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Covid-19 Vaccination: The Role of Crisis Experience

Abstract

We propose that crisis experience influences preferences towards COVID-19 vaccination and the speed of vaccination during the initial phase when vaccines became available. We use macro and micro data to empirically investigate our theory and introduce a novel crisis experience index. Evidence based on macro data shows that a one-standard-deviation increase in our new crisis experience index gives rise to around 10 additional administered vaccine doses per 100 citizens (around one standard deviation). Our micro-level analysis provides evidence for a microfoundation of the macro-level results, indicating that the crisis history of countries is positively correlated with preferences towards COVID-19 vaccination. Disentangling socialization effects and experience effects, we find that citizens who have experienced crises during their impressionable years (ages 18–25) have stronger preferences for being vaccinated against COVID-19 than others.

JEL-Codes: H120, H510, I120, I150, I180.

Keywords: Covid-19 vaccination, crisis experience, crisis management, experience effects.

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1 Introduction

"We are a significant step closer to providing people around the world with a much-needed breakthrough to help bring an end to this global health crisis."
— Dr. Albert Bourla, Chairman of Pfizer (9 November 2020)

COVID-19 vaccines are likely to be the most effective measure against the COVID-19 pandemic. On 9 November 2020, the enterprises Pfizer and BioNTech announced that their mRNA-based vaccine candidate (BNT162b2) was found to have a 95% efficacy rate in preventing the disease beginning 28 days after the first dose. Governments, however, had to organize the ordering of the vaccine well before the results of the Phase 3 efficacy analyses of the vaccine candidates had become available, dealing with a considerable amount of uncertainty. Governments also needed to derive plans on how to vaccinate their citizens once the vaccine would have been delivered. Even though the COVID-19 pandemic is a global crisis with devastating consequences for almost all countries, we observe startling cross-country differences in the progress of vaccination. The key question is why some countries did achieve fast vaccination—and others did not. Answers to this question are important to learn from the COVID-19 pandemic and to prepare for crises in the future.

We propose that individuals who experienced severe crises in the past have greater preferences for COVID-19 vaccination. Our theory builds on the literature on experience effects. Studies examining experience effects show that crises and shocks leave a long-lasting imprint on individuals (Cogley and Sargent, 2008; Malmendier and Nagel, 2011; Malmendier and Nagel, 2016; Malmendier et al., 2020a). Citizens in countries that experienced crises in the past know how long-lasting and profound the negative effects of crises can be, become more risk-averse and perceive the probability for future crises to be higher (Brown et al., 2018; Hanaoka et al., 2018). These citizens put greater value on remedies for crises, resulting in a greater willingness to pay for the vaccine and an earlier procurement of vaccination doses. Citizens from countries that lack traumatic experiences on the other hand underestimate the positive effects of a vaccine. Crisis experience translates into a more rigorous vaccine purchase via citizens seeking politicians who put great effort in preventing and mitigating crises. Crisis experience may also increase the willingness of citizens to be vaccinated. Our simple theoretical framework shows how the trade-off between the price of the vaccine and other expenditure is solved in favor of the vaccine when citizens who experienced crises have better estimates about the (unknown) future excess payoff of vaccines.

We provide evidence for our theory in two steps. First, we show that the crisis experience of OECD countries is positively correlated with the number of administered COVID-19 vaccine doses during the early stages of mass vaccination rollouts. When we control for other potential determinants of COVID-19 vaccination, such as real per capita GDP, health spending per capita, and COVID-19 deaths per 100 citizens, the crisis history of countries is the most robust predictor of administered COVID-19 vaccination doses. To tackle unobserved omitted variables that are correlated with both vaccination and crisis experience, we employ an instrumental variable approach exploiting the geospatial correlation of crises. Second, we study the microfoundations of our macro-level results by using micro-level data on participants' attitudes towards a potential COVID-19 vaccine collected in June 2020. The micro-level estimates are in line with the macro-level results, suggesting that citizens living in countries with more severe crises histories place a higher preference on COVID-19 vaccination than citizens living less crisis-experienced countries. We investigate whether this result stems from socialization effects or from directly experienced traumatic events by examining crises that individuals experienced during their "impressionable years", the period of great mental plasticity during which the formation of preferences takes place (usually ages 18–25). Our results suggest that experience effects during the impressionable years play the dominant role for the formation of preferences towards COVID-19 vaccination.

A key question for our "crisis-experience" argument is which types of crises leave an imprint on individuals. The literature on experience effects has shown that many types of crises may influence citizens' preferences, including natural disasters (Cassar et al., 2017; Hanaoka et al., 2018), epidemics (Gründler and Potrafke, 2020), conflicts (Voors et al., 2012), violent episodes (Callen et al., 2014), autocratic regimes (Alesina and Fuchs-Schündeln, 2007), terrorist attacks (Hetherington and Suhay, 2011), and many others (e.g. Malmendier and Nagel, 2011; Giuliano and Spilimbergo, 2014). Hence, a major challenge is measuring the multifaceted dimensions of crises with a single indicator. Our strategy is to compile a new index of crisis experience to cover the great variety in types of crises that may influence individuals' preferences. The index is based on observational data regarding several types of severe natural disasters including previous epidemics and violent conflict. To proxy crisis components that are not directly observed, we also include military expenditure as a share of GDP.

For our macro-level estimates, we use Tobit and OLS models and find that the crisis experience index is a robust predictor for the number of administered COVID-19 vaccine doses per 100 citizens. The results show that a one-standard-deviation increase in the crisis experience index is associated with around 10 additional administered vaccine doses per 100 citizens (also around one standard deviation) during the initial stage of COVID-19 vaccination. The correlation between crisis experience and administered vaccine doses per 100 citizens is robust over various model specifications.

Our macro-level results suggest that the collective memory of a society influences collective vaccination efforts. Using micro-level data, we examine the microeconomic foundation of this mechanism, investigating how crisis experience relates to individual preferences towards COVID-19 vaccination. The micro-level results suggest that individuals' preferences towards COVID-19 vaccination correlate with the crisis history of countries. We disentangle effects from cultural socialization and experience effects studying whether crises experience by individuals during young adulthood translates to greater preferences towards COVID-19 vaccination. This strategy builds on findings reported by social psychologists who show that core preferences, attitudes, and beliefs are shaped during early adulthood ("impressionable years hypothesis") and remain largely unaltered ("increasing persistence hypothesis") afterwards (e.g. Mannheim, 1970; Krosnick and Alwin, 1989; Giuliano and Spilimbergo, 2014). The results of our micro-level estimates corroborate the findings on the macro-level, suggesting that citizens who experienced crises during their impressionable years have stronger preferences to be vaccinated against COVID-19 than others.

Taken together, our results suggest that countries with crisis experience have been more successful than non-crisis-experienced countries in vaccinating their citizens. We propose that crisis-experienced countries are willing to invest greater amounts in potentially effective vaccines when the payoffs are still uncertain, and may also have greater experience on how to handle the organization of the vaccines' distribution. Our argument of "crisis-experience" specifically applies to the initial stage of vaccination. In the long-run, these effects are likely to be overcompensated by other factors, predominantly economic power. Hence, while there was massive critique leveled against the European Union (EU) for its weak management of the vaccination rollout during the initial stage, the EU may well have higher vaccination rates than many front-running countries by the end of 2021.

Contribution to the literature: Our study is related to papers on COVID-19 (for an overview see Brodeur et al., 2021), especially the literature exploiting cross-sectional variation across countries in handling the COVID-19 pandemic (Lokshin et al., 2020; Bjørnskov, 2021). Our study is also related to those studies that examine attitudes towards COVID-19 vaccine (Galasso et al., 2021; Lazarus et al., 2021; Karlsson et al., 2021) and the management of COVID-19 vaccination across the US states (Goel and Nelson, 2021). We propose a new theory about the origins of the observable cross-country differences in COVID-19 vaccination. Our theory suggests that crisis experience is a key predictor of COVID-19 vaccination, and the results on the macro- and the micro-level provide strong support of our theory.

We also connect to the literature on the development of innovation during crises. This literature finds a surge in innovation activity during several crises in history Filippetti and Archibugi, 2011; Gross and Sampat, 2021). A prime example is the development of mass-produced penicillin, antimalarials, and a flu vaccine during World War II. Our results suggest that crises experienced in the past foster innovation activity also in the wake of new crises.

Another related strand of literature examines determinants of vaccination against other diseases such as diphtheria, tetanus, pertussis (DTP) and measles across countries (Gauri and Khaleghian, 2002; de Figueiredo et al., 2016). While our theory regarding crisis experience may apply also for regular vaccination against these known diseases, the COVID-19 pandemic provides an ideal testing ground for studying the role of experience effects for vaccination, given its unparalleled impact on health, living conditions, and wealth.

We also relate to studies examining the "impressionable years hypothesis" (e.g., Giuliano and Spilimbergo, 2014; Aksoy et al., 2020). A study closely related to ours is Eichengreen et al. (2021) who examine how having experienced epidemics in impressionable years influences trust in scientists and vaccines for the pre-COVID-19 era. We move beyond these studies by investigating the determinants of COVID-19 vaccination. Given the profound consequences for a country's health and economic situation, we might expect that attitudes towards COVID-19 vaccination are fundamentally different to attitudes towards a established vaccines against measles, diphtheria, pertussis, or tetanus. Consistent with our theoretical prediction, we also relate attitudes towards COVID-19 vaccination to a more encompassing measure of crisis experience, thereby avoiding a potentially large number of false negatives, i.e. individuals who experienced devastating crises but not epidemics (e.g. natural disasters or conflict). In line with our theory, we expect citizens who experienced these types of crises to be more supportive of a remedy regardless of the type of previously experienced crisis than citizens who did not experience these types of crises.

2 Crises experience and vaccination: a theory

Our analysis is based on the literature of experience effects, which shows that experiencing crises and shocks leaves a lasting imprint on individuals (Cogley and Sargent, 2008; Malmendier and Nagel, 2011; Malmendier and Nagel, 2016; Malmendier et al., 2020a) and changes their beliefs about the frequency and magnitude of future shocks and crises (Brown et al., 2018; Hanaoka et al., 2018). We develop a simple model in the spirit of this literature, particularly borrowing from Malmendier et al. (2020b).

2.1 The basic macroeconomic model

Consider an economy i that has been hit by a pandemic. At time t, a new vaccine against the pandemic has been developed. Policymakers need to decide about the quantity of the vaccine, x_{it}, they want to purchase. We assume a political economy framework in which politicians are election-motivated and hence follow the will of the median voter. Suppose that the entire government budget needs to be spent to tackle the pandemic. The budget constraint of the government is

$$W_{it} = x_{it}p_t + H_{it}, \tag{1}$$

where W_{it} is the wealth of country i at time t, p_t is the price of one unit of the vaccine, and H_{it} describes all other health expenditure spent to fight the pandemic (e.g. hospitals, workers in the medical sector, drugs, etc.). When the vaccine is more effective in fighting the pandemic than other health expenditure, it pays a dividend d on a country's wealth in $t + 1$. This dividend can be thought of as a direct economic return when better health allows for a more effective production of output, but it may also reflect societal gains in the form of better living conditions, health, and life satisfaction that indirectly manifest in economic returns. Hence, wealth in $t + 1$ can be expressed as

$$W_{it+1} = x_{it}(d_{t+1}) + H_{it}R = x_{it}(d_{t+1} - p_tR) + W_{it}R, \tag{2}$$

where R is the payoff of traditional health spending H_{it}. The excess payoff obtained by buying one unit of the vaccine therefore is

$$s_{it+1} = d_{t+1} - p_tR, \tag{3}$$

where p_tR is the opportunity cost of buying the vaccine. At time t, the excess payoff is unknown. Citizens want to maximize W_{it+1}, and hence the decision on the allocation of resources between x_{it} and H_{it} depends on citizens' expectations about the excess payoff, $\mathrm{E}_{it}[s_{it+1}]$.

The theory of experience-based learning shows how individuals form expectations $\mathrm{E}_{it}[s_{it+1}]$ based on past experiences. The intuition of this literature can be expressed via (see Malmendier and Nagel, 2011; Malmendier et al., 2020b)

$$\mathrm{E}_{it}[s_{it+1}] = \sum_{k=0}^{\text{age}} \omega(k, \lambda, \text{age}) d_{t-k}, \tag{4}$$

where $\text{age} = t - n$ and $\omega(k, \lambda, \text{age})$ denotes the weight citizens assign to the payoff of tackling similar events observed k periods earlier. These payoffs are directly observable when citizens have experienced a pandemic in the past, but similar payoffs may also be observed by remedies to other profound traumatic events that have plagued the country in the past.

Equation (4) highlights the mechanism underlying our key hypothesis for why countries differ in their effort to vaccinate: citizens who have experienced crises in the past have great knowledge about the excess payoff provided by remedies that become available to tackle the crises because they have observed some d_{t-k} in the past. On the one hand, this suggests that countries that experienced similar crises in the past have more accurate expectations about the excess payoff than countries that did not experience similar crises. When this payoff is large, the willingness to pay for the remedy and the effort put into acquiring it is higher. On the other hand, citizens living in countries that did not experience crises in the past did not observe any d_{t-k} and may therefore have misperceptions about s_{it+1}.

As the accuracy to infer s_{it+1} depends on past observations of d_{t-k}, and these observations are available only when there has been a crisis, we can express our central mechanism as

$$\mathrm{E}_{it}[s_{it+1}] = f(C_{it-k}), \quad \frac{\partial \mathrm{E}_{it}[\cdot]}{\partial C_{it-k}} > 0, \tag{5}$$

where C_{it-k} denotes crises that have occurred in $t-k$. A key question is how much citizens discount crisis experience over the years, that is, how large $\omega(\cdot)$ may be. The literature on experience effects often models monotonically falling effects from past experiences (e.g. Malmendier et al., 2020b), which is a reasonable strategy for individuals after their early adulthood. However, social psychologists describe that citizens' preferences are shaped during a period of great mental plasticity during early adulthood (typically between ages 18 and 25). Core beliefs are formed during this period and remain relatively unaltered thereafter (see, e.g. see, e.g., Mannheim, 1970; Krosnick and Alwin, 1989; Giuliano and Spilimbergo, 2014). For this critical period of socialization, we hence expect crisis experience to be particularly influential, i.e. we may expect that there is no discount factor at all and hence $\omega(\cdot) = 1$.

Remarks related to the COVID-19 pandemic: In principle, the excess payoff s_{it+1} may be small or even negative, in which case purchasing COVID-19 vaccines would be an unfavorable strategy. However, against the backdrop of the momentous costs of lockdowns and other means to tackle the pandemic, current vaccination success suggests s_{it+1} to be (very) large. Hence, individuals living in countries that did not experience similar crises in the past may drastically underestimate s_{it+1} and therefore take less effort in acquiring the vaccine. In a similar vein, we may also suppose that the willingness to be vaccinated is lower when the payoff of the vaccine is underestimated. Our key hypothesis is consistent with the observation that many countries that were heavily hit by the SARS crisis of 2002/03 seem to do remarkably well in the SARS-CoV-2 pandemic of 2020/21 (Lin and Meissner, 2020).

Government budgets need not be constrained when there is a possibility to take on debt in order to buy vaccines. When there is leeway for taking new debt, our key argument is even stronger, because buying vaccines would not crowd-out other expenditure spent for measures leveled against the pandemic in equation (1).

The member states of the EU decided to establish a buyer community to acquire vaccines against COVID-19. Given that at least the economically most powerful countries are relatively homogeneous in terms of past crises, the EU's strategy is in line with our central hypothesis.

In a more complex version of our model, we could also directly account for supplier dynamics initiated by countries' willingness to pay, but the key arguments regarding crisis experiences and vaccination remain unchanged: we expect those countries that experienced crises to be more willing to pay for additional production capacities, and hence supplier dynamics would favor countries with past crises experiences.

2.2 Transferring the theory into an empirical model

The main argument behind experience-based learning in our framework is that citizens living in countries that have experienced crises in the past are more likely to have more accurate perceptions about the excess payoff of the newly developed COVID-19 vaccines than citizens living in countries that have not experienced in the past. Our framework suggests that these experiences influence the trade-off between regular health expenditure and investing in the purchase of the newly developed vaccines. The potential to spend resources for either of these components is constrained by the government budget, determined by a country's wealthiness.

Our theory suggests that country i's progress in vaccination V_i depends on its wealthiness W_i, health expenditure H_i, and the extent of crisis experience in the past, C_i. We combine these components into a linear model of vaccination via

$$V_i = \alpha + \beta C_i + \gamma W_i + \psi H_i + \varepsilon_i. \tag{6}$$

This specification depends on the assumption that there is a linear link between these variables, but our theory does not provide guidance on how the exact functional form might be. Also, our theory is built on a simplification of the real world to show how experience effects influence the progress in vaccination, and there may be other variables that influence V_i beyond these channels, particularly differences in a country's ex ante vulnerability to crises. The uncertainty introduced by the linearity assumption and potential covariates is captured by an idiosyncratic error ε_i.

Multidimensional nature of crises experience: Our theory describes that experiencing past crises increases the accuracy to infer s_{it+1}. A wide range of crises may influence individuals' willingness to pay for a remedy to the crisis, and empirically examining our theory by focusing on single types of past crises would bias our estimates by unobserved confounding events when unobserved crises are included in the non-treated units ("false negatives"). The key challenge is hence to derive a metric that comprehensively reflects past crises experience.

3 Measuring crisis experience

We develop a composite measure that reflects the degree to which countries experienced past crises. A composite index is needed as various types of crises may initiate the central mechanism described in Section (2).

Creating an index is a three-step problem (Munck and Verkuilen, 2002; Gründler and Krieger, 2019, 2021). In the first step, the term researchers want to measure needs to be defined (*"conceptualization"*). Second, scholars need to find observable components that reflect their chosen definition (*"operationalization"*). Finally, researchers need to find a rule to transform the observable components into a uni-dimensional index (*"aggregation"*). We next describe these steps taken to create our crisis experience index in greater detail.

3.1 Conceptualization

The question of how to best define the term "crisis" is afflicted with two key challenges: (i) the selection of features that are associated with "crises" and (ii) the specification of how these features interact with each other (Gründler and Krieger, 2021). Regarding the first challenge, we may use a minimalist or maximalist concept of crises. From a conceptual perspective, both concepts are equally valid, because there is no objective guideline for when a situation may be sufficiently bad in order to justify the label "crisis". From an empirical perspective, however, maximalist definitions may be unfavourable because they often overlap with other economic and societal circumstances and it is hence unclear how a parameter estimate for a broad concept should be interpreted (Gründler and Krieger, 2021). Regarding the second challenge, the main question is whether the aspects underlying the definition of crises are necessary conditions for crises or whether they are (partial) substitutes.

For our definition of crises, we aim to strike a good balance between minimalist and maximalist concepts of crises. We define crises as plausibly exogenous non-economic events that have profound influence on a country's living conditions and health situation. Our definition of crises rests on three pillars, including (i) conflict and war, (ii) natural and technical disasters including previous epidemics and (iii) government expenditure to tackle crises. Aspects (i)–(ii) measure the occurrence of crises that are directly observable. To account more generally for other types of crises that may be too broad in variety to capture them directly, we also include government expenditure spent for crisis management. Our aspects are substitutes because they do not need to occur at the same time in order to constitute a crisis.

3.2 Operationalization

We collect data on the number of deaths relative to population caused by (i) conflict and war and (ii) natural and technical disasters to operationalize our definition of crises. Equation (4) suggests that collective experience of traumatic events may substantially reach back in time. We hence use data on deaths caused by the three types of crises over the past 20 years. Data comes from the Uppsala Conflict Data Program (UCDP) accessed via the World Bank, and the Centre for Research on the Epidemiology of Disasters (EM-DAT database). We proxy government expenditure for crisis management by military spending relative to GDP. The military plays an important role in many countries during the COVID-19 pandemic in managing the crises, and it is similarly important for crisis management during natural disasters and other types of external crises. We hence argue that military expenditure is the budgetary position that is most closely related to crisis management.[1] Data on military expenditure compiled by the Stockholm International Peace Research Institute (SIPRI) is taken from the World Bank.

3.3 Aggregation

Data aggregation requires finding a function f that maps our set of observable characteristics ($\mathbf{z}$) onto a the level of crises (C)

$$C_i = f(\mathbf{z}_i) \, \forall \, \mathbf{z}_i = z_1, \ldots, z_3 \tag{7}$$

where i denotes countries and the characteristics $\mathbf{z}_i$ are observed over 20 past periods. The specification of the aggregation scheme is the most fundamental step in computing the index and has been shown to substantially influence the results in em-

[1] A concern may be that increasing military expenditure may reflect the cause rather than the effect of crises. While this concern is valid, we argue that the countries included in the sample of OECD countries are rarely involved in wars of aggression.

pirical models (Gründler and Krieger, 2019). The main challenges involved in specifying the function of equation (7) are (i) the selection of a scale for C_i and (ii) the selection of an aggregation rule. Regarding (i), we use a continuous scale, which has been shown to provide greater discrimination power in empirical studies. It also allows for a fine-grained investigation of our main hypothesis, as coding errors are particularly severe for dichotomous scales. Regarding (ii), we obtain weights that reflect the relative importance of the aspects entering our index by running a Principal Component Analysis (PCA). The transformation of the PCA is defined by weights $\mathbf{w}_k$ that map each vector of $\mathbf{z}_i$ to a new vector of principal component scores $\mathbf{t}_i = (t_1, \ldots, t_n)$ so that $t_i, \ldots, t_n$ successively inherit the maximum possible variance from the data. The first weight vector satisfies

$$\mathbf{w}_1 = \arg\max_{||\mathbf{w}||=1} \left\{ \sum_i (t_1)_i^2 \right\} = \arg\max_{||\mathbf{w}||=1} \left\{ \sum_i (\mathbf{z}_i \times \mathbf{w})^2 \right\}.$$

Based on these weights, the first principal component can be computed via $t_1 = \mathbf{x}_i \times \mathbf{w}_1$. Aggregation obtained by PCA fulfills our conceptual requirement that different aspects of crises are partial substitutes. To facilitate the interpretation of our results, we re-scale our final indicator so that $C_i \in (0, 1)$.[2]

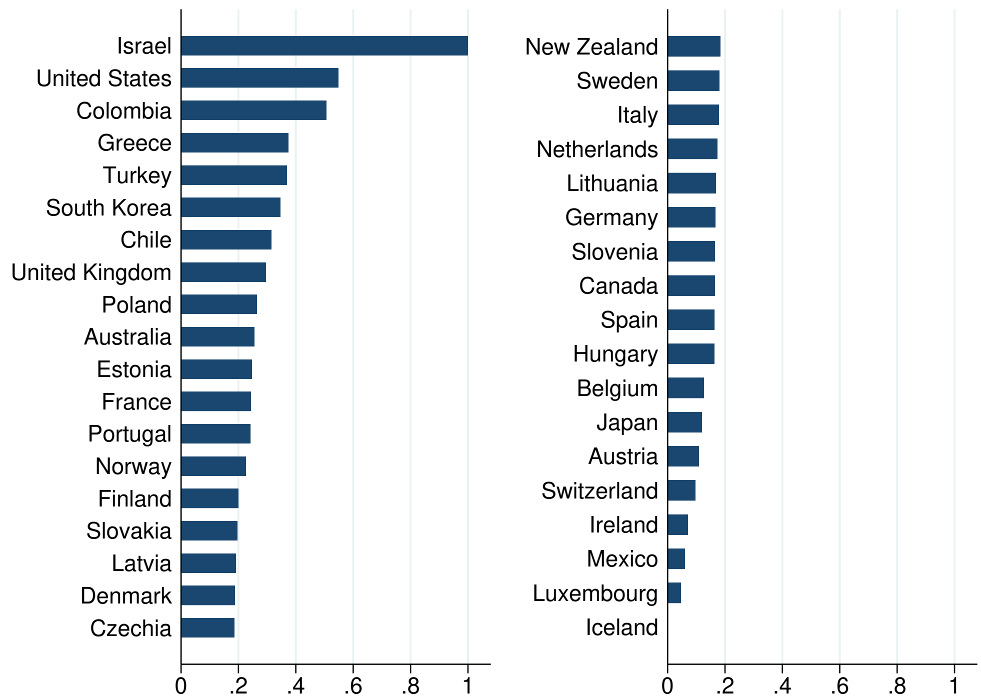
3.4 Crises in the OECD countries

Figure (1) shows how our index of crisis experience is distributed across the 37 OECD countries. The maximum index value is reached for Israel, followed by the United States, Colombia, Greece, and Turkey. On the other end of the spectrum, Mexico, Luxembourg, and Iceland have experiences substantially less crises. The sample average is $C_{\text{OECD}} = 0.365$.

Our indicator suggests that there is great heterogeneity across types of crises. Conflict-related crises are widespread in Colombia (10,642 deaths), Turkey (6,859), and Israel (5,834). The United States were involved in several conflicts during the past 20 years, which can arguably be thought of similarly severe crises (e.g. the Gulf War, American-led interventions in Syria, Iraq, Afghanistan, and Somalia, as well as interventions in several Latin American countries). This dimension is measured by military expenditure relative to GDP, where the United States ranks second (3.90%)

[2]The weights of the PCA suggest a homogeneous contribution of the individual elements to the final crisis indicator: Conflict and war (0.3875), natural and technical disasters including previous epidemics (0.3317), and government expenditure to tackle crises (0.2807).

Figure 1 CRISIS EXPERIENCE INDEX FOR THE OECD COUNTRIES



Notes: The figure shows the levels of our crisis experience index for each of the 37 OECD member states, scaled to the range $[0, 1]$. The index includes the death rate caused by natural and technical disasters, the death rate caused by war and conflict, as well as crisis-related government expenditure. For more details, see Section (3).

after Israel (5.96%). Similar arguments can be made also for other countries such as the United Kingdom. Crises sparked by natural disasters, however, have occurred in quite different countries, including France (26,350 deaths), Italy (23,216), Japan (23,184), and Spain (16,050). Severe epidemics before the COVID-19 pandemic broke out primarily in South Korea, Mexico, the United States, and Canada. Examples are the H1N1 epidemic in 2009-10, which caused 60.8 million cases and 12,469 deaths in the United States alone (CDC, 2010) and the 2002-2004 SARS outbreak, which out all OECD countries primarily affected Canada (251 registered cases and 44 deaths, fatality rate 17.5%).

4 Descriptive statistics and unconditional correlations

The variables for our analysis and their underlying data sources are described in Table (A-1) in the appendix. Summary statistics are reported in Table (A-2). We measure a country's progress in vaccination by the number of administered COVID-19 vaccine doses per 100 citizens by 3 February 2021.[3] For most vaccines that were available by early February 2021, full vaccination protection requires two inoculations that are administered with a temporal gap of several weeks. Hence, our variable does not directly translate into the number of vaccinated citizens.

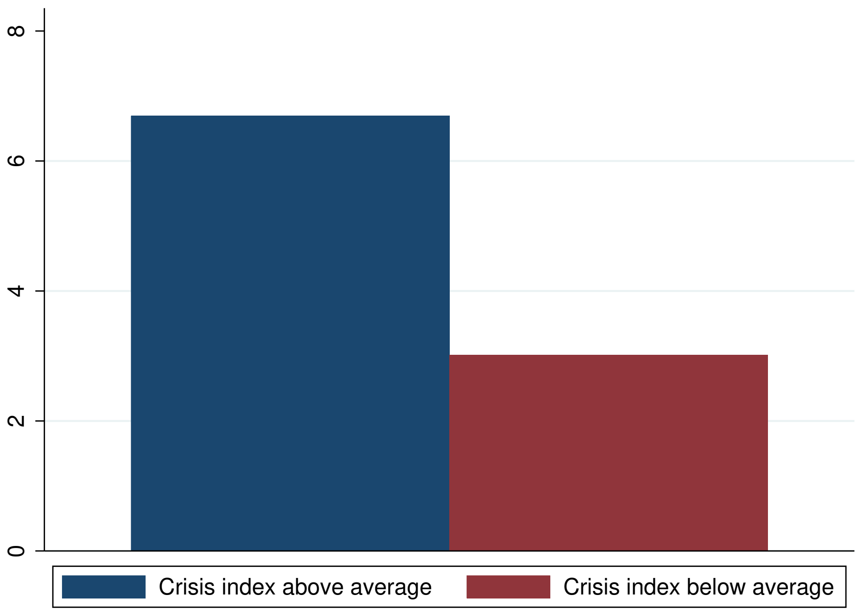
Figure (B-1) in the appendix shows the number of administered COVID-19 vaccine doses per 100 citizens for each country that had started vaccination by 3 February 2021. The figure suggests that Israeli citizens received by far the largest share of vaccine doses (over 61.0 doses per 100 citizens), followed by the United Kingdom (16.2), the United States (10.1), and Denmark (5.1). In contrast, progress in vaccination was much slower in countries in the EU.

COVID-19 vaccination and crisis experience: Figure (2) shows the number of administered COVID-19 vaccine doses per 100 citizens for the sub-samples of OECD countries above and below the sample mean of crises experience. Both variables are positively correlated (coefficient of correlation: 74.8%). The unconditional correlation is statistically significant at the 1% level ($p = 0.000$). The figure shows that there are stark differences in vaccination between countries with high and low levels of crisis experience (an average of 6.69 doses in high-crises countries versus 3.02 doses in low-crises countries).

Expository example: The case of Israel. Israel serves as a prime example of our theory of crisis experience. There have been conflicts between Israelis and Palestinians since the mid-20th century. The crisis indicator is highest for Israel (Figure 1). The number of conflict-related deaths since 2000 amounts to a total of 5,834, greatly exceeding the OECD average (637). As a consequence of the permanent conflict, military expenditure relative to GDP (5.96%) is much higher than in the rest of the OECD (1.65%). The case of Israel illustrates how military expenditure serves as an indirect

[3] We choose to measure vaccination success two months after the first mass vaccination rollouts in the OECD sample started. However, our results also hold when using vaccination success from early January and early March 2021.

Figure 2 NUMBER OF ADMINISTERED COVID-19 VACCINE DOSES BY SAMPLE MEANS OF CRISIS EXPERIENCE



Notes: The figure shows the unconditional relationship between our crisis indicator and the number of administered COVID-19 vaccine doses separate for countries below and above the OECD average of the crisis indicator ($C_{\mathrm{OECD}} = 0.365$). The index includes the death rate caused by natural disasters, the number of deaths caused by war and conflict as well as crisis-related government expenditure (all averaged over the period 2000–2019). For more details, see Section (3).

source to measure crisis experience, and it also emphasizes the need for a composite measure of crisis experience. The number of deaths related to natural disasters falls below the OECD average by a factor of 32 (123 in Israel versus 3,891 in the OECD). Before the COVID-19 pandemic, the record also did not show a single death related to epidemic breakouts.

The considerable conflict experience of the Israeli population is associated with by far the fastest progress in vaccination against COVID-19 during the initial stages when vaccines became available. Large parts of the Israeli population, particularly those involved in the care of COVID-19 patients, have a positive attitude towards COVID-19 vaccination (Dror et al., 2020), even though some observers have expressed skepticism given the limited amount of data available regarding the efficacy of the vaccines. Taken together, Israel serves as an expository example of our main hypothesis.

5 Macro-level evidence: Crisis experience and COVID-19 vaccination

We empirically examine the relationship between crisis experience and COVID-19 vaccination, transferring our theory described in Section (2) to an empirically estimable model.

5.1 Estimation strategy

5.1.1 The baseline specification

By 3 February 2021, approx. 100 countries had started vaccination against COVID-19 worldwide. We restrict our sample to the 37 OECD countries for the sake of comparability in both data and vaccination roll-out capacity.[4] 32 OECD countries had started vaccination by 3 February 2021. Hence, data on vaccination is censored: we observe the progress in vaccination for some countries, but those who did not start vaccination are not missing values in the sample; rather, these observations are censored. We use two strategies to examine the relationship between our crisis experience index and vaccination. First, we show OLS results to investigate raw correlations between the variables. Using OLS specifications based on censored data, however, yields biased and inefficient results. This is particularly the case when the number of censored observations relative to the observations with known outcomes is high. Hence, the second strategy, our preferred specification, is a Tobit-Model.

Our benchmark Tobit model specification follows a standard setting (see, e.g., Amemiya, 1984) and brings the theoretical model of equation (6) to the data via

$$V_i = \alpha + \beta C_i + \mathbf{X}_i \boldsymbol{\theta} + \varepsilon_i, \; i = 1, \ldots, N, \tag{8}$$

where the dependent variable, V_i, denotes the number of administered COVID-19 vaccine doses per 100 citizens in country i, measured on 3 February 2021. This variable is observable for a subsample $N^1 \in N$ of the total number of observations and censored for a subsample $N^2 \in N$. Estimating model (8) based on N^1 and neglecting N^2, there is no guarantee that $\mathrm{E}(\varepsilon) = 0$ and hence the results may be biased.

[4] For instance, daily data on the vaccination progress is not available for Russia and China, especially in the early months of vaccination. Furthermore, it has been estimated that over 85 countries will not have widespread access to COVID-19 vaccines until mid 2023 (The Economist Intelligence Unit, 2021).

The main explanatory variable is our index reflecting crises experience, C_i. In the most parsimonious model specification, we consider unconditional correlations. We also account for the components of our theoretical model (a country's wealthiness and health expenditure) by the vector $\mathbf{X}_i$. We proxy wealthiness and the government budget constraint by real per capita GDP (averaged over the period 2000–2019, logarithms). This strategy also accounts for the positive relation between income and vaccination found in previous studies (e.g. Masia et al., 2018). Health expenditure enters the equation in per capita terms (averaged over the period 2000–2018, logarithms). Including this variable is in line with past studies that account for the entanglement between health policies and vaccination (e.g. Finkelstein, 2004).

The control variables of our model also account for the fact that the Pfizer/BioNTech and the Moderna vaccines lose effectiveness and potency if they are exposed to temperatures higher than minus 70 degrees Celsius and minus 20 degrees Celsius. We might expect that handling these hurdles is easier in richer countries with more sophisticated health systems. Finally, to adjust the model specifically to the COVID-19 pandemic, we include COVID-19 deaths per 100 citizens. This strategy helps disentangling the effect of *past* crisis experiences from the very *recent* crisis experiences caused by the COVID-19 pandemic. Including measures for COVID-19 exposure also addresses the argument that disease outbreaks may influence vaccination (Oster, 2018). Descriptive statistics and data sources of these variables are shown in Tables A-2 and A-1 in the appendix.

5.1.2 Accounting for endogeneity

A concern of the model described in equation (8) is that crisis experience may be correlated with the error term. The threat of endogeneity does not come from a potential reverse causation, because the variables used to construct the index pre-date the discovery of COVID-19 cases in OECD countries and thus COVID-19 vaccinations efforts in 2020/21. However, there may be unobserved confounding factors that correlate with crisis experience and COVID-19 vaccination (omitted variable bias). We address this concern by transferring equation (8) into an instrumental variable model.

Our instrumental variable exploits the substantial geospatial correlation in crisis experience (*"relevance condition"*). Natural disasters depend on regional geography and climate, epidemics and conflict spill over to neighboring countries, and military expenditure is also spatially clustered (see, e.g., Harari and Ferrara, 2018; Yesilyurt and

Elhorst, 2017; Blum, 2018; Phillips, 2015). We compute jack-knifed regional averages that we use as instrumental variables for domestic crisis experience via

$$Z_i = |\mathfrak{S}_i|^{-1} \sum_{\tilde{i} \in \mathfrak{S}_i} \mathrm{C}_i, \tag{9}$$

where $\mathfrak{S}_i \equiv \{\tilde{i} : \tilde{i} \neq i, r_{\tilde{i}} = r_i\}$ denotes the number of countries that are located in the same geographic area r as i (see Acemoglu et al., 2019 for a similar strategy and Gründler and Krieger, 2019 for a detailed discussion). Table (A-4) in the appendix lists the regional classification of countries. The key identifying assumption of this strategy is that regional levels of crisis experience do not influence national levels of vaccination (*"exclusion restriction"*). This strategy cannot be tested directly. However, there are two arguments why this assumption is likely to be fulfilled. First, the jack-knifed approach leaves out i in the computation of the instrumental variable. Second, the time span since when vaccination has started is small: there are no apparent channels through which crisis experience in neighboring countries should translate into higher domestic vaccination other than through crisis experience in the considered country.

5.2 Results

5.2.1 Benchmark estimates

Table (1) reports our benchmark estimates. The table shows estimates of equation (8) using OLS (Columns 1–2) and Tobit (3–4) models. For both techniques, the table reports unconditional correlations and results conditional on controls that may be correlated with crisis experience and vaccination. The table reports regressions that are obtained using the full sample, including censored data.

The main result is that crisis experience is positively related to the number of administered COVID-19 vaccine doses per 100 citizens. The parameter estimates are economically and statistically significant. In Column (1), the parameter estimate of the crisis experience index is positive and statistically significant at the 1% level ($t =$ 3.07). Numerically, the parameter estimate suggests that when the crisis experience index increases by one standard deviation (0.029 points), the number of administered COVID-19 vaccine doses per 100 citizens increases by around 0.87 standard deviations. The parameter estimate slightly increases when we control for real per capita GDP, health expenditure, and the number of COVID-19 deaths per 100 citizens (Column 2).

Table 1 VACCINATION AND CRISIS EXPERIENCE—BASELINE-RESULTS

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	OLS Models		**Tobit Models**	
	(I) Parsimonious	(II) Full specification	(III) Parsimonious	(IV) Full specification
Crisis Experience Index	297.206***	314.094***	317.165***	340.794***
	(3.07)	(3.40)	(3.19)	(3.75)
Log(GDP^{pc})		13.209*		15.778**
		(1.73)		(2.08)
Log(Health Exp.^{pc})		-11.936		-14.981*
		(-1.36)		(-1.74)
COVID-19 Deaths		0.004		0.004
		(1.36)		(1.56)
Obs. (# of Countries)	37	37	37	37
(Pseudo) R-Squared	0.677	0.736	0.160	0.190
F-Stat	3.075	1.968	10.346	7.600
Prob. > F-Stat	0.023	0.089	0.000	0.000
Regional controls	YES	YES	YES	YES

Notes: The table shows the results of the estimations on the correlation between the crisis experience index and the number of administered COVID-19 vaccine doses per 100 citizens. Columns (1)–(2) show results of OLS regressions, Columns (3)–(4) report results from Tobit models. t values that are obtained using robust standard errors (adjusted for arbitrary heteroskedasticity) are reported in parentheses.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Given that some of our observations are censored, the OLS estimates may be biased. To tackle this potential bias, Columns (3)–(4) report results of our Tobit specification. Qualitatively, the results are comparable to the OLS regressions. The size of the estimated coefficients somewhat increases as compared to the OLS regressions. The parameter estimate in Column (4) suggests that when the crisis experience index increases by one standard deviation (0.029 points), the number of administered COVID-19 vaccine doses per 100 citizens increases by 10 additional administered vaccine doses per 100 citizens (around one standard deviation).

To facilitate comparison between the models, Table (1) is based on the full sample of 37 countries for both the OLS models and the Tobit model (N^1 and N^2). An important question is how the OLS results change when the model only incorporates the non-censored observations. Table (A-5) in the appendix compares the OLS estimates of Table (1) with regressions that focus on the sample of 32 non-censored observations (N^1). When excluding censored observations, the parameter estimate of the crisis experience index remains statistically significant at the 1% level and is somewhat smaller than when we include the censored observations.

5.2.2 The role of Israel

Figure (B-1) suggests that Israel may be an outlier in the OECD sample. Israel is also an expository example of our theoretical hypothesis: given its political history, Israel has experienced manifold crises during the past decades and has insured against future crises by high levels of military spending. Experience with crises also brought about considerable experience with crisis management.[5] An important question is whether our benchmark results are driven by Israel.

In Table (A-6) in the appendix, we re-estimate equation (8) excluding Israel. Qualitatively the results remain unchanged. The estimated parameters of the crisis experience index becomes smaller, however. The parameter estimate in column (4) suggests that when the crisis experience index increases by one standard deviation (0.019 points), the number of administered COVID-19 vaccine doses per 100 citizens increases by 0.46 standard deviations. These results suggest that Israel serves as a prime example for our theory, but the relationship between crises experience and vaccination occurs independent from the rapid progress in vaccination in Israel.

5.2.3 Other robustness tests

We conduct many complementary analyses to examine the robustness of our results. In Table (A-7), we account for globalization (on the consequences of globalization see, for example, Potrafke, 2015). On the one hand, globalization may increase the potential to acquire COVID-19 vaccines because of more developed trade infrastructures and better trade relationships. On the other hand, globalization may also increase the cross-country spread of COVID-19. We find that globalization as measured by the KOF Globalisation Index (Dreher, 2006; Gygli et al., 2019) is positively related to COVID-19 vaccination, but including globalization does not change the inferences regarding how crisis experience relates to COVID-19 vaccination. We also account for cross-

[5] On Israel and international relations see, for example, Becker et al. (2015), Hillman and Potrafke (2015) and Mosler (2021).

country differences in the start date of COVID-19 vaccination using the rollout date of a country's vaccination campaign as a control variable.[6] Doing so does not change the inferences regarding the crisis experience index (see Table A-9). To explore the avenues of individual preferences in the macro-level specification, we look at cross-country differences in the citizens' willingness to take risks (Falk et al., 2018) and their trust in scientists (Gallup, 2019). As Table A-8 shows, risk-taking alone is not related to vaccination progress. However, when interacted with the crisis experience index, risk-taking itself is negatively correlated with vaccination progress, whereas the interaction is largely positively correlated with administered vaccine doses. This might point towards different transmission channels. A higher willingness to take risk on its own may give rise to short-sighted vaccination management, whereas risk-taking coupled with higher crisis experience may increase crisis management efficiency.[7] As shown in Table A-10, higher trust in scientists is associated with higher vaccination rates only if not accounting for other observables.

5.3 Instrumental variable results

To tackle the potential threat of a bias in our estimates caused by (unobserved) omitted variables, we next discuss results from instrumental variable regressions as described in Section 5.1.2.

5.3.1 First-stage results

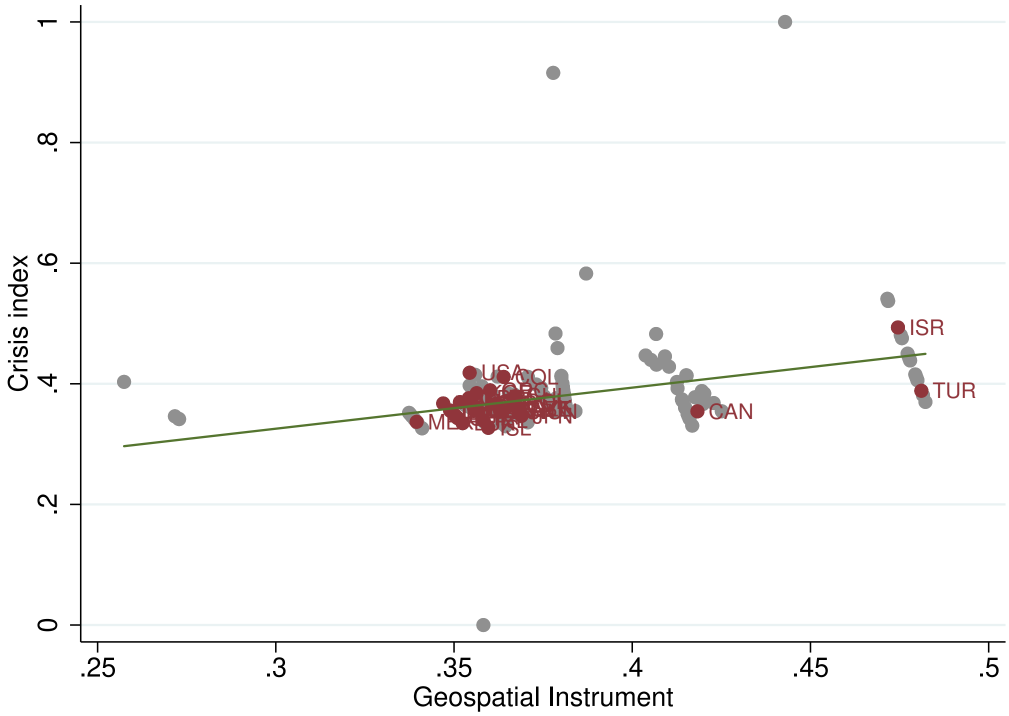
Figure (3) shows the correlation between our crisis experience index and the geospatial instrumental variable, which exploits the geospatial distribution of crisis experience. The figure shows the full sample of countries for which the crises index can be computed (grey dots) as well as the sub-sample of OECD countries that we use for estimation (red dots). For both samples, the correlation is positive (0.35 for the full sample and 0.58 for the OECD) and statistically significant at the 1% level.

Table (2) reports our instrumental variable results, replicating the model specification of the benchmark model. In Panel B, we present first-stage estimates. The results

[6]The start date is implemented as a date variable. Even though some observations are censored in the baseline specification, all OECD countries had started their vaccination rollouts by the publication of this working paper. Hence, we also include vaccination start dates later than 3 February 2021.

[7]One could imagine that countries with risk-loving citizens would favour the chance of heard immunity over mass vaccination, or order only one type of vaccination instead of diversifying their vaccination portfolio.

Figure 3 CRISIS EXPERIENCE INDEX AND GEOSPATIAL INSTRUMENT



Notes: The figure shows the unconditional correlation between a country's crisis experience index and our instrumental variable that draws on the geospatial correlation of crises, measured by jack-knifed regional averages of our crisis experience index (see Section 5.1.2 for a detailed description). The grey dots represent the full sample of countries for which the crisis experience index can be computed, the red dots mark the sample of OECD countries upon which our estimates are based.

show that our instrumental variable is a strong predictor of national crisis experience. In the parsimonious model, the parameter estimate for jack-knifed regional averages of the crisis experience indicator is 0.567. The parameter estimate is statistically significant at the 10% level ($t = 1.94$) for the 2SLS model and at the 5% level ($t = 1.96$) for the Tobit IV model. Augmenting the model by the control variables yields little changes in the first-stage regression results (parameter estimate 0.611, $t = 1.92$ and $t = 2.03$).

Table (2) also reports instrument diagnostics. As the Tobit IV results are obtained using Maximum Likelihood Estimation, traditional tests for instrument strength are available only for the 2SLS model. Estimating the Tobit IV model based on the approach suggested by Newey (1987) would result in identical test statistics for most of the tests ("two-step" Tobit IV). The large F statistics for the first-stage (18.12 in the parsimonious model and 19.87 when including controls) suggests that jack-knifed regional averages provide strong instruments for national crisis experience. In particular, the first-stage F statistics greatly exceed the critical values of the demanding threshold of a 15% IV size (Stock et al., 2005). The indication of a strong instrument is bolstered by the p-values of the Stock and Wright (2000) test, which provides robust inferences for $H_0 : \beta = 0$ even in the presence of weak instruments ("weak-instrument-robust tests"). The low p-values (~ 0.00) suggest that the null hypothesis of a zero impact of crisis experience has to be rejected even when the instrument *would* be weak. We also perform additional tests for underidentification, which suggest that the excluded instruments are "relevant" i.e. correlated with the endogenous regressors.

5.3.2 Second-stage results

In Panel A of Table (2), we present second-stage results of our instrumental variable models. The model specifications are identical to the benchmark models, reporting parsimonious models and models that account for observable confounding factors. Columns (1)–(2) show results for the "traditional" 2SLS model, Columns (3)–(4) apply Maximum-Likelihood Estimations that enable estimation of Tobit models with continuous endogenous regressors.

In each of the specifications, the parameter estimates of the crisis experience variable are statistically significant at the 1% level. Numerically, the parameter estimates are comparable to those obtained in our OLS specifications. Consistent with the results of the OLS model, estimating the 2SLS model using only observations from the subsample of non-truncated observations (N^1), the economically and statistically significant parameter estimate on crisis experience reappears and standard errors decrease. Again, when omitting censored observations, the results become quite comparable to the Tobit estimates.

Taken together, the instrumental variable regressions strongly support our benchmark estimates. Given that the weak instrument diagnostics all suggest that crises in regionally close countries serve as a strong instrument for national crises, there is indication that the parameter estimates in our benchmark model are not confounded by unobserved omitted variables.

Table 2 VACCINATION AND CRISIS EXPERIENCE—INSTRUMENTAL VARIABLE RESULTS

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	2SLS Models		**Tobit IV Model**	
	(I) Parsimonious	(II) Full specification	(III) Parsimonious	(IV) Full specification
	Panel A: Second-stage regression results			
Crisis Experience Index	340.6***	372.7***	347.7***	389.8***
	(3.38)	(5.43)	(3.47)	(5.94)
	Panel B: First-stage regression results			
Instrument	0.567*	0.611*	0.567**	0.611**
	(1.94)	(1.92)	(1.96)	(2.03)
Obs. (# of Countries)	37	37	37	37
R-Squared	0.501	0.635		
F-Stat (χ^2)	10.82	6.56	12.02	35.84
Prob. > F-Stat (χ^2)	0.0000	0.000	0.001	0.000
F-Stat (first-stage)	18.12	19.87		
Stock-Yogo 15% max IV size	8.96	8.96		
Stock-Wright (p-val)	0.005	0.000		
Control variables	NO	YES	NO	YES

Notes: The table shows the results of our estimations on the effect of crisis experience on the number of administered COVID-19 vaccine doses per 100 citizens. Columns (1)–(2) show results of 2SLS regressions, Columns (3)–(4) report results from Tobit IV models. t values (2SLS) and z values (Tobit IV) are reported in parentheses. Each model uses jack-knifed regional averages of our crisis experience index as instrumental variable. F-Stat (first-stage) reports the F-statistic of the first-stage regression, along with critical thresholds for a 15% maximum IV size computed by Stock et al. (2005). Stock-Wright (p-val) reports the p-value of Stock and Wright (2000)'s test that allows for weak-instrument-robust inferences for $H_0 : \beta = 0$.

*** Significant at the 1 percent level
** Significant at the 5 percent level,
* Significant at the 10 percent level

6 Micro-Evidence from Survey-Data

We investigate the microeconomic foundation of our macroeconomic results using data from a cross-national survey on individuals' attitudes towards vaccination against COVID-19.

Our theory in section (2) describes how experience effects influence citizens' preferences towards COVID-19 vaccination in response to crisis experience. Our macro-level results are based on the implicit assumption that the collective memory of a society influences vaccination efforts. We now study the microeconomic foundation of the cross-country results using survey data on individuals' attitudes towards COVID-19 vaccination. Our analysis follows two steps. First, we relate vaccination preferences of individuals to the crisis history of countries. Second, we study whether socialization or experiences drive our results, relating preferences to crises experienced when young.

6.1 Data on attitudes towards COVID-19 vaccination

We use data compiled by Lazarus et al. (2021) who collect an international survey on COVID-19 vaccine acceptance rates of 13,426 individuals from 19 countries.[8] The survey was conducted from 16 June 2020 to 20 June 2020. An advantage of this timing is that respondents' preferences regarding COVID-19 vaccination are not biased by controversies in the public debate about the efficacy or potential adverse effects of specific vaccines.[9]

The survey elicits respondents' attitudes regarding vaccination against COVID-19 via two questions:

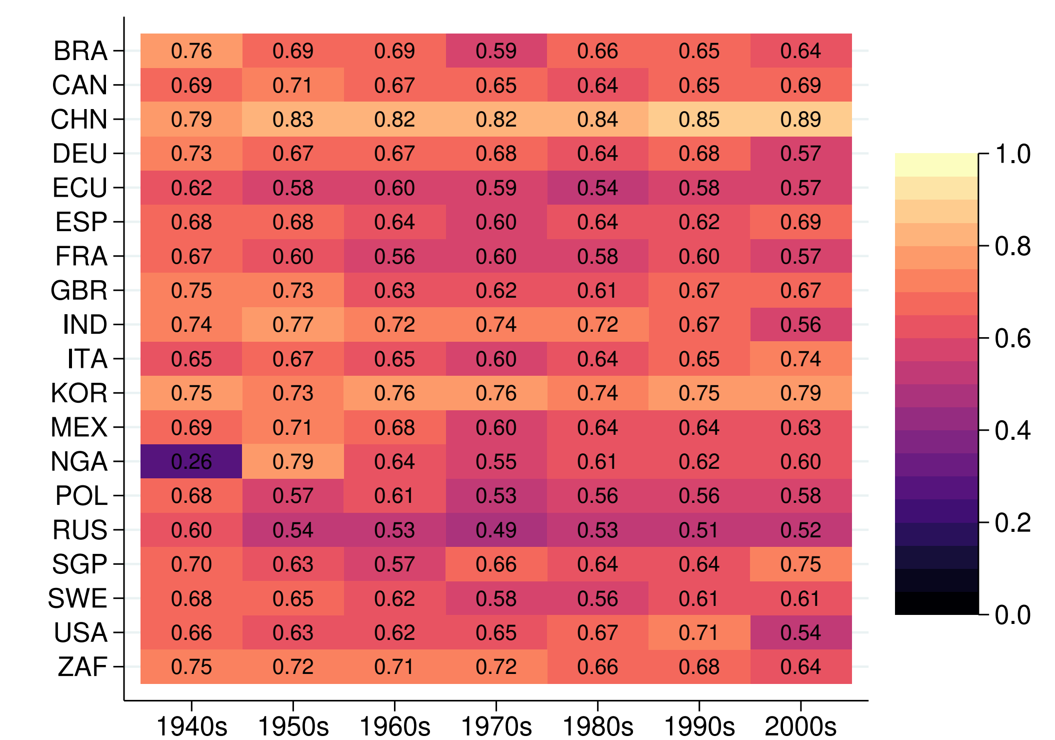
(Q1) "If a COVID-19 vaccine is proven safe and effective and is available to me, I will take it".

(Q2) "I would follow my employer's recommendation to get a COVID-19 vaccine once the government has approved it as safe and effective".

[8]These countries are Brazil, Canada, China, Ecuador, France, Germany, India, Italy, Mexico, Nigeria, Poland, Russia, Singapore, South Africa, South Korea, Spain, Sweden, the United Kingdom, and the United States.

[9]The public debate around varying efficacy rates amongst different COVID-19 vaccines as well as the suspension of vaccination due to concerns about cerebral venous sinus thrombosis in many countries in the spring of 2021 may well influence individuals' reported preferences.

Figure 4 HETEROGENEITY IN VACCINE ACCEPTANCE: COUNTRIES AND BIRTH COHORTS



Notes: The figure shows the mean value of the standardized vaccination index by country and birth cohort. Higher scores indicate higher vaccination acceptance. Vaccination preferences are based on own calculations using raw data on vaccine acceptance taken from Lazarus et al. (2021).

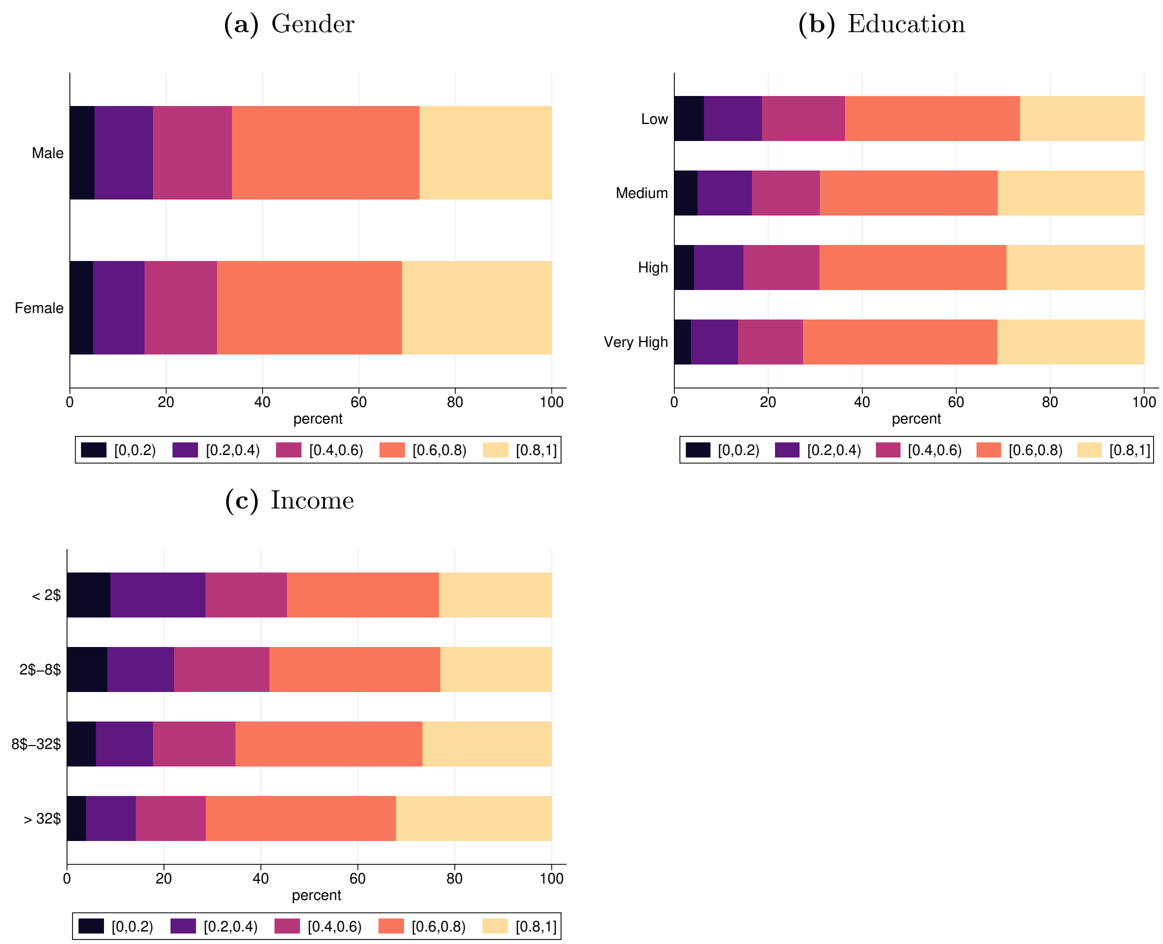
The responses are coded on a Likert scale running from 1 ("completely disagree") to 5 ("completely agree").[10] For our benchmark specification, we exploit the full set of information by combining responses to both questions into an index reflecting individuals' general attitudes towards COVID-19 vaccines that assumes values between 0 (no vaccine accpetance) and 1 (full vaccine acceptance). We use responses to individual questions in our robustness analyses.

Consistent with our theory on crisis experience, the data reveals heterogeneity in the acceptance of a potential COVID-19 vaccine across countries and country-specific age cohorts. Figure (4) shows how our combined measure of COVID-19 vaccination preferences is distributed across countries and birth cohorts: there is substantial het-

[10]The coding scheme is 1 ("completely disagree"), 2 ("somewhat disagree"), 3 ("neutral/no opinion"), 4 ("somewhat agree"), 5 ("completely agree").

erogeneity across time and across countries, and there is no clear trend in preferences. We observe a similar heterogeneity in vaccine preferences regarding individuals' key socioeconomic characteristics (Figure 5). Acceptance rates are particularly high for individuals with high levels of education and income. Also, the descriptive statistics suggest that on average women are more positive towards COVID-19 vaccines than men.

Figure 5 HETEROGENEITY IN VACCINE ACCEPTANCE: SOCIOECONOMIC CHARACTERISTICS



Notes: The figure shows the percentage of respondents with a standardized vaccination indicator in a given range. Higher scores indicate higher vaccination acceptance. Vaccination preferences are based on own calculations using raw data on vaccine acceptance taken from Lazarus et al. (2021). Following their notation on educational levels, "Low" corresponds to "Less than high school". "Medium" to "High School or some college", "High" to "Bachelor" and "Very High" to "Postgraduate". Income levels refer to Gapminder income levels, which give the US Dollar equivalent of what an individual earns per day.

6.2 Empirical strategy

Our benchmark model relates citizens' crisis experience to attitudes towards COVID-19 vaccination via

$$\text{Vacc}_{ijh} = \psi C_j^h + \mathbf{A}_j \boldsymbol{\beta} + \mathbf{B}_i \boldsymbol{\rho} + \mathbf{X}_i \boldsymbol{\gamma} + \eta_r + \zeta_h + \varepsilon_{ijh}, \tag{10}$$

where Vacc_{ijh} denotes attitudes toward COVID-19 vaccination of citizen j born in birth-year cohort h and living in country i. Our key variable of interest, C_j^h, is the country-specific measure of past crises. We employ two types of crisis measures. First, we closely replicate our macro-level crisis indicator to facilitate the comparison between the micro-level and the macro-level analysis and to examine whether our macroeconomic effects have a microeconomic foundation. Second, we disentangle socialization effects from experience effects by specifically examining crises individuals experienced when young. The socio-psychological literature emphasizes that core attitudes, beliefs, and values are predominantly formed during a period of great mental plasticity in early adulthood and remain largely unaltered throughout the remaining adult years (see, e.g., Mannheim, 1970; Krosnick and Alwin, 1989). Against the backdrop of these findings, we expect that the experience effects discussed in section (8) should manifest primarily in response to crises experienced during the impressionable years (ususally between ages 18 and 25). When examining crises in the impressionable years, the crisis variable $C_{jh}^{t^h}$ captures the extent of crises experienced by j during their impressionable years t^h , implied by birth-year cohort h and country i.

In the most parsimonious specification, we relate attitudes towards vaccination to crisis experience of citizens and gradually include an array of control variables that account for potential confounding effects. These variables include country-specific COVID-19 controls $\mathbf{A}_j$ such as the number of COVID-19 cases and deaths in a citizens' country at the time the survey was conducted. The model also includes citizen-specific COVID-19 dummies $\mathbf{B}_i$ that assume a value of 1 if the respondent or a family member had fallen sick with COVID-19. We also include citizen-level socioeconomic characteristics $\mathbf{X}_i$, including respondents' gender, income, and education. In our analysis examining experience effects in individuals' impressionable years, we also disentangle effects of crises and effects of economic recessions by including a dummy for whether the individual has experienced a recession during their impressionable years (see Giuliano and Spilimbergo, 2014). To account for cultural socialization, institutions, geography, and the ex ante vulnerability to crises, the model also includes fixed effects η_r for geographic regions r. To address changes in preferences over the life-cycle (i.e. that citizens may become more risk-avers when they get older), we also account for birth-cohort fixed effects ζ_h.

Remarks on the data structure and control variables: As data on citizens' preferences towards COVID-19 vaccination is available only for a cross-section of individuals, we cannot account for time-varying covariates across birth-cohorts or countries to consider differential trends across geographic units or age cohorts. A related limitation is that the number of observations per country-birth-cohort is restricted. Hence, the within variation exploited when conditioning on fixed effects for countries is potentially not large enough for identification, particularly when examining crises experienced by individuals during their formative years. When accounting for country-level fixed effects, variation for identification would only stem from country-specific changes over time. To strike a good balance between having enough variation and eliminating time-invariant unobservables, we account for fixed effects of geographical regions r. We classify these regions to be as homogeneous as possible in terms of political institutions, culture, geography, and infrastructure (see Table A-4 for a detailed list underlying our classification). We also cannot account for fixed effects for regions and cohorts at the same time, as doing so would eliminate all variation in our data.

6.3 Attitudes towards COVID-19 vaccination and the crisis history of countries

We examine the microfoundation of our macroeconomic approach by relating a country's crisis history to individual-level preferences for vaccination against COVID-19. To cover the full range of age-cohorts included in the survey, our variable of interest, C_j^h, quantifies the crisis history of countries since the end of World War II. The computation of the crisis history follows our macro-level approach as closely as possible. The longer time-span necessary for the microeconomic analysis, however, comes at the cost of excluding data for military expenditure, which is available with sufficient coverage only for the post-1980 period.

When examining the relationship between the crisis history of countries and preferences towards COVID-19 vaccination, we cannot account for those controls described in Section (6.2) that are time-invariant, because they are perfectly correlated with the

Table 3 ATTITUDES TOWARDS COVID-19 VACCINATION AND THE CRISIS HISTORY OF COUNTRIES

Dependent variable: COVID-19-Vaccine Acceptance, continuous indicator, Vacc_{ijh}

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
C_j^h	0.110***	0.108***	0.118***	0.114***	0.114***	0.120***	0.119***
	(12.81)	(12.59)	(13.68)	(13.12)	(13.24)	(13.82)	(13.87)
Obs. (# of Ind.)	13426	13426	13426	13418	13418	13418	13418
R-Squared (adj.)	0.012	0.016	0.033	0.017	0.017	0.041	0.041
Pers. C19 Cont.	-	X	-	-	-	X	X
Socio-Ec. Cont.	-	-	X	-	-	X	X
Birth-Year FE	-	-	-	X	-	X	-
Birth Coh. FE	-	-	-	-	X	-	X

Notes: This table shows the results of the estimations on the correlation between the crisis history of countries and individuals' vaccination preferences. "Pers. C19 Cont." denotes personal COVID-19 controls, reflecting dummy variables that are equal to one if the respondent or a family member had fallen sick with COVID 19. "Socio-Ec. Cont." denotes socioeconomic control variables. These variables include gender, income, and educational background. The t statistics reported in parentheses are adjusted to arbitrary heteroskedasticity.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

historical crisis indicator of countries. The results are reported in Table (3). The main result is that the crisis history of countries is positively related to citizens' vaccination preferences. The parameter estimates are all statistically significant at the 1% level ($t > 10$ in each model specification). The size of the parameter estimate is comparable across model specifications, suggesting that the included covariates hardly influence the estimated relationship between countries' crisis history and citizens' vaccination preferences.

6.4 Intergenerational cultural transmission versus experience effects

A pending question is whether the microeconomic effects presented in Table (3) are based on collective memories that are transmitted from one generation to the next or whether they are driven by specific crises individuals experienced when they were young. We examine this question building on the "impressionable years hypothesis" and link citizens' past crisis experience to current preferences towards COVID-19 vaccination. Social psychologists found that core attitudes, beliefs, and values are primarily formed during a period of great mental plasticity in early adulthood and remain largely unaltered throughout the remaining adult years. These impressionable years mark a sensitive period in the lives of citizens during which socializing has the most profound impact. After this critical period of socialization, core orientations of citizens are unlikely to change ("increasing persistence hypothesis"). While it is difficult to precisely qualify the period of mental plasticity, there is a consensus in the literature that the ages 18 to 25 are particularly shaped by socializing effects (see, e.g., Mannheim, 1970; Krosnick and Alwin, 1989).

Past studies have shown that individuals' preferences are influenced by economic incidences experienced during the impressionable years. In a seminal paper, Giuliano and Spilimbergo (2014) show that experiencing recessions during the impressionable years increases individuals' support for government redistribution. Other studies find that preferences are related to experienced inequality during the impressionable years (Roth and Wohlfart, 2018) and that pandemic experiences influences individuals' trust in scientists and politicians (Eichengreen et al., 2021; Aksoy et al., 2020).

We examine whether citizens who have experienced an epidemic, a war, or a natural disaster place higher value on mitigating the effects of another crisis than individuals who did not experience traumatic events. Following our theory, we expect that such experiences influence preferences particularly during the impressionable years of individuals. When experience effects dominate, we would expect that citizens who have not experienced the severity of previous crises might underestimate the consequences of the COVID-19 pandemic and place less value on getting vaccinated. Hence, we hypothesize that citizens with more crisis experience during their formative years will have higher preferences for COVID-19 vaccination than those with less or no crisis experience.

6.4.1 Measuring crises during the impressionable years

To measure individual crisis experience during the impressionable years, we construct a crisis experience indicator for each surveyed citizen j parallel to the macro-level approach and the strategy used to compute measures reflecting the crisis history of countries. To this end, we compile data on disaster- and conflict-related deaths during a citizen's formative years to construct a crisis experience index from the ten log-death measures via PCA (see Section 3 for a description). We obtain a dataset with the relative crisis experience during the impressionable years of each surveyed individual j born in country i in year h by taking the average of the eight impressionable years' crisis experience index. This suggests that all citizens born in the same year and in the same country have the same crisis experience during their impressionable years. Variation stems from citizens born in the same country but in different years; born the same year but in different countries; or both. We then match this index by country and birthyear to the respondents of the survey by Lazarus et al. (2021).

Figure (6) shows how the country-specific crisis indicators have developed over time. The figure suggests that there is substantial between-country variation in the extent of crises experienced by individuals aged 18–25. The figure also shows that countries differ substantially in the extent of within-variation. While some countries such as Sweden, Canada, or Germany have experienced few crises over the sample period, there is considerable temporal variation in China, Russia, Nigeria, or India.

6.4.2 Crisis experience and COVID-19 vaccination preferences

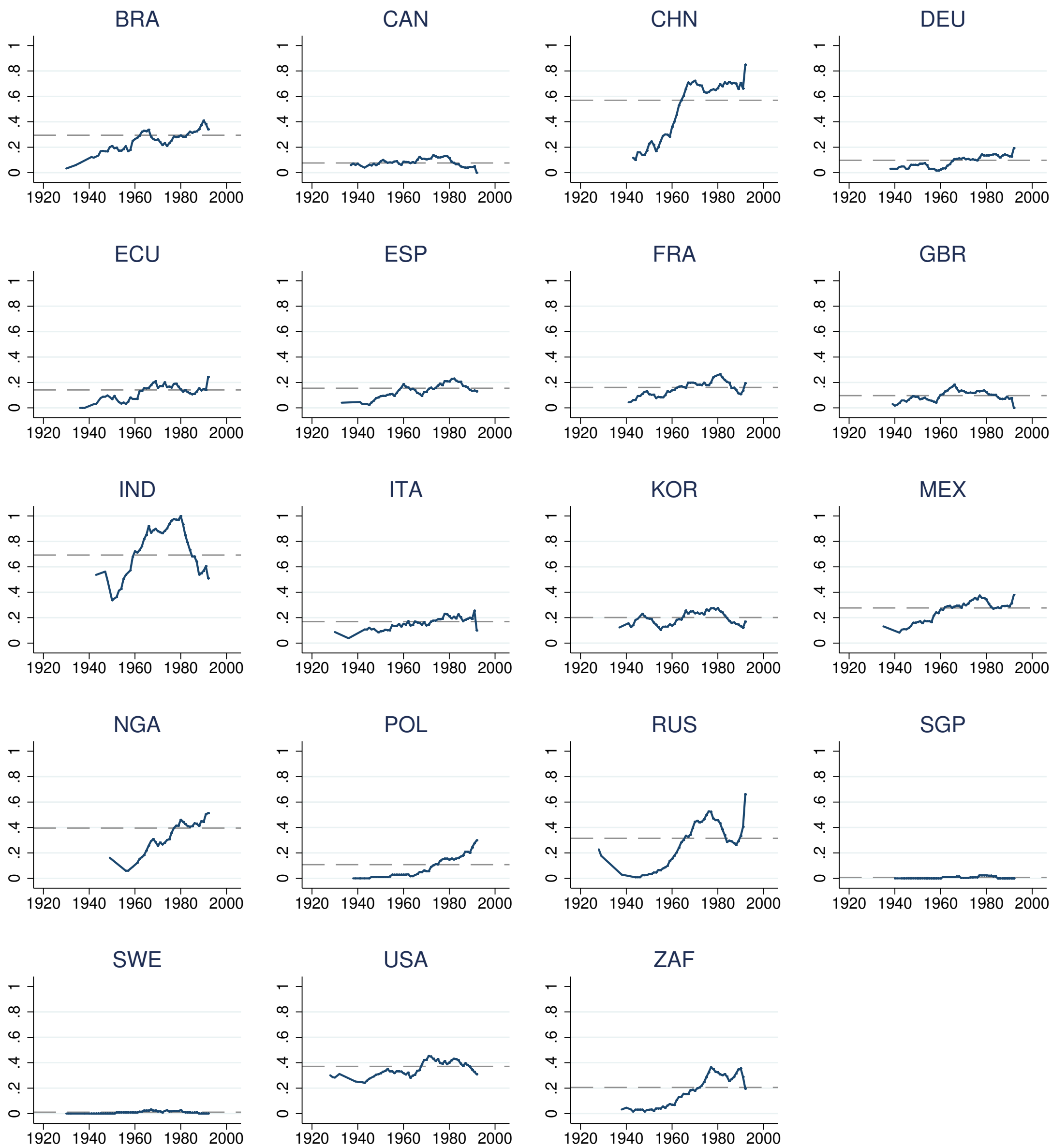
Our benchmark results on crisis experience during the impressionable years and preferences regarding COVID-19 vaccination are reported in Table (4). The results are obtained using the continuous composite measure of attitudes towards COVID-19 vaccination as the dependent variable and the crisis experience index during individuals' impressionable years as the explanatory variable. For our benchmark results, we estimate Equation (10) by OLS using heteroskedasticity robust standard errors.[11]

In the most parsimonious specification (Column (I)), citizens' attitudes towards COVID-19 vaccination are regressed onto crisis experience during an individual's impressionable years. The estimated parameter has a positive sign and is statistically significant at the 1% level. Numerically, the parameter estimate suggests that when the crisis experience index increases by one standard deviation (0.20), the vaccine acceptance index increases by around 0.13 standard deviations (0.03 points).

In Columns (II)–(VII), we gradually add the control variables described in Equation (10). In all specifications, the parameter estimate remains positive and statistically significant at the 1% or the 5% level. While including COVID-19 controls in Column (II) does not change the parameter estimate of the benchmark model in Column (I),

[11] We cannot model standard errors to be nested within countries, as the number of included countries is not sufficiently large to cluster standard errors on the country-level (see, e.g., Cameron and Miller, 2015).

Figure 6 CRISES DURING THE IMPRESSIONABLE YEARS OF INDIVIDUALS PER COUNTRY



Notes: The figure shows how the country-specific crisis indicators have developed over time, reflecting the degree of crises experienced by individuals that were of age 18–25 in the respective years. The sample average of crises across all countries and years is represented via grey dashed lines.

Table 4 ATTITUDES TOWARDS COVID-19 VACCINATION AND CRISIS EXPERIENCE — BENCHMARK RESULTS

Dependent variable: Covid 19-Vaccine Acceptance, continuous indicator, Vacc_{ijh}

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
$C_{jh}^{t^h}$	0.150***	0.173***	0.179***	0.0647***	0.0503***	0.0777***	0.252***
	(12.59)	(13.71)	(14.34)	(3.92)	(3.06)	(4.24)	(17.77)
Obs. (# of Ind.)	10149	10149	9996	10149	9996	9996	9996
R-Squared (adj.)	0.015	0.022	0.040	0.068	0.080	0.083	0.063
Pers. C19 Cont.	-	X	-	-	-	X	X
Count. C19 Cont.	-	X	-	-	-	X	X
Soc-Econ. Cont.	-	-	X	-	X	X	X
Regional FE	-	-	-	X	X	X	-
Birth Coh. FE	-	-	-	-	-	-	X

Notes: This table shows the results of the estimations on the correlation between crisis experience during the impressionable years and individuals' vaccination preferences. Personal COVID-19 controls ("Pers. C19 Cont") are dummy variables that are equal to one if the respondent or a family member had fallen sick with COVID 19. Country COVID-19 controls ("Count. C19 Cont.") are the number of COVID-cases and COVID-deaths in the respondents' country at the time the survey was conducted (June 2020). Socioeconomic controls ("Soc-Econ. Cont.") are gender, income level, and educational background, as well as a dummy indicating whether the individual experienced a recession in their impressionable years. Differences in the number of observations stem from people born more than 25 years before GDP coverage for their country begins in the Penn World Tables, leaving them with no impressionable-years-recession information. We control for whether the impressionable years could be observed fully or partially, both in regard to crises and recessions. The t statistics reported in parentheses are adjusted to arbitrary heteroskedasticity.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

the estimated parameter becomes smaller when accounting for socioeconomic characteristics (Column III) and country-level fixed effects (Column IV and Column V). We observe no changes in the inferences when we combine individual-level controls for COVID-19 and socioeconomic characteristics with fixed effects for geographic regions (Column VI). The size of the estimated parameter increases when we replace country fixed effects by birth cohort fixed effects (Column VII).

Robustness of the benchmark results: We also disentangle the components underlying our composite measure of COVID-19 vaccination attitudes by separately using Q1 and Q2 as the dependent variable. Given that these variables are coded on a Likert scale running from 1 to 5, we re-estimate our empirical specifications using an ordered probit model. This strategy accounts for non-linearity in the relationship between crisis experience and COVID-19 vaccination preferences, i.e. when a change from, say, 1 to 2 has a different meaning than a change from 2 to 3. The results are reported in Tables (A-11) and (A-12) in the appendix. Consistent with our benchmark results, the parameter estimates are positive in each model, but the estimates are stronger for Q2 than for Q1, suggesting that an additional recommendation of citizens' employers on top of the government's approval increases the willingness of citizens to get vaccinated against COVID-19.

Interpretation of the results: Our results are consistent with the theory outlined in Section (2), suggesting that citizens who experienced crises during their impressionable years are more likely to accept COVID-19 vaccination. Our strategy includes an array of possible crises individuals may have experienced when young, and the results should be interpreted as individuals' support of a remedy conditional on having experienced *any* profound crises in the past. Previous studies link epidemic experiences to pre-COVID-19 attitudes towards scientists and vaccines (see, e.g., Eichengreen et al., 2021). Our strategy extends these studies in two steps. First, we examine vaccination against COVID-19. Given the profound consequences on citizens' health, living conditions, and wealth, we might expect that attitudes towards COVID-19 vaccination are fundamentally different to attitudes towards an established vaccination against measles, diphtheria, pertussis, or tetanus. This argument particularly applies to industrialized countries. Second, we account for a large number of crises because focusing on epidemics may produce a considerable number of false negatives, i.e. individuals who experienced devastating crises which are not epidemics (e.g. natural disasters or wars). In line with our theoretical model, we expect citizens treated with these types of crises to have higher preferences towards a remedy regardless of the type of crises as they know how long-lasting the negative effects of crises might be.

7 Conclusion

We propose that crisis experience influences preferences towards COVID-19 vaccination. Countries with high crisis experience have been faster in vaccinating their citizens against COVID-19 than countries with less crisis experience in the initial stages of vaccination. We use a new index measuring crisis experience. The results show that a one-standard-deviation increase in the crisis experience index gives rise to around 10 additional administered vaccine doses per 100 citizens (around one standard deviation). We examine the micro foundation of these macro-level results by using micro data:Citizens who experienced crises during their impressionable years (age 18–25) were more likely to prefer vaccination against COVID-19 than citizens who did not experience crises during their impressionable years. The results suggest that when the crisis experience index increases by one standard deviation (0.20), the vaccine acceptance index increases by around 0.13 standard deviations (0.03 points).

Countries with crisis experience understand how long-lasting the negative effects of crises might be, and hence put great effort in preventing crises and act decisively when crises occur. Early vaccination progress against COVID-19 suggests that countries with crisis experience have handled the COVID-19 crisis in a better manner than countries with less crisis experience such as EU countries. Those countries which were untroubled by crises for a long time may well learn from the COVID-crisis by, for example, investing in crisis management infrastructure and crisis prevention.

References

Acemoglu, D., Naidu, S., Restrepo, P., and Robinson, J. A. (2019). Democracy does cause growth. *Journal of Political Economy*, 127(1):47–100.

Aksoy, C. G., Eichengreen, B., and Saka, O. (2020). The political scar of epidemics. *NBER Working Paper No. 27401*.

Alesina, A. and Fuchs-Schündeln, N. (2007). Goodbye lenin (or not?): The effect of communism on people's preferences. *American Economic Review*, 97(4):1507–1528.

Amemiya, T. (1984). Tobit models: A survey. *Journal of Econometrics*, 24(1-2):3–61.

Becker, R., Hillman, A., Potrafke, N., and Schwemmer, A. (2015). The preoccupation of the United Nations with Israel: Evidence and theory. *Review of International Organizations*, 10(4):413–437.

Bjørnskov, C. (2021). Did lockdown work? an economist's cross-country comparison. *CESifo Economic Studies*, forthcoming.

Blum, J. (2018). Defense burden and the effect of democracy: Evidence from a spatial panel analysis. *Defence and Peace Economics*, 29(6):614–641.

Brodeur, A., Gray, D. M., Islam, A., and Bhuiyan, S. J. (2021). A literature review of the economics of COVID-19. *Journal of Economic Surveys*, forthcoming.

Brown, P., Daigneault, A. J., Tjernström, E., and Zou, W. (2018). Natural disasters, social protection, and risk perceptions. *World Development*, 104:310–325.

Callen, M., Isaqzadeh, M., Long, J. D., and Sprenger, C. (2014). Violence and risk preference: Experimental evidence from Afghanistan. *American Economic Review*, 104(1):123–48.

Cameron, A. C. and Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, 50(2):317–372.

Cassar, A., Healy, A., and Von Kessler, C. (2017). Trust, risk, and time preferences after a natural disaster: experimental evidence from Thailand. *World Development*, 94:90–105.

CDC (2010). *2009 H1N1 Pandemic (H1N1pdm09 virus)*. Center for Disease Control and Prevention, Druid Hills, GA.

Centre for Research on the Epidemiology of Disasters (2021). The International Disaster Database (EM-DAT). https://public.emdat.be/.

Cogley, T. and Sargent, T. (2008). The market price of risk and the equity premium: A legacy of the Great Depression? *Journal of Monetary Economics*, 55(3):454–476.

de Figueiredo, A., Johnston, I. G., Smith, D. M. D., Agarwal, S., Larson, H. J., and Jones, N. S. (2016). Forecasted trends in vaccination coverage and correlations with socioeconomic factors: a global time-series analysis over 30 years. *Lancet Glob Health*, 4:e726–35.

Dreher, A. (2006). Does globalization affect growth? Evidence from a new index of globalization. *Applied Economics*, 38(10):1091–1110.

Dror, A. A., Eisenbach, N., Taiber, S., Morozov, N. G., Mizrachi, M., Zigron, A., Srouji, S., and Sela, E. (2020). Vaccine hesitancy: the next challenge in the fight against covid-19. *European Journal of Epidemiology*, 35(8):775–779.

Eichengreen, B., Aksoy, C. G., and Saka, O. (2021). Revenge of the experts: Will COVID-19 renew or diminish public trust in science? *Journal of Public Economics*, 193:104343.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., and Sunde, U. (2018). Global evidence on economic preferences. *Quarterly Journal of Economics*, 133(4):1645–1692.

Filippetti, A. and Archibugi, D. (2011). Innovation in times of crisis: National systems of innovation, structure, and demand. *Research Policy*, 40(2):179–192.

Finkelstein, A. (2004). Static and dynamic effects of health policy: Evidence from the vaccine industry. *Quarterly Journal of Economics*, 119(2):527–564.

Galasso, V., Profeta, P., Pons, V., and Foucault, M. (2021). Covid-19 vaccine's gender paradox. *Working Paper*.

Gallup (2019). Wellcome Global Monitor 2018. https://wellcome.org/reports/wellcome-global-monitor/2018.

Gauri, V. and Khaleghian, P. (2002). Immunization in developing countries: its political and organizational determinants. *World Bank Policy Research Working Paper 2769*.

Giuliano, P. and Spilimbergo, A. (2014). Growing up in a recession. *Review of Economic Studies*, 81(2):787–817.

Goel, R. and Nelson, M. (2021). Drivers of covid-19 vaccinations: Vaccine administration and delivery efficiency in the United States. *CESifo Working Paper No. 8972*.

Gross, D. P. and Sampat, B. N. (2021). The economics of crisis innovation policy: A historical perspective. *AEA Papers and Proceedings*, 111:346–350.

Gründler, K. and Krieger, T. (2016). Democracy and growth: Evidence from a machine learning indicator. *European Journal of Political Economy*, 45:85–107.

Gründler, K. and Krieger, T. (2019). Should we care (more) about data aggregation? evidence from democracy indices. *CESifo Working Paper No.7480*.

Gründler, K. and Krieger, T. (2021). Using machine learning to measure democracy: A practitioners guide and a new updated dataset for 186 countries from 1919 to 2019. *European Journal of Political Economy*, forthcoming.

Gründler, K. and Potrafke, N. (2020). Experts and epidemics. *CESifo Working Paper No.8556*.

Gygli, S., Haelg, F., Potrafke, N., and Sturm, J.-E. (2019). The KOF globalization index – revisited. *Review of International Organizations*, 14(3):543–574.

Hanaoka, C., Shigeoka, H., and Watanabe, Y. (2018). Risk-taking behavior in the wake of natural disasters. *American Economic Journal: Applied Economics*, 10(2):298–330.

Harari, M. and Ferrara, E. L. (2018). Conflict, climate, and cells: a disaggregated analysis. *Review of Economics and Statistics*, 100(4):594–608.

Hetherington, M. and Suhay, E. (2011). Authoritarianism, threat, and americans' support for the war on terror. *American Journal of Political Science*, 55(3):546–560.

Hillman, A. and Potrafke, N. (2015). The UN Goldstone Report and retraction: An empirical investigation. *Public Choice*, 163(3-4):247–266.
Hooghe, L., Marks, G., Schakel, A. H., Osterkatz, S. C., Niedzwiecki, S., and Shair-Rosenfield, S. (2016). *Measuring regional authority: A postfunctionalist theory of governance, Volume I.* Oxford University Press.
Karlsson, L. C., Soveri, A., Lewandowsky, S., Karlsson, L., Karlsson, H., Nolvi, S., Karukivi, M., Lindfelt, M., and Antfolk, J. (2021). Fearing the disease or the vaccine: The case of covid-19. *Personality and Individual Differences*, 172:110590.
Krosnick, J. A. and Alwin, D. F. (1989). Aging and susceptibility to attitude change. *Journal of Personality and Social Psychology*, 57(3):416.
Lazarus, J. F., Ratzan, S. C., Palayew, A., Gostin, L. O., Larson, H. J., Rabin, K., S., K., and El-Mohandes, A. (2021). A global survey of potential acceptance of a covid-19 vaccine. *Nature Medicine*, 27:225–228.
Lin, P. Z. and Meissner, C. M. (2020). A note on long-run persistence of public health outcomes in pandemics. *NBER Working Paper No.27119*.
Lokshin, M., Kolchin, V., and Ravallion, M. (2020). Scarred but wiser: World war 2's covid legacy. *NBER Working Paper 28291*.
Malmendier, U. and Nagel, S. (2011). Depression babies: Do macroeconomice experiences affect risk-taking? *Quarterly Journal of Economics*, 126:373–416.
Malmendier, U. and Nagel, S. (2016). Learning from inflation expectations. *Quarterly Journal of Economics*, 131:53–87.
Malmendier, U., Nagel, S., and Yan, Z. (2020a). The making of hawks and doves. *Journal of Monetary Economics*, forthcoming.
Malmendier, U., Pouzo, D., and Vanasco, V. (2020b). Investor experiences and financial market dynamics. *Journal of Financial Economics*, 136(3):597–622.
Mannheim, K. (1970). The problem of generations. *Psychoanalytic Review*, 57(3):378–404.
Masia, N. A., Smerling, J., Kapfidze, T., Manning, R., and Showalter, M. (2018). Vaccination and gdp growth rates: Exploring the links in a conditional convergence framework. *World Development*, 103:88–99.
Mosler, M. (2021). Autocrats in the united nations general assembly: A test of the decoy voting hypothesis. *European Journal of Political Economy*, forthcoming.
Munck, G. L. and Verkuilen, J. (2002). Conceptualizing and measuring democracy: Evaluating alternative indices. *Comparative Political Studies*, 35(1):5–34.
Newey, W. K. (1987). Efficient estimation of limited dependent variable models with endogenous explanatory variables. *Journal of Econometrics*, 36(3):231–250.
Oster, E. (2018). Does disease cause vaccination? disease outbreaks and vaccination response. *Journal of Health Economics*, 57:90–101.
Our World in Data (2021). Data on COVID-19 (coronavirus) vaccinations. https://github.com/owid/covid-19-data/tree/master/public/data/vaccinations.
Phillips, B. J. (2015). Civil war, spillover and neighbors' military spending. *Conflict Management and Peace Science*, 32(4):425–442.
Potrafke, N. (2015). The evidence on globalisation. *World Economy*, 38(3):509–552.

Roth, C. and Wohlfart, J. (2018). Experienced inequality and preferences for redistribution. *Journal of Public Economics*, 167:251–262.

Stock, J. H. and Wright, J. H. (2000). Gmm with weak identification. *Econometrica*, 68(5):1055–1096.

Stock, J. H., Yogo, M., et al. (2005). Testing for weak instruments in linear iv regression. *Identification and inference for econometric models: Essays in honor of Thomas Rothenberg*, 80(4.2):1.

The Economist Intelligence Unit (2021). More than 85 poor countries will not have widespread access to coronavirus vaccines before 2023. https://www.eiu.com/n/85-poor-countries-will-not-have-access-to-coronavirus-vaccines/.

Voors, M. J., Nillesen, E. E., Verwimp, P., Bulte, E. H., Lensink, R., and Van Soest, D. P. (2012). Violent conflict and behavior: a field experiment in Burundi. *American Economic Review*, 102(2):941–64.

World Bank (2010). World development indicators. https://datacatalog.worldbank.org/dataset/world-development-indicators.

Yesilyurt, M. E. and Elhorst, J. P. (2017). Impacts of neighboring countries on military expenditures: A dynamic spatial panel approach. *Journal of Peace Research*, 54(6):777–790.

Appendix A: Supplementary Tables

Table A-1 VARIABLE DESCRIPTIONS

Variable	**Description**	**Source**
V_i	Administered doses of COVID-19 vaccines per 100 citizens on 3 February 2021 (extracted on 28 March 2021)	Our World in Data (2021)
Crisis Experience Index	Index for crisis experience, compiled from Military Expenditure, Conflict Deaths and Disaster Deaths	For individual sources see variables below
Military Expenditure	Military expenditure as share of GDP, average over the years 2000 to 2019	World Bank (2010)
Conflict Deaths	Battle-related deaths divided by population over the years 2000 to 2019	calculated from World Bank (2010)
Disaster Deaths	Deaths from technical and natural disasters divided by population over the years 2000 to 2019	calculated from Centre for Research on the Epidemiology of Disasters (2021) and World Bank (2010)
Log(GDP^{pc})	GDP per capita in constant 2010 USD, Logged average over the years 2000 to 2019	World Bank (2010)
Log(Health Exp^{pc})	Health expenditure per capita, PPP (current international dollars), Logged average over the years 2000 to 2018	World Bank (2010)
COVID-19 Deaths	COVID-19 attributed deaths per 1 million citizens on 3 February 2021 (extracted on 28 March 2021)	Our World in Data (2021)
Vaccination Start	Start date of a country's mass vaccination rollout, expressed as $t_0 + t_i$	Own research
Globalisation	KOF Globalisation Index 2018	Dreher (2006); Gygli et al. (2019)
Regional Authority Index	Regional Authority Index for 2018	Hooghe et al. (2016)
Trust in Scientists	Wellcome Global Monitor Trust in Scientists Index 2018	Gallup (2019)

Table A-2 SUMMARY STATISTICS: MACRO LEVEL

Panel A: Restricted sample (N^1)

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
V_i	5.671	10.455	0.53	60.97	32
Crisis Experience Index	0.364	0.029	0.327	0.493	32
Military Expenditure	1.601	1.085	0	5.965	32
Conflict Deaths	0	0.0001	0	0.0008	32
Disaster deaths	0.0001	0.0001	0	0.0004	32
Log(GDP^{pc})	10.326	0.66	9.167	11.553	32
Log(Health Exp.^{pc})	7.868	0.587	6.702	8.936	32
COVID-19 Deaths	932.26	481.111	84.982	1830.604	32
Vaccination Start	18.094	6.244	0	37	32
Globalisation	83.419	5.471	70.566	90.794	32
Trust in Scientists	0.242	0.095	0.08	0.42	32
Regional Authority Index	13.901	11.06	0	37.672	32
Will. to take risks	-0.075	0.231	-0.792	0.244	23

Panel B: Full Sample (N^1, N^2)

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
V_i	4.904	9.899	0	60.97	37
Crisis Experience Index	0.365	0.029	0.327	0.493	37
Military Expenditure	1.652	1.062	0	5.965	37
Conflict Deaths	0	0.0001	0	0.0008	37
Disaster Deaths	0.0001	0.0001	0	0.0004	37
Log(GDP^{pc})	10.303	0.677	8.758	11.553	37
Log(Health Exp^{pc})	7.837	0.591	6.588	8.936	37
COVID-19 Deaths	838.591	530.588	5.184	1830.604	37
Vaccination Start	25.649	20.262	0	80	37
Globalisation	82.396	6.172	63.659	90.794	37
Will. to take risks	-0.075	0.223	-0.792	0.244	27
Regional Authority Index	14.26	10.473	0	37.672	37
Trust in Scientists	0.234	0.1	0.06	0.42	37

Table A-3 SUMMARY STATISTICS: MICRO LEVEL

Panel A: Country History Regression Sample

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Vacc_{ijh}	0.651	0.239	0	1	13,426
C_j^h	0.466	0.244	0	1	13,426
Pers. C19	0.853	0.354	0	1	12,603
Gender (Female=1)	0.539	0.498	0	1	13,301
Educational Level	2.166	0.941	1	4	13,395
Income	3.529	0.768	1	4	12,796
Birthyear	1979.288	15.827	1928	2002	13,418
Birth Cohort	1974.981	16.203	1920	2000	13,418

Panel B: Individual Experience Regression Sample

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Vacc_{ijh}	0.653	0.239	0	1	10,149
Vaccination Preferences (Q1)	3.964	1.254	1	5	10,149
Vaccination Preferences (Q2)	3.284	1.155	1	5	10,149
$C_{jh}^{t^h}$	0.230	0.200	0	1	10,149
Pers. C19	0.864	0.342	0	1	9,605
Country C19 Cases	320322.100	526826.100	12257	2234475	10,149
Country C19 Deaths	20929.410	29431.330	26	119941	10,149
Gender (Female=1)	0.545	0.498	0	1	10,077
Educational Level	2.224	0.947	1	4	10,122
Income	3.610	0.692	1	4	9,786
Recession	0.250	0.433	0	1	9,996
Birthyear	1973.537	13.885	1928	1992	10,149
Birth Cohort	1969.275	14.392	1920	1990	10,149
Dummy: Incomplete GDP Data	0.029	0.167	0	1	10,149
Dummy: Incomplete Crisis Data	0.258	0.438	0	1	10,149

Table A-4 CLASSIFICATION OF REGIONS USED FOR THE CONSTRUCTION OF GEOSPATIAL INSTRUMENTS

I. ASIA	
Central Asia	Afghanistan, Armenia, Azerbaijan, Bhutan, Georgia, India, Iran, Kazakhstan, Kyrgyzstan, Maldives, Mongolia, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, Uzbekistan
East-Southeast Asia	Bangladesh, Cambodia, China, Japan, Laos, Myanmar, North Korea, South Korea, Taiwan, Thailand, Vietnam
Arabic Region	Bahrain, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen
Oceania	Australia, Brunei Darussalam, Fiji, Indonesia, Malaysia, New Zealand, Papua New Guinea, Philippines, Samoa, Singapore Solomon Islands, Tonga, Vanuatu
II. EUROPE	
Central-Northern Europe	Austria, Belgium, Denmark, Finland, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Sweden, Switzerland, United Kingdom
South-Southwest Europe	Cyprus, France, Greece, Italy, Malta, Portugal, Spain
East Europe	Belarus, Czech Republic, Estonia, Latvia, Lithuania, Moldova, Poland, Russia, Slovakia, Ukraine
Balkan States	Albania, Croatia, Bulgaria, Hungary, Kosovo, Macedonia, Montenegro, Romania, Serbia, Slovenia
III. AFRICA	
North Africa	Algeria, Egypt, Libya, Morocco, Tunisia
Central-East Africa	Cameroon, Central African Republic, Chad, Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan
West Africa	Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo
Southern Africa	Angola, Burundi, Comoros, Democratic Republic of the Congo, Republic of the Congo, Equatorial Guinea, Gabon, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, São Tomé and Príncipe, Seychelles, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe
IV. AMERICA	
North America	Bahamas, Canada, United States
Central America	Belize, Costa Rica, El Salvador, Grenada, Guatemala, Honduras, Mexico, Nicaragua, Panama
South America	Argentina, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela
Caribbean	Antigua and Barbuda, Barbados, Cuba, Dominica, Dominican Republic, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent, Trinidad and Tobago

Notes: The table shows the classification of regions used for the computation of the geospatial instruments, dividing each continent into four sub-regions (see Gründler and Krieger, 2016, 2019).

Table A-5 VACCINATION AND CRISIS EXPERIENCE—COMPARISON OF OLS RESULTS BASED ON THE FULL SAMPLE AND ON NON-TRUNCATED OBSERVATIONS

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	Full Sample		**Non-Truncated Observations**	
	(I) Unconditional	(II) With Controls	(III) Unconditional	(IV) With Controls
Crisis Experience Index	257.353**	295.630***	294.826***	317.756***
	(2.37)	(3.09)	(3.22)	(3.91)
Log(GDP^{pc})		15.761*		14.246*
		(1.96)		(1.94)
Log(Health Exp.^{pc})		-13.268		-13.039
		(-1.53)		(-1.51)
COVID-19 Deaths		0.005**		0.003
		(2.09)		(1.16)
Observations (# of Countries)	37	37	32	32
R-Squared	0.560	0.681	0.689	0.759
F-Stat	5.627	3.046	10.353	4.167
Prob. > F-Stat	0.023	0.031	0.003	0.009
Regional controls	NO	NO	NO	NO

Notes: The table compares the results of the benchmark OLS estimates with identical model specifications that are based on the subsample of non-truncated observations. The regression estimate the correlation between the crisis experience index and the number of administered COVID-19 vaccine doses per 100 citizens. Columns (1)–(2) replicate the benchmark OLS results of Table (1), Columns (3)–(4) report results from the subsample of non-truncated observations. t values that are obtained using robust standard errors (adjusted for arbitrary heteroskedasticity) are reported in parentheses.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Table A-6 VACCINATION AND CRISIS EXPERIENCE — EXCLUDING ISRAEL

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	OLS Models		**Tobit Models**	
	(I) Unconditional	(II) With Controls	(III) Unconditional	(IV) With Controls
Crisis Experience Index	65.934*	64.966	70.641**	71.151*
	(1.97)	(1.64)	(2.08)	(1.72)
Log(GDP^{pc})		0.312		1.048
		(0.09)		(0.29)
Log(Health Exp.^{pc})		1.148		0.246
		(0.33)		(0.07)
COVID-19 Deaths		0.002		0.002
		(0.87)		(1.02)
Observations (# of Countries)	36	36	36	36
(Pseudo) R-Squared	0.367	0.475	0.137	0.168
F-Stat	10.871	9.046	4.333	8.912
Prob. > F-Stat	0.000	0.000	0.004	0.000
Regional controls	YES	YES	YES	YES

Notes: The table shows the results of the estimations on the correlation between the crisis experience index and the number of administered COVID-19 vaccine doses per 100 citizens. Columns (1)–(2) show results of OLS regressions, Columns (3)–(4) report results from Tobit models. t values that are obtained using robust standard errors (adjusted for arbitrary heteroskedasticity) are reported in parentheses. The model specifications are identical to our benchmark estimates, but exclude the observation for Israel.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Table A-7 VACCINATION AND CRISIS EXPERIENCE—ACCOUNTING FOR GLOBALIZATION

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	OLS Models		**Tobit Models**	
	(I) Unconditional	(II) With Controls	(III) Unconditional	(IV) With Controls
Crisis Experience Index	296.762***	315.961***	316.432***	342.180***
	(3.01)	(3.47)	(3.18)	(3.90)
KOF Globalisation Index	0.027	-0.298	0.030	-0.257
	(0.10)	(-0.73)	(0.11)	(-0.61)
Log(GDP^{pc})		13.024		15.536*
		(1.64)		(2.03)
Log(Health $Exp.^{pc}$)		-10.113		-13.335
		(-1.04)		(-1.40)
COVID-19 Deaths		0.004*		0.005**
		(2.00)		(2.28)
Observations (# of Countries)	37	37	37	37
(Pseudo) R-Squared	0.677	0.746	0.160	0.193
F-Stat	2.479	1.895	9.787	8.602
Prob. > F-Stat	0.046	0.096	0.000	0.000
Regional controls	YES	YES	YES	YES

Notes: The table shows the results of our estimations on the correlation between the crisis experience index and the number of administered COVID-19 vaccine doses per 100 citizens, accounting for the influence of globalization. Columns (1)–(2) show results of OLS regressions, Columns (3)–(4) report results from Tobit models. t values that are obtained using robust standard errors (adjusted for arbitrary heteroskedasticity) are reported in parentheses.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Table A-8 VACCINATION AND CRISIS EXPERIENCE—ACCOUNTING FOR RISK-TAKING

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	Control for Risk-taking		**Interactions**	
	(I) OLS Model	(II) Tobit Model	(III) OLS Model	(IV) Tobit Model
Crisis Experience Index	347.073***	349.344***	180.677***	175.350***
	(4.27)	(4.51)	(4.70)	(4.28)
Risk-taking	-4.629	-3.810	-368.366***	-379.664***
	(-1.15)	(-0.97)	(-6.10)	(-5.71)
Crisis Experience Index × Risk-taking			1006.333***	1037.303***
			(6.08)	(5.72)
Log(GDP^{pc})	27.556***	27.720***	16.181**	16.333**
	(2.90)	(2.96)	(2.47)	(2.78)
Log(Health Exp.^{pc})	-24.440**	-24.669**	-14.318**	-14.356**
	(-2.62)	(-2.74)	(-2.10)	(-2.36)
COVID-19 Deaths	0.009***	0.011***	0.006**	0.007***
	(3.42)	(3.57)	(2.73)	(2.95)
Observations (# of Countries)	27	27	27	27
(Pseudo) R-Squared	0.788	0.185	0.924	0.303
F-Stat	4.944	5.416	41.856	45.453
Prob. > F-Stat	0.004	0.002	0.000	0.000
Controls	NO	NO	NO	NO

Notes: The table shows the results of the estimations on the correlation between the crisis experience index and the number of administered COVID-19 vaccine doses per 100 citizens. Columns (1)–(2) show results of OLS regressions, Columns (3)–(4) report results from Tobit models. t values that are obtained using robust standard errors (adjusted for arbitrary heteroskedasticity) are reported in parentheses. The table tests for the influence of citizens' willingness to take risks. The specifications shown in Columns (I) and (II) augments the list of control variables of the benchmark model by the risk-taking variable compiled by Falk et al. (2018). Columns (3)–(4) show results from models that include interaction terms between risk-taking and the crisis experience index.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Table A-9 VACCINATION AND CRISIS EXPERIENCE—ACCOUNTING FOR THE START-DATE OF VACCINATION

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	OLS Models		**Tobit Models**	
	(I) Unconditional	(II) With Controls	(III) Unconditional	(IV) With Controls
Crisis Experience Index	218.676***	238.564***	139.947**	163.407**
	(3.18)	(3.26)	(2.22)	(2.12)
Vaccination Start	-0.323***	-0.282**	-0.841***	-0.761***
	(-2.86)	(-2.61)	(-3.17)	(-2.97)
Log(GDP^{pc})		7.718		4.996
		(1.30)		(0.91)
Log(Health Exp.^{pc})		-6.390		-4.133
		(-0.89)		(-0.63)
COVID-19 Deaths		0.002		0.001
		(0.93)		(0.36)
Observations (# of Countries)	37	37	37	37
(Pseudo) R-Squared	0.792	0.815	0.283	0.291
F-Stat	6.249	3.673	12.448	11.775
Prob. > F-Stat	0.000	0.004	0.000	0.000
Regional controls	YES	YES	YES	YES

Notes: The table shows the results of our estimations on the correlation between the crisis experience index and the number of administered COVID-19 vaccine doses per 100 citizens, accounting for cross-country differences in the start date of vaccination. Columns (1)–(2) show results of OLS regressions, Columns (3)–(4) report results from Tobit models. t values that are obtained using robust standard errors (adjusted for arbitrary heteroskedasticity) are reported in parentheses.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Table A-10 VACCINATION AND CRISIS-EXPERIENCE—ACCOUNTING FOR HIGH TRUST IN SCIENTISTS

Dependent variable: Number of administered COVID-19 vaccine doses per 100 citizens, V_i

	OLS Models		**Tobit Models**	
	(I) Unconditional	(II) With Controls	(III) Unconditional	(IV) With Controls
Crisis Experience Index	285.185*** (3.22)	303.538*** (3.37)	303.798*** (3.41)	330.753*** (3.81)
Trust in Scientists	22.162** (2.23)	15.802 (1.37)	23.538** (2.43)	17.844 (1.68)
Log(GDP^{pc})		11.645 (1.58)		14.088* (1.97)
Log(Health Exp.^{pc})		-11.505 (-1.35)		-14.623* (-1.77)
COVID-19 Deaths		0.003 (1.29)		0.004 (1.52)
Observations (# of Countries)	37	37	37	37
(Pseudo) R-Squared	0.715	0.750	0.177	0.199
F-Stat	2.972	2.016	9.924	7.736
Prob. > F-Stat	0.021	0.077	0.000	0.000
Regional controls	YES	YES	YES	YES

Notes: The table shows the results of our estimations on the correlation between the crisis experience index and the number of administered COVID-19 vaccine doses per 100 citizens, accounting for the influence of globalization. Columns (1)–(2) show results of OLS regressions, Columns (3)–(4) report results from Tobit models. t values that are obtained using robust standard errors (adjusted for arbitrary heteroskedasticity) are reported in parentheses.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Table A-11 ATTITUDES TOWARDS COVID-19 VACCINATION AND CRISIS EXPERIENCE — ORDERED PROBIT RESULTS, QUESTION Q1 ("VACCINE PROVEN TO BE SAFE AND EFECTIVE")

Dependent variable: Covid 19-Vaccine Acceptance, Response (1–5), Vacc_{ijh}

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
$C_{jh}^{t^h}$	0.361***	0.455***	0.419***	0.278***	0.204**	0.276***	0.752***
	(6.59)	(7.72)	(7.15)	(3.44)	(2.61)	(3.05)	(10.96)
Obs. (# of Ind.)	10149	10149	9996	10149	9996	9996	9996
Pers. C19 Cont.	-	X	-	-	-	X	X
Count. C19 Cont.	-	X	-	-	-	X	X
Soc-Econ. Cont.	-	-	X	-	X	X	X
Regional FE	-	-	-	X	X	X	-
Birth Coh. FE	-	-	-	-	-	-	X

Notes: This table shows the results of an ordered probit regression of COVID-19-vaccine acceptance on crisis experience in respondents' impressionable years. Personal COVID-19 controls ("Pers. C19 Cont") are a dummy variables that are equal to one if the respondent or a family member had fallen sick with COVID 19. Country COVID-19 controls ("Count. C19 Cont.") are the number of COVID-cases and COVID-deaths in the respondents' country at the time the survey was conducted (June 2020). Socioeconomic controls ("Soc-Econ. Cont.") are gender, income level, and educational background, as well as a dummy indicating whether the individual experienced a recession in their impressionable years. Differences in the number of observations stem from people born more than 25 years before GDP coverage for their country begins in the Penn World Tables, leaving them with no impressionable-years-recession information. We control for whether the impressionable years could be observed fully or partially, both in regard to crises and recessions. The t statistics reported in parentheses are adjusted to arbitrary heteroskedasticity.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Table A-12 ATTITUDES TOWARDS COVID-19 VACCINATION AND CRISIS EXPERIENCE — ORDERED PROBIT RESULTS, QUESTION Q2 ("VACCINE APPROVED BY GOVERNMENT AND RECOMMENDED BY EMPLOYER")

Dependent variable: Covid 19-Vaccine Acceptance, Response (1–5), Vacc_{ijh}

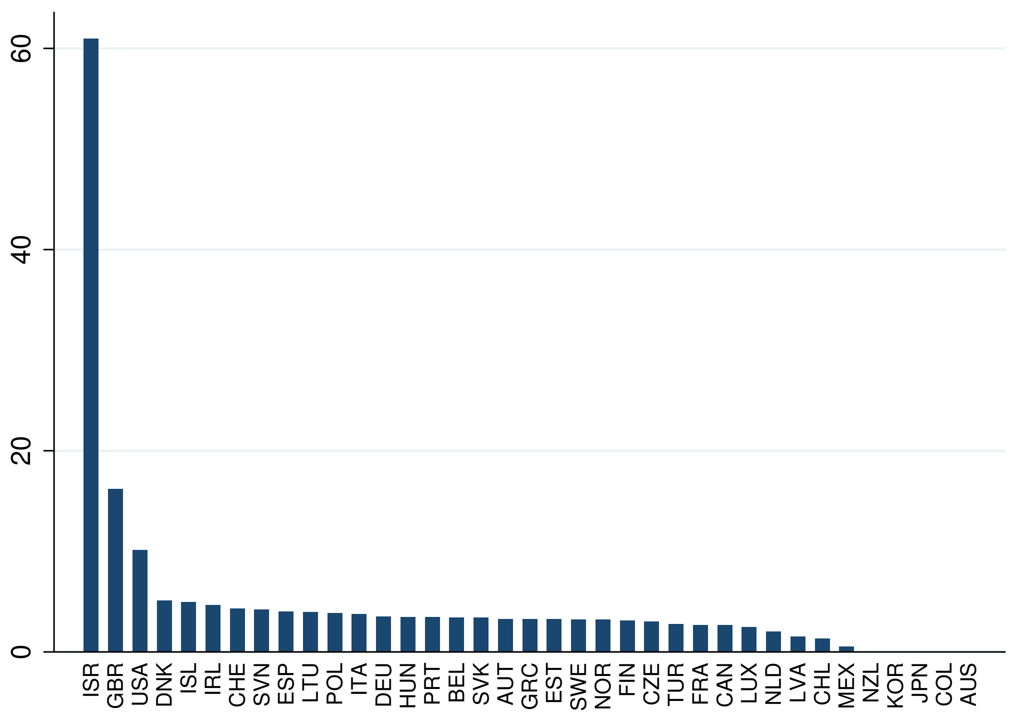
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
$C_{jh}^{t^h}$	0.742***	0.836***	0.897***	0.312***	0.267***	0.467***	1.128***
	(13.24)	(13.83)	(15.08)	(3.83)	(3.18)	(4.88)	(16.51)
Obs. (# of Ind.)	10149	10149	9996	10149	9996	9996	9996
Pers. C19 Con.	-	X	-	-	-	X	X
Count. C19 Cont.	-	X	-	-	-	X	X
Soc.-Econ. Cont.	-	-	X	-	X	X	X
Regional FE	-	-	-	X	X	X	-
Birth Cohort FE	-	-	-	-	-	-	X

Notes: This table shows the results of an ordered probit regression of COVID-19-vaccine acceptance on crisis experience in respondents' impressionable years. Personal COVID-19 controls ("Pers. C19 Cont") are a dummy variables that are equal to one if the respondent or a family member had fallen sick with COVID 19. Country COVID-19 controls ("Count. C19 Cont.") are the number of COVID-cases and COVID-deaths in the respondents' country at the time the survey was conducted (June 2020). Socioeconomic controls ("Soc-Econ. Cont.") are gender, income level and educational background, as well as a dummy indicating whether the individual experienced a recession in their impressionable years. Differences in the number of observations stem from people born more than 25 years before GDP coverage for their country begins in the Penn World Tables, leaving them with no impressionable-years-recession information. We control for whether the impressionable years could be observed fully or partially, both in regard to crises and recessions. The t statistics reported in parentheses are adjusted to arbitrary heteroskedasticity.

*** Significant at the 1 percent level,
** Significant at the 5 percent level,
* Significant at the 10 percent level

Appendix B: Supplementary Figures

Figure B-1 NUMBER OF ADMINISTERED COVID-19 VACCINE DOSES DURING THE INITIAL STAGE OF COVID-19 VACCINATION IN THE OECD COUNTRIES



Notes: The figure shows how progress in COVID-19 vaccination, measured by the number of administered doses per 100 citizens, is distributed across the OECD countries. The figure includes vaccination until 3 February 2021.