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Abstract

This note contributes to the literature on the air pollution consequences determined by hosting mega-events. An econometric analysis is provided to document the increase in air pollution observed in Naples (Italy) during the G20 Ministerial meeting on the Environment, Climate, and Energy carried out in July 2021. Such evidence contributes to understanding the potential costs of mega-events in a metropolitan area with low air quality and high private car density. Findings suggest that mega-events cause a decrease in air quality. Therefore, we suggest to organize mega-event outside cities. The media coverage would not be lowered by this policy, and on the contrary it could be a useful occasion to re-discover inner, less urbanized area.

JEL-Codes: Q510, Q530.

Keywords: G20 meeting, mega-event, pollution.

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1. Introduction

Several scholars share the idea that mega-events deteriorate air quality, mainly because of their impact on traffic in the hosting city (Xu and Gonzalez, 2017). Nevertheless, some China-focused evidence exists that these events might also generate a short-term positive impact on air quality (Shi et al., 2016; Liu et al., 2017; Fu et al., 2019) because they trigger stringent pollution control measures and generate political incentives to promote environmental protection. According to some studies, such a positive impact can be long-lasting (Li et al., 2019).

This note adds to this literature by providing evidence on the air pollution consequences of hosting an intergovernmental meeting in a European metropolitan area. Our case study is the G20 meeting on the Environment, Climate, and Energy Ministerial in Naples (Italy) on 22-23 July 2021 under the Italian G20 Presidency.

Naples is a city full of traffic where the number of private cars is high (>550 vehicles per 1000 inhabitants) and the public transport supply is well below the one reported by other European metropolitan areas (Tomassetti et al., 2020). Traffic emissions play a remarkable role in determining air pollution in the city, which documents a yearly average NO2 concentration that exceeds the EU limits[1] (Tomassetti et al., 2020). According to newspapers' reporting, the G20 meeting activities aggravated such a situation[2].

[1] See European Union directive 2008/50/CE.
[2] See local newspapers' articles such as https://www.ilmattino.it/napoli/cronaca/g20_napoli_paralisi_traffico_bloccate_ambulanze-6094512.html [accessed on 29/10/2021]

We provide an econometric analysis of hourly air quality data collected over the event by the monitoring control units in Naples and other cities from the same regions to check whether such anecdotal evidence is reliable. Our results suggest that hosting the intergovernmental discussion about the environment determined environmental costs because of increased car emissions.

2. The event

On 22 and 23 July 2021, Naples hosted the G20 Ministerial meeting on the Environment, Climate, and Energy. For safety reasons, a ban on vehicles and pedestrian transit was posed during the event in an extended area between the Lungomare seafront and some of the most renowned historical attractions in the city center. This area also included two of the most crucial road axes of the city that connect its Eastern and Western parts. The ban was active from 7 AM on 21st July to the end of the event and was restricted to a smaller area on the 22nd [3].

The ban made it harder to reach the city center by car. Furthermore, it implied a relevant deviation for cars that aimed to move from the Eastern to the Western part of the city, and vice-versa. Indeed, these cars had to cross the banned area or its surroundings. In addition, on the 22nd, many environmental activists protested against the G20 meeting in the streets[4]. As a consequence, heavy traffic was observed in the city.

Figure 1 shows the area of the event (the red circle), the alternative routes officially suggested for the cars that had to reach the center of the city and to cross the city from East to West (the orange line), and the ring road of the city (in blue).

3. Methodology and Data

Like previous research (Chen et al., 2013), the analysis proposed is based on the difference-in-differences strategy. This methodology mimics an experimental research design using observational study data. Exploiting a natural experiment allows studying the differential effect of a treatment on a treatment group versus a control group.

We gathered data from ARPAC, the Regional Agency for the Protection of Environment of Campania (Naples' region). The Meteorologic and Climatologic Center (CEMEC) of this Agency allows access to hourly data on air quality from 36 weather stations active in the Campania region. Eight of them are located within the city of Naples. Through these data, we record the presence of benzene, CO2, NO2, and SO2 in the air and of some meteorological data that can impact the pollution (air temperature, atmospheric pressure, and wind speed).

We use data on all the days of July 2021 to estimate the impact of the G20 event on air pollution through the following equation:

$$Pol_{st} = \alpha + \beta_0 Wea_{st} + \beta_1 DNap_{st} + \beta_2 DG20_t + \beta_3 DNap_{st} * DG20_t + \varepsilon \quad (1)$$

[3] Detailed information about the ban was provided by Naples Municipality through the following link: https://www.comune.napoli.it/dispositivo-circolazione-g20

[4] See local newspapers' articles such as: https://napoli.repubblica.it/cronaca/2021/07/22/news/g20_napoli_protesta_porto-311235988/ [accessed on 4/10/2021]

Where Pol is the amount of pollution reported by the s-th weather station *at* hour *t*. Our analysis alternatively considers many different pollutants. Wea is a set of variables observing weather conditions. $DNap$ is a binary variable taking the value of 1 in case the station is in Naples and to 0 otherwise. $DG20$ is a binary variable taking the value of 1 for those days and hours when the G20 event was carried out (i.e., between 7 AM of July 21st and the midnight of July the 23rd). Descriptive statistics are presented in Table 1.

Equation 1 was estimated through the F-GLS estimator (Aigner and Balestra, 1988; Hsiao, 1986). The estimated β_3 coefficient measures the effect of the G20 in Naples on Pol. Such an effect is estimated by comparing the observed data with a counterfactual represented Naples in the rest of the month and other Campania municipalities in the whole period.

Unfortunately, our dataset reports some missing pollution and weather data. Listwise deletion leads to a heterogeneous number of observations across the estimated models. Given the random nature of these missing values (which depend upon registration errors), we are confident that they do not significantly affect the estimates.

4. Results

Table 2 shows the results obtained when the analysis only considers the main regressors we are interested in (*Nap* and *G20*). According to the estimates, we find a positive and statistically significant increase in pollution in Naples during the G20. Such an increase is observed for all the pollutants considered by the analysis.

To check the robustness of these findings, we first replicated the estimates by including the weather station fix effect to avoid biased estimated due to any time-invariant station-level effect. These additional results are presented in Table 3 and confirm our preliminary evidence.

We further enhance the analysis by adding (one per time) three variables observing weather conditions. We included these variables following an order is inspired by the objective of losing as few observations as possible (i.e., keeping the observations' numerosity as high as possible). The results, presented in Tables 4, 5 and 6, confirm the existence of a statistically significant impact of the interaction term displayed in equation 1.

The magnitude of this effect is remarkable. We estimate it as the percentual growth compared to the average value measured per pollutant over July in Naples. In formal terms, we computed the growth as

$$Grw_p = \frac{\beta_p}{\mu Nap_p} \qquad (2)$$

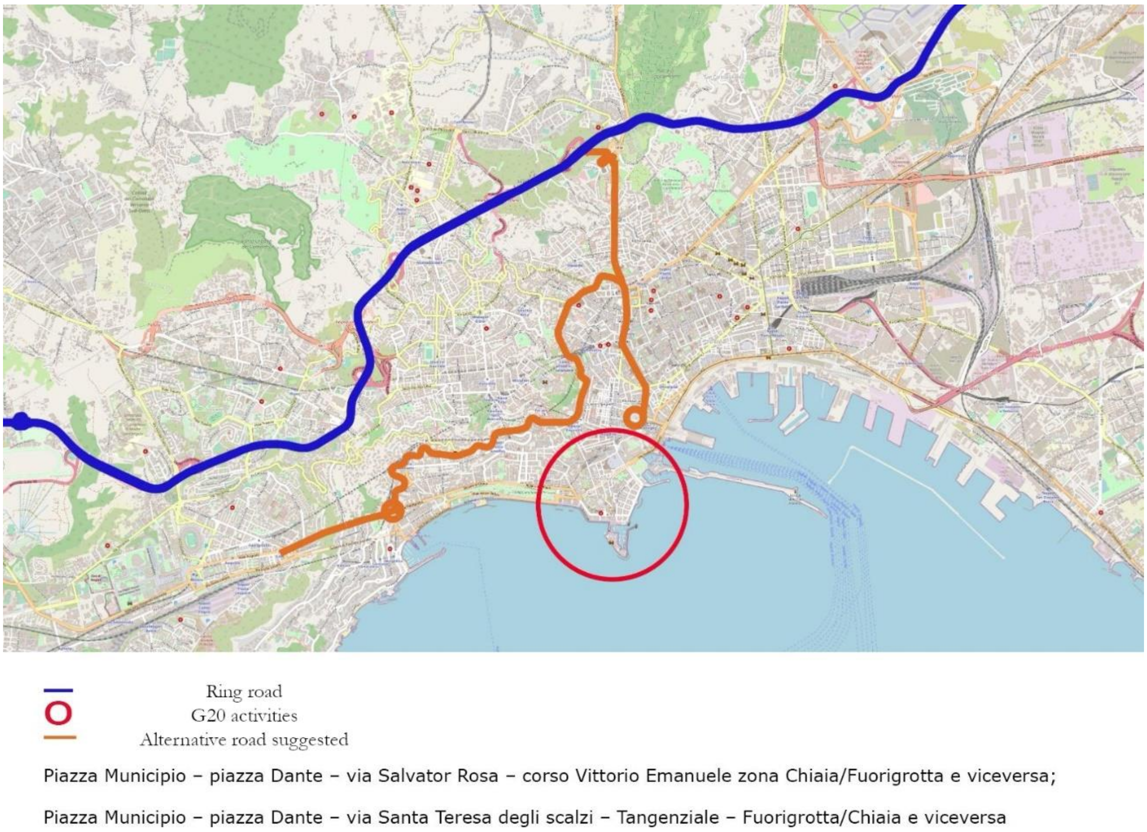
Grw is the growth for each pollutant *p*, β is the coefficient estimated through the most complete specification considered by our analysis, and μNap is the mean value of the pollutant *p* per the city of Naples in July. The increase turns out to be 22.48% for the benzene, 21.73% for CO, 21.66% for SO2, and 12.02% for NO2. These pollutants have a detrimental effect on human health, as exposure to these is associated with cardiovascular and respiratory diseases and even mortality and morbidity (Barman et al., 2010).

5. Conclusion

Our analysis provides evidence of a remarkable increase in air pollution in Naples (Italy) during the G20 Ministerial meeting on the Environment, Climate, and Energy held in July 2021. Of course, we are aware that this increase is temporary and only lasted two days. Nevertheless, such evidence This finding suggests devoting more attention to assessing the potential G20 meetings costs for their detrimental effects on the environment and health. Taking care of this aspect would also be valuable in terms of communication. For all these reasons, we suggest to organize mega-event of these kind outside cities. The media coverage would not be lowered by this policy, and on the contrary it could be a useful occasion to re-discover inner, less urbanized area.

Authors perceive no conflict of interest.

Figure 1 – Alternatives routes suggested by Naples' municipality.



Source: Naples municipality website (https://www.comune.napoli.it/dispositivo-circolazione-g20#id-188444bc25d6c8f983142c8aa07eed836 [accessed on 4/10/2021]. Legend translated into English

Table 1 – Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
DNap	26,416	.2197153	.4140616	0	1
DG20	26,416	.0876363	.2827706	0	1
DNap*DG20	26,416	.0176787	.1317832	0	1
Benzene	17,093	.5265372	.5057499	0	12.8
CO	13,351	.3657778	.3130464	0	10.8
NO2	24,808	22.14937	19.26614	-13.6	171.6
SO2	9,383	2.732548	2.689936	0	41.6
AirTemp	21,920	26.58031	4.901626	11.11	64.31
AtmPress	19,774	998.006	17.5495	921.86	1015.91
WindSpeed	11,910	1.507895	1.431149	0	50.62

Table 2 - F-GLS Diff in Diff - Random Effect

	(1) Benzene	(2) CO	(3) NO2	(4) SO2
DNap	0.0922	0.0197	14.09***	0.684
	(0.86)	(0.27)	(3.73)	(0.58)
DG20	0.0405***	-0.0447***	2.107***	-0.710***
	(2.92)	(-4.37)	(5.45)	(-8.11)
DNap*DG20	0.108***	0.0811***	2.852***	0.936***
	(3.25)	(4.19)	(3.33)	(4.29)
Constant	0.504***	0.360***	18.64***	2.618***
	(10.27)	(9.03)	(10.46)	(4.83)
Observations	17093	13351	24808	9383

t statistics in parentheses   * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3 - F-GLS Diff in Diff - Fixed effects

	(1) Benzene	(2) CO	(3) NO2	(4) SO2
DG20	0.0405***	-0.0446***	2.107***	-0.710***
	(2.92)	(-4.37)	(5.45)	(-8.11)
DNap*DG20	0.108***	0.0811***	2.841***	0.936***
	(3.25)	(4.19)	(3.32)	(4.29)
Constant	0.521***	0.368***	21.91***	2.781***
	(141.26)	(145.03)	(213.19)	(118.51)
Observations	17093	13351	24808	9383

t statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Table 4 - F-GLS Diff in Diff with Air Temperature - Fixed effects

	(1) Benzene	(2) CO	(3) NO2	(4) SO2
DG20	0.0370***	-0.0486***	2.110***	-0.451***
	(2.63)	(-4.24)	(5.11)	(-4.40)
DNap*DG20	0.107***	0.101***	2.768***	0.673***
	(2.83)	(3.94)	(2.76)	(2.82)
AirTemp	-0.000108	0.0000404	0.0183	0.0756***
	(-0.13)	(0.06)	(0.73)	(10.44)
Constant	0.522***	0.378***	21.57***	0.505***
	(22.81)	(20.95)	(32.04)	(2.62)
Observations	14982	10709	20617	7364

t statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Table 5 - F-GLS Diff in Diff with Air Temperature and Atmospheric Pressure - Fixed effects

	(1) Benzene	(2) CO	(3) NO2	(4) SO2
During G20=1	-0.0317**	-0.0797***	0.108	-0.313***
	(-2.12)	(-6.38)	(0.25)	(-3.00)
Naples=1 # During G20=1	0.101***	0.114***	3.934***	0.719***
	(2.72)	(4.29)	(3.58)	(3.03)
AirTemp	-0.00105	0.000971	-0.110***	0.0840***
	(-1.10)	(1.25)	(-4.01)	(11.45)
AtmPress	0.0314***	0.00822***	1.064***	-0.0814***
	(18.65)	(6.11)	(20.46)	(-6.62)
Constant	-30.78***	-7.834***	-1036.8***	81.50***
	(-18.38)	(-5.87)	(-20.03)	(6.66)
Observations	13621	10019	18581	7364

t statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Table 6 - F-GLS Diff in Diff with Air Temperature, Atmospheric Pressure, and Wind Speed - Fixed effects

	(1) Benzene	(2) CO	(3) NO2	(4) SO2
DG20	-0.0502**	-0.0445**	0.126	-0.378***
	(-2.21)	(-2.56)	(0.20)	(-2.68)
DNap*DG20	0.135***	0.0843***	4.064***	0.723***
	(3.10)	(3.10)	(3.35)	(3.01)
AirTemp	0.00374***	0.00379***	0.301***	0.114***
	(2.60)	(3.73)	(7.77)	(11.67)
AtmPress	0.0241***	0.00494***	0.821***	-0.0664***
	(10.78)	(3.37)	(12.26)	(-4.92)
WindSpeed	-0.0456***	-0.00998***	-2.260***	-0.0599*
	(-12.01)	(-4.51)	(-18.59)	(-1.68)
Constant	-23.69***	-4.671***	-805.0***	65.85***
	(-10.62)	(-3.19)	(-12.03)	(4.91)
Observations	7744	5374	9924	3892

t statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

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