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Giulia Montresor, Lucia Schiavon

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Social capital and vaccination compliance: Evidence from Italy *

Giulia Montresor,† Lucia Schiavon‡

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Abstract

Exploiting high-frequency vaccination data for COVID-19 and social capital measures at the municipal level in Italy between January and October 2021, this paper estimates the effect of social capital on vaccination compliance. We find that high social capital had a significant positive effect on the increase in weekly vaccination coverage rate for the overall population throughout the entire period of observation. The maximum effect magnitude of 1.25% is registered in the last week of July, before the introduction of the COVID-19 certificate. Results do not differ by gender and the effect is mainly driven by younger generations. Our findings shed light on the role of social capital as a driver of health protective behaviour, which can be leveraged on by public health campaigns and health intervetions.

JEL Classification: I10, I18, D80
Keywords: Social Capital, Vaccination, Health behaviour, COVID-19

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†University of Verona, Italy. ORCID: 0000-0002-3530-2768

‡University of Verona, Italy; CHILD - Collegio Carlo Alberto, Torino. ORCID: 0000-0002-4874-7539. Corresponding author: lucia.schiavon@univr.it

1 Introduction

Vaccination stands as the main public health measure in the prevention of communicable diseases, which pose a significant threat to human health and well-being. In addition to protecting individuals, vaccination also contributes to herd immunity, where a sufficient portion of the population is vaccinated, making it more difficult for the disease to spread.

In early 2020, the COVID-19 virus emerged and rapidly spread around the world, causing an unparalleled pandemic. Between late 2020 and early 2021, several vaccines received extraordinarily quick approval from national medicines agencies around the world for public use in vaccination campaigns. Watson et al. (2022) estimate that COVID-19 vaccination prevented 19.8 million deaths worldwide during the first year of its availability.

Social capital, generally defined as a combination of shared community values and beliefs, has the potential to play a vital role in promoting vaccination compliance. By fostering a sense of community and promoting trust and cooperation, social capital can help overcome vaccine hesitancy and improve vaccination rates at the local level.

Various studies have documented that regions with higher levels of social capital tended to adopt more health protective behaviour during the COVID-19 pandemic when compared to regions with lower social capital.

For instance, a number of studies document that high social capital regions reduced mobility more than low social capital ones both in the United States (Bai et al., 2020; Barrios et al., 2021; Borgonovi & Andrieu, 2020; Brodeur et al., 2021; Ding et al., 2020) and in Europe (Bargain & Aminjonov, 2020; Barrios et al., 2021; Durante et al., 2021).

In addition, there is evidence that regions with higher social capital led to fewer COVID-19 cases and deaths during the lockdown in the early stages of the COVID-19 pandemic both in the United States (Borgonovi et al., 2020) and in Europe (Bartscher et al., 2021).

In general, relatively little is known about how social capital may interplay with vaccination compliance. A few studies from the medical literature found that different dimensions of social capital, including generalized or governmental trust as well as voting participation, are positively associated with vaccination intentions or actual uptake during past infectious disease outbreaks around the world. Specifically, this association was observed during outbreaks of the severe acute respiratory syndrome (Chuang et al., 2015), swine flu (Rönnerstrand, 2013, 2014) and measles (Nagaoka et al., 2012). More recently, Ferwana & Varshney (2021) have shown that local institutional health - measured as confidence in media, corporations, schools and participation in institutions (e.g. elections and census) - positively correlated with vaccination uptake during the COVID-19 pandemic in the United States.

This paper examines the effect of social capital on compliance with COVID-19 vaccination using high-frequency municipal-level data from Italy, the first Western country hit by the COVID-19 pandemic.

Two previous studies, namely Buonanno, Galletta, & Puca (2022) and Paseyro Mayol &

Razzolini (2022), have documented a positive association between different measures of municipal-level social capital and vaccination coverage rates during the COVID-19 pandemic. However, these studies are limited to the single region of Lombardy [1]. We contribute to the literature, by expanding the analysis to the universe of Italian municipalities, which have been historically characterized by heterogeneous levels of social capital (Putnam, 1993; Guiso et al., 2016). The fine geographic level of our data allows us to control for confounding shocks, such as regional or provincial policies, by including province-level fixed effects.

Furthermore, we make use of a unique dataset which includes weekly vaccination information detailed by vaccine dose and individual characteristics such as age and gender. This enables us to investigate the differential effect of social capital on vaccination uptake across different subsets of the population.

We focus on the civic duty dimension of social capital, i.e. the propensity to cooperate and help in the creation of collective goods (Amodio et al., 2012; Guiso et al., 2011). To do so, we proxy social capital with voter turnout, a measure that has been widely used in the literature (see, for instance, Amodio et al. 2012; Bartscher et al. 2021; Bracco et al. 2015, 2021; Guiso et al. 2011; Nannicini et al. 2013; Ponzetto & Troiano 2018; Putnam et al. 1993). We use voter turnout to 2011 referenda as our baseline measure of social capital.

We find that municipalities lying at top quartile of social capital distribution experienced a positive and significant difference in vaccination coverage rate for the overall population as compared to the rest of municipalities, with a maximum weekly gap of 1.25%. Female and male populations share the same pattern in the evolution of the effect of high social capital on the vaccination coverage rate. However, the heterogeneous analysis by age groups reveals that the overall positive effect of social capital is mainly driven by individuals aged 40-49, with the maximum estimated weekly increase equal to 2.47% on May 31. Results are robust to the use of alternative measures of social capital commonly used in the literature as correlates of civic mindedness such as voter turnout at European elections or compliance rates with the TV licence fee as well as measures of general trust and social participation. Importantly, we document that results are neither driven by differences inherent to the North-South divide of the country nor by the specific region of Lombardy, the epicenter of the COVID-19 outbreak in Italy. Results are also robust to alternative model specifications, and definition of vaccination coverage. Taken toghether, our results show that local level social capital can significantly affect vaccination uptake. Such evidence is instrumental not for advancing vaccination campaigns targeting communicable diseases, and more generally, for designing effective public health policies and interventions. The rest of the paper is organized as follows. Section 2 provides background information on the COVID-19 outbreak and vaccination campaign in Italy and describes the data sources and variables used in the analysis. Section 3 presents the identification strategy and section 4 discusses main results and their robustness to a battery of checks. Section 5 concludes.

[1]Lombardy was the epicenter region of the COVID-19 outbreak in Italy

2 Background and data

2.1 COVID-19 outbreak and vaccination in Italy

Italy has been the first Western country hit by the COVID-19 pandemic. The first COVID-19 cases were reported on February 21 in Lombardy, followed by other cases in the neighboring region Veneto. In response, the government established local quarantine measures. The exponential spread of COVID-cases and deaths led the government to impose a national lockdown in the spring of 2020, with the closure of all non-primary activities and the impossibility for citizens to leave their homes for other than emergency reasons. In the following months, restrictions were progressively eased thanks to the set up of contact tracing and epidemic monitoring systems accompanied by less favorable epidemic conditions during the summer season. In November 2020, amidst the second wave of the COVID-19 pandemic, the government introduced a zoning system. Each week, regions were assigned one of three tiers (red, orange, yellow) associated with different levels of restrictions based on the evolving epidemic situation. In line with the vaccination campaigns across Europe, Italy initiated its COVID-19 vaccination campaign in late December 2020. The actual administration and distribution of vaccines within Italy commenced on December 31.

In the early months of 2021, the Ministry of Health unveiled a new comprehensive National strategic plan, outlining the prioritization and implementation framework for the COVID-19 vaccination campaign. The plan delineated a systematic approach for administering vaccines by categorizing the population into distinct vulnerability groups based on pre-existing medical conditions, age and occupation. The objective of the plan was to achieve a vaccination coverage of at least 80% of the population by September 2021.[2] In parallel to the vaccination campaign, the government introduced a new tier (white), imposing minimal restrictions on low-risk regions.

At first vaccination was reserved for workers in the medical sector, fragile or elderly people. Since February, priority to vaccination was recognized also to school and university personnel. Vaccination priority followed a decreasing order in age. By the end of May, the Italian National Medicines Agency (AIFA) approved the use of vaccines also on teenagers in the age group 12-15 years.

Over time, various vaccines were introduced. Pfizer-BioNTech was the initial vaccine followed by Moderna in early January, Astrazeneca in early February, and Johnson & Johnson in mid-March. As of early June, vaccination became accessible to all individuals.

The rapid approval process for COVID-19 vaccines led to frequent debates and, at times, revisions in vaccination implementation plans. One notable occurrence was the suspension in mid-March of the Astrazeneca vaccine by AIFA. The same action was undertaken by other European countries, namely Germany, France and Spain, in response to emerging reports of

[2] See https://www.governo.it/it/dipartimenti/cscovid19-pianovaccini/16417.

suspected cerebral thrombosis cases. This suspension lasted four days until the cases were disproved, leading to the reapproval of the vaccine by the European Medicines Agency.

On April 22, the government issued a decree which outlined the gradual reopening of the country and introduced a plan to establish a COVID-19 certificate system based on vaccination, testing and recovery from infection. This progressively tightened restrictions for unvaccinated individuals. On August 6, the government announced the COVID-19 certificate to become compulsory in order to be able access indoor dining, public events and services. On September 1st, the requirement of the COVID-19 certificate was extended for school and university staff and students and for accessing public transportation. On October 15, the COVID-19 certificate became compulsory for all workers in the private and public sector. Figure B.1 in the Appendix shows the weekly distribution of vaccination coverage from January 1 until October 25. By the end of October, vaccination coverage reached 75%.

2.2 Data

Vaccination coverage. To measure vaccination coverage, we use weekly data on COVID-19 vaccinations in Italian municipalities between January 4 and October 25 2021.[3] Vaccination counts are categorized by vaccine dose, gender and age group. We define *vaccination coverage* as COVID-19 first dose vaccination counts over the total population.[4][5] We instead refer to *full vaccination coverage* as COVID-19 second dose vaccination counts over the total population.

Social capital. We intend to measure the civic duty dimension of social capital in Italian municipalities. Our baseline measure of social capital is voter turnout in 2011 national referenda. These referenda addressed four matters of national significance, specifically the privatisation of water and local public services and the prohibition of nuclear power plant construction and immunity of government officials. Figure B.12 displays the geographic distribution of the referenda turnout across all municipalities in our sample. In general, voter turnout to popular referenda are argued as better proxies of civic responsibility and interest in the common good with respect to voter turnout to local or national elections. In particular, they are expected to be less affected by people's everyday life perceptions such as evaluations about the political performance of local incumbents (Bracco et al., 2021). However, it can happen that also such events are politicized. In occasion of the 2011 referenda, the then prime minister, Silvio Berlusconi invited to boycott the vote in order not to reach the required threshold of 50% plus 1 for its validity. Nevertheless, the referenda reached the highest turnout since 1995. Furthermore, Bracco et al. (2021) report a high correlation between the 2011 referenda with the one in 1974 related

[3]The dataset includes 7902 municipalities, out of a total of 7904 municipalities existing in Italy as of January 1st 2021.

[4]Vaccination is mainly observed in the municipality of residence (98.4% of the records).

[5]Total population refers to the total resident population on January 1 2021 and is obtained from the Italian National Institute of Statistics.

to the legalisation of divorce.[6] We test the sensitivity of our results to the use of alternative measures of social capital. First, we consider a different measure of voter turnout, specifically the voter turnout to European elections in 2014 and 2019.[7]

Further, we consider alternative municipal-level measures of social capital suggested by the literature. In particular, tax compliance with the TV licence fee has been extensively used to proxy for social capital and, in particular, civic preferences in Italy (see, for instance, Bracco et al., 2015, 2021; Buonanno, Cervellati, et al., 2022; Buonanno et al., 2009; Buonanno & Vanin, 2017). All households in Italy owning a television (or a radio) are subject to a yearly TV license fee ("canone") payment, however until 2015 this obligation was poorly enforced.[8] We use the share of households in a given municipality that paid the TV license fee in 2014.

Finally, we resort to survey measures of social capital. In line with Durante et al. (2023), we use data from the Aspects of Daily Life (ADL) survey and apply principal component analysis to construct indices reflecting distinct dimensions of social capital: i) social participation, ii) political participation, iii) trust in others, iv) trust in institutions. We construct municipal-level indices using data from all municipalities (1065) for which ADL information is available for the period bewteen 2012 and 2019. A detailed explanation of the construction of the social capital indices based on the ADL survey and related summary statistics can be found in the online Appendix. In our robustness analysis, we use the social participation and general trust dimensions of social capital, which we find to correlate the most with the 2011 national referenda voter turnout as well as all other alternative measures of social capital used in the analysis (online Appendix Table O.5). This evidence is different from what found in the provincial-level analysis conducted by Durante et al. (2023) and remarks the authors' advocacy that social capital is not only multifaceted but may well differ depending on the level of aggregation.

Control variables. In our baseline specification, we account for the temporal and geographical incidence of the pandemic. Specifically, we control for the cumulative number of COVID-19 cases and deaths available from official reports of Italian health authorities. We include the one-week lags of these variables. This allows us to take into account the history of exposure of citizens to the pandemic severity from the end of December 2020 until the week before a given

[6]Two more referenda were held after 2011 and before the COVID-19 pandemic broke out, both in 2016. However, these referenda were highly politically charged, and for this reason, they are not used in this paper. The first one was held on April 17 and concerned the duration of concessions for the extraction of hydrocarbons in sea areas. Turnout fell short of the required threshold of 50% for its validity. This outcome was associated with the influence exerted by the prime minister at that time, Matteo Renzi, who encouraged eligible voters to refrain from participating in the referendum (Bordignon & Sobbrio, 2016). The second referendum, held on December 4, addressed a constitutional reform advocated by the prime minister. Yet, the referendum was widely perceived as a vote on the prime minister himself. Eventually, the outcome of this referendum compelled the prime minister to resign (Ceccarini & Bordignon, 2017).

[7]We calculate average voter turnout as the simple average between the voter turnout in 2014 and 2019 European elections.

[8]Following law no. 208/2015, the TV license fee has been directly included in the electricity bills starting from 2016. This is because the law introduced a "presumption of ownership" of the television.

vaccination record.[9] COVID-19 cases are observed at the provincial level, while COVID-19 deaths are observed at the regional level.

We test the robustness of our main results to the inclusion of a battery of additional control variables. First, we consider municipal population density as well as a wealth of provincial-level characteristics using data most recently available before the onset of the COVID-19 pandemic.[10] We include hospitalization capacity, measured by the number of hospital beds available per hospital in a given province, averaged across the period 2010-2019. As socio-economic and demographic factors, we consider the share of population with a high school diploma or higher educational qualification, the share of population not in employment, education or training (NEET), income pro-capite, the employment rate, and the share of municipalities in a given province offering online services to their inhabitants[11].

Their values are measured at provincial-level and refer to the year 2019, with the exception of the share of municipal online services which refer to the year 2018 and provincial income pro-capite which refers to the year 2017.

We also include two provincial measures of air quality, namely, the concentration of particulate (PM10) and fine particulate (PM2.5) matters in 2019. [12][13]

Finally, we use a modified version of the municipal-level stringency index from Conteduca & Borin (2022) to control for weekly policy provisions enacted by central or local government over the course of the COVID-19 pandemic. The stringency index summarises 11 policy indicators, capturing restrictions on schools, production sector, shops, bars and restaurants, public events, gatherings, public transport, quarantine and isolation mandates, internal movements, international travel and the presence of public information campaigns.[14]

Appendix table A.1 lists all the variables used in the analyses and related data sources. Appendix table A.2 reports the descriptive statistics of the variables used in the analyses conducted

[9] We ran alternative specifications where we include different time lags for the COVID-19 pandemic controls. Changing the time lags does not alter the main results.

[10] Population density is measured as total population over total surface area of a municipality in square kilometers. Total surface area data are retrieved from the Italian National Institute of Statistics.

[11] Municipalities offering online services are defined as municipalities that provide at least one online service for families or individuals, allowing for the entire process to be conducted electronically, including online payment options.

[12] Particulate matter (or particle pollution) are defined by their diameter for air pollution measurement. Particulate matter with a diameter up to 10 microns (PM10) are inhalable into the lungs and can induce adverse health effects. Fine particulate matter is defined as having a diameter of up to 2.5 microns (PM2.5).

[13] Data on hospitalization capacity, socio-economic and demographic factors and air quality measures are obtained from the "Equitable and Sustainable Well-being" (BES) survey conducted by the Italian National Institute of Statistics.

[14] We compute the stringency index following equation 1 from Conteduca & Borin (2022): $I_{mti} = 100 * v_{mti} * V_i^{-1}$, where v is the value of a policy indicator for unvaccinated individuals i in municipality m at week t and V is the maximum value of policy indicator V. See Conteduca & Borin (2022) for a detailed explanation of the policy indicators and their values. Conteduca & Borin (2022) use this formula for the period between the COVID-19 pandemic outbreak in 2020 and August 6 2021, when the green pass was implemented. Starting from August 6 2021, the authors adjust the formula to allow for different weights between vaccinated and unvaccinated populations. We do not apply this adjustment and only consider policy restrictions affecting unvaccinated individuals throughout the period of analysis.

on the main sample.

3 Empirical strategy

To estimate the effect of predetermined social capital on vaccination coverage, we employ the following linear specification:

$$\begin{aligned} ln(Y)_{mt} = \beta_t HighSocialCapital_m * Week_t + Month_i * Region_r + Week_t * VaxWeek_{mt} \\ + Province_p \mu ln(Cases)_{pt-1} + \pi ln(Deaths)_{rt-1} + \varepsilon_{mt} \end{aligned} \quad (1)$$

where Y indicates COVID-19 vaccination coverage (in log + 1 form) in a given municipality m in calendar week t. $HighSocialCapital$ is a dummy that takes on a value of one if the municipality lies in the top quartile of voter turnout in the 2011 referenda, and zero otherwise. This indicator is interacted with week calendar dummies. The time-varying β are our coefficients of interest and capture the differential evolution of vaccination coverage between high and low social capital municipalities.

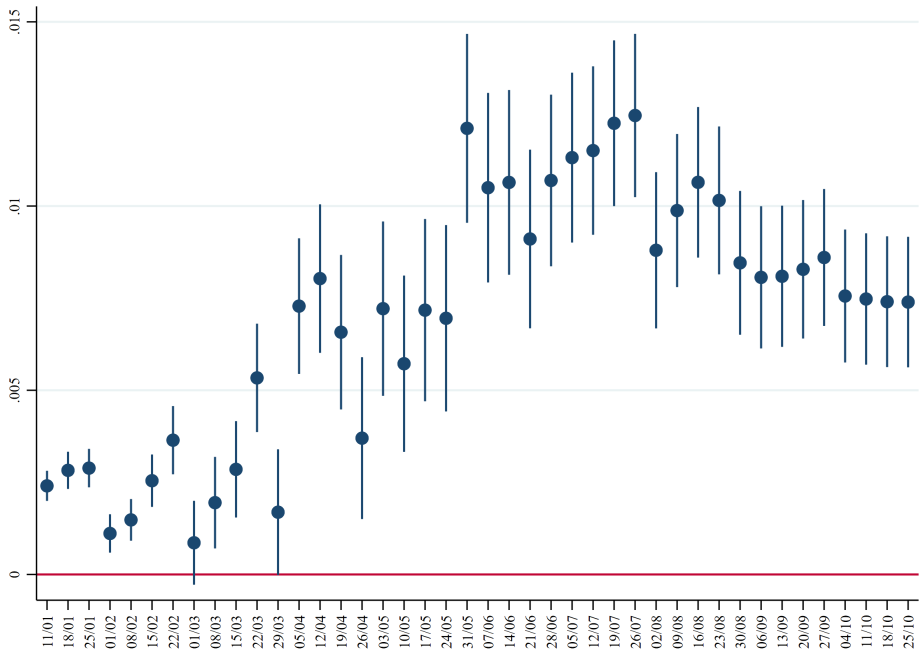
Our identifying assumption is that no unobserved factor correlated with social capital systematically and differentially affects the evolution of vaccination coverage across municipalities. To make this assumption as plausible as possible, we include a wealth of time-varying fixed effects to flexibly account for differential trends in vaccination coverage. The interaction between region and month calendar dummies ($Month_i * Region_r$) controls for any regional-level policy response at a monthly frequency. Importantly, the health care system in Italy is regulated at the regional level. In addition, the interaction between calendar week dummies and the number of weeks since vaccination became available in a given municipality ($Week_t * VaxWeek_{mt}$) accounts for the differential start of the vaccination effort across municipalities, while flexibly allowing for any update over the vaccination campaign. The effect estimation is also conditioned province fixed effects and on the local and temporal degree of the pandemic severity, which we proxy using weekly lags of cumulative COVID-19 cases recorded in a given province and cumulative deaths recorded in a given region. Both variables are taken in log + 1 form. Standard errors are clustered at the municipal level.

4 Results

Average effects. Figure 1 illustrates the differential evolution of vaccination coverage over time for high relative to low social capital municipalities. The figure plots the β_t coefficients estimated using equation (1). We see a clear and consistent pattern of positive and significant effects of high social capital on vaccination coverage over the period, increasing in magnitude until the end of July.

In January 2021, the first month of the vaccination campaign, vaccination was reserved for workers in the medical sector, fragile or elderly people. For this period, overall we observe a slightly positive and significant effect of high social capital on vaccination compliance, which amounts to +0.27%. In February, the vaccination priority was extended to include school and university personnel. However, at the end of the same month, the Alpha variant of COVID-19 virus began to circulate in Italy, leading to the onset of the third wave of the pandemic. The new variant was more transmissible than the previous one. Given the sharp increase of Covid-cases, the Italian government adopted new restrictions on the mobility of people and other limitations to contain the spread of the new COVID-19 variant. The peak of the cases was later recorded at the end of March. According to our assumption, the expansion of the eligible population would have boosted vaccination coverage in high social capital municipalities. On the other hand, existing literature indicates that high social capital regions reduced mobility more than low social capital ones when restrictions were in place. This reduction in mobility may have led to lower vaccination rates in the former regions. The two effects go in opposing directions. Nonetheless, throughout these months, the estimate of the effect of high social capital remains positive and statistically significant, at around +0.25%. This suggests that the influence of the first effect outweighed that of the second effect.

Figure 1: Effect of social capital on vaccination coverage



Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are obtained from the model outlined in equation (1) performed on a sample of 7,902 municipalities (339,786 observations). Confidence interval at 95% level.

Following the end of the third wave and the subsequent lifting of restriction on April 6, we can notice an increase in the estimated coefficients up to 0.80%. However, a small temporary reduction is visible in the week of April 26, coinciding with the implementation of the "decree on reopening". The decree defined the provisions for the gradual easing of COVID-19 restrictions in Italy going from the reopening of business to outdoor activities.

Starting from June until the end of July, we can detect a further increase in the effect of high social capital on vaccination coverage. Within this interval, the average effect is equal to 1.12% (the highest effect equal to 1.25% is estimated in the week of July 26). Remarkably, as of June, the easing of COVID-19 restrictions was proceeding and vaccination became available to all the population, including younger generations. At the same time, the organization of open-days became more popular[15]. During a vaccination open-day, any individual could receive the vaccine also without reservation. These findings further support our assumption that individuals in high social capital municipalities respond more promptly to vaccination as soon as vaccines are available.

In parallel, during the month of July, a new pandemic wave emerged due to the transmission of the Delta variant, and persisted until autumn. Starting from August, a decreasing pattern can be observed in the estimated effect of high social capital on vaccination coverage. This is in correspondence with the requirement of a COVID-19 certificate for accessing public events and services as well as indoor restaurants starting from August 6. This certificate could have been obtained either through testing or by being fully vaccinated. The certificate obtained through testing was valid for 48 hours, while the one obtained through vaccination was valid for several months. Moreover, the cost of the former was covered by the citizen, while the latter was covered by the Italian health system. Therefore, there was a double incentive for citizens to get vaccinated rather than testing to obtain the certificate. A subsequent reduction is visible at the end of August when the COVID-19 certificate became compulsory for school and university staff and students for attending lectures and accessing public transport. Eventually, we observe an additional small reduction at the beginning of October, anticipating the requirement of COVID-19 certificate for all workers in public and private sectors in force from October 15.

Overall, the introduction of restrictions based on testing or vaccination status reduced but not crowded-out the role played by high social capital in the decision to vaccinate. By the end of October, a significant and positive differential vaccination coverage of 0.74% still remains between high social capital municipalities and the rest.

Heterogeneous effects by gender To explore whether there are differences in the effect of social capital on vaccination coverage among females and males, we perform the analysis separately by gender. In figure B.2 in the Appendix, we can observe that the patterns in the two

[15]See for example: https://napoli.corriere.it/notizie/cronaca/21_giugno_06/vaccini-cento-open-day-campania-si-parte-anche-le-somministrazioni-farmacia-93395058-c690-11eb-a1c9-66b1a1d14d07.shtml; https://www.ilrestodelcarlino.it/modena/cronaca/open-day-vaccini-1.6443894

subpopulations are exactly the same with the exception of the first month, during which we can notice a positive and significant effect in the female subpopulation but no effect in the male subpopulation. This difference may be driven by the fact that priority was given to elderly people, with females representing the highest proportion.

Heterogeneous effects by age groups We also investigate heterogeneous effects by age groups. We consider six age groups: 12-19 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years, and 60 years or older people. The different access to vaccination according to the age group dictated by the vaccination plan emerges clearly from Figure B.3 in the Appendix. For instance, in the population aged 12-19 (panel a), no effect was revealed until the end of May, when teenagers became eligible for COVID-19 vaccination and vaccination open-days without age requirement started to take place. We can recognize a significant positive pattern for the effects of high social capital on vaccination coverage across all cohorts, with some differences in the magnitude of the effects. Differently from younger cohorts, for people aged 50 or older, the estimated β coefficients never exceed 2%. Moreover, if we focus on the elderly population (panel f), we observe a drop in the estimated effects around the beginning of March and end of April, coinciding with the emergence of the COVID-19 Alpha variant. In those weeks, no difference is detected between high and low social capital municipalities in vaccination coverage.

4.1 Robustness checks

To confirm the validity of our results, we conduct a range of robustness checks.

Additional controls. We investigate whether our findings are driven by other factors, not considered in the baseline equation (1), that may correlate with both vaccination and social capital. We enrich the model specification with control variables for the risk of contagion, measured with the population density at the municipal level, the time-varying municipal stringency index representing current policy restriction provisions, the hospitalization capacity at the provincial level, and a rich set of other geographic, socio-economic and demographic characteristics at the provincial level (see section 3 for a detailed description of the control variables). Provicial-level control variables have been interacted with monthly dummies. The estimated results are similar to the ones of our baseline model (Figure B.4 in the Appendix).

Comparison between North-Center and South-Center of Italy. To rule out the hypothesis that our results are driven by previous differences in social capital between Northern-Central and Southern-Central Italian regions, we perfom the analysis on the two respective subsamples[16]. The identification of the municipalities lying in the top quartile of high social capital has

[16]Northern-Central Italian regions: Piemonte, Valle d'Aosta, Liguria, Lombardia, Trentino Alto-Adige, Veneto, Friuli Venezia Giulia, Emilia Romagna, Toscana, Marche.
Southern-Central Italian regions: Molise, Umbria, Puglia, Sicilia, Sardegna, Abruzzo, Basilicata, Calabria, Cam-

been conducted by referring to the social capital distribution within the respective subsample. Results confirm the positive trend of high social capital in both subsamples (Figures B.5 in the Appendix).

Excluding Lombardy. Among the Italian regions, Lombardy stands out for two reasons. Firstly, it was the first region to report a confirmed case of COVID-19 and experienced a significant impact from the pandemic. Secondly, and more important for the current study, it faced challenges in the initial phase of the vaccination campaign, experiencing a slower start compared to other regions[17]. Hence, as a robustness check, we re-perform the analysis excluding the municipalities of Lombardy. Municipalities in the top quartile of social capital have been identified referring to the distribution without Lombardy. Figure B.6 in the Appendix shows similar results to those obtained in the baseline model. The exclusion (inclusion) of Lombardy does not affect our findings.

Alternative measures of social capital. Results are robust to different measures of social capital. The use of our main measure of social capital in continous form does not alter the baseline results (Figure B.7 in the Appendix). The alternative use of average electoral turnout at the last two EU elections in 2014 and 2019 as as a measure to identify municipalities in the top quartile of the high social capital distribution also leads to consistent results (Figure B.8 in the Appendix). Although in the first period, the estimated pattern shows some differences from our results, the persistent and positive effect of high social capital on vaccination coverage is later confirmed. Additionally, as an alternative measure of social capital, we take into consideration the share of households paying TV license fee in 2014 over fee-eligible population at the municipal level. Our main findings are again confirmed (Figure B.9 in the Appendix).

Average effects on full vaccination coverage. To assess whether our findings are confirmed also in terms of full vaccination coverage, we estimate the effects using COVID-19 second dose vaccination coverage as a dependent variable.[18] As shown in Figure B.10 in the Appendix, the effect of high civic capital on full vaccination coverage exhibits a similar pattern to that observed for vaccination coverage considering the first dose (Figure 1), with a slight time lag. This is consistent with the time interval required between the two vaccine doses. Yet, the timing can differ depending on the specific type of the COVID-19 vaccine, ranging from 3 to 12 weeks. In addition to this, during the analyzed period, AIFA - in line with EMA - updated its recommendations multiple times regarding the timing between the first and the second doses for each type of vaccine. These two factors contribute to understanding why we do not observe

pania, Lazio.

[17]See for example: https://milano.repubblica.it/cronaca/2021/03/12/news/vaccinazioni_a_rilento_lombardia_in_coda_alla_classifica_nazionale-291853937/; https://www.ilpost.it/2021/03/22/caos-vaccinazioni-lombardia/

[18]We estimate a modified version of equation (1), where we substitute the interaction term $Week_t * VaxWeek_{mt}$ with $Week_t * Vax2Week_{mt}$. $Vax2Week_{mt}$ represents the number of weeks since COVID-19 second dose vaccination became available in a given municipality.

exactly the same pattern observed in Figure 1. When reasoning on full vaccination coverage, we have to consider that not all types of COVID-19 vaccines, such as Johnson & Johnson, require a second dose for their optimal effectiveness. Moreover, individuals who have been infected by COVID-19 in the previous 12 months only require one dose of vaccine for full coverage. Hence, the proportion of people who received a second dose that we observe in the data is a proxy for the measure of full vaccination coverage, whose real value may be higher.

5 Conclusions

In this paper, we investigate the relationship between social capital and vaccination compliance using high-frequency vaccination data from Italy during the COVID-19 pandemic. After measuring social capital at the municipal level, we estimate its effect on the weekly vaccination coverage rate from January to October 2021.

Our results document a significant positive effect of social capital on weekly vaccination coverage. Once vaccines are available, municipalities with stronger social ties and a sense of civic duty show higher compliance. The estimated effect of high social capital is consistent across female and male populations and is driven primarily by younger generations.

Overall, these findings confirm the importance of social capital as a driver of health-protective behaviour, specifically in the context of vaccination compliance. The present study thus extends our understanding of the role of social capital, which has previously been explored in the contexts of social mobility, the spread of Covid-19 cases and the number of excess deaths.[19] Communities with higher social capital value public health and exhibit greater engagement in vaccination efforts than those with lower social capital. This evidence holds substantial implications for policymakers. First, social capital may play a substantial role in shaping effective vaccination campaigns. Authorities should design different nudging strategies to promote vaccination compliance, such as information campaigns that emphasise a sense of community and cooperation between individuals, depending on the average level of social capital in the target communities.

Second, given the pivotal role of social capital in enhancing health-protective behaviours, policymakers should invest in the formation of social capital itself. Recent studies have indicated a significant positive relationship between civic duty and civic education (Feitosa, 2020; Galais, 2018), as well as with horizontal teaching practices (e.g. working in groups) (Algan et al., 2013). Thus, schools could encourage the cultivation of civic duty in the younger generations by offering appropriate civic education courses or promoting progressive education. Additionally, local initiatives can contribute to the establishment of stronger social bonds and cooperation (Attanasio et al., 2015; Fearon et al., 2009).

In conclusion, our findings advocate for novel public health policies and interventions that

[19]See, for instance, Bai et al., 2020; Bargain & Aminjonov, 2020; Barrios et al., 2021; Bartscher et al., 2021; Borgonovi & Andrieu, 2020; Borgonovi et al., 2020; Brodeur et al., 2021; Ding et al., 2020; Durante et al., 2021.

take into account the role of social capital to enable more effective responses to exigent scenarios like pandemics.

References

Algan, Y., Cahuc, P., & Shleifer, A. (2013). Teaching practices and social capital. *American Economic Journal: Applied Economics*, *5*(3), 189–210.

Amodio, F., et al. (2012). Hard to forget: long-lasting effects of social capital accumulation shocks. *Universitat Pompeu Fabra. Faculta de Economia de Forlí, Working paper*, *105*.

Attanasio, O., Polania-Reyes, S., & Pellerano, L. (2015). Building social capital: Conditional cash transfers and cooperation. *Journal of Economic Behavior & Organization*, *118*, 22–39.

Bai, J. J., Du, S., Jin, W., & Wan, C. (2020). The impact of social capital on individual responses to covid-19 pandemic: Evidence from social distancing. *Shuili and Jin, Wang and Wan, Chi, The Impact of Social Capital on Individual Responses to COVID-19 Pandemic: Evidence from Social Distancing (June 14, 2020)*.

Bargain, O., & Aminjonov, U. (2020). Trust and compliance to public health policies in times of covid-19. *Journal of public economics*, *192*, 104316.

Barrios, J. M., Benmelech, E., Hochberg, Y. V., Sapienza, P., & Zingales, L. (2021). Civic capital and social distancing during the covid-19 pandemicâ. *Journal of public economics*, *193*, 104310.

Bartscher, A. K., Seitz, S., Siegloch, S., Slotwinski, M., & Wehrhöfer, N. (2021). Social capital and the spread of covid-19: Insights from european countries. *Journal of Health Economics*, *80*, 102531.

Bordignon, M., & Sobbrio, F. (2016). Report of the sage working group on vaccine hesitancy..

Borgonovi, F., & Andrieu, E. (2020). Bowling together by bowling alone: Social capital and covid-19. *Social science & medicine*, *265*, 113501.

Borgonovi, F., Andrieu, E., & Subramanian, S. (2020). Community level social capital and covid-19 infections and fatality in the united states. *Covid Economics*, *32*, 110–126.

Bracco, E., De Paola, M., & Green, C. P. (2015). Long lasting differences in civic capital: Evidence from a unique immigration event in italy. *Journal of Economic Behavior & Organization*, *120*, 160–173.

Bracco, E., Liberini, F., Lockwood, B., Porcelli, F., Redoano, M., Sgroi, D., et al. (2021). *The effects of social capital on government performance and turnover: Theory and evidence from italian municipalities* (Tech. Rep.). Quantitative and Analytical Political Economy Research Centre.

Brodeur, A., Grigoryeva, I., & Kattan, L. (2021). Stay-at-home orders, social distancing, and trust. *Journal of Population Economics*, *34*(4), 1321–1354.

Buonanno, P., Cervellati, M., Lazzaroni, S., & Prarolo, G. (2022). Historical social contracts and their legacy: a disaggregated analysis of the medieval republics. *Journal of Economic Growth*, *27*(4), 485–526.

Buonanno, P., Galletta, S., & Puca, M. (2022). The role of civic capital during the covid-19 pandemic.

Buonanno, P., Montolio, D., & Vanin, P. (2009). Does social capital reduce crime? *The journal of law and economics*, *52*(1), 145–170.

Buonanno, P., & Vanin, P. (2017). Social closure, surnames and crime. *Journal of Economic Behavior & Organization*, *137*, 160–175.

Ceccarini, L., & Bordignon, F. (2017). Referendum on renzi: The 2016 vote on the italian constitutional revision. *South European Society and Politics*, *22*(3), 281–302.

Chuang, Y.-C., Huang, Y.-L., Tseng, K.-C., Yen, C.-H., & Yang, L.-h. (2015). Social capital and health-protective behavior intentions in an influenza pandemic. *PloS one*, *10*(4), e0122970.

Conteduca, F. P., & Borin, A. (2022). A new dataset for local and national covid-19-related restrictions in italy. *Italian Economic Journal*, *8*(2), 435–470.

Ding, W., Levine, R., Lin, C., & Xie, W. (2020). *Social distancing and social capital: Why us counties respond differently to covid-19* (Tech. Rep.). National Bureau of Economic Research.

Durante, R., Guiso, L., & Gulino, G. (2021). Asocial capital: Civic culture and social distancing during covid-19. *Journal of Public Economics*, *194*, 104342.

Durante, R., Mastrorocco, N., Minale, L., & Snyder Jr, J. M. (2023). *Unpacking social capital* (Tech. Rep.). National Bureau of Economic Research.

Fearon, J. D., Humphreys, M., & Weinstein, J. M. (2009). Can development aid contribute to social cohesion after civil war? evidence from a field experiment in post-conflict liberia. *American Economic Review*, *99*(2), 287–291.

Feitosa, F. (2020). Does civic education foster civic duty? a systematic cross-country analysis of the effect of three forms of civic education on the sense of civic duty to vote. *Canadian Journal of Political Science/Revue canadienne de science politique*, *53*(4), 887–901.

Ferwana, I., & Varshney, L. R. (2021). Social capital dimensions are differentially associated with covid-19 vaccinations, masks, and physical distancing. *Plos one*, *16*(12), e0260818.

Galais, C. (2018). How to make dutiful citizens and influence turnout: The effects of family and school dynamics on the duty to vote. *Canadian Journal of Political Science/Revue canadienne de science politique*, *51*(3), 599–617.

Guiso, L., Sapienza, P., & Zingales, L. (2011). Civic capital as the missing link. *Handbook of social economics*, *1*, 417–480.

Nagaoka, K., Fujiwara, T., & Ito, J. (2012). Do income inequality and social capital associate with measles-containing vaccine coverage rate? *Vaccine*, *30*(52), 7481–7488.

Nannicini, T., Stella, A., Tabellini, G., & Troiano, U. (2013). Social capital and political accountability. *American Economic Journal: Economic Policy*, *5*(2), 222–250.

Paseyro Mayol, J., & Razzolini, T. (2022). Covid-19 vaccine uptake: the role of civic capital to overcome the free rider problem. *Applied Economics Letters*, 1–7.

Ponzetto, G. A., & Troiano, U. (2018). *Social capital, government expenditures and growth* (Tech. Rep.). National Bureau of Economic Research.

Putnam, R. D., Leonardi, R., Nanetti, R., et al. (1993). *Making democracy work: civic traditions in modern italy* (Tech. Rep.). Princeton University Press.

Rönnerstrand, B. (2013). Social capital and immunisation against the 2009 a (h1n1) pandemic in sweden. *Scandinavian Journal of Public Health*, *41*(8), 853–859.

Rönnerstrand, B. (2014). Social capital and immunization against the 2009 a (h1n1) pandemic in the american states. *Public health*, *128*(8), 709–715.

Watson, O. J., Barnsley, G., Toor, J., Hogan, A. B., Winskill, P., & Ghani, A. C. (2022). Global impact of the first year of covid-19 vaccination: a mathematical modelling study. *The Lancet Infectious Diseases*, *22*(9), 1293–1302.

Appendix A: Tables

Table A.1: Description of variables and data sources

Variable	Description	Source
Dependent variables		
Vaccination coverage rate	Weekly (first dose) cumulative vaccinations as a ratio with respect to the population as of January 1 2021, in a municipality	Vaccination data: ISS. Population data: ISTAT
Vaccination coverage rate by gender	Weekly (first dose) cumulative vaccinations of female (male) individuals as a ratio with respect to the female (male) population as of January 1 2021, in a municipality	Vaccination data: ISS. Population data: ISTAT
Vaccination coverage rate by age group	Weekly (first dose) cumulative vaccinations of individuals in a given age group (12-19, 20-29, 30-39, 40-49, 50-59, 60+) as a ratio relative to the respective population-age group as of January 1 2021, in a municipality	Vaccination data: ISS. Population data: ISTAT
Full vaccination coverage rate	Weekly (second dose) vaccination coverage rate, i.e. weekly cumulative vaccinations as a ratio with respect to the population as of January 1 2021, in a municipality	Vaccination data: ISS. Population data: ISTAT
Social capital		
Referenda turnout	Average turnout at 2011 referenda in a municipality	Italian Ministry of Interior
European election turnout	Average turnout at European elections in 2014 and 2019 in a municipality	Italian Ministry of Interior
TV fee compliance rate	Share of households complying with TV lincese fee in 2014 in a municipality	RAI TV
Social participation index	Index combining social participation attitudes following Durante et al. (2023), for the period 2012-2019 and aggregated at municipal level	ADL survey
Political participation index	Index combining political participation attitudes following Durante et al. (2023), for the period 2012-2019 and aggregated at municipal level	ADL survey
General trust index	Index combining general trust beliefs following Durante et al. (2023), for the period 2012-2019 and aggregated at municipal level	ADL survey
Institutional trust index	Index combining institutional trust beliefs following Durante et al. (2023), for the period 2012-2019 and aggregated at municipal level	ADL survey
Control variables		
COVID-19 cases	Weekly cumulative number of COVID-19 cases recorded in a province as a ratio with respect to the total population as January 1 2021	Italian Civil Protection Department
COVID-19 deaths	Weekly cumulative number of COVID-19 deaths recorded in a region, as a ratio with respect to the total population as January 1 2021	Italian Civil Protection Department
Population density	Population per square kilometer in a municipality as of January 1 2021	ISTAT
Hospitalization capacity	Average number of hospital beds for high care specialities per hospital in a given province per 10k inhabitants in 2019	ISTAT
High school diploma share	Share of population with a high school diploma or higher educational qualitification as a ratio with respect to the population aged 25-64 in 2019	ISTAT
NEET population share	Share of population not in employment, education or training (NEET) as a ratio with respect to the population aged 15-29 in 2019	ISTAT
Income pro capite	Average income pro capite in a given province in 2017	ISTAT
Employment rate	Share of population in employment as a ratio with respect to the population aged 20-64 in 2019	ISTAT
Online service municipality share	Share of municipalities offering online services to their residents in a given province in 2018	ISTAT
PM10	Average PM10 particles concentration in a province in 2019	ISTAT
PM2.5	Average PM25 particles concentration in a province in 2019	ISTAT
Green urban share	Share of green urban areas in a province in 2019	ISTAT
Stringency index	Idex combining all COVID-19 policy measures present in a given week in a municipality	Conteduca & Borin (2022)

Note: ISS stands for the "Istituto Superiore di Sanità". ISTAT stands for Italian National Institute of Statistics. ADL stands for "Aspects of Daily Life".

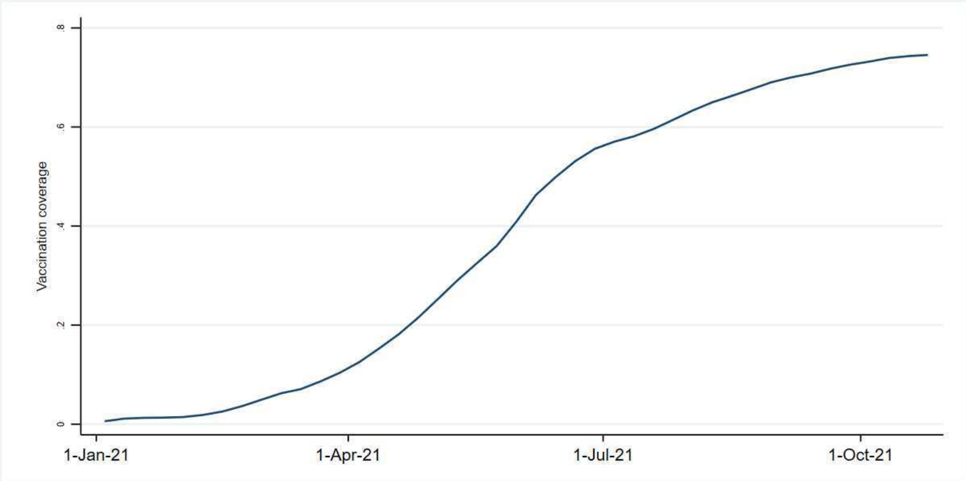
Table A.2: Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max	N. Obs.
Vaccination coverage rate	0.281	0.219	0	1	363492
Vaccination coverage rate: female population	0.286	0.218	0	1	363492
Vaccination coverage rate: population aged 12-19	0.188	0.232	0	1	363492
Vaccination coverage rate: population aged 20-29	0.245	0.238	0	1	363492
Vaccination coverage rate: population aged 30-39	0.245	0.226	0	1	363492
Vaccination coverage rate: population aged 40-49	0.272	0.237	0	1	363492
Vaccination coverage rate: population aged 50-59	0.307	0.251	0	1	363492
Vaccination coverage rate: population aged 60+	0.364	0.258	0	1	363492
Full vaccination coverage rate	0.208	0.198	0	1	363492
Referenda turnout	0.566	0.074	0	1	363492
Turnout to EU-elections	0.600	0.149	0	1	363492
TV fee compliance rate	0.695	0.120	0	1	363400
PM 10	26.070	6.463	9	39	350152
PM 2.5	16.061	5.195	6	26	312892
Urban green areas share	46.647	71.872	3	395	363492
Population density	299.126	636.996	1	11886	363492
Hospital bed capacity per 10k inhabitants	2.880	1.056	0	9	363492
Population share with at least high school diploma	61.564	6.973	42	76	363492
Share of municipalities with online services	25.314	16.414	4	100	360134
NEET share	20.544	8.383	9	46	363492
Income pro capite	18268.364	3600.069	10881	27301	358570
Employment rate	64.630	10.874	39	80	363492
Stringency index	59.297	11.813	37	85	363492

Note: The table reports mean, standard deviation, mininum, maximum value and number of observations for each variable in our sample.

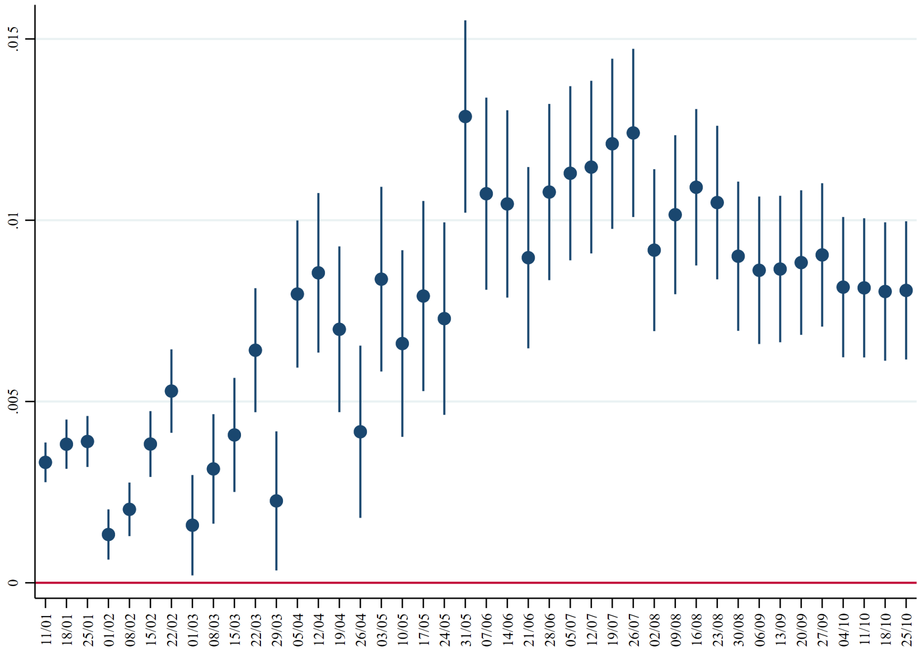
Appendix B: Figures

Figure B.1: COVID-19 vaccination coverage by week

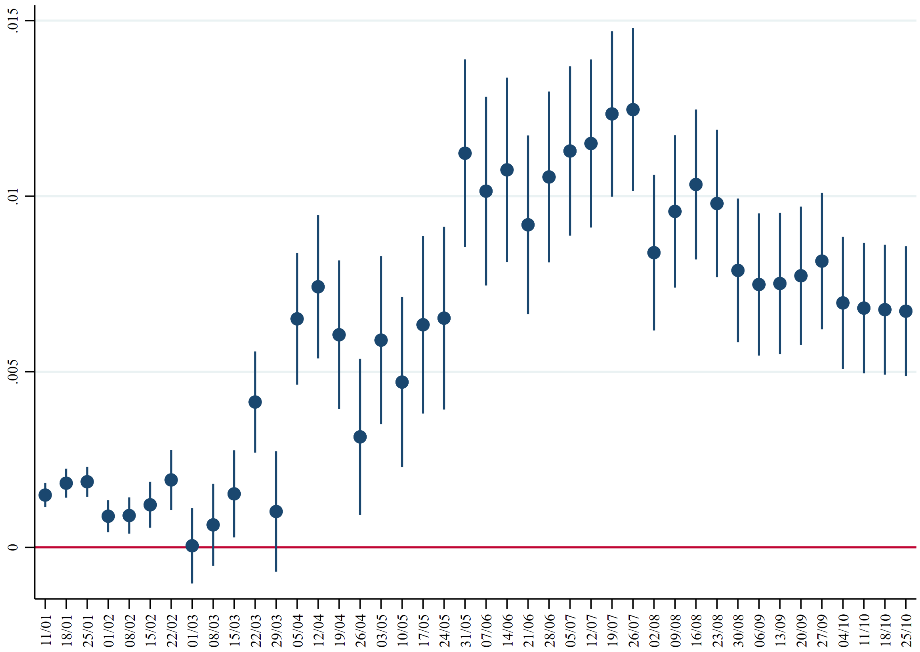


Note: Authors' calculations based on data from Istituto Superiore di Sanità. Vaccination coverage is measured as the ratio between cumulative COVID-19 first dose vaccination counts to the total population as of January 1 2021.

Figure B.2: Effects of social capital on vaccination coverage by gender



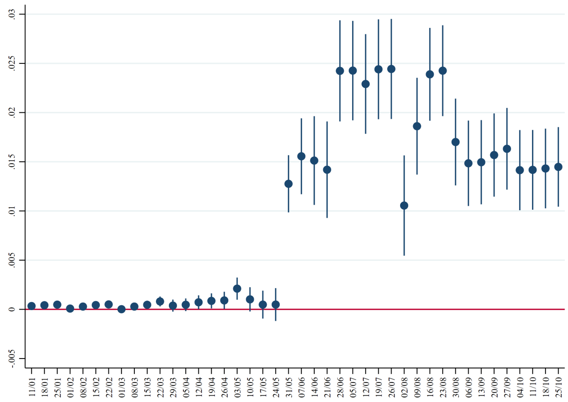
(a) Female population



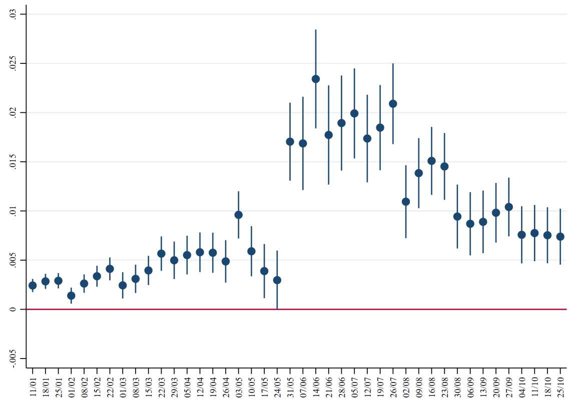
(b) Male population

Note: The figure plots differences in COVID-19 full vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week, for female and male subpopulations respectively. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sample of 7,902 municipalities (339,786 observations). Confidence interval at 95% level.

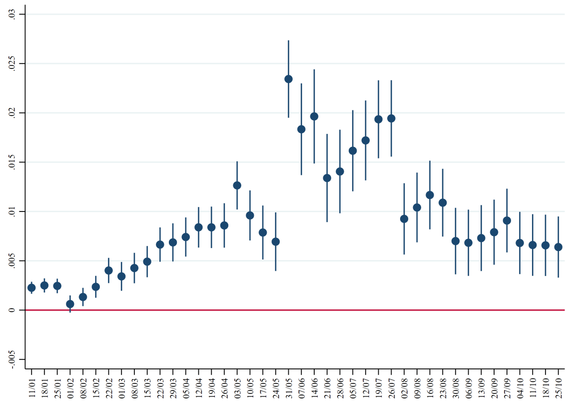
Figure B.3: Effect of high social capital on the vaccination cumulative rate by age group



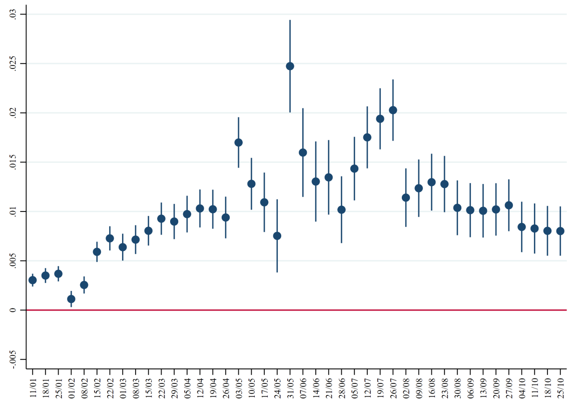
(a) Population aged 12-19



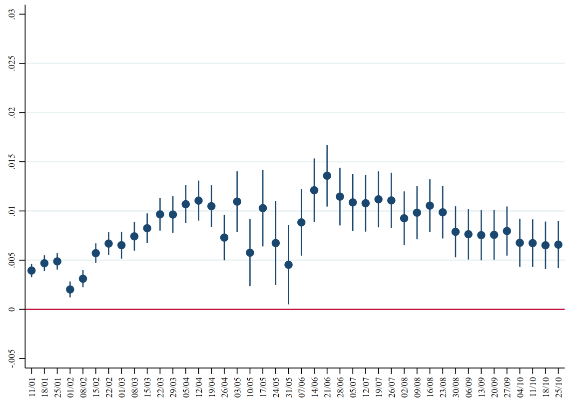
(b) Population aged 20-29



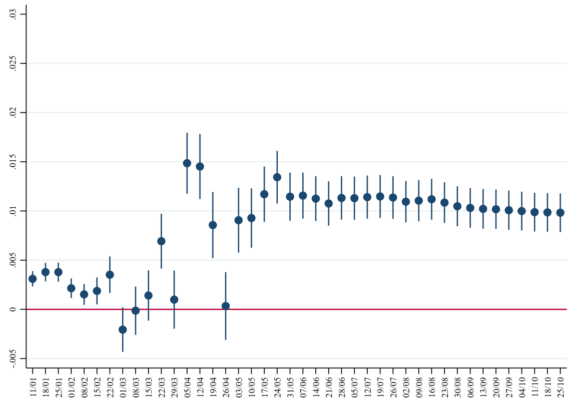
(c) Population aged 30-39



(d) Population aged 40-49



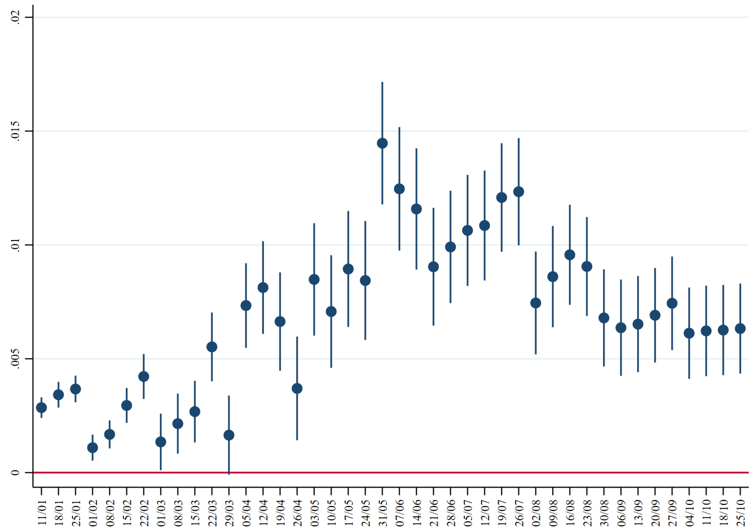
(e) Population aged 50-59



(f) Population aged 60+

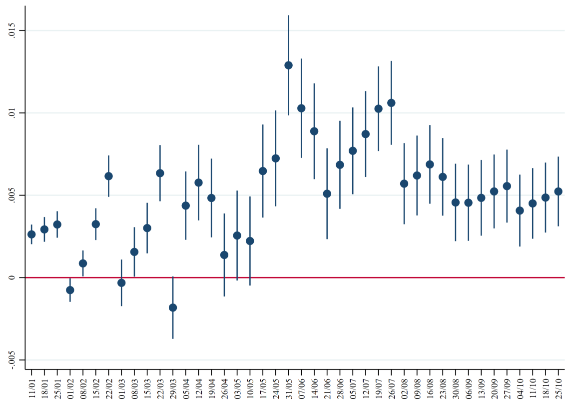
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week, respectively for age groups: (a) 12-19, (b) 20-29, (c) 30-39, (d) 40-49, (e) 50-59 and (f) 60+. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sample of 7,902 municipalities (339,786 observations). Confidence interval at 95% level.

Figure B.4: Effect of high social capital on the vaccination coverage, controlling for a rich set of geographical, socio-demographic factors

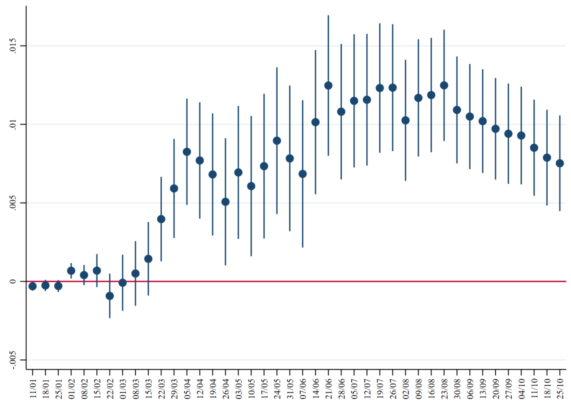


Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. We control for population density and stringency index at the municipal level, hospitalization capacity at the provincial level, and other geographical and socio-demographic factors at the provincial level. The analysis was performed on a sample of 6,729 municipalities (289,347 observations). Confidence interval at 95% level.

Figure B.5: Effect of high social capital on the vaccination coverage - Northern-Central vs Southern-Central Italian regions



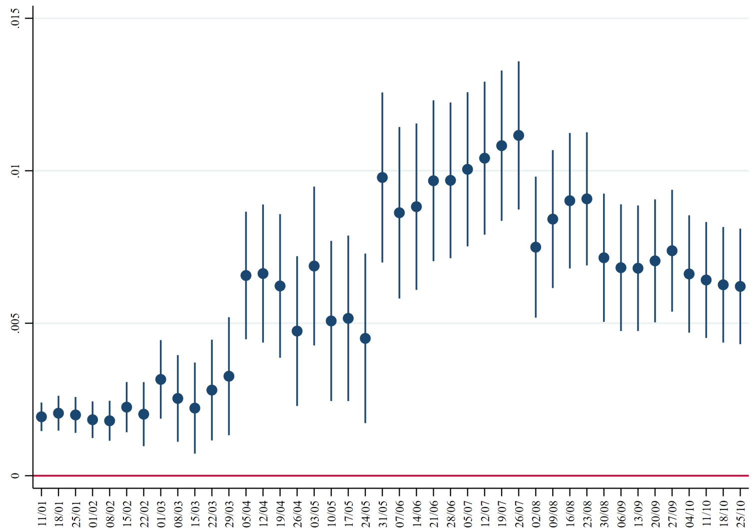
(a) Northern-Central Italian regions



(b) Southern-Central Italian regions

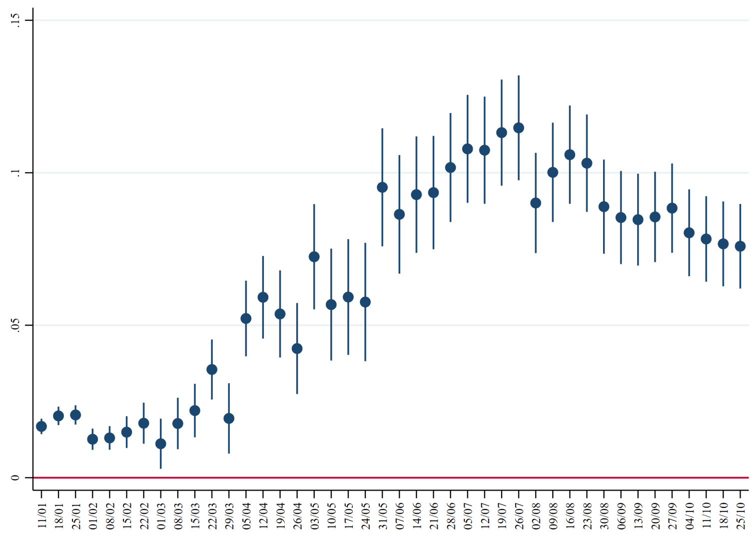
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week, for (a) Northern-Central and (b) Southern-Central Italian regions separately. Northern-Central Italian regions are: Piemonte, Valle d'Aosta, Liguria, Lombardia, Trentino Alto-Adige, Veneto, Friuli Venezia Giulia, Emilia Romagna, Toscana, Marche. Southern-Central Italian regions are: Molise, Umbria, Puglia, Sicilia, Sardegna, Abruzzo, Basilicata, Calabria, Campania, Lazio. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sample of (a) 4,882 municipalities (209,926 observations); and (b) 3,020 municipalities (129,860 observations) respectively. Confidence interval at 95% level.

Figure B.6: Effect of high social capital on the vaccination coverage - excluding Lombardy region



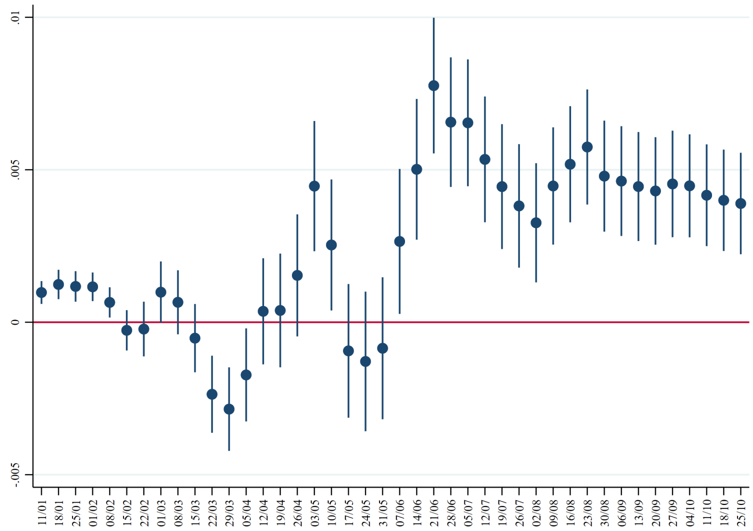
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sample of 6,396 municipalities (275,028 observations). Confidence interval at 95% level.

Figure B.7: Effect of social capital on the vaccination coverage using a continuous measure of social capital



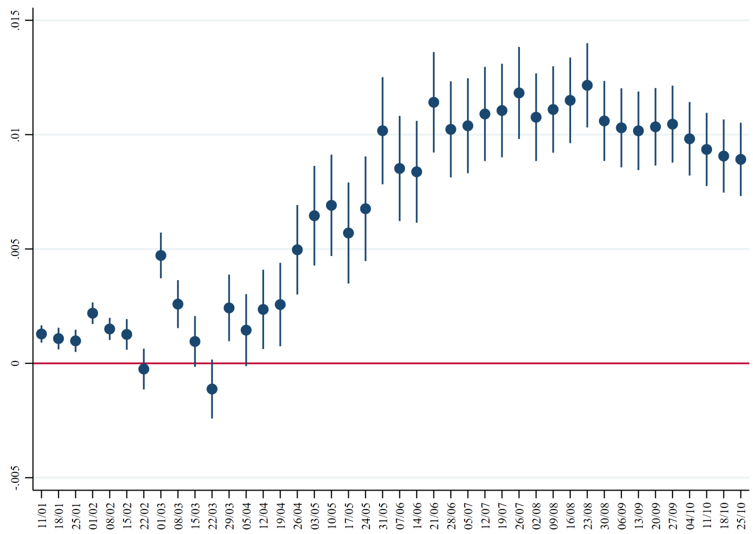
Note: The figure plots the effect of social capital on COVID-19 (first dose) vaccination coverage by calendar week. Social capital is measured as the average municipal turnout in 2011 referenda. The plotted estimates are the coefficients of the interaction terms between weekly dummies and the social capital. The analysis was performed on a sample of 7,902 municipalities (339,786 observations). Confidence interval at 95% level.

Figure B.8: Effect of high social capital on the vaccination coverage using EU turnout as social capital measure



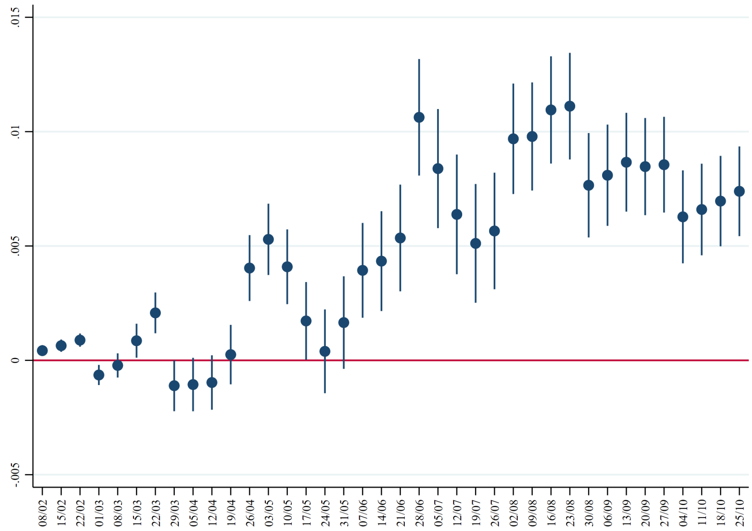
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. Social capital is measured by the average turnout in the European election in 2014 and 2019. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sample of 7,902 municipalities (339,786 observations). Confidence interval at 95% level.

Figure B.9: Effect of high social capital on the vaccination coverage using the share of households paying TV license fee as social capital measure



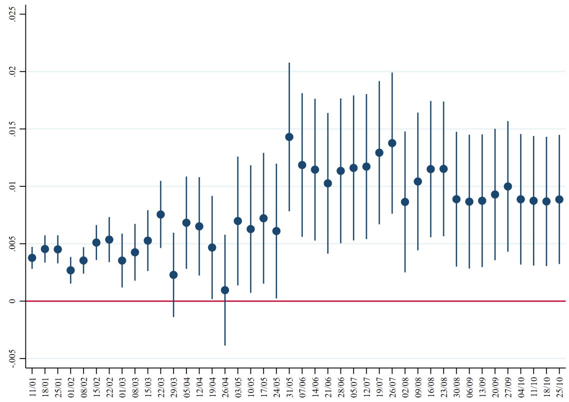
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. Social capital is measured by the share of households paying TV license fee in 2014. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sample of 7,902 municipalities (339,786 observations). Confidence interval at 95% level.

Figure B.10: Effects of social capital on full vaccination coverage

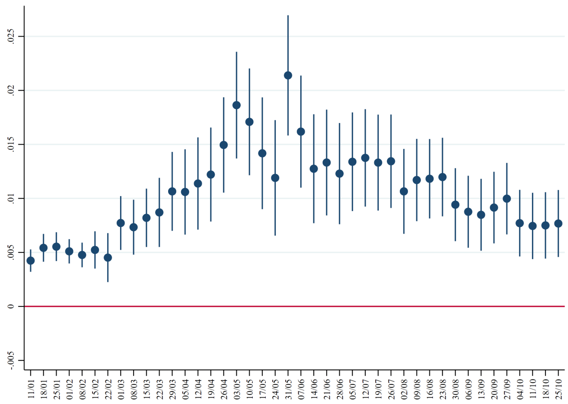


Note: The figure plots differences in COVID-19 full (second dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sample of 7,902 municipalities (308,178 observations). Confidence interval at 95% level.

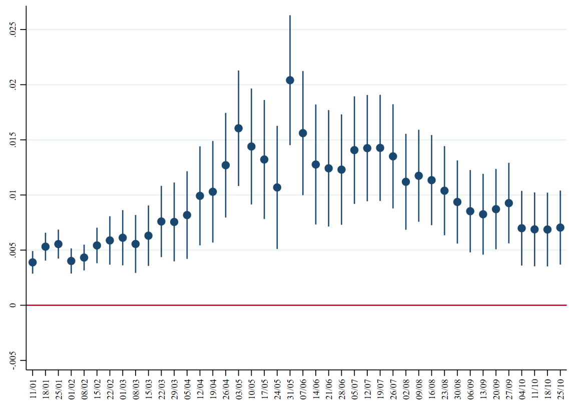
Figure B.11: Effect of high social capital on the vaccination coverage using social capital measures from the Aspects of Daily Life survey



(a) Voter turnout in 2011 referenda



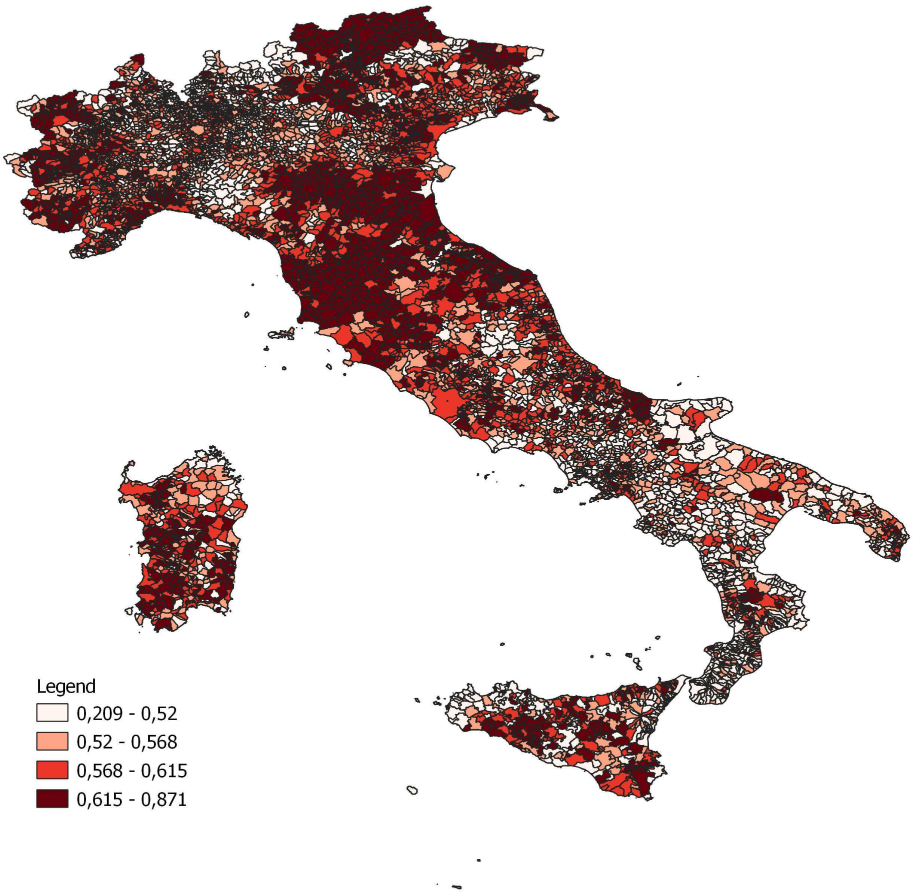
(b) Social participation index



(c) General trust index

Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. Social capital is measured by: (a) voter turnout in 2011 referenda, (b) the social participation index and (c) the general trust index derived from the Aspects of Daily Life survey. The plotted estimates are the coefficients of the interaction terms between week fixed effects and the dummy variable for municipalities in the top quartile of the social capital distribution. The estimates are based on the model outlined in equation 1 performed on a sub-sample of 1065 municipalities. Confidence interval at 95% level.

Figure B.12: Geographic distribution of social capital in Italy



Note: The figure plots the geographical distribution of our main social capital measure, i.e. turnout to 2011 referenda, across all the municipalities in the sample.

Online Appendix: Survey-based measures of social capital

We follow the procedure outlined by Durante et al. (2023) to construct social capital indices using ADL survey data. We use individual-level data with information on social activities and attitudes collected through a series of questions administered between 2012 and 2019.[20] One limitation of our analysis is that we have access to only 20 out of the 24 questions used by Durante et al. (2023) due to privacy constraints set by the data provider. Table O.1 reports the full list of questions employed in the analysis.

We apply principal component analysis (PCA) to the answers to these survey questions. In line with Durante et al. (2023), the first four components explain a large portion of the total variation in the variables (see screeplot in Figure O.1). Table O.2 reports the variables against the four components with the respective factor loadings after orthogonal varimax rotation. As expected, there is a clear univocal relation between the components and variables corresponding to the same dimension of social capital, with no overlap.

Variables are associated to the components based on their highest loadings. Scale variables are normalized to range between 0 and 1. Finally, indices are constructed by computing simple averages between all variables that compose them. Table O.3 reports the descriptive statistics of the variables and respective indices for the period 2012-2019 and, for comparison, the period 2012-2015 as employed in the analysis by Durante et al. (2023). Table O.4 displays the pairwise correlations among social capital indices. We collapse the indices at the municipality level, pooling the years 2012-2019. In total, we have information on 1,065 municipalities to which we restrict our analysis to run additional robustness checks on the measure of social capital used. Table O.5 displays municipal-level correlations between the ADL-based social capital indices and the other measures of social capital used in our analysis. Interestingly, among the ADL survey-based indices, social participation (SP) and general trust (GT) correlate the most with all other measures of social capital employed in our analysis: voter turnout in 2011 referenda, voter turnout in 2014-2019 European elections and the share of households paying the TV license fee in 2014. Interestingly, political participation is poorly correlated with referenda voter turnout. This result stands out as it differs substantially from what found by Durante et al. (2023) at province level. However, it is not fully comparable with Durante et al. (2023), due to missing information on one subcomponent due to data privacy restrictions, namely attendance to meetings of a political party or trade union. Hence, we are not able to verify whether these results are driven by the different level of geographical aggregation rather than missing information.

Table O.6 compares the average characteristics from 2011 census data between municipalities in the ADL survey versus the universe of Italian municipalities in our dataset. There is evidence that the ADL survey is more likely to represent larger municipalities, with a higher share of elderly population and a lower share of individuals with upper secondary or higher education.

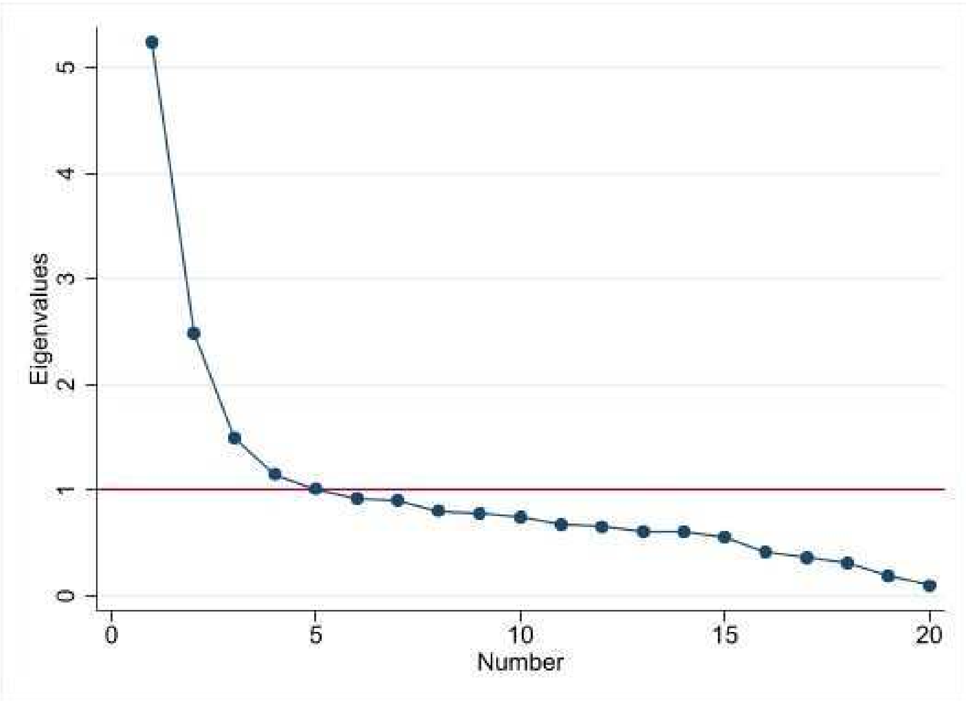
[20] Questions on institutional trust are only recorded from 2012 onwards. As in Durante et al. (2023), we exclude individuals with missing responses to any of the relevant questions. However, their inclusion does not alter the results.

Table O.1: List of survey questions capturing social capital measures

Variable	Question
sp1	Did you give money to voluntary associations?
sp2	Did you perform unpaid activities for voluntary associations?
sp3	Did you perform unpaid activities for non-voluntary associations?
sp4*	Did you participate to meetings of voluntary associations?*
sp5*	Did you participate to meetings of environmental or civic rights associations?*
sp6*	Did you participate to meetings of cultural or recreational associations?*
pp1	Did you attend a political rally?
pp2	Did you participate in a public demonstration?
pp3	Did you attend and listen a political debate?
pp4	Did you give money to a political party?
pp5	Did you perform non-paid activity for a political party?
pp6	Did you perform non-paid activity for a trade union?
pp7*	Did you attend a meeting of a political party or trade union?*
gt1	Do you think that most people can be trusted?
gt2	If you loose your wallet, what are the chances that it will be returned by a neighbour?
gt3	If you loose your wallet, what are the chances that it will be returned by a stranger?
it1	How much do you trust the Italian Parliament?
it2	How much do you trust the European Parliament?
it3	How much do you trust the regional government?
it4	How much do you trust the provincial government?
it5	How much do you trust the municipal government?
it6	How much do you trust the political parties?
it7	How much do you trust the judiciary system?
it8	How much do you trust the police?

Note: The table reports 24 questions selected by Durante et al. (2023) from the ADL survey for the construction of social capital indices. Questions 1 to 13 refer to the 12 months previous to the interview. Questions marked with * are not available for our analysis.

Figure O.1: Effect of social capital on vaccination coverage



Note: The figure plots the factors and eigenvalues resulting from a principal component analysis conducted on the 20 survey ADL-survey questions of interest for the construction of social capital indices. The red horizontal line corresponds to an eigenvalue of 1. N. Observations = 337,254. Period: 2012-2019.

Table O.2: PCA results

Variable	SP	PP	GT	IT	Unexplained
sp1	**0.5176**	0.0297	0.0906	0.0058	0.5014
sp2	**0.6187**	0.0346	0.0113	0.002	0.4009
sp3	**0.554**	0.0107	0.0794	0.0046	0.525
pp1	0.0109	**0.4635**	0.0074	0.0055	0.5634
pp2	0.0571	**0.3485**	0.0017	0.0119	0.7238
pp3	0.1501	**0.3157**	0.0716	0.0098	0.6857
pp4	0.0502	**0.4644**	0.0162	0.0103	0.5709
pp5	0.0542	**0.4962**	0.0293	0.0062	0.5177
pp6	0.0263	**0.3001**	0.0269	0.0005	0.8069
gt1	0.0053	0.0244	**0.5398**	0.006	0.529
gt2	0.0134	0.0283	**0.5602**	0.0024	0.5027
gt3	0.0229	0.0011	**0.6043**	0.0094	0.4361
it1	0.0317	0.0077	0.0247	**0.3897**	0.2386
it2	0.0009	0.0107	0.0027	**0.3731**	0.2911
it3	0.0228	0.0172	0.0118	**0.4005**	0.1877
it4	0.0278	0.0245	0.0145	**0.3975**	0.201
it5	0.0613	0.0287	0.0275	**0.3334**	0.4113
it6	0.0513	0.0694	0.0264	**0.3564**	0.3513
it7	0.0288	0.0177	0.0383	**0.3138**	0.4798
it8	0.006	0.0388	0.0634	**0.231**	0.7023

Note: Source: ADL survey. The table displays factor loadings resulting from a PCA analysis of the 20 questions from the 20 survey questions of interest for the measurement of social capital. The highest loadings per variable are reported in bold font. SP stands for Social participation; PP stands for Political participation; GT stands for General trust; IT stands for Institutional trust.

Table O.3: Descriptive statistics for social capital indices and respective variables

	2012-2019					2012-2015				
Variable	Mean	Std. Dev.	Min	Max	N. Obs.	Mean	Std. Dev.	Min	Max	N. Obs.
SP	0.099	0.212	0	1	337254	0.097	0.209	0	1	186747
PP	0.056	0.121	0	1	337254	0.061	0.126	0	1	186747
GT	0.462	0.205	0.167	1	337254	0.455	0.204	0.167	1	186747
IT	0.409	0.204	0	1	337254	0.4	0.198	0	1	186747
sp1	0.153	0.36	0	1	337254	0.151	0.358	0	1	186747
sp2	0.106	0.308	0	1	337254	0.103	0.303	0	1	186747
sp3	0.038	0.191	0	1	337254	0.037	0.189	0	1	186747
pp1	0.053	0.225	0	1	337254	0.058	0.233	0	1	186747
pp2	0.042	0.2	0	1	337254	0.045	0.207	0	1	186747
pp3	0.204	0.403	0	1	337254	0.223	0.417	0	1	186747
pp4	0.019	0.137	0	1	337254	0.021	0.144	0	1	186747
pp5	0.01	0.098	0	1	337254	0.011	0.103	0	1	186747
pp6	0.011	0.103	0	1	337254	0.011	0.105	0	1	186747
gt1	0.217	0.412	0	1	337254	0.213	0.409	0	1	186747
gt2	0.748	0.236	0.25	1	337254	0.74	0.237	0.25	1	186747
gt3	0.422	0.186	0.25	1	337254	0.414	0.184	0.25	1	186747
it1	0.362	0.259	0	1	337254	0.345	0.255	0	1	186747
it2	0.394	0.259	0	1	337254	0.396	0.256	0	1	186747
it3	0.371	0.258	0	1	337254	0.359	0.255	0	1	186747
it4	0.363	0.258	0	1	337254	0.354	0.255	0	1	186747
it5	0.453	0.274	0	1	337254	0.445	0.274	0	1	186747
it6	0.248	0.24	0	1	337254	0.231	0.235	0	1	186747
it7	0.433	0.267	0	1	337254	0.428	0.266	0	1	186747
it8	0.648	0.237	0	1	337254	0.639	0.235	0	1	186747

Note: Source: ADL survey. The table reports mean, standard deviation, minimum and maximum values as well as the number of observations over the period 2012-2019 for the social capital indeces and the 20 variables that compose them. For comparison, the table also displays the same statistics for the period 2012-2015, as in the analysis of Durante et al. (2023). SP stands for Social participation; PP stands for Political participation; GT stands for General trust; IT stands for Institutional trust.

Table O.4: Pairwise correlations between social capital indices, individual-level

Variable	SP	PP	GT	IT
SP	1			
PP	0.3092*	1		
GT	0.2051*	0.1188*	1	
IT	0.0474*	0.0388*	0.2288*	1

Note: Source: ADL survey. The table reports individual-level pairwise correlations between the ADL survey-based social ,capital indices. SP stands for Social participation; PP stands for Political participation; GT stands for General trust; IT stands for Institutional trust. N.Obs.= 337,254. Significance levels at the 5% or more are marked with *.

Table O.5: Pairwise correlations between social capital indices, municipal-level

	Social participation participation	Political participation	General trust	Institutional trust	Referenda turnout rate	EU-election turnout	TV fee compliance rate
Social participation	1						
Political participation	0.2496*	1					
General trust	0.5672*	0.0809*	1				
Institutional trust	0.1830*	0.0287*	0.4061*	1			
Referenda turnout	0.4164*	0.0561*	0.3904*	0.1382*	1		
EU election turnout	0.2834*	-0.1427*	0.2531*	0.1460*	0.3997*	1	
TV fee compliance rate	0.4040*	0.0154*	0.3421*	0.1854*	0.5119*	0.3990*	1

Note: Source: ADL survey. N. Obs.= 1,065. The table reports pairwise correlations among municipal-level social capital measures.

Table O.6: Comparison of ADL-survey with main sample municipalities

	ADL-survey Mean	Main sample Mean	Diff. p-value
Population	7462.04	31348.73	0.00
Population density	300.46	664.91	0.00
Employment rate	45.05	45.56	0.05
Old age depedency ratio	35.96	31.78	0.00
Pop. share with a. l. upper secondary education	49.45	53.69	0.00

Note: Source: 2011 census. The first two columns report mean values for the ADL-survey and the main sample of analysis. The third column reports the p-value of the mean difference.