DOI: 10.28934/ea.23.56.1.pp1-19 First Online: March 29, 2023

ORIGINAL SCIENTIFIC PAPER

Corruption as an Obstacle to Pandemic Response: a COVID-19 Case Study

Bruno Škrinjarić[1,*] | Jelena Budak[1] | Allison Carragher[2]

[1] Institute of Economics, Zagreb, Croatia
[2] Carnegie Europe, Brussels; Institute of Economics, Zagreb, Croatia

ABSTRACT
This research explores the relationship between corruption and pandemic outcomes by investigating whether European countries with higher levels of corruption were less successful in fighting COVID-19. Data were analyzed using exploratory factor analysis and structural equation modeling techniques. Results indicate that corruption prevalence and poor bureaucratic quality both decrease trust in government, and this effect is persistent notwithstanding the socioeconomic conditions or geographic attributes of a country. Trust in government, coupled with stringency measures, is positively associated with the number of new people vaccinated and, thus, fewer COVID-19-related deaths. Furthermore, corruption undermines trust in the government and its institutions and, through this mechanism, prevents the suppression of the pandemic. Unlike other scarce studies that looked at the direct link between corruption and vaccination only, we also investigated the impact of corruption on the outcomes of government pandemic restriction measures and added several contextual variables into the model. We found that corruption poses a significant obstacle to the pandemic response. Our findings suggest to policymakers that their best weapon against COVID-19 is vaccination and that renewed efforts to eradicate corruption and establish trust between governments and citizens can positively impact vaccination rates and limit the most devastating effects of the pandemic.

Keywords: *corruption, trust in government, vaccination, COVID-19, population health, Europe*

JEL Classification: D73, I18

INTRODUCTION

Corruption and its causes and consequences have been assessed from many different points of view. However, the understanding of corruption in circumstances of global disasters, such as the situation caused by the COVID-19 pandemic, is rather limited (Collins et al., 2020; Greer et al., 2020). The pandemic generated social, economic, and governance crises (OECD, 2020) that opened opportunities for corruption (Rose-Ackerman, 2021), where the latter remains largely unexplored.

The goal of this research is to investigate the relationship between levels of corruption and disastrous consequences of the COVID-19 pandemic on the European continent by seeking to determine if countries where corruption is more dominant were less effective in combating the COVID-19 pandemic and examining which factors explain the variations. Our intuition is that societies where there is more corruption, poor bureaucracy, and poor socio-economic conditions

[*] Corresponding author, e-mail: bskrinjaric@eizg.hr

do not trust the government and thus faced more institutional impediments to effectively coping with the pandemic and witnessed worse outcomes. Concerns that corruption and low levels of trust in government could further distort efforts to fight the pandemic were raised in the early days of the outbreak before a vaccine was available. However, there has been little scientific study on whether corruption stands as an impediment to efficiently fighting COVID-19 and, if so, whether the situation changed when vaccination became largely available. Beyond corruption, could related determinants such as institutional quality and a government's capacity to conduct sound policy measures mitigate the expected negative effects of the COVID-19 pandemic? Does the country's health infrastructure play a key role in affecting the new cases of infection and COVID-19-related deaths? Considering these contextual factors and the overall socioeconomic conditions of a country, this research sheds new light on neglected aspects of fighting the COVID-19 pandemic in Europe.

Our contribution to the literature is that, unlike other scarce studies that looked at the direct link between corruption and vaccination only, we looked at the impact of corruption on the outcomes of government pandemic restriction measures. Secondly, we use a large sample of European countries. This gives us the right amount of heterogeneity between countries to explore relationships between different variables but also enough homogeneity in terms of geographical effects, season effects, and the general level of development. Considering the contextual variables in a structural equation modeling (SEM) model, the findings allow us to derive data-driven policy implications/recommendations. Thirdly, we use detailed monthly data on the level of corruption, bureaucracy quality, and socioeconomic conditions for the observed countries in order to analyze changes in the relationships among variables throughout the waves of the pandemic and the introduction of vaccines.

This paper is structured as follows: following the introduction, the literature review is provided in Section 2. The research methodology and data sources are presented in Section 3. In Section 4, the empirical results of descriptive statistics, exploratory factor analysis, and a structural equation model are provided. Finally, the conclusions, including suggestions for further research, are presented in the final section.

LITERATURE REVIEW

The abundant literature on determinants of corruption (Treisman, 2000; Elbahnasawy and Revier, 2012) finds that low democratic standards (Kolstad and Wiig, 2016) and political risks and instability (Serra, 2006) are positively associated with corruption, while the quality of political institutions is negatively associated with corruption (Lederman et al., 2005). Furthermore, there is ample empirical evidence that corruption impedes growth and is associated with lower levels of economic development (d'Agostino et al., 2016).

The relationship between the prevalence of corruption and the COVID-19 pandemic has two components. Firstly, corrupt rent-seeking might increase in times of crisis (such as wars, natural disasters, or a pandemic) due to market distortions mirrored in shortages that lead to price increases, illegal trade, and profiteering. A global 'corruption wave' during the COVID-19 pandemic was observed in Europe, with cases of misuse of public procurement and purchasing equipment on the grey market (Steingrüber et al., 2020). The (initially limited) availability of vaccines further created opportunities for rent-seeking behavior and corruption (Goel and Nelson, 2021; UNDOC, 2020) throughout the vaccine value chain (Transparency International, 2021). This corruption contributes to supply chain issues, thus depriving citizens of their ability to access medical supplies and receive quality health care (Teremetskyi et al., 2020). In times of pandemics, the implementation of anti-corruption policies is endangered (Amundsen, 2020; Estrada, 2020), resulting in more corrupt societies becoming even more vulnerable to crises (Yamen, 2021).

On the other hand, the COVID-19 pandemic has also given governments a chance to gain more legitimacy, enhance governance, and increase the level of trust in public institutions. Messner (2020) explored institutional and cultural factors that influenced the COVID-19 outbreak and found that a strong institutional context, including low corruption and high political participation, is negatively associated with the outbreak. Ezeibe et al. (2020) concentrated on Nigeria and explored the effect of political distrust on COVID-19 spread. They concluded that boosting public sector accountability helps stem the spread of COVID-19 by motivating citizens to obey safety measures. Relevant research also indicates a strong negative relationship between corruption and effective government (Mohamadi et al., 2017; Schwab and Sala-i-Martín, 2015). It is reasonable to assume that in corruption-free environments, governments and societies can respond to pandemic challenges promptly, and in a well-organized and responsible manner. Transparency, public trust, and government accountability are all seen as crucial to the effective and rapid response to a pandemic (Rose-Ackerman, 2021).

In the initial COVID-19 outbreak stages, most governments imposed non-pharmaceutical intervention measures such as lockdowns, travel bans, movement restrictions, and social distancing (Megna, 2021), as well as public health and economic measures (Chilton et al., 2020). Some countries, such as Switzerland and Nordic countries, invoked new or amended laws on epidemics to allow for the implementation of stricter measures (Francetic, 2021). The urgency of the crisis called for immediate policy responses. The late introduction of social distancing and lockdown measures seems to worsen the effects of the first wave (as Arnold et al. (2022) showed for England). Success in implementing these non-pharmaceutical interventions is dependent on trust, good communication (Balog-Way and McComas, 2020; Cairney and Wellstead, 2021), public perceptions of risk, and behavioral responses to personal protection (Dryhurst et al., 2020; M-Amen et al., 2021). Nevertheless, further studies show that the success of the severe measures imposed during the first wave of the pandemic had a contrary effect in the later stages, primarily due to a reduction in public trust in actions undertaken by the government (Sagan et al., 2022), with the level of trust varying significantly among countries (Sabat, 2020).

Since the outbreak of the pandemic, several studies have contributed to the assessment of public policies to control the incidence of COVID-19 (Haug et al., 2020; Saez et al., 2020). National responses across the globe have been shaped by two sets of factors: i) the capacity of the healthcare system and health infrastructure readiness, and ii) the governance quality from an organizational perspective, the administrative ability to operationalize actions, and political leadership (Capano et al., 2020). Literature on healthcare systems and policy responses to COVID-19 pointed out heterogeneity in regulations and operationalization of measures among countries (Berger et al., 2021), concluding there are no one-size-fits–all policy recommendations.

The capacity, organization, management, and other characteristics of health infrastructure garnered attention as the costs of COVID-19 were expected to be higher in countries with less developed health systems and higher population densities (McKibbin and Fernando, 2020). As COVID-19 imposed an extra burden on health systems and hospitals (Winkelmann et al., 2021), the combination of rather limited supply and increased demand for health services, and the lack of strict clinical acuity-based criteria for the allocation of health and medical resources, might lead to more corruption, especially in public procurement in the health sector (Teremetskyi et al., 2020).

Nations with lower corruption prevalence have evidenced slower pandemic growth (Attila, 2020; Farzanegan, 2021), which suggests corruption stands as an obstacle to the efficient and effective fight against COVID-19. Finally, wealthier economies providing better socioeconomic and health conditions to citizens should be better equipped to handle the negative effects of the pandemic (Bokhari et al., 2007), despite the negative economic consequences of COVID-19 (see e.g. Bodroža & Lazić (2021) for Western Balkans). However, inversely, developed countries also tend to have older populations, which contributed to higher death rates due to COVID-19.

There is less research linking vaccination, corruption, and government efficiency, and the existing research has yielded contradictory results. Vaccination is regarded as a powerful tool in the fight against pandemics, both to alleviate the burden on hospitals and health workers and to reduce fatalities. However, the public reactions to COVID-19 vaccines have varied from strong demand to 'anti-vax' behaviors (Benoit and Mauldin, 2021), with different responses reflecting differing levels of trust in governments and science at both the individual and societal levels (Debus and Tosun, 2021; Grawitch and Lavigne, 2021). Jelnov and Jelnov (2022) showed that government accountability contributes to the success of vaccination campaigns, with higher vaccination rates observed in more liberal and less corrupt countries. Farzanegan and Hoffmann (2021) found a negative relationship between countries' corruption prevalence and vaccination rates. On the other hand, this relationship was found to be positive in a comparative study of the 50 US states, indicating that corruption might also work as a 'greasing mechanism' in vaccine delivery and priority access (Goel and Nelson, 2021).

DATA AND METHODOLOGY

Data Sources

This research is based on three data sources: (1) summarized data on the COVID-19 pandemic (hereinafter: COVID dataset) by Ritchie et al. (2020); (2) data on economic, financial, and political risk ratings for 140 countries (hereinafter: PRS dataset), obtained from The PRS Group (PRS group, 2021); and (3) data on health system infrastructure (hereinafter: WHO dataset), taken from the World Health Organization (WHO, 2021). The COVID dataset includes data directly related to COVID-19, including new confirmed cases and deaths, total confirmed cases and deaths, data on hospitalized patients, and data on COVID-19 tests and vaccinations, as well as health-related data. The PRS dataset contains political, social, and economic data for various countries around the world. Among others, it includes estimates on a country's corruption level, bureaucracy quality, democratic accountability, government stability, and socioeconomic conditions. Finally, the WHO dataset includes data on hospital capacity and health infrastructure.

The COVID dataset is reported on a daily basis, the PRS dataset on a monthly basis, and the WHO dataset on a yearly basis; upon merging these three datasets, they were all transformed to a daily basis covering the period from February 1st, 2020, to December 31st, 2021.

Our analysis focuses on a set of 34 European countries (Table 2 in Appendix), as this gives us the right amount of heterogeneity among countries to explore relationships between different variables, but also enough homogeneity in terms of geographical effects, seasonal effects, and the general level of development.

Empirical Methodology and Variables

Our empirical model to be tested is presented in Figure 1. Vaccination rate is a mediation variable between latent construct Trust in government (*GovtTrust*) and two outcome variables: (1) new cases of COVID-19 (*New cases*); and (2) new deaths connected to COVID-19 (*New deaths*). *GovtTrust* represents the government's capacity to carry out sound policies and citizen readiness to follow government recommendations. It is estimated from a set of manifest variables (items): (1) Corruption index, (2) Bureaucracy quality index, and (3) Socioeconomic index. These manifest variables are highly constant over time (Figure 5 in the Appendix), suggesting that pre-pandemic levels are very similar to those in the analyzed time frame. Trust in government is hypothesized to affect the vaccination rate, which in turn affects new cases and new deaths attributed to COVID-19.

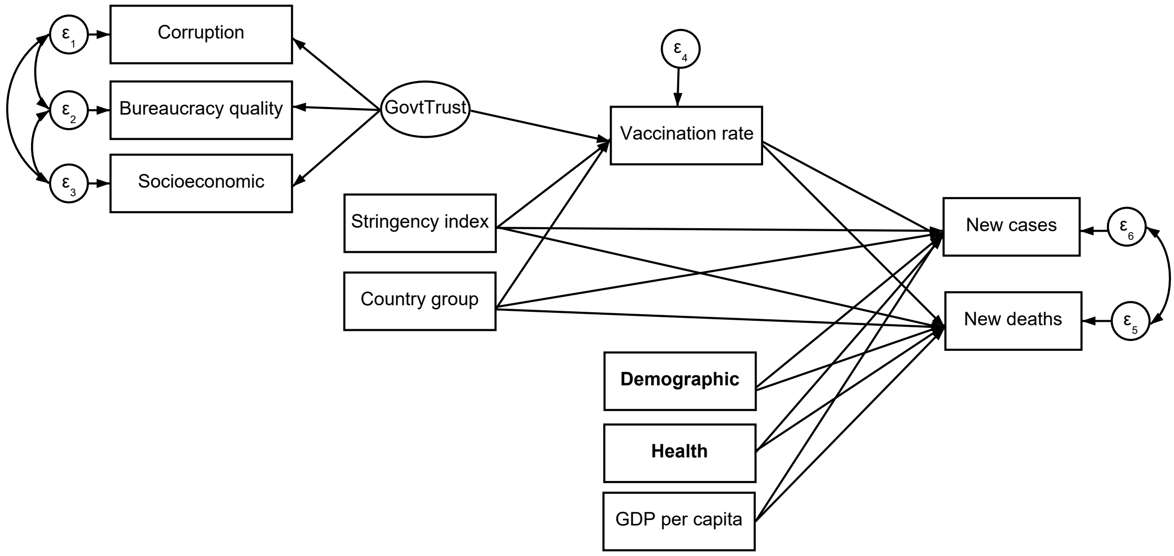

Figure 1. Empirical model

Source: Authors' own work.

Note: "Demographic" and "Health" are in bold as these represent matrices of variables.

Additional variables which are hypothesized to affect the vaccination rate and two dependent variables are the *Stringency index* and specific *Country group* effects. The stringency index enters the model as a 7-day moving average, as it takes some time for stringency measures to affect both vaccination rates and new cases/deaths.

Country group effects enter the model as a set of dummy variables. **DEMOGRAPHIC** is a matrix of variables capturing a country's demographics: namely, median age and population density. **HEALTH** is a matrix of variables capturing a country's health infrastructure: specifically, the number of hospital beds and the universal health care (UHC) service coverage index. We also add GDP per capita (PPP) to account for the general wealth of an economy. A more detailed description of all variables used in this research is presented in Table 3 in the Appendix.

There are two stages to our empirical methodology. Firstly, we test the latent construct *GovtTrust* for dimensionality, consistency, and reliability. Cronbach's alpha (CA) coefficient, alpha-if-deleted indicator, and different correlations were used to analyze the reliability of measurement scales. Exploratory factor analysis (EFA) was used to examine the dimensionality of the measurement scale, whereby the measurement models specified that each manifest variable (scale items) was loaded by only one latent construct (factor), and the independence of measurement errors was assumed (Kline, 2015). Secondly, after testing and estimating the latent construct (variable) *GovtTrust*, structural equation modeling (SEM) was used to estimate the empirical model.

RESULTS

Descriptive Statistics

Figure 2 presents a distribution of corruption, bureaucracy quality, socioeconomic conditions (measures available on a monthly basis), and estimated trust in government in selected European countries as averages during the 2020–2021 period. Corruption is lowest in Nordic countries (Denmark, Finland, Norway, and Sweden), closely followed by Austria, Germany, Iceland, Ireland, Netherlands, Switzerland, and the UK. Conversely, the highest corruption rates are recorded in non-EU Eastern European countries like Russia, Belarus, Serbia, Moldova, Albania, and Ukraine.

The relationship between corruption and bureaucracy quality essentially divides European countries into two groups: those in which corruption is higher than bureaucracy quality and vice versa. Socioeconomic conditions have been traditionally the most favorable in Northern European countries like Denmark, Finland, and Sweden; and in Western European countries like Belgium, Germany, Netherlands, and Switzerland. Countries with low corruption and high socioeconomic conditions have higher trust in government and vice versa. Figure 5 in the Appendix shows that these trends are rather stable over time.

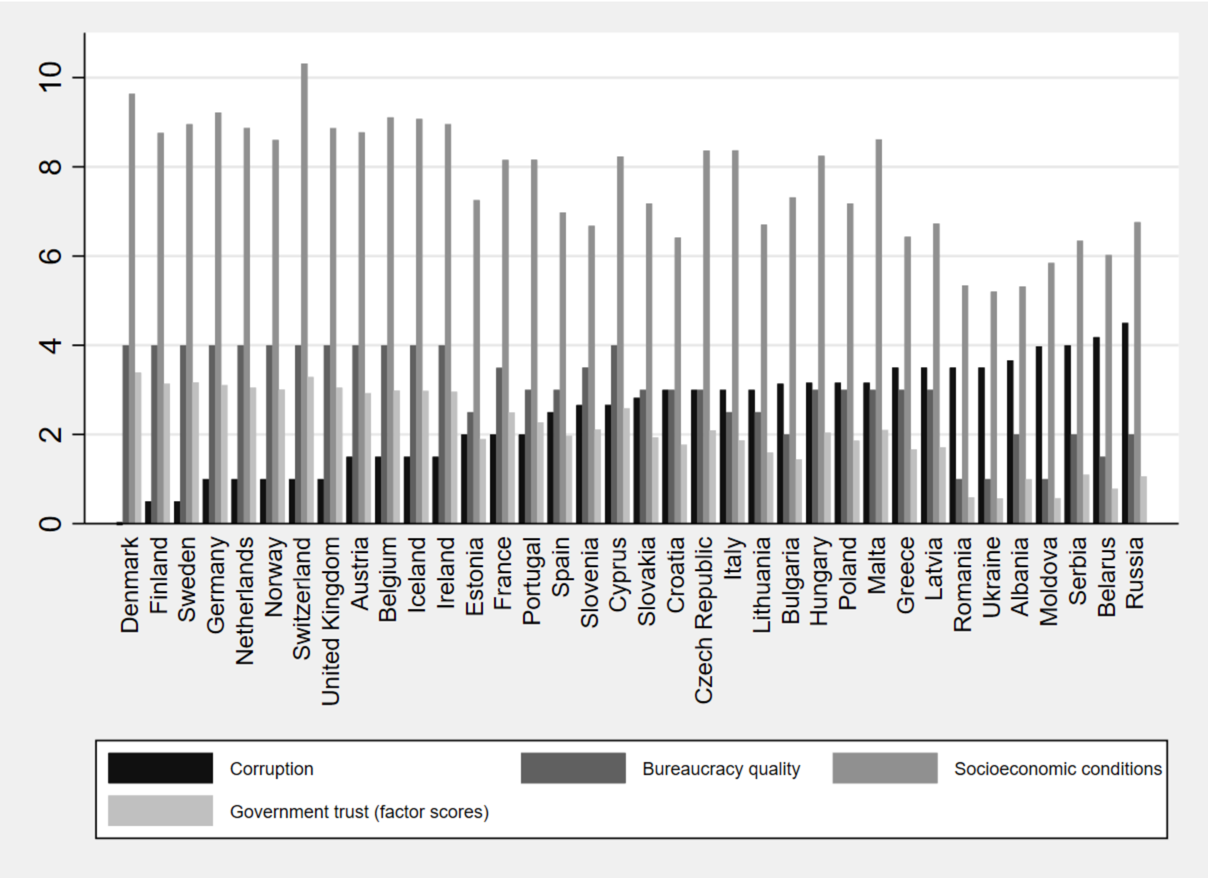

Figure 2. Corruption, bureaucracy quality, socioeconomic conditions, and estimated trust in government in selected European countries (average 2020–2021)

Source: Authors' own work.

Figure 3 displays the distribution of people vaccinated with one dose at least (per hundred) and estimated government trust in selected European countries from the beginning of 2021 onwards when the vaccine was made available to the public. The solid black line represents a linear trend between these two variables, illustrating that trust in government is positively correlated with vaccination rate.

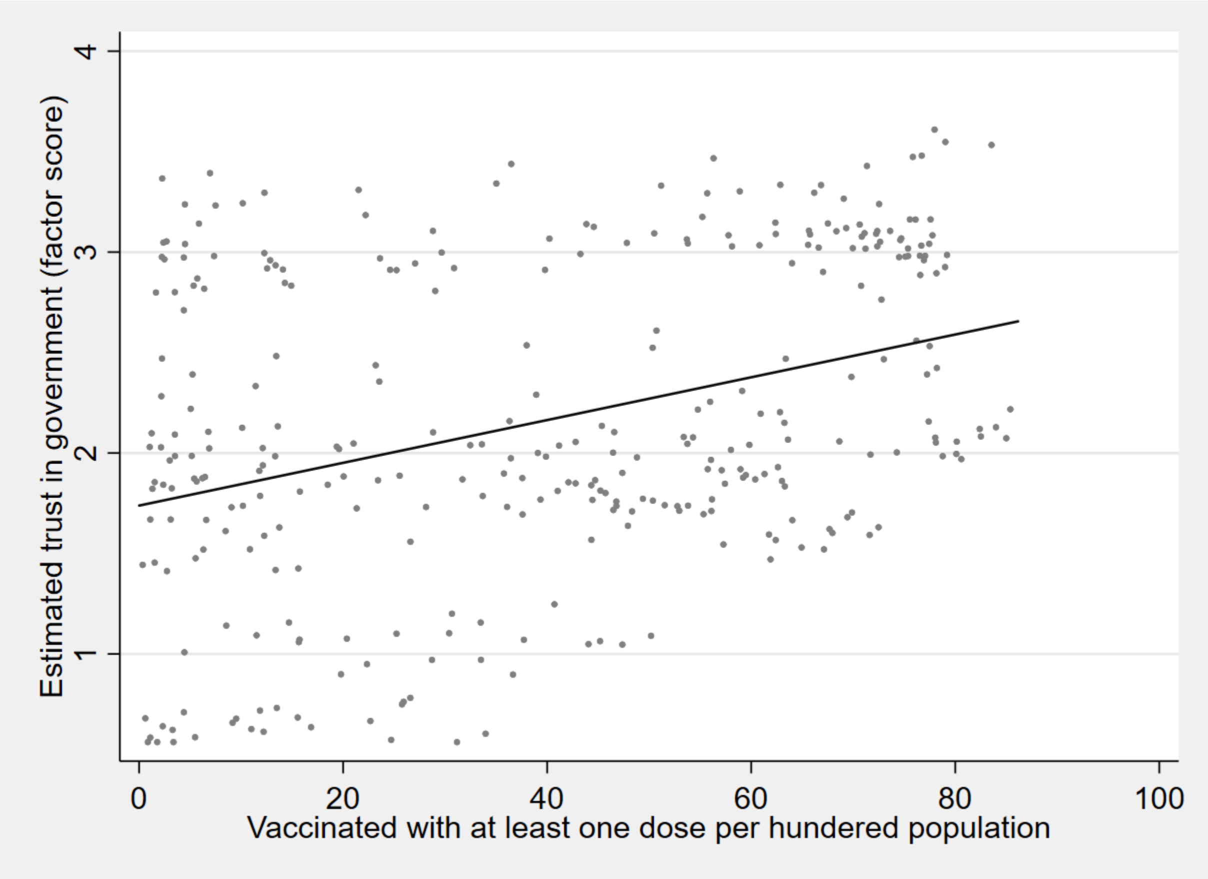

Figure 3. Vaccination rates and estimated trust in government in selected European countries

Source: Authors' own work.

Figure 4 presents a scatter diagram for the analyzed European countries showing four dimensions: (1) population vaccination rate (people vaccinated with one dose at least per hundred inhabitants); (2) total COVID-19 deaths per million inhabitants; (3) average level of trust in government during the period 2020-2021 (those with a score below the median are designated as low-government-trust countries, and those above the median high-government-trust countries); (4) time horizon throughout 2021 with balances at the end of each month. Trust in government is highest in Denmark, Finland, Norway, and Sweden (Nordic countries), followed by Austria, Germany, Iceland, Ireland, the Netherlands, Switzerland, and the UK (marked in black). On the other hand, the lowest rates of government trust were recorded in Eastern European countries that are not members of the EU, such as Russia, Belarus, Moldova, Serbia, and Ukraine (marked in light gray). Considering the time horizon, the vaccination rate progression is clearly visible. It is very low in the first quarter of 2021 in all countries, regardless of the level of government trust (given that the vaccine became available only at the beginning of 2021), and rising in the second and the third quarters of 2021, most significantly in countries with a higher government trust rate (which reached vaccination rates of over 70 percent). Finally, looking at the correlation between vaccination rate and COVID-19 deaths, it is evident that this association is stronger (in the sense of a higher absolute value of the correlation coefficient) in countries with a higher government trust rate. In other words, the increase in the population vaccinated in high-government-trust countries is correlated with fewer deaths from COVID-19.

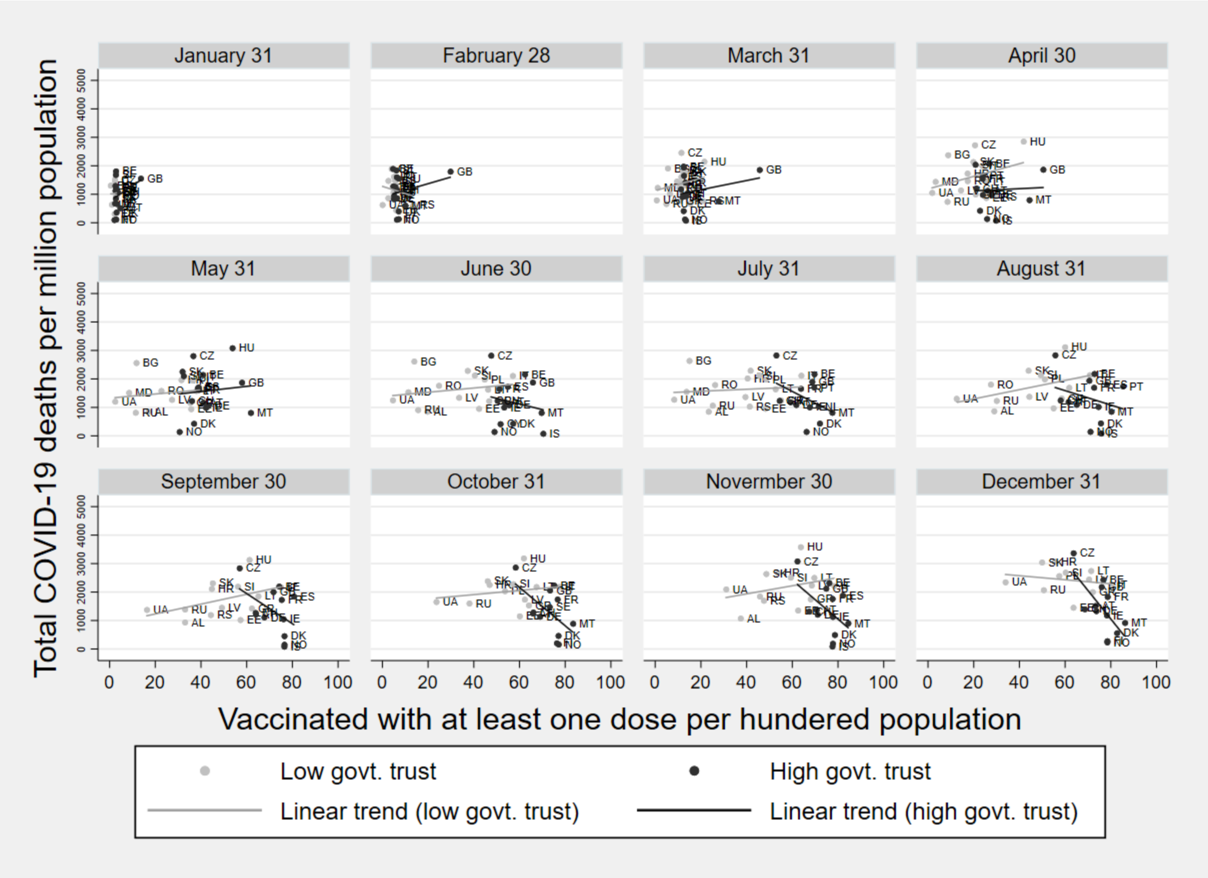

Figure 4. Vaccination rate and total COVID-19 deaths in selected European countries

Source: Authors' own work.

The presented situation regarding the spread of the virus and associated deaths, vaccine dynamics, and non-pharmaceutical measures applied vary across European countries. This indicates some trends and relationships worthy of an in-depth investigation, where institutional factors of public trust in government should be considered.

Estimation of Latent Constructs

List and descriptive statistics of manifest variables (items) used to estimate the latent "Trust in Government" variable are presented in Table 4 in the Appendix. CA coefficients and item correlations are shown in Table 5 in the Appendix. A CA coefficient value of 0.9225, coupled with measurement scale reliability analysis results, indicate that the measurement scale used to construct the *GovtTrust* variable possesses a satisfactory level of reliability. Measurement scales' convergent validity and dimensionality were analyzed by EFA (Table 6 in the Appendix) and results show that these scales possess convergent validity and are one-dimensional. Hence, the group of items can be considered a unique measurement scale that measures the perception of latent structures.

Model estimation

Latent construct *GovtTrust* estimated in the previous subsection, together with other variables, were then entered into the SEM framework. Results of this model are shown in Table 1, which is presented in three panels – Panel A shows the results of measurement equations (equations used to estimate latent construct); Panel B details the results of structural equations (main equations in our model); and Panel C enumerates goodness of fit indicators for the overall model. Regarding the measurement equations (Table 1, Panel A), both an increase in socioeconomic conditions and bureaucracy quality are positively related to government trust, while a corruption increase is inversely associated with government trust.

Structural equation results (Table 1, Panel B) are divided into three parts: first, we examine the connection of various variables with the number of new people vaccinated; second, we consider covariates of new COVID-19 cases; and third, we investigate covariates of new deaths attributable to COVID-19. During the interpretation of these results, the reader should keep in mind that all dependent variables are in "per million of the population" units to account for different population sizes.

Table 1. Estimated SEM results

Panel A: Measurement equations

	Non-standardized	Standardized
Trust in government		
Bureaucracy	1.000 (-)	0.875*** (0.006)
Corruption	-1.342*** (0.011)	-0.911*** (0.006)
Socioeconomic	1.506*** (0.012)	0.822*** (0.006)

Panel B: Structural equations

	Non-standardized	Standardized
New people vaccinated		
Stringency index	0.002*** (0.000)	0.203*** (0.010)
Country group (benchmark: Central and Eastern Europe)		
Western Europe	-0.015** (0.006)	-0.039 (0.016)
Southern Europe	0.048*** (0.004)	0.106*** (0.010)
Northern Europe	0.034*** (0.005)	0.082*** (0.012)
Trust in government	0.044*** (0.003)	0.195*** (0.014)
New cases		
New people vaccinated	-1.278*** (0.035)	-0.750*** (0.018)
Stringency index	0.006*** (0.000)	0.334*** (0.016)
Country group (benchmark: Central and Eastern Europe)		
Western Europe	-0.042*** (0.012)	-0.063** (0.019)
Southern Europe	-0.137*** (0.014)	-0.179*** (0.019)
Northern Europe	0.019* (0.011)	0.027 (0.015)
Total people vaccinated	0.002*** (0.000)	0.214 (0.014)
Median age	0.007*** (0.001)	0.056 (0.011)
Population density	0.042*** (0.012)	0.037*** (0.011)
GDP per capita	-0.001 (0.000)	-0.024 (0.017)
Hospital beds	-0.226*** (0.021)	-0.142*** (0.013)
UHC	-0.001 (0.001)	-0.020 (0.015)
New deaths		
New people vaccinated	-12.940*** (0.417)	-0.523*** (0.015)
Stringency index	-0.139*** (0.003)	-0.528*** (0.012)
Country group (benchmark: Central and Eastern Europe)		
Western Europe	-2.835*** (0.149)	-0.298*** (0.015)
Southern Europe	-3.025*** (0.177)	-0.272*** (0.016)
Northern Europe	-0.322** (0.131)	-0.031*** (0.013)
Total people vaccinated	-0.010*** (0.002)	-0.066 (0.012)
Median age	0.185*** (0.017)	0.107*** (0.010)
Population density	0.283* (0.150)	0.017*** (0.009)
GDP per capita	-0.017*** (0.005)	-0.057 (0.015)

	Non-standardized	Standardized
Hospital beds	-0.838*** (0.262)	-0.036*** (0.011)
UHC	-0.016* (0.009)	-0.022 (0.013)

Panel C: Goodness of fit indicators

N	9,925
Chi-squared statistic	8,238.81***
RMSEA	0.044
CFI	0.927
TLI	0.917
GFI	0.920

Notes: *** p<0.01, ** p<0.05, * p<0.10. Standard errors are in parentheses. CFI - Comparative fit index, GFI - Goodness of fit index, RMSEA - Root mean square error of approximation, TLI - Tucker-Lewis index. Since this model is estimated once COVID-19 vaccines were readily available, the number of observations (9,925) is different from that reported in Table A1 in the Appendix.

Source: Authors' own work.

The first part of our model, which examined the effects of different variables on vaccination rates, reveals that trust in the government is positively and significantly related to new people being vaccinated. On average, a one index point increase in trust in government (all other things held constant) will increase the number of new vaccinations by 0.044 per million citizens (a similar interpretation is for the standardized estimated coefficient as well). The stringency index is also positively and significantly related to the level of trust in the government, where a unit increase in this index, ceteris paribus, will increase the number of newly vaccinated by 0.002 per million citizens, on average. This suggests that citizens who trust their government and its pandemic response efforts are more likely to get vaccinated and that trust in government is a stronger incentive for vaccination than strict government policies.

The second part of our model, in which we considered new cases of COVID-19 (per million), shows that a unit increase in new people vaccinated, all other things held constant, will lead to a decrease in new cases by 1.278 cases per million citizens. Somewhat surprisingly, there is a positive association between the stringency index and the number of new cases, although the magnitude of this effect is very small. This can partly be explained by a certain lag between the introduction of stricter measures and the time taken for them to reduce new cases. Median age and population density are both positively associated with new COVID-19 cases, given that COVID-19 has been disproportionately lethal among older populations and higher population density facilities transmission of the virus (McKibbin and Fernando, 2020).

The third part of our model, focusing on factors connected to new deaths attributable to COVID-19, indicates that the number of new people vaccinated is also again negatively correlated with new deaths, with this magnitude being far greater than the one on new cases. This is in line with communications regarding the COVID-19 vaccine that the primary goals of vaccination are to reduce fatalities and to alleviate the symptoms of the virus, while it does not eliminate the possibility of transmission. This relationship would be expected to be different for pandemics in which a virus was completely prevented by a vaccine. The stringency index in this case is also negatively associated with the number of new deaths, albeit to a much smaller magnitude. This result is also in line with the trend presented in Figure 4, where most countries began reducing restrictive measures once the vaccine became readily available. As with the number of new cases, median age and population density are also positively associated with new deaths, and these effects are of a higher magnitude. In terms of healthcare infrastructure, both the count of available hospital beds and accessibility of healthcare (universal healthcare index) are, as expected, negatively associated with the number of new deaths.

DISCUSSION AND CONCLUSION

Corruption, including the quality of bureaucracy and socioeconomic conditions, is significantly associated with a loss of confidence in the government. This trust in government, in combination with COVID-19 government response strategies administrated and other effects stemming from specific country groups has been associated with an increase in people vaccinated, which in turn had been shown to reduce new COVID-19 cases and new COVID-19 deaths. This means that corruption seriously erodes trust in government, and this mechanism weakens the pandemic response. Unlike other scarce studies that looked only at the direct link between corruption and vaccination, we also considered non-pharmaceutical interventions and the impact of corruption on pandemic outcomes, with several contextual variables included in the SEM model. This broader analysis shows the negative effects of corruption on efficiently fighting COVID-19 through both government policies and vaccination campaigns.

The results of this paper are in line with previous research. Our findings are similar to those of Jelnov and Jelnov (2022), who also find higher vaccination rates in countries that are perceived as less corrupt. Their data show that a unit increase in Corruption Perception Index (index scaled 0 to 10) is related to a 1 percentage point decrease in vaccination rate. Farzanegan and Hofmann (2021) analyze the association between public corruption and COVID-19 vaccination rates in more than 90 countries worldwide and find that corruption in 2020 can explain about 50% of vaccination progress by mid-2021.

These findings also hold practical relevance for policymakers. Obtained results demonstrate that non-pharmaceutical interventions and vaccination are effective tools to reduce the spread of COVID-19 and to minimize its fatality, although vaccination should be the primary target. This is despite claims to the contrary by anti-vax and anti-restriction communities. The model also indicates that government trust is a key component of an effective vaccination campaign and an effective response to COVID-19. This leads us to believe that more needs to be done to eradicate corruption and build trust between citizens and governments. Anti-corruption programming and efforts to increase public trust should be included in global health policy. Current COVID-19 challenges should not reduce funding or focus on such efforts, as corruption is severely undermining pandemic relief measures.

Lastly, this study is not without limitations and open questions for future research. First, a standard challenge in any latent variable estimation stems from the possibility of omitting an important item which is connected to the latent construct being measured. Instead of relying on nationwide questionnaires on trust in government, which is prone to self-evaluation bias, we utilize the PRS dataset with measures of various economic and financial risks for each country. However, future research is encouraged to use additional variables to approximate trust in government, such as government stability or democratic accountability. Second, in spite of the limited data available, this research takes into account country-level sociodemographic attributes such as median age and population density; and for country-level healthcare, infrastructure is approximated by the number of hospital beds. These data were amended with country-level indicators on various key daily indicators related to the pandemic. Future research is suggested to add demographic, social, and economic data on those who were affected and/or died from COVID-19 to the model and estimate it on an individual level, (some initial attempts were already made by Rieger and Wang (2021)), and to expand the geographic scope of the research beyond the European continent to see if our findings remain consistent. Thirdly, this research focused exclusively on the COVID-19 pandemic, but future research is encouraged to determine whether these findings hold true for other past pandemics. Fourth, there may also be an issue with the direction of causality, i.e., it is also possible that increased levels of COVID-19 cases and deaths negatively impact government trust. Lastly, instead of performing a general equilibrium analysis, this research performs an average analysis for given countries. During a pandemic, there are likely to be other spillovers and externalities, such as decreased mental health, increased levels of anxiety, disruptions of global value chains, etc., which we do not estimate.

ACKNOWLEDGMENTS

This research has been fully supported by The Institute of Economics, Zagreb under the grant "TVOJ GRANT@EIZ" (Project no. 3220).

REFERENCES

Amundsen, I. (2020). COVID-19, cash transfers, and corruption. Chr. Michelsen Institute U4 Brief 2020:9. Retrieved from https://www.researchgate.net/profile/Inge-Amundsen/publication/344189638_Covid-19_cash_transfers_and_corruption_Policy_guidance_for_donors/links/5f59f4d0299bf1d43cf9242b/Covid-19-cash-transfers-and-corruption-Policy-guidance-for-donors.pdf

Attila, J. G. (2020). Corruption, Globalization and the Outbreak of COVID-19. *SSRN Working paper*. DOI: http://dx.doi.org/10.2139/ssrn.3742347

Balog-Way, D. H., & McComas, K. A. (2020). COVID-19: Reflections on trust, tradeoffs, and preparedness. *Journal of Risk Research*, 23(7-8), 838-848. DOI: https://doi.org/10.1080/13669877.2020.1758192

Benoit, S. L., & Mauldin, R. F. (2021). The "anti-vax" movement: a quantitative report on vaccine beliefs and knowledge across social media. *BMC Public Health* 21, 2106. DOI: https://doi.org/10.1186/s12889-021-12114-8

Berger, E., Winkelmann, J., Eckhardt, H., Nimptsch, U., Panteli, D., Reichebner, C., Rombey, T., & Busse, R. (2022). A country-level analysis comparing hospital capacity and utilisation during the first COVID-19 wave across Europe. *Health Policy*, 126(5), 373-381. DOI: https://doi.org/10.1016/j.healthpol.2021.11.009

Bodroža, D., & Lazić, M. (2021). Economic Impact of the COVID-19 Pandemic on Western Balkan Countries. *Economic Analysis: journal of emerging economics*, *54*(21), 30-40. DOI: 10.28934/ea.21.54.2.pp30-40

Cairney, P., & Wellstead, A. (2021). COVID-19: effective policymaking depends on trust in experts, politicians, and the public. *Policy Design and Practice*, 4(1), 1-14. DOI: 10.1080/25741292.2020.1837466

Capano, G., Howlett, M., Jarvis, D., Ramesh, M., & Goyal, N. (2020). Mobilizing Policy (In)Capacity to Fight COVID-19: Understanding Variations in State Responses. *Policy and Society*, 39(3), 285-308. DOI: 10.1080/14494035.2020.1787628

Collins, A., Florin, M. V., & Renn, O. (2020). COVID-19 risk governance: drivers, responses and lessons to be learned. *Journal of Risk Research*, 23(7-8), 1073-1082. DOI: https://doi.org/10.1080/13669877.2020.1760332

d'Agostino, G., Dunne, J. P., & Pieroni, L. (2016). Government Spending, Corruption and Economic Growth. *World Development*, 84, 190-205. DOI: https://doi.org/10.1016/j.worlddev.2016.03.011

Debus, M., & Tosun, J. (2021). Political ideology and vaccination willingness: implications for policy design. *Policy sciences*, 54, 477-491. DOI: https://doi.org/10.1007/s11077-021-09428-0.

Dryhurst, S., Schneider, C. R., Kerr, J., Freeman, A. L., Recchia, G., Van Der Bles, A. M., Spiegelhalter, D., & van der Linden, S. (2020). Risk perceptions of COVID-19 around the world. *Journal of Risk Research*, 23(7-8), 994-1006. DOI: https://doi.org/10.1080/13669877.2020.1758193

Elbahnasawy, N. G., & Revier, C. F. (2012). The Determinants of Corruption. *The Developing Economies*, 50, 311-313. DOI: https://doi.org/10.1111/j.1746-1049.2012.00177.x

Estrada, R. A. M. (2020). Can COVID-19 Generate a Massive Corruption in Developing Countries and Least Developed Countries? *SSRN Working paper 3597367*. DOI: http://dx.doi.org/10.2139/ssrn.3597367

Ezeibe, C. C., Ilo, C., Ezeibe, E. N., Oguonu, C. N., Nwankwo, N. A., Ajaero, C. K., & Osadebe, N. (2020). Political distrust and the spread of COVID-19 in Nigeria. *Global Public Health*, 15(12), 1753-1766. DOI: https://doi.org/10.1080/17441692.2020.1828987

Farzanegan, M. R. (2021). The Effect of Public Corruption on COVID-19 Fatality Rate: A Cross-Country Examination. *CESifo Working Paper No. 8938*. DOI: http://dx.doi.org/10.2139/ssrn.3805464

Farzanegan, M. R., & Hofmann, H. P. (2021). Effect of public corruption on the COVID-19 immunization progress. *Scientific Reports 11*, 23423. DOI: https://doi.org/10.1038/s41598-021-02802-1

Francetic, I. (2021). Bad law or implementation flaws? Lessons from the implementation of the new law on epidemics during the response to the first wave of COVID-19 in Switzerland. *Health Policy*, 125 (10), 1285-1290. DOI: https://doi.org/10.1016/j.healthpol.2021.08.004

Goel, R. K., & Nelson, M. A. (2021). Drivers of COVID-19 vaccinations: vaccine delivery and delivery efficiency in the United States. *NETNOMICS: Economic Research and Electronic Networking*, 22(1), 53-69. DOI: http://dx.doi.org/10.2139/ssrn.3819093

Grawitch, M. J., & Lavigne, K. (2021). Do Attitudes, Trust, and Acceptance of Pseudoscience and Conspiracy Theories Predict COVID-19 Vaccination Status?. *PsyArXiv*. DOI: https://doi.org/10.31234/osf.io/tg7xr.

Greer, S. L., King, E. J., Massard da Fonseca, E., & Peralta-Santos, A. (2020). The comparative politics of COVID-19: The need to understand government responses. *Global Public Health*, 15(9), 1413-1416. DOI: 10.1080/17441692.2020.1783340

Haug, N., Geyrhofer, L., Londei, A., Dervic, E., Desvars-Larrive, A., Loreto, V., Pinior, B., Thurner, S., & Klimek, P. (2020). Ranking the effectiveness of worldwide COVID-19 government interventions. *Nature Human Behaviour*, 4, 1303–1312. DOI: https://DOI.org/10.1038/s41562-020-01009-0org

Jelnov, A., & Jelnov, P. (2022). Vaccination Policy and Trust. *Economic Modeling,* 108, 105773. DOI: https://doi.org/10.1016/j.econmod.2022.105773

Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling*. The Guilford Press: New York.

Kolstad, I., & Wiig, A. (2016). Does democracy reduce corruption?. *Democratization*, 23(7), 1198-1215. DOI: https://doi.org/10.1080/13510347.2015.1071797

Lederman, D., Loayza, N. V., & Soares, R. R. (2005). Accountability and Corruption: Political Institutions Matter. *Economics & Politics*, 17, 1-35. DOI: https://doi.org/10.1111/j.1468-0343.2005.00145.x

M-Amen, K., Mahmood, K. I., Shabu, S. A., & Shabila, N. P. (2021). Exploring perspectives on COVID-19 risk, protective behavior and control measures. *Journal of Risk Research*, 1-13. DOI: https://doi.org/10.1080/13669877.2021.1936607

McKibbin, W. J., & Fernando, R. (2020). The Global Macroeconomic Impacts of COVID-19: Seven Scenarios. *CAMA Working Paper No. 19/2020*. DOI: http://dx.doi.org/10.2139/ssrn.3547729

Megna, R. (2021). Inferring a cause-effect relationship between lockdown restrictions and COVID-19 pandemic trend during the first wave. *Health Policy*, 125(11), 1441-1447. DOI: https://doi.org/10.1016/j.healthpol.2021.09.008

Messner, W. (2020). The Institutional and Cultural Context of Cross-National Variation in COVID-19 Outbreaks. *medRxiv 2020.03.30.20047589*. DOI: https://doi.org/10.1101/2020.03.30.20047589

Mohamadi, A., Peltonenb, J., & Wincent J. (2017). Government efficiency and corruption: A country-level study with implications for entrepreneurship. *Journal of Business Venturing Insights*, 8, 50-55. DOI: https://doi.org/10.1016/j.jbvi.2017.06.002

OECD. (2020, November 10). The territorial impact of COVID-19: Managing the crisis across levels of government. Retrieved from https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/

Rieger, M. O., & Wang, M. (2021). Trust in government actions during the COVID-19 crisis. *Social Indicators Research*, 1-23. DOI: https://doi.org/10.1007/s11205-021-02772-x

Ritchie, H., Mathieu, E., Rodés-Guirao, L., Appel, C., Giattino, C., Ortiz-Ospina, E., Hasell, J., Macdonald, B., Beltekian, D., & Roser, M. (2020). Coronavirus Pandemic (COVID-19). Our World in Data. Retrieved from https://ourworldindata.org/coronavirus

Rose-Ackerman, S. (2021). Corruption and COVID-19. *Eunomía. Revista en Cultura de la Legalidad* 20, 16-36. DOI: https://doi.org/10.20318/eunomia.2021.6061

Sabat, I., Neuman-Böhme, S., Varghese, N. E., Barros, P. P., Brouwer, W., van Exel, J., Schreyögg, J., & Stargardt, T. (2020). United but divided: Policy responses and people's perceptions in the EU during the COVID-19 outbreak. *Health Policy*, 124(9), 909-918. DOI: https://doi.org/10.1016/j.healthpol.2020.06.009

Saez, M., Tobias, A., Varga, D., & Barceló, M. A. (2020). Effectiveness of the measures to flatten the epidemic curve of COVID-19. The case of Spain. *Science of The Total Environment*, 727, 138761. DOI: https://doi.org/10.1016/j.scitotenv.2020.138761.

Sagan, A., Bryndova, L., Kowalska-Bobko, I., Smatana, M., Spranger, A., Szerencses, V., Webb, E., & Gaal, P. (2022). A reversal of fortune: Comparison of health system responses to COVID-19 in the Visegrad group during the early phases of the pandemic. *Health Policy*, 126(5), 446-455. DOI: https://doi.org/10.1016/j.healthpol.2021.10.009

Schwab, K., & Sala-i-Martín, X. (2015). The Global Competitiveness Report 2015–2016. Retrieved from https://www3.weforum.org/docs/gcr/2015-2016/Global_Competitiveness_Report_2015-2016.pdf

Serra, D. (2006). Empirical Determinants of Corruption: A Sensitivity Analysis. *Public Choice*, 126(1–2), 225–256. DOI: https://doi.org/10.1007/s11127-006-0286-4

Steingrüber, S., Kirya, M., Jackson, D., Mullard, S. (2020). Corruption in the time of COVID-19: A double-threat for low income countries. Chr. Michelsen Institute U4 Brief 2020:6. Retrieved from https://www.cmi.no/publications/7210-corruption-in-the-time-of-COVID-19-a-double-threat-for-low-income-countries

Teremetskyi, V., Duliba, Y., Kroitor, V., Korchak, N., & Makarenko, O. (2020). Corruption and strengthening anti-corruption efforts in healthcare during the pandemic of COVID-19. *Medico-Legal Journal*, 89(1), 25-28. DOI: https://doi.org/10.1177/0025817220971925

The PRS Group. (2021). International Country Risk Guide. Retrieved from https://www.prsgroup.com/explore-our-products/international-country-risk-guide/

Transparency International. (2021). Mitigating Corruption Risks in COVID-19 vaccine rollout. Anti-Corruption Helpdesk brief. Retrieved from https://knowledgehub.transparency.org/helpdesk/mitigating-corruption-risks-in-covid-19-vaccine-rollout

Treisman, D. (2000). The Causes of Corruption: A Cross-National Study. *Journal of Public Economics*, 76, 399-457. DOI: https://doi.org/10.1016/S0047-2727(99)00092-4

UNODC. (2020). COVID-19 vaccines and corruption risks: preventing corruption in the manufacture, allocation and distribution of vaccines. Retrieved from https://www.unodc.org/documents/Advocacy-Section/20-07643_Vaccines_CorruptionA4_approv2.pdf

Winkelmann, J., Webb, E., Williams, G. A., Hernández-Quevedo, C., Maier, C. B., & Panteli, D. (2022). European countries' responses in ensuring sufficient physical infrastructure and workforce capacity during the first COVID-19 wave. *Health Policy*, 126(5), 362-372. DOI: https://doi.org/10.1016/j.healthpol.2021.06.015

World Health Organization. (2021). Retrieved from https://www.who.int/
Yamen, A. E. (2021). Tax evasion, corruption and COVID-19 health risk exposure: across country analysis. *Journal of Financial Crime*, 28(4), 995-1007. DOI: https://doi.org/10.1108/JFC-10-2020-0220

APPENDIX

Table 2. List of countries that entered analysis

Country	Frequency [a]	Percent	Cumulative
Albania	602	2.86	2.86
Austria	615	2.93	5.79
Belarus	612	2.91	8.7
Belgium	636	3.03	11.73
Bulgaria	603	2.87	14.6
Croatia	615	2.93	17.53
Czech Republic	610	2.90	20.43
Denmark	613	2.92	23.35
Estonia	613	2.92	26.26
Finland	642	3.06	29.32
France	647	3.08	32.4
Germany	644	3.06	35.46
Greece	614	2.92	38.39
Hungary	607	2.89	41.27
Iceland	612	2.91	44.19
Ireland	611	2.91	47.09
Italy	640	3.05	50.14
Latvia	609	2.90	53.04
Lithuania	611	2.91	55.95
Moldova	603	2.87	58.82
Netherlands	613	2.92	61.73
Norway	614	2.92	64.66
Poland	607	2.89	67.54
Portugal	609	2.9	70.44
Romania	614	2.92	73.36
Russia	640	3.05	76.41
Serbia	605	2.88	79.29
Slovakia	605	2.88	82.17
Slovenia	606	2.88	85.05
Spain	639	3.04	88.09
Sweden	639	3.04	91.13
Switzerland	615	2.93	94.06
Ukraine	608	2.89	96.95
United Kingdom	640	3.05	100.00
TOTAL	**21,013**	**100.00**	

Note: [a] Frequency in this table refers to days observed in each country.

Table 3. Description of variables used in analysis

Variable	Description	Values
Source: COVID dataset [a]		
New cases	New confirmed cases of COVID-19 (7-day smoothed) per million people in the total population.	
New deaths	New deaths attributed to COVID-19 (7-day smoothed) per million people in the total population.	
New vaccinations	Daily number of people receiving their first vaccine dose (7-day smoothed) per hundred people in the total population.	
Stringency index	Government Response Stringency Index: composite measure based on 9 response indicators including school closures, workplace closures, and travel bans. (Oxford COVID-19 Government Response Tracker, Blavatnik School of Government)	0 – 100, 100 = strictest response
GDP per capita	Gross domestic product at purchasing power parity (constant 2011 international dollars).	
Median age	Median age of the population, UN projection for 2020.	
Population density	Number of people divided by land area, measured in square kilometers.	
Source: PRS dataset [b]		
Corruption	Corruption index: A measure of corruption within the political system concerned with actual or potential corruption in the form of excessive patronage, nepotism, job reservations, 'favor-for-favors', secret party funding, and suspiciously close ties between politics and business.	0 – 6, higher values indicate higher corruption
Bureaucratic quality	Bureaucratic quality index: A measure of the strength and expertise to govern without drastic changes in policy (autonomous from political pressure) or interruptions in government services (established mechanism for recruitment and training).	0 – 4, higher values indicate higher quality
Socioeconomic conditions	Socioeconomic conditions index: A measure of the socioeconomic pressures at work in a society that could constrain government action or fuel social dissatisfaction. This index consists of unemployment, consumer confidence, and poverty.	0 – 12, higher values indicate better conditions
Source: WHO dataset		
Hospital beds	Hospital beds per thousand people, which include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers. In most cases, beds for both acute and chronic care are included.	
UHC index	Coverage index for essential health services (based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, noncommunicable diseases, and service capacity and access).	0 – 100, higher values indicate better services
Other variables		
Country group	1 – Central and Eastern Europe, 2 – Western Europe, 3 – Southern Europe, 4 – Northern Europe	

Notes: [a] Definition, methodology and sources behind all variables from COVID dataset are available here https://github.com/owid/COVID-19-data/tree/master/public/data. [b] Definition, methodology and sources behind all indices from PRS dataset are available here https://www.prsgroup.com/wp-content/uploads/2018/01/icrgmethodology.pdf. Definition, methodology and sources behind all indices from WHO dataset are available here https://covid19.who.int/data.

Table 4. Descriptive statistics of latent constructs' items

Latent construct	Item	Mean	Standard deviation	Minimum	Maximum
GovtTrust	Corruption	2.42	1.18	0	4.5
	Bureaucracy	3.03	0.95	1	4
	Socioeconomic	7.70	1.39	4.5	11

Note: "St. dev." denotes standard deviation.

Table 5. Item correlations and Cronbach alphas

Latent construct	Item	Inter-item correlation	Item-rest correlation	Cronbach alpha	Alpha-if-deleted
GovtTrust	Corruption	0.8084	0.8340	0.9225	0.8940
	Bureaucracy	0.7681	0.8648		0.8689
	Socioeconomic	0.8179	0.8268		0.8998

Table 6. Exploratory factor analysis results

Panel A: Eigen values

Factor	Eigen values	Percentage of explained variance	Cumulative percentage of explained variance
1	2.30986	1.0804	1.0804
2	-0.0731	-0.0342	1.0462
3	-0.0987	-0.0462	1.0000

Panel B: Eigen vector

Latent construct	Item	F1
GovtTrust	Corruption	-0.8697
	Bureaucracy	0.9011
	Socioeconomic	0.8610

Figure 5. Long-run trends (1985-2021) of corruption, bureaucracy quality, and socioeconomic conditions in selected European countries

Source: Authors' own work.

Article history:	Received: 16.1.2023.
	Revised: 20.3.2013.
	Accepted: 27.3.2023