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ORIGINAL PAPER

Corruption and health outcomes within an economic and cultural framework

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Abstract

The purpose of this paper is to investigate the relationship between corruption and population health. Our cross-sectional sample covers 185 countries (54 high-income and 131 low-income countries) and the period of the analysis is 2005–2017. This research provides clear evidence that the level of corruption significantly affects physical health (expressed as life expectancy and Mortality rate) and mental health (expressed by happiness), under the moderating role of economic development and cultural framework. Moreover, we validate a powerful and positive correlation between the income level and both physical and mental health. Culture also has an important role in the corruption–health nexus, because we find evidence supporting four out of the six dimensions of culture (individualism versus collectivism, indulgence versus restraint, uncertainty avoidance and masculinity vs femininity) as having influence upon the physical and mental health of individuals. When we estimate the results on subsamples of countries (high-income and low-income countries), we validate a crisscross effect of corruption. Thus, a high level of corruption more deeply affects the physical health of population in low-income countries than in high-income countries. On the other hand, mental health is more pronouncedly affected by corruption in high-income countries than in low-income countries. This study may have important implications for national or international policy makers who need to acknowledge that anti-corruption policies play an important role in increasing population health, but they also need to adopt them according to the economic and cultural context of each nation.

Keywords Corruption · Physical health · Mental health · Wealth · Culture

JEL Classification I18 · I31 · H42 · Z10

Introduction

The idea of this paper sprang from [3] who find that "83% of all deaths from building collapse in earthquakes over the past 30 years occurred in countries that are anomalously corrupt". A high level of corruption would mean a low transparency, paying bribes for getting some contracts, jobs or services by violating the law and rules, which may create people's dissatisfaction or even huge damages in society. Important evidences on the destructive role of corruption upon people's lives are revealed by the numerous fires under the illegal operating permits which kill many people. There can be mentioned the recent 2015 Colectiv nightclub fire from Romania which killed 64 people and injured other 147. That huge accident created a large mass movement entitled "corruption kills", against the painful situation of Romania. The Romanian government was perceived as a symbol of corruption and it was forced to resign [17, 35].

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But Romania's case has not been an isolated one. Around the world, there were many similar cases: the 2013 Kiss nightclub fire from Brazil who killed 230 people, the 2003 Station nightclub fire in Rhode Island in the United States that killed 100 people, the 2008 deaths in Wuwang Club fire in Shenzhen, China, the 2004 República Cromañón nightclub fire in Argentina, Buenos Aires that killed 194 people, the 2015 Formosa Fun Coast explosion from Taiwan that killed 14 people and injured 498 and many other painful examples [36].

All these mishaps constitute the starting point of our research and thus, the overall aim of this paper is to empirically explore the relationship between corruption and population health. Actually, during recent years, the corruption phenomenon in the health care sector has gained considerable attention, as it acknowledges the fact that service providers who are acting in accordance with the institutional and environmental settings can undermine a healthcare system's purposes. [41] study whether the Austrian healthcare system is prone to institutional corruption or not and if it is, which will be the channels for corruption development.

Conceptually, a first main element of originality of our research consists in analysing the relation between corruption and health outcomes by viewing health outcomes through their two facets: people's physical but also mental health. Although since 1948, the World Health Organization have kept the same definition of health as "a complete state of physical, mental and social well-being and not merely the absence of disease or infirmity" [50], so far, we have not identified studies that would investigate the influence of corruption on people's health through its both sides (physical and mental health) in the specialized research literature.

The literature contains numerous studies documenting a clear relationship between corruption and the perception upon healthcare (or healthcare satisfaction) and these are revealing negative effects of corruption on healthcare satisfaction [7, 21]. But we have identified very few empirical studies (such as [23, 27, 30, 33]) that validate a clear relationship between corruption and the physical health of people, when the latter is expressed not as a perception but rather as a fact reflected by indicators such as Life expectancy or Mortality rate. Thus, a second aim of our research consists in filling such a gap in the literature by investigating the corruption–health relationship when the physical health of population is expressed as an indicator of objective evidence not as a perception.

Furthermore, within the field of the corruption–happiness nexus, we have found very few research studies [4, 5, 14, 20, 51] in the previous existing literature and these results contradict each other. Thus, a third aim of this paper is to cover this literature gap and to clarify whether the level of corruption in a country reduces or increases the population's happiness. In addition, starting from some intriguing findings on the relation between corruption and health outcomes [4, 6], we are also interested whether this relation may vary or not among high-income and low-income countries. Thus, a fourth aim of our research rises in this respect.

Nevertheless, we are interested in the cultural context of societies that might influence the degree to which individuals are and feel physically and mentally happy.

For our purpose, we use a cross-sectional sample covering 185 countries over the period 2005–2017. We find clear evidence that a higher level of corruption affects health (in both its forms—physical and mental health) and this influence differs among high-income and low-income countries.

Our paper is structured as follows: the next section sets out a literature survey along with the working hypotheses, Sect. 3 describes our data sources, Sect. 4 presents the econometric models, Sect. 5 highlights our empirical findings, which are further discussed in detail. The paper ends with the conclusions including a summary and a brief discussion of policy implications, limitations and the avenues for future research.

Literature review

Holmberg and Rothstein [27] comes with an extremely interesting remark on indicators of population health, considering that they can be interpreted as revealing more about a society than just how healthy its population is. Taking matters further, they support the idea that population health is a measure of how successful different societies are. It is our firm belief that, to a certain extent, a healthy population is the product of a powerful country with well-developed and healthy systems.

Corruption, perceived as a wide-spread phenomenon and an important problem in the health sector, has a major impact on access to and the quality of health services, and these in turn, further affect health outcomes. Gaitonde et al. [18] further emphasize the idea that corruption reduces the effectiveness, efficiency and equity of health services, which in turn has adverse effects on health outcomes and development. Their study reviews interventions to be applied to reduce the incidence of this phenomenon and its adverse effects on health. One of their main conclusions is that the large amount of corruption in the health sector determines wasted resources, worse health care and worse health outcomes [18].

Petkov and Cohen [37] consider healthcare systems to be particularly vulnerable to corruption for several reasons. The study also confirms factors that influence health outcomes not to be limited to changes in health policy and legislation, because there is need to also include trade policies, education systems and nutrition practices, all having a direct or indirect impact on health. The study identifies no more

than 37 distinct types of corruption, ranging from the easiest to identify ones to the chained and more complex types, occurring in various areas of the healthcare sector and leading towards other types of corruption. All these different types of corruption have the negative impact upon health outcomes in common [37].

Regarding the corruption–physical health nexus, there exist various studies investigating the influence of corruption on health when health is expressed as a perception about healthcare under the form of healthcare satisfaction [7, 21, 42]. But there are very few empirical studies that sustain a clear influence of corruption on physical health when the latter is expressed not as a perception, but rather as a fact, such as various population mortality rates and as life expectancy. We can mention here the studies of [23] who found that a one-point decrease in Corruption Perception Index (CPI) is associated with an increase in the log of national under-five mortality rate of 0.0644. Based on these findings, they conclude that more than 140,000 children deaths a year could be indirectly attributed to corruption. In [27], the validated positive relations indicate that the Quality of Government variables (Rule of Law, Corruption Perception Index and Government Effectiveness) are positively associated with higher levels of Life Expectancy and lower levels of Mortality Rates for Children under the age of 5. Similarly, a study conducted among developing countries finds that an improvement in political rights leads to a higher level of health aid [16].

In the light of the arguments mentioned above, the following main hypotheses are stated:

Hypothesis 1 *Increased corruption is associated with lower physical health of population.*

Atanasova et al. [6] reveals that out-of-pocket patient payments are used by patients and healthcare providers "as a means to overcome the poor service quality, to compensate the low remuneration of health care personnel, and to receive proper attention". Intuitively, as a consequence of not using these bribes, the received services and attention from the health personnel may be of a poor quality and thus they create dissatisfaction for the patients. [6] investigates the role of "low remuneration" in the relationship between corruption and healthcare. Thus, at this point, we are wondering whether income may count in the physical health—corruption relationship. Following [6], we would be interested in finding an empirical answer to the following research question:

Research question 1 How do the results of testing hypothesis 1 differ among high-income and low-income countries?

If we turn to the other facet of health, the mental health of population, the literature contains very few research studies in the field of corruption—happiness or life satisfaction nexus and their results contradict each other [4, 5, 11, 20]. One strand of the literature [11, 20] does not validate any relationship between corruption and mental health. However, another strand of the literature [4, 14] documents the viability of this relationship. Thus, [11] investigates a wide range of cross-country determinants of life satisfaction on a sample of more than 70 countries and does not find corruption (along other institutional rules such as press freedom) among the significant determinants of life satisfaction. Some similar results are found by [20] for the Latin American countries, who does not find corruption as a possible determinant of happiness. He argues that "people in Afghanistan, for example, are as happy as Latin Americans and are 20 percent more likely to smile in a day than are Cubans" and the explanation resides in a matter of adaptation.

On the other hand, the study of [4] conducted among world countries over the 1996–2010 time period partially contradicts the findings of [20]. Arvin and Lew [4] empirically validate that corruption reduces happiness, but only for high-income countries. As for low-income countries, happiness is not correlated with corruption. On the other hand, the study conducted over 24 European countries by [14] finds that corruption has a detrimental effect on mental health when mental health is measured by the degree of depressive symptoms. However, the results are not robust in models where the country's wealth is accounted for and no significant differences are found between western and eastern European countries.

One may think that higher levels of corruption conduct to lower levels of happiness in countries, so we state the following hypothesis:

Hypothesis 2 *Increased corruption is associated with lower mental health of population.*

Following [4], we would be interested in finding an empirical answer to the following research question:

Research question 2 How do the results of testing hypothesis 2 differ among high-income and low-income countries?

Data

To measure population health, we refer to physical health and mental health. We express physical health through the Mortality rate, under 5 (per 1000 live births) (Mortality_rate) and Life expectancy (LE), while mental health is expressed as a happiness index (happiness). We consider that the mortality rate in children reflects the physical health state of people best, based on the wide-spread scientific argument of the importance of the first 1000 days in one's life. According to [13], the best opportunity to

build a strong foundation for lifelong health and well being occurs during the first 1000 days, defined as a critical time for one's future development.

The independent variable is corruption which is taken from the Corruption Perceptions Index report (CPI) [45]. This index is used to measure the perceived levels of public sector corruption in 185 countries. The scores range from 0 (highly corrupt) to 100 (corruption free/very clean). In our study, we deal with the rankings of countries, ranging from 1 (lowest level of corruption) to 185 (highest level of corruption). Our paper investigates the influence of corruption on population health. Following some researchers, we have to control for several economic and cultural variables which are used in the literature, namely the level of economic development and the culture of nations. Various researches document a positive relationship between economic development and population health thus the lower the income, the poorer the health and conversely higher incomes are found to be related to better health outcomes [10, 46]. Thus, for Latin America and the Caribbean countries, [10] found that the wealthier are indeed healthier, but how much healthier depends on how increases in wealth are distributed. Moreover, after a large overview of the literature in the field, [43] concluded that "people with lower incomes report poorer health and have a higher risk of disease". For our purpose, the level of economic development is determined using the Gross Domestic Product (GDP) per capita, provided by World Development indicators [48].

Regarding culture, Lancet Commission is considered to be the first ever detailed appraisal of the role of culture in health and it documents that the effect of cultural systems of values on health outcomes is huge, within and across cultures [34]. Moreover, [2] find evidence that culture produces changes in human behaviour, and therefore, Life expectancy could be affected. The authors document that changes in human behaviour over the life span include biological processes (e.g., hormonal production in puberty; biological changes in old age) which are interrelated with socio-cultural factors (e.g., changing social roles and "developmental tasks").

In our paper, culture relies on Hofstede's cultural model [44] comprising the following six dimensions: Power distance (CULT_PD), individualism versus collectivism (CULT_IDV), masculinity versus femininity (CULT_MAS), uncertainty avoidance (CULT_UAI), long-term orientation (CULT_LTO), indulgence and restraint (CULT_IND). The studies conducted by Hofstede are beneficial for understanding the cultural dynamics of nations [28].

A synthesis of the variables and the estimators is presented in Online Appendix 1. The descriptive statistics of these variables are presented in Table 1. Table 2 provides the correlation matrix between these key variables.

Table 1 Summary statistics for the dependent and independent variables

Variable	Full sample				High-income countries				Low-income countries			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Mortality_rate	38.3	39.3	2.10	211.	8.54	15.4	2.10	135.	49.7	39.7	3.50	211.
LE	70.1	8.84	43.6	84.3	78.2	4.55	54.3	84.3	66.7	7.95	43.6	79.8
Happiness	5.44	1.13	2.66	8.02	6.51	0.750	4.67	8.02	4.94	0.901	2.66	7.61
Corruption	86.4	50.5	1.00	182.	33.3	29.9	1.00	172.	109.	39.0	11.0	182.
GDPcap	1.31×10^4	1.88×10^4	150.	1.19×10^5	3.58×10^4	2.10×10^4	5.22×10^3	1.19×10^5	3.62×10^3	3.25×10^3	150.	1.57×10^4
CULT_PD	63.9	20.8	11.0	100.	51.6	22.5	11.0	100.	73.0	13.6	35.0	100.
CULT_IDV	39.5	21.9	6.00	91.0	54.1	22.0	16.0	91.0	28.7	14.3	6.00	80.0
CULT_MAS	47.7	18.7	5.00	100.	46.2	22.5	5.00	100.	48.7	15.1	10.0	88.0
CULT_UAI	64.0	21.4	8.00	100.	66.1	22.9	8.00	100.	62.5	20.1	13.0	99.0
CULT_LTO	41.8	22.8	4.00	100.	52.5	21.8	13.0	100.	32.2	19.0	4.00	87.0
CULT_IND	48.2	22.8	4.00	100.	48.9	19.6	13.0	80.0	47.5	25.5	4.00	100.

Table 2 Correlation coefficients (missing values were skipped) 5% critical value (two-tailed) = 0.0401 for $n = 2391$

	Mortality_rate	Life expectancy	Happiness	Corruption	GDPcap	CULT_PD	CULT_IDV	CULT_MAS	CULT_UAI	CULT_LTO	CULT_IND
Mortality_rate	1	−0.9298	−0.6343	0.6007	−0.4762	0.2677	−0.3745	−0.0245	−0.184	−0.3553	0.1398
Life expectancy	−0.9298	1	0.7275	−0.6568	0.6092	−0.3935	0.4197	0.0437	0.1446	0.3581	−0.0599
Happiness	−0.6343	0.7275	1	−0.6476	0.7171	−0.5017	0.4697	−0.0448	0.0607	0.135	0.4611
Corruption	0.6007	−0.6568	−0.6476	1	−0.6804	0.5799	−0.5883	0.1492	0.0704	−0.34	−0.145
GDPcap	−0.4762	0.6092	0.7171	−0.6804	1	−0.5941	0.628	−0.0333	−0.0965	0.2755	0.2454
CULT_PD	0.2677	−0.3935	−0.5017	0.5799	−0.5941	1	−0.6541	0.1109	0.1536	−0.1206	−0.2456
CULT_IDV	−0.3745	0.4197	0.4697	−0.5883	0.628	−0.6541	1	0.0502	−0.1294	0.2691	0.0923
CULT_MAS	−0.0245	0.0437	−0.0448	0.1492	−0.0333	0.1109	0.0502	1	0.0461	0.0812	−0.0944
CULT_UAI	−0.184	0.1446	0.0607	0.0704	−0.0965	0.1536	−0.1294	0.0461	1	0.1002	−0.1982
CULT_LTO	−0.3553	0.3581	0.135	−0.34	0.2755	−0.1206	0.2691	0.0812	0.1002	1	−0.4637
CULT_IND	0.1398	−0.0599	0.4611	−0.145	0.2454	−0.2456	0.0923	−0.0944	−0.1982	−0.4637	1

Models

The baseline model specification has the following form:

$$\text{Health}_{it} = \beta_0 + \beta_1 \text{corruption}_{it} + \beta_2 \text{economic\_development}_{it} + \beta_3 \text{culture}_i + \varepsilon_{it} \quad (1)$$

Generally, we write x_{it} for the value of variable x for country i at year t. We want to estimate the effect of corruption on health outcomes for country i in year t, alternatively including under-five child mortality rate per 1000 live births, life expectancy at birth and reported happiness over a life ladder.

The current research is further developed to classify the countries by the level of economic development, in high-income and low-income countries. This classification is based on the data provided by [49], where countries are classified as high income, upper middle income, lower middle income and low income countries. We follow the classification made by [48] in low-income countries (the low and middle income economies) and high-income countries (the high income countries), with a detailed list of the two subsamples in Online Appendix 2.

The sample used in the present study consists of 185 countries (54 high-income and 131 low-income countries) and the period of the analysis is 2005–2017. These unbalanced panel structured data for 185 cross-sections over a time period of 13 years have been processed with the Pooled OLS method at first, for the full sample, and the subsamples of high-income and low-income countries, respectively. We apply a sequential search method, the backward elimination approach, for finding the best regression estimates. Furthermore, we analyse the panel data with the help of a fixed effects model (FEM) and a random effects model (REM) to decide for the best estimation technique. The optimal models have been summarized and their implications have been analysed.

Results

First, to demonstrate the association between corruption and health, we plot them against each other for the whole sample (Fig. 1). Figure 1 suggests a positive correlation with Mortality rate under the age of 5 (Mortality_rate). There is a negative correlation between corruption and Life expectancy (LE) and Happiness (Happiness), respectively. It may be observed that higher levels of corruption correlate with lower levels of health proxies where health outcomes are expressed as Mortality rate under 5, Life expectancy and Happiness. The visual correlations are supported by the Pearson correlations (see Table 2) showing the pairwise Pearson correlations between the

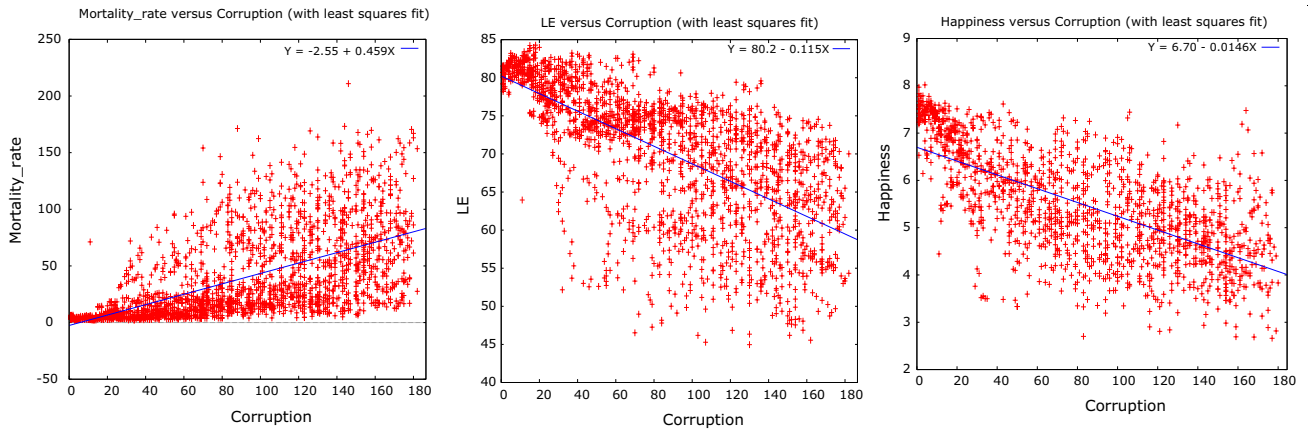

Fig. 1 Plot of corruption against health variables

variables. The data reveal values of correlation coefficients between health and corruption higher than 0.6, thus reflecting a strong relationship between these variables. Indirect and high correlations are found between Corruption and the health variables namely Life expectancy and Happiness ($r = -0.6568$ and -0.6476). In addition, Mortality rate under 5 (Mortality_rate) is directly correlated with corruption ($r = 0.6007$).

Tables 3 and 4 present the main econometric results for the health variables using corruption and additional control variables. Basically, our estimations reveal the dependency relationship between the health proxies and certain independent variables, through the least squares method for panel data (Pooled OLS) (Table 3) and consequently, the fixed effects model (FEM) and the random effects model (REM) (Table 4).

Table 3 Multiple regression analysis of health and corruption

Variables	Model 1			Model 2			Model 3		
	Mortality rate under 5			Life expectancy			Happiness		
	Full range	High-income	Low-income	Full range	High-income	Low-income	Full range	High-income	Low-income
Constant	12.8172	−2.8498	6.7316	72.8325***	76.9549***	75.9451***	5.3589***	5.04773***	4.46083***
Corruption	0.2915***	0.10507**	0.24471**	−0.0692***	−0.0884***	−0.03551*	−0.0111***	−0.00567*	
GDPcap	−0.0004**	−0.00007**	−0.0064***	0.00014***	0.00004**	0.00135***			0.00012***
CULT_PD									
CULT_IDV			0.57892***			−0.15023***	0.01013***	0.00972***	−0.0129***
CULT_MAS				0.03977*	0.0248**				
CULT_UAI	−0.2666**			0.05768**	0.0292*				
CULT_LTO									
CULT_IND	0.3283**	0.16141**	0.46189**	−0.06502**		−0.11241***	0.0158***	0.02271***	0.0103***
Adjusted R^2	0.43181	0.52605	0.50894	0.57106	0.58667	0.48127	0.60098	0.71677	0.45621
P value (*F*)	0.000	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F	10.916	3.801	21.781	19.309	24.281	11.641	69.789	48.219	22.382
N cross-sectional units	77	38	39	78	42	39	77	39	38
Observations	986	494	492	922	504	454	813	413	404

The dependent variable is health expressed through Mortality rate under 5, Life expectancy and Happiness. Pooled OLS. Main results I. The default robust estimator is that suggested by Arellano, handling both heteroskedasticity and autocorrelation (the HAC approach)

*,**,***Statistically significant at 10%, 5% and 1% levels

Table 4 Panel data analysis of health and corruption

Variables	Model 1			Model 2			Model 3		
	Mortality rate under 5			Life expectancy			Happiness		
Sample Optimal model	Full FEM	High-income FEM	Low-income FEM	Full FEM	High-income FEM	Low-income FEM	Full FEM	High-income REM	Low-income FEM
Constant	40.9671***	10.4584***	56.9518***	69.1334***	76.0586***	65.366***	5.6629***	4.595***	4.8131***
Corruption	− 0.00779	− 0.0226	0.0056	− 0.00033	0.0141	− 0.0045	− 0.0024*		
GDPcap	− 0.00023***	− 0.00005***	− 0.00226***	0.00009***	0.00005***	0.00054***		0.000009***	0.00004**
CULT_PD									
CULT_IDV								0.0096***	
CULT_MAS									
CULT_UAI									
CULT_LTO									
CULT_IND								0.0216***	
	LSDV R^2			LSDV R^2			LSDV R^2	"Between" variance	LSDV R^2
	0.9457	0.9833	0.9281	0.9721	0.9671	0.9585	0.9024	0.0938	0.8284
	Within R^2			Within R^2			Within R^2	"Within" variance	Within R^2
	0.0067	0.0236	0.0537	0.0036	0.1212	0.113	0.0049	0.0723	0.0099
N cross-sectional units	179	50	129	182	53	129	160	39	111
Obs	2145	633	1512	1996	608	1388	1512	413	1040

The dependent variable is health expressed by Life expectancy, Mortality rate under 5 and Happiness. FE/RE estimator. Main results II. Robust (HAC) standard errors (Arellano)

*,**,***Statistically significant at 10%, 5% and 1% levels

The key results from Table 3 are that, controlling for various cultural and economic factors, the coefficients for corruption upon mortality are positive, indicating that corruption increases the mortality rate (direct relationship—model 1). Then, the coefficients are negative in the life expectancy and happiness specifications, indicating that corruption levels have a negative impact upon physical and mental health (indirect relationship, models 2 and 3).

We may note that the higher influences of corruption and controlling variables are exercised on mental health rather than on psychical health. Thus, when we analyse the results for the whole sample, the variation of happiness is 60.098% due to corruption, economic development and culture (MODEL 3) compared to smaller variations of 57.106% (Table 3, model 2) and 43.181% (Table 3, model 1) of Life expectancy and Mortality rate under 5, respectively, due to the same explanatory variables.

Furthermore, the unbalanced panel data are estimated through a fixed effects model and a random effects model (Table 4). The coefficients of various cultural dimensions are omitted in the fixed effects specification due to the inexistent variations within the same country over the rather short analysed time period. According to research studies in the field of culture [9], cultural differences between country pairs are generally stable and the scores on the Hofstede dimensions relative to the scores of other countries have not changed very much in time. The Pooled OLS model may be inappropriate, while the fixed effects model (FEM) or the random effects model (REM) estimation techniques can provide better results. The *F* test, the Breusch-Pagan test and the Hausman test are applied and the estimations of the resulting optimum techniques are presented in Table 4. Least Squares Dummy Variables (LSDV) is equivalent fixed effects estimation that explicitly includes the range of dummy variables for countries and years. It gets an R^2 generally above 0.9. We apply the backwards elimination estimation technique. Corruption stays significant in model 3, with a negative influence on happiness, for the full sample of countries. Thus, the decrease in corruption levels should have a positive impact on perceived life happiness.

Discussions

First, the multiple regression analysis of health and corruption (Table 3) offers clear evidence of their relationship. Our results are in line with the studies of [23, 27, 30] who also find that a lower degree of corruption is associated with better health outcomes as measured by various mortality rates and life expectancies. In addition, the control of corruption has a substantial effect on happiness which is also in line with the literature [14, 24, 39, 51].

Regarding the economic development as one of the control variables, the coefficients are positive and statistically significant. Therefore, an increase in per capita GDP reduces mortality (Table 3, model 1 Mortality rate under 5, negative relationship) and increases life expectancy (Table 3, model 2 Life expectancy, positive relationship). The results are in line with the literature [19, 23, 30] which documents that a higher income leads to an improved access to housing, education, health services and other items which tend to improve health, lower mortality rates and increase life expectancy.

Also, we remark there is an important role of culture (as control variable) upon population health but various dimensions of culture are at play for different indicators of population health. Thus, we may note that Happiness is mostly influenced by two main dimensions of culture: Individualism versus collectivism (CULT_IDV) and Indulgence versus restraint (CULT_IND). Thus, our finding conducted for the full sample supports the idea that people in countries with an individualistic culture (a higher level of the CULT_IDV score) have higher levels of happiness than those with collectivistic countries. In addition, high indulgent societies (a high level of CULT_IND) increase the level of happiness for all samples. This result is expected because indulgence versus restraint is the "perception of life control and importance of leisure in the respondent's life" according to [25, 26]. Thus, a restraint society which manifests a very low propensity to enjoy life and spending time with friends and loved ones in exchange for a stressful life spent only for work purposes, generates dissatisfaction for people's own lives. [31] finds that there are greater percentages of happy people in indulgent societies relative to restraint societies. On the other hand, indulgent societies are formed by people that enjoy life and are happy, and thus a positive relation is expected between these variables. Similar positive and significant influences of CULT_IDV and CULT_IND on the level of happiness are found by [32] which conclude that individualistic and indulgent societies are more happy than collectivistic and restraint ones.

However, when we analyse the influence of cultural dimensions upon the physical health, our results are opposed. Thus, we may also observe a high, but negative significant influence of Indulgence versus restraint (CULT_IND) on the psychical health. A high level of indulgence increases the level of Mortality rate under 5 and reduces the level of Life expectancy. This is explained by the fact that a more indulgent society has an increased affinity for entertainment, thus promoting untidiness and being exposed to higher health-threatening risks (taking up entertaining games that increase adrenaline levels but also expose people to several dangers, such as racing games, bungee jumping, skydiving and others). On the other hand, a restraint society

is characterized by the fact that "maintaining order in the nation is considered a high priority" according to [26, 31] that leads towards a decreased exposure to health risks, furthermore, resulting in better health outcomes.

Moreover, we find evidence that a higher level of uncertainty avoidance (a higher level of CULT_UAI) increases the level of physical health (it decreases the level of Mortality rate under 5—Table 3, model 1 and it increases the level of Life expectancy—Table 3, model 2). According to [44], uncertainty avoidance (CULT_UAI) is considered a dimension of people's culture that can be defined as "the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity". Thus, a high level of uncertainty avoidance reflects a high tendency to avoid the risks coming from ambiguous or unknown situations, thus reducing the extent of engaging in risky activities (dangerous hobbies) which determines better health outcomes. (Table 3, models 1 and 2).

Regarding masculinity, we have some evidence that it has a positive influence on physical health, increasing the Life expectancy (Table 3, model 2). The Masculinity versus femininity dimension of culture (CULT_MAS) refers to the concern of a society for achievement, heroism, assertiveness and material rewards for success (masculinity) or for cooperation, modesty, caring for the weak, and quality of life (femininity) [44]. Our results confirm the fact that masculine societies do live longer than feminine societies (this does not refer to a male versus female gender peculiarity, but it rather refers to the masculine or feminine character of individuals). (Table 3, model 2 and also the positive correlation coefficient between CULT_MAS and Life expectancy from Table 2).

When we analyse the results on the two subgroups of countries (high income and low income countries) our main results from Table 3 reflect that corruption reduces the physical health of people both in high-income and low-income countries. Thus, for both subsamples, a higher level of corruption increases the Mortality rate under 5 and reduces the Life expectancy. In addition, we may note that the level of corruption has a higher influence upon physical health in low-income countries compared to high-income countries (see Table 3, model 1). More specifically, a 1-point increase in the level of corruption conducts to a higher increase of the Mortality rate under 5 for the people who live in low-income countries (0.24471) compared to those who live in high-income countries (0.10507). Thus, we may sum up that corruption seems to affect physical health outcomes more in low-income countries than it does in high-income ones and this is in line with the results of [33]. As for the results of the Life expectancy estimation on the two subsamples (Table 3, model 2), a one-unit increase in the level of corruption conducts towards an average decrease of Life expectancy with almost 13 days in low-income countries and 32 days in high-income countries, everything else unchanged.

For mental health, our estimations prove that corruption diminishes the happiness of population in high-income countries. A 1-unit increase in the corruption level of high-income countries leads towards a 0.00567-point decrease in their declared happiness levels. In the same time, corruption does not seem to have a significant effect upon the happiness of people from low-income countries. [4] also validated the influence of corruption upon happiness for high-income countries only.

Furthermore, by correlating the resulting influences of corruption upon the physical and mental health of population for the two categories of analysed countries, we notice a crisscross effect of corruption. Basically, corruption reduces physical health to a higher extent in high-income countries than in low-income ones. When it turns to mental health, the influence of corruption is more pronounced in high-income countries than in low-income ones. The explanation of this crisscross effect needs to be investigated among the happiness studies of [4, 15, 20, 29]. First, for low-income countries, wealth is very important to fulfil the basic needs of people such as medical treatments. Once basic needs are fulfilled, other factors such as rising aspirations, relative income differences, and the security of gains become increasingly important, in addition to income [20, 29]. Second, in low-income countries, corruption may not correlate with happiness, because corruption itself may be merely one of the many depravities poor people face and, as a consequence, it alone has a discernible impact on happiness. If income levels increase, corruption "will begin to sting, and people will increasingly become concerned". Beyond a certain income threshold, corruption negatively interferes with the happiness levels of people [4].

Moreover, the per capita GDP has a positive influence upon physical health outcomes for the two subsamples. We notice that a one-unit increase of GDP per capita leads towards a higher improvement of health outcomes in low-income countries compared to high-income countries. Our results are in line with the studies of [38, 40] which document an existing so-called Preston curve regarding the relationship between per capita GDP and life expectancy meaning that individuals born in richer countries, on average, can expect to live longer than those born in poorer countries; however, this relationship tends to be weak after reaching a certain level. We do find such a positive and significant influence for low-income countries only (the estimated coefficient of Happiness is 0.00012 and it is significant at a 1% threshold—Table 3, model 3). In high-income countries, the income levels already are sufficiently high so that their supplementary increase no longer influences the happiness levels of individuals in these countries. On the other hand, in low-income countries, any increase in people's income

produces a higher marginal utility, sustaining our results. The fundament of these results is Maslow's "theory of needs". The more people's needs are met, the happier people are. Basic needs such as material needs can be easily met, but the effects of satisfying these needs on happiness are limited, with diminishing marginal utility [32]. Similar existing results of the specialized literature even establish income thresholds up to which happiness levels are sensitive, and above which happiness levels tend to maintain themselves constant (e.g., [29] for the American population and [32] for the European population establish such a maximum income threshold of 75,000 USD/year and 35,000 USD/year, respectively, beyond which there is no progress in the level of happiness).

For the influence of cultural dimensions upon health outcomes, our results reflect a differentiated influence on the two subsamples of countries. First, the influence of CULT_IDV appears to be more prominent and with a different sign for low-income countries than for high-income countries. Therefore, we may notice that in low-income countries, a higher individualism has negative effects upon physical health (it reduces Life expectancy with 0.15023 years and it increases the level of Mortality rate with 0.57892) and mental health as well (it reduces the level of Happiness with 0.0129 points). In other words, an increase in the collectivism of these countries leads towards a consolidation of physical health (by reducing Mortality rate and increasing Life expectancy) and that of mental health (the Happiness level increases).

People from low-income countries are significantly more collectivistic than people from high-income countries. According to [25], collectivist societies are the cultures "in which people from birth onwards are integrated into strong, cohesive in-groups" that continue protecting them in exchange for unquestioning loyalty. Thus, a more collectivistic culture increases the relationship between its members that determines a greater care towards one another, further having positive health outcomes. So, collectivism exists in poorer countries, because it is highly functional in that environment and it can be seen as a "survival mechanism" for these countries, according to [47].

An opposed but expected effect of individualism upon happiness is found in high-income countries (Table 3, model 3). For these countries, we notice that an increased individualism determines an increase in people's happiness. Similar results are obtained by [47] who find that among poor countries, individualism is negatively associated with happiness but for the rich countries, individualism is positively associated with happiness. This situation is explainable by the fact that in high-income countries, the average value of Cult_IDV is much higher (54.1 points) than for low-income countries (28.7 points—Table 1). Thus, for high-income countries, increasing the individualism fosters the happiness of people. This result is similar with those of [43] who explain this by the fact that psychological attributes characterizing the self (e.g., self-esteem, self-consistency) are more relevant to the happiness of Western individualists than to the happiness of collectivists. In a more detailed manner, [1] explains the same outcome by referring to some existing differentiated goals (the so-called "intrinsic"/"extrinsic" goals) for the two categories of countries. [1] underlines the fact that as societies put relatively less emphasis on extrinsic goals such as financial gain, and relatively more emphasis on intrinsic goals such as having rich social relationships or making contributions to the community, their people tend to register higher levels of happiness. In high-income countries, individuals already have a high level of financial satisfaction so they may further aspire to higher goals, thus reaching a higher level of happiness. Our results are also in line with the findings of [12] who documents that increasing national wealth and the rise of individualism are strongly related in a syndrome of modernization, so it is difficult to separate their influences.

Another cultural dimension whose influence differs significantly on the two categories of countries is CULT_IND. Thus, an increase of the indulgence level has a more pronounced effect upon reducing physical health outcomes in the low-income countries compared to the high-income ones (Table 3, models 1 and 2). A more indulgent society exacerbates its desire for entertainment, thus being more untidy and more exposed to risks that could threaten its health status. However, a higher importance given to leisure activities which characterizes indulgent societies has a higher positive impact for the happiness of the people from high-income countries than in low-income countries (Table 3, model 3).

When the influence of corruption upon health is analysed using the fixed effects model (Table 4), we do not find any significant relationship when health is expressed as Morality rate under 5 and Life expectancy. However, a negative influence of corruption remains significant in model 3, on Happiness, for the full sample of countries.

These results are similar to [30], whose corruption variable does not remain significant when regressed against three mortality rates and life expectancy at birth, in a fixed effects multiple model. The coefficients of the economic control variable are consistent with our expectations. An increase in per capita GDP reduces mortality and increases life expectancy, with a positive impact on happiness. The estimated specification is optimal on the random effects modelling technique only for Happiness as a dependent variable (Table 4, model 3), for the high-income subsample of countries. Happiness is most influenced by two main dimensions of culture, such as Individualism versus collectivism (CULT_IDV) and Indulgence versus restraint (CULT_IND). We find that increased individualism and indulgence have a positive impact upon the mental health

of people in developed countries. The results are similar with those obtained in Table 3, Model 3.

Robustness checks

To further strengthen our results, we conduct several robustness checks. First, we use an alternative measure of population health, namely Mortality rate under 1 (at 1000 live births) which is provided by World Development indicators [48]. The baseline model specification is used to check the stability of the estimations for this new independent variable. The synthesized results are presented in Table 5 (see in Online Appendix 3).

The coefficients for corruption rankings remain significantly positive, pointing out that corruption increases infant mortality rates. These results are in line with our previous main results. Regarding culture, we obtain evidence that some components of culture significantly influence the level of this mortality rate: a higher collectivism increases the level of physical health under the form of reducing the level of Mortality rate under 1, but only for the low-income countries (Table 5 in Online Appendix 1, Pooled OLS); a high level of uncertainty avoidance reduces the exposure to healthy risks and thus the level of mortality rate decreases; people with a high level of restraint (low level of indulgence) tend to define a discipline for each behaviour and try to keep themselves generally disinterested in the opposite [8], being less exposed to the risk that threatens their health and thus the mortality rate decreases. Nonetheless, the fixed effects estimators are supported, matching previous results in the literature [30].

Empirical approaches to model validation include additional or split samples [22]. A separate model is estimated with a new subsample and then compared with the original equation on characteristics such as the significant variables included, sign, size and relative importance of variables; and predictive accuracy. The validity of our original model is checked by comparing it to regression models estimated with the new sample. The two subsamples we work with are a randomly drawn subsample (Table 6 in Online Appendix) and a subsample that dropped all the observations with missing values (Table 7 in Online Appendix 3). The robustness checks presented in Tables 6 and 7 come to support our basic results confirming the role of corruption on the health outcomes of nations. By comparing the results obtained by modelling, the two subsamples with our basic results, we mainly confirm the same significant variables are still included (Corruption, GDP per capita and cultural dimensions as control variables), their sign is always the expected one (the one we obtained on the Pooled OLS model using the full sample, mainly a positive relationship between corruption and mortality rates and a negative relationship between corruption on the one hand and life expectancy and happiness on the other hand), their size and relative importance of variables are extremely similar (their magnitude and significance is kept). Nevertheless, the predictive accuracy of the models estimated on the two subsamples is approximatively the same with the one of the main results. Basically, the predictive accuracy of these two new samples ranges between 41.77% (Table 7 Mortality_rate_under_5) and 68.43% (Table 7 happiness). The variation of the level of happiness due to the level of corruption and control variables in our two robustness checks (presented in Tables 6 and 7) is even higher (Table 6 in Online Appendix, adjusted $R^2 = 67.76\%$ and Table 7 in Online Appendix adjusted $R^2 = 68.43\%$) than in the case of our main results (Table 3, adjusted $R^2 = 60.098\%$).

Conclusions

The aim of this paper is to explore the relationship between corruption and population health. Using a cross-sectional sample covering 185 countries over the 2005–2017 time period, our research provides empirical evidence on the existence of a significant impact of corruption upon population health outcomes. Thus, we obtain clear evidence that the level of corruption significantly affects physical health (expressed as Mortality rate and Life expectancy) and mental health (expressed as Happiness), under the moderating role of economic development and cultural framework. In the same time, we establish that the income level is strongly and positively correlated with physical and mental health. Nevertheless, culture plays an important role in the corruption—health nexus. The most representative cultural dimensions that influence the mental and physical health of individuals are Individualism versus collectivism, indulgence versus restraint, uncertainty avoidance and masculinity. When analysing the estimations on subcategories of countries (low-income versus high-income countries), we depict a crisscross effect of corruption upon health. Thus, a high level of corruption affects in a more pronounced manner the physical health of population (expressed as mortality rates) in low-income countries than in high-income countries. On the other hand, mental health is more strongly affected by corruption in high-income countries than in low-income countries. Moreover, cultural dimensions exert a differentiated influence upon population health (both physical and mental). Individualism does enhance the physical and mental health of individuals in high-income countries, while a reverse effect is obtained in low-income countries where collectivism improves the health state of individuals.

Our research may have important implications for national or international policy makers who must know that anti-corruption policies play an important role for improving

population health. The development of a package of effective anti-corruption policies would determine positive health outcomes for the population of those countries, regardless of their economic status. Basically, the quality of government matters for an increased population health among high-income as well as among low-income countries. Our results prove that reduced corruption phenomena determine better life expectancies, lower mortality rates and more happiness for nations. Moreover, a strong economic strategy, that would increase the per capita GDP of nations, should come with positive effects on the physical and mental health of people. Higher income provides people with the resources to invest in their health and well-being state. Furthermore, our findings document that some dimensions of culture play an important role in the corruption–health relationship. Thus, policy makers need to acknowledge these to adopt the best policies according to the cultural context of each nation. Our findings prove that increased happiness levels are attained by high individualistic and indulgent rich societies, while for low-income nations, an increased indulgent cultural character confers happiness as well. From the point of view of their masculinity versus femininity cultural trait, a more masculine character of rich nations ensures happiness, as opposed to a more feminine character for poorer nations. For the physical health outcomes to attain a better life expectancy and lower under 5 and under 1 mortality rates, a high-income country could work on the premises of increasing masculinity, uncertainty avoidance and indulgence. For low-income countries, it seems that a more collectivistic and restraint cultural character is correlated with an improved life expectancy. These results are extremely important for individuals and nations, as cultural traits are adapting and evolving. Nonetheless, our results are in line with the existing literature and they even validate original elements such as investigating both mental and physical health as dependent variables within the same research paper and weighting the precise impact of corruption upon population health, separately for high-income and low-income countries.

Some limitations of our research include the use of a rather low number of variables that measure the physical and mental health of individuals. To substantiate our findings, for our future studies, we intend to use additional alternative variables for estimating population health (immunization rates, neonatal mortality rate, self-perceived health status), and some supplementary explanatory variables of theirs (healthcare expenditures, urban population rate, education). Another distinct path we would like to follow would be to evaluate the impact held by the level of public/private spending on healthcare upon health outcomes of nations, and to determine the role played by the quality of governance, including the level of corruption, within that relationship. Financing problems have always affected healthcare systems, especially in low-income countries, and the mechanisms which are at play can be blamed, to a certain extent, for the lower life expectancies and higher mortalities. The efficiency of using the rather limited resources of any healthcare system is another aspect we would like to follow-up.

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