

Association of Covid-19 and Macroeconomic Growth: Lessons Learned in Managing with Future Pandemics and Preventing Economic System Degeneration

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ARTICLE INFO			ABSTRACT
Article History:			<i>What impact would the COVID-19 lockdown have on the number of infections and fatalities in 2019 as well as the GDP growth rate of each country? During the first wave of the COVID-19 pandemic, the number of confirmed cases in countries with short lockdown periods (about 15 days: Austria, Portugal, and Sweden) was divided by the average population. Moreover, nations with shorter lockdown times had lower average mortality rates (5.45% of independent sample tests have substantially shorter lockdown rates (5.4% vs. 12.7%), p-value of 0.05). According to the Mann-Whitney test, shorter lockdown durations were associated with reduced average death rates ($U = 0$, p-value = 0.005). According to the research, long-term lockdowns also had a detrimental effect on GDP growth. The loss in GDP (2010 index = 100) of nations with a long lockdown period (2010 index = 100) was in the order of 21% between the second quarter of 2019 and 2022 ($t_4 = 2.274$, p-value 0.085, significant change from test sample). This data demonstrated how AR control attempts need extended periods of social isolation, resulting in a systematic deterioration of the economic system. Another significant discovery was that nations with high healthcare spending (as a percentage of GDP), had lower COVID-19 mortality rates and shorter lockdown periods, lessening the negative effects of the economic slowdown. What does this imply? As a result of the lessons learned during the first wave of the COVID-19 pandemic, this study recommends that the health sector must be strengthened in order to create methods to mitigate the negative consequences of a future COVID-19-like epidemic. When novel viral viruses emerge, new and effective health institutions may respond with low fatality. Finally, substantial healthcare spending has established the social circumstances for a short-term lockdown with low mortality.</i>
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Introduction

COVID-19 is an acute viral disease caused by SARS-CoV-2, a new coronavirus strain, and SARS coronavirus-2. COVID-19 has been designated a pandemic by the World Health Organization (WHO) as of 11th March, 2020. COVID-19 is primarily a respiratory infection that can spread to other organs and causes a variety of symptoms ranging from mild respiratory issues to severe pneumonia and other complications (Ardito et al., 2021). In this context, the primary objective of this research was to ascertain the effect of the duration of COVID-19 pandemic lockdown on infection rates, death, and gross domestic product (GDP) growth in a nation. The first wave of the COVID-19 pandemic (March–August 2020) was investigated in six European nations that implemented varying-length lockdowns. The purpose of this study was to assess the social impact to create effective social solutions capable of containing future outbreaks of COVID-19-like illnesses both domestically and internationally while minimizing social damage.

With the epidemic rising, several countries imposed lockdown, which comes at a high cost in terms of economic and social effects, including widespread unemployment. A nation needs to wisely select how to safely release the lockdown when it has successfully decreased the number COVID-19 cases to the intended level. The biggest source of concern is the risk of a recurrence of the pandemic. We have carefully presented a plan to relieve the lockdown and preserve economic activity to avoid the pandemic from reoccurring (if reduced). This strategy can be utilized once containment has reduced the number of severe cases per day to levels that the healthcare system can handle. In the following text, "containment" refers to the population-level isolation of the residence, as well as all other potential precautions (e.g., testing and social distancing).

On these themes, what is already known is based on several studies. According to (Atalan, 2020a), containment measures were designed to prevent as many infectious disease transmissions as feasible. Governments can, for example, limit or prevent transmission chains (Coccia, 2020a). The study's primary focus is on the ground information to understand and clarify it. According to (Liu et al., 2021), containment measure are "a temporary condition imposed by the government." Government agencies require citizens to stay at home and avoid or limit outdoor activities that require interaction (such as eating out and attending large gatherings). This lockdown measure varies in duration during the outbreak and is subjected to several restrictions, including closing schools and workplaces, canceling private/public events, closing attractions, prohibiting mass gatherings in private and public places, forcing people to stay home, limiting international travel and internal mobility, maintaining social distance, and so on (Mahato et al., 2020; Tunio et al., 2021). Countries can initiate a public policy of lockdown when the number of daily confirmed cases hits a critical threshold, and they can cease it when the number of Intensive Care Unit (ICU) admissions drops rapidly (Tobías, 2020). Moreover, (Nicoll and Coulombier, 2009) claimed that lockdown had a negative impact. It restricted social contact and allowed enterprises that are important to the country's supply lines to operate. According to (Atalan, 2020a), the COVID-19 cases appeared to have been slowed down by the lockdowns. To restrict the COVID-19 from spreading, (Thomas Hale et al., 2020) proposed that a lockdown policy be imposed and developed soon as a step towards social distancing and limiting the pandemic's impact. According to (Thomas Hale et al., 2020), the propagation of COVID-19 causes consequence waves of diminishing amplitude, which continue even if the lockdown is released gradually. Lockdown has a variety of repercussions on several aspects of society, including mortality and illness rates, ICU admissions, air pollution levels, country's GDP growth, and so on. (Nicoll and Coulombier, 2009); (Atalan, 2020a); (T Hale et al., 2020); (Flaxman et al., 2020); (Tobías, 2020); (Coccia, 2021a). On the other hand, according to (Verma et al., 2020), earlier implementation of lockdown can decrease the cases of COVID-19.

According to (Balmford et al., 2020), countries that enforced lockdown immediately at the outbreak of COVID-19 had fewer deaths than countries that delayed implementing this rigorous containment method. A study of 50 nations with many actual cases of COVID-19 was conducted by (Tarrataca et al., 2021). In this study, the authors found that 40 countries imposed a complete lockdown, five imposed a partial lockdown, and five imposed only curfew only, each with its own set of consequences. Furthermore, according to this research, the low country's sensitivity to reduce biological threats was associated with a better chance of patient recovery (Chakraborty and Maity, 2020). According to (Coccia, 2020b), limiting people's movement and human interactions can diminish COVID-19 transmission dynamics by roughly 45%. As a substitute, (Toba et al., 2021) showed that after the slopes of deaths, the daily confirmed cases and ICU admissions reduced after the initial lockdown in Italy and Spain. However, when the underlying dynamics of the COVID-19 were held steady, it increased in number. Consequently, the second lockdown, based on stricter mobility restrictions, was implemented and appeared to have slowed the underlying growth pattern. (Glass, 2020) examined the four central European states and found that the data revealed that the relaxations had an impact in terms of raising the number of cases, with dates ranging from early June to mid of July in some countries. According to the poll, European nations are feeling relief in the range of 31% to 57%, and if the current trend continues, a second wave that lasts longer than the first wave might emerge. According to the model, reduced inadvertent person-to-person contact might help reduce and attenuate the COVID-19 pandemic's peak phase (Coccia, 2021b).

According to several studies, certain settings such as discos, restaurants, stadiums, stadiums, and bars might enhance the probability of COVID-19 infection (Aruga et al., 2020; Chang et al., 2021; Klemeš et al., 2020; Lindsey et al., 2020; Mahato et al., 2020; Yao et al., 2020; Zidouemba et al., 2020), resulting in a large number of infections (Coccia, 2021c). Furthermore, obligatory confinement will be regulated by three elements (Coccia, 2021d): the number of proven COVID-19 cases, the economic cost, and the impact of isolation on the population's well-being. In the final phase of a health crisis, this is required. A prolonged but lesser severe time of social isolation, according to (N. Islam et al., 2020), "is extremely likely to alleviate the economic effects and alienation of the crisis." Finally, there is the European continent (Sabat et al., 2020). According to the report, "the numbers revealed that remission has led to a spike in the number of cases," with data ranging from early June to mid-July in several nations.

Methods and Materials

The primary purpose of this research was to investigate the impact of COVID-19 pandemic's total lockdown duration on population health and socio-economic system dynamics. The research was based on a comprehensive examination of six European countries with similar institutional, socio-foundations, and geographic locations. The countries under investigation were France, Austria, Italy, Spain, Portugal, and Sweden. These six European countries, in particular, served as homogeneous research units for a case study looking at the societal effects of various lockdowns duration with response to the COVID-19 pandemic. These six-country case studies can be viewed as a foundation for prospective generalization of findings to explain the impacts of different lockdowns duration to build better public policies to meet future infectious disease health and socio-economic risks (M. S. Islam et al., 2020).

The study was a detailed examination of six European countries (France, Austria, Portugal, Italy, Sweden, and Spain) with similar socio-economic backgrounds as defined by the European Union, as previously stated. The investigation occurred from March 2020 to August 2020, coinciding with the first wave of the COVID-19 pandemic. The following are some examples that help sustain a

country's long-term economic growth. The number of people infected with COVID-19 was calculated by dividing the confirmed cases by the population of the country under study. Total health care spending measures the amount of money spent on health-related functions. The term "health care expense" refers to the cost of products and services used by resident units.

Sampling Technique and data analyzing

The six countries under investigation were divided into two groups: those under lockdown for a shorter time and those under lockdown for a longer time. The following countries have brief lockdown periods (the entire lockdown length is about 15 days): (1) From 16th March to 13th April, 2020, I spent 29 days in Austria; (2) From 19th March through 2nd April, 2020, I was in Portugal for 15 days; and in Sweden, there were no limits. The following countries have been placed on long-term lockdown (for a total of 61 days or nearly two months): (1) France had 56 days from 17th March to 11th May, 2020; (2) 71 days were spent in Italy (From 9th March to 18th May, 2020); and (3) From 14th March to 9th May, 2020, I was in Spain for 57 days. To compute the national economy, we utilized the arithmetic mean and standard deviation (standardized population) of confirmed cases, the death rate (i.e., the average for each country from April to August 2020), and the quarterly GDP index. Additionally, the longest and shortest lockdown durations were also compared and contrasted. In addition, from 15th April 2020 to 30th August 2020, we utilized the normalized mean change in the population and the mean change in mortality for confirmed cases to estimate the impact of alternative containment periods on the number of infections and fatalities. The first wave of COVID-19 pandemic in Europe occurred between 15th April, 2020 and 30th August, 2020. The arithmetic mean of these variables for each nation is used as a cut-off point to capture the impact of lockdown periods in various countries depending on each country's health care investment. Descriptive statistics were used to establish which countries were high and which were low.

The arithmetic mean difference between nations with long and short lockdown times was then determined using an independent sample t-test (groups 1 and 2). The averages of these two separate groups were analyzed to discover whether statistical evidence shows that the means of linked populations differ significantly. In independent samples, the null hypothesis (H_0) and alternative hypothesis (H_1) of the null t-test were: $1 = 2$ signifies that both groups have the same mean in nations / areas with short or extended lockdown periods. In nations with short or extended lockdown durations, H_1 is not the same. For small samples, the Mann-Whitney test was performed. The U-test was used to see if the dependent and independent variables vary. The U-test examines if the two groups of individuals have the same distribution of the dependent variable (i.e., the population or confirmed cases adjusted for mortality) and hence belong to the same population. Finally, the report shows how the number of contaminations and deaths in the countries changed between August 2020 and August 2020. The nations that were prohibited and those that were banned for less than 15 days were assaulted for a total of 61 days.

In this article, we used a basic link-based linear regression model to examine these models. (1), where x is the average number of illnesses or fatalities, and t denotes the months of April to August 2020. Misspelled words are represented by the letter u . Using the general least squares (OLS) approach, estimate the parameters of the linear model equation (1). The statistical analysis was performed using SPSS® 26 statistical software.

Data Sources

A case study conducted by Washtenaw County in Michigan (USA) (Tobías, 2020) employed a discrete and stochastic network model; the results suggest that delaying the reopening does not lessen, but rather delays, the total effect of the second peak of confirmed cases. The study included data on confirmed cases, death rates, and GDP levels in countries that implemented full lockdowns for various periods from 15th April, 2020 to 30th August, 2020, which was at the first wave of the COVID-19 pandemic. These data can be used to examine the impact of various lockdowns lengths, to deal with the COVID-19 pandemic, in society (Chick et al., 2020; Elgin et al., 2020; Estrada et al., 2020; Howarth et al., 2020; Khan et al., 2020; Klemeš et al., 2020; Leung et al., 2020; Mahato et al., 2020; Sachs et al., 2021; Yao et al., 2020; Yarovaya et al., 2021). The Johns Hopkins University and the Johns Hopkins Center for System Science (Glass, 2020) provided data on COVID-19 deaths and infected people, (Renardy et al., 2020) provided economic data, (Chang et al., 2021) provided health care expenses, and (Karnon, 2020) provided a population structure indicator.

Results and Discussion

Descriptive analysis of COVID-19

COVID-19 and full lockdowns of varying lengths have affected the number of deaths and individuals infected. As a result of COVID-19 and full lockdowns of varied lengths, countries with shorter lockdown had reduced death cases and infected persons (Sabat et al., 2020).

Table 1 Cultures that have a shorter period of repression

Group A: Firm-level variable

Variable	sample			Before COVID-19			COVID-19		
	Obs.	Mean	Standard Deviation	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
TDM	670,117	0.327	0.395	606,307	0.324	0.389	63,810	0.363	0.441
TDA	902,628	0.251	0.196	748,155	0.252	0.196	77,192	0.26	0.199
Size	782,434	19.39	2.263	653,099	19.391	2.268	63,718	19.51	2.292
Tang	795,518	0.882	0.178	661,069	0.881	0.179	67,698	0.886	0.173
Profit	820,094	0.006	0.067	679,833	0.006	0.068	71,281	0.005	0.06
Dep	744,842	0.01	0.009	619,869	0.01	0.009	66,429	0.01	0.009
MTB	670,121	1.426	1.602	606,311	1.426	1.593	63,810	1.43	1.688
Book IML	902,628	0.225	0.092	748,155	0.226	0.091	77,192	0.234	0.091
Market IML	784,685	0.244	0.188	715,432	0.242	0.187	69,256	0.284	0.223
RD	94,846	0.047	0.083	78,974	0.048	0.085	7176	0.043	0.068
Group B: Macroeconomic variable									
Variable	Whole samples								
	No. of countries- years	Mean	Standard Deviation.						
GGDP	888	3.265	2.947						
INF	888	3.229	3.737						
DC	857	82.604	49.663						

SMC	868	68.892	122.618
Group C: The COVID-19 pandemic variables			
Variable	COVID-19		
	No. of countries- quarters	Mean	Std. Dev.
Total no. of reported cases per million	304	8066.612	13,738.58
New reported cases per million	304	5407.668	10,221.08

Source: Author calculation

Table 1 presents the data of comparison of variables such as the number of observations, mean, and standard deviation before and after the COVID-19 pandemic. In the firm-level analysis, the standard deviation of tang, profit, and RD (0.179, 0.068, and 0.084) decreased after the pandemic (0.173, 0.06, and 0.069). With 304 number of countries-quarters, the average cases per million were 8066.611 with 5407.667 new cases per million.

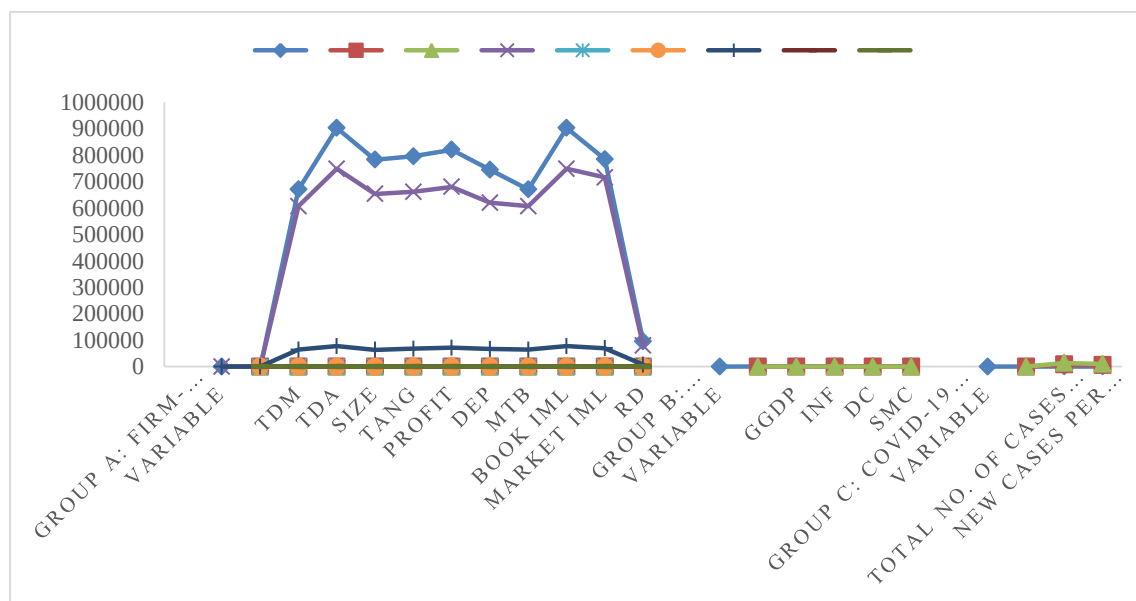


Figure 1. shows the mean and standard deviation of the identified cases/populations.

Figure 1. Average and mean variation (percentage) of confirmed cases/populations in countries subjected to short lockdown (about 15 days) and countries with lengthy lockdown (about 61 days) from April to August 2020.

Table 2. Descriptive statistics between countries

Period Apr. 2020–Aug. 2020	Countries with a shorter period of lockdown; about 15 days (Portugal, Austria, and Sweden)		Countries with a long period of lockdown; about 61 days (Italy, France, and Spain)	
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation
Lockdown days	14.67	14.503	61.33	8.386
Cases per population	0.004	0.002	0.004	0.001
Death rate	0.055	0.032	0.127	0.02
Variation of cases per population	0.004	0.003	0.003	0.002
Variations death rate	−0.007	0.012	−0.019	0.02
Healthcare expenditures (Euro per inhabitant)	3806.44	1692.6	2937.47	899.99
Avg. age of the population (years)	43.033	2.371	44.167	2.454

Source: Author calculation

The above table compares the statistics between the two different populations and periods of lockdown with a short period (15 days) and long period (61 days). The countries with an average lockdown of 14.67 days had a standard deviation of 14.503, while countries with 61.33 days had a standard deviation of 8.386.

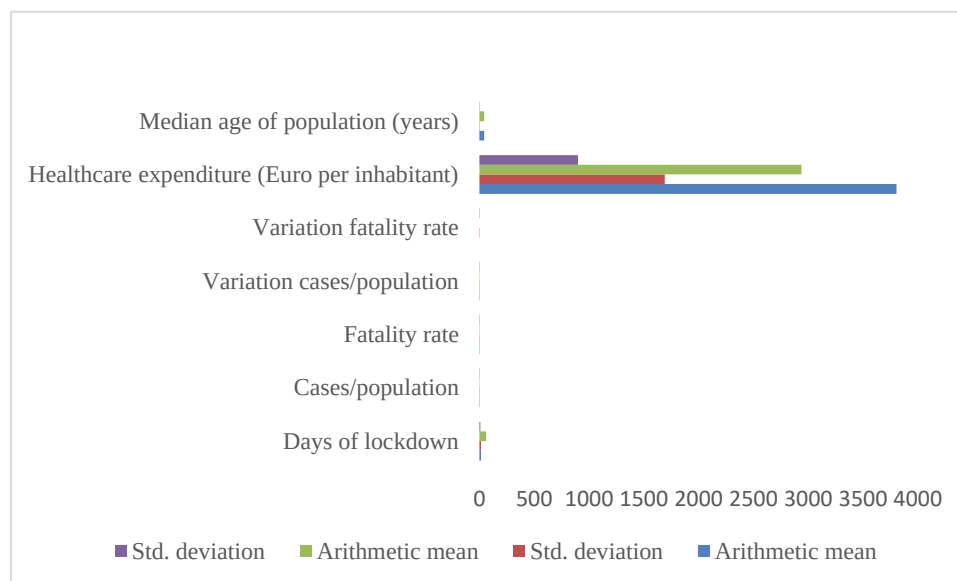


Figure 2. Results of countries had a shorter period of lockdown

Countries with a shorter lockdown period

Compared to countries with long lockdown periods (April to August 2020), countries with short lockdown periods had a lower mean (percentage) mortality and a reduction in mean mortality (0.72% versus 1.90%; Figure 2; see Table 1). By using an independent sample t-test to examine the mean of arithmetic differences, the population standardized the variance of confirmed cases and the evolution of mortality between countries with the short and long lockdown. The p-value of the Levene test for this statistical study was not significant, so we have to rely on the output of the

"hypothesis of equal variance." The survey results showed that the average mortality rates in countries with long and short lockdown periods were significantly different ($t_4 = 3.343$, p-value 0.0). The remaining differences were less relevant than in countries with longer lockdown (Table 2).

Table 3. Effects of lockdown independent sample test on COVID-19 infection and mortality

		Levene's test for variances equality		t-test for equality of means				
		F	Sign.	t	df	Sig. (2- tailed)	Mean difference	Std. error difference
Lockdown Days	Assuming equal variances	0.445	0.541	-4.825	4	0.008	-46.667	9.672
	Not assuming equal variances			-4.825	3.203	0.015	-46.667	9.672
Cases per population	Assuming equal variances	0.047	0.84	-0.382	4	0.722	0	0.001
	Not assuming equal variances			-0.382	3.83	0.723	0	0.001
Mortality rate	Assuming equal variances	1.51	0.286	-3.343	4	0.029	-0.073	0.022
	Not assuming equal variances			-3.343	3.386	0.037	-0.073	0.022
Variation cases per population from Apr. 2020 to Aug. 2020	Assuming equal variances	0.132	0.735	0.376	4	0.726	0.001	0.002
	Not assuming equal variances			0.376	3.704	0.727	0.001	0.002
Variation mortality per population from Apr. 2020 to Aug. 2020	Assuming equal variances	0.393	0.565	0.878	4	0.429	0.012	0.013
	Not assuming equal variances			0.878	3.273	0.44	0.012	0.013

Source: Author calculation

To analyze the development of mortality between countries with short and long absences, the t-test for independent samples was employed to estimate the difference between the arithmetic mean of the data and the population-adjusted variance of confirmed cases. For this statistical research, the p-value of the Levene test was not significant. Hence we must depend on the conclusion "assuming equal variances." The statistics demonstrated that nations with long and short lockdowns had statistically different mean death rates ($t_4 = 3.343$, p-value of 0.05). 7.3 percent is the percentage.

Table 4 shows the Mann-Whitney test results and rank the impact of a lockdown

Period Apr. 2020–Aug. 2020	Countries with a short period of lockdown; approximately 15 days		Countries with a long period of lockdown; approximately 61 days	
	Avg. rank	Sum of all ranks	Avg. ranks	Sum of all ranks
Lockdown days	2	6	5	15
Cases per population	3	9	4	12
Mortality rates	2	6	5	15
Variation cases per population	3.67	11	3.33	10
Variation mortality rate	3.67	11	3.33	10

Source: Author calculation



Figure 3. The Mann-Whitney test results and rank on the impact of a lockdown

Table 5 shows the effect of lockdown on the rate of COVID-19 infected and death cases

Test statistics					
Days of lockdown	Cases/population	Fatality rates	Variation of cases/population from April to August 2020	Variation of fatality rate from April to August 2020	
Mann-Whitney U	0	3	0	4	4
Wilcoxon W	6	9	6	10	10
- Z	-1.964	-0.655	-1.964	-0.218	-0.218
- Asymp. sig. (2-tailed)	0.05	0.513	0.05	0.827	0.827
- Exact [2 * (tailed Sig.)]	<u>0.100b</u>	<u>0.700b</u>	<u>0.100b</u>	<u>1.000b</u>	<u>1.000b</u>

Finally, the inferred linkages results in Table 5 were not significant due to the small sample size. Figure 3 shows the trends in confirmed cases and death rates that suggests minimal variation in COVID-19 pandemic progression amongst countries that have been under national lockdown for longer or shorter periods. According to (Alkhaled, 2021), "There was a trend toward a decline, but no significant decrease in the mean prevalence and mean fatality rate attributed to the COVID-19 pandemic in 27 nations, 15 days after the lockdown compared to 15 days before the lockdown and 15 days during the lockdown.". The average growth factor for patients was 1.18, while the fatality rate was 1.16. The graphic representation in Figure 3 indicates that the population's mean death rate has reduced over time. The reduction was most likely owing to the summer of 2020's high rainfall. According to several assessments, the climate during that season was hot and dry, and has the potential to lower the death rates.

Econometric data analysis of COVID-19

Table 6. Relationship estimated using a linear regression model

	Confirmed case reported in countries with a short period of lockdown; about 15 days	Confirmed cases in countries with a long period of lockdown; about 61 days	Fatality rates in countries with a long period of lockdown; about 61 days	Fatality rates in countries with a long period of lockdown; about 62 days
- Constant α (st. err.)	-5.34*** (0.18)	-2.97*** (0.18)	26.00* (8.88)	21.95 (14.06)
- Coefficient β (st. err.)	3.87E-10a (0.001)	2.156E-10a (0.001)	-1.88E-9a (0.001)	-1.58E-9a (0.001)
- Stand. coefficient beta	0.995	0.896	-72	-0.48
- R2 (st. err. of estimate)	0.99 (0.001)	0.77 (0.001)	0.52 (0.008)	0.23 (0.013)

Source: Author calculation

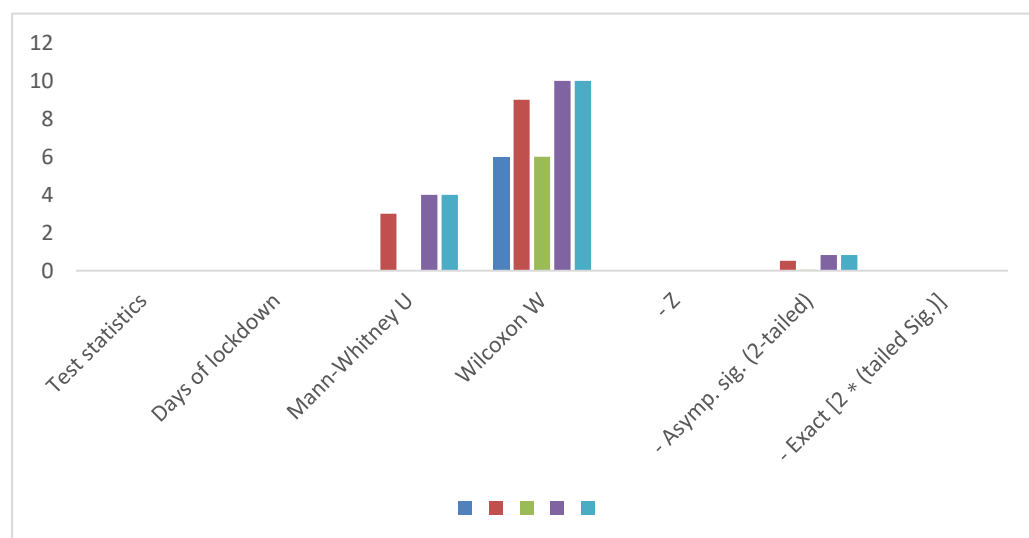


Figure 4. The development in confirmed cases per population and mortality

Figure 4 depicts the changes in confirmed cases and deaths in countries with shorter lockdown periods (about 15 days) and longer lockdown periods (around five months) from April to August 2020.

Economic consequences due to the COVID-19 epidemic with full lockdowns

Figure 4 and Table 6 demonstrate the following results when comparing the Q2 2020 2010 = 100 index to the 2019 concurrent index. The GDP decreased more in countries that have implemented longer lockdown, and GDP fell more severely from the 2020 Index to 2020 for the first quarter (T). Figure 4 shows the average difference in GDP across nations with longer and shorter lockdown periods from Q2 to Q2 2019 (Index 2010 = 100) and from Q1 to Q2 2020 (Index 2010 = 100).

Table 7. Statistical groups for the level of gross domestic products (GDP)

Countries with a short period of lockdown; about 15 days (Portugal, Austria, and Sweden)		Countries with a long period of lockdown; about 61 days (Italy, France, and Spain)		
Arithmetic mean	Std. deviation	Arithmetic mean	Std. deviation	
GDP2019Q2	114.83	9.00	108.67	6.39
GDP-2020/Q1	109.83	9.31	100.27	6.90
GDP-2020/Q2	100.50	13.52	87.30	4.19
— Δ GDP (2020/Q2 – 2019/Q2)	–14.33	4.59	–21.37	2.76
— Δ GDP (2020/Q2 – 2020/Q1)	–9.33	4.37	–12.97	2.83

Source: Author calculation

Table 7 shows that the average GDP ($t_4 = 2,274$, p-value) of countries with extended closing periods decreased from Q2 2019 to Q2 2020 using the 'assuming the same variance' results. If we compare countries with long lockdown periods and countries with shorter lockdown periods, the average level of GDP in European countries was about seven percentage points lower (Coccia, 2021a). The negative impact of the COVID-19 pandemic on society and restrictions on economic and social activities had impacted structural economic indicators, especially in countries where the duration of the blockade exceeds 61 days.

Table 8. Results of a t-test independent samples to determine the economic impact of aggressive measures.

			Levene's test for equality of variance		t-Test for Avg. equality				
			F	Sig.	t	df	Sig. (2- tailed)	Mean difference	Std. error difference
(variation) GDP (2020Q2 – 2019Q2)	Equal variances assumed		1.503	0.287	2.274	4	0.085	7.033	3.093
	Equal variances not assumed				2.274	3.276	0.1	7.033	3.093

Ultimately, based on the findings, this study concluded that an efficient method to mitigate the adverse effects of potential outbreaks, such as COVID-19, needs to be supported by significant

investments in health prevention. Furthermore, establishing effective pretreated tissues can reduce the death rate from an outbreak caused by a new virus without relying on its resistance. Figure 5 shows a graphic representation of these findings.

According to the research results, countries that have been under nationwide lockdown for a prolonged time had a higher COVID-19 mortality rate, as shown in Table 8; this may be due to lower average health care costs and an aging population (i.e., a higher middle age group). As a result, some countries with low health care costs and an aging population may not be able to extend the lockdown to slow and ease the epidemic's peak. This would enable the growth of health and emergency response mechanisms, therefore mitigating the detrimental impact of the projected worldwide COVID-19 pandemic on society. Additionally, the GDP growth was also significantly slowing down as a result of deteriorating economic structural indicators, consistent with the government's crisis management strategies and social challenges, such as growing unemployment and public debt as a proportion of GDP (Coccia, 2017a). Economic losses may also result in reducing critical future expenditures (such as health and research), exposing these countries to future epidemics such as the COVID-19 pandemic and other environmental dangers (Coccia, 2021c). Table 8 presents the following significant findings: Countries with high health care expenses (as a proportion of GDP) implement accelerated foreclosure procedures to avoid economic growth deprivation while also having a lower COVID-19 mortality rate (due to a reliable health care structure), although they have a higher occurrence of AIDS.

Economic crisis due to the COVID-19 epidemic and controlling speed

Table 8 presents the essential data. During the economic crisis of COVID-19, accounting records (TDA changes) and market values changed faster than ever. During this period, leveraged prices in target markets converged at a rate of 7.79%/Q compared to 5.61% before the COVID-19 outbreak (Columns 4, 3, and Table 9). Looking at security variables such as R&D, public sector domestic credit (CD), and market capitalization (SMC) as a regression, very similar results can be obtained (see Table 9).

Table 9 shows the speed at which the target leverage is adjusted

	TDA _{i,t}		TDM _{i,t}	
	Pre COVID-19	COVID-19	Pre COVID-19	COVID-19
TDA _{i,t-1}	0.9602*** -0.0018	0.9512*** -0.0051		
TDM _{i,t-1}			0.9438*** -0.0045	0.9220*** -0.0056
SOA	3.98%	4.88%	5.60%	7.80%
Size _{i,t-1}	0.0006*** -0.0002	0.0017*** -0.0004	0.0027*** -0.0007	0.0062*** -0.0006
Tang _{i,t-1}	-0.0037*** -0.0007	0.0007 -0.0018	0.0012 -0.0019	0.0064* -0.0037
Profit _{i,t-1}	-0.0513*** -0.0067	-0.0221*** -0.0051	-0.0680*** -0.0152	-0.0355 -0.0248
Dep _{i,t-1}	0.1754* -0.1004	0.1814*** -0.0572	0.2692** -0.1188	0.3133 -0.2666
MTB _{i,t-1}	-0.0004*** -0.0002	-0.0005 -0.0005	-0.0014*** -0.0003	-0.0014*** -0.0004
Book IML _{i,t-}	0.0219***	0.0145**		

1				
	-0.0028	-0.0047		
Market				
IML _{i,t-1}			0.0152***	0.0214***
			-0.0035	-0.0058
GGDP _{i,t-1}	0.00003	0.0033***	-0.00003	-0.0028*
	-0.0003	-0.0004	-0.0005	-0.0016
INF _{i,t-1}	-0.0002	-0.0002	-0.0005	0.0081***
	-0.0003	-0.0002	-0.0008	-0.0005
Constants	-0.0045	-0.0194***	0.0069	-0.0351***
	-0.0042	-0.0042	-0.0108	-0.0128
Fixed time effect	Yes	Yes	Yes	Yes
Fixed country effect	Yes	Yes	Yes	Yes
Observations	359,258	35,932	355,356	35,488
Adjustment R squared	0.9125	0.9148	0.9138	0.8921
Author calculation				

This is true considering that many companies in the sample missed many observations due to incomplete R&D data. Quick Leverage Adjustment (SOA) is a fixed effect created by resetting the current price of Accounting Leverage (TDA) and Market Leverage (TDM). It was determined when ADD and TDM are lagging and its impact on ADD and TDM country numbers and rates in the fourth quarter (See Appendix A for descriptions of variables and data sources). After adjusting for inconsistent variance, standard errors were grouped at the country level. The exponent * indicates statistical significance, ** and *** are at the levels of 10%, 5%, and 1%, respectively.

The adjusted target leverage ratios are presented in Table 9 (additional control). The Quick Leverage Adjustment (SOA) was calculated by zeroing the current account (TDA) and the market leverage (TDM) on the overdue counterparties. Various controls were also available, including country and fixed-effect time models, ADT and TDM delay values, and country and fixed-effect time models. COVID-19 was valid from the first quarter to the fourth quarter of 2020, and from the first quarter of 2011 to the fourth quarter of 2019 (See Appendix A for definitions of variables and sources of data). After correcting for the unequal variance, the standard errors were grouped by country/region. The exponent * indicates statistical significance, ** and *** are at the levels of 10%, 5%, and 1%, respectively.

Table 10 shows the speed at which the target leverage is adjusted

	TDA _{i,t}		TDM _{i,t}	
	Pre-COVID-19	COVID-19	(Pre-COVID-19	COVID-19
TDA _{i,t-1}	0.9517***	0.9264***		
	-0.0006	-0.0016		
TDM _{i,t-1}			0.9460***	0.8870***
			-0.004	-0.0039
SOA	4.81%	7.38%	5.42%	11.30%
Size _{i,t-1}	0.0018***	0.0026***	0.0018***	0.0060***
	-0.0002	-0.0002	-0.0004	-0.0005

Tang _{i,t-1}	-0.0012*** -0.0003	-0.0033*** -0.0012	-0.0052*** -0.0009	-0.0216*** -0.0032
Profit _{i,t-1}	-0.0755*** -0.0006	0.0131*** -0.0027	-0.0708*** -0.0053	-0.0362*** -0.0091
Dep _{i,t-1}	0.5125*** -0.0068	0.1594** -0.0588	0.3454*** -0.015	0.8277*** -0.1259
RD _{i,t-1}	-0.0304*** -0.0018	0.0292*** -0.0044	-0.0572*** -0.0055	-0.0965*** -0.0056
MTB _{i,t-1}	-0.0002*** -0.00002	0.0004 -0.0003	-0.0011*** -0.00004	-0.0010*** -0.0005
Book IML _{i,t-1}	0.0261*** -0.0025	0.0304*** -0.0069		
Market IML _{i,t-1}			0.0394*** -0.0032	0.0314*** -0.0053
GGDP _{i,t-1}	-0.00003 -0.0002	0.0355*** -0.0025	0.0009* -0.0006	-0.224*** -0.0026
INF _{i,t-1}	-0.0003 -0.0007	0.0162*** -0.0016	-0.0012 -0.0021	-0.0929*** -0.0025
DC _{t-1}	-0.00003 -0.00002	-0.0002*** -0.00002	0.0002 -0.0002	0.0006*** -0.00002
SMC _{t-1}	0.00004 -0.00002	-0.0003*** -0.00002	-0.00004 -0.0003	-0.0012*** -0.00002
Constants	-0.0258*** -0.0029	-0.1161*** -0.0075	-0.0498*** -0.0114	0.8891*** -0.0116
Fixed time impacts	Yes	Yes	Yes	Yes
Fixed country impacts	Yes	Yes	Yes	Yes
Observations	64,228	5,884	63,724	5,809
Adjustment	0.8818	0.8822	0.897	0.8538
R squared				

Author calculation

This table summarizes a number of factors, including the target leverage adjustment rate (SOA) and country and time impacts, which were determined by regressing the current book and market leverage values (TDA and TDM) to their lagged values. COVID-19 is valid from January to December 2020 and from January to December 2011 (See Appendix A for variable and data source definitions). The standard errors have been adjusted for inconsistency in variance and were then grouped by nation. Each quarter anterior to COVID-19 was 5.61% significant, as indicated by the exponents *, **, and *** (columns 4 and 3, Table 9). When other variables like R&D, credit to the domestic private sector (CD), and national market capitalization (SMC) were included in the regression, similar findings can be achieved (see Table 9). Numerous findings, however, were missed in the majority of the organizations in the sample due to a lack of R&D values.

In light of these numbers, the yearly adjustment rate should generally be between 8% and 15%. On the other hand, Flanery and Rangan (2006) discovered that the rate of adjustment increased by 34.4% during the crisis-free era. Outside the crisis, the average quarterly debt adjustment on the markets was 5.61% (22.44% per annum), while the quarterly adjustment rate for accounting debt was 3.99% (15.996 percent annual growth rate) (columns 3 and 1, Table 9). (Öztekin and

Flannery, 2012) found that the average yearly rate of accounting debt adjustment was around 21% from 1991 to 2006. This is a somewhat higher than the 3.99% quarterly rate recorded in the poll (annual interest rate of 15.96%) (column 1, Table 9).

The samples were evaluated using the following set of regressions depending on the severity of COVID-19's economic impact. The COVID-19's economic effect was calculated as the ratio of total cases per million to the economy per million new cases. After these two measurements, the samples were divided (i.e., 3 min). Countries in the top quartile of the COVID-19 measure distribution were classified as "severely impacted," while those in the bottom quartile were classified as "mildly affected." Additionally, we included GDP growth and inflation in all metrics. The outcomes of these experiments are summarized in Table 4. As indicated in the table, the estimated coefficients corroborate the findings of earlier investigations. Group A demonstrated that when COVID-19 strikes the economy, businesses accelerated their processes in order to obtain the necessary leverage. Its effect on leveraged book value (TDA) and market value is the same (TDM). In terms of the harshness of COVID-19 pandemic economic adversity, the outcome of the second infection was nearly identical (Figure B). All calculated correlation coefficients were statistically significant at 1%.

Table 11. shows the speed of adjustment to the goal leverage (Countries that have been disproportionately impacted vs. disproportionately unaffected countries)

Variables	Panel A			
	TDA _{i,t}		TDM _{i,t}	
	Highly-affected	Weakly-affected	Highly-affected	Weakly-affected
TDA _{i,t-1}	0.9492*** -0.006	0.9516*** -0.0121		
TDM _{i,t-1}			0.9160*** -0.0052	0.9266*** -0.004
SOA	5.08%	4.86%	8.42%	7.36%
Size _{i,t-1}	0.0020*** -0.0004	0.0005 -0.0005	0.0061*** -0.0006	0.0053*** -0.0015
Tang _{i,t-1}	0.0022 -0.0031	-0.0006 -0.0062	0.0031 -0.004	-0.0115 -0.0077
Profit _{i,t-1}	-0.0207*** -0.0043	-0.0557 -0.0357	-0.0160 -0.0187	-0.1981*** -0.0448
Dep _{i,t-1}	0.3012*** -0.0433	0.0571 -0.0749	0.8505*** -0.1272	0.0055 -0.1925
MTB _{i,t-1}	-0.0004 -0.0006	-0.0009* -0.0004	-0.0019*** -0.0008	0.001 -0.0013
Book IML _{i,t-1}	0.0147** -0.0069	0.0213 -0.0179		
Market IML _{i,t-1}			0.0272*** -0.0042	0.0248* -0.0131
GGDP _{i,t-1}	0.0048*** -0.0009	0.0095* -0.0049	-0.0065*** -0.0015	-0.0106 -0.0135
INF _{i,t-1}	-0.0013*** -0.0003	0.0051* -0.0021	0.0041*** -0.0007	-0.0211* -0.0095
Constants	-0.0267*** -0.0054	-0.0067 -0.0158	-0.0073 -0.0149	0.0484 -0.0584

Time fixed effect	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes
Observation	21,904	4,467	21,656	4,423
Adjustment R squared	0.9071	0.9423	0.8811	0.9206

Variable	Panel B			
	TDA _{i,t}		TDM _{i,t}	
	Strongly-affected	Weakly-affected	Strongly-affected	Weakly-affected
TDA _{i,t-1}	0.9509*** -0.0064	0.9513*** -0.0082		
TDM _{i,t-1}			0.9170*** -0.0046	0.9184*** -0.0085
SOA	4.93%	4.87%	8.32%	8.18%
Size _{i,t-1}	0.0021*** -0.0003	0.0009* -0.0004	0.0061*** -0.0006	0.0075* -0.0041
Tang _{i,t-1}	0.0029 -0.0033	-0.0003 -0.0044	0.0027 -0.004	0.0118 -0.0073
Profit _{i,t-1}	-0.0226*** -0.0037	-0.0437 -0.0264	-0.0161 -0.0187	-0.2006** -0.0844
Dep _{i,t-1}	0.2898*** -0.0437	0.1705** -0.0675	0.7907*** -0.1312	0.1215 -0.4026
MTB _{i,t-1}	-0.0005 -0.0006	-0.0013*** -0.0004	-0.0018** -0.0008	0.0007 -0.0011
Book IML _{i,t-1}	0.0127* -0.0073	0.0253* -0.0138		
Market IML _{i,t-1}			0.0265*** -0.0046	0.0169* -0.0093
GGDP _{i,t-1}	0.0047*** -0.0008	-0.0432*** -0.0087	-0.0065*** -0.0014	-0.1828*** -0.0125
INF _{i,t-1}	-0.0012*** -0.0001	-0.0025** -0.0009	0.0042*** -0.0007	0.0627*** -0.0052
Constants	-0.0283*** -0.0051	0.1293*** -0.0238	-0.0108 -0.0139	0.2968*** -0.0675
Fixed time impacts	Yes	Yes	Yes	Yes
Fixed firm impacts	Yes	Yes	Yes	Yes
Observation	21,581	6,185	21,335	6,145
Adjustment R squared	0.9086	0.9404	0.8819	0.9155

Author calculation

Robustness test

We used the approaches of (Faulkender et al., 2012; Öztekin and Flannery, 2012) to test the robustness of the results. To do this, we used the generalized moment method (GMM) estimate with fixed effects and a fixed time for further testing. The results were qualitatively equivalent to those in our baseline specification, as reported in Table 5. As an outcome, the study's significant findings were unaffected.

Table 12 shows the robustness test results analyzed using GMM

	TDA _{i,t}		TDM _{i,t}	
	Pre COVID-19	COVID-19	Pre COVID-19	COVID-19
TDA _{i,t-1}	0.9671*** -0.0033	0.9487*** -0.0105		
TDM _{i,t-1}			0.9483*** -0.0038	0.9275*** -0.0129
SOA	3.31%	5.15%	5.19%	7.27%
Size _{i,t-1}	0.0007*** -0.0002	0.0008*** -0.0003	0.0013*** -0.0003	0.0021*** -0.0005
Tang _{i,t-1}	-0.0042*** -0.001	-0.0031 -0.003	-0.0039*** -0.0015	-0.0026 -0.0045
Profit _{i,t-1}	-0.0523*** -0.0055	-0.0195*** -0.0048	-0.0508*** -0.0105	0.0097 -0.0195
Dep _{i,t-1}	0.1787** -0.0761	0.1918*** -0.0648	0.1752 -0.1332	0.5439*** -0.1949
MTB _{i,t-1}	-0.0003*** -0.0002	-0.0008** -0.0004	-0.0014*** -0.0003	-0.0018*** -0.0006
Book IML _{i,t-1}	0.0146*** -0.0024	0.0241*** -0.0044		
Market IML _{i,t-1}			0.0175*** -0.0036	0.0111* -0.0057
GGDP _{i,t-1}	-0.0005 -0.0004	-0.0013** -0.0006	-0.0006 -0.0008	-0.0032** -0.0014
INF _{i,t-1}	0.0002 -0.0002	0.0002 -0.0002	0.0006 -0.0004	-0.0017** -0.0008
Fixed time impacts	Yes	Yes	Yes	Yes
Fixed firm impacts	Yes	Yes	Yes	Yes
Observations	359,258	35,930	355,354	35,488

Author calculation

Research showed that the death rate from COVID-19 had increased in countries with long lockdown period. This is due to lower average health care costs and higher demographics (i.e., higher average age based on demographic structure and Table 8). Consequently, many countries with declining investment in health and aging populations were expected to introduce longer national lockdowns as they postpone and shorten the peak of the epidemic and allow health systems more opportunities to establish and respond to emergencies. As a result, they reduced the expected negative impact of the COVID-19 pandemic on society. Furthermore, public policies to address this crisis weaken structural economic indicators associated with related socio-economic problems, such as a sharp decline in the GDP growth rate, an increase in the unemployment rate, a low public debt ratio, high GDP ratio, and so on (Goethel and Berger, 2017). Future COVID-19-like epidemic and other environmental threats (Martin et al., 2020) in Table 8 highlight some key findings: Shorter lockdowns have been employed in nations with more significant health care investments (as a percentage of GDP), which has reduced the economic system's deterioration in terms of shrinkage. Despite a higher incidence of AIDS, it has a lower COVID-19 fatality rate (due

to a consistent health care structure) and a lower COVID-19 fatality rate (due to a consistent health care system).

Table 13. Descriptive data of factors related to the COVID-19 pandemic crisis, as a percentage of GDP, in nations with low and high health care investments

	HIGH investments in health care as percentage GDP		LOW investments in health care as percentage GDP.	
	St. dev.	Mean	St. dev.	Mean
Mean				
⊕ Healthcare as percent of GDP 2018	10.83	0.47	9.04	0.39
⊕ Healthcare per inhabitants in Euros, PPS 2018	€ 3,862.95	€ 142.76	€ 2,398.34	€ 150.70
⊕ Days of lockdown in 2020	28.33	28.01	47.67	29.14
⊕ Difference between GDP2020Q2 and 2019Q2	-15.63	6.27	-20.07	3.43
⊕ Difference between GDP2020Q1 and 2020Q2	-10.13	5.28	-12.17	2.45
⊕ Median age population 2019, years	41.9	1.45	45.3	1.35
⊕ Percent fatality rate COVID-19, December 2020	2.03	0.63	2.6	0.98
⊕ Percent cases/population, December 2020	3.36	0.32	3.33	0.35

In summary, the findings indicated that prolonging the lockdown had a mixed effect on COVID-19 infection and fatality rates. The mean height (percentage of confirmed cases) was lower in nations with short-term total lockdown (about 15 days), but the variability (percentage of confirmed cases) is substantially more significant. Due to the high expense of health treatment, the average (percentage) mortality rate in nations with short-term lockdown is lower than in countries with long-term lockdown. Long-term lockdown has a detrimental effect on economies: countries with longer lockdown experience a greater decline in GDP than countries with shorter lockdown (comparison of the GDP index for the second quarter of 2020 and the same period in 2019; Q1 2020-2020 1 quarterly GDP by quarter). In other words, statistical analysis demonstrated that extending the lockdown countrywide has a counterintuitive and non-specific effect on COVID-19 infection and mortality reduction. On the other hand, long-term lockdown can have a detrimental impact on social and ecological processes. Globally, the data indicated that in the event of a pandemic such as COVID-19, prolonged and strict quarantine procedures based on complete lockdown may cost the economy but dramatically minimize mortality.

Discussion

Existing restrictions on COVID-19 lockdown might ze global economic stability, but given the dynamic lockdown measures included in local health resource budgets, restricting COVID-19 hospital admissions is difficult. Regions can absorb the overhead associated with time-varying lockdown rules and use this method to regulate lockdown levels. Complete lockdown can have substantial and unanticipated health and economic consequences, but it can also be an excellent approach to avert an epidemic. They can, however, produce a vicious loop of regular lockdown separated by gaps. These studies demonstrated that combining community and home care with social distancing and helmet use was a more effective method for mitigating the COVID-19 pandemic's detrimental consequences (rather than long-term full lockdown). According to

(Salvatore et al., 2020), lockdown is only partially efficient in containing the COVID-19 outbreak in India, owing to the country's extreme heterogeneity. (Caulkins et al., 2020) established the efficacy of two distinct lockdown tactics. An eradication strategy, is when a long lockdown period reduces the epidemic's adverse health effects and the country's economic activity. When hospitals are already overloaded, these varied lockdown tactics can have similar impacts in reducing the number of people who require rapid medical assistance (Caulkins et al., 2020). While little benefits from compulsory stay-at-home policies and business closures cannot be ruled out, (Bendavid et al., 2021) contended that the findings do not support considerable case growth and gains from more local non-pharmaceutical measures. The authors also stated that equivalent growth losses could be achieved with less stringent containment measures. Therefore, the complex issue of epidemiological risks requires an interdisciplinary approach and not a long-term containment strategy to implement containment measures in high-risk areas, taking into account health and economic aspects. Research has shown that some places (restaurants, cafes, gyms, etc.) can pose a serious risk of infection. Therefore, reducing lockdown and increasing masks usage at sites could be more effective than nationwide lockdowns. (Janssen and Van Der Voort, 2020) showed that several countries have achieved positive results emphasizing ownership and have "smart lockdown" based on recommendations rather than mandatory mitigation actions. In summary, flexible and responsive regional and regional strategies in high-risk areas can be used to replace long-term global bottlenecks to address the societal challenges posed by the new COVID-19 type pandemic (Janssen and Van Der Voort, 2020). Ultimately (Evans and Bahrami, 2020) have suggested that super-flexibility, or decision-making based on adaptability, agility, and resilience, is a practical way to deal with the COVID-19 pandemic. The main goal of containment policy as a containment tool is to reduce the impact of the infection on society. The data showed during a pandemic, such as COVID-19, complete long-term lockdown has a negative effect on mortality and a small but significant negative impact on the economic system. At the same time, increasing medical spending is the key to managing unexpected epidemics and reducing social mortality.

In a strategic response to the risks of the COVID-19 pandemic, lockdowns could have long- and short-term implications. This article examined the effects of full lockdown on COVID-19 infection, mortality, and economic growth in six representative European countries with specific socio-economic and institutional conditions.

Conclusion and Policy Implications

Overall, the results showed that an extension lockdown period was needed to reduce the number of infections and deaths from COVID-19. In countries/regions with shorter general lockdown periods (around 15 days), the number of confirmed cases (percentage) is much lower. Still, the variation of confirmed cases (percentage) is much smaller (Rosario et al., 2020) (Coccia, 2020b). In other words, the statistical analysis showed that long-term global lockdown at the national level contradicted itself. Furthermore, there was no single impact on reducing the number of COVID-19 infections and deaths (i.e., there did not appear to be a significant reduction in confirmed cases and deaths). Conversely, long-term lockdown would affect social and ecological mechanisms.

Overall, the data showed that in the face of widespread infections such as COVID-19, long-term strict lockdown policies based on total containment could significantly harm the economy and society. Current lockdown restrictions on COVID-19 can disrupt the global economy (Atalan, 2020b) by examining dynamic lockdown methods for local health resource budgets to limit the number of COVID-19 hospital admissions. A budget for local health resources is recommended. This allows regions to handle the overhead associated with dynamic lockdown rules that change over time and adjust lockdown levels. According to (Prem et al., 2020), full containment can negatively impact socio-economic and health aspects. Long-term lockdown is not a versatile drug

for stopping outbreaks, but it can create a vicious cycle of successive lockdown with spaces in between. According to these researchers, social and home care is a more viable option. The combination of social isolation and wearing masks can help reduce the adverse effects of the COVID-19 pandemic (it is not a comprehensive and widespread safety measure). According to (Coccia, 2017b; Tobías, 2020), containment due to major state-level mutations has partially and effectively delayed the spread of the COVID-19 epidemic in India. The governments have shown that both containment strategies can be used successfully, where: (1) An extermination strategy that not only reduces the damage to health caused by the epidemic but also reduces the country's economic activity if the duration of the lockdown is extended. (2) The flattening curve strategy is inspired by the limitations of critical care and uses a relatively short lockdown period to reduce the peak of pandemic infection without damaging economic activity. These different lockdown strategies can be applied to different scenarios such as when the hospitals are overburdened; they have equivalent benefits in reducing the number of patients requiring immediate medical attention (Coccia, 2020b). (Roy et al., 2021) noted that while the required company and stay-at-home restrictions do provide certain benefits, they were insignificant. Although closures cannot be ruled out, the findings showed that non-pharmaceutical interventions with a smaller scope did not result in significant case growth advantages. Similar reductions in case growth can be obtained with less strict containment measures.

Case growth can be reduced with less strict containment techniques as well. Ultimately, based on the results, this study concluded that, rather than relying on reacting to future epidemics/pandemics like COVID-19, each country's economy is unique; the advantages of a circular departure strategy vary as well. Those that rely too much on entertainment and tourism have not reaped the same benefits as countries where industry and agriculture account for the majority of economic activity. From nation to country, the cost-benefit analysis of using this strategy differs. Even if just a tiny portion of the economy is affected by a circular strategy, the economic advantages are likely to be considerable.

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