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Scientists' Opinions on Immunity Certificates: Evidence from a Large-Scale Survey Among more than 12,000 Scientists

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Scientists' Opinions on Immunity Certificates: Evidence from a Large-Scale Survey Among more than 12,000 Scientists

Iván Aranzales[1,2], Ho Fai Chan[1,2], Reiner Eichenberger[3,4], Rainer Hegselmann[5], David Stadelmann[2,4,6,7]*, Benno Torgler[1,2,4]

[1] School of Economics and Finance, Queensland University of Technology, Brisbane, Queensland, Australia. [2] Centre for Behavioural Economics, Society and Technology (BEST), Brisbane, Queensland, Australia. [3] University of Fribourg, Switzerland. [4] CREMA - Center for Research in Economics, Management and the Arts. [5] Frankfurt School of Finance & Management, Germany. [6] University of Bayreuth, Germany. [7] IREF - Institute for Research in Economic and Fiscal Issues.

Significance:

The challenges posed by the COVID-19 pandemic have prompted scientists from different fields to evaluate whether the use of immunity certificates would allow for a safer and faster return to normality. This policy has been recently implemented by Israel (Green Pass) and similar legislation is currently being proposed at the European Commission. We show that there is a high level of scientific consensus regarding the benefits of such a passport for public health and the economy, while its effects on fairness and inequality remain controversial. In general, it is essential to understand the opinions of the scientific community regarding this controversial topic, so we may address shortcomings and tackle both the current and any possible future pandemics humanity may face.

Abstract:

What is the scientific opinion on immunity certificates as a tool to mitigate the health and economic impacts of the COVID-19 pandemic? We conducted a survey and collected over 12,000 responses from scientists whose publications have appeared in the top journals of different fields. In general, we find that scientists perceive immunity certificates as favorable for public health and the state of the economy; although, many stipulate some concerns about fairness and inequality arising from implementation of immunity certification. We show

differences among scientific fields, particularly between health scientists and social scientists, with the latter being more positive about the effect of immunity certification. Scholars in the United States, including health scientists, are more likely to view the immunity certificates favorably and mention fewer concerns about this policy's effect on fairness and inequality. Female scholars are significantly less in favor of immunity certificates, while scientists with more conservative political views and those who expect the return to normality to take longer hold more favorable views.

More than twelve months of pandemic-related uncertainty have caused major disruptions in almost every country, with the US and several Western European nations experiencing disproportionately high levels of infections and societal fallouts (1, 2). Case numbers continued to quickly rise worldwide till January. On December 2, the vaccine made by Pfizer and BioNTech became the first fully-tested immunization approved for emergency use (3). By the start of December, developers of several vaccines announced excellent results. Several vaccine candidates have reached the final stages of clinical trial evaluation for safety and protection efficacy, with more insights being generated over time through careful longitudinal studies on safety, immunogenicity, and protection rate (4). The United Kingdom was the first country to approve a vaccine, beginning their vaccination program on December 8 by administering the Pfizer and BioNTech vaccine. The first COVID-19 vaccination took place in the US on December 14 – when the US death toll reached 300,000. Other vaccine candidates have been approved by regulatory agencies around the world. While the duration of vaccine-acquired immunity is yet uncertain, neutralizing antibodies after infection and induced immunological memory reactions to SARS-CoV-2 have been shown to persist for over six months (5, 6). As the number of people with natural and infection-induced immunity in the population continues to increase, and President Joe Biden aims to vaccinate 100 million people by April[1], the utility of strict infection control measures decreases continuously while the social cost of such measures remains high. The increased number of vaccinations combined with the delays involved in reaching a large population makes the potential introduction of immunity certificates an important policy topic. Many countries have announced the implementation or are debating the use of these certificates. For instance, Israel has recently introduced the "Green Pass", intended for those vaccinated or those who have already contracted the disease.[2] The

[1] https://www.bbc.com/news/world-us-canada-55305720
[2] https://www.reuters.com/article/health-coronavirus-israel-green-pass-int-idUSKBN2AO2K3

President of the European Commission Ursula von der Leyen is presenting a legislative proposal for a "Green Pass" that will include information on whether there is a "Proof that a person has been vaccinated" or "Info on COVID19 recovery".[3] Apart from the prominent example of Israel, some type of immunity certification is already a reality in other countries such as Iceland and Hungary[4] . It should also be taken into account that the acceptance of COVID-19 vaccines may differ among individuals. Existing evidence points to the usefulness of focusing on prosocial concerns when motivating vaccination uptake (7). A global survey assessing potential acceptance of a COVID-19 vaccine indicates country-level differences in acceptance rates ranging from less than 55% in Russia to 90% in China (8). Another study using European data reports that people's willingness to vaccinate varies from 30% (Hungary) to 80% (Denmark) (9). Several individual-level differences are also associated with the willingness to receive a vaccine (10). Organized campaigns by vaccine-hesitant groups promote beliefs that vaccinations are unsafe via social media, leading to a growing vaccine hesitancy; a large proportion of the content shared about vaccines on popular social media sites are anti-vaccination messages (11). Thus, vaccine refusal is seen as a very significant problem (9). Individual acceptance of vaccination may also be negatively affected by increasing immunity levels in the population, as the incentive to free ride on others' vaccinations grows (12, 13). This raises the question of whether immunity certificates would offer further motivation and positive incentive to vaccinate if they also allow more individual freedom of movement and restoration of liberties, thereby empowering individuals to contribute to the common good (14). Enforced measures have been shown to crowd out voluntary support for COVID-19 policies (15), but scholarly debates were ignited by the proposal to use immunity certificates to deal with the COVID-19 pandemic and continue without consensus. As disagreements about appropriate COVID-19 responses are inevitable, a careful understanding and mapping of scholarly positions is valuable. The unique feature of this study is that we have collected the opinions of 12,738 scientists across 37 subfields and 63 countries (see Fig. S1 in *SI Appendix*). The survey was sent to the corresponding authors of scholarly articles published in the last five years in the top 20-ranked journals (see Dataset S1 for the full list of 1,100 journals). We measured attitudes towards immunity certification in the context of COVID-19 and assessed the consensus of scientists' opinions on different aspects of immunity certification.

[3] https://twitter.com/vonderleyen/status/1366346729289904128
[4] https://edition.cnn.com/travel/article/hungary-iceland-covid-immunity-passport-scn/index.html

Results

Overall attitudes towards immunity certificates. We explore answers from scientists across the following key domains relevant for immunity certificates: Whether the concept is perceived to be 1) *good for public health*; 2) *good for the economy*; 3) *fair to others who do not have immunity*; and 4) whether it is perceived to *increase inequality* (7-point scale from 1 (strongly disagree) to 7 (strongly agree)). The results are provided in Fig. 1A. About half of scientists agree that issuance of immunity certificates for the duration of immunity is good for public health (50.2%) and the economy (54.4%), while one-fifth (19.1%) and one-sixth (15.4%) disagree, respectively. However, in terms of fairness, only about 36.5% of scholars think that issuing immunity certificates will not be fair to those who do not have immunity. Around 45.5% of the respondents think that immunity certificates will increase inequality in society.

We also confronted scholars with the following two scenarios: "Suppose that you were medically assessed to be in a *low-risk* group (*high-risk* group) and you are offered the possibility of receiving an immunity certificate for 12 months through *intentional coronavirus self-infection*. Further suppose that among every 1000 infected people in the *low-risk* group (*high-risk* group), 1 person (50 people) dies (die) due to the coronavirus. How willing would you be to self-infect if the immunity certificate allowed for a) *lifting of social-isolation restrictions for the certificate holders*, and b) *lifting of all restrictions and resumption of local and international travel*. Willingness to self-infect is generally low in both scenarios (Fig. 1B). Overall, in the hypothetical low-risk scenario, 56.1% to 58.4% of respondents indicated that they are not likely (< neutral preference) to self-infect to receive an immunity certificate. Further, about 70% of participants say they will be unlikely to self-infect themselves if they were part of the high-risk group. It is reasonable to expect that the probability of self-infection to obtain immunity certification is even lower given the existence of vaccines. Vaccination is associated with substantially smaller health risks than self-infection even for very low-risk groups[5,6]. We also asked scientists the maximum amount (in US$) they would be willing to pay for opportunity to have such an immunity certificate {$0, $100, $200, $500, $1,000, more than $1,000} (Fig. 1C). Most scientists (38.2% and 44.3%) reported they would not pay to obtain an immunity certificate.

[5] https://www.bmj.com/content/372/bmj.n363
[6] https://www.tga.gov.au/node/936106

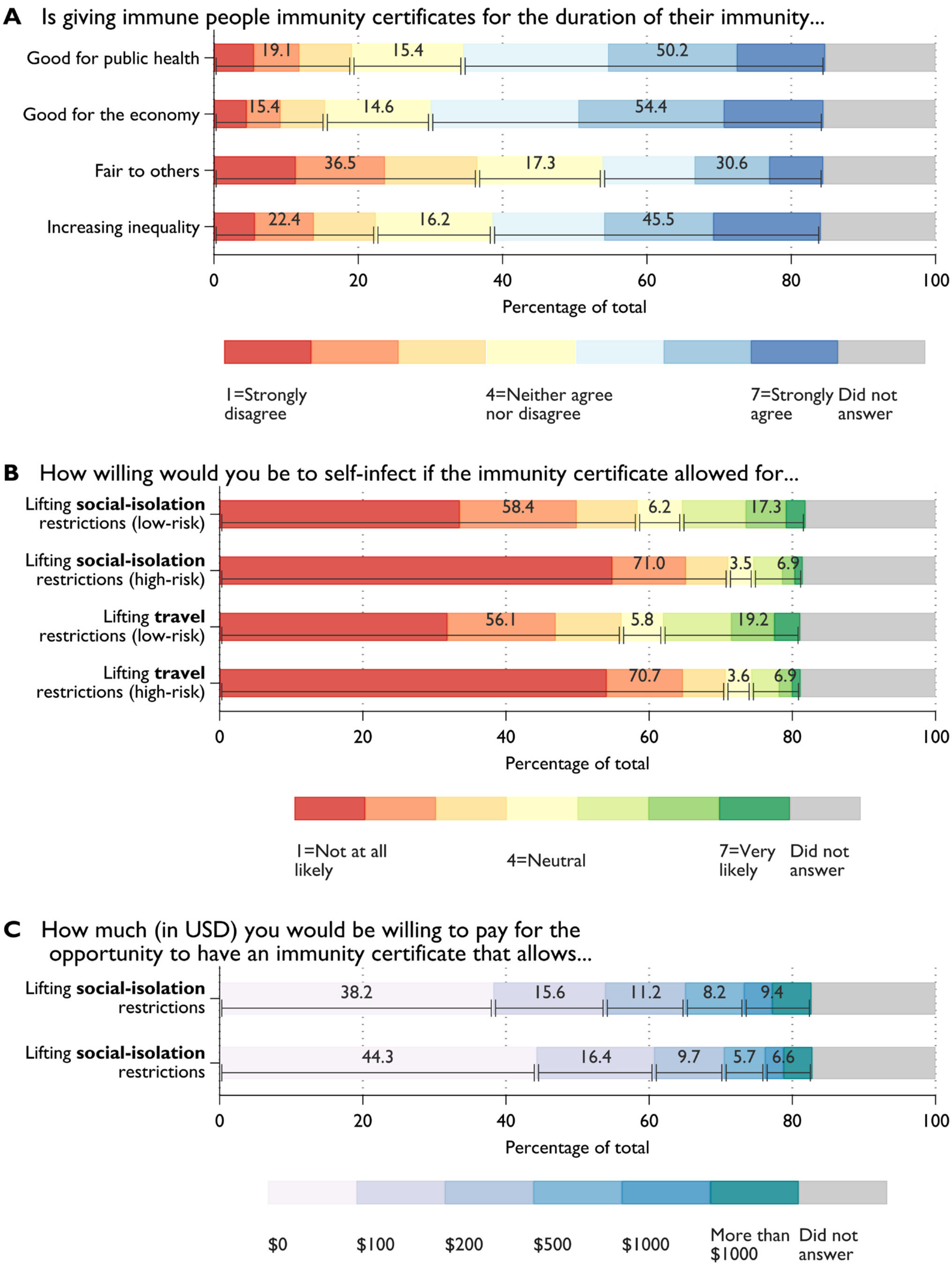

Fig. 1. Scientists' attitudes towards immunity certificates. N = 12,738 participants. *(A)* Distribution of responses to the question "*Is giving immune people immunity certificates for the duration of their immunity...*" regarding 1) *good for public health*; 2) *good for the economy*; 3) *fair to others who do not have immunity*; and 4) *increasing inequality*. Share of respondents who did not answer ranges from 15.29% to 15.89%. *(B)* Willingness to self-infect for immunity certificate lifting *social-isolation* and *travel* restrictions, if medically assessed as *low-risk* or *high-risk* groups. *(C)* Willingness to pay for immunity certificate lifting *social-isolation* and *travel* restrictions. Share of respondents who did not answer ranges from 18.15% to 18.90%.

Field Comparisons. To explore differences across fields with respect to opinions about immunity certificates, we follow (16) in classifying fields into five groups: *Natural Sciences* (n = 1,710), *Applied Sciences* (n = 829), *Economic & Social Sciences* (n = 4,901), *Health Sciences* (n = 4,851), and *Arts & Humanities* (n = 295). The distributional differences across fields are reported in the Appendix (see Fig. S2 to S5 and Table S1 in *SI Appendix*). Our results indicate that Health Scientists are more skeptical about whether immunity certificates are good for public health, particularly relative to scholars in the area of Applied Sciences (Cohen's d = .075, p = .041) and Economic & Social Sciences (d = .076, p = .006). Economists and Social Scientists are also more in favor of immunity certificates than scholars in Arts & Humanities. The differences between Economics and Social Sciences and Health Scientists are especially visible when evaluating the economic benefit of immunity certificates (d = .06, p = .067). This does not come as a surprise, given that many of the economic advantages of immunity certificates suggested in the academic discussion were raised by Economists and Social Scientists early in the pandemic (see, e.g., 17). These scholars argue for viewing immune people as a vital resource that can be employed effectively to reduce the economic burden to society and promote the return to normality sooner, which will reduce secondary societal side effects caused by the pandemic. In the political discussion, economists have strongly emphasized the importance of putting numbers on the economic costs of shutdowns. For example, Kip Viscusi – an economist specializing in the economics of risk and uncertainty – argued in a New York Times article[7] that "[m]aking people poorer has health consequences as well" and that "[j]obless people sometimes commit suicide, and poor people are more likely to die if they become sick, estimating that every loss of $100 million in income from the economy causes one additional death". Health scientists are much more concerned about the fairness considerations of immunity certificates (again, there are statistically significant differences between scholars from the fields of Applied Sciences (d = .093, p = .007) and Economics and Social Sciences (d = .095, p = .0002)). In an article for *The Lancet*, Alexandra Phelan – a health scientist at the Center for Global Health Science at Georgetown University Medical Center – is critical that the administration of immunity certificates would be subject to corruption and implicit biases that will then be reflected in existing socioeconomic, racial, and ethical inequities, thereby exacerbating the harm inflicted to vulnerable populations (18). In addition, immunity certificates would risk enshrining discrimination and undermining the right to health

[7] See, e.g., https://www.nytimes.com/2020/03/24/business/economy/coronavirus-economy.html

of individuals and the population through perverse incentives. In June 2020, the Nuffield Council of Bioethics published a rapid policy briefing stating that "immunity certification raises many ethical questions concerning respect for individual rights and interests, public health responsibilities, and social justice"[8]. For example, the report stressed that "An immune certified workforce may offer businesses a commercial or reputational advantage over competitors. Pursuing these incentives could lead to major social upheaval (as seronegative employees potentially lose opportunities to seropositive colleagues or applicants) and create coercive and stigmatising work environments". On the other hand, in a more recent article (19), a group of health scholars argue that the "strength of much of this opposition does not seem justified by the strength of the arguments opposing immunity passports" (14, p. 3), stating that "[i]mmunity passports are a potentially valuable and ethical tool" (p. 4). Interestingly, when looking at the opinions on increasing inequality, no statistically significant differences are found between fields.

When exploring the maximum amount (in US$) scientists would be willing to pay for the opportunity to have an immunity certificate that allows a) lifting social-isolation restrictions for the certificate holders and b) lifting all restrictions and resumption of local and international travel for the certificate holders (Fig. S6 and Table S2 in *SI Appendix*), Economists and Social Scientists report a higher willingness to pay; a result that is statistically significant relative to scholars in Applied Sciences (d = -.121, p < .001), Health Sciences (d = .16–.176 p < .001), and Natural Sciences (d = .13–.134, p < .001). On the other hand, whilst there is no statistically significant difference between willingness to self-infect to receive immunity certificates in the low-risk scenario (with the exception between Economics & Social Sciences and Health Sciences, d = .062, p = .031), field differences emerge in the high-risk scenario (see Fig. S7 and Table S3 in *SI Appendix*). Applied Scientists (followed by Economists and Social Scientists) were more willing to self-infect to receive immunity certificates (statistically significant relative to all other groups) and Health Scientists are least likely to self-infect to obtain immunity certificates.

Differences Between US and Non-US Scholars. Our data consists of a large number of US scholars (N = 4,076, Applied Sciences: n = 169; Arts & Humanities: n = 102; Economics and Social Sciences: n = 1,450; Health Sciences: n = 1,937; Natural Sciences: n = 418). This allows

[8] https://www.nuffieldbioethics.org/assets/pdfs/Immunity-certificates-rapid-policy-briefing.pdf

us to take a closer look at whether we observe differences in opinions between US and Non-US scholars, and indeed, we find appreciable disparities (see Fig. 2 and Table S4). US scholars are significantly more in favor of immunity certificates when considering its relevance for public health (d = -.117, p < .001) and the economy (d = -.113, p < .001) (Fig. 2*A*). In general, Non-US scientists regard immunity certificates as unfairer to others (d = -.037, p < .001) and more likely to increase inequality (d =.053, p < .001), relative to their US-based counterparts; however, the effect sizes are small. US scholars also show a substantially higher willingness to pay for immunity certificates, question a) M = 249.49 (SD = 426.37) for US versus M = 149.33 (SD = 322.27) for Non-US (d = -.25, p < .001); question b) M = 302.18 (SD = 462.38) for US versus M = 213.53 (SD = 382.43) for Non-US (d = -.188, p < .001) (Fig. 2*B*). Nevertheless, US scientists are less willing to self-infect when in a low-risk (d = .048–.07, p < .01) and high-risk group (d = .195–.189, p < .001), regardless of the type of restrictions the immunity certificate could lift (Fig. 2*C*).

Comparing US and Non-US scholars within fields (Fig. S8 to S10 and Table S5 in *SI Appendix*), both the US Health Sciences scholars and the US Economists and Social Scientists are more positive towards immunity certificates as something that is good for public health (d = -.193, p < .001 and d = -.069, p = .0278) and good for the economy (d = -.198, p < .001 and d = -.068, p = .029) (Fig. S8). US Health Scientists have less fairness concerns with respect to immunity certificates (d = -.083, p = .007) and are less likely to view immunity passports as increasing inequality (d = .09, p = .004). US and non-US differences in willingness to pay for an immunity certificate are evident in almost all fields, with the largest discrepancy among Natural Scientists (d = -.32–-.343, p < .001) (Fig. S9). In terms of willingness to acquire an immunity certificate through self-infection, US Health Scientists hold stronger opposing views compared to their non-US counterparts in all four scenarios (low- or high-risk groups and whether immunity certificate would mean lifting social-isolation and travel restrictions; d = -.075–-.206, all p < .05). Nevertheless, while US scientists in other fields are also less willing to self-infect to receive an immunity passport (relative to non-US scientists in the same field) when they were in the hypothetical high-risk group, said differences were less visible in the low-risk scenario (Fig. S10).

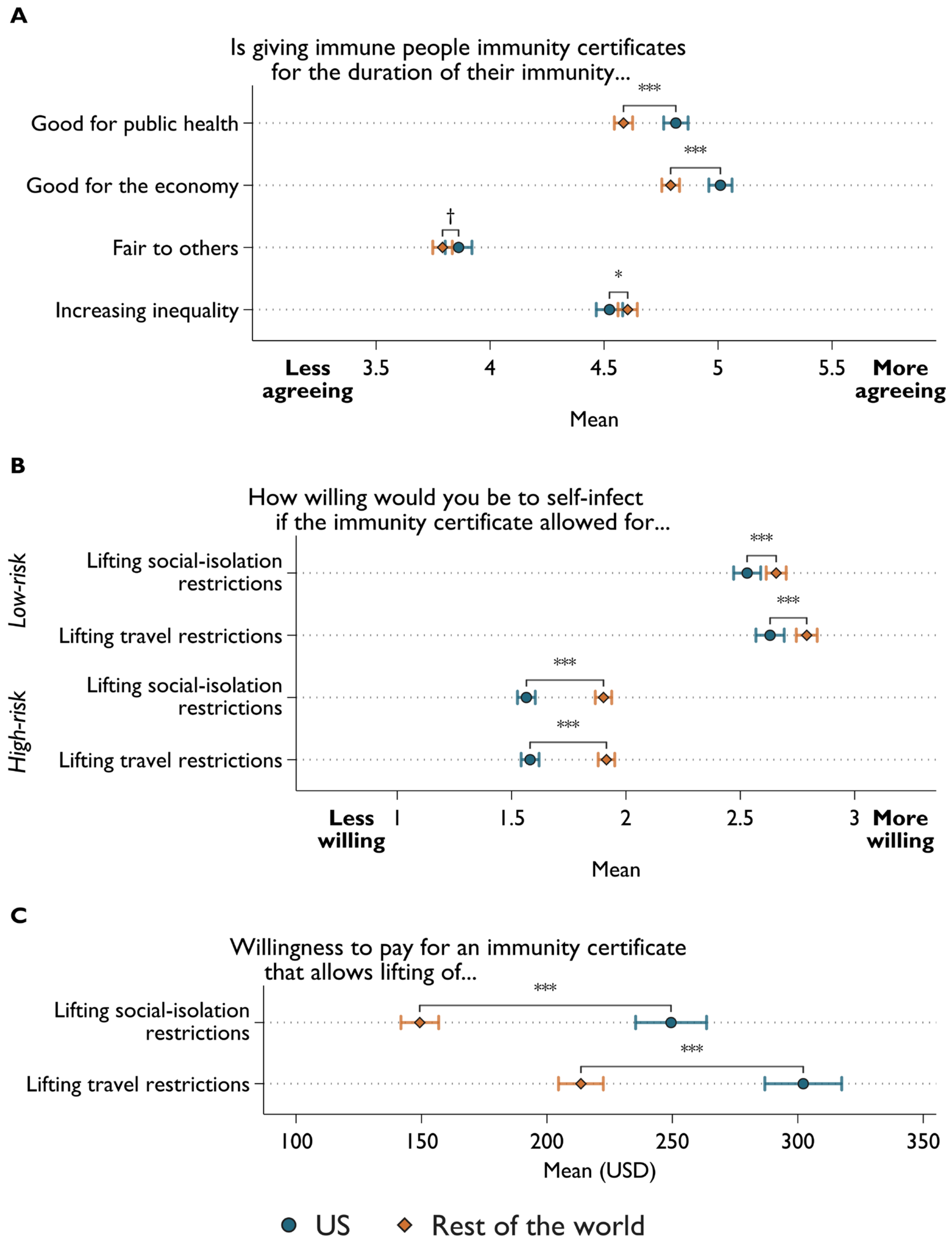

Fig. 2. Difference in views on immunity certificates between US and non-US based scientists. (*A*) Views regarding perceived benefits to public health and economy, fairness, and societal inequality of immunity certificate. (*B*) Willingness to pay for immunity certificate for lifting social-isolation and travel restrictions. (*C*) Willingness to self-infect for immunity certificate for lifting social-isolation and travel restrictions. Two-sample mean comparison with *t*-test (two-tailed). Error bars represent 95% confidence intervals. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$. Results are robust to using the Wilcoxon rank sum test (Table S4).

Return-to-normality timeline. When asking scientists about the expected timelines within which they believe the current policy measures could bring back normality *without* the use of immunity certificates, more than half (52%) of the respondents think the pandemic will last longer than 12 months (Fig. S11). Health Scientists were far more convinced that it will take a longer time to get back to normality (Table S6 in *SI Appendix*). A nonparametric pairwise comparison shows Health Scientists' opinions differ from Applied Scientists (d = .122, p < .001), Natural Scientists (d = .121, p < .001), and Economists and Social Scientists (d = .116, p < .001). US-based scientists are also less optimistic about the time it will take for life to return to normal (d = .301, p < .001) and this difference is evident across all fields (Table S7). Scientists who expected the return to normality to last longer were more likely to have more favorable views on all aspects related to immunity certificates compared to those who gave more optimistic estimates regarding the return to some form of normality (Fig. S12 in *SI Appendix*). We found that the average favorability of immunity certificates with respect to public health and the economy increases with estimated time-to-normality – as does the willingness-to-pay. Interestingly, willingness to self-infect to receive immunity certificates decreases with the back-to-normal timeline projections. There is no apparent association between the timeline estimates to fairness and inequality concerns of immunity certificates.

Consensus. We observe that scholars show a higher level of consensus on the questions around favoring immunity certificates for public health (C = .578) and the economy (C = .606) compared with the questions around fairness (C = .535) and inequality (C = .538) (Fig. 3*A*). The latter questions are discussed from an ethical perspective in both academic and non-academic channels. Looking at the consensus *within* each field (Fig. S13 in *SI Appendix*), Economics and Social Sciences and Health Sciences tend to report higher levels of consensus. However, when closely looking at whether field differences are statistically significant with Bonferroni adjustments, only the fairness and inequality questions lead to statistically significant field differences (Table S8 in *SI Appendix*). Natural Scientists indicate the lowest levels of consensus within their field and the differences are statistically significant in comparison to Health Scientists (p = .0089) for fairness; and Health Sciences (p < .001), and Economics & Social Sciences (p = .063) for inequality.

Overall, consensus on the willingness to pay (C = .6–.674) for an immunity passport is quite high (Fig. 3*B*). Economists report the lowest levels of consensus on the willingness to pay for an immunity passport (significantly lower than Health Sciences, Natural Sciences, and Applied Sciences) (Fig. S14*A* and Table S9 in *SI Appendix*). The lowest level of consensus among all questions is on the issue of self-infection with the low-risk scenario (Fig. 3*C*; C = .495–.519); there are no significant differences between fields on the low-risk scenario (Fig. S14*B* and Table S9 in *SI Appendix*). On the other hand, consensus is high for the high-risk scenario (C = .668–.671), with Health Scientists reporting a significantly higher level of consensus than do Economists and Social Scientists ($p = .013$ and $p = .0057$), Natural Scientists ($p = .027$ for lifting social-isolation restrictions) or Applied Scientists ($p = .0021$ and $p = .0022$).

US scholars demonstrate higher levels of consensus than non-US scholars across all questions (Fig. S15 and Table S10 in *SI Appendix*), except for those regarding willingness to pay, where consensus is lower for US scientists. The differences are statistically significant for all the questions. In the comparison of US and non-US scholars within fields (Fig. S16 to S17 and Table S11 in *SI Appendix*), again, US scholars tend to show a higher level of consensus, except for willingness-to-pay questions. However, key differences are found within Economics and Social Science and Health Sciences on scientists' perceptions that immunity passports are good for public health ($p = .0072$ and $p < .001$, respectively) and good for the economy ($p = .014$ and $p < .001$, respectively), and among Health Sciences with respect to fairness to others ($p = .048$). Strong field differences are also found for willingness to pay, and self-infection in the high-risk scenario (statistically significant differences for Economics and Social Sciences, Health Sciences, and Natural Sciences). Consensus is also higher among US Health Scientists (relative to Health Scientists elsewhere) in relation to willingness to self-infect in the low-risk scenario.

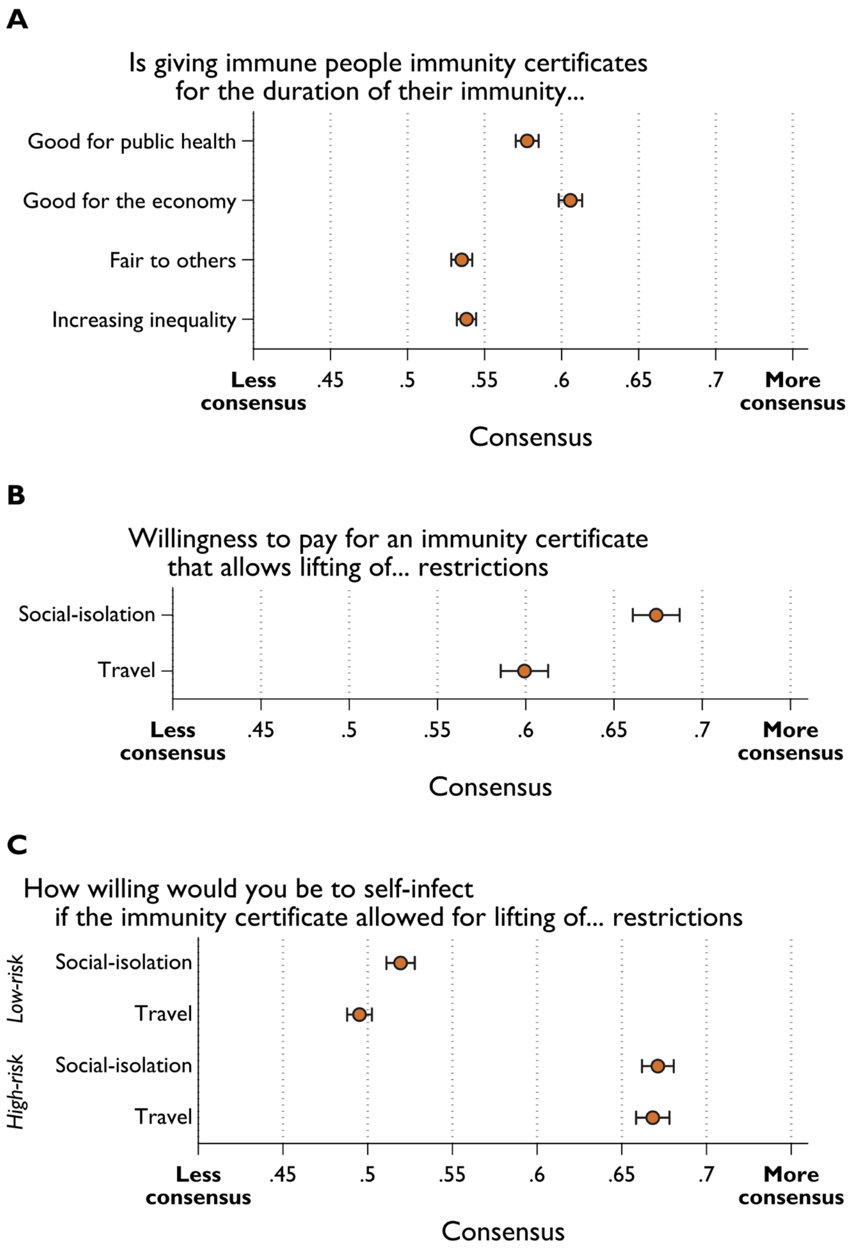

Fig. 3. Consensus among scientists. The entropy-based consensus measure takes the value of 1 when all responses are concentrated on one option and value of 0 when responses are evenly distributed in each available option. (*A*) Views on perceived benefits to public health and economy, fairness, and societal inequality of immunity certificate. (*B*) Willingness to pay for immunity certificate for lifting social-isolation and travel restrictions. (*C*) Willingness to self-infect for immunity certificate for lifting social-isolation and travel restrictions. Error bars represent 95% confidence intervals obtained from bootstrap resampling with 300 replications. Null responses are excluded from the calculation of consensus.

Political views. We run a set of ordered logit regressions to explore the relevance of political views in greater detail (Fig. 4 and Table S12 and S13 in *SI Appendix*). A clear pattern emerges throughout all questions. Scientists who hold more conservative views (more right-wing) are significantly more in favor of immunity certificates. They evaluate them as good for public health (*Odds Ratios* = 1.044, p = .023), good for the economy (*OR* = 1.038, p = .052), fair to others (*OR* = 1.130, p < .001) and do not see them as potentially increasing inequality (*OR* = .893, p < .001). Their willingness to pay is also higher (*OR* = 1.071–1.073, p < .001), as is their willingness to self-infect to receive immunity certificates (Low-risk scenario: *OR* = 1.156, p < .001; High- risk scenario: *OR* = 1.178–1.206, p < .001). This holds while accounting for individual characteristics, confirmed COVID-19 cases, case fatality rate, stringency index and fixed effects. (20) classify and reject arguments for immunity certificates as belonging to a conservative political view by highlighting the relevance of liberal individualism. They frame their own political rejection of immunity certificates as part of a communitarian approach to public health in line with progressive views. (21) responded by stressing that "liberties should be restored to immune individuals precisely because they are not anymore a threat to the greater good".

Individual Differences. The results from the ordered logit regressions revealed individual differences in scientists' attitudes toward immunity certification. Some clear patterns are observed throughout all questions. Women scholars are significantly less likely to favor immunity certificates (estimates are statistically significant at 0.1% level for all ten dependent variables) even when accounting for other characteristics, political views, and contextual factors, such as case and fatality rates as well as the stringency implementations. Interestingly, a recent study also indicates that women are more likely to perceive COVID-19 as a very serious health issue and more likely to favor using restrictive public policy measures, a difference that is considerable in all eight OECD countries explored (22). Controlling for academic rank, younger scholars (age group 18–29) tend to be more supportive of immunity certificates in terms of their benefit for public health (*OR* = 1.24, p = .026) and the economy (*OR* = 1.31, p = .009) compared to the baseline age group (30–39), while scientists above 40 showed less agreement regarding the economic benefit (p < .001 for all age groups above 40). Scientists in the age group >50 demonstrated substantially more support for immunity passports with respect to fairness and inequality (relative to the age group 30–39, p < .001 for all age groups above 50). Nevertheless, scientists with full professorship showed more support (compared to assistant professor or below) in terms of economic benefit (*OR* = 1.149, $p = .026$) and inequality concerns (*OR* = .83, $p = .003$). More senior ranked academics (full professorship) also expressed higher willingness to pay (*OR* = 1.716–1.723, $p < .001$) and self-infect for immunity certificates (*OR* = 1.268–1.362, $p < .001$), while older age groups are less willing to pay for immunity certificates. Age groups 40–49 and 50–59 report a weak inclination to self-infect in both scenarios. One should note that the correlation between academic rank and age is high (0.605, $p < .001$); in an unreported analysis without controlling for academic rank, scientists in the older age group (60+) expressed more favorable views towards immunity certificates (the estimated odds ratios are above 1 for the fairness, willingness to pay, and willingness to self-infect questions and less than 1 for inequality concerns).

Married scientists (relative to those who are not in a relationship) are more supportive of the concept of a immunity certificate for its perceived benefit for the economy (*OR* = 1.216, $p = .007$) but less willing to self-infect to receive one ($p < .001$; this also holds for those in a de facto partnered relationship). Non-religious scientists (who never attend religious services) are more supportive of immunity certificates due to the potential benefit but are less inclined to self-infect. There is a tendency that those who believe that it will take longer to get back to normality are more in favor of immunity certificates in terms of promoting public health and the economy. Scientists who imagine better prospects of returning to normality sooner have a lower willingness to pay but a higher willingness to self-infect to obtain an immunity certificate.

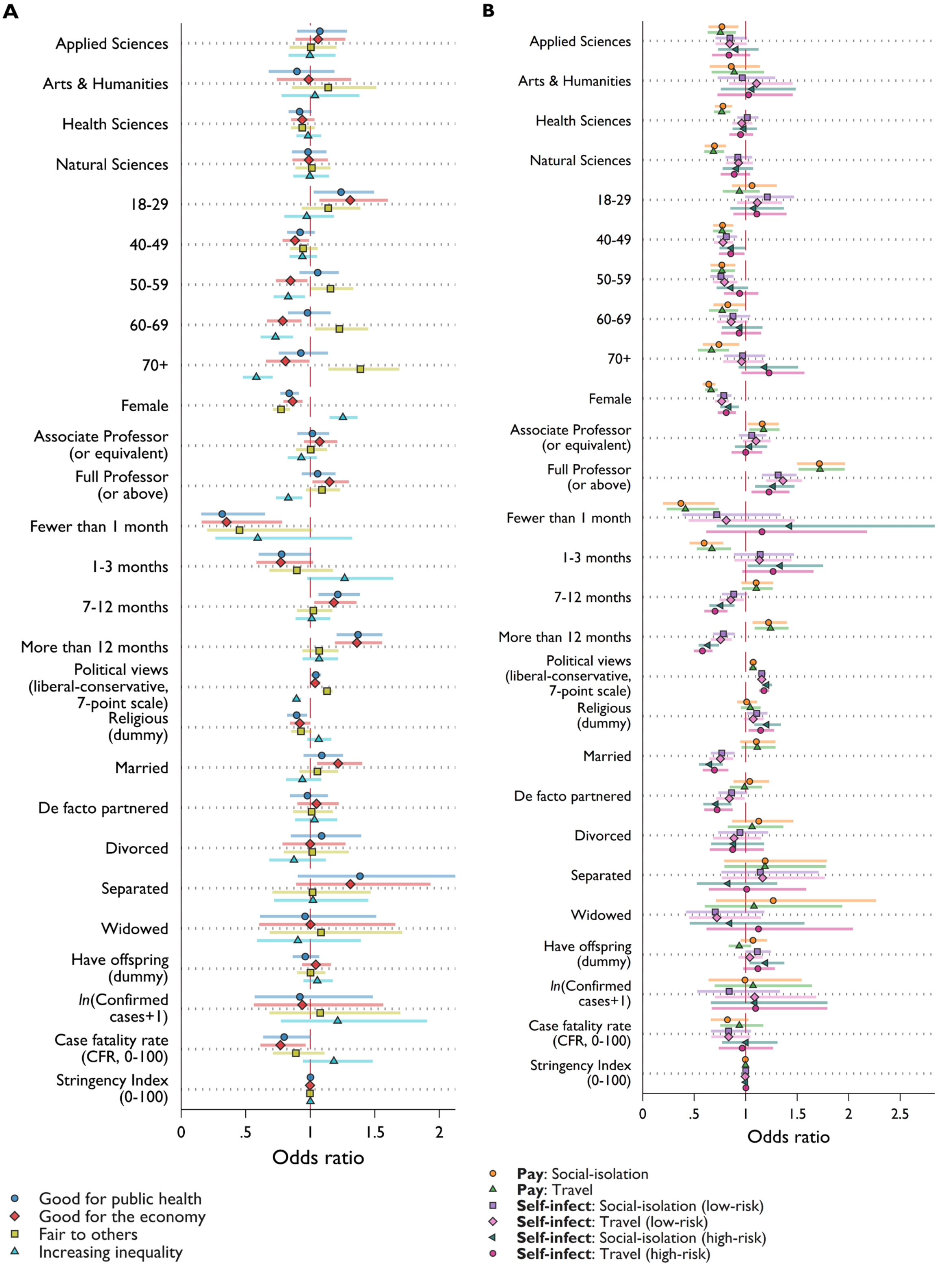

Fig. 4. Ordered logit regressions. Presented are odd ratios of covariates from 10 ordered logit regressions for (*A*) perceived benefits to *public health* and the *economy*, and *fairness* and *inequality* concerns and (*B*) willingness to pay and willingness to self-infect for immunity certificate. Error bars represent 95% confidence intervals. Full regression results are presented in Table S12 for (*A*) and S13 for (*B*).

Discussion

Although a variety of survey studies are available on COVID-19 related issues, no study has yet extensively explored scientists' attitudes and opinions. Thus, as an innovative contribution, we present results based on our large-scale survey conducted among 12,738 scientists from 37 subfields and 63 countries, with 4,076 respondents from the US alone. With protection from infection rising due to vaccination campaigns and increasing numbers of convalescents from the disease, immunity certificates are again a topic of contention (as shown by the discussions surrounding Israel's "Green Pass"). It is relevant to consider whether these mechanisms provide a viable transition to comparative normality. As our survey on scientists' perceptions of immunity certificates was conducted when vaccinations were not yet available, our results can be interpreted as a conservative threshold on the acceptance of vaccination-induced immunity and corresponding certification. Several arguments put forward by scholars against immunity certificates for convalescents are also applicable to vaccine-induced immunity; thus, the same scholars may object to any reduction of restrictions for vaccinated individuals until herd immunity is achieved (21), even though models have failed to support achieving herd immunity as a practical objective (23). Due to the uniform and controlled nature of treatment, the response of a vaccine-induced immunity is more predictable. Our results indicate that Health Scientists are particularly less in favor of immunity certification, while Economists and Social Scientists tend to be supportive. US scientists tend to be more in favor of immunity passports even after controlling for many factors including contextual aspects such as the number of COVID-19 cases or deaths. A similar result is also found for Health Scientists. There is less consensus among scientists on the questions of fairness and inequality. Scholars from fields that are more active in the policy discussion process report higher levels of consensus; in particular, Health Scientists report high consensus values in relative terms. Self-infection in the low-risk scenario produced less agreement compared with other questions. In addition, US scholars report a higher level of consensus than non-US scholars. Political views matter for support of immunity certificates – with scientists holding conservative views being more in favor. When exploring individual differences, we found that women are less supportive of immunity certificates. Young people also tend to care more about the immunity value in terms of economic benefit.

In general, the debate on immunity passports has been quite heated. In their response to (14), (20) warn that "[r]eaders should reflect carefully on the philosophies that undergird different perspectives on the ethical acceptability of COVID-19 immunity passport. Not doing so puts individuals and the communities they are part of at risk". We can expect that the discussion over whether vaccines will guarantee greater rights and freedoms to those who are vaccinated will intensify as more vaccines are administered (24), which will require further insights into the acceptability of immunity certificates for vaccinated people or convalescents of the illness. In addition, one should note that higher income countries have brokered deals with companies to secure products, which means that middle-income and lower-income countries will experience delays in accessing the vaccines (25). Canada, the US, UK, Australia, and EU have already ordered about half the expected capacity for 2021 (26). Thus, while many scholars are concerned about the effects of immunity certification on fairness and inequality, there will be a lag in vaccine-induced protection for countries that are particularly vulnerable to prolonged lockdowns but in which many convalescents might be found due to their comparatively young populations. As we have seen in the results, the perceived benefits of immunity passports increase the longer it takes to bring back normality. Besides understanding the opinions of single scholars who hold the microphone in scientific outlets, it is worth mapping – as we have done – the opinions of a large number of scholars from different fields, and analyzing how individual differences shape the scholars' opinions. Such mapping contributes to the important debate regarding which policy responses society should follow when coping with pandemics such as COVID-19.

Method

Data. We conducted an online survey via the SurveyMonkey platform with scholars who have served as the corresponding author of an article published in the top journals in 55 scientific fields in the last five years (from 2015 to beginning of 2020). The list of journals comprises 849 titles (Dataset S1 in *Appendix SI*) representing the top 20 journals (in terms of the 2019 SCImago Journal Rank (SJR)) in the 55 subject categories from 13 scientific areas defined by Scopus (*Arts and Humanities; Business, Management and Accounting; Economics, Econometrics and Finance; Energy; Health Professions; Immunology and Microbiology; Medicine; Multidisciplinary; Neuroscience; Nursing; Pharmacology, Toxicology and Pharmaceutics; Psychology; Social Sciences*). We extracted the e-mail address of the corresponding authors from the journal publication records downloaded from the Scopus citation database when available (total of 318,251 emails). To increase the representation of social scientists, we also include scholars registered in the bibliographic database RePEc (https://econpapers.repec.org/RAS/) in our sample pool (addition of 68,470 e-mail addresses); this provides a total of 353,583 unique e-mail addresses for scientists. From the sample pool, we randomly selected two-thirds and sent out the survey invitations from May 4 to 17, 2020, except on Sundays. The number of survey invitations sent on each day were evenly distributed. A reminder email was sent to invited participants who have not opened the survey link two weeks after the initial email invitation. The survey was closed on June 3, 2020.

Of the 220,923 invitations sent (22,074 (9%) email addresses were invalid), 41.35% (91,346) were opened. The response rate based on emails opened was 13.93% (5.76% based on valid invitation), with 98% completed within 24 hours upon opening the invitation link. The median response time was 16 minutes (M = 0.12 days, SD = 1.25). Our response rate is comparable to other studies with surveys sent to scientists through email lists obtained from academic databases such as Scopus. For example, (27) reported a 14.1% response rate from the online survey on public communication with 100,000+ faculty members from 73 land-grant universities; (28) recorded a response rate of 12% in a web survey study exploring the consensus among scientists on the highly debated topic of climate change and environmental policy, using an email list composed from Scopus; (29) reported a response rate of 10.3% with a survey distributed to 729 authors via email and social networking sites; (30) investigated the opinion of scientists on the peer review process from a list of academics at universities ranked highly at the Times Higher Education (THE) university rankings and obtained a response rate of about 5%. We also acknowledge the variation in the response rates across fields (see Table S16 in *SI Appendix*), ranging from 8.19% (*Health Professions*) to 19.47% (*Economics*). While our sample is large, self-selection remains one of the significant challenges in survey studies; for example, scholars in health science might be less inclined to respond due to increased workload during COVID-19.

The survey consisted of several sections on topics related to COVID-19, including a section devoted to opinions about immunity certificates. Questions pertaining to basic demographics were asked at the start of the survey. In addition, we asked our participants a series of control questions, including their political views, religiosity, and marital status at the end of the survey. Participation in the survey was completely voluntary and subjects were able to skip any question they did not want to answer or quit the survey at any time. For this reason, there is a larger proportion of missing values on the control variables at the end of the survey (about 33%). To assess the reliability of the regression analysis (sensitivity to missing data), we report the results without these control variables (see *SI Appendix*). Participants were self-selected from the pool of scientists mentioned above. They were told that the survey pertained to the COVID-19 health crisis, but they were not aware of the specific contents of each section before taking part in it. In order to incentivize the interest in the survey, the subjects were offered a $500 lottery for themselves and $ 500 for a charity of their choice upon leaving an email address to contact them in case they won the prize. Ethical clearance for the data collection was granted on April 23 by the Ethics Commission of the Frankfurt School of Finance and Management. Preliminary analysis on the difference in responses between health scientists and non-health scientists is provided in (31).

Sample description. Descriptive statistics of the sample are presented in Table S17 (*SI Appendix*). We recorded a total of 12,738 responses from scientists across different disciplines. Females represent around 42% (n = 5,335) of the sample, while 57% (n = 7,218) of the participants are male. Most participants were in the age brackets 30 to 39 years old (32%, n = 4,131) and 40 to 49 years old (29%, n = 3,637). In addition, we recorded information of unique relevance to this demographic group such as their field of study, how many of them have completed a PhD and whether they hold a professorship (28.5%, n = 3,631). Most of the respondents are from Europe (42.3% n = 5,408) and North America (37.22% n = 4,759). The majority of participants held an assistant professorship (equivalent or below) (52.8% n = 6,664).

Compared to economics scholars recruited from the top journals in the fields, the pool of survey participants drawn from the *RePEc* register composed of more males (5.58 percentage points, p = .003) and are from older age groups (p =.044 based on a two-tailed rank sum test). We did not find significant discernible difference in other sample characteristics between the two samples (all $p > .1$). Nevertheless, we control for this by including a dummy variable for participants from the *RePEc* sample in the regression analyses. While the sample from *RePEc* were more supportive of the immunity certificates in terms of inequality concerns and have higher willingness to pay for the immunity certificates, removing the *RePEc* sample from the analysis does not change our qualitative and quantitative findings.

COVID-19 data. To control for contextual factors due to development of the COVID-19 pandemic, we collected the daily confirmed case and case fatality rate (CFR) statistics at the country level, as well as a measure designed to capture the stringency level of government policy responses. COVID-19 statistics were obtained from the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (32) and the Stringency Index were obtained from the Oxford COVID-19 Government Response Tracker (OxCGRT)) (33). We add 1 to the daily number of COVID-19 confirmed case variable and implement a log transformation. The Stringency Index is the sum of eight containment and closure policy indicators together with the presence of public information campaigns (see (33) for details). The three cross-country daily measures were merged with the self-reported country of residency and survey submission date variables. These variables were included as controls in the regression models, together with country and time fixed effects.

Empirical Approach. Appropriate statistical tests were chosen to perform the response comparisons between groups; both parametric and non-parametric tests were employed. Due to the ordinal nature of the response variables, we perform a non-parametric pairwise multiple comparison (34) and adjust the false discovery rate using the Benjamini-Hochberg stepwise adjustments. We also report the results of the Kruskal-Wallis rank test of the hypothesis that responses from different fields are from the same population. We employed both mean comparison *t*-test and the non-parametric Wilcoxon rank-sum for comparison between US and non-US responses. For US and non-US difference within fields, we implemented the Bonferroni correction to account for multiple comparison by inflating the significance cut-off by five-fold. To calculate the effect size for these comparisons, we follow the transformation of Cohen's *d* for ordinal data proposed by (35), where $d = 2*z/\sqrt{n}$. Exact p-values (two-tailed) are reported. Statistical analyses were performed using Stata MP 16.1.

Consensus. To examine the degree of agreement among scientists, we closely follow the approach of (36, 37) when measuring consensus from variables with an ordinal scale. Consensus of the ordinal response variable X with i categories is defined as: $\text{Consensus}(X) = 1 + \sum_{i=1}^{n} p_i \log_2(1 - \frac{|X_i - \mu_X|}{max_X - min_X})$, where p is the share of responses (excluding non-responses). A value of 0 indicates the participants' responses are evenly split to the two extremes, while a value of 1 means that all responses are in the same category. The consensus score is around .45 (depending on the number of response categories) if responses are evenly split into each category. 95% confidence intervals (error bars) of the consensus measure are constructed by performing bootstrap resampling with 300 replications. We employ the two-sample *t*-test to test for statistically significant differences in the consensus scores between groups (across fields or US to non-US). Bonferroni adjustments were also used for multiple-field comparisons. Computing consensus using the Shannon Entropy equation, i.e., $1 - \frac{\sum p_i \times \ln p_i}{n \times 1/n \times \ln(1/n)}$, yields identical qualitative conclusions.

Ordered logit regressions. We employed the ordered logit regression model to examine the effect of sample characteristics and other factors on the response outcome. The ordered logit model is a more suitable model than the commonly used ordinary least squared (OLS) model as it recognizes that the response data is ordinal rather than interval. The ordered logit coefficient indicates the expected increase in the log odds of being in a higher level of the response variable, given a 1-unit increase in the predictor variable, holding other variables in the model constant. For ease of interpretation, we report the estimated proportional odds ratios (by exponentiating the coefficients), which can be interpreted as the odds for being in a higher level of the response variable (i.e., proportional odds times larger).

*To whom correspondence may be addressed. Email: david.stadelmann@uni-bayreuth.de.

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The authors declare no competing interest.

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Supplementary Information to:

"Scientists' Opinions on Immunity Certificates: Evidence from a Large-Scale Survey Among more than 12,000 Scientists"

Iván Aranzales, Ho Fai Chan, Reiner Eichenberger, Rainer Hegselmann, David Stadelmann, Benno Torgler

Data

Fig. S1. Survey participants by country. Responses were received from 63 countries, with 44 countries returning at least 30 responses.

Field difference

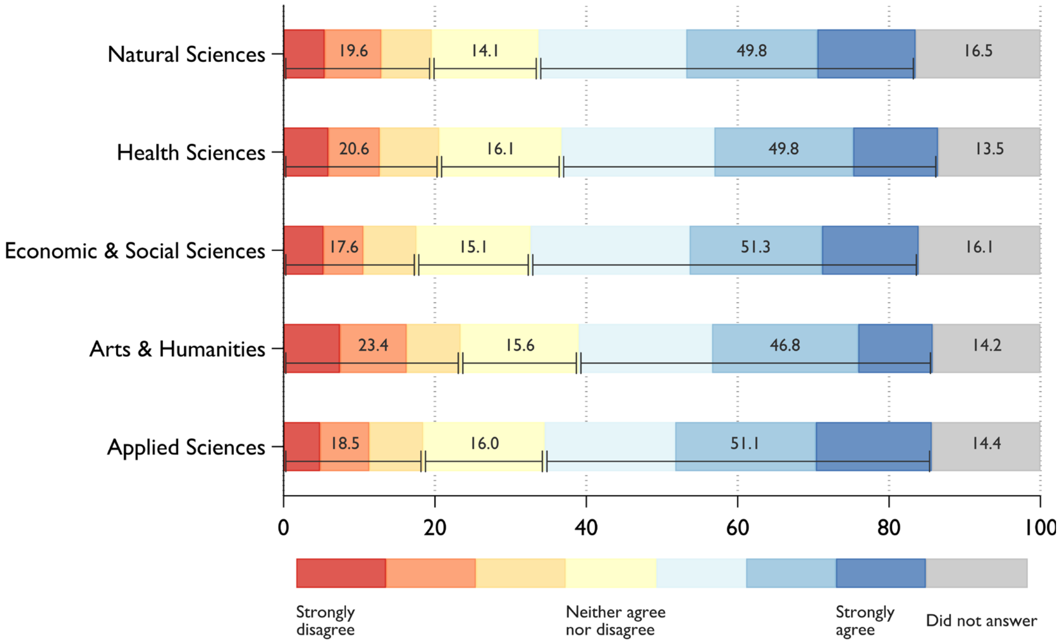

Fig. S2. Opinion on whether immunity certificates are *good for public health*, by field. N = 10,789 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4)$ = 18.11; p = .00117).

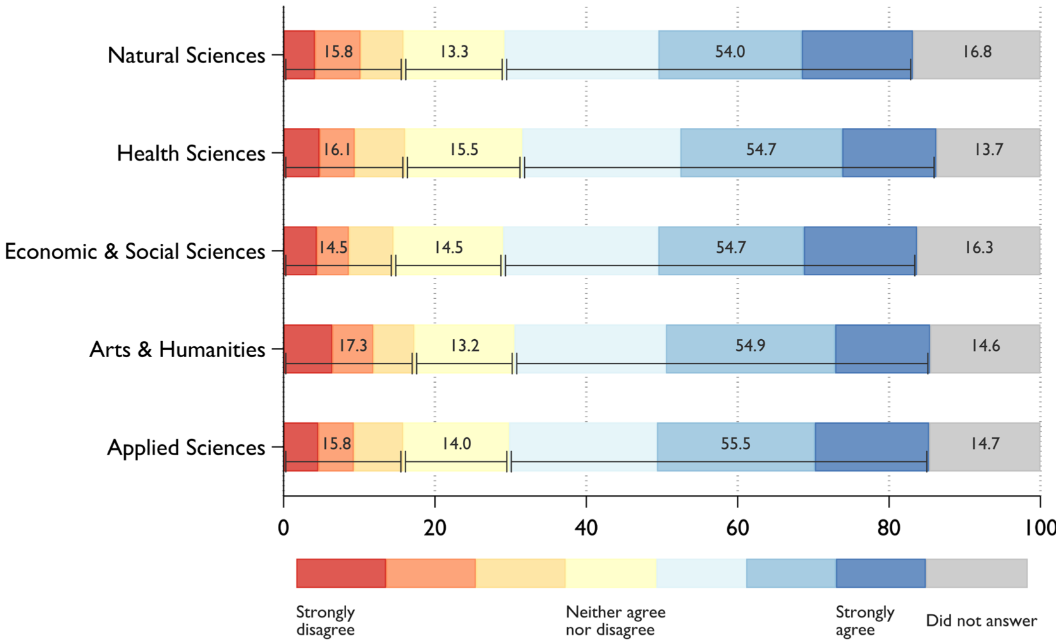

Fig. S3. Opinion on whether immunity certificates are *good for the economy*, by field. N = 10,758 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4)$ = 8.271; p = .0821).

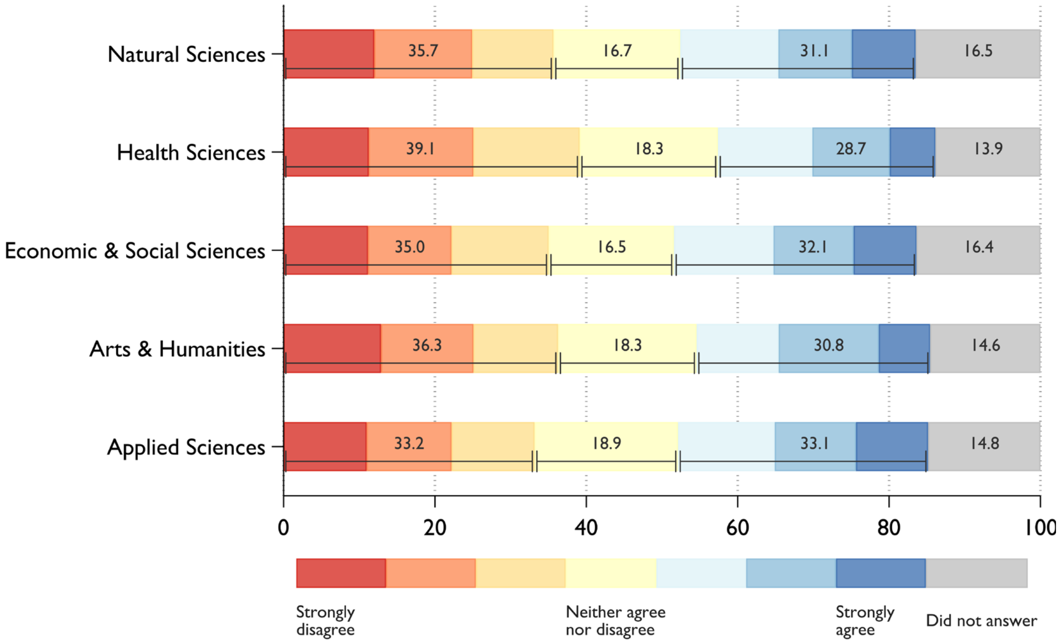

Fig. S4. Opinion on whether immunity certificates are *fair to others who do not have immunity*, by field. N = 10,754 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 22.89$; $p = .000133$).

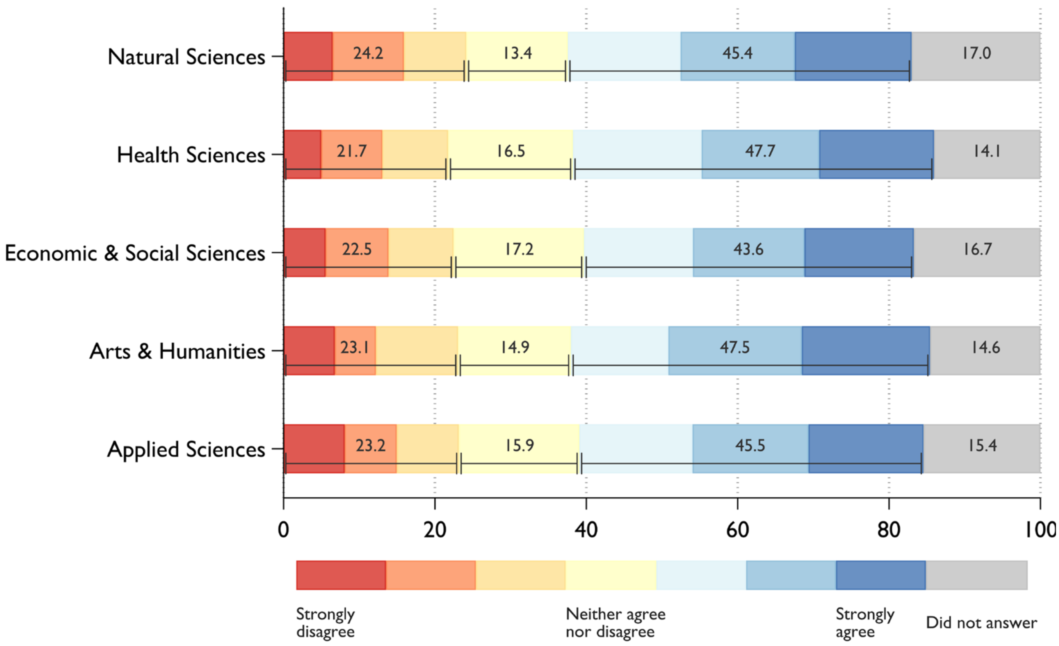

Fig. S5. Opinion on whether immunity certificates would *increase inequality*, by field. N = 10,712 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 4.972$; $p = .29$).

Table S1. Differences in opinion towards COVID-19 immunity certificates across fields.

			Good for public health			*Good for the economy*			*Fair to others*			*Increase inequality*		
			d	z-stat.	*p*-val.	*d*	z-stat.	*p*-val.	*d*	z-stat.	*p*-val.	*d*	z-stat.	*p*-val.
Applied Sciences	vs.	Arts & Humanities	.151	2.365*	.03	.05	.767	.443	.07	1.101	.226	-.06	-.955	.425
Applied Sciences	vs.	Economic & Social Sciences	.023	.771	.22	.001	.029	.488	.026	.894	.265	.004	.149	.49
Arts & Humanities	vs.	Economic & Social Sciences	-.066	-2.189*	.036	-.026	-.848	.495	-.02	-.684	.275	.035	1.174	.601
Applied Sciences	vs.	Health Sciences	.075	2.640*	.021	.043	1.494	.338	.093	3.206**	.003	-.026	-.919	.298
Arts & Humanities	vs.	Health Sciences	-.031	-1.02	.192	.002	.069	.525	.023	.766	.277	.016	.502	.44
Economic & Social Sciences	vs.	Health Sciences	.076	3.454**	.003	.06	2.711*	.034	.095	4.278***	<.001	-.044	-1.981	.238
Applied Sciences	vs.	Natural Sciences	.055	1.276	.144	.019	.446	.41	.068	1.616	.133	-.006	-.125	.45
Arts & Humanities	vs.	Natural Sciences	-.081	-1.679†	.093	-.026	-.523	.429	-.005	-.094	.463	.046	.941	.347
Economic & Social Sciences	vs.	Natural Sciences	.023	.888	.208	.017	.628	.442	.032	1.234	.217	-.009	-.385	.437
Health Sciences	vs.	Natural Sciences	-.042	-1.584†	.094	-.035	-1.311	.316	-.048	-1.831	.112	.027	1.033	.503
N			10,789			10,758			10,754			10,712		

Notes. Cohen's $d = 2*z/\sqrt{n}$. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$. Non-parametric pairwise multiple comparison (Dunn, 1964) controlling for the false discovery rate using the Benjamini-Hochberg stepwise adjustments.

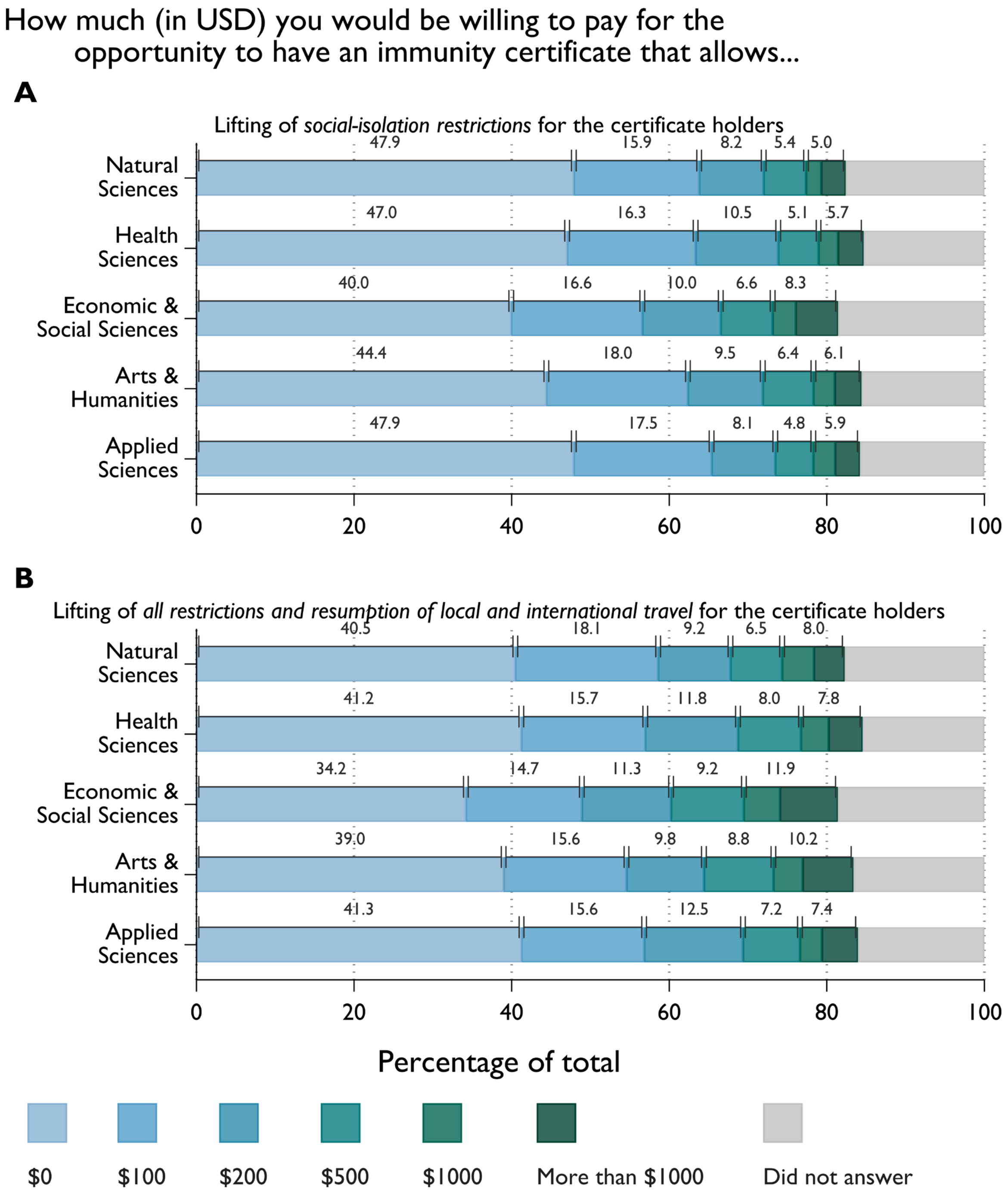

Fig. S6. Willingness to pay for immunity passports by field of research. (*A*) lifting social restrictions. N = 10,547 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 75.48$; $p < .001$). (*B*) lifting travel restrictions. N = 10,530 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 86.35$; $p < .001$).

Table S2. Differences in willingness-to-pay for COVID-19 immunity certificate across fields.

			Lifting social restrictions			*Lifting travel restrictions*		
			d	z-stat.	*p*-val.	*d*	z-stat.	*p*-val.
Applied Sciences	vs.	Arts & Humanities	-.052	-.838	.402	-.056	-.943	.288
Applied Sciences	vs.	Economic & Social Sciences	-.121	-4.645***	<.001	-.121	-4.614***	<.001
Arts & Humanities	vs.	Economic & Social Sciences	-.055	-1.962†	.062	-.05	-1.824†	.085
Applied Sciences	vs.	Health Sciences	-.011	-.393	.386	.001	.062	.475
Arts & Humanities	vs.	Health Sciences	.02	.702	.402	.031	1.105	.269
Economic & Social Sciences	vs.	Health Sciences	.16	7.883***	<.001	.176	8.671***	<.001
Applied Sciences	vs.	Natural Sciences	-.019	-.522	.376	-.015	-.426	.372
Arts & Humanities	vs.	Natural Sciences	.026	.551	.416	.032	.728	.333
Economic & Social Sciences	vs.	Natural Sciences	.13	5.423***	<.001	.134	5.528***	<.001
Health Sciences	vs.	Natural Sciences	-.005	-.261	.397	-.016	-.723	.293
N			10,547			10,530		

Notes. Cohen's $d = 2*z/\sqrt{n}$. Significance levels: $***p < .001$, $**p < .01$, $*p < .05$, $†p < .1$. Non-parametric pairwise multiple comparison (Dunn, 1964) controlling for the false discovery rate using the Benjamini-Hochberg stepwise adjustments.

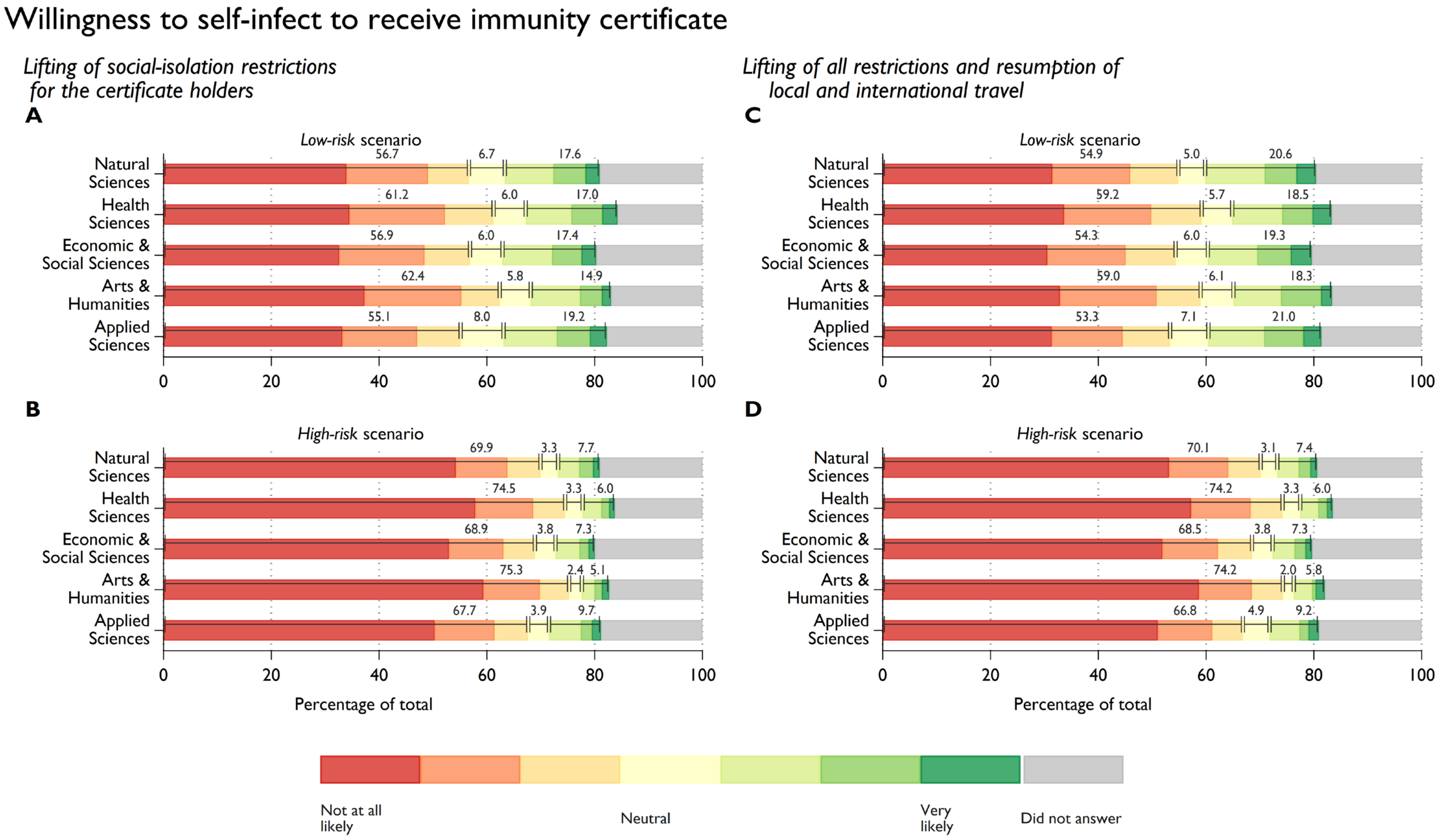

Fig. S7. Willingness to self-infect for immunity passports by field of research. (*A*) lifting social restrictions (low-risk scenario). N = 10,424 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 6.023$; $p = .197$). (*B*) lifting social restrictions (high-risk scenario). N = 10,374 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 24.7$; $p < .001$). (*C*) lifting travel restrictions (low-risk scenario). N = 10,328 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 9.983$; $p = .0407$). (*D*) lifting travel restrictions (high-risk scenario). N = 10,336 non-missing responses. Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 23.38$; $p < .001$).

Table S3. Differences in willingness to self-infect to receive COVID-19 immunity certificate across fields.

			Low-risk scenario						*High-risk scenario*					
			Lifting social restrictions			*Lifting travel restrictions*			*Lifting social restrictions*			*Lifting travel restrictions*		
			d	z-stat.	*p*-val.	*d*	z-stat.	*p*-val.	*d*	z-stat.	*p*-val.	*d*	z-stat.	*p*-val.
Applied Sciences	vs.	Arts & Humanities	.142	2.186	.144	.073	1.117	.33	.198	3.084**	.003	.174	2.704*	.011
Applied Sciences	vs.	Economic & Social Sciences	.03	1.009	.196	.016	.543	.367	.067	2.314*	.021	.041	1.401	.101
Arts & Humanities	vs.	Economic & Social Sciences	-.057	-1.837	.165	-.029	-.921	.357	-.062	-2.029*	.035	-.067	-2.177*	.037
Applied Sciences	vs.	Health Sciences	.046	1.588	.187	.059	2.023	.108	.119	4.066***	<.001	.1	3.408**	.002
Arts & Humanities	vs.	Health Sciences	-.045	-1.476	.14	.001	.015	.494	-.029	-.929	.196	-.029	-.917	.2
Economic & Social Sciences	vs.	Health Sciences	.024	1.068	.204	.062	2.740*	.031	.073	3.247**	.003	.084	3.724***	.001
Applied Sciences	vs.	Natural Sciences	.05	1.163	.204	.03	.688	.351	.099	2.317*	.026	.073	1.672†	.067
Arts & Humanities	vs.	Natural Sciences	-.077	-1.564	.147	-.036	-.734	.386	-.086	-1.751*	.05	-.088	-1.779†	.063
Economic & Social Sciences	vs.	Natural Sciences	.011	.402	.382	.008	.31	.42	.01	.394	.347	.018	.644	.26
Health Sciences	vs.	Natural Sciences	-.01	-.364	.358	-.045	-1.659	.162	-.053	-1.939*	.038	-.056	-2.032*	.042
N			10,424			10,374			10,328			10,336		

Notes. Cohen's $d = 2*z/\sqrt{n}$. Significance levels: ***p < .001, **p < .01, *p < .05, †p < .1. Non-parametric pairwise multiple comparison (Dunn, 1964) controlling for the false discovery rate using the Benjamini-Hochberg stepwise adjustments.

US and non-US difference

Table S4. Difference in views on immunity certificates between US and non-US based scientists.

Non-US vs. *US*	*d*	*z*-stat.	*p*-val.
Good for public health	-.117	-6.06***	<.001
Good for the economy	-.113	-5.84***	<.001
Fair to others who do not have immunity	-.037	-1.93†	.0533
Increasing inequality	.053	2.75**	.0059
Willingness to pay			
Lifting of social-isolation restrictions	-.25	-12.82***	<.001
Lifting of all restrictions and resumption of local and international travel	-.188	-9.63***	<.001
Willingness to self-infect			
Low-risk scenario			
Lifting of social-isolation restrictions	.048	2.43*	.0152
Lifting of all restrictions and resumption of local and international travel	.07	3.56***	<.001
High-risk scenario			
Lifting of social-isolation restrictions	.195	9.92***	<.001
Lifting of all restrictions and resumption of local and international travel	.189	9.63***	<.001

Notes. Wilcoxon rank sum test (two-tailed). Cohen's $d = 2*z/\sqrt{n}$. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$.

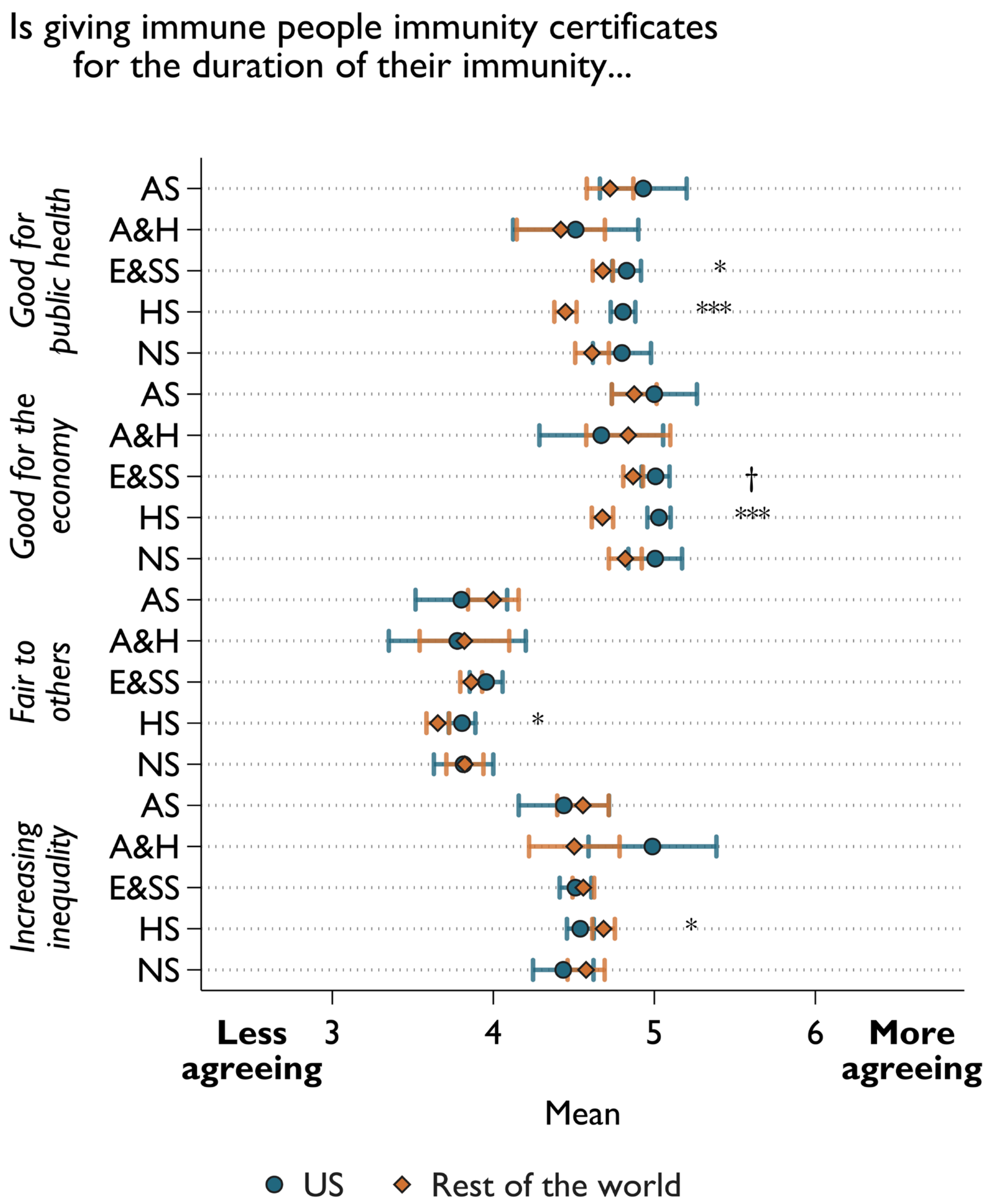

Fig. S8. Difference in opinion on immunity certificates between US and non-US based scientists by field. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Two-sample mean comparison with *t*-test (two-tailed). Error bars represent 95% confidence intervals. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$ based on *p*-values with Bonferroni correction for multiple-comparison. Results are robust to using the Wilcoxon rank sum test.

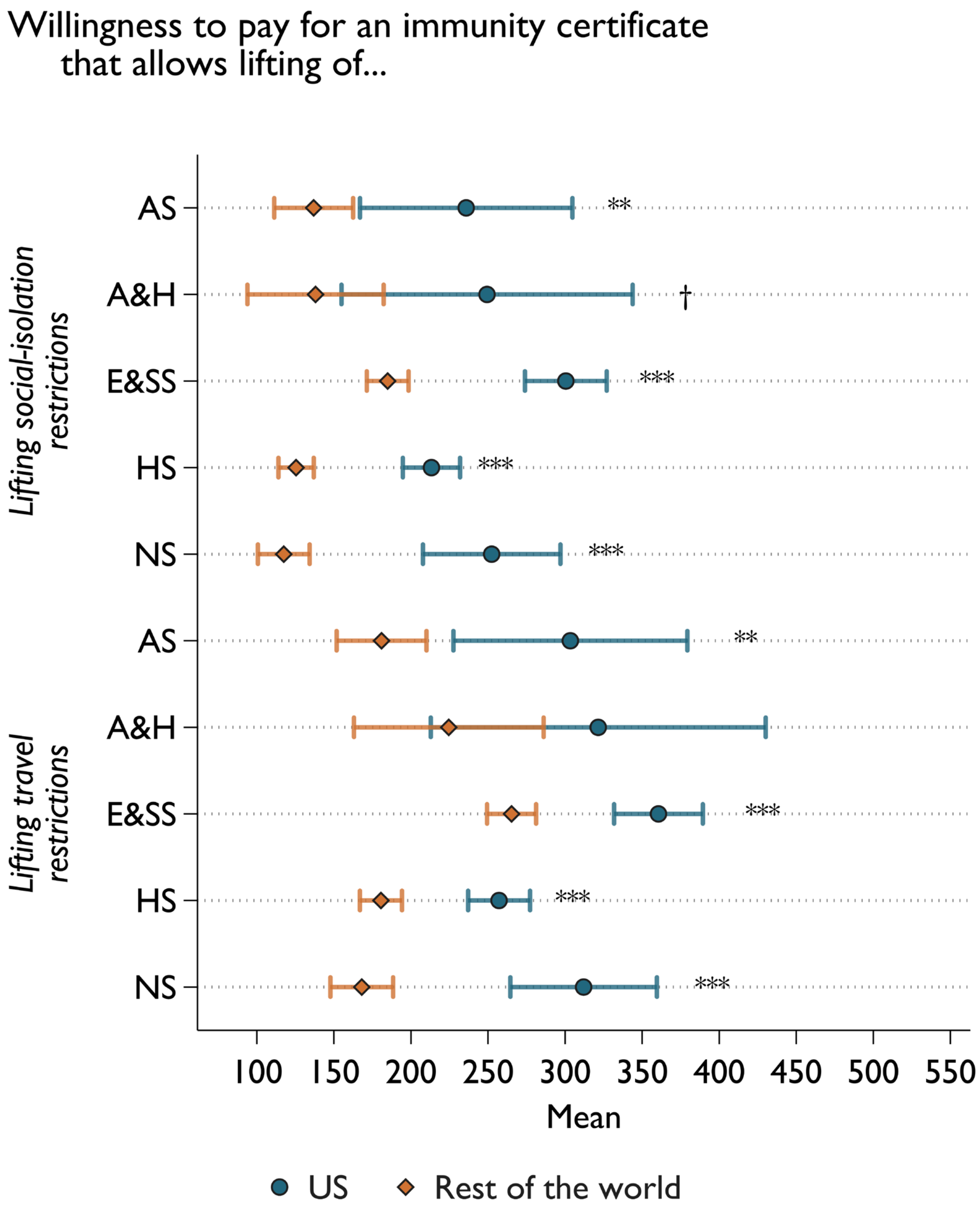

Fig. S9. Difference in willingness-to-pay for immunity certificates between US and non-US based scientists by field. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Two-sample mean comparison with *t*-test (two-tailed). Error bars represent 95% confidence intervals. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$ based on *p*-values with Bonferroni correction for multiple-comparison. Results are robust to using the Wilcoxon rank sum test.

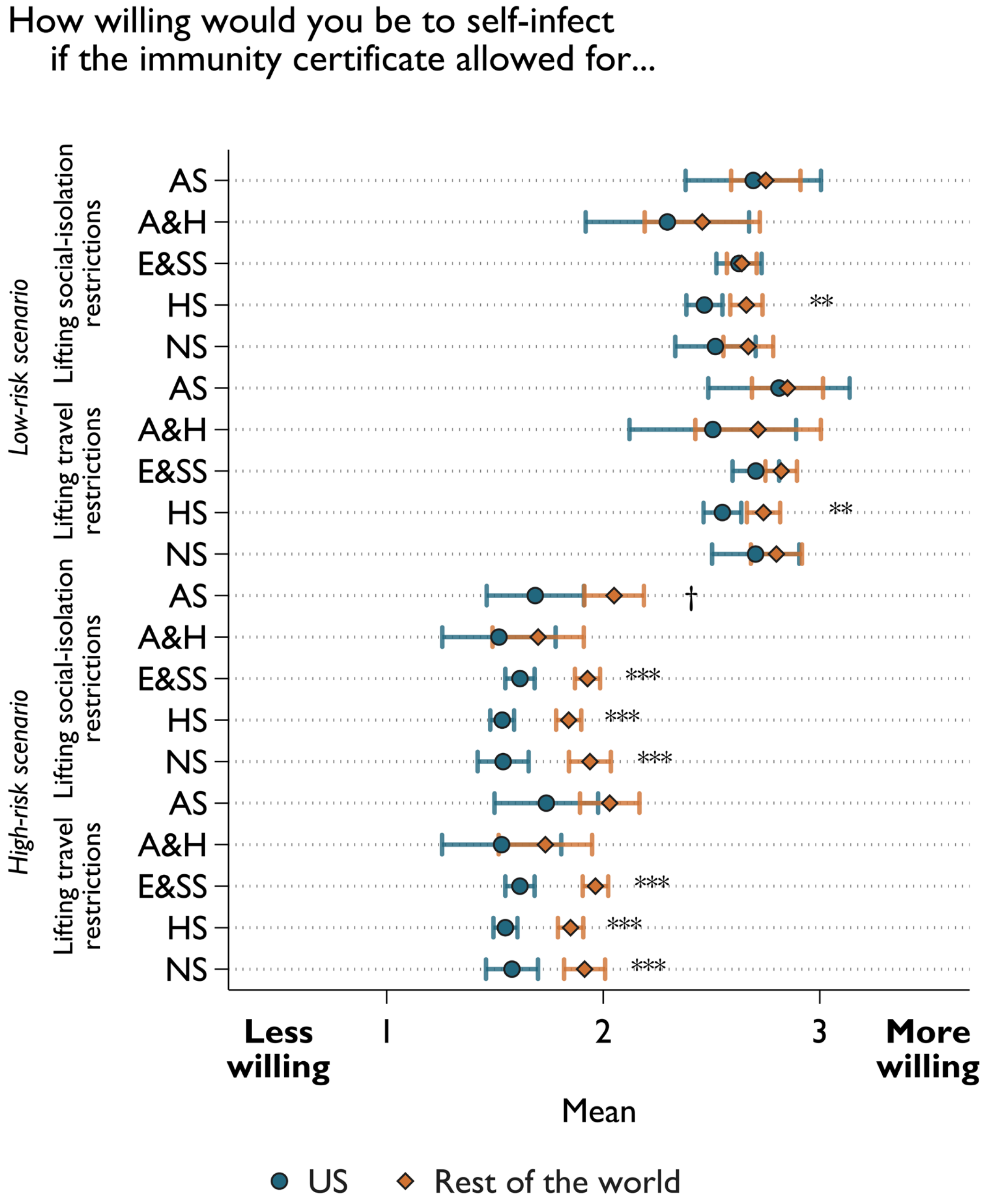

Fig. S10. Difference in willingness to self-infect for immunity certificates between US and non-US based scientists by field. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Two-sample mean comparison with *t*-test (two-tailed). Error bars represent 95% confidence intervals. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$ based on *p*-values with Bonferroni correction for multiple-comparison. Results are robust to using the Wilcoxon rank sum test (Table S5).

Table S5. Difference in views on immunity certificates between US and non-US based scientists, by field.

Non-US vs. *US*	*d*	*z*-stat.	*p*-val.
Good for public health			
Applied Sciences	-.091	-1.209	.227
Arts & Humanities	-.058	-.46	.645
Economic & Social Sciences	-.069	-2.2*	.0278
Health Sciences	-.193	-6.249***	<.001
Natural Sciences	-.099	-1.868†	.0618
Good for the economy			
Applied Sciences	-.054	-.717	.473
Arts & Humanities	.092	.731	.465
Economic & Social Sciences	-.068	-2.183*	.029
Health Sciences	-.198	-6.410***	<.001
Natural Sciences	-.091	-1.707†	.0878
Fair to others who do not have immunity			
Applied Sciences	.089	1.18	.238
Arts & Humanities	.018	.14	.889
Economic & Social Sciences	-.048	-1.533	.125
Health Sciences	-.083	-2.683**	.00729
Natural Sciences	.001	.014	.988
Increasing inequality			
Applied Sciences	.08	1.062	.288
Arts & Humanities	-.264	-2.092*	.0365
Economic & Social Sciences	.032	1.007	.314
Health Sciences	.09	2.902**	.00371
Natural Sciences	.083	1.554	.12
Willingness to pay			
Lifting of social-isolation restrictions			
Applied Sciences	-.219	-2.889**	.00387
Arts & Humanities	-.312	-2.462*	.0138
Economic & Social Sciences	-.222	-7.014***	<.001
Health Sciences	-.277	-8.870***	<.001
Natural Sciences	-.32	-6.007***	<.001
Lifting of all restrictions and resumption of local and international travel			
Applied Sciences	-.228	-3.007**	.00264
Arts & Humanities	-.196	-1.539	.124
Economic & Social Sciences	-.134	-4.240***	<.001
Health Sciences	-.213	-6.808***	<.001
Natural Sciences	-.343	-6.425***	<.001
Willingness to self-infect			
Low-risk scenario			
Lifting of social-isolation restrictions			
Applied Sciences	.016	.209	.834
Arts & Humanities	.085	.666	.506
Economic & Social Sciences	.005	.164	.87
Health Sciences	.075	2.406*	.0161
Natural Sciences	.055	1.031	.303
Lifting of all restrictions and resumption of local and international travel			
Applied Sciences	.017	.214	.83
Arts & Humanities	.075	.589	.556

Economic & Social Sciences	.054	1.681†	.0928
Health Sciences	.082	2.612**	.00901
Natural Sciences	.048	.894	.371
High-risk scenario			
Lifting of social-isolation restrictions			
Applied Sciences	.187	2.420*	.0155
Arts & Humanities	.121	.947	.343
Economic & Social Sciences	.151	4.731***	<.001
Health Sciences	.206	6.573***	<.001
Natural Sciences	.221	4.106***	<.001
Lifting of all restrictions and resumption of local and international travel			
Applied Sciences	.157	2.039*	.0415
Arts & Humanities	.186	1.449	.147
Economic & Social Sciences	.177	5.539***	<.001
Health Sciences	.192	6.118***	<.001
Natural Sciences	.165	3.067**	.00216

Notes. Wilcoxon rank sum test (two-tailed). Cohen's $d = 2*z/\sqrt{n}$. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$ based on p-values with Bonferroni correction for multiple-comparison.

Time to normality

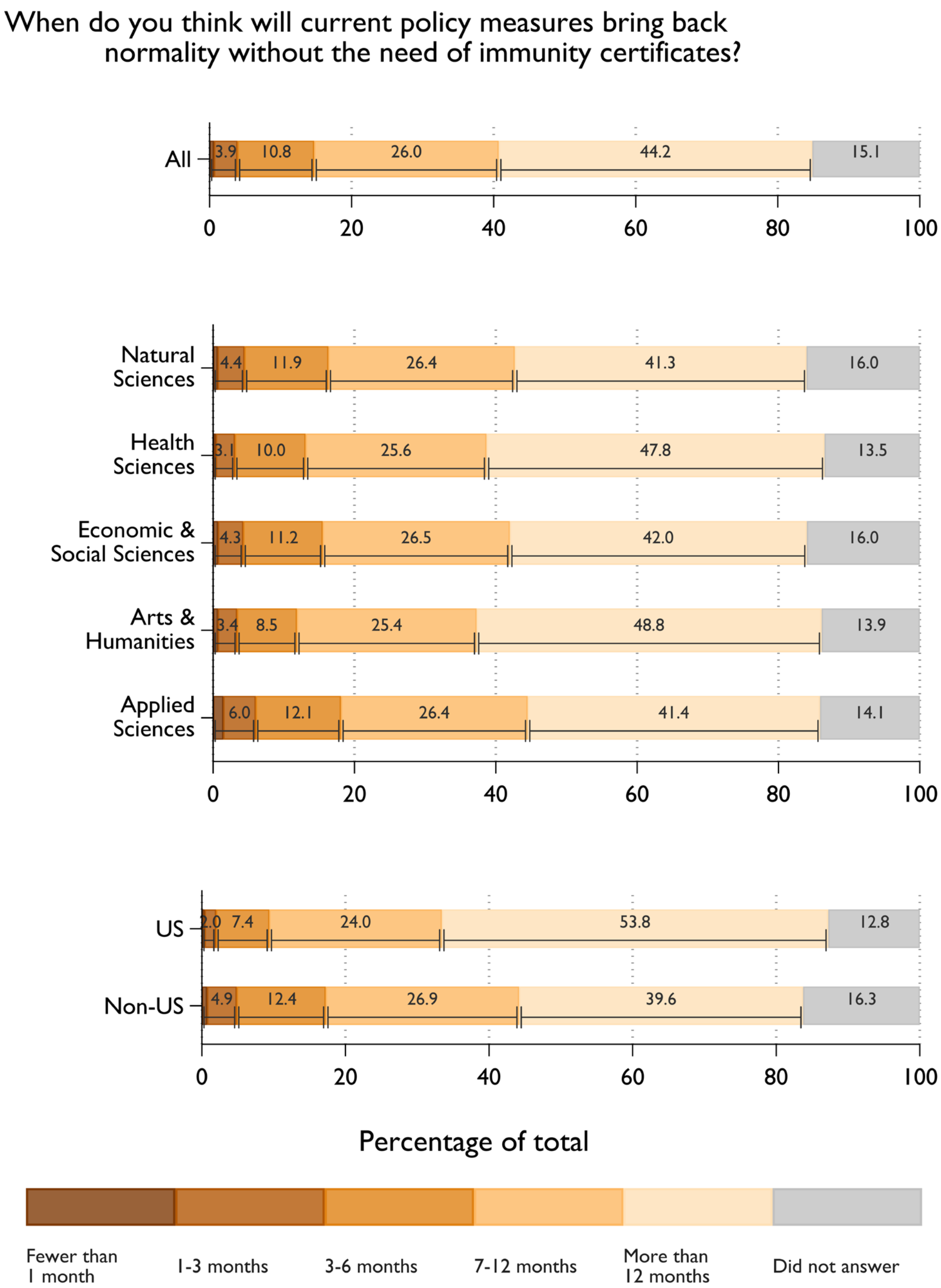

Fig. S11. Time to normality projections. N = 10,809 non-missing responses. Distributional difference by fields: Kruskal-Wallis equality-of-populations rank test (tie-corrected $\chi^2(4) = 45.56$; $p < .001$). Difference between US and Non-US: Cohen's $d = -.301$; $z = -15.66$; $p < .001$.

Table S6. Differences in expected back-to-normality timelines across fields.

Expected 'back-to-normal' timeline without the need for immunity certificates?					
			d	z-stat.	*p*-val.
Applied Sciences	vs.	Arts & Humanities	-.177	-2.801**	.006
Applied Sciences	vs.	Economic & Social Sciences	-.041	-1.419	.111
Arts & Humanities	vs.	Economic & Social Sciences	.068	2.276*	.019
Applied Sciences	vs.	Health Sciences	-.122	-4.264***	<.001
Arts & Humanities	vs.	Health Sciences	.015	.494	.311
Economic & Social Sciences	vs.	Health Sciences	-.116	-5.254***	<.001
Applied Sciences	vs.	Natural Sciences	-.034	-.772	.275
Arts & Humanities	vs.	Natural Sciences	.12	2.487*	.013
Economic & Social Sciences	vs.	Natural Sciences	.019	.724	.261
Health Sciences	vs.	Natural Sciences	.121	4.495***	<.001
N			10,809		

Notes. Cohen's $d = 2*z/\sqrt{n}$. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$. Non-parametric pairwise multiple comparison (Dunn, 1964) controlling for the false discovery rate using the Benjamini-Hochberg stepwise adjustments.

Table S7. Differences in expected back-to-normality timelines between US and Non-US scholars, by field.

Non-US vs. *US*	*d*	*z*-stat.	*p*-val.
Applied Sciences	-.229	-3.055**	.00225
Arts & Humanities	-.47	-3.744***	<.001
Economic & Social Sciences	-.314	-10.069***	<.001
Health Sciences	-.303	-9.811***	<.001
Natural Sciences	-.163	-3.093**	.00198

Notes. Wilcoxon rank sum test (two-tailed). Cohen's $d = 2*z/\sqrt{n}$. Significance levels: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .1$.

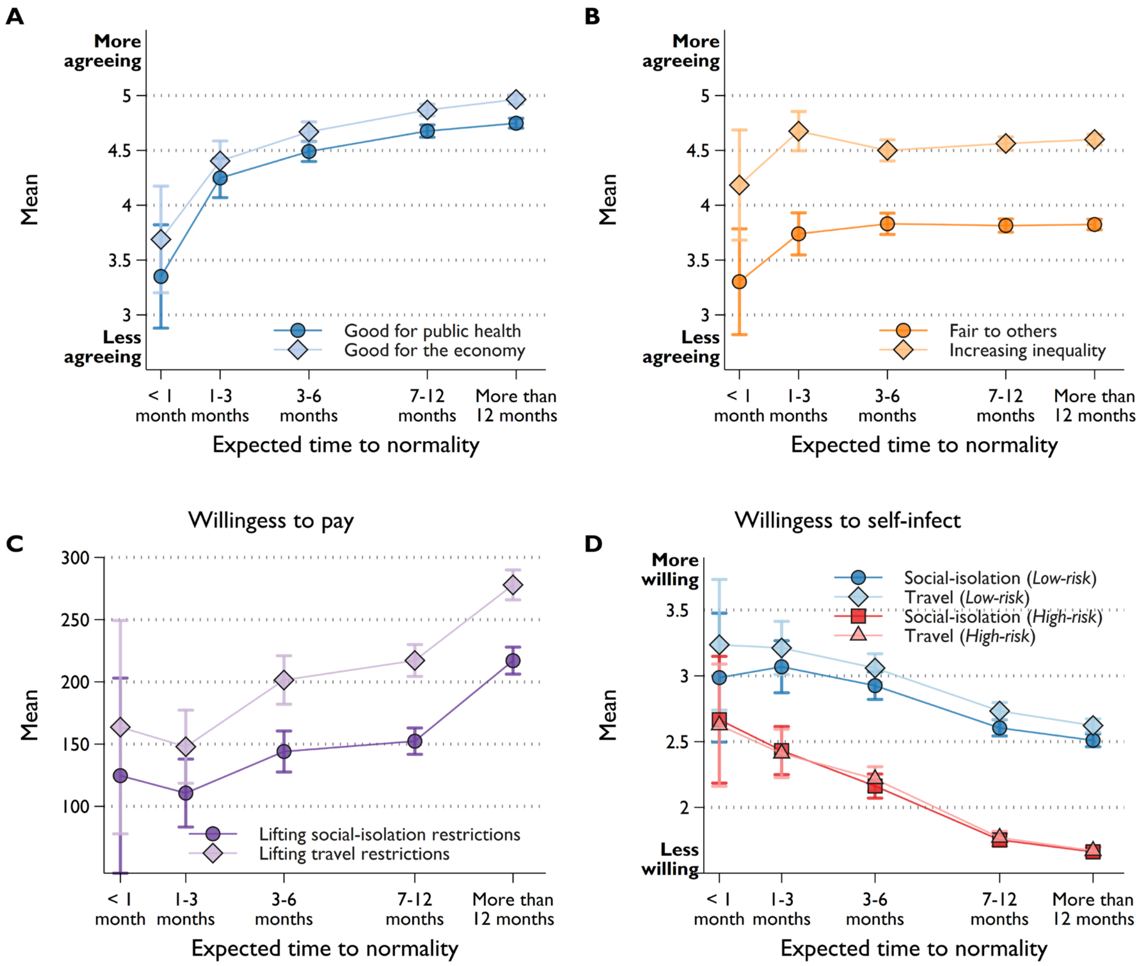

Fig. S12. Time-to-normality and attitude toward immunity certificate. "*Is giving immune people immunity certificates for the duration of their immunity...*" regarding *good for public health*, *good for the economy* (*A*), *fair to others who do not have immunity,* and *increase inequality* (*B*). Willingness to self-infect for immunity certificate lifting *social-isolation* and *travel* restrictions, if medically assessed as *low-risk* or *high-risk* groups (*C*). Willingness to pay for immunity certificate lifting *social-isolation* and *travel* restrictions (*D*). Responses were averaged according to the answer given to the question "*When do you think will current policy measures (including social distancing and investment in medical research) bring back normality without the need of immunity certificates*". Error bars represent 95% confidence intervals.

Consensus

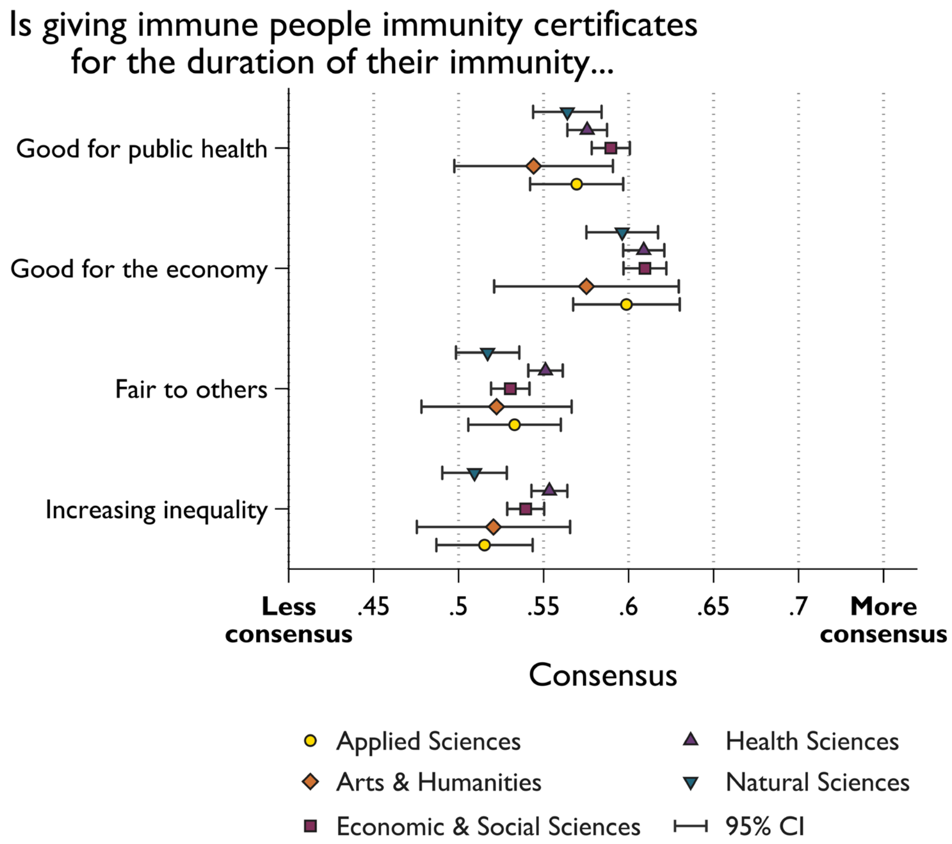

Fig. S13. Consensus on perceived benefits to public health and economy, fairness, and societal inequality of immunity certificate within field. Error bars represent 95% confidence intervals obtained from bootstrap resampling with 300 replications. Null responses are excluded from the calculation of consensus.

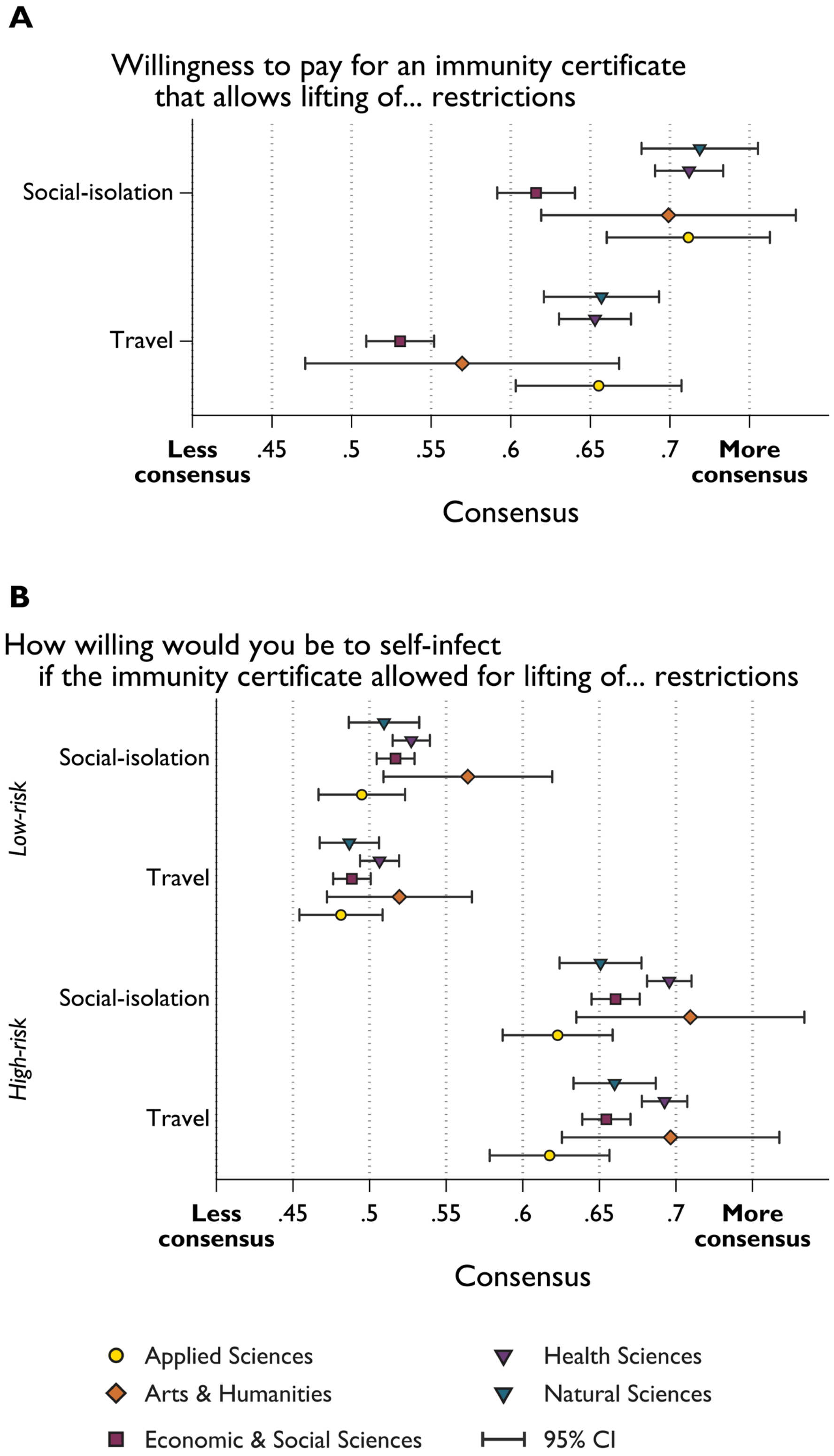

Fig. S14. Consensus on willingness to pay (*A*) and self-infect (*B*) for immunity certificate for lifting social-isolation and travel restrictions within field. Error bars represent 95% confidence intervals obtained from bootstrap resampling with 300 replications. Null responses are excluded from the calculation of consensus.

Table S8. Differences in the level of consensus on perceived benefits to public health and economy, fairness, and societal inequality of immunity certificate across fields.

Field 1	Field 2	Mean 1	SD 1	Mean 2	SD 2	p (unadj.)	p (adjusted)
Good for public health							
AS	*A&H*	0.569	0.372	0.544	0.379	0.36	1
AS	*E&SS*	0.569	0.372	0.59	0.367	0.18	1
AS	*HS*	0.569	0.372	0.576	0.385	0.69	1
AS	*NS*	0.569	0.372	0.564	0.388	0.76	1
A&H	*E&SS*	0.544	0.379	0.59	0.367	0.057	0.57
A&H	*HS*	0.544	0.379	0.576	0.385	0.21	1
A&H	*NS*	0.544	0.379	0.564	0.388	0.45	1
E&SS	*HS*	0.59	0.367	0.576	0.385	0.094	0.94
E&SS	*NS*	0.59	0.367	0.564	0.388	0.026	0.26
HS	*NS*	0.576	0.385	0.564	0.388	0.32	1
Good for the economy							
AS	*E&SS*	0.599	0.425	0.575	0.44	0.46	1
AS	*HS*	0.599	0.425	0.61	0.411	0.52	1
AS	*NS*	0.599	0.425	0.609	0.4	0.54	1
A&H	*E&SS*	0.599	0.425	0.596	0.406	0.9	1
A&H	*HS*	0.575	0.44	0.61	0.411	0.2	1
A&H	*NS*	0.575	0.44	0.609	0.4	0.2	1
E&SS	*HS*	0.575	0.44	0.596	0.406	0.45	1
E&SS	*NS*	0.61	0.411	0.609	0.4	0.94	1
HS	*NS*	0.61	0.411	0.596	0.406	0.29	1
Fair to others who do not have immunity							
AS	*A&H*	0.533	0.369	0.522	0.358	0.69	1
AS	*E&SS*	0.533	0.369	0.53	0.369	0.87	1
AS	*HS*	0.533	0.369	0.551	0.334	0.19	1
AS	*NS*	0.533	0.369	0.517	0.36	0.34	1
A&H	*E&SS*	0.522	0.358	0.53	0.369	0.74	1
A&H	*HS*	0.522	0.358	0.551	0.334	0.19	1
A&H	*NS*	0.522	0.358	0.517	0.36	0.83	1
E&SS	*HS*	0.53	0.369	0.551	0.334	0.0074	.074†
E&SS	*NS*	0.53	0.369	0.517	0.36	0.24	1
HS	*NS*	0.551	0.334	0.517	0.36	0.0011	.011*
Increasing inequality							
AS	*A&H*	0.515	0.383	0.521	0.365	0.85	1
AS	*E&SS*	0.515	0.383	0.539	0.354	0.099	0.99
AS	*HS*	0.515	0.383	0.553	0.349	0.0082	.082†
AS	*NS*	0.515	0.383	0.509	0.365	0.73	1
A&H	*E&SS*	0.521	0.365	0.539	0.354	0.41	1
A&H	*HS*	0.521	0.365	0.553	0.349	0.15	1
A&H	*NS*	0.521	0.365	0.509	0.365	0.65	1
E&SS	*HS*	0.539	0.354	0.553	0.349	0.072	0.72
E&SS	*NS*	0.539	0.354	0.509	0.365	0.0063	.063†
HS	*NS*	0.553	0.349	0.509	0.365	<.001	<.001***

Notes. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Two-tailed t-test. Significance levels: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †$p < 0.1$ based on p-values with Bonferroni correction for multiple-comparison. Standard deviations are computed using bootstrap resampling with 300 replications.

Table S9. Differences in the level of consensus on willingness to pay and willingness to self-infect for immunity certificate across fields.

Field 1	Field 2	Mean 1	SD 1	Mean 2	SD 2	*p* (unadj.)	*p* (adjusted)
Willingness to pay: Lifting of social-isolation restrictions							
AS	*A&H*	0.712	0.691	0.699	0.644	0.8	1
AS	*E&SS*	0.712	0.691	0.616	0.787	0.0026	.026*
AS	*HS*	0.712	0.691	0.712	0.699	0.99	1
AS	*NS*	0.712	0.691	0.719	0.701	0.82	1
A&H	*E&SS*	0.699	0.644	0.616	0.787	0.1	1
A&H	*HS*	0.699	0.644	0.712	0.699	0.78	1
A&H	*NS*	0.699	0.644	0.719	0.701	0.68	1
E&SS	*HS*	0.616	0.787	0.712	0.699	<.001	<.001***
E&SS	*NS*	0.616	0.787	0.719	0.701	<.001	<.001***
HS	*NS*	0.712	0.699	0.719	0.701	0.76	1
Willingness to pay: Lifting of all restrictions and resumption of local and international travel							
AS	*A&H*	0.655	0.701	0.569	0.789	0.11	1
AS	*E&SS*	0.655	0.701	0.531	0.686	<.001	<.001***
AS	*HS*	0.655	0.701	0.653	0.738	0.94	1
AS	*NS*	0.655	0.701	0.657	0.693	0.96	1
A&H	*E&SS*	0.569	0.789	0.531	0.686	0.39	1
A&H	*HS*	0.569	0.789	0.653	0.738	0.086	0.86
A&H	*NS*	0.569	0.789	0.657	0.693	0.074	0.74
E&SS	*HS*	0.531	0.686	0.653	0.738	<.001	<.001***
E&SS	*NS*	0.531	0.686	0.657	0.693	<.001	<.001***
HS	*NS*	0.653	0.738	0.657	0.693	0.86	1
Willingness to self-infect: Lifting of social-isolation restrictions (Low-risk scenario)							
AS	*A&H*	0.495	0.376	0.564	0.44	0.019	0.19
AS	*E&SS*	0.495	0.376	0.517	0.397	0.18	1
AS	*HS*	0.495	0.376	0.527	0.397	0.047	0.47
AS	*NS*	0.495	0.376	0.509	0.436	0.46	1
A&H	*E&SS*	0.564	0.44	0.517	0.397	0.073	0.73
A&H	*HS*	0.564	0.44	0.527	0.397	0.16	1
A&H	*NS*	0.564	0.44	0.509	0.436	0.071	0.71
E&SS	*HS*	0.517	0.397	0.527	0.397	0.25	1
E&SS	*NS*	0.517	0.397	0.509	0.436	0.55	1
HS	*NS*	0.527	0.397	0.509	0.436	0.16	1
Willingness to self-infect: Lifting of all restrictions and resumption of local and international travel (Low-risk scenario)							
AS	*A&H*	0.481	0.36	0.52	0.378	0.16	1
AS	*E&SS*	0.481	0.36	0.489	0.39	0.66	1
AS	*HS*	0.481	0.36	0.507	0.413	0.14	1
AS	*NS*	0.481	0.36	0.487	0.367	0.75	1
A&H	*E&SS*	0.52	0.378	0.489	0.39	0.23	1
A&H	*HS*	0.52	0.378	0.507	0.413	0.63	1
A&H	*NS*	0.52	0.378	0.487	0.367	0.2	1

E&SS	*HS*	0.489	0.39	0.507	0.413	0.046	0.46
E&SS	*NS*	0.489	0.39	0.487	0.367	0.89	1
HS	*NS*	0.507	0.413	0.487	0.367	0.12	1
Willingness to self-infect: Lifting of social-isolation restrictions (High-risk scenario)							
AS	*A&H*	0.623	0.475	0.709	0.593	0.023	0.23
AS	*E&SS*	0.623	0.475	0.661	0.502	0.069	0.69
AS	*HS*	0.623	0.475	0.696	0.471	<.001	.0021**
AS	*NS*	0.623	0.475	0.651	0.507	0.23	1
A&H	*E&SS*	0.709	0.593	0.661	0.502	0.15	1
A&H	*HS*	0.709	0.593	0.696	0.471	0.66	1
A&H	*NS*	0.709	0.593	0.651	0.507	0.11	1
E&SS	*HS*	0.661	0.502	0.696	0.471	0.0013	.013*
E&SS	*NS*	0.661	0.502	0.651	0.507	0.53	1
HS	*NS*	0.696	0.471	0.651	0.507	0.0027	.027*
Willingness to self-infect: Lifting of all restrictions and resumption of local and international travel (High-risk scenario)							
AS	*A&H*	0.618	0.516	0.697	0.563	0.047	0.47
AS	*E&SS*	0.618	0.516	0.655	0.502	0.079	0.79
AS	*HS*	0.618	0.516	0.693	0.482	<.001	.0022**
AS	*NS*	0.618	0.516	0.66	0.509	0.078	0.78
A&H	*E&SS*	0.697	0.563	0.655	0.502	0.21	1
A&H	*HS*	0.697	0.563	0.693	0.482	0.9	1
A&H	*NS*	0.697	0.563	0.66	0.509	0.31	1
E&SS	*HS*	0.655	0.502	0.693	0.482	<.001	.0057**
E&SS	*NS*	0.655	0.502	0.66	0.509	0.73	1
HS	*NS*	0.693	0.482	0.66	0.509	0.032	0.32

Notes. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Two-tailed *t*-test. Significance levels: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †$p < 0.1$ based on p-values with Bonferroni correction for multiple-comparison. Standard deviations are computed using bootstrap resampling with 300 replications.

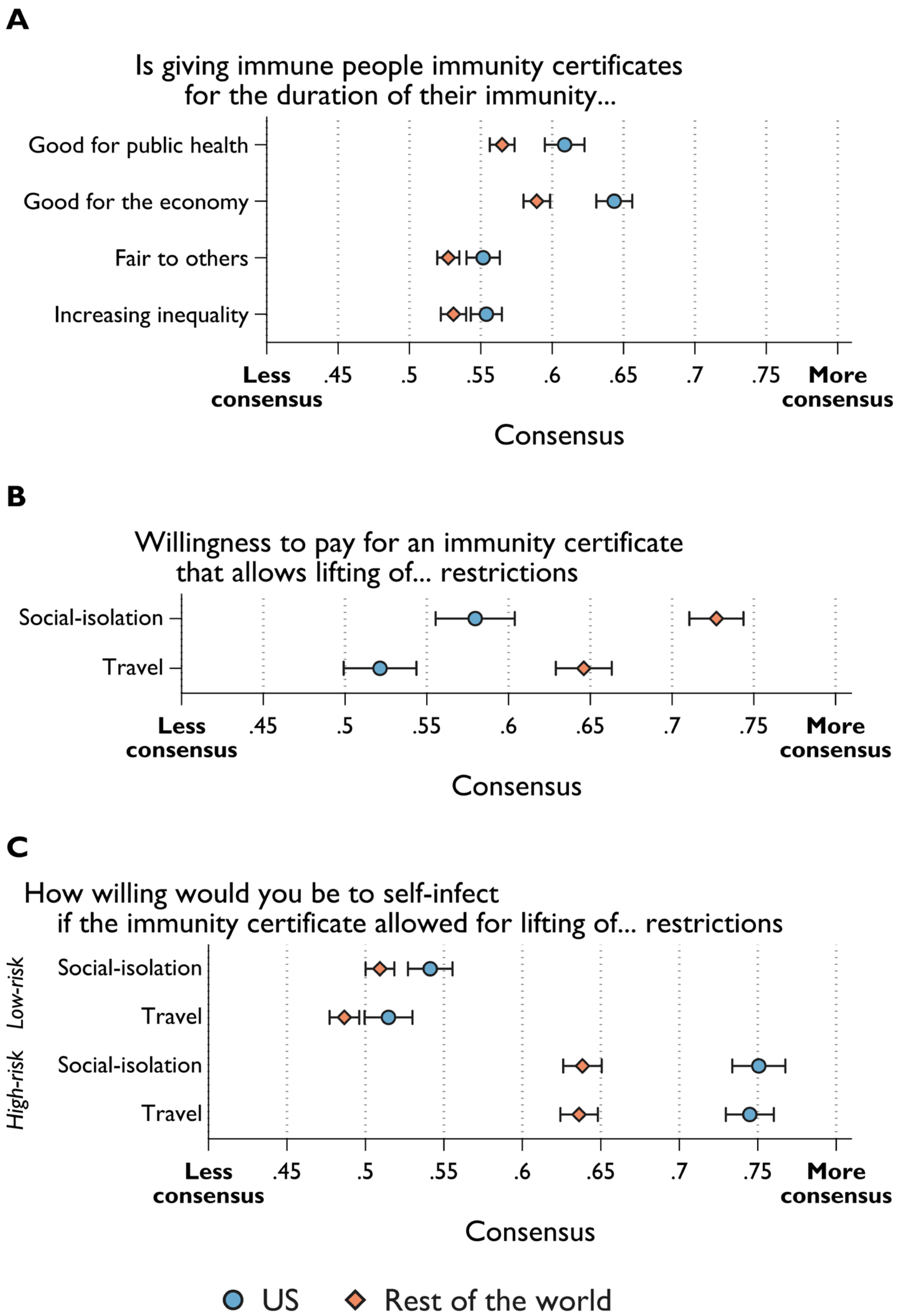

Fig. S15. Differences in the level of consensus between US and non-US scientists. Error bars represent 95% confidence intervals obtained from bootstrap resampling with 300 replications. Null responses are excluded from the calculation of consensus.

Table S10. Differences in the level of consensus between US and non-US scientists.

	Non-US		US			
	M 1	SD 1	M 2	SD 2	*p* (unadj.)	*p* (adjusted)
Good for public health	0.565	0.376	0.609	0.425	<.001	<.001***
Good for the economy	0.589	0.402	0.643	0.384	<.001	<.001***
Fair to others who do not have immunity	0.527	0.334	0.552	0.357	<.001	.0047***
Increasing inequality	0.531	0.382	0.554	0.332	0.0022	.022**
Willingness to pay: Lifting of social-isolation restrictions	0.727	0.709	0.58	0.73	<.001	<.001***
Willingness to pay: Lifting of all restrictions and resumption of local and international travel	0.646	0.732	0.521	0.671	<.001	<.001***
Willingness to self-infect: Lifting of social-isolation restrictions (*Low-risk* scenario)	0.509	0.39	0.541	0.427	<.001	.0013***
Willingness to self-infect: Lifting of all restrictions and resumption of local and international travel (*Low-risk* scenario)	0.487	0.399	0.515	0.456	0.0013	.013**
Willingness to self-infect: Lifting of social-isolation restrictions (*High-risk* scenario)	0.638	0.521	0.751	0.508	<.001	<.001***
Willingness to self-infect: Lifting of all restrictions and resumption of local and international travel (*High-risk* scenario)	0.636	0.504	0.745	0.46	<.001	<.001***

Notes. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Two-tailed *t*-test. Significance levels: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †$p < 0.1$ based on p-values with Bonferroni correction for multiple-comparison. Standard deviations are computed using bootstrap resampling with 300 replications.

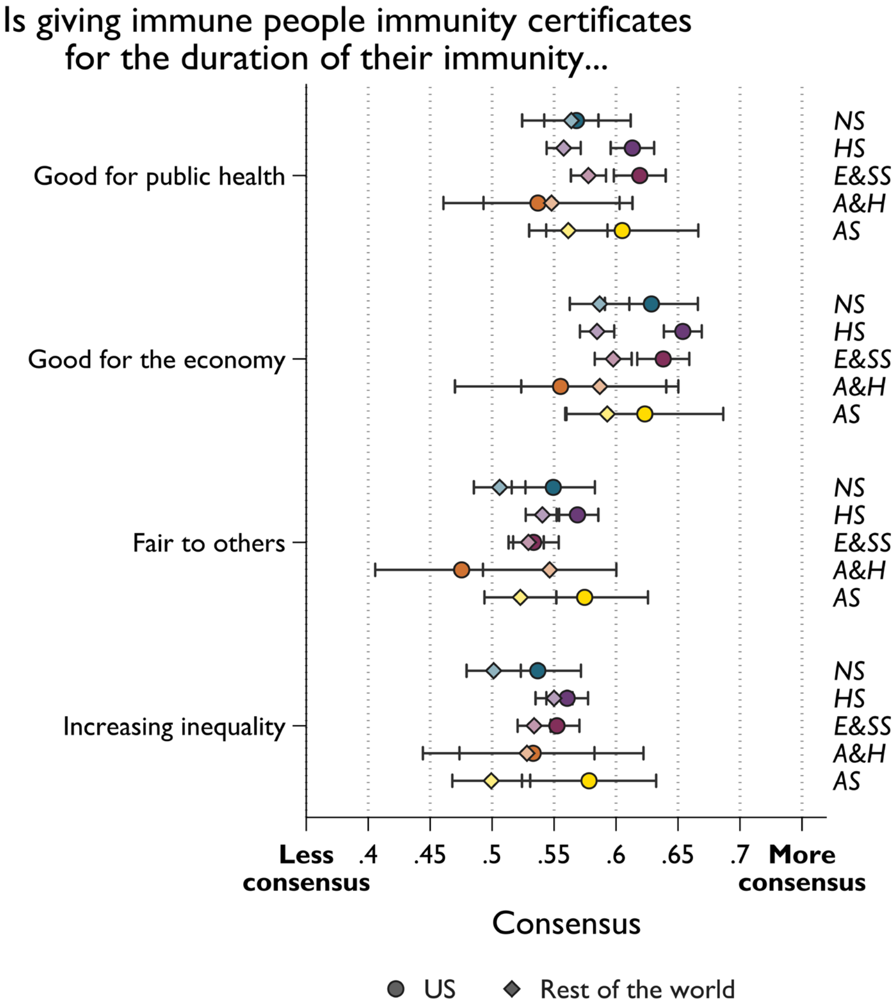

Fig. S16. Differences in consensus on perceived benefits to public health and economy, fairness, and societal inequality of immunity certificate between US and non-US scientists, by field. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Error bars represent 95% confidence intervals obtained from bootstrap resampling with 300 replications. Null responses are excluded from the calculation of consensus.

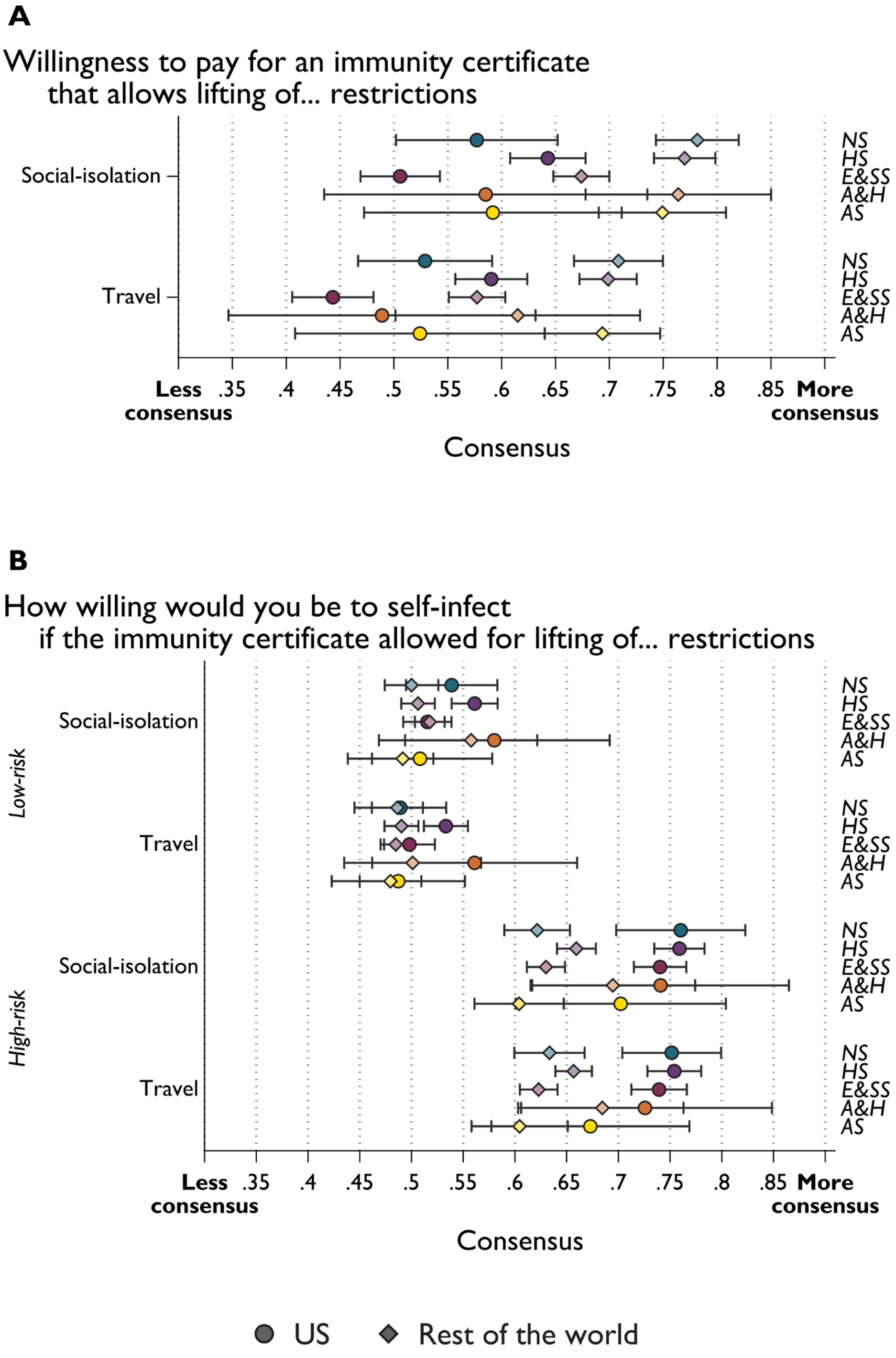

Fig. S17. Differences in consensus on willingness to pay (*A*) and willingness to self-infect (*B*) of immunity certificate between US and non-US scientists, by field. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Error bars represent 95% confidence intervals obtained from bootstrap resampling with 300 replications. Null responses are excluded from the calculation of consensus.

Table S11. Differences in the level of consensus between US and non-US scientists by field.

	Non-US		US			
	M 1	SD 1	M 2	SD 2	*p* (unadj.)	*p* (adjusted)
Good for public health						
AS	0.561	0.383	0.605	0.379	0.22	1
A&H	0.548	0.362	0.537	0.361	0.82	1
E&SS	0.578	0.385	0.619	0.379	0.0014	.0072**
HS	0.558	0.35	0.613	0.369	<.001	<.001***
NS	0.564	0.365	0.568	0.426	0.86	1
Good for the economy						
AS	0.593	0.411	0.623	0.389	0.42	1
A&H	0.587	0.418	0.555	0.401	0.57	1
E&SS	0.598	0.405	0.638	0.379	0.0027	.014*
HS	0.585	0.352	0.654	0.321	<.001	<.001***
NS	0.587	0.399	0.629	0.363	0.079	0.4
Fair to others who do not have immunity						
AS	0.523	0.35	0.575	0.315	0.1	1
A&H	0.546	0.355	0.475	0.328	0.13	1
E&SS	0.529	0.335	0.534	0.366	0.72	1
HS	0.541	0.342	0.569	0.353	0.0096	.048*
NS	0.506	0.346	0.549	0.327	0.037	0.19
Increasing inequality						
AS	0.499	0.377	0.578	0.334	0.022	0.11
A&H	0.528	0.359	0.533	0.419	0.92	1
E&SS	0.534	0.362	0.552	0.327	0.12	1
HS	0.55	0.379	0.561	0.354	0.36	1
NS	0.501	0.364	0.537	0.337	0.1	1
Willingness to pay: Lifting of social-isolation restrictions						
AS	0.749	0.709	0.592	0.734	0.018	.092†
A&H	0.764	0.57	0.585	0.689	0.031	0.16
E&SS	0.674	0.698	0.506	0.657	<.001	<.001***
HS	0.77	0.717	0.643	0.729	<.001	<.001***
NS	0.782	0.636	0.577	0.723	<.001	<.001***
Willingness to pay: Lifting of all restrictions and resumption of local and international travel						
AS	0.694	0.642	0.524	0.712	0.0059	.03*
A&H	0.615	0.748	0.489	0.646	0.2	1
E&SS	0.577	0.704	0.443	0.671	<.001	<.001***
HS	0.699	0.67	0.59	0.695	<.001	<.001***
NS	0.708	0.682	0.529	0.6	<.001	<.001***

Willingness to self-infect: Lifting of social-isolation restrictions (*Low-risk* scenario)						
AS	0.492	0.352	0.508	0.421	0.63	1
A&H	0.558	0.417	0.58	0.512	0.71	1
E&SS	0.518	0.383	0.515	0.414	0.86	1
HS	0.506	0.406	0.561	0.463	<.001	<.001***
NS	0.5	0.424	0.539	0.426	0.14	1
Willingness to self-infect: Lifting of all restrictions and resumption of local and international travel (*Low-risk* scenario)						
AS	0.48	0.352	0.487	0.386	0.83	1
A&H	0.501	0.434	0.561	0.455	0.32	1
E&SS	0.485	0.39	0.498	0.433	0.34	1
HS	0.49	0.409	0.533	0.441	0.0015	.0074**
NS	0.486	0.403	0.489	0.424	0.91	1
Willingness to self-infect: Lifting of social-isolation restrictions (*High-risk* scenario)						
AS	0.604	0.51	0.702	0.607	0.054	0.27
A&H	0.695	0.518	0.741	0.57	0.53	1
E&SS	0.63	0.49	0.74	0.449	<.001	<.001***
HS	0.659	0.469	0.759	0.505	<.001	<.001***
NS	0.622	0.518	0.76	0.601	<.001	<.001***
Willingness to self-infect: Lifting of all restrictions and resumption of local and international travel (*High-risk* scenario)						
AS	0.605	0.548	0.673	0.572	0.2	1
A&H	0.685	0.508	0.726	0.564	0.57	1
E&SS	0.623	0.483	0.739	0.475	<.001	<.001***
HS	0.657	0.441	0.754	0.539	<.001	<.001***
NS	0.633	0.554	0.752	0.46	<.001	.0016**

Notes. *AS* = Applied Sciences; *A&H* = Arts & Humanities; *E&SS* = Economic & Social Sciences; *HS* = Health Sciences; *NS* = Natural Sciences. Two-tailed *t*-test. Significance levels: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, †$p < 0.1$ based on p-values with Bonferroni correction for multiple-comparison. Standard deviations are computed using bootstrap resampling with 300 replications.

Regressions-based results

Table S12. Ordered logit regression for attitudes toward immunity certificates.

Dependent variable	Good for public health	Good for the economy	Fair to others	Increasing inequality
Scientific fields				
Applied Sciences	1.075	1.061	1.005	0.998
	(0.0980)	(0.0980)	(0.0926)	(0.0926)
Arts & Humanities	0.897	0.988	1.139	1.037
	(0.128)	(0.145)	(0.165)	(0.152)
Health Sciences	0.918†	0.938	0.939	0.984
	(0.0454)	(0.0460)	(0.0468)	(0.0487)
Natural Sciences	0.983	0.990	1.013	0.997
	(0.0681)	(0.0700)	(0.0692)	(0.0703)
Age				
18–29	1.239*	1.310**	1.140	0.973
	(0.119)	(0.135)	(0.115)	(0.0975)
40–49	0.921	0.882*	0.945	0.939
	(0.0544)	(0.0521)	(0.0546)	(0.0543)
50–59	1.058	0.847*	1.157*	0.829*
	(0.0774)	(0.0621)	(0.0841)	(0.0617)
60–69	0.979	0.787**	1.226*	0.731***
	(0.0841)	(0.0679)	(0.105)	(0.0638)
70+	0.927	0.808*	1.389**	0.582***
	(0.0967)	(0.0856)	(0.140)	(0.0587)
Gender				
Female	0.837***	0.863***	0.774***	1.254***
	(0.0368)	(0.0379)	(0.0341)	(0.0555)
Other	0.382*	0.263***	0.607	3.553*
	(0.187)	(0.106)	(0.357)	(2.158)
Prefer not to say	0.763	0.733	0.696	1.392
	(0.258)	(0.237)	(0.239)	(0.472)
Professorship				
Associate Professor (or equivalent)	1.017	1.073	1.003	0.931
	(0.0627)	(0.0657)	(0.0612)	(0.0575)
Full Professor (or above)	1.057	1.149*	1.091	0.830**
	(0.0665)	(0.0720)	(0.0673)	(0.0519)
Time to normality				
Fewer than 1 month	0.318**	0.352*	0.452†	0.593
	(0.116)	(0.143)	(0.187)	(0.243)
1-3 months	0.778†	0.772†	0.897	1.266†
	(0.103)	(0.111)	(0.125)	(0.168)
7-12 months	1.214**	1.183*	1.024	1.012
	(0.0820)	(0.0834)	(0.0697)	(0.0685)
More than 12 months	1.370***	1.362***	1.070	1.069
	(0.0903)	(0.0929)	(0.0712)	(0.0700)
Political views (liberal-conservative, 7-point scale)	1.044*	1.038†	1.130***	0.893***
	(0.0196)	(0.0198)	(0.0212)	(0.0172)
Religious (dummy)	0.895*	0.919†	0.929†	1.066

	(0.0394)	(0.0407)	(0.0407)	(0.0475)
Marital status				
Married	1.090	1.216**	1.055	0.939
	(0.0777)	(0.0886)	(0.0765)	(0.0694)
De facto partnered	0.978	1.049	1.011	1.033
	(0.0750)	(0.0813)	(0.0783)	(0.0831)
Divorced	1.088	1.000	1.016	0.874
	(0.138)	(0.124)	(0.127)	(0.111)
Separated	1.385	1.312	1.018	1.021
	(0.302)	(0.259)	(0.190)	(0.183)
Widowed	0.960	1.002	1.084	0.904
	(0.222)	(0.258)	(0.253)	(0.199)
Have offspring (dummy)	0.962	1.043	1.002	1.055
	(0.0526)	(0.0571)	(0.0554)	(0.0581)
ln(# confirmed cases+1)	0.920	0.939	1.077	1.213
	(0.225)	(0.245)	(0.250)	(0.280)
Case fatality rate (CFR, 0–100)	0.798†	0.769*	0.889	1.183
	(0.0933)	(0.0887)	(0.101)	(0.137)
Stringency Index (0–100)	1.002	0.998	0.998	1.002
	(0.00667)	(0.00656)	(0.00640)	(0.00688)
RePEc	1.052	1.132	1.117	0.756***
	(0.0924)	(0.101)	(0.0942)	(0.0618)
Country fixed-effects	Yes	Yes	Yes	Yes
Time fixed-effects	Yes	Yes	Yes	Yes
N	7898	7885	7882	7856
Pseudo R^2	0.015	0.015	0.018	0.020

Notes. Odd ratios from ordered logistic regression. Standard errors (robust) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$. Reference category: *Economic & Social Sciences*, *Age (30-39), Gender (Male), Assistant Professor (or below), Time to normality (3-6 months), Never attend religious services, Single,* and *No children*.

Table S13. Ordered logit regression for willingness to pay and self-infect for immunity certificates.

Dependent variable	Willingness-to-pay		Willingness to self-infect			
			Low-risk		*High-risk*	
	Lifting social-isolation restrictions	Lifting travel restrictions	Social-isolation	Travel	Social-isolation	Travel
Scientific fields						
Applied Sciences	0.770**	0.755**	0.847†	0.845†	0.907	0.770**
	(0.0734)	(0.0694)	(0.0780)	(0.0764)	(0.0996)	(0.0734)
Arts & Humanities	0.860	0.889	0.968	1.105	1.062	0.860
	(0.123)	(0.128)	(0.141)	(0.155)	(0.182)	(0.123)
Health Sciences	0.779***	0.767***	1.016	0.961	0.984	0.779***
	(0.0424)	(0.0406)	(0.0527)	(0.0497)	(0.0605)	(0.0424)
Natural Sciences	0.697***	0.687***	0.924	0.931	0.912	0.697***
	(0.0525)	(0.0490)	(0.0656)	(0.0657)	(0.0754)	(0.0525)
Age						
18–29	1.062	0.940	1.210†	1.114	1.080	1.109
	(0.110)	(0.0911)	(0.120)	(0.110)	(0.132)	(0.131)
40–49	0.776***	0.771***	0.813***	0.779***	0.861*	0.855*
	(0.0500)	(0.0482)	(0.0505)	(0.0480)	(0.0638)	(0.0632)
50–59	0.769***	0.770***	0.760***	0.794**	0.857†	0.941
	(0.0612)	(0.0598)	(0.0580)	(0.0597)	(0.0777)	(0.0844)
60–69	0.826*	0.772**	0.877	0.858†	0.945	0.936
	(0.0783)	(0.0716)	(0.0780)	(0.0757)	(0.100)	(0.0985)
70+	0.740*	0.669***	0.970	0.960	1.186	1.227
	(0.0896)	(0.0764)	(0.102)	(0.101)	(0.146)	(0.154)
Gender						
Female	0.642***	0.664***	0.788***	0.767***	0.838**	0.811***
	(0.0315)	(0.0313)	(0.0364)	(0.0356)	(0.0464)	(0.0447)
Other	0.219*	0.242*	0.478	0.737	0.980	1.147
	(0.134)	(0.137)	(0.281)	(0.310)	(0.698)	(0.661)
Prefer not to say	0.684	0.970	1.153	1.322	1.372	1.480
	(0.250)	(0.374)	(0.492)	(0.506)	(0.571)	(0.579)
Professorship						
Associate Professor (or equivalent)	1.161*	1.174*	1.059	1.100	1.041	1.000
	(0.0764)	(0.0743)	(0.0678)	(0.0686)	(0.0793)	(0.0755)
Full Professor (or above)	1.716***	1.723***	1.316***	1.362***	1.268**	1.227**
	(0.119)	(0.114)	(0.0857)	(0.0887)	(0.0974)	(0.0939)
Time to normality						
Fewer than 1 month	0.371**	0.415**	0.719	0.811	1.428	1.159
	(0.120)	(0.122)	(0.229)	(0.248)	(0.500)	(0.373)
1-3 months	0.596***	0.671**	1.141	1.134	1.336*	1.267†
	(0.0823)	(0.0839)	(0.147)	(0.140)	(0.185)	(0.175)
7-12 months	1.102	1.104	0.884†	0.855*	0.760***	0.702***
	(0.0784)	(0.0761)	(0.0625)	(0.0601)	(0.0622)	(0.0573)
More than 12 months	1.222**	1.241**	0.783***	0.756***	0.635***	0.580***
	(0.0848)	(0.0833)	(0.0539)	(0.0517)	(0.0504)	(0.0460)
Political views (liberal-conservative,	1.073***	1.071***	1.156***	1.156***	1.206***	1.178***

7-point scale)	(0.0197)	(0.0188)	(0.0216)	(0.0212)	(0.0252)	(0.0246)
Religious (dummy)	1.010	1.045	1.108*	1.073	1.207***	1.145*
	(0.0491)	(0.0489)	(0.0509)	(0.0494)	(0.0660)	(0.0633)
Marital status						
Married	1.104	1.113	0.768***	0.754***	0.652***	0.697***
	(0.0870)	(0.0841)	(0.0588)	(0.0588)	(0.0591)	(0.0630)
De facto partnered	1.039	0.989	0.864†	0.840*	0.713***	0.723***
	(0.0879)	(0.0798)	(0.0711)	(0.0701)	(0.0693)	(0.0703)
Divorced	1.127	1.062	0.945	0.886	0.885	0.874
	(0.150)	(0.136)	(0.123)	(0.118)	(0.130)	(0.132)
Separated	1.190	1.187	1.142	1.164	0.829	1.010
	(0.247)	(0.245)	(0.235)	(0.248)	(0.192)	(0.233)
Widowed	1.268	1.081	0.705	0.720	0.847	1.124
	(0.376)	(0.322)	(0.186)	(0.172)	(0.267)	(0.342)
Have offspring (dummy)	1.071	0.937	1.113†	1.040	1.194*	1.119
	(0.0647)	(0.0554)	(0.0633)	(0.0594)	(0.0856)	(0.0784)
ln(Confirmed cases+1)	0.993	1.072	0.839	1.087	1.090	1.096
	(0.223)	(0.234)	(0.198)	(0.243)	(0.277)	(0.275)
Case fatality rate (CFR, 0–100)	0.823†	0.939	0.834	0.836	1.005	0.967
	(0.0924)	(0.106)	(0.0975)	(0.0962)	(0.136)	(0.133)
Stringency Index (0–100)	0.997	0.999	1.001	0.996	1.001	1.002
	(0.00663)	(0.00656)	(0.00726)	(0.00708)	(0.00793)	(0.00811)
RePEc	1.524***	1.525***	1.032	1.027	0.949	1.006
	(0.131)	(0.129)	(0.0859)	(0.0872)	(0.0979)	(0.102)
Country fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
N	7793	7786	7770	7709	7763	7734
Pseudo R^2	7793	7786	7770	7709	7763	7734

Notes. Odd ratios from ordered logistic regression. Standard errors (robust) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$. Reference category: *Economic & Social Sciences*, *Age (30-39), Gender (Male), Assistant Professor (or below), Time to normality (3-6 months), Never attend religious services, Single,* and *No children*. For the two variables on willingness to self-infect in high-risk scenario, we merge the two highest responses into a single group to avoid non-convergence issue in the maximum likelihood estimation.

Below we report the ordered logistic regression results without controlling for political views, religiosity, marital status, and offspring dummy from Table S12 and S13.

Table S14. Robustness checks - attitudes toward immunity certificates.

Dependent variable	Good for public health	Good for the economy	Fair to others	Increasing inequality
Scientific fields				
Applied Sciences	1.063	1.076	1.028	0.970
	(0.0828)	(0.0825)	(0.0792)	(0.0776)
Arts & Humanities	0.788†	0.892	1.011	1.054
	(0.0966)	(0.107)	(0.120)	(0.133)
Health Sciences	0.899*	0.924†	0.910*	0.993
	(0.0382)	(0.0396)	(0.0390)	(0.0421)
Natural Sciences	0.962	0.986	0.933	1.013
	(0.0569)	(0.0592)	(0.0555)	(0.0610)
Age				
18–29	1.200*	1.154	1.075	0.939
	(0.101)	(0.102)	(0.0919)	(0.0803)
40–49	0.968	0.950	1.007	0.896*
	(0.0476)	(0.0465)	(0.0488)	(0.0431)
50–59	1.065	0.917	1.211**	0.802***
	(0.0645)	(0.0556)	(0.0726)	(0.0495)
60–69	1.016	0.865*	1.247**	0.731***
	(0.0732)	(0.0628)	(0.0904)	(0.0530)
70+	0.947	0.889	1.427***	0.582***
	(0.0850)	(0.0809)	(0.125)	(0.0509)
Gender				
Female	0.852***	0.856***	0.765***	1.270***
	(0.0318)	(0.0319)	(0.0285)	(0.0481)
Other	0.515†	0.373**	0.637	2.424†
	(0.193)	(0.130)	(0.255)	(1.140)
Prefer not to say	0.582*	0.511**	0.702	1.425
	(0.142)	(0.132)	(0.191)	(0.374)
Professorship				
Associate Professor (or equivalent)	0.973	1.044	0.980	0.947
	(0.0505)	(0.0540)	(0.0507)	(0.0494)
Full Professor (or above)	1.049	1.140*	1.105†	0.842**
	(0.0561)	(0.0612)	(0.0581)	(0.0448)
Time to normality				
Fewer than 1 month	0.298***	0.353***	0.530*	0.724
	(0.0853)	(0.110)	(0.159)	(0.227)
1-3 months	0.805*	0.801†	0.907	1.154
	(0.0884)	(0.0955)	(0.104)	(0.124)
7-12 months	1.221***	1.176**	1.027	1.020
	(0.0711)	(0.0705)	(0.0602)	(0.0592)
More than 12 months	1.345***	1.340***	1.027	1.100†
	(0.0759)	(0.0777)	(0.0583)	(0.0617)

ln(# confirmed cases+1)	0.982	1.029	1.219	1.142
	(0.197)	(0.219)	(0.236)	(0.221)
Case fatality rate (CFR, 0–100)	0.951	0.948	1.008	1.026
	(0.156)	(0.149)	(0.111)	(0.0632)
Stringency Index (0–100)	1.005	1.004	1.001	1.002
	(0.00548)	(0.00547)	(0.00538)	(0.00567)
RePEc	1.085	1.151†	1.138†	0.752***
	(0.0799)	(0.0868)	(0.0840)	(0.0534)
Country fixed-effects	Yes	Yes	Yes	Yes
Time fixed-effects	Yes	Yes	Yes	Yes
N	10438	10412	10407	10367
Pseudo R^2	0.013	0.013	0.015	0.015

Notes. Odd ratios from ordered logistic regression. Standard errors (robust) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$. Reference category: *Economic & Social Sciences*, *Age (30-39), Gender (Male), Assistant Professor (or below),* and *Time to normality (3-6 months)*.

Table S15. Ordered logit regression for willingness to pay and self-infect for immunity certificates.

	Willingness-to-pay		**Willingness to self-infect**			
			Low-risk		*High-risk*	
Dependent variable	Lifting social-isolation restrictions	Lifting travel restrictions	Social-isolation	Travel	Social-isolation	Travel
Scientific fields						
Applied Sciences	0.754***	0.753***	0.953	0.938	0.970	0.892
	(0.0630)	(0.0604)	(0.0760)	(0.0747)	(0.0897)	(0.0846)
Arts & Humanities	0.853	0.855	0.897	1.013	0.890	0.869
	(0.106)	(0.110)	(0.109)	(0.121)	(0.131)	(0.131)
Health Sciences	0.773***	0.756***	1.021	0.975	0.970	0.950
	(0.0368)	(0.0351)	(0.0460)	(0.0438)	(0.0513)	(0.0502)
Natural Sciences	0.688***	0.692***	0.928	0.946	0.897	0.877†
	(0.0450)	(0.0424)	(0.0566)	(0.0575)	(0.0641)	(0.0619)
Age						
18–29	1.005	0.917	1.310**	1.254**	1.187†	1.180†
	(0.0907)	(0.0774)	(0.112)	(0.107)	(0.121)	(0.118)
40–49	0.844**	0.796***	0.810***	0.778***	0.872*	0.849**
	(0.0460)	(0.0417)	(0.0420)	(0.0404)	(0.0538)	(0.0524)
50–59	0.863*	0.844**	0.816**	0.839**	0.960	1.004
	(0.0577)	(0.0548)	(0.0522)	(0.0537)	(0.0719)	(0.0748)
60–69	0.885	0.795**	0.916	0.894	1.013	0.970
	(0.0719)	(0.0631)	(0.0693)	(0.0676)	(0.0905)	(0.0862)
70+	0.865	0.723**	1.009	0.940	1.318**	1.303*
	(0.0909)	(0.0713)	(0.0923)	(0.0863)	(0.138)	(0.138)
Gender						
Female	0.655***	0.660***	0.770***	0.747***	0.780***	0.755***
	(0.0276)	(0.0268)	(0.0307)	(0.0299)	(0.0367)	(0.0354)
Other	0.172**	0.244**	0.483	0.668	0.875	1.068
	(0.103)	(0.117)	(0.233)	(0.250)	(0.438)	(0.479)
Prefer not to say	0.499**	0.680	0.878	1.094	1.074	1.172
	(0.130)	(0.191)	(0.225)	(0.286)	(0.322)	(0.347)
Professorship						
Associate Professor (or equivalent)	1.137*	1.115*	1.066	1.067	1.039	1.011
	(0.0648)	(0.0609)	(0.0585)	(0.0582)	(0.0675)	(0.0656)
Full Professor (or above)	1.706***	1.656***	1.239***	1.252***	1.159*	1.137†
	(0.102)	(0.0954)	(0.0698)	(0.0706)	(0.0767)	(0.0749)
Time to normality						
Fewer than 1 month	0.382**	0.507**	0.900	1.115	1.476	1.384
	(0.116)	(0.128)	(0.250)	(0.296)	(0.435)	(0.378)
1-3 months	0.704**	0.742**	1.178	1.195	1.428**	1.341*
	(0.0838)	(0.0806)	(0.132)	(0.129)	(0.172)	(0.163)
7-12 months	1.113†	1.112†	0.851**	0.852**	0.717***	0.693***
	(0.0682)	(0.0665)	(0.0523)	(0.0522)	(0.0503)	(0.0485)
More than 12 months	1.235***	1.217***	0.732***	0.735***	0.589***	0.560***
	(0.0732)	(0.0705)	(0.0438)	(0.0438)	(0.0399)	(0.0379)
ln(Confirmed cases+1)	1.058	1.023	0.942	1.078	1.133	1.123

	(0.208)	(0.194)	(0.189)	(0.204)	(0.241)	(0.232)
Case fatality rate (CFR, 0–100)	1.054	1.134†	1.038	1.041	1.073	1.063
	(0.0653)	(0.0857)	(0.0648)	(0.0645)	(0.0897)	(0.0856)
Stringency Index (0–100)	1.001	1.001	1.002	0.998	1.000	1.001
	(0.00564)	(0.00544)	(0.00586)	(0.00573)	(0.00672)	(0.00680)
RePEc	1.475***	1.464***	1.031	1.049	0.938	0.955
	(0.111)	(0.108)	(0.0753)	(0.0776)	(0.0834)	(0.0838)
Country fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
N	10219	10206	10105	10010	10057	10017
Pseudo R^2	0.032	0.026	0.018	0.017	0.042	0.042

Notes. Odd ratios from ordered logistic regression. Standard errors (robust) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$. Reference category: *Economic & Social Sciences*, *Age (30-39), Gender (Male), Assistant Professor (or below),* and *Time to normality (3-6 months)*. For the two variables on willingness to self-infect in high-risk scenario, we merge the two highest responses into a single group to avoid non-convergence issue in the maximum likelihood estimation.

Table S16. Survey response rate, by scientific areas

Scientific areas	# Email sent	# Email opened	# Responses	% per opened	% sent
Arts and Humanities	11,819	5,316	888	16.70%	7.51%
Business, Management and Accounting	10,901	4,295	706	16.44%	6.48%
Economics, Econometrics and Finance	23,712	11,964	2,329	19.47%	9.82%
Energy	14,794	5,580	489	8.76%	3.31%
Health Professions	7,814	3,185	261	8.19%	3.34%
Immunology and Microbiology	7,400	3,077	320	10.40%	4.32%
Medicine	63,391	23,848	2,735	11.47%	4.31%
Multidisciplinary	20,113	8,306	946	11.39%	4.70%
Neuroscience	5,531	2,268	267	11.77%	4.83%
Nursing	4,864	1,942	273	14.06%	5.61%
Pharmacology, Toxicology and Pharmaceutics	3,657	1,239	152	12.27%	4.16%
Psychology	15,295	6,615	994	15.03%	6.50%
Social Sciences	31,632	13,711	2,360	17.21%	7.46%
Total	220,923	91,346	12,720	13.93%	5.76%

Notes. Scientific areas are based on the Scimago journal classification. In addition, 36 scientists received a web invitation for a total of 12,756 responses. Of these, 18 responses were excluded as these participants started the survey after the 3rd of June, 2020.

Table S17. Descriptive statistics of sample characteristics

Demographic characteristics	N	%
Gender		
Male	7,218	56.67%
Female	5,335	41.87%
Other/Prefer not to say	185	1.46%
Age		
18–29	577	4.53%
30–39	4,131	32.44%
40–49	3,637	28.56%
50–59	2,248	17.65%
60–69	1,341	10.53%
>70	639	5.02%
Prefer not to say	165	1.28%
Region		
Africa	364	2.85%
Asia	995	7.78%
Europe	5,408	42.3%
North America	4,759	37.22%
Oceania	553	4.33%
South America	453	3.54%
Prefer not to say	253	1.98%
Field		
Applied Sciences	6.51	6.51%
Arts & Humanities	295	2.32%
Economic & Social Sciences	4,901	38.48%
Health Sciences	4,851	38.09%
Natural Sciences	1,710	13.43%
Not specified	150	1.18%
Professorship		
Assistant Professor (or below)	6,664	52.8%
Associate Professor (or equivalent)	2,327	18.44%
Full Professor (or above)	3,630	28.76%
Not specified	115	0.9%
Political View		*M (SD)*

Liberal to Conservative (7-point scale)	8,287	2.79 (1.35)
Marital Status		
Married	5,634	44.24%
De facto partnered	1,288	10.11%
Divorced	321	2.52%
Separated	124	0.97%
Widowed	75	0.59%
Single	1,157	9.08%
Not specified	4,139	32.48%
Number of children		
None	3,160	24.81%
1 child	1,621	12.73%
2 children	2,586	20.3%
3 children	920	7.22%
4 children	224	1.76%
5 or more children	95	0.75%
Not specified	4,132	32.43%
Religious service attendance		
> once a week	243	1.91%
Once a week	838	6.58%
Once a month	447	3.51%
Only on special holy days	918	7.21%
Once a year	518	4.07%
Less often	802	6.3%
Never, practically never	4,840	38%
Not specified	4,132	32.43%

Dataset S1. List of journals. This data file contains the full list of journals from which our sample of scientists was surveyed. These journals ranked top 20 in the SCImago based on SJR (SCImago Journal Rank Indicator 2020) in 55 categories from 13 areas.