Place-specific lockdown? A tentative analysis of the Italian case

Dipasquale, Daniela and Torrisi, Gianpiero

University of Catania, Department of Economics and Business

2020

Place-specific lockdown? A tentative analysis of the Italian case^

Daniela Dipasquale✉, Gianpiero Torrisi*

✉danieladipasqualeip@gmail.com

*University of Catania, Department of Economics and Business, Catania, Italy & University of Portsmouth, Portsmouth Business School, Portsmouth, UK, gianpiero.torrisi@unict.it

Abstract

The number of COVID-19 cases occurred unevenly across the national territory. This analysis adopts a provincial perspective on the spread of COVID-19. A Multiple Linear Regression (MLR) analysis shows the positive link between the number of COVID-19 cases with population density, life-expectancy and pollution level. While the result of a positive link with the population density and the level of pollution is rather intuitive, this is not the case w.r.t. life expectancy whose result calls for further investigation.

1. Introduction

The spatial distribution of the number of COVID-19 cases seems to reflect some of the territorial characteristics of the Italian regions. A first characteristic taken into consideration is the quality in general of both public and private institutions present in the area, as a determining factor in the ability to respond to a global epidemic. To this end, in this analysis, life expectancy is considered as an indirect indicator of the quality of life in general (Dasgupta and Weale 1992; Veenhoven 1996) and the quality of the National Health Service (NHS) or in Italian *Servizio Sanitario Nazionale* (SSN) (Mant 2001; Evans et al. 2001; Pamuk, Wagener, and Molla 2004). In order to consider the mode of spread of the pandemic, population density is considered as a relevant characteristic. This, as a measure of the concentration of individuals expressed by the ratio between the number of inhabitants and the surface of the territory, is used as an indicator of the probability of meeting referring to measures of social distancing[1] (Lau et al. 2020; Bourouiba 2020). Another characteristic considered for the purpose of spreading the pandemic is the level of pollution, referred to airborne particulate matter, as an environmental predisposition factor for populations residing in more polluted areas (Martelletti and Martelletti 2020; Zhu et al. 2020; Wu et al. 2020).

As expected, higher levels of population density and pollution show more COVID-19 cases. While unlike what one would expect, even higher levels of life expectancy result in more COVID-19 cases, which indicates that higher SSN quality levels do not translate into better response than SSN in terms of containment to the spread of the pandemic.

The positive link leads us to reflect on whether a measure, such as that of the lockdown, rather than being applied uniformly at national level, could be reviewed and designed according to the territorial characteristics of each Italian region or province.

^ The authors gratefully acknowledge the suggestions made by Roberto Cellini and Benedetto Torrisi. The usual disclaimer applies.

This document is organized as follows: section 2 presents the methodology used, section 3 presents the econometric model, section 4 presents the results and section 5 presents the conclusions.

[1] Source:
http://www.salute.gov.it/portale/news/p3_2_1_1_1.jsp?lingua=italiano&menu=notizie&p=dalministero&id=4156 .
Retrieved on 28/05/2020

2. The Methodology

For the purposes of the analysis, a dataset was created as a result of a merge of data taken from the *Istituto nazionale di Statistica* (ISTAT) and the *Ministero della Salute*.

The pollution level data are taken from ISTAT in the context of data relating to the *Ambiente urbano - Aria*[2].
Data on the number of COVID-19 cases are taken from the *Ministero della Salute*[3].
The population density data are taken from ISTAT in the context of data referring to the *Popolazione e famiglie*[4].
Life-expectancy data are taken from ISTAT and are part of the data set relating to *Benessere Equo e Sostenibile* (BES)[5].

Table 1 reports the main descriptive statistics.

TABLE 1 ABOUT HERE

Table 2 reports the spearman correlation index between the variables.

TABLE 2 ABOUT HERE

Based on the results of Table 2, it is decided to use the explanatory variable PM10 as an indicator of the level of pollution, since this is correlated with the variable PM25 (rho equal to 0.738) and also has fewer missing data (Table 1).
Table 2 shows a positive correlation between the number of COVID-19 cases with the population density (rho equal to 0.423), life expectancy (rho equal to 0.302) and the PM10 pollution level (rho equal to 0.378).

3. The model

To test the relationship, which already shown in Table 2, regarding the existence of a statistical link between the number of COVID-19 cases as a function of population density, life expectancy and pollution level, we proceed with a MRL analysis according to the scheme:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

where Y represents the number of COVID-19 cases and Xi represent the parameters, respectively the population density as a proxy of the probability of meeting referring to measures of social distancing, life expectancy as a proxy of the quality of SSN and the level of pollution as a proxy for the environmental predisposition factor of populations residing in more polluted areas.

[2]https://www.istat.it/it/archivio/236912 - Retrieved on 01/05/2020
[3] Last updated 1 May 2020, 5:00 pm GMT. Source: http://www.salute.gov.it/portale/nuovocoronavirus/dettaglioContenutiNuovoCoronavirus.jsp?area=nuovoCoronavirus&id=5351&lingua=italiano&menu=vuoto
[4]http://dati.istat.it/Index.aspx?DataSetCode=DCIS_POPRES1 - 01/01/2019 - the population resident as of 01/01/2019 was considered and the population density was recalculated, thus obtaining an updated figure compared to that available on ISTAT dated to the last 2012 census.
[5]https://www.istat.it/it/archivio/230627 - Retrieved on 01/05/2020

4. The results

This section reports the results of the empirical analysis concerning the link between housing density, life expectancy and the level of pollution with the number of COVID-19 cases.

Figure 1 shows the scatter plot of the number of infected COVID-19 as a function of population density.

FIGURE 1 ABOUT HERE

The data are distributed in such a way that as the population density increases, the variability of the number of infections increases, the observations move further and further away, presenting a wider interval. The graph shows how the data of the province of Milano represents an outlier than the rest of the provinces, as well as the data on Torino, Brescia and Bergamo which seem higher.

Figure 2 shows the scatter plot of the number of infected COVID-19 as a function of life expectancy.

FIGURE 2 ABOUT HERE

The distribution of the data shows a positive linear relationship. Some data, such as those in the province of Milano, Brescia, Torino and Bergamo, represent outliers.

Figure 3 shows the scatter plot of the number of COVID-19 infected people as a function of the PM10 particle pollution level.

FIGURE 3 ABOUT HERE

There is a positive correlation of a linear type. Data on the provinces of Milano, Torino, Brescia and Bergamo are presented as outliers. The trend of the data shows that higher levels of pollution suggest a greater number of infected people.

The MLR analysis tries to explain the number of COVID-19 infected people as a function of population density, life expectancy and pollution level.
The estimation of the model is performed through a linear scheme with heteroskedasticity robust standard error, to be attributed to the heterogeneity present in the data, the difference in scale of the data on population density and the presence of outliers.
The regression analysis reported in Table 3, confirms the results that have already emerged in Table 2, and shows the existence of a positive and statistically significant link between the number of COVID-19 cases and the parameters of the model.

TABLE 3 ABOUT HERE

For all the variables there is a positive and statistically significant correlation, therefore the population density, life expectancy and pollution level played a statistically significant role in determining the number of COVID-19 cases.

While it was expected to detect a positive link between population density, pollution level and the number of COVID-19 infected people, the same was not expected from life expectancy. It is counterintuitive that a higher level of SSN quality translates into more infections. In other words, it seems that a better quality of SSN has failed to ensure the containment of the number of infected COVID-19.

5. Conclusion

This analysis, dictated by the initial curiosity of how a measure such as that of the lockdown could contain the spread of COVID-19, developed a basic intuition, that of trying to identify the possible drivers of the spread. From the results of the analysis, population density, life expectancy and pollution level show a positive and statistically significant link. From the results it seems that the virus finds fertile ground for the spread in the most populated and most polluted areas, while the higher quality of SSN does not affect the result in terms of containment of the spread of the virus, it seems that the SSN has not been able to confront with the epidemiological emergency.
In the light of the results, one wonders if a measure such as that of the lockdown, which provides for the blocking of the entire social and economic system, can be tailored, rather than uniformly at national level, with reference to the territorial characteristics of the province or region concerned , in order to contain its social and economic repercussions (Fernandes 2020; Nicola et al. 2020).

References

Bourouiba, Lydia. 2020. «Turbulent Gas Clouds and Respiratory Pathogen Emissions: Potential Implications for Reducing Transmission of COVID-19». *JAMA* 323 (18): 1837–38.

Dasgupta, Partha, e Martin Weale. 1992. «On Measuring the Quality of Life». *World Development* 20 (1): 119–31.

Evans, David B., Ajay Tandon, Christopher J. L. Murray, e Jeremy A. Lauer. 2001. «Comparative Efficiency of National Health Systems: Cross National Econometric Analysis». *BMJ* 323 (7308): 307–10.

Fernandes, Nuno. 2020. «Economic Effects of Coronavirus Outbreak (COVID-19) on the World Economy». SSRN Scholarly Paper ID 3557504. Rochester, NY: Social Science Research Network.

Lau, Hien, Veria Khosrawipour, Piotr Kocbach, Agata Mikolajczyk, Justyna Schubert, Jacek Bania, e Tanja Khosrawipour. 2020. «The Positive Impact of Lockdown in Wuhan on Containing the COVID-19 Outbreak in China». *Journal of Travel Medicine* 27 (3).

Mant, Jonathan. 2001. «Process versus Outcome Indicators in the Assessment of Quality of Health Care». *International Journal for Quality in Health Care* 13 (6): 475–80.

Martelletti, Luigi, e Paolo Martelletti. 2020. «Air Pollution and the Novel Covid-19 Disease: A Putative Disease Risk Factor». *SN Comprehensive Clinical Medicine* 2 (4): 383–87.

Nicola, Maria, Zaid Alsafi, Catrin Sohrabi, Ahmed Kerwan, Ahmed Al-Jabir, Christos Iosifidis, Maliha Agha, e Riaz Agha. 2020. «The Socio-Economic Implications of the Coronavirus Pandemic (COVID-19): A Review». *International Journal of Surgery* 78 (giugno): 185–93.

Pamuk, Elsie R., Diane K. Wagener, e Michael T. Molla. 2004. «Achieving National Health Objectives: The Impact on Life Expectancy and on Healthy Life Expectancy». *American Journal of Public Health* 94 (3): 378–83.

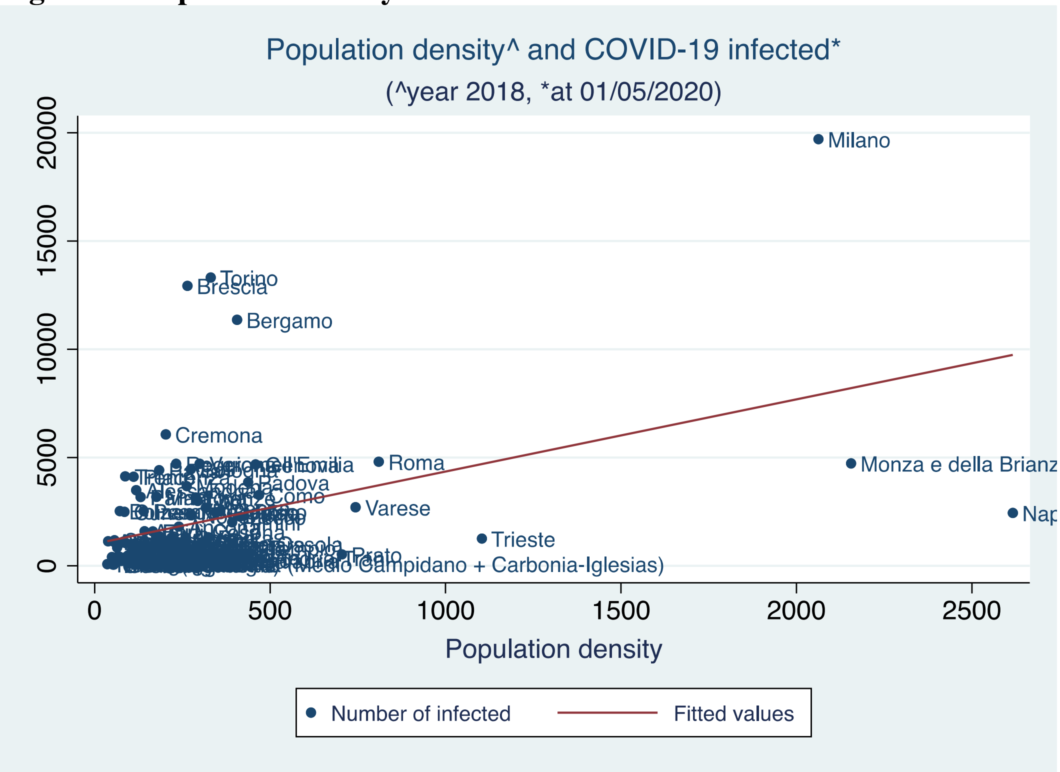
Veenhoven, Ruut. 1996. «Happy Life-Expectancy». *Social Indicators Research* 39 (1): 1–58.

Wu, Xiao, Rachel C. Nethery, Benjamin M. Sabath, Danielle Braun, e Francesca Dominici. 2020. «Exposure to Air Pollution and COVID-19 Mortality in the United States: A Nationwide Cross-Sectional Study». *MedRxiv*, aprile, 2020.04.05.20054502.

Zhu, Yongjian, Jingui Xie, Fengming Huang, e Liqing Cao. 2020. «Association between Short-Term Exposure to Air Pollution and COVID-19 Infection: Evidence from China». *Science of The Total Environment* 727 (luglio): 138704.

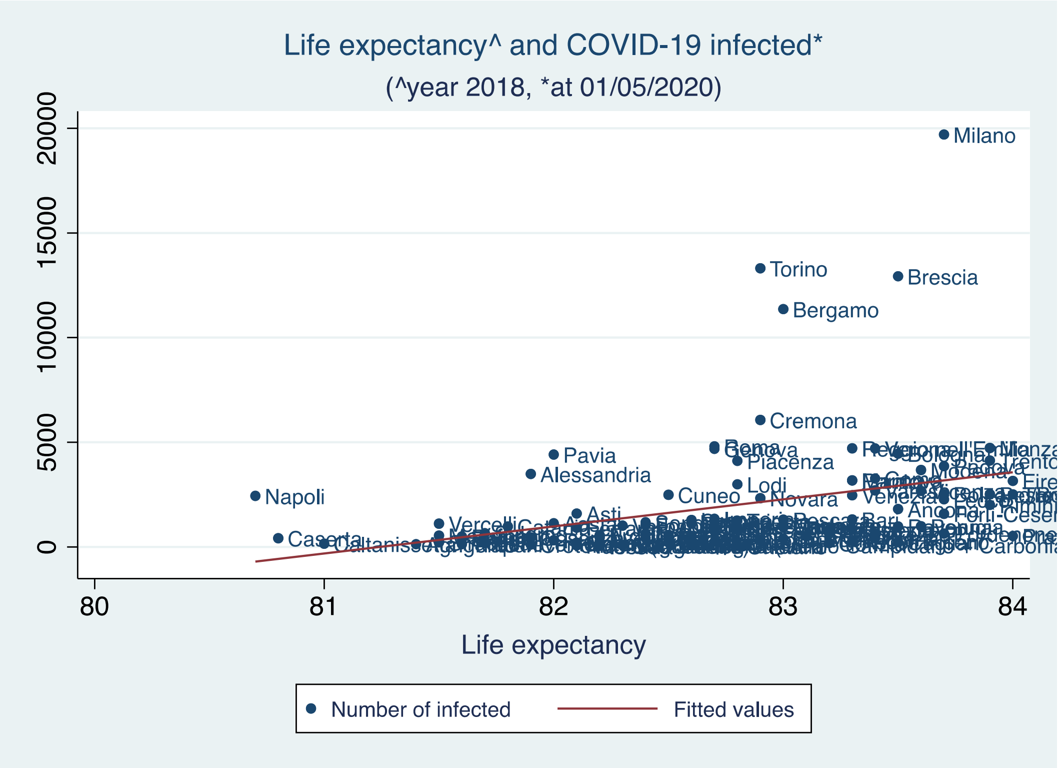
FIGURES

Figure 1 - Population density and number of COVID-19 cases



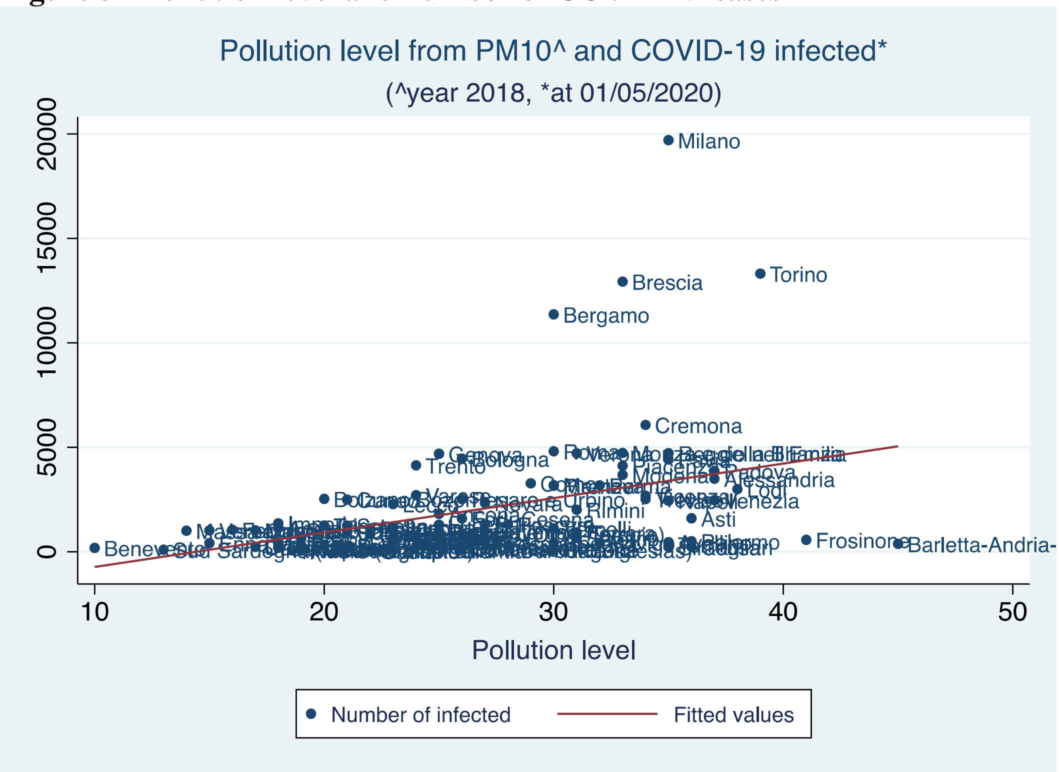
Source: author's elaboration.

Figure 2 - Life expectancy and number of COVIS-19 infected



Source: author’s elaboration.

Figure 3 - Pollution level and number of COVID-19 cases



Source: author’s elaboration.

TABLES

Table 1 - Summary statistics

	N	Mean	St.Dev	min	max
Number of infected by province^	107	1910.598	2902.723	55	19701
Population density	107	268.01	382.261	36.042	2616.679
Life expectancy at birth	107	82.719	.755	80.7	84
Number of days exceeding PM10 particulate limit value	103	26.408	6.939	10	45
Number of days exceeding PM25 particulate limit value	90	16.333	5.453	6	36

^ number of infected COVID-19 at 01/05/2020. People per Km^2 at 01/01/2019. Life expectation year 2018. The passing of the alert levels for pollution year 2018.
Source: author's elaboration.

Table 2 - Matrix of correlations

	NumCases	PopDensity	LifeExp	PM10	PM25
NumCases	1.000				
PopDensity	0.423	1.000			
LifeExp	0.302	0.057	1.000		
PM10	0.378	0.251	0.099	1.000	
PM25	0.484	0.256	0.278	0.738	1.000

Note: number of infected COVID-19 at 01/05/2020. Inhabitants per Km^2 at 01/01/2019. Life expectation year 2018. The passing of the alert levels for pollution year 2018.
Source: author's elaboration.

Table 3 - Regression analysis

VARIABLES	(1) ln_NumCases
ln_PopDensity	0.438***
	(0.132)
ln_LifeExp	47.47***
	(10.7555)
ln_PM10	1.194***
	(0.375)
Constant	-208.9***
	(47.31)
Observations	103
R-squared	0.412

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: author's elaboration.