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Death takes no bribes: Impact of perceived corruption on the effectiveness of non-pharmaceutical interventions at combating COVID-19

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ABSTRACT

Corruption is considered in the literature as an activity with several externalities and spillover effects. Adding to the recent research on the corruption-COVID-19 nexus, we study the impact of corruption on coronavirus cases. High perceived levels of corruption have been proven to lead to lower institutional trust, and hence possibly to lower levels of citizen compliance with non-pharmaceutical interventions (NPIs), such as lockdowns, imposed by the authorities during the first wave of the pandemic to reduce the spread of coronavirus. Applying quantitative analysis with the use of hybrid models, we find that in countries with higher levels of perceived corruption, across alternative corruption measures, more COVID-19 cases are observed, *ceteris paribus*. This suggests that corruption has a detrimental effect on the spread of COVID-19, and that countries experiencing higher levels of corruption should pay extra attention when implementing NPIs.

1. Introduction

The biggest disease is corruption, the greatest cure is transparency. - Bono (2013)

Corruption is a frequently occurring activity worldwide that undermines governmental institutional capacity. It is well known that corruption, being by definition a rent-seeking activity (Aidt, 2016; Rose-Ackerman, 1999, 2008), with or without the involvement of the government (Goel et al., 2015), entails a number of economic costs being incurred by the community that usually exceed the benefits enjoyed by bribe-takers and bribe-givers. A strand of the literature has suggested that there are also other, less evident, costs that a society with high levels of corruption has to sustain. One such cost consists in the fact that highly corrupt societies experience lower levels of trust in institutions (Kubbe, 2014; Richey, 2010; Uslaner, 2013). It is an established finding that the levels of compliance with a policy are also

influenced by the level of trust in the underlying institutions enforcing it (Norris, 1999, 2011).

In this rationale, corruption, directly influencing governance, can trigger a mechanism of distrust in institutions, potentially able to reduce compliance with government measures. Indeed, from an individual perspective, citizens who are worried about corruption may tend to reduce the value of perceived benefits associated with government choices. The existence of such a relation has been pointed out by several studies (e.g. Marien and Hooghe, 2011; Torgler et al., 2007). This mechanism, among others, can also play a major role in the effectiveness of government policies put in place to prevent the spread of COVID-19 contagion.

It has already been suggested that governance quality and the quality of institutions (see La Porta et al., 1999) impact the population's respect for social distancing policies, and through it influence the spread of COVID-19 (Alfano and Ercolano, 2021, 2022), and so it does work ethics

Abbreviations: NPI, Non-pharmaceutical intervention; CPI, Corruption Perceptions Index; ISSP, International Social Survey Program; OxCGR, Oxford COVID-19 Government Response Tracker; DAG, Directed acyclic graph.

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(Alfano, 2021) and social capital (Alfano, 2022). In this respect, the impact of corruption on a policy with a massive scale of implementation, such as social distancing measures set in place to combat COVID-19, could be very important, impacting both governance quality and trust in institutions (another determinant of lockdown efficiency, according to Bargain and Aminjonov, 2020). Along similar lines, it was recently argued by Goel et al. (2021) that the scale and speed of vaccinations pose some unique challenges with respect to corruption, where corruption and the scale of vaccination are positively related, but the speed-corruption relation could go either way. As a result, the overall effect of corruption on the COVID-19 trend is unclear, and remains an empirical question whose answer is likely to emerge over time (contingent on the ability to adequately capture the true level of corruption). Another study, without taking into account the temporal dimension of the pandemic, concluded that, during the first wave, corruption added to the number of COVID fatalities (Farzanegan, 2021). More analysis seems to be needed, given the reduced external validity of these preliminary results that do not take the temporal dimension into account. Our focus on the effects of corruption on COVID-19 cases can be seen as complementary to these studies that consider other, related dimensions. This issue gains added importance with the emergence of recent variants of coronavirus.

For all the above reasons, the recent COVID-19 crisis could represent an interesting case study that might yield insights into this spillover mechanism which from widespread corruption leads to a detrimental outcome for society, outweighing the cost of corruption itself. Further, the spread of the pandemic has driven national governments to adopt different containment measures, also called non-pharmaceutical intervention (NPI) policies (Alfano and Ercolano, 2020; Goel and Haruna, 2021). In the absence of an effective cure for COVID-19, and of a vaccine that prevents contagion (which was not available up to the end of 2020, hence, throughout the first wave of the pandemic, usually considered to last from January to August 2020), the early strategy adopted by almost all governments worldwide relied on imposing social distancing and lockdowns, and other such NPIs, that aimed to reduce the probability of contagion within the population.

In spirit, this is a similar strategy to what was done by the Republic of Venice during the Middle Ages, when the first public authorities with the specific mandate to combat an epidemic were instituted (Alfano and Sgobbi, 2021). Also for this reason, as already pointed out by Lau et al. (2020), confinement policies like lockdowns are binding measures that people are unaccustomed to.

But even if there are some similarities with how the various public authorities over time chose to tackle health crises (Alfano et al., 2022), it is also important to recognize that there are reasons to believe that the recent crisis is unique, and that it has unfolded differently in different parts of the world. Indeed, the COVID-19 pandemic marks the first time in the history of mankind that a worldwide pandemic has hit an information-intensive, globally interconnected society. Information now travels faster than it ever did before, and new problems such as the believability of fake news and conspiracy theories deeply affect citizen behavior. If the public mistrusts the authorities, it has a great incentive not to behave as suggested by the authorities themselves. This would undermine the intent and effectiveness of any preventive measures.

The link between trust and regulatory compliance has been recently addressed elsewhere. Bargain and Aminjonov (2020), examining the case of COVID-19, suggest that trust affects individual compliance. Alfano and Ercolano (2022), by means of a cross-country analysis, further expand this strand, suggesting that the effectiveness of lockdown measures may depend on how citizens perceive the capacity of the government to set up and implement sound policies. In their study, the authors “shed some light on hidden benefits related to better institutional environments, which are able to affect citizens’ compliance positively even in the presence of very restrictive policies”. This also appears to be confirmed at the local level for Italian provinces, where both social capital and institutional quality can be considered factors

able to influence the efficacy of lockdowns (Alfano, 2022; Alfano and Ercolano, 2020b, 2021). In particular, as suggested by the latter, institutional quality may boost individual compliance, since political trust can further the legitimacy and hence effectiveness of government actions (Letki, 2006; Marien and Hooghe, 2011). The centrality of trust is also confirmed when looking at the positive effect of social capital on the effectiveness of lockdown measures. Indeed, following the definition of Putnam (1995) this concept includes features correlated with social trust, which is then able to facilitate coordination and cooperation among individuals. In this rationale, Alfano (2022) and Alfano and Ercolano (2020b) suggest that social capital, fostering trust and cooperation amongst citizens, represents a push or an enabling factor for citizen compliance, making the necessity and appropriateness of lockdown more acceptable, both in the case of Italy and in a broader cross-country context.

In this perspective, it thus seems legitimate to imagine societies with higher levels of perceived corruption incurring a higher cost from the COVID-19 crisis, due to greater mistrust in the authorities and lower compliance with implemented NPIs (incidentally, corruption might also impact the recording of COVID cases: other things being equal, officials in more corrupt jurisdictions would be more likely to misreport cases to their advantage. Nonetheless, in this case, it is harder to detect the overall direction such misreporting will take). After all, NPIs are policy instruments which are very hard to enforce without the population concerned voluntarily complying. By their very nature, it is hard, especially in Western countries and in societies which enjoy greater respect for civil liberties and democracy, to implement NPIs with the use of force.

The aim of the present paper is to contribute to the extant literature empirically investigating the role of perceived corruption on the spread of the pandemic. Our results suggest that perceived corruption plays an important role in the trend of COVID-19 cases, leading to a considerable increase in the number of new cases. The corruption perceived in politicians is even more detrimental, in this relationship, than that attributed to public officials. Intuitively, political corruption may be more related to grand corruption, while corruption associated with public officials might be more of a petty nature. This result is also robust to a different, cross-national measure of corruption (i.e., the CPI from Transparency International).

The rest of the paper is organized as follows: the next section is devoted to introducing the tested hypothesis and describes the mechanisms that link corruption, mistrust and NPI; in Section 3 data and methodology adopted in the analysis are presented; Section 4 reports the main estimation results; the last section is devoted to conclusions.

2. Corruption, mistrust and NPIs

On the basis of the above reasoning, the aim of the present research is to provide empirical support by testing the following hypothesis:

H1. Greater perceived corruption, generating mistrust, negatively impacts the effectiveness of NPIs, *ceteris paribus*.

We aim to test this hypothesis by means of an empirical analysis on a cross-country panel dataset built using International Social Survey Program (ISSP) data about perceived corruption (gathered in 2016, and thus before the COVID-19 crisis, to avoid any look-behind effect or circular effect), the Corruption Perceptions Index (CPI) from Transparency International (<https://www.transparency.org/en/>) as an alternative operationalization of corruption, and data about the evolution of the pandemic from the Oxford COVID-19 Government Response Tracker (OxCGRT, from Hale et al., 2020, with data about COVID-19 cases and a stringency index summarizing on a daily basis NPIs in place in each country). More details on data and empirical strategy are given below. From a theoretical perspective, testing this hypothesis contributes to the recent literature focusing on understanding the impact of trust on the effectiveness of NPIs, which markedly restrict individual freedom.

Another dimension of trust may be related to the willingness of the public to share their vaccination status when vaccine passports are instituted (Goel and Jones, 2022).

It is worth noting that corruption is a multifaceted phenomenon, able to impact upon different aspects of society. There are therefore other plausible channels that may affect the relationship between COVID-19 spread and corruption, such as the misallocation of public funds and the impact that public corruption has on the efficiency of the public transport system (believed to play a major role in the spread of the virus). Therefore, it is important to warn the reader already at this point that identification of a specific causal mechanism has to be treated with caution. Fig. 1 shows, through the use of a directed acyclic graph (DAG), the different sources of effects on the new daily cases of COVID-19 (our dependent variable): other than unobserved factors, mainly the stage of the pandemic so far, e.g. the total amount of cases experienced, and the stringency measures adopted. We expect compliance with such stringency measures to have an impact on our dependent variable.

While this is not the first paper in the nascent literature on the link between corruption and COVID-19, it is the first to examine the link between corruption and the COVID-19 cases coming to light. Other researchers have focused on corruption-vaccination links (Goel and Nelson, 2021; Goel et al., 2021) and corruption-coronavirus fatalities (Farzanegan, 2021). Given the multidimensional nature of corruption, with numerous causes and effects, effective policies to combat the pandemic require an understanding of the impacts of corruption on different aspects and stages of the pandemic (such as NPIs, vaccinations, fatalities and reporting).

3. Data and methodology

The related literature has already suggested the importance of using fixed-effects estimation to determine the impact of dependent variables on the trend in COVID-19 cases (Alfano and Ercolano, 2020a). Indeed, the usual argument is that this family of models has a crucial advantage

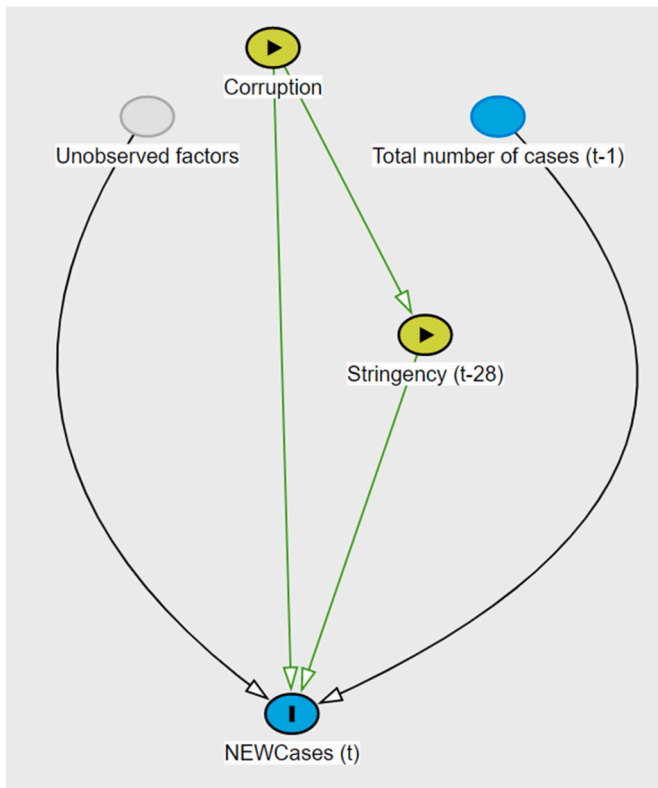


Fig. 1. Directed acyclic graph.

when modeling a new phenomenon. By implicitly controlling for all the time-invariant variables, the results have a fundamental advantage when modeling a phenomenon on which the influences of the determinants are not entirely clear from a theoretical perspective. At the same time, this advantage is the main drawback of such an approach: the impossibility of including in the estimation variables that do not vary over the time frame analyzed. The solution that some have adopted to overcome this limitation is to split the sample into quantiles, according to the values of the time-invariant variable (Alfano and Ercolano, 2020b, 2021 and 2022). This empirical strategy relies on the opportunity to compare coefficients estimated in different samples, hence potentially affected by different biases. Therefore, results should be taken with caution. A more sophisticated strategy recently proposed in this field to overcome this limitation (Alfano, 2021, 2022) is the use of a hybrid model (Allison, 2009; Schunck, 2013; Wooldridge, 2005, 2010).

As already suggested by Schunck (2013), this empirical strategy allows the inclusion in the regression of random slopes, letting the effects of time-invariant variables vary between clusters and thus be estimated. In other words, this enables us to estimate the impact of an independent time-invariant variable on a dependent variable, in the context of a fixed-effect estimation. Hence, we may have the advantage of a fixed-effects model, in terms of controlling for observed and unobserved time-invariant characteristics, and at the same time be able to test the impact on this relationship of a time-invariant variable (as is typically the case with the perception of corruption, being offered as yearly values in most datasets).

In more formal terms, following the previous empirical literature on the topic (Alfano and Ercolano, 2020, 2021 and 2022; Alfano, 2021, 2022) we estimate this equation:

$$\Delta i_{ct} = \alpha + \beta_1 (i_{ct-1} - \bar{i}_c) + \beta_2 \bar{i}_c + \beta_3 (Str_{ct-28} - \overline{Str}_c) + \beta_4 \overline{Str}_c + \beta_5 Corr_c + \beta_6 T_t + \varepsilon \tag{1}$$

where:

- Δi_{ct} are the new daily COVID-19 cases (labeled *NEWCases*) on day t in country c ;
- i_{ct-1} (labeled *TOTCases*) is the total number of cases in country c on day $t-1$, to take into account the exponential nature of the pandemic. Please note that, as is usual in hybrid models, this variable is decomposed into its *within-country* part (i.e. the difference from the country mean of each observation: $i_{ct-1} - \bar{i}_c$) and a *between country* part (i.e. each country mean, \bar{i}_c);
- Str_{ct-28} (labeled *STRINGENCY*) is the set of stringency measures set up on a number of days sufficient for NPIs to have an effect (28 days, more details on this choice below). Also, this variable is decomposed into its *within-country* part (i.e. the difference from the country mean of each observation: $Str_{ct-28} - \overline{Str}_c$) and a *between country* part (i.e. each country mean, \overline{Str}_c);
- $Corr_c$ (labeled *PolCORR* and *PubCORR*) is a measure of the perceived corruption of the government in country c ;
- T_t , a matrix of time dummies to include time (monthly) fixed effects, and thus to take into account the variability due to time elapsing;
- ε , as usual, is the error term.

Following the literature that models the spread of COVID-19 in this way (Alfano and Ercolano, 2021, 2022; Alfano, 2022), it is thereby possible to measure the impact of corruption perceptions on pandemic evolution in β_5 , and thus, in general, the cost incurred, in terms of the extra number of cases, by countries where the public sector is perceived as more corrupt, as highlighted in the DAG.

In order to empirically build this dataset, the following are required: the daily number of COVID-19 cases in a sample of countries; daily data on the stringency of NPIs; and a comparable measure of cross-national

operationalization of corruption. Data for the first two variables are gathered from the Oxford COVID-19 Government Response Tracker dataset (henceforth OxCGRT, Hale et al., 2020a; <https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker>). It is a dataset (we used the latest version available at the time of writing, namely the edition of March 26, 2021) compiled from publicly available information by a cross-disciplinary Oxford University team (Hale et al., 2020b). It offers a country-by-country daily estimate of COVID-19 cases, enabling us to study the impact of corruption as the virus spread across the nations concerned.

We decided to focus on the first wave of the pandemic, i.e. from January 1, 2020 to August 31, 2020, for three main reasons. First, in this way we can rely on a more homogeneous sample, in which no country knew much about the structural characteristics of the emergency, and had to learn it the hard way, by trial and error. We thereby avoid biased estimates due to very different approaches that lead to a higher variance of the spread of COVID-19. As highlighted by Alfano et al. (2022), the reaction of the government was fairly homogeneous within the waves, making the *ceteris paribus* assumption more acceptable and therefore lowering the likelihood of biases and raising the quality of estimation. Second, by reducing our population to the first wave we manage to avoid biases due to differences in testing strategies and reporting. Finally, we do not find heterogeneity in the number of COVID-19 cases due to the different implementation and speed of the vaccination campaigns.

Once again, from Hale et al. (2020a), we computed *NEWCases*, the operationalization of Δi in equation (1). This variable is computed as the first difference between the total COVID-19 cases reported on day t and on day $t-1$, for each country c . We normalized these data for the different sizes of the country, dividing the total by the population of country c (data from the World Bank dataset in 2019) and then multiplying it by 1,000,000, to have a per *million* variable (which makes the coefficients more easily readable than a *per capita* variable). Once again from the same source, we computed *TOTCases*, the operationalization of i_{t-1} . It is equal to the absolute value of cases at $t-1$, once again computed in a per *million* inhabitants term.

Looking at the stringency measures, it is worth noting that it would not be possible to imply the *ceteris paribus* caveat in the analysis, ignoring that the country has in place different sets of NPIs on different days. In order to control the stringency level of the different NPIs in place each day in the different countries we include from OxCGRT the Oxford Stringency Index, a daily measure of the different policies in place in each country c for each day t . It is a variable on a 0–100 scale, including different NPIs in place. We used this index in the analysis, labeled *STRINGENCY*, as a proxy of all the NPIs that may affect the dependent variable *NEWCases*. All things considered, this seems to be a very good proxy for taking into account and controlling for all the NPIs which (if respected) should affect the outbreak of coronavirus. As already suggested in the literature (Alfano, 2021), this variable should be lagged, given that NPIs need some time to show results in reducing new cases, and their effect is not immediate. Following therefore previous contributions (Alfano, 2021), we lag the variable *STRINGENCY* by 28 days, to measure the impact of *STRINGENCY* on people who did not exhibit symptoms after the NPI was enforced. This permits us to have four full weeks of lag, avoiding the so-called weekend effect that has an effect on the number of cases reported (Soukhovolsky et al., 2021).

Finally, there is the operationalization of *CORR*. In order to empirically test the impact of corruption on COVID-19 spread, we relied on data from the International Social Survey Program (ISSP) in its 2016 edition (GESIS, 2018; <http://www.issp.org/menu-top/home/>). ISSP is a cross-country survey that collects individual-level data through interviews done in different countries, and it is widely used in social sciences research. Please note that since the interviews in question date from 2016, the corruption perception proxies precede the COVID-19 crisis, and hence are not affected by the way the national governments managed the pandemic. There is thus no risk of reverse causality. At the same time, previous findings in the literature suggest that cultural traits

persist for surprisingly long periods of time at a national level (Bjørnskov, 2007), and thus we should not be overly worried about the representativeness of these values.

In detail, we exploited questions Q20 (that states: *How many politicians in your country are involved in corruption?*) and Q21 (*How many public officials in your country are involved in corruption?*) to operationalize corruption perceptions both for politicians (*PolCORR*) and public officials (*PubCORR*). The interviewee can respond to both questions by indicating a value on a 1 to 5 scale, where 1 stands for “Almost none” and 5 for “Almost all”. We computed the median for these questions for each country included in the analysis, taking into account the statistical weights provided by GESIS (2018).

All this led to the creation of a dataset comprising 34 countries (all those included in GESIS, 2018, reported in Appendix 1) observed for 216 days (between January 1 and August 31, losing 28 observations per country per lags imposed upon *STRINGENCY*), for a total of 7344 observations. Descriptive statistics of the variables are presented in Table 1, while Fig. 2 presents a heat map with the mean values of the main variables included in the study, to permit the reader to have an idea of the values at a glance.

4. Results

4.1. Baseline results

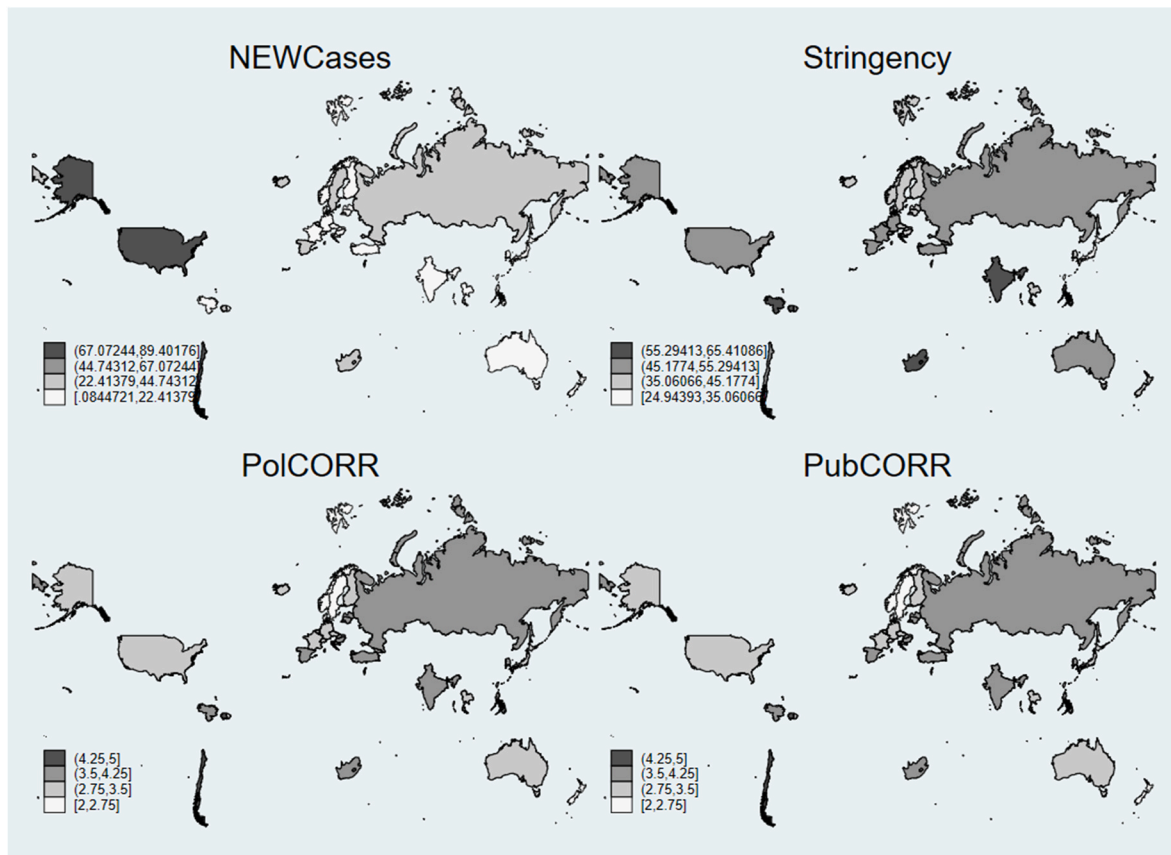
Estimation results are presented in Tables 2 and 3. All the coefficients were estimated through F-GLS hybrid models, with standard errors clustered at the country level.

First of all, in all the different specifications *TOTCases* is positive and statistically significant, suggesting that the more COVID-19 cases there were yesterday, the more there are today. This is a finding in line with what we know about the exponential nature of the pandemic and with the previous literature (Alfano, 2021; Alfano and Ercolano, 2020).

Table 2 shows empirical support for the hypothesis that perceived corruption has an impact on the spread of COVID-19. Indeed, the coefficients of both specification 2.1 (regarding perceptions of corruption in politicians - *PolCORR*), and specification 2.2 (corruption in public officials - *PubCORR*) show the positive and statistically significant impact of these perceptions of corruption on the evolution of new COVID-19 cases per million inhabitants. These results suggest that countries with higher levels of perceived corruption in both politicians and public officials have more COVID-19 cases, *ceteris paribus* for NPIs in place. We consider it an interesting result, both for policymakers and stakeholders more generally, given that corruption perception can be seen as a factor that facilitates the spread of the virus. Also of interest is the magnitude of the related coefficient. Indeed, perceived corruption in politicians leads to pretty much the same increase in the number of cases as corruption perception in public officials. This may be due to the fact that during the pandemic many public officials, such as police officers and public health sector workers, were entrusted with greater responsibility and consequently perceived as wielding greater power than usual. Specifically, for each increase in the level of median perception of corruption among politicians (the original question states: *In your opinion, about how many politicians in [your country] are involved in corruption? Almost none; A few; Some; Quite a lot; Almost all*) in the country, there are 3.992 more daily COVID-19 cases per million inhabitants. While this number may seem almost negligible, given the exponential nature of the pandemic it could lead to a worrisome number of cases in the space of a few days. On the other hand, a similar increase in the perceived level of corruption in public officials, leads to 3.902 more COVID-19 cases. This represents a difference of about 0.1 more daily cases per million inhabitants, a low increase which nonetheless is again more serious than may seem once the exponential nature of the epidemic is taken into account. More details on the exact impact on each country are shown in a histogram in Fig. 3, where the coefficients of *PolCORR* and *PubCORR* are multiplied, obtaining the estimated amount of daily

Table 1
Descriptive statistics.

Label	Variable	Mean	Sample	Std. Dev.	Min	Max	Observations	Source
<i>NEWCases</i>	First difference between total cases per one million inhabitants reported today and those reported yesterday.	20.33433	overall	44.84029	-255.0705	756.6371	N = 7344	Oxford COVID-19 Government Response Tracker
			between	24.09381	.0934733	100.577	n = 34	
			within	38.04125	-255.7473	755.9603	T = 216	
<i>TOTCases</i>	Total cases reported yesterday.	1557.384	overall	2817.794	0	21632.19	N = 7344	Oxford COVID-19 Government Response Tracker
			between	1744.326	14.00347	7296.82	n = 34	
			within	2233.02	-5739.436	15892.75	T = 216	
<i>STRINGENCY</i>	Daily value of the Stringency Index from the Oxford COVID-19 Government Response Tracker	52.09349	overall	26.78862	0	100	N = 7344	Oxford COVID-19 Government Response Tracker
			between	10.06546	26.73745	73.63287	n = 34	
			within	24.8854	-14.93017	103.0884	T = 216	
<i>PolCORR</i>	Country median value for the answer to the question <i>How many politicians are corrupt?</i> From ISSP 2018	3.441176	Overall	.8114149	2	5	N = 7344	ISSP 2018
			Between	.8235612	2	5	n = 34	
			Within	0	3.441176	3.441176	T = 216	
<i>PubCORR</i>	Country median value for the answer to the question <i>How many public officials are corrupt?</i> From ISSP 2018	3.294118	Overall	.6655576	2	4	N = 7344	ISSP 2018
			Between	.6755205	2	4	n = 34	
			Within	0	3.294118	3.294118	T = 216	
<i>PercepCORR</i>	Inverted Corruption Perceptions Index, obtained by subtracting 100 from the country CPI value in 2020.	39.44118	Overall	18.5488	13	84	N = 7344	Transparency International
			Between	18.82657	13	84	n = 34	
			Within	0	39.44118	39.44118	T = 216	



Note: Means of *NEWCases*, *STRINGENCY*, *PolCORR*, and *PubCORR* in the countries studied. Authors' calculations from data reported in the text.

Fig. 2. Heat maps.

COVID-19 cases due to corruption. This impact seems relevant: while of course depending on the size of the population, the increase in the number of cases due to corruption comes to over 5474.

4.2. Further results

The main limitation of our analysis so far is the difficulty in

attributing the effect that we measure to the theoretical mechanism we assumed. Indeed, as reported in the DAG in Fig. 1, corruption may play a direct role on the spread of the virus but its effect could also be triggered by the interaction between the stringency of the measures and the level of perceived corruption; accordingly we are able to study the effect of corruption on the trend of COVID-19 cases through the stringency level of the measures in order to impute the effect measured to the lack of

Table 2
Determinants of new COVID cases: F-GLS Hybrid Model.

	(2.1)	(2.2)
Dependent variable: <i>NEWCases</i>		
<i>TOTCases_within</i>	0.00646*** (5.17)	0.00646*** (5.17)
<i>TOTCases_between</i>	0.0133*** (16.63)	0.0134*** (15.74)
<i>L28.STRINGENCY_within</i>	0.0944 (0.90)	0.0942 (0.90)
<i>L28.STRINGENCY_between</i>	0.315** (2.08)	0.322* (1.88)
<i>PolCORR</i>	3.992*** (3.49)	
<i>PubCORR</i>		3.902** (2.32)
Time Fixed Effects	YES	YES
Constant	-33.48*** (-5.12)	-32.98*** (-3.93)
Observations	7344	7344
Overall R2	0.392	0.391

Notes: See Table 1 for variable details. t statistics are in parentheses; *p < 0.1, **p < 0.05, ***p < 0.01.

Table 3
Robustness check with alternative corruption measure: F-GLS Hybrid Model.

	(3.1)
Dependent variable: <i>NEWCases</i>	
<i>TOTCases_within</i>	0.00646*** (5.17)
<i>TOTCases_between</i>	0.0138*** (15.28)
<i>L28.STRINGENCY_within</i>	0.0945 (0.90)
<i>L28.STRINGENCY_between</i>	0.335* (1.82)
<i>PercepCORR</i>	0.130** (2.11)
Time Fixed Effects	YES
Constant	-26.42*** (-3.64)
Observations	7344
Overall R2	0.390

Notes: See Table 1 for variable details. t statistics are in parentheses; *p < 0.1, **p < 0.05, ***p < 0.01.

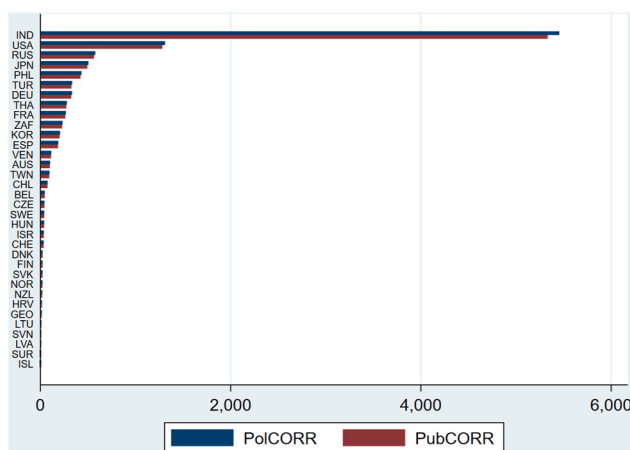


Fig. 3. Total impact of new daily COVID-19 cases due to *PolCORR* and *PubCORR* per country.

compliance with NPIs.

To study the impact of stringency measures on the COVID-19 case trend at different levels of corruption, a possible empirical approach to the problem would be the inclusion in the model of an interaction term between the variable proxying stringency measures and that proxying corruption. Computing the marginal effects of such a regression, we would estimate the impact of the stringency index on new COVID-19 cases, at different levels of corruption.

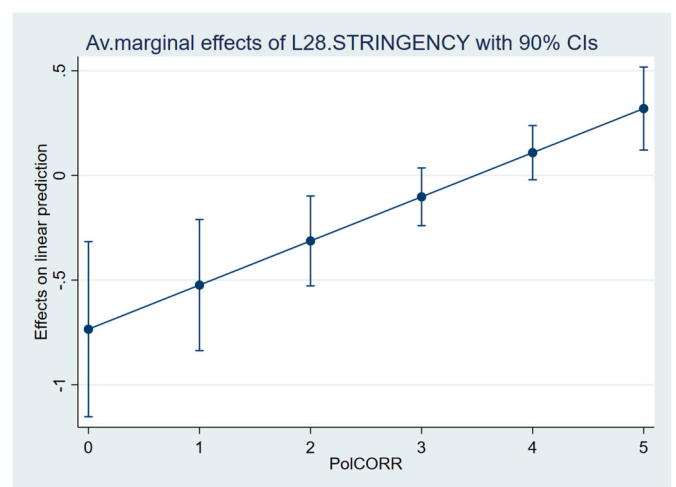
Unfortunately, the shortcoming of this approach is that it is not implementable in the context of a fixed effect or a hybrid estimation in an unbiased way. Indeed, as suggested by [Giesselmann and Schmidt-Catran \(2020\)](#), the use of interactions in fixed-effects regression models may easily lead to biased estimates. They propose an alternative empirical strategy, that relies on the use of a de-meanned interaction term, which would be nonetheless useless in our setting, due to the lack of variability of the corruption proxy, which is time-invariant (and therefore does not change within the time-frame analyzed).

However, to offer some empirical evidence of this impact, and hence to provide grounds for the mechanism in place in the relationship we found, we consider it useful to modify Eq. (1) with the inclusion of an interaction term, and estimate it without decomposing *STRINGENCY* in its *within* and *between* parts. In this way, while our estimate may potentially be subject to other biases (that should have been avoided in the previous estimate, thanks to the use of a hybrid model), we may through this empirical strategy compute the marginal effect, and hence obtain an estimate of the impact of *STRINGENCY* on *NEWCases* at different levels of *PolCORR* and *PubCORR*.

In more formal terms, we amended Eq. (1) by adding an interaction term, thereby obtaining Eq. (2):

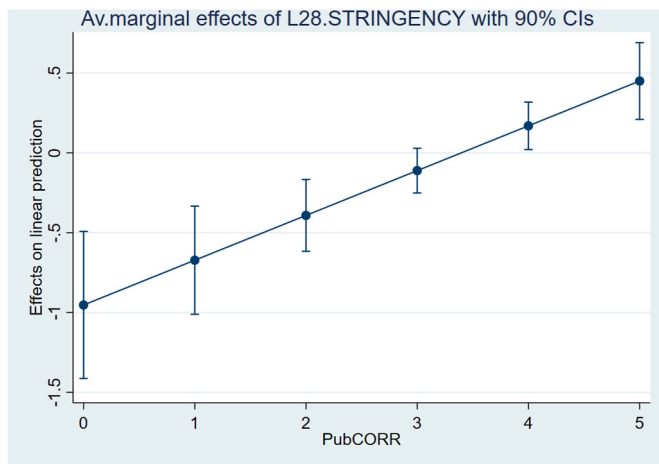
$$\Delta i_{ct} = \alpha + \beta_1(i_{ct-1} - \bar{i}_c) + \beta_2 \bar{i}_c + \beta_3 Str_{ct-28} + \beta_4 Corr_c + \beta_5 Str_{ct-28} * Corr_c + \beta_6 T_t + \varepsilon \quad (2)$$

We estimated this equation through an F-GLS estimator, and computed the marginal effects. Results are presented in [Figs. 4 and 5](#). As may be clearly seen, an increase in perceived corruption, both among politicians and public officials, leads to a decrease in the efficiency of stringency measures, that fail to further reduce the dependent variable *NEWCases*. It is especially interesting, according to this estimate, that when each kind of corruption reaches a level of 3, the effect of the stringency measures in place becomes non-influential on the reduction in growth of COVID-19 case numbers.



Notes: Model estimated through an F-GLS estimator

Fig. 4. Average impact of *STRINGENCY*, lagged for 28 days, on *NEWCases*, for different levels of *PolCORR*.



Notes: Model estimated through an F-GLS estimator

Fig. 5. Average impact of *STRINGENCY*, lagged for 28 days, on *NEWCases*, for different levels of *PubCORR*.

4.3. Robustness checks

We perform a number of robustness checks to test the validity of our findings. As a first robustness check, we replicate the analysis using another index of perceived corruption: the Corruption Perceptions Index (CPI) by Transparency International (labeled *PercepCORR*). It is a well-known and widely used index that ranks countries by perceived levels of public sector corruption, according to experts and businesspeople. The index is scaled to a 0–100 range, and has been inverted by subtracting 100 from the value. Indeed, the original CPI was built to indicate that 0 means highly corrupt and 100 very clean. To facilitate interpretation, we transform it, with higher values indicating higher corruption, and thus proceed with the operation described above. The use of alternative corruption measures partly addresses the debate surrounding the best way to measure corruption (Donchev and Ujhelyi, 2014), and can be seen as a (relatively minor) contribution of this work.

Our results, as shown in Table 3, point again in the same direction, suggesting that more corrupt countries have a higher daily increase in the number of COVID-19 cases. This is consistent with the notion that heightened corruption (or perceptions of corruption) undermine the trust in institutions, which weakens their effectiveness. Broadly speaking, the findings point to spillovers of corruption and suggest that policymakers should take account of such externalities in efforts to effectively control and combat the pandemic.

A further possible shortcoming of our analysis is that the daily number of new COVID-19 cases is an extremely noisy variable compared to the main variables of interest. Therefore, we consider removing the cyclical component from the time series for each country. In this regard, we applied the Hodrick-Prescott filter (Hodrick and Prescott, 1997) in order to remove excess variability in each of the national series of COVID-19 cases. Results, presented in Table SM1, are consistent with our main findings, since all the variables show the same signs and statistical significance. Recently, Hamilton (2018) criticized the Hodrick-Prescott filter, since it introduces spurious dynamic relations that have no basis in the underlying data-generating process. Therefore, we replicated the analysis treating the variable with the procedure suggested by Hamilton (2018). Results, presented in Table SM2, once again point in the same direction, and are consistent with our main estimates. We may thus conclude that excess variability does not affect our findings. The concluding section follows.

5. Conclusions

Two years after the beginning of the COVID-19 pandemic, the way out still seems a considerable distance away. For this reason, and given the fact that pandemics are predicted to occur with increasing frequency in the near future, research to ascertain the impact of socio-cultural characteristics on NPI compliance seems to be both highly relevant and important. This is especially true with regard to policymakers, who have to design policies to protect public health and who need to tailor them to the population as closely as possible, in order to obtain the best results.

In this paper, we tested the impact of corruption perceptions about the behavior of politicians and public officials on the COVID-19 dynamic. While the empirical setting and the data do not let us identify a single mechanism that causes this dynamic, our results suggest that, as expected, countries where the public sector is perceived as more corrupt have a higher number of cases, *ceteris paribus* (i.e. controlling for stringency measures, and the unfolding of the pandemic). Reflecting on the possible mechanisms driving the increase in COVID-19 cases coming to light following heightened perceptions about corruption, affected individuals in a corrupt economy could discount potential consequences (mandatory isolations, job separations, etc.). This would prompt more cases to come to light. Another channel of influence of corruption is more direct: weak institutions due to widespread corruption undermine containment and mitigation efforts, which contribute to the spread of the pandemic. Whereas the literature has considered the role of corruption in combating the current pandemic (Farzanegan, 2021; Goel and Nelson, 2021; Goel et al., 2021), the focus of this paper linking corruption to daily cases of the pandemic spread seems unique.

This result contributes to supporting previous findings aimed at understanding the mechanisms able to influence individual compliance with NPIs, which represent a set of policies envisaging major limitations to personal freedom. In this perspective, recent studies detecting the positive effect of social capital and institutional quality on the effectiveness of NPIs (Alfano and Ercolano, 2021, 2022) suggested that trust could represent the transmission channel through which citizens tend to show more disciplined behavior. Our results are consistent with previous findings, lending support to the idea that all the factors able to influence individual trust in institutions can represent an important feature for governments to implement effective policies.

Moreover, in terms of the generalization of such results, COVID-19 and related containment measures like NPIs represent a unique case study which could nevertheless yield insights into the mechanisms correlated with individual compliance and, accordingly, feed into the effective implementation of sound policies.

Although this work expands the literature on the detrimental effects of corruption, on NPI effectiveness, and further contributes to previous findings on COVID-19 spread determinants, the present analysis has some limitations. First, and most importantly, the countries analyzed are not the result of a sampling operation but are dependent on data availability. This may of course entail a bias that could have affected the results. Nonetheless, we believe at the same time, as also highlighted by the heat maps in Fig. 2, that the countries we were able to include in the analysis (reported in Appendix 1) represent an interesting sample of the world at large. Indeed, the sample includes countries that represent an important share of the world population at different latitudes and different levels of economic development.

Another limitation is due to the reporting of COVID-19 cases. This is our dependent variable which, as we all know, is far from a perfect reflection of the actual number of cases that each country has experienced. Indeed, Hale et al. (2020a) obtained their data from national sources. This means that the reported cases are influenced by many factors, such as the quality of the tests themselves, the different national policies in the matter of testing, and the number of contagions that were asymptomatic. The results should therefore be treated with caution, since we recognize that this is a potential source of bias in our analysis.

Yet we also believe that it is difficult to imagine a better way to operationalize the spread of COVID-19. Indeed, the number of deaths, or excess deaths, seems to be an even worse option. Indeed, the former variable is potentially affected by exactly the same potential issue in the number of reported cases. The latter, instead, although it may seem a better operationalization of the national effects of COVID-19, suffers from other problems. First, data availability concerning the daily number of deaths in 2019 and 2020 is very limited, and in the case of many countries is not available at all. This reduces the effective possibility of using daily excess deaths as a proxy for the spread of COVID-19. While COVID-19 has caused many deaths, it is very hard to compute which deaths occurred due to a lack of compliance with NPIs, and which would have occurred regardless. More precisely, while it seems reasonable to connect the event of COVID-19 contagion to a personal lack of compliance with an NPI that occurred a short time before, it is harder to connect COVID-19 deaths to the moment when the contagion occurred, which may be an event distant in time from death, and hard to connect to the stringency level of measures.

In conclusion, this work underlined a particular spillover effect of corruption in this specific setting. A considerable role is played by trust in politicians and public officials in the spread of COVID-19, suggesting that corruption levels should be taken into account by policymakers when designing an NPI, with a view to containing contagion. Future studies may be devoted to extending these findings to a different geographical region or a wider set of countries, exploiting data from other surveys or analyzing different measurements of corruption.

Credit author statement

Vincenzo Alfano: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. Salvatore Capasso: Conceptualization, Methodology, Project administration, Validation, Supervision, Writing – review & editing. Salvatore Ercolano: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft. Rajeev K. Goel: Conceptualization, Methodology, Project administration, Validation, Supervision, Writing – review & editing.

Appendix 1. Countries included in the analysis

Australia, Belgium, Chile, Croatia, Czech Republic, Denmark, Finland, France, Georgia, Germany, Hungary, Iceland, India, Israel, Japan, Latvia, Lithuania, New Zealand, Norway, Philippines, Republic of Korea, Russian Federation, Slovak Republic, Slovenia, South Africa, Spain, Suriname, Sweden, Switzerland, Taiwan, Thailand, Turkey, United States of America, Venezuela.

Appendix B. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.socscimed.2022.114958>.

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