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The role of civic capital on vaccination

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Abstract

Can civic-minded individuals fight against a pandemic? In this paper, we show that civic capital plays an important role when assessing the level of compliance with COVID-19 vaccination recommendations. Analyzing data on a large sample of municipalities from the Italian region of Lombardy, we show that the share of vaccinated individuals is significantly higher in municipalities with higher pre-determined levels of civic capital. These findings are robust to the possibility of spatial spillovers across neighboring municipalities. Our findings contribute to the existing evidence highlighting the importance of individual contributions and civic capital as important behavioral determinants affecting the containment of infectious diseases.

KEYWORDS
civic capital, containment measures, COVID-19, diffusion models, SARS-CoV-2

JEL CLASSIFICATION
I10, I18

1 | INTRODUCTION

After 3 years, the negative effects of the COVID-19 pandemic span the globe. As of the end of December 2022, more than 600 million SARS-CoV-2 infections have been detected, while the number of reported deaths exceeds 6 million. With the emergence of new variants of concern (VOC), the number of cases across the globe surged, confirming many experts' predictions about the arrival of further waves of infections (Xu & Li, 2020) as for the 1918 Spanish Flu (Barry, 2004). While further waves may become less and less severe - because of VOCs becoming less fatal or, partially, thanks to post-infection immunization (Barry et al., 2008) - successful health policies against the spread of the pandemic require a massive vaccination campaign. Despite the international and robust evidence that vaccines help to contain the spread of the pandemic, many countries are still experiencing problems with individuals' hesitancy and often insufficient vaccination rates (Sallam, 2021). Vaccine hesitancy, defined by the World Health Organization as the delay in acceptance or refusal of vaccination despite its availability, threatens public health policy aimed at ending the COVID-19 pandemic. For this reason, understanding the behavioral determinants that explain why the shares of vaccinated individuals are still low have important policy implications for both the current and future pandemics (see, e.g., Kaplan & Milstein, 2021; Machingaidze & Wiysonge, 2021; Razai et al., 2021).

In this paper, we study the relationship between municipality-level compliance with COVID-19 vaccination recommendations and civic capital. The term "civic capital" (Putnam, 1993) has been used to indicate a variety of concepts and the debate over its definition is ongoing. Following Guiso et al. (2011) and Guiso et al. (2016), we define civic capital as the set of "shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities." These mutual

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values are important in bad times. From a theoretical point of view, indeed, any threat to human activities can spur cooperative behavior among individuals (e.g., climate disasters (Buggle & Durante, 2021), earthquakes (Buonanno et al., 2021), etc.). As a public health threat, the COVID-19 pandemic gave individuals the incentive to commonly contribute to the public good, for example, comply with the vaccination campaign. The ability to internalize the negative externality caused by vaccine hesitancy, however, depends on the individual's propensity to contribute to a common good. Our empirical exercise, therefore, aims to assess whether more civic-minded individuals, on average, are also more compliant with vaccination recommendations.

To do so, we focus on a large sample of municipalities of the Italian region of Lombardy, sadly known as the European epicenter because of the severity and the early start of the first wave in 2020. We document the existence of a positive and significant relationship between civic capital and vaccination rates. More specifically, municipalities with higher levels of civic capital have higher vaccination rates conditioning on several potential confounding factors, such as the local severity of the pandemic and the demographic composition. Our results are robust to different specifications and to the use of a spatial econometric model that accounts for possible spatial spillovers across municipalities. Overall, we document that civic capital plays a central role in explaining the vaccination decision of individuals.

Our paper contributes to a growing literature connecting social norms to individual behavior, such as vaccination decisions or the observance of measures against the spread of infectious diseases (e.g., Agranov et al., 2021; Bargain & Aminjonov, 2020; Barrios et al., 2021; Bartscher et al., 2021; Ferwana & Varshney, 2021; Jung et al., 2013; Qiao et al., 2022; Reich, 2020; Zhang et al., 2022). Similarly to the act of contributing to a public good, the individual decision to get vaccinated contributes to the creation of herd immunity, which makes possible to protect the whole population from the disease, including those who cannot be vaccinated like newborns or those with compromised immune systems. Our results are consistent with the idea that civic-minded individuals internalize more than others the effects of their actions on the diffusion of infectious disease and adapt their behavior accordingly.

The rest of the paper is organized as follows. We describe the data and the empirical methodology in Section 2. Section 3 presents the estimation results, and Section 4 concludes.

2 | MATERIALS AND METHODS

2.1 | Data

2.1.1 | Civic capital

To study the role of civic capital in the spread of the pandemic, we combine three proxies for civic capital commonly used in the literature: organ donations, the share of urban solid waste recycling, and tax compliance, which we aggregate via a polychoric principal component analysis (Kolenikov & Angeles, 2009). As the three variables used to build our civic capital proxy are pre-determined with respect to the pandemic, we are confident that they only capture the existing propensity of individuals to contribute to a common good. Since there is no unique definition of civic capital, we follow Guiso et al. (2011) and Guiso et al. (2016) and focus on measures of the "shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities." That is, we collect information on different dimensions of civic capital.

First, we use a dummy variable that records the presence of an organ donation association (specifically, an "*Associazione Italiana per la Donazione di Organi*," AIDO; the main association of this type in Italy) within a municipality (Guiso et al., 2016). As the decision to donate an organ brings no monetary reward for the donor, the concern that the presence of an AIDO may be related to economic motives is minimized. This variable, therefore, provides a valid proxy for the average municipal contribution to a common good. The presence of an organ donation association group is taken from the Lombardy association website and refers to 2021.[1]

Second, we consider individuals' propensity to free ride by collecting information on payment of the TV license fee required of all households in Italy owning a telecommunication device (e.g., radio or television). This information allows us to build a measure of local tax compliance. More specifically, for each municipality, we use the share of households paying the annual license fee (Buonanno et al., 2022; Buonanno & Vanin, 2017), as reported by the Italian national public broadcasting company (RAI - *Radiotelevisione Italiana*), which is a good proxy for tax compliance for the following reasons. First, the fee is mandatory and has a negligible impact on RAI's yearly budget.[2] Second, the fee amount is flat, small (about 9 euros per month), and independent of the household size. Moreover, customers can watch TV even without actually paying the fee, making its payment a pure public good contribution with no extrinsic incentive to comply.[3] Data for the tax compliance rate were obtained from Italy's national public broadcasting company (RAI) and are available for 2004–2010.

Finally, we also consider the 2014–2017 average share of recycling over the total amount of urban waste produced, which is taken from the Italian National Statistical Institute (ISTAT).[4] As recycling solid waste requires a non-negligible effort from an individual (time, space to separate waste types, etc.), and because the result of this effort—a cleaner environment—has a positive impact on the rest of society, the share of solid waste recycling is a perfect example of contribution to a public good.[5] The combination of the three via principal components results in an aggregate measure of civic capital *Civic Capital*, a variable that captures the propensity of individuals to contribute to the public good and to comply with legal and social norms.

2.1.2 | Vaccines

Our primary variable of interest is a measure of vaccine compliance. This variable consists of the number of vaccinated individuals over the number of residents for each municipality in Lombardy from June 1 to October 1, 2021. We gather data from the Lombardy Region.[6] This variable is used in Section 3 to estimate the effect of civic capital on vaccination compliance in 2021.

2.1.3 | Excess mortality

To measure the severity of the pandemic at the municipality level, we use excess mortality, defined as the difference between the number of deaths observed in Lombardy during the first COVID-19 wave (between January 1 and May 31, 2020), and the average number of deaths observed during the same time-span for all the years between 2015 and 2019 (see also Buonanno et al., 2020). We gathered mortality data released on October 22, 2020, by ISTAT.[7] The dataset includes the total mortality of 1501 out of the 1506 municipalities of Lombardy, covering virtually the entire regional population. We merge this information with data on the number of new cases observed during the second COVID-19 wave, from September 1 to November 1, 2020. We obtained data from the Lombardy Region.[8]

2.1.4 | Other control variables

We also collect information on the age structure of the population and compute the share of individuals over 60 years old (*Share of over 60*) from ISTAT. As an indicator of the air quality (*Pollution*), we collect data on the prevalence of fine particulate matter ($PM_{2.5}$) over the period 2017–2019 from ARPA Lombardia (Regional Environmental Protection Agency). Table A1 reports basic summary statistics for the variables used in our analysis.

2.2 | Methods

In Section 3, we analyze our dataset using both ordinary least-squares (OLS) and the generalized spatial two-stage least squares (GS2SLS) estimator of Kelejian and Prucha (1998). Specifically, we estimate the following model

$$y_{i,(t)} = \alpha + \beta \mathbf{CC}_i + \gamma \mathbf{Z}_i + \varepsilon_i \tag{1}$$

where, for each municipality i, y is the share of vaccinated individuals at different points in time (t), and **CC** is a set of dummy variables denoting civic capital tertiles. **Z** is a set of control variables that we use to account for possible confounding factors that may affect the interpretation of our findings, including the excess mortality per 100k inhabitants observed during the first epidemic wave, the second-wave number of detected cases, the share of the population over 60, and an indicator of air quality. Finally, α is the constant, and ε is a disturbance term.

3 | RESULTS

In this section, we report the results of our analysis focusing on the relationship between compliance with COVID-19 vaccination recommendations and civic capital across Lombardy municipalities. Vaccines for COVID-19 became available for the public from February 2021 onward, with older and more vulnerable groups in the population having priority over other individuals. At

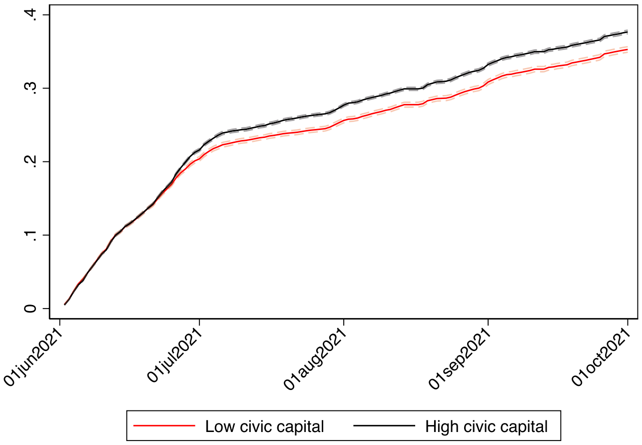

FIGURE 1 COVID19 vaccination rates (first dose), by municipality type. This figure shows the average growth of vaccination rate over time for municipalities with low and high civic capital from June 1, 2021 to October 1, 2021. Solid lines represent the mean value. Dashed lines define the 95 percent confidence interval. [Colour figure can be viewed at wileyonlinelibrary.com]

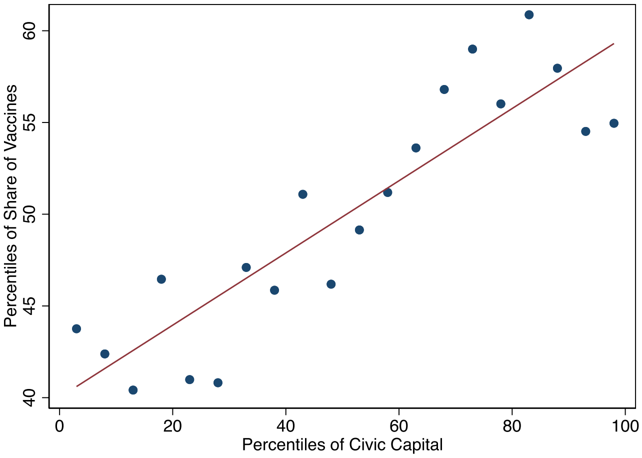

FIGURE 2 Civic capital and shares of vaccines. This figure shows the binned scatterplot between the percentiles of the vaccination rate and civic capital distributions. The distributions refer to all municipalities in our sample on October 1, 2021 (i.e., the sample used in column (4) of Table 1). [Colour figure can be viewed at wileyonlinelibrary.com]

the beginning of June 2021, vaccines became available for everyone regardless of age and individual conditions. For this reason, we restrict our analysis to the period from June 2021 to October 2021 to account for the staggered implementation of the policy.

To conduct an initial evaluation of the effect of civic capital on vaccination rates, in Figure 1, we graphically compare the trends for vaccination rates for high (above median) and low (below median) civic capital municipalities. Figure 1 highlights that the two types of municipalities follow a very similar trend during the first 3 weeks of June. The two trends start diverging after June, become significantly different during the first weeks of July, and remain on two parallel paths until the end of September. This initial descriptive evidence hints at differential compliance with the national vaccination recommendation depending on the level of civic capital. Another piece of evidence is shown in Figure 2, which shows the binned scatterplot between the percentiles of the civic capital (horizontal axis) and the share of vaccination (vertical axis) distributions. This figure shows a clear linear positive relationship between civic capital and the share of vaccinations. The regression coefficient of such an estimate is 0.007 and statistically significant at the one percent level.[9]

To provide more robust estimates, we run a set of regressions using the specification of Equation (1). In Table 1, we report the results of these regressions, where the dependent variable is the share of the municipal population vaccinated with at least one dose.[10] Each column from (1) to column (4) refers to a different point in time at which this variable is measured, while in column (5), we use the full set of days in our panel.[11] The progress on the *High Civic Capital* coefficients size from column (1) to column (5) shows that the effect begins to be significant by the beginning of July and remains stable in later months. The estimated coefficients are consistent with the initial evidence that high civic capital municipalities have a statistically significantly higher share of vaccinated individuals later in the summer than low civic capital municipalities. The effect size is around one percentage point of additional vaccinated individuals by October, that is, an additional 670 vaccinated individuals for an average-size municipality. Column (5) confirms the overall evidence in magnitude and significance level.

This relationship is robust to the inclusion of a minimal set of demographic controls such as population density (*Population density*), the share of individuals older than 60 (*Share of over 60*), a proxy for air pollution (*Pollution*) as well as the excess mortality observed during the first wave per 100k inhabitants (*first-wave excess mortality*) and the second-wave cumulative number of positive cases (*second-wave cases*). Controlling for the severity of the COVID-19 epidemic during the first and

TABLE 1 Civic capital and vaccination rates.

Dep. variable: Vaccination rate	July 1 (1)	Aug 1 (2)	Sep 1 (3)	Oct 1 (4)	July 1–Oct 1 (5)
High civic capital	0.008***	0.015***	0.017***	0.014***	0.005*
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Second wave per capita cases	0.103	0.381	−0.092	0.024	0.103***
	(0.307)	(0.282)	(0.302)	(0.258)	(0.031)
First-wave excess mortality	0.941*	1.235***	1.325***	1.035**	1.193***
	(0.502)	(0.471)	(0.466)	(0.408)	(0.050)
Population density	0.000	0.000*	0.000	0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pollution	0.000	0.000	−0.000	0.001*	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Share of over60	0.219***	0.162***	0.089**	0.081**	0.140***
	(0.042)	(0.039)	(0.039)	(0.036)	(0.004)
Mean Vaccination rate	0.609	0.666	0.722	0.763	0.689
N. observations	1379	1379	1379	1379	124,110

Note: This table reports coefficients estimates from ordinary least-squares regressions. The dependent variable is *vaccination rate* at the day specified in the column headers in columns (1) to (4). In column (5) we use all days from the July 1 to October 1. The main explanatory variables is *High Civic Capital*, which identifies municipalities with a level of civic capital proxy above the median. Additional controls include: the second-wave cumulative number of positive cases (*second-wave cases*), the excess mortality observed during the first wave per 100k inhabitants (*first-wave excess mortality*), the share of individuals over 60 years old (*share of over 60*), and an indicator of the air quality (*Pollution*) based on the prevalence of fine particulate matters ($PM_{2.5}$) over the period 2017–2019. In column (5) we also add interactions between *High Civic capital* and day fixed effects. Robust standard errors are presented in parentheses. *, ** and *** denote rejection of the null hypothesis of the coefficient being equal to 0 at 10%, 5% and 1% significance levels, respectively.

second waves is important to exclude a potential behavioral effect in demand for vaccination due to the previous and heterogeneous diffusion of the pandemic.

Second, we control for possible spatial spillovers such as interactions among municipalities (e.g., Drukker et al., 2013). There is no reason to believe that infections, contagion, and vaccination decisions follow the administrative boundaries of municipalities. Failing to consider the possibility that infections and vaccination decisions may not follow administrative boundaries may reduce the efficiency of our estimates and bias them. As an initial assessment, in Table A7 reported in the Appendix, we find that standard errors are basically unaffected if we account for spatial correlation across nearby units using Conley standard errors in the OLS regressions (Conley, 1999).[12] Next, we estimate a spatial model using the generalized spatial autoregressive two-stage least squares (GS2SLS) estimator of Kelejian and Prucha (1998). In Table A8 we report the results of spatial estimations of the correlation between the vaccination rate and civic capital, where we control for the first-wave excess mortality, the second-wave number of cases, and our wealth of control variables. This model reproduces the same specification as Column (4) of Table 1 in a spatial framework, that is, the vaccination rate is evaluated on October 1. We employ a contiguity matrix, and we implement a spatial autoregressive model (Column 1), a spatial error model (Column 2), and a model that combines the two by considering both a spatial lag and a spatial error structure (Column 3).[13] Allowing for a spatial structure in our data does not alter our baseline estimates: the coefficient of *High Civic capital* is positive, statistically significant at 1%, and comparable in magnitude to the baseline estimates.

4 | CONCLUSIONS

Our findings show a positive relationship between civic capital and COVID-19 vaccination rates. We find that municipalities of Lombardy displaying a historically higher level of collective contribution to the public good also record higher vaccination rates. This seems to be a permanent effect, as municipalities with lower civic capital do not catch up with those with higher civic capital over time. Our results are in line with the hypothesis that behavioral responses play a crucial role in the containment of the COVID-19 pandemic.

Understanding how civic and social capital may play a role in determining individual and collective responses to vaccination campaigns and, more in general, health policies is crucial for the efficacy of their implementation. Our results suggest that civic capital is important in explaining differences in public behaviors during pandemic and health crizes. On the other hand, our findings should be interpreted considering the multidimensionality of civic capital and its relationships with other factors (e.g., healthcare quality, culture, religion, etc). In this respect, further research should investigate the specific mechanism inducing individuals to get vaccinated. As vaccines remain the most effective containment measure of the COVID-19 pandemic, policymakers and health authorities should consider the behavioral response of individuals when designing public health policies.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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ENDNOTES

[1] https://www.aidolombardia.it/sezioni-e-gruppi/.

[2] Other authors have successfully used a similar proxy to measure tax compliance in other European countries (e.g., Berger et al., 2016; Fellner et al., 2013).

[3] For this reason, since July 2016, the Italian government has asked energy providers to levy the TV license fee through their bills.

[4] Available at http://amisuradicomune.istat.it/aMisuraDiComune/.

[5] Indeed, this measure is highly correlated with other measures of social capital, such as blood donations or electoral turnout.

[6] Available at https://hub.dati.lombardia.it/.

[7] Available at https://www.istat.it/it/archivio/240401.

[8] The two datasets are available at https://datawrapper.dwcdn.net/iMArO/12/ and https://www.datawrapper.de/_/567DW/.

[9] Depending on the age the resident population could get access to free vaccines. People 80 years old and older start the vaccination from February 15, 2021, from 75 to 79 on April 2, from 70 to 74 on April 8, from 65 to 69 on April 19, from 60 to 64 on April 22, from 50 to 59 on May 10, from 40 to 49 May 20, from 30 to 39 May 27, from 12 to 29 June 2.

[10] This result reassures us that the main evidence is not dependent on our definition of high/low civic capital municipalities.

[11] Specifically, in column (5) we flexibly control for time variation, by estimating the following equation: $y_{i,t} = \alpha + \beta \mathbf{CC}_i \times \delta_t + \gamma \mathbf{Z}_i + \varepsilon_i$, where δ_t are day fixed effects. As we consider a period of 90 days, we obtain 1379 (municipalities) x 90 (days) = 124,110 observations.

[12] The estimates presented in Table A7 are based on a Conley estimator and use a 25 km distance threshold. Unlike in Table 1, these estimates are not weighted by population, hence the slightly different coefficients. Alternative specifications using thresholds of 5 , 10, 50, and 75 km produce similar results.

[13] More specifically, in Column 3, we estimate the model $y_i = \rho W y_i + \beta \mathbf{CC}_i + \gamma \mathbf{Z}_i + \varepsilon_i$, with $\varepsilon_i = \lambda M \varepsilon_i + u$ and $u \sim iid(0, \sigma^2 I)$. In Column 1 and Column 2 we omit, respectively, the spatial autoregressive component (i.e., $\rho W y_i$), and the spatial error structure (i.e., $\varepsilon_i = \lambda M \varepsilon_i + u$).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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