke utječu ne samo na njih nego i na druge oko njih, što znači da ishod, a time i zadovoljstvo ili zdravlje pojedinaca, u biti ovisi o odlukama svih s kojima su u interakciji. Stoga je važno razumjeti i pokazati da donošenje odluka u takvim interaktivnim situacijama nije samo jednostavan proces donošenja odluka gdje analiza ulaganja i dobiti na individualnoj razini daje ishod koji je također društveno poželjan. Jedan od načina da se uzme u obzir ta međusobna ovisnost jesu modeli teorije igara. Oni su već korišteni za proučavanje neusklađenosti u krizi COVID-19 (npr. Stoddard i sur., 2020; Wei i sur., 2020; von Siemens, 2021).

Glavna motivacija i svrha ovog rada je bolje razumijevanje ponašanja u skladu s propisima u početnim fazama COVID-19 pandemije, kada cijepljenje još nije bilo opcija. Problem promatram i prezentiram iz drugačije perspektive – perspektive teorije igara. Nakon pažljivog proučavanja nekoliko teorijskih i empirijskih/eksperimentalnih studija, moja glavna zapažanja su sljedeća. Prvo, ljudi su se općenito – barem prema vlastitim tvrdnjama, koje mogu patiti od pristranosti socijalne poželjnosti – pridržavali preporuka i mjera, ali ne u punoj mjeri i ne svi u istoj mjeri. Drugo, teorija i eksperimentalni

INTRODUCTION

The year 2020 will go down in history as the year in which we witnessed the newly identified coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), spreading around the world. In 2022, the coronavirus is still present and negatively affects not only our health but also our economy and tourism. The latter has been hit particularly hard in the initial phases of the outburst, when foreign visitors were unable to travel abroad freely (see, e.g., Gössling et al., 2021, and references therein). One problem in the early phases was only partial compliance with behavioural advice given by the authorities which allowed the virus to spread more rapidly.

Since people meet and interact with others on a regular basis, their decisions affect not only them but also others around them, meaning that the outcome and hence satisfaction or health of individuals essentially depends on the decisions of everyone with whom they interact. It is therefore important to understand and demonstrate that making choices in such interactive situations is not just a simple decision-making process where a cost-benefit analysis on the individual level produces the outcome that is also socially desirable. One way to account for this mutual interdependence is by employing game theoretic models. These have already been used to study non-compliance in the COVID-19 crisis (e.g., Stoddard et al., 2020; Wei et al., 2020; von Siemens, 2021).

The main motivation and purpose of the present paper is to better understand the compliance behaviour in the initial phases of COVID-19, when vaccination was not an option yet. I look at and present the problem from different – game theoretic – perspective. After carefully examining several theoretical and empirical/experimental studies, my main observations are the following. First, people in general – at least according to self-reports, which may suffer from social desirability bias – complied with the recommendations and measures but not to the full extent and not

dokazi sugeriraju da bi bilo moguće održavati visoke stope pridržavanja propisa tijekom korona krize čak i bez daljnjih intervencija, ali samo pod strogim pretpostavkama koje u praksi nisu u potpunosti ispunjene. Drugim riječima, bez daljnjih intervencija razina pridržavanja propisa najvjerojatnije bi se s vremenom smanjila. Treće, jednostavno uvođenje nagrada/novčanih kazni može pojedince usmjeriti prema društveno poželjnom ishodu.

Vjerujem da ovaj rad pridonosi literaturi na nekoliko načina. Prvo, ilustrira kako se stvarni problem može modelirati i analizirati pomoću alata teorije igara, koji su u posljednjim desetljećima postali snažan adut u rješavanju problema koji uključuju neku vrstu interakcije. To također pokazuje da stroge pretpostavke na kojima su teorijski modeli izgrađeni često nisu ispunjene u praksi, jer su ljudi preheterogeni i samo ograničeno racionalni. Treće, pokazuje kako se postojeći rezultati eksperimenta mogu koristiti kao posrednik u raspravi i razumijevanju stvarnog ponašanja u skladu s propisima. Osim toga, u radu su sažeti i rezultati brojnih studija o ponašanju u skladu s propisima, čime je prikazana opća situacija u Europi u ranim fazama pandemije COVID-19.

Rad ima sljedeću strukturu: nakon ovog uvoda, odjeljak 2 pregledava nekoliko studija koje su istraživale usklađenost s preporukama u ranim fazama izbijanja koronavirusa. Fokusiram se isključivo na europske zemlje, jer su one bile u središtu pozornosti u ranoj fazi. Nakon što sam prikazao situaciju u Europi, prelazim na sljedeću svrhu ovog članka, a to je prvo pokazati kako se ponašanje ljudi u ranim fazama izbijanja koronavirusa može prevesti u okvir teorije igara (odjeljak 3), a zatim ilustrirati, koristeći postojeće teorijske i empirijske dokaze, do kakvog ishoda može dovesti nepridržavanje (odjeljak 4). Odjeljak 5 rezerviran je za kratku raspravu, a odjeljak 6 zaključuje članak.

everyone to the same degree. Second, the theory and experimental evidence suggest that it would be possible to maintain high compliance rates during the coronavirus crisis even without further interventions, but only under strict assumptions which are in practice not fully met. In other words, without further interventions the level of compliance would most likely decrease over time. Third, the simple introduction of rewards/fines may direct individuals towards the socially desirable outcome.

I believe this paper contributes to the literature in several ways. First, it illustrates how a real-world problem can be modelled and analysed using game theoretic tools, which in the last decades have become a powerful asset in solving problems that involve some sort of interaction. It also demonstrates that strict assumptions on which the theoretical models are built, are often not met in practice, because people are too heterogeneous and only boundedly rational. Third, it demonstrates how existing experimental findings can be used as a proxy to discuss and understand the actual compliance behaviour. In addition, the paper also summarizes the results of numerous studies on compliance behaviour, thus portraying the general situation in Europe in the early phases of COVID-19.

The paper has the following structure: after this introduction, section 2 reviews several studies that investigated compliance with recommendations in the early phases of the coronavirus outbreak. I focus exclusively on European countries, as they were the centre of attention in the early stages. Having portrayed the situation in Europe, I proceed to the next purpose of this article which is first to demonstrate how people's behaviour in the early phases of the coronavirus outbreak can be translated into a game theoretic framework (section 3), and then to illustrate, using the existing theoretical and empirical evidence, to what outcome could non-compliance potentially lead (section 4). Section 5 is reserved for short discussion and section 6 concludes the article.

COVID-19 U EUROPI

Smrtonosni koronavirus, koji uzrokuje bolest koronavirusa 2019 (COVID-19), stigao je u Europu u drugoj polovini siječnja 2020. (Stoecklin i sur., 2020; Olsen i sur., 2020) i brzo se proširio Europom. Poseban problem u početnim fazama bio je samo djelomično pridržavanje preventivnih mjera, što je omogućilo brže širenje virusa. Kako bi procijenili stope pridržavanja i identificirali potencijalne pokretače ponašanja u pogledu pridržavanja mjera, istraživači su proveli brojna istraživanja diljem Europe. Pregled nekih od tih istraživanja nalazi se u nastavku.

Započinjemo studijom iz Italije (Barari i sur., 2020), koja je izvijestila o relativno visokim stopama pridržavanja mjera, što se barem djelomično može pripisati činjenici da su do trenutka istraživanja (sredina ožujka 2020.) ispitanici već doživjeli negativne emocije, jer je Italija već bila teško pogođena virusom. Također je otkriveno da su mlađe odrasle osobe poštivale mjere socijalnog distanciranja i higijene znatno manje od ostalih dobnih skupina (iako su stope pridržavanja još uvijek bile iznad 78%). Studija je dodatno istražila pridržavanje karantene i utvrdila da ispitanici rijetko napuštaju kuću iz "nebitnih" razloga, kao što su dosada ili sastanak s prijateljima. Ali opet, mladi su oni s najvećim postotkom "nebitnih" razloga. Studija iz Francuske (Brouard i sur., 2020) također je otkrila da je pridržavanje mjera u pozitivnoj korelaciji s dobi. Uočen je i rodni učinak, jer je manja vjerojatnost da će muškarci promijeniti svoje ponašanje zbog pandemije bolesti COVID-19. Slične rodne i dobne učinke utvrdili su i Roozenbeek i sur. (2020), koji su ispitali Irsku, Veliku Britaniju i Španjolsku (osim SAD-a i Meksika).[1] Motivirani nalazima prethodnih studija, uključujući Barari i sur. (2020), Nivette i sur. (2021) proveli su istraživanje u Švicarskoj, koje se usredotočilo isključivo na mlade odrasle osobe. Izvijestili su o relativno visokoj ukupnoj stopi pridržavanja, pri čemu su se ispitanici pridržavali mjera socijalnog distanciranja više nego

COVID-19 IN EUROPE

The deadly coronavirus, causing a coronavirus disease 2019 (COVID-19), reached Europe in the second half of January 2020 (Stoecklin et al., 2020; Olsen et al., 2020, among others) and has since then rapidly spread across Europe. One problem in the initial phases was only partial compliance with preventive measures which enabled the virus to spread faster. To estimate compliance rates and identify potential drivers of compliance behaviour, researchers conducted numerous studies across Europe, several of which are reviewed below.

We begin with the study from Italy (Barari et al., 2020) that reported relatively high compliance rates, which can be at least partially attributed to the fact that by the time of the survey (mid-March 2020) respondents have already experienced negative emotions, as Italy had already been hit hard by the virus. It also revealed that younger adults complied with social distancing and hygiene measures significantly less than the other age groups (although compliance rates were still above 78%). The study further investigated compliance with the quarantine and found that respondents rarely left house for "non-essential" reasons such as boredom or meeting with friends. But again, young adults were those with the highest percentage of "non-essential" reasons. The study from France (Brouard et al., 2020) also discovered that compliance with measures is positively correlated with age. There was also a gender effect with men less likely to make changes in their behaviour due to COVID-19. Similar gender and age effects were also found by Roozenbeek et al. (2020) who examined Ireland, UK, and Spain (besides USA and Mexico).[1] Motivated by the findings of previous studies, including that of Barari et al. (2020), Nivette et al. (2021) conducted a study in Switzerland focusing exclusively on young adults. They reported a relatively high overall compliance rate, with respondents following social distancing measures more likely than hygiene measures. Regarding the latter, authors also revealed that respondents

higijenskih mjera. Kada je riječ o potonjem, autori su također otkrili da su se ispitanici pridržavali nekih higijenskih mjera, poput redovnog pranja ruku, znatno više nego drugih (npr. dezinfekcija mobitela). Kod određenih mjera su također utvrdili razliku u spolu, pri čemu su žene bile sklonije slijediti preporuke od muškaraca. Važan čimbenik povezan s nepoštivanjem socijalnog distanciranja bilo je nepovjerenje u vlasti. Za razliku od gore navedenih studija, međunarodna studija Clark i sur. (2020), koja je uključivala različite jezične skupine (engleski, francuski, njemački, talijanski, portugalski, španjolski i mandarinski), utvrdila je da dob nije važan čimbenik pridržavanja zdravstvenih mjera opreza. Međutim, utvrdili su da se rezultati u vezi s ponašanjem u pogledu zdravstvenih mjera opreza znatno razlikuju između određenih jezičnih skupina, pri čemu ispitanici koji govore talijanski, francuski i španjolski češće poduzimaju zdravstvene mjere opreza nego ispitanici koji govore engleski i njemački jezik. Također, žene su češće poduzimale zdravstvene mjere nego muškarci.

U drugom međunarodnom istraživanju, provedenom sredinom ožujka 2020. godine, kada je situacija u Italiji bila puno lošija nego u Nizozemskoj i Njemačkoj, Meier i sur. (2020) utvrdili su da ispitanici u Nizozemskoj, Njemačkoj i Italiji nisu primjenjivali osobno zaštitno ponašanje na istoj razini, što bi moglo ukazivati na to da su ljudi iz zemalja koje su u početku bile "sigurnije od COVID-a" možda podcijenili učinke koronavirusa dok nije bilo prekasno.[2] Doista, Rieger (2020a) je utvrdio da u Njemačkoj u ranim fazama bolesti COVID-19 mnogi ispitanici ne bi nosili masku za lice na ulici ako to nije zakonski propisano[3], dok se u Portugalu prije proglašenja izvanrednog stanja[4] samo oko 20% ispitanika pridržavalo preventivnih mjera socijalne izolacije (Valente de Almeida i sur., 2020). Dodatni dokazi koji pokazuju da se ljudi nisu u potpunosti pridržavali zdravstvenih smjernica došli su iz Engleske (Freeman i sur., 2020), Irske, Velike Britanije, Španjolske (Roozenbeek i sur., 2020, dopunski materijal, tablica S5) i Srbije (Teovanović i sur., 2020).

adhered to some hygiene measures such as regular hand washing substantially more than to others (e.g., disinfection of mobile phones). For certain measures they also found gender difference, with females following the recommendations more likely than males. An important factor that was associated with social distancing non-compliance was mistrust in authorities. Unlike the above studies, the international study by Clark et al. (2020) that included different language speaking groups (i.e., English, French, German, Italian, Portuguese, Spanish and Mandarin) found that age is not an important factor of health precaution behaviour. They did find, however, that results regarding the health precaution behaviour significantly differed between certain language groups, with Italian, French and Spanish speaking subjects taking health precautions more likely than English and German speaking subjects. Also, women were more likely than men to take health precautions.

In another international survey conducted in mid-March 2020, when the situation in Italy was much worse than in the Netherlands and Germany, Meier et al. (2020) found that respondents in the Netherlands, Germany and Italy did not apply personal protective behaviours at the same level, which could indicate that people from the countries that were initially more "COVID-safe", may have underestimated the effects of the coronavirus until it was too late.[2] Indeed, Rieger (2020a) found that in Germany in the early phases of COVID-19 many respondents would not wear a face mask in the street if it were not legally required,[3] while in Portugal before the state of emergency was declared,[4] only around 20% of respondents adhered to preventive social isolation measures (Valente de Almeida et al., 2020). Further evidence showing that people did not fully adhere to health guidance measures came from England (Freeman et al., 2020), Ireland, UK, Spain (Roozenbeek et al., 2020, supplementary material, table S5) and Serbia (Teovanović et al., 2020). For example, Freeman et al. (2020) reported that approximately 20% of respondents only partially followed government

Na primjer, Freeman i sur. (2020) su izvijestili da je otprilike 20% ispitanika samo djelomično slijedilo smjernice vlade, dok su Teovanović i sur. (2020) izvijestili da je više od 20% ispitanika napustilo svoju kuću iz "nebitnog" razloga više od tri puta u protekla dva tjedna.

Postoje i studije koje su istraživale vezu između osobina ličnosti i pridržavanja mjera. Studija iz Poljske (Zajenkowski i sur., 2020) izvijestila je o relativno visokoj stopi pridržavanja i utvrdila da osobine ličnosti i percepcija pojedinaca o situaciji COVID-19 oblikuju razine pridržavanja. Što se tiče percepcije pojedinaca, autori su utvrdili da su oni koji su situaciju vidjeli kao negativnu više slušali savjete, a oni koji su to vidjeli kao romantičnu priliku manje su se pridržavali savjeta. Što se tiče osobina ličnosti, pridržavanje mjera je pozitivno koreliralo s prilagodljivošću i negativno s određenim osobinama "mračne trijade" (tj. makijavelizmom, određenim čimbenicima psihopatije, narcizmom; vidi također Paulhus i Williams, 2002). Osobine ličnosti ispitane su i u spomenutoj studiji iz Francuske (tj. Brouard i sur., 2020) te je utvrđeno da je pridržavanje pozitivno koreliralo sa savjesnošću, a negativno s ekstrovertnošću. Dodatno su pronašli pozitivnu korelaciju sa strahom i negativnu korelaciju s ideološkim ekstremizmom. Kao što je vidljivo iz rada Pfattheichera i sur. (2020), empatija također može imati pozitivan učinak na stope pridržavanja mjera.

Na temelju prezentiranih rezultata, čini se da su barem na početku epidemije koronavirusa određene skupine ljudi bile neupućenije ili nisu bile svjesne ozbiljnosti situacije te stoga nisu bile dovoljno motivirane da stalno peru ruke, nose maske, održavaju socijalnu distancu i smanje kupovinu i okupljanja.[5] Ove preventivne mjere su "psihološki" skupe, ali bi pomogle u suzbijanju širenja koronavirusa. Međutim, postoji još jedan čimbenik koji može negativno utjecati na poštivanje mjera COVID-19 (diljem Europe), a to je vjerovanje u teorije zavjere povezane s COVID-19 (vidi Freeman i sur., 2020; Imhoff i Lamberty, 2020; Pavela Banai i sur., 2020; Rieger,

guidance, while Teovanović et al. (2020) reported that more than 20% of respondents have left their house for a "non-essential" reason more than three times in the past two weeks.

There are also studies that investigated the connection between personality traits and compliance behaviour. The study from Poland (Zajenkowski et al., 2020) reported a relatively high rate of compliance and found that personality traits and individuals' perception of the COVID-19 situation shape the levels of compliance. Regarding the individuals' perception, authors found that those who saw the situation as negative complied more with the advice and those who saw it as a romantic opportunity complied less with the advice. Regarding personality traits, compliance correlated positively with agreeableness and negatively with certain Dark Triad traits (i.e., Machiavellianism, certain psychopathy factors, narcissistic rivarly; see also Paulhus & Williams, 2002). The above-mentioned study from France (i.e., Brouard et al., 2020) examined personality traits too, and found that compliance correlated positively with conscientiousness and negatively with extraversion. They additionally found positive correlation with fear and negative correlation with ideological extremity. As evidenced by Pfattheicher et al. (2020), empathy may also have a positive effect on compliance rates.

Based on the presented findings, it seems that at least in the beginning of the coronavirus outbreak certain groups of people were more ignorant or not aware of the seriousness of the situation and hence were not motivated enough to constantly wash hands, wear masks, maintain social distance and reduce shopping and gatherings.[5] These preventive measures are "psychologically" costly, but would help curb the spread of coronavirus. There is, however, another factor that may negatively affect compliance with COVID-19 measures (across Europe), namely belief in COVID-19 related conspiracy theories (see Freeman et al., 2020; Imhoff & Lamberty, 2020; Pavela Banai et al., 2020; Rieger, 2020b;

2020b; Roozenbeek i sur., 2020; Teovanović i sur., 2020; Constantinou i sur., 2021).

U ovom se odjeljku preispituje pridržavanje mjera ponašanja u Europi. Glavno je opažanje da su se ljudi općenito – barem prema vlastitim tvrdnjama – pridržavali preporuka i mjera, ali ne u punoj mjeri, i ne svi u istoj mjeri. Iako su ukupni rezultati istraživanja o bolesti COVID-19 obećavajući, treba ih uzeti s oprezom, jer mogu biti podložne pristranosti socijalne poželjnosti, kao što su istaknuli, npr., Barari i sur. (2020).[6] U sljedećim odjeljcima prvo formuliram problem usklađenosti COVID-19 s modelom teorije igara, a zatim demonstriram do čega naizgled bezazlena niska početna neusklađenost može dovesti.

MODEL

Kako bih demonstrirao sukob interesa pojedinaca i interesa društva, koristim vrlo jednostavni model teorije igara u kojoj pojedinci donose odluke tijekom vremena, koje utječu ne samo na njih, već i na druge članove društva. Konkretno, pretpostavljam da je u nekim slučajnim trenucima svaki pojedinac uparen s jednim nasumično odabranim članom društva koji je u tom trenutku u blizini. Radi jednostavnosti, pretpostavljam da su svi pojedinci uvijek upareni i da je društvo razumno veliko, tako da su 1) upareni subjekti uvijek stranci jedni drugima[7] i 2) vjerojatnost susreta s istim strancem je vrlo mala. U svakom trenutku, upareni pojedinci istodobno i neovisno odlučuju hoće li *slijediti* ili *ignorirati* preporuke nadležnih tijela. Međusobni dogovori u cilju poticanja određenog izbora nisu dopušteni. Donesene odluke odnose se na oba spojena pojedinca. Pridržavanje preporuka je skupo, jer zahtijeva od pojedinca da uloži određeni napor $c > 0$ (npr. pravilno nošenje maske za lice, održavanje distance, pranje ruku), ali je korisno za drugu stranu, čije su šanse za dobivanje koronavirusa smanjene. Neka korist bude $b > c$. Ignoriranje savjeta nije skupo za pojedinca ni korisno za drugu

Roozenbeek et al., 2020; Teovanović et al., 2020; Constantinou et al., 2021).

This section reviewed compliance with behavioural measures in Europe. The main observation is that people in general – at least according to self-reports – complied with the recommendations and measures but not to the full extent and not everyone to the same degree. Although overall COVID-19 survey results are promising, they should be taken with caution, as they may suffer from social desirability bias, as highlighted, e.g., by Barari et al. (2020).[6] In the following sections I first formulate the problem of COVID-19 compliance with a game theoretic model and then demonstrate what a seemingly innocuous low initial non-compliance could lead to.

MODEL

To demonstrate the conflict between individuals' interests and interests of society I use a very simple game theoretic setting where individuals make decisions over time that affect not only them but also other members of society. In particular, I assume that at some random times each individual is paired with one randomly chosen member of the society that is in that moment nearby. For simplicity, I assume that all individuals are always paired, and that the society is reasonably large, so that 1) paired subjects are always strangers to each other,[7] and 2) the probability of meeting the same stranger is very small. At each time, paired individuals simultaneously and independently decide whether to *follow* or *ignore* the recommendations given by the authorities. Binding agreements to enforce specific choices are not allowed. The decisions made affect both paired individuals. Following the recommendations is costly, as it requires the individual to put some effort $c > 0$ into it (e.g., wearing a face mask properly, maintaining distance, washing hands), but is beneficial for the other party whose chances of getting the coronavirus are reduced. Let the benefit be $b > c$. Ignoring the advice is neither costly for

stranu. "Psihološke" vrijednosti koje odgovaraju odluci pojedinca sažete su u Tablici 1.

Budući da oba uparena pojedinca donose odluke, njihove konačne psihološke vrijednosti (po jednom periodu) određene su odlukama obojice. Ukupno postoje četiri moguća scenarija, tj. oba slijede; oba ignoriraju; ili jedan slijedi, a jedan ignorira preporuke.

Opisana strateška situacija može se prikazati sljedećom tablicom, Tablicom 2.[8] U literaturi se to ponekad naziva i *donacijskom igrom* (vidi, na primjer, Hilbe i sur., 2013), a poseban je slučaj poznate *igre dileme zatvorenika*. Nakon donošenja svih odluka, pojedinci promatraju ishod svoje posljednje interakcije, a zatim se ponovno uključuju u donacijsku igru s (drugom) nasumično odabranom osobom.

Kao i mnoge druge krize, kriza s koronavirusom donijela je puno neizvjesnosti. Neizvjesnost se može ugraditi u model putem parametra $\delta \in (0,1)$, a to je vjerojatnost da se kriza uzrokovana koronavirusom nastavi ili vjerojatnost da koronavirus ostane prisutan u populaciji. Budući da je praćenje drugih i praćenje njihove reputacije kognitivno zahtjevno, posebno tijekom korona krize, izgradnja reputacije nije moguća u ovom modelu.

Zaključujem odjeljak 3 uvođenjem igre slične donacijskoj igri, tj. *igre pomaganja*, koja se također proučava u literaturi (vidi Nowak i Sigmund, 1998a; Wedekind i Milinski, 2000; Seinen i Schram, 2006; Ule i sur., 2009), a također će se razmatrati u odjeljku 4. Razlika

the individual nor beneficial for the other party. The "psychological" values corresponding to the individual's decision are summarized in Table 1.

Since both paired individuals make decisions, their final (per-period) psychological values are determined by the decisions of both. In total there are four possible scenarios, i.e., both follow; both ignore; and one follows, one ignores the recommendations.

The described strategic situation can be represented by the following Table 2.[8] In the literature it is sometimes called the *donation game* (see, for example, Hilbe et al., 2013), and it is a special case of the famous *prisoner's dilemma game*. After all decisions are made, individuals observe the outcome of their last interaction and then engage in the donation game again with (another) randomly chosen individual.

Like many other crises, the coronavirus crisis has brought a lot of uncertainties. The uncertainty can be incorporated into the model through the parameter $\delta \in (0,1)$ which is the probability that the coronavirus crisis continues or the probability that the coronavirus remains present in the population. Since monitoring others and keeping track of their reputations is cognitively demanding, especially during the coronavirus crisis, reputation building is not possible in this model.

I conclude section 3 by introducing a game similar to the donation game, i.e., the *helping game*, which is also studied in the literature (see Nowak & Sigmund, 1998a; Wedekind & Milinski, 2000; Seinen & Schram, 2006; Ule et al., 2009, among

TABLICA 1. PSIHOLOŠKE VRIJEDNOSTI / TABLE 1. PSYCHOLOGICAL VALUES

		POJEDINAC INDIVIDUAL	DRUGA STRANA OTHER PARTY
Odluka pojedinca / Individual's Decision	Prati / Follow	$-c$	b
	Zanemaruje / Ignore	0	0

TABLICA 2. DONACIJSKA IGRA / TABLE 2. THE DONATION GAME

		POJEDINAC 2 / INDIVIDUAL 2	
		Prati / Follow	Zanemaruje / Ignore
POJEDINAC 1 / INDIVIDUAL 1	Prati / Follow	$b - c, b - c$	$-c, b$
	Zanemaruje / Ignore	$b, -c$	0, 0

Napomena: Redci (stupci) odgovaraju mogućim izborima pojedinca 1 (2). U svakoj ćeliji prvi broj odgovara psihološkim vrijednostima pojedinca 1, a drugi psihološkim vrijednostima pojedinca 2.
Note: The rows (columns) correspond to the possible choices of Individual 1 (2). In each cell, the first and second number correspond to the psychological values of Individual 1 and 2, respectively.

između donacijske igre i igre pomoći je u tome što u potonjoj igri samo jedan od uparenih pojedinaca (*donositelj odluka*) donosi odluku, dok je drugi pojedinac (*primatelj*) pasivan. U igri pomaganja, izbor donositelja odluke izravno određuje konačne psihološke vrijednosti obaju spojenih pojedinaca – navedene su u Tablici 1. U ovom slučaju Tablica 1 u biti predstavlja igru pomoći. Donacijska igra može se smatrati igrom pomaganja koja se igra u obje uloge (tj. kao donositelj odluke i primatelj) istodobno. Budući da su te dvije igre slične, ovaj članak pokušava objasniti ljudsko ponašanje tijekom epidemije koronavirusa koristeći uvide iz literature koja proučava jednu ili drugu igru.

POSTOJEĆI DOKAZI

Teorijski dokazi

Važna značajka donacijske igre i općenito igre dileme zatvorenika jest da su interesi pojedinaca u sukobu s interesima društva. Da biste to vidjeli, pod pretpostavkom da se igra samo jednom, odredite odluku druge strane i primijetite da je svakom pojedincu bolje ignorirati preporuke.[9] Budući da oboje radije ignoriraju preporuke nego da ih slijede, bez obzira što onaj drugi radi, na kraju oboje završavaju s psihološkim vrijednostima 0. Međutim, u slučaju mogućeg obvezujućeg sporazuma, obama

others) and will also be considered in section 4. The difference between the donation and helping game is that in the latter game only one of the paired individuals (*a decision maker*) makes a decision while the other individual (*a receiver*) is passive. In the helping game, the choice made by the decision maker directly determines the final psychological values of both paired individuals – these are listed in Table 1. Note that in this case Table 1 essentially represents the helping game. The donation game can be thought of as the helping game played in both roles (i.e., as the decision maker and the receiver) simultaneously. Since the two games are similar, this article attempts to explain human behaviour during the coronavirus outbreak using insights from the literature that studies either one or the other game.

EXISTING EVIDENCE

Theoretical evidence

An important feature of the donation game, and prisoners' dilemma games in general, is that individuals' interests conflict with the interests of society. To see this, suppose the game is played only once, fix the decision of the other party, and observe that each individual is always better off ignoring the recommendations.[9] Since both prefer to ignore the recommendations than to follow them, regardless

bi bilo bolje da primijene socijalno optimalnu odluku o pridržavanju preporuka. Dakle, ako se igra samo jednom, ishod je prilično negativan. Međutim, u stvarnom životu ljudi se svakodnevno susreću i komuniciraju sa strancima, i to ne samo jednom u životu. Kao što je prikazano u nastavku, ako članovi društva više puta sudjeluju u takvim dijadnim situacijama, onda ishod može biti pozitivniji.

Jedna od pretpostavki modela formuliranog u odjeljku 3 je pretpostavka velike populacije, koja jamči da je vjerojatnost interakcije s istim neznancem vrlo mala. To se čini razumnom pretpostavkom, s obzirom na to da čak i u malim europskim zemljama, kao što je Slovenija, najveći gradovi imaju više od 25 000 stanovnika (Statistički ured Republike Slovenije, 2021), što je znatno više od veličina uzoraka koje se koriste u računalnim simulacijama (npr. Nowak i Sigmund, 1998a; Leimar i Hammerstein, 2001) ili laboratorijskim eksperimentima (npr. Seinen i Schram, 2006; Ule i sur., 2009). Budući da model pretpostavlja ponovljene susrete unutar populacije, a ne između iste dvije osobe, osobna primjena (izravni reciprocitet) ne funkcionira. Ni primjena zajednice (neizravni reciprocitet) na temelju ugleda pojedinca ne funkcionira, jer pojedinci, prema pretpostavci, ne uspijevaju uspostaviti sustav ugleda. Međutim, ta postavka može dovesti do 1) neizravnog reciprociteta na temelju prošlih iskustava i 2) primjenu u zajednici na temelju zaraznih kazni, gdje kažnjavanje – u tom kontekstu, namjerno nekooperativno djelovanje – provodi pojedinac koji ima iskustva s nekooperativnim ponašanjem u prošlosti. U ostatku ovog poglavlja razrađujem neke poznate teorijske rezultate. Prije toga, vrijedno je spomenuti da standardna literatura koristi pojmove *(C)ooperate* i *(D)efect* (ili *(H)elp* i *(P)ass* u igri pomaganja) za opis društveno poželjnih i nepoželjnih odluka, koje u kontekstu bolesti COVID-19 odgovaraju *pridržavanju* i *ignoriranju*.

Beskrajno ponavljane igre dileme zatvorenika sa slučajnim podudaranjem i bez prijenosa

of what the other does, they eventually both end with psychological values of 0. If, however, a binding agreement were possible, then both would be better off by enforcing the socially optimal decision to follow the recommendations. So, if the game is played only once, the outcome is rather negative. In real life, however, people meet and interact with strangers daily and not just once in a lifetime. As shown below, if members of a society repeatedly engage in such dyadic situations, then the outcome may be more positive.

One of the assumptions of the model formulated in section 3 is the large population assumption which guarantees that the probability of interacting with the same stranger is very small. This seems a reasonable assumption, given that even in small European countries, such as Slovenia, the largest cities have more than 25.000 inhabitants (Statistical Office of the Republic of Slovenia, 2021) which is substantially more than the population sizes used in computer simulations (e.g., Nowak & Sigmund, 1998a; Leimar & Hammerstein, 2001) or laboratory experiments (e.g., Seinen & Schram, 2006; Ule et al., 2009). Since the model assumes repeated encounters within a population and not between the same two individuals, personal enforcement (direct reciprocity) does not work. Neither does community enforcement (indirect reciprocity) based on reputation work, as individuals, by assumption, fail to establish a reputation system. This setting may, however, give rise to 1) indirect reciprocity based on past experience, and to 2) community enforcement based on contagious punishment, where punishment – in this context, an intentional uncooperative act – is carried out by an individual who experienced uncooperative behaviour in the past. In the remainder of this section, I elaborate on some well-known theoretical results. Before that, it is worth mentioning that the standard literature uses the terms *(C)ooperate* and *(D)efect* (or *(H)elp* and *(P)ass* in helping game) to describe socially desirable and undesirable actions, which in COVID-19 context correspond to *follow* and *ignore*.

informacija teoretski su najprije proučavali Kandori (1992) i Ellison (1994), a odnedavno i Camera i Gioffré (2018).[10] Ovi radovi istražuju može li suradnja potrajati dulje vrijeme u takvom neprijateljskom okruženju i pod kojim uvjetima te je li moguće uspostaviti rezultate tipa Folk teorema. Naša polazišna točka je Ellison (1994, Prijedlog 4, str. 582), gdje autor generalizira Kandorijev (1992) prvi rezultat (Kandori, 1992, Teorem 1, str. 69) o *bilo kojoj* igri dileme zatvorenika.[11] Naime, tretirajući cijelu ponovljenu igru kao raskomadani savez "mini-igara" – u slučaju k mini-igara, r-ta mini-igra se odvija u razdobljima r, $k + r$, $2k + r$..., gdje je $r \in \{1,...,k\}$ – autor pokazuje da se suradnja može održati u svakoj igri dileme zatvorenika ako je δ dovoljno visok te svi koriste strategiju okidača sličnu onoj koju je definirao Kandori (1992), koja se oslanja na zarazne kazne.[12] Ova strategija proskribira suradnju u početnoj fazi svake mini-igre. Zatim, u svakoj mini-igri, ona proskribira suradnju tek nakon što su oba uparena pojedinca surađivala, a u protivnom nekooperativno ponašanje (tj. nesuradnje).[13] Rezultat da se suradnja može održati je obećavajuć, jer sugerira da bi u situaciji bolesti COVID-19 društva mogla zadržati visoke stope pridržavanja mjera (bez ikakvih medicinskih ili vladinih intervencija) ako svi usvoje strategiju okidača. Nažalost, kao što je govorio Ellison (1994), model može imati ograničenu uporabu u praksi zbog određenih strogih pretpostavki. Naime, kao i modeli Kandorija (1992) i Camere i Gioffréa (2018), on se i dalje oslanja na klasične pretpostavke teorije igara, kao što su opće znanje i (sekvencijalna) racionalnost. Štoviše, pojedinci moraju zapamtiti u kojoj su mini-igri i jesu li već doživjeli nesuradnju u toj mini-igri, što je još jedan kognitivno zahtjevan zadatak. Ideja iza zaraznih strategija je da, ako ih svi usvoje, suradnja se održava, inače se nekooperativno ponašanje širi populacijom kao virus. U oba slučaja, kod Kandorija (1992) i Ellisona (1994), čim se pretpostavi da postoji pojedinac koji koristi "iracionalnu" nekooperativnu strategiju, kao što je *nikad ne surađuj*, ili ako jedan unosi buku u

Infinitely repeated prisoners' dilemma games with random matching and no information transmission have been theoretically studied first by Kandori (1992) and Ellison (1994) and more recently by Camera and Gioffré (2018).[10] These papers investigate if and under what conditions cooperation can persist over time in such hostile environments and establish Folk theorem-type results. Our point of departure is Ellison (1994, Proposition 4, p. 582), where the author generalizes Kandori's (1992) first result (Kandori, 1992, Theorem 1, p. 69) to *any* prisoner's dilemma game.[11] Namely, by treating the whole repeated game as a disjoint union of "minigames" – in the case of k minigames, the r-th minigame takes place in periods r, $k + r$, $2k + r$..., where $r \in \{1,...,k\}$ – the author shows that cooperation can be sustained in any prisoner's dilemma game if δ is sufficiently high and everyone uses a trigger strategy similar to that defined by Kandori (1992) that relies on contagious punishments.[12] This strategy prescribes cooperation in the initial period of each minigame; Then, in each minigame, it prescribes cooperation only after both paired individuals have cooperated, and uncooperative behaviour (i.e., defection) otherwise.[13] The result that cooperation can be sustained is promising, because it suggests that in the COVID-19 situation societies could maintain high compliance rates (without any medical or government interventions) if everyone adopts trigger strategies. Unfortunately, as discussed by Ellison (1994), the model may be of limited use in practice due to some of its stringent assumptions. Namely, like models of Kandori (1992) and Camera and Gioffré (2018), it still relies on classical game-theoretic assumptions such as common knowledge and (sequential) rationality. Moreover, individuals must remember in which minigame they are and if they had experienced defection in that minigame before, which is another cognitively demanding task. The idea behind the contagious strategies is that if everyone adopts them then cooperation is sustained, otherwise uncooperative behaviour spreads throughout the population like a virus. In both, Kandori (1992) and Ellison (1994), as soon

model, onda, budući da kazne traju zauvijek, stope suradnje bi počele padati i postupno se približavati nuli. U kontekstu bolesti COVID-19 to znači da bi nisko početno nepridržavanje preventivnih mjera na kraju dovelo do potpunog nepridržavanja.

Novija studija, čiji je autor Dilmé (2016) premošćuje pitanje "iracionalnog pojedinca" razmatranjem strategija koje podsjećaju na strategije "milo za drago", a koje propisuju, uz vjerojatnost blizu vrijednosti jedan, suradnju (nesuradnju) nakon igranja ili iskustva suradnje (nesuradnje). Koristeći ove strategije, Dilmé (2016) pokazuje da se suradnja ili pomoć mogu održati u ponovljenim igrama pomoći i donacija čak i u prisutnosti bezuvjetnih defektora koji nikada ne surađuju (pomažu). Ponovljene igre pomoći (sa slučajnim uparivanjem i bez prijenosa informacija) također proučavaju Camera i Gioffré (2019), koji pružaju još jedan zanimljiv uvid. Pod teorijskim pretpostavkama klasične igre, oni prvo teoretski pokazuju da strategije okidača mogu podržati suradnju i u ovoj igri. Zatim ispituju jesu li te strategije u skladu s eksperimentalnim podacima iz rada Camere i Casarija (2014), ali ne pronalaze uvjerljive dokaze da takve strategije koristi većina, što ih motivira da konstruiraju jednostavan model ponašanja koji održava djelomičnu suradnju i bolje objašnjava podatke. U tom modelu razmatraju dvije vrste pojedinaca: racionalne maksimalizatore korisnosti, koji nikad ne surađuju ili koriste strategiju okidača, i bihevioralne pojedince, koji uvijek koriste istu strategiju – neki od njih su bezuvjetni suradnici/altruisti, a ostali su "opraštajući" kažnjavači, koji surađuju sve dok doživljavaju potpunu suradnju, a nakon toga ne surađuju s određenom pozitivnom vjerojatnošću. Rezultati istraživanja Dilméa (2016) i Camere i Gioffréa (2019) robusniji su od rezultata gore navedenih radova i podrazumijevaju da bi opće pridržavanje preporuka u vezi COVID-a 19 moglo ostati relativno visoko čak i u prisutnosti male skupine pojedinaca koji ih uvijek ignoriraju.

Da rezimiramo, teorija sugerira da bi bilo moguće održavati visoke stope pridržavanja tijekom korona

as one assumes that there is an individual using an "irrational" uncooperative strategy, such as *never cooperate*, or if one introduces noise, then, since punishments last forever, cooperation rates would start to fall and gradually approach zero. In the context of COVID-19 this means that a low initial non-compliance with preventive measures would eventually lead to full non-compliance.

A more recent study by Dilmé (2016) overcomes the "irrational individual" issue by considering strategies reminiscent of the *tit-for-tat* strategies which prescribe, with probability close to one, cooperation (defection) after playing or experiencing cooperation (defection). Using these strategies, Dilmé (2016) shows that cooperation or help can be sustained in repeated helping and donation games even in the presence of unconditional defectors who never cooperate (help). Repeated helping games (with random matching and no information transmission) are also studied by Camera and Gioffré (2019) who provide another interesting insight. Under classical game theoretic assumptions, they first show theoretically that trigger strategies can support cooperation in this game, too. Then they examine whether these strategies are consistent with the experimental data from Camera and Casari (2014) and find no convincing evidence that such strategies are used by the majority, which motivates them to construct a simple behavioural model that sustains partial cooperation and better explains the data. In that model they consider 2 types of individuals: rational utility maximizers, who either always defect or use trigger strategy; and behavioural individuals, who always use the same strategy – some of them are unconditional cooperators/altruists and the rest are "forgiving" punishers who cooperate as long as they experience full cooperation, and defect with some fixed positive probability thereafter. The results of Dilmé (2016) and Camera and Gioffré (2019) are more robust than those of the above-mentioned papers and imply that the overall compliance with COVID-19 recommendations could remain relatively high even in the presence of a small group of individuals who always ignore them.

krize čak i bez daljnjih intervencija, ali samo ako 1) populacija nije previše heterogena i ne sadrži previše defektora i 2) je sve o ljudima (npr. njihova uvjerenja i načini ponašanja) i virusu općepoznato. Međutim, dokazi iz odjeljka 2 upućuju na to da nijedan od ta dva uvjeta nije u potpunosti ispunjen, što upućuje na to da bi se bez daljnjih intervencija razina pridržavanja najvjerojatnije s vremenom smanjila.

Eksperimentalni dokazi

U prethodnom pododjeljku pregledali smo neke dobro poznate teorijske rezultate kako bismo bolje razumjeli gdje nas može dovesti nisko početno nepridržavanje preventivnih mjera. Ovaj pododjeljak pregledava nekoliko eksperimentalnih studija koje istražuju stvarno ljudsko ponašanje u situacijama u kojima su ljudi mogli pružiti dragocjenu pomoć. Nažalost, dokazi iz stvarnog života ne nude mnogo mogućnosti za učenje o strategijama pojedinaca, što znači da često dobivamo samo djelomične podatke ili podatke na nacionalnoj razini. Na primjer, možemo saznati u kojoj se mjeri određena zajednica priklanja željenom ponašanju (tj. pridržava se savjeta zdravstvenih vlasti), ali informacije o specifičnim prekršiteljima nikada se ne otkrivaju. Dakle, na temelju ukupnih podataka, općenito je vrlo teško procijeniti je li populacija homogena (tj. svi ignoriraju preporuke u sličnoj mjeri) ili heterogena (tj. neki ljudi su oprezni i pridržavaju se preporuka, dok ih drugi potpuno ignoriraju). Jedan od alternativnih načina za ispitivanje ponašanja pojedinaca su laboratorijski eksperimenti. Duffy i Ochs (2009), Camera i Casari (2009), Camera i sur. (2012) i Stahl (2013) istražuju ponašanje ispitanika u igrama dileme zatvorenika u ponovljenim igrama dileme zatvorenika sa slučajnim uparivanjem,[14] dok Bolton i sur. (2005), Seinen i Schram (2006), Camera i Casari (2014), Horita i sur. (2016), Camera i Gioffré (2019) te Ule i Velkavrh (2022) ispituju ponašanje ispitanika u ponovljenim igrama pomoći sa slučajnim uparivanjem. Opći zaključak u tim radovima je da je u nedostatku sustava ugleda[15] teško održati suradnju (pomoć) ako su troškovi

To summarize, the theory suggests that it would be possible to maintain high compliance rates during the coronavirus crisis even without further interventions, but only if 1) population is not too heterogeneous and in particular does not contain too many defectors, and 2) everything about people (e.g., their beliefs and modes of behaviour) and about the virus is common knowledge. The evidence from section 2, however, hints that neither of the two conditions is fully met, suggesting that without further interventions, the level of compliance would most likely decrease over time.

Experimental evidence

In the previous subsection we have looked at some well-known theoretical results to better understand where a low initial non-compliance with preventive measures could lead us to. This subsection reviews several experimental studies that investigate actual human behaviour in situations where people could provide costly help. Unfortunately, real life evidence does not offer many opportunities to learn about individuals' strategies, meaning that we often get only partial data or data on the national level. For example, we may learn to what degree a particular community conforms to the desired behaviour (i.e., complies with the advice given by the medical authorities), but information about particular violators is never disclosed. So, based on the overall data, it is in general very difficult to estimate whether the population is homogeneous (i.e., everyone is ignoring the recommendations to a similar degree) or heterogeneous (i.e., some people are cautious and comply with the recommendations, while others completely ignore them). One alternative way to examine individuals' behaviour is with laboratory experiments. Duffy and Ochs (2009), Camera and Casari (2009), Camera et al. (2012) and Stahl (2013) investigate subjects' behaviour in repeated prisoners' dilemma games with random matching,[14] while Bolton et al. (2005), Seinen and Schram (2006), Camera and Casari (2014), Horita et al. (2016), Camera and Gioffré (2019) and Ule and Velkavrh (2022) examine

suradnje ili pomoći razumno visoki. Na temelju te eksperimentalne literature bilo bi vrlo optimistično očekivati da će ljudi moći održati visoke stope pridržavanja bez daljnjih medicinskih i vladinih intervencija. Međutim, prosječne stope suradnje ili pomoći su iznad nule, osobito u prvom ponavljanju igre, što upućuje na to da ljudi u početku nisu koordinirani na nesuradnju.

Kao što je spomenuto u gornjem stavku, troškovi "ljubaznosti" su razumno visoki u tim eksperimentima, tako da je omjer troškova i koristi, *c/b*, relativno visok. Međutim, u kontekstu pandemije bolesti COVID-19, čini se da je omjer troškova i koristi nizak, budući da se pridržavanjem preventivnih mjera (koje se ne čine previše psihološki skupima) može spasiti nečiji život (što je ogromna korist). Što se tiče okruženja s niskim omjerom troškova i koristi, Bolton i sur. (2005) pokazuju da su visoke stope pomoći održive.

Nadalje, Camera i sur. (2012) te Ule i Velkavrh (2022) procjenjuju strategije pojedinaca u njihovim igrama sa slučajnim uparivanjem i utvrđuju da postoji široka heterogenost u strategijama. Heterogenost među pojedincima nalaze i Duffy i Ochs (2009). Najčešće strategije koje su zabilježili Camera i sur. (2012) su bezuvjetna suradnja, bezuvjetna nesuradnja i strategije koje uvjetuje iskustvo iz prošlosti, pri čemu su potonje dvije kategorije također najčešće kategorije kod Ulea i Velkavrha (2022). Dokaz da je vlastito iskustvo važno nalaze i Bolton i sur. (2005), Camera i Casari (2009) te Camera and Casari (2014).

U kontekstu pandemije bolesti COVID-19, ponašanje u skladu s iskustvom znači *pridržavanje preporuka ako ih se drugi pridržavaju*. Također treba naglasiti da i u takvom anonimnom okružju postoje neki bezuvjetni suradnici/altruisti, što znači – prevedeno u kontekstu COVID-19 – da možemo očekivati da će neki ljudi slijediti preporuke čak i ako ih većina ignorira.

Da rezimiramo, empirijski dokazi sugeriraju da bi bilo moguće održavati visoke stope pridržavanja

subjects' behaviour in repeated helping games with random matching. The general finding in these papers is that for reasonably high cooperation or helping costs it is difficult to sustain cooperation (help) in the absence of reputation systems.[15] Based on this experimental literature it would be very optimistic to expect people to be able to sustain high compliance rates without any further medical and government interventions. However, the average cooperation or helping rates are above zero, especially in the first round, suggesting that people do not initially coordinate on defection.

As mentioned in the above paragraph, the costs of being "nice" are reasonably high in those experiments, so that the cost-to-benefit ratio, *c/b*, is relatively high. However, in the context of COVID-19, the cost-to-benefit ratio seems to be low, since by adhering to preventive measures (which does not appear to be too psychologically costly) one can save someone's life (which is a huge benefit). As for an environment with low cost-to-benefit ratio, Bolton et al. (2005) shows that high helping rates can be sustained.

Furthermore, Camera et al. (2012) and Ule and Velkavrh (2022) estimate individuals' strategies in their respective random matching games and found that there is a wide heterogeneity in strategies. Heterogeneity among individuals is also found by Duffy and Ochs (2009). The most common strategies reported in Camera et al. (2012) are unconditional cooperation, unconditional defection and strategies that condition on past experience, with the latter two categories also being the most common categories in Ule and Velkavrh (2022). The evidence that one's experience matters is also found by Bolton et al. (2005), Camera and Casari (2009) and Camera and Casari (2014).

In the context of COVID-19, behaving according to experience means *following the recommendations if others follow them*. It should also be emphasized that even in such anonymous environments there are some unconditional cooperators/altruists, which means – translated to the context of COVID-19

mjera tijekom korona krize čak i bez daljnjih intervencija, ali samo ako je 1) omjer troškova i koristi nizak za sve i 2) populacija nema previše ljudi koji ne surađuju. Međutim, kao što je navedeno u studijama iz odjeljka 2, omjer troškova i koristi može biti relativno visok za neke članove populacije, što ukazuje na to da bi se bez daljnjih intervencija stope pridržavanja vjerojatno smanjile.

RASPRAVA

Izneseni dokazi ukazuju na to da bi bilo teško pobijediti virus bez daljnjih mjera i intervencija, pogotovo zato što su neki ljudi još uvijek povremeno izlazili iz nebitnih razloga (podsjetimo, npr. Barari i sur., 2020; Teovanović i sur., 2020). Jedan od mogućih načina da potaknete, ako ne i prisilite ljude da ostanu kod kuće je uvođenje nagrada za osobe koje se pridržavaju propisa i/ili novčanih kazni za one koji ih se ne pridržavaju. S teorijskog stajališta, to bi bilo učinkovito rješenje, jer (razumno visoke) nagrade i novčane kazne pretvaraju donacijsku igru (Tablica 2), koja obuhvaća sukob interesa pojedinaca i interesa društva, u igru u kojoj su interesi pojedinaca i društva usklađeni, a konačni ishod, gdje oboje slijede preporuke, je Pareto optimalan (Tablica 3).

Iz teorijske perspektive, ne postoji razlika između nagrade i novčane kazne sve dok su iste (tj., $r = -f$). Obje usmjeravaju pojedince prema poželjnom djelovanju. Iz praktične perspektive, može postojati razlika između nagrade i kazne. Prvo, u kriznim situacijama zbog pandemije bolesti COVID-19, čini se da je lakše identificirati osobe koje krše pravila nego osobe koje ih se pridržavaju, budući da su one prve izložene. Također se čini teže odrediti nagradu. Može li to biti naknada za plaće izgubljene zbog karantene, smanjenje poreza, ili možda obiteljski bon? Drugo, Kahneman i Tversky (1979) i Tversky i Kahneman (1991) sugeriraju da gubici imaju veći utjecaj na ljude od ekvivalentnih dobitaka (tj. koncept averzije prema gubicima), što u smislu sadašnjeg konteksta znači da kazne mogu imati

– that we can expect some people to follow the recommendations even if the majority ignore them.

To sum up, the empirical evidence suggests that it would be possible to maintain high compliance rates during the coronavirus crisis even without further interventions, but only if 1) the cost-to-benefit ratio is low for everyone and 2) population does not contain too many defectors. However, as hinted by studies from section 2, the cost-to-benefit ratio may be relatively high for some members of the society, indicating that without further interventions compliance rates would probably go down.

DISCUSSION

The presented evidence suggests that it would be difficult to defeat the virus without further measures and interventions, especially because some people were still occasionally going out for non-essential reasons (recall, e.g., Barari et al., 2020; Teovanović et al., 2020). One possible way to encourage, if not force, people to stay home is by introducing rewards for compliers and/or fines for non-compliers. From a theoretical point of view that would be an effective solution, as (reasonably high) rewards and fines convert the donation game (Table 2) that captures the conflict between the individuals' interests and those of society to the game where the interests of individuals and society are aligned and the final outcome, where both follow the recommendations, is Pareto optimal (Table 3).

From a theoretical perspective, there is no difference between the reward and fine paid as long as they are the same (i.e., $r = -f$). They both direct individuals towards the desirable action. From a practical perspective, there may be a difference between the reward and punishment. First, in the COVID-19 crisis it seems easier to identify violators than compliers, since the former are more exposed. It also seems harder to determine the reward. Could it be a compensation for lost wages due to quarantine, a tax reduction, or perhaps a family voucher? Second, Kahneman and Tversky

TABLICA 3. VARIJANTA DONACIJSKE IGRE / TABLE 3. A VARIANT OF A DONATION GAME

		POJEDINAC 2 / INDIVIDUAL 2	
		Prati / Follow	Zanemari / Ignore
POJEDINAC 1 / INDIVIDUAL 1	Prati / Follow	$b-c+r, b-c+r$	$-c+r, b-f$
	Zanemari / Ignore	$b-f, -c+r$	$-f, -f$

Napomena: Varijanta donacijske igre s nagradom $r \geq 0$ i novčanom kaznom $f \geq 0$. Pojedinac (strogo) preferira opciju pratiti ako je razlika između nagrade i troškova veća od plaćene kazne: $r - c > -f$. U slučaju samoizolacije, c može uključivati i izgubljene plaće, f psihološke troškove zatvora i r psihološku korist od primanja praktične potpore.

Note: A variant of the donation game with reward $r \geq 0$ and fine $f \geq 0$. An individual (strictly) prefers option follow if the difference between the reward and cost of following is greater than fine paid: $r - c > -f$. In the case of the self-quarantine, c may also incorporate lost wages, f psychological costs of imprisonment, and r psychological benefit from receiving practical support.

veći utjecaj na ukupne stope pridržavanja nego ekvivalentne nagrade. Treće, nagrade su skupe za vlasti, dok kazne nisu.

Kao što je vrijeme pokazalo, mnoge europske zemlje uvele su novčane kazne, neke čak i prijetile zatvorom, kao i ponuđene nagrade u obliku naknade za plaće izgubljene zbog karantene ili praktične podrške (npr. pružanje alternativnog smještaja, lijekova) (Patel i sur., 2021). Kao što je, na primjer, dokazano u radu Chae i Parka (2020), novčane kazne doista mogu smanjiti širenje bolesti.

ZAKLJUČAK

Studije diljem Europe pokazale su da je u ranoj fazi pandemije COVID-19 stopa pridržavanja ovisila o mnogim različitim čimbenicima, uključujući osobine ličnosti, spol, dob i vjerovanje u teorije zavjere, te su otkrile heterogenost među ljudima. Ovi rezultati, u kombinaciji sa spoznajama iz teorije igara i eksperimentalne ekonomije, ukazuju na to da uvjeti za održavanje suradnje (tj. potpunog pridržavanja mjera) nisu u potpunosti ispunjeni, što znači da bi bilo vrlo teško prevladati krizu bez restriktivnijih mjera i vladinih intervencija. Europske zemlje u početku su reagirale uvođenjem novčanih kazni za one koji se ne pridržavaju i

(1979) and Tversky and Kahneman (1991) suggest that losses have higher impact on people than equivalent gains (i.e., the concept of loss aversion), which in terms of the present context means that fines may have higher impact on overall compliance rates than equivalent rewards. Third, rewards are costly for authorities, while fines are not.

As time has shown, many European countries have imposed fines, some even threatened with imprisonment, as well as offered rewards in the form of a compensation for lost wages due to quarantine or practical support (e.g., provision of alternative accommodation, medication) (Patel et al., 2021). As evidenced, for example, by Chae and Park (2020) the fines may indeed reduce the spreading of the disease.

CONCLUSION

Studies across Europe have shown that in the early stages of COVID-19 compliance rates depended on many different factors, including personality traits, gender, age, and belief in conspiracy theories, and revealed heterogeneity among people. These results, combined with the insights from game theory and experimental economics, indicate that conditions for sustaining cooperation (i.e., full compliance) were not fully met, meaning that it would be very difficult

nagrada za one koji se pridržavaju mjera, potonjih u obliku naknada za plaće izgubljene zbog karantene i/ili praktične potpore, kao što je pružanje alternativnog smještaja. Dvije godine kasnije virus je još uvijek prisutan, ali čini se da su te intervencije, zajedno s kasnijim programima cijepljenja, znatno usporile širenje i spasile mnoge živote.

to overcome the crisis without more restrictive measures and government interventions. European countries initially responded by imposing fines for non-compliers and rewards for compliers, the latter in the form of compensations for lost wages due to quarantine and/or practical support, such as the provision of alternative accommodation. Two years later, the virus is still present, but these interventions, coupled with vaccination programmes developed later, appear to have substantially slowed the spread and saved many lives.

BILJEŠKE

[1] U Španjolskoj je bio prisutan samo rodni efekt.

[2] Međutim, u travnju su također zabilježene više stope usklađenosti u Nizozemskoj (Kuiper i sur., 2020).

[3] Ipak, vjerojatnije bi je nosili u autobusu i zrakoplovu, u samoposluživanju ili na fakultetu.

[4] Prvo istraživanje bilo je provedeno 13. ožujka.

[5] Drugi mogući razlog za podcjenjivanje učinaka koronavirusa mogao bi biti to što ljudi pogrešno percipiraju rast virusa kao linearan, a ne eksponencijalan (Lammers i sur., 2020).

[6] Međutim, to nije uvijek slučaj (vidi, npr., Larsen i sur., 2020).

[7] Umjesto da se pojedinac uzme kao neovisna cjelina, može se uzeti par ili troje srodnih istomišljenika kao jednu neovisnu cjelinu i zatim razmotriti interakcije između tih grupa umjesto pojedinaca. Ono što je bitno jest to da su u oba slučaja razmatrane interakcije dijadne.

[8] Unosi u Tablici 2, npr. u gornjoj desnoj ćeliji, mogu se protumačiti na sljedeći način: ako pojedinac 1 slijedi preporuke, a pojedinac 2 ih ignorira, tada su psihološke vrijednosti pojedinca 1 $-c$ (trošak c zbog vlastite odluke, plus korist 0 zbog odluke pojedinca 2), dok su psihološke vrijednosti pojedinca 2 b (trošak 0 zbog vlastite odluke, plus korist b zbog odluke pojedinca 1).

[9] Ako druga strana slijedi preporuke, psihološke vrijednosti pojedinca su b ako ih ignorira, a niže, $b - c$, ako ih slijedi. Slično, ako druga strana ignorira preporuke, psihološke vrijednosti pojedinca su 0 ako ih ignorira, a niže, $-c$, ako ih slijedi.

[10] Čitatelji koji žele saznati više o općim ponavljanim igrama za 2 igrača sa slučajnim uparivanjem i bez prijenosa informacija također mogu pročitati rad Deba i sur. (2020).

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[1] For Spain, there was only a gender effect.

[2] In April, however, higher compliance rates were also reported in the Netherlands (Kuiper et al., 2020).

[3] They would, however, more likely wear it on the bus and airplane, in the supermarket or at the university.

[4] The first survey was conducted on the 13th of March.

[5] Another possible reason for underestimating the effects of the coronavirus might be that people mistakenly perceived virus growth as linear rather than exponential (Lammers et al., 2020).

[6] This is not always the case, though (see, e.g., Larsen et al., 2020).

[7] Instead of taking an individual as one independent entity, one may take a pair or a triple of related like-minded individuals as one independent entity and then consider interactions between those groups instead of individuals. What is important is that in both cases the considered interactions are dyadic.

[8] The entries in Table 2, e.g., in the upper-right cell, can be interpreted as follows: if Individual 1 follows the recommendations and Individual 2 ignores them, then Individual 1's psychological values are $-c$ (cost c due to own decision, plus benefit 0 due to the decision of Individual 2), while Individual 2's psychological values are b (cost 0 due to own decision, plus benefit b due to the decision of Individual 1).

[9] If the other party follows the recommendations, the individual's psychological values are b by ignoring them, and lower, $b - c$, by following them. Similarly, if the other party ignores the recommendations, the individual's psychological values are 0 by ignoring them, and lower, $-c$, by following them.

[11] Ovaj se rezultat može primijeniti na donacijsku igru prikazanu u odjeljku 3, budući da je donacijska igra ništa drugo nego poseban slučaj igre dileme zatvorenika.

[12] U radu Camere i Gioffréa (2018), autori dokazuju da se suradnja može održati za proizvoljni δ ako je iskušenje za nesuradivanje dovoljno malo. Dakle, razlika između Camere i Gioffréa (2018) i Ellisona (1994) je u tome što prvi autori razmatraju proizvoljan δ i identificiraju izvedive isplate (tj. igre), dok drugi autor razmatra proizvoljne isplate/igre i identificira izvedive parametre δ.

[13] Dakle, ako postoje npr. 3 mini-igre, a pojedinac doživi prvo i jedino nesuradivanje u četvrtom periodu, što odgovara prvoj mini-igri, tada neće surađivati ni u jednom budućem razdoblju prve mini-igre (tj. u razdobljima 7 ,10, 13...,), ali će surađivati u svim ostalim mini-igrama.

[14] Iako ove studije ne razmatraju donacijske igre, uključio sam ih, jer su njihove dileme zatvorenika konceptualno vrlo bliske igrama donacija definiranima u Tablici 2. U ovim igrama dileme zatvorenika (kao u igrama donacija) cijena suradnje je konstantna bez obzira na to što drugi pojedinac čini. Konkretno, njihove dileme zatvorenika mogu se konstruirati iz generalizirane verzije igre pomoći (Tablica 1), u kojoj su psihološke vrijednosti opcije ignoriranja, tj. (0,0), zamijenjene s (a,a) gdje je $a \in (-c, (b-c)/2)$.

[15] Camera i Casari (2009), Camera i sur. (2012) te Camera i Casari (2014) izvještavaju o višim stopama suradnje, no u njihovom se eksperimentu svaka grupa sastoji od samo 4 osobe. Prvi provode dodatne sesije s grupama od 14 pojedinaca i nalaze mnogo niže razine suradnje.

[10] The readers who want to learn more about the general repeated 2-player games with random matching and no information transmission may also read Deb et al. (2020).

[11] This result can be applicable to the donation game presented in section 3 since the donation game is just a special case of the prisoner's dilemma game.

[12] In Camera and Gioffré (2018) the authors prove that cooperation can be sustained for an arbitrary δ if the temptation to defect is sufficiently small. So, the difference between Camera and Gioffré (2018) and Ellison (1994) is that in the former authors consider an arbitrary δ and identify feasible payoffs (i.e., games), whereas in the latter the author considers arbitrary payoffs/games and identify feasible parameters δ.

[13] So, if there are, e.g., three minigames, and an individual experiences the first and only defection in the fourth period, which corresponds to the first minigame, then she will defect in all future periods of the first minigame (i.e., in periods 7,10, 13...,) but will cooperate in all other minigames.

[14] Although these studies do not consider donation games, I have included them, because their prisoners' dilemma games are conceptually very close to donation games defined in Table 2. In these prisoners' dilemma games (like in donation games) the cost of cooperation is constant no matter what the other individual does. In particular, their prisoners' dilemma games can be constructed from a generalized version of helping game (Table 1), in which the psychological values of option ignore, i.e., (0,0), are replaced by (a,a) where $a \in (-c, (b-c)/2)$.

[15] Camera and Casari (2009), Camera et al. (2012) and Camera and Casari (2014) report higher cooperation rates, but in their setting each group consists of only 4 individuals. The former conduct additional sessions with groups of 14 individuals and find much lower cooperation levels.

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