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Keywords
Social Capital, Vaccination, Health behaviour, COVID-19

JEL Codes
I10, I18, D80

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Social capital and vaccination compliance: Evidence from Italy *

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February 2024

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 vaccination coverage increased significantly more in municipalities with higher social capital. 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.

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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 diseases 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, defined by Putnam (2000) as "connections among individuals social networks and the norms of reciprocity and trustworthiness that arise from them", has the potential to play a vital role in overcoming 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 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 following past infectious disease outbreaks around the world. Specifically, these studies focused on 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 correlates 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 other recent studies, namely Buonanno et al. (2023) 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, i.e. the epicentre region of the COVID-19 outbreak in Italy. Our first contribution to the literature is to expand the analysis to the universe of Italian municipalities, which have been historically characterized by heterogeneous levels of social capital (Guiso et al., 2011; Putnam et al., 1993).

Secondly, the fine temporal and geographical dimensions of our data allow us to control for potential confounding factors by including municipality-level fixed effects as well as region by week dummies accounting for differential trends in vaccination deliveries or policy responses across regions. Importantly, the Italian health system is regulated at the regional level in Italy.

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.

Social capital is inherently multidimensional and has been measured by the literature using many different facets (see Durante et al. 2023 for a recent review).

In this study, we focus on the civic duty dimension of social capital, also known as "civic capital" - as defined by Guiso et al. (2011), i.e. "those persistent and shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities". Following Putnam (2000)'s definition reported above, civic duty along with other close correlates such as law abindigness belong to the realm of "norms of reciprocity".

We proxy the civic duty dimension of social capital with voter turnout, in line with several studies in the social capital 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).

As a baseline measure, we use voter turnout to 2011 referenda. We find that municipalities lying at top quartile of the 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 1.60 percentage points. Female and male populations share the same pattern in the evolution of the effect of high social capital on vaccination coverage. However, the heterogeneous analysis by age groups reveals that the overall positive effect of social capital is mainly driven by young generations, with the maximum estimated weekly increase equal to 3.25 percentage points in the first week of July, recorded by teenagers aged 12-19.

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 survey measures of general trust and social participation. Importantly, we document that our main results are neither driven by differences inherent to the North-South divide of the country nor by the specific region of Lombardy. Results are also not affected by within-region differences in the degree of access to health services or by "open day" vaccination events. Finally, our main findings do not alter when considering alternative model specifications or a different definition of vaccination coverage.

Taken together, our results show that social capital at the local level can significantly influence vaccine uptake. Such evidence is important for promoting vaccination campaigns against 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, section 4 discusses main results and section 5 examines their robustness to a battery of checks. Section 6 concludes.

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 2020 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 late December 2020, in line with other countries across Europe, Italy approved the first vaccine against COVID-19 (Cadeddu et al., 2022). The actual vaccine distribution within Italy started on December 31 and a National vaccination plan was published on January 2 2021. (Ministero della Salute, 2021b).[1] In March, the Ministry of Health issued a decree that updated and detailed the execution of the National vaccination plan (Ministero della Salute, 2021a). In parallel to the start of the vaccination campaign, the government introduced a new tier (white), imposing minimal restrictions on low-risk regions.

The National vaccination plan outlined the prioritization and implementation framework for the COVID-19 vaccination campaign. For the administration of vaccines, the population was categorized into distinct vulnerability groups based on pre-existing medical conditions, age and occupation. Initially, vaccination was reserved for workers in the medical sector, fragile or

[1] See https://www.epicentro.iss.it/en/vaccines/covid-19-vaccination-plan

elderly people. Vaccination priority followed a decreasing order in age, starting from the age category 80 and over (Ministero della Salute, 2021b).[2] Since February, priority to vaccination was recognised also to school and university personnel (Consiglio dei Ministri, 2021f).

The objective of the vaccination plan was to achieve a vaccination coverage of at least 80% of the population by September 2021. To reach this objective, the plan worked on three areas of activity with a close coordination between the central government and the regions: supply and distribution, constant monitoring of needs and widespread vaccine administration (Ministero della Salute, 2021a).[3]

On May 12 the extraordinary commissioner for the COVID-19 emergency, announced a new phase of the vaccination campaign, with the extension of vaccinations from May 17 to the population aged 40 and above.[4] In the following days, the commissioner further announced that vaccinations would be opened up to all age groups (over 16) from June 3.[5] On May 31, the Italian Medicines Agency (AIFA) approved COVID-19 vaccination for adolescents in the age groups 12-15.[6] Thus, as of early June, vaccination became accessible to all individuals above 12 years of age.

Over time, several vaccines were approved and introduced. Pfizer-BioNTech was the first one to be approved in December 2020, followed by Moderna and Astrazeneca in January 2021, and Johnson & Johnson in March (AIFA, 2020, 2021a,b,c).

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 (AIFA, 2021d). The same action was undertaken by other European countries, namely Germany, France and Spain, in response to emerging reports of 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.[7]

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 (Consiglio dei Ministri, 2021c). This progressively tightened restrictions for unvaccinated individuals. On August 6, the COVID-19 certificate became compulsory in order to be able access indoor dining, public events and services (Consiglio dei Ministri, 2021d). On September 1, the requirement of the COVID-19 certificate was extended for school and university staff and students and for accessing public transportation (Consiglio dei Ministri, 2021e). On October 15, the COVID-19 certificate became compulsory for all workers in the private and public sector (Consiglio dei Ministri, 2021b).

[2]See https://www.epicentro.iss.it/en/vaccines/covid-19-vaccination-plan

[3]See https://www.epicentro.iss.it/en/vaccines/covid-19-vaccination-plan

[4]https://www.governo.it/it/dipartimenti/commissario-straordinario-lemergenza-covid-19/16823.

[5]V commissione della Camera dei Deputati (2021)

[6]AIFA (2021e)

[7]See https://www.aifa.gov.it/en/-/aifa-revoca-il-divieto-d-uso-riprendono-dalle-15-le-vaccinazioni-con-astrazeneca.

2.2 Data

Vaccination coverage. To measure vaccination coverage, we use weekly data on COVID-19 vaccinations in Italian municipalities between January 4 to October 31 2021.[8] 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.[9][10]

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, a measure widely used in the social capital literature (see, for instance, Bracco et al., 2015, 2021; Nannicini et al., 2013; Ponzetto & Troiano, 2018). 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. Appendix Figure B.13 displays the geographic distribution of the referenda turnout across all municipalities in our sample. In general, voter turnout to popular referenda is argued as a better proxy of civic responsibility and interest in the common good with respect to voter turnout to political elections. In particular, voting in popular referenda is expected to be less affected by people's everyday life perceptions such as evaluations about the political performance of 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 one 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 to the legalisation of divorce.[11] 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 turnout in the 2014 and 2019 European elections.[12]

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

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

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

[11]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% plus one 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).

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

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 et al., 2022, 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.[13] 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 (1,065) for which ADL information is available for the period between 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. We test the sensitivity of our results to the inclusion of a battery of control variables to the specification in (1). First, we account for characteristics correlated with the risk of COVID-19 contagion, namely COVID-19 cases, COVID-19 policy responses as well as hospitalization capacity. We include the weekly number of total COVID-19 cases at the province-level available from official reports of Italian health authorities. We use the one-week lag of this variable.[14] Hospitalization capacity is measured by the number of hospital beds available per hospital in a given province in 2019. 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.[15]

[13]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.

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

[15]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

Second, we account for municipal-level socio-demographic characteristics measured using data most recently available before the onset of the COVID-19 pandemic. We include population density, the share of the population aged 60 and over, the share of the population with at a least upper secondary education and the employment rate. In addition, we include income pro-capite, measure available at the provincial level.

Finally, we control for the political party affiliation of mayors which reflect the political preferences of their constituents. Borga et al. (2022) show a positive association between vaccine hesitancy and right-wing party support. Nevertheless, the study also documents that vaccine hesitants represented less than 15% of the Italian population as of June 2021.

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 on the main sample.

3 Empirical strategy

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

$$Y_{mt} = \beta_t High\ Social\ Capital_m * Week_t + Week_t + Municipality_m + Week_t * Region_r + \varepsilon_{mt} \quad (1)$$

where Y indicates COVID-19 vaccination coverage in a given municipality m in calendar week t. $High\ Social\ Capital$ 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 higher social capital municipalities and the rest.

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 full set of fixed effects. Week dummies, $Week_t$, account for the common evolution of vaccination coverage across all municipalities in a given week. Municipality fixed effects, $Municipality_m$, capture any difference in vaccination coverage due to time-invariant characteristics. Finally, the interaction between region and week calendar dummies, $Week_t * Region_r$, absorbs any differential evolution in vaccination coverage due to regional-level shocks such as vaccine deliveries or policy responses at a weekly frequency.

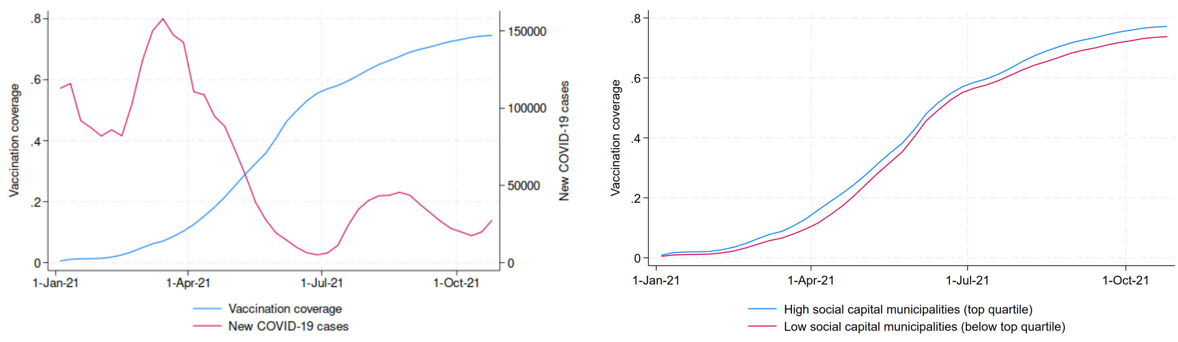
indicators and their values. Conteduca & Borin (2022) use this formula for the period between the COVID-19 pandemic outbreak in 2020 and August 6 2021, when the green pass was implemented. Starting from August 6 2021, the authors adjust the formula to allow for different weights between vaccinated and unvaccinated populations. We do not apply this adjustment and only consider policy restrictions affecting unvaccinated individuals throughout the period of analysis.

Standard errors are clustered at the municipal level. In Section 5, we test the robustness of our estimates to enriching the specification in equation (1) with the control variables described in the previous section.

4 Results

Descriptive evidence. Figure 1 depicts the evolution of vaccination coverage using the raw data over the period of observation, from January 4 until October 31 2021. Panel (a) plots weekly vaccination coverage (in blue) across the universe of municipalities. To put it into context with respect to the incidence of the pandemic, new weekly COVID-19 cases (in red) are also reported. The pace of vaccination accelerates in the spring and until the end of June. In the last week of June, vaccination coverage amounts to 56%. After that, the curve changes its slope and gradually flattens out. By the end of October, vaccination coverage reaches 75%.

Figure 1: The evolution of vaccination coverage



(a) (b)

Note: Authors' calculations. In panel (b) the sample is divided at the top quartile of the turnout in the 2011 referenda. Top quartile municipalities are defined as high social capital and those at below the top quartile as low-social capital municipalities. Vaccination is calculated as the ratio between cumulative COVID-19 first dose vaccination counts to the total population as of January 1 2021. See Table A.2 for the data sources. New COVID-19 cases are retrieved from the Italian Civil Protection Department and are reported as a share of the total resident population as of January 1 2021.

In panel (b), we explore the relationship between vaccination and social capital. As described above, our baseline measure of social capital is the turnout rate in the 2011 referenda. The evolution of weekly vaccination coverage in the top quartile of the social capital distribution (in blue) is plotted against that of other municipalities (in red). Higher social capital municipalities consistently register higher levels of vaccination coverage as compared to the rest, from the early days of the vaccination campaign and throughout the period of observation. Therefore, the evidence based on raw data suggests that municipalities with a higher level of social capital behaved as first movers in taking up the COVID-19 vaccination. At the end of the period, a gap of 3.4 percentage points in vaccination coverage remains between higher social capital municipalities and the rest. Yet, the pattern in panel (b) may be driven by confounding factors. In the following, we present the results of the econometric analysis.

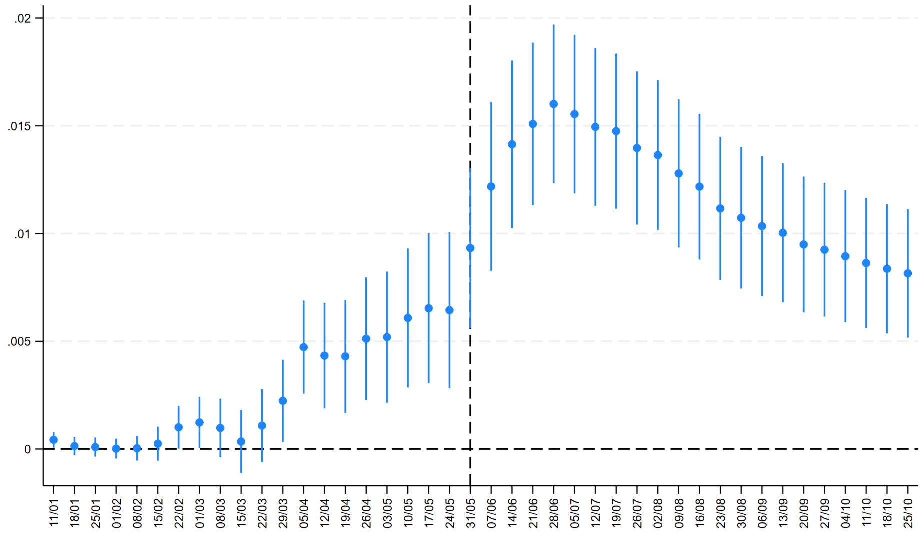
Average effects. Figure 2 plots the β_t coefficients estimated using equation (1). We see a clear and consistent pattern of positive and significant effects of high social capital on vaccination coverage over the period, starting from April and persisting until the end of October.[16] Notably, early April coincides with a decrease in COVID-19 cases (see Figure 1). Mobility restrictions and other limitations to contain the spread of the new Alpha variant of COVID-19 virus were lifted on April 6 (Consiglio dei Ministri, 2021a). As described above, in early June vaccination became available to the entire population, including younger generations.

Throughout June, we detect the highest effect estimates. Within this month, the average effect is equal to 1.34 percentage points. This extra increase in vaccination coverage for higher social capital municipalities is about 2.73% of the average vaccination coverage over the same period (49.13%). The highest effect size equal to 1.60 percentage points is registered in the last week of June. At that time, Italy reached the level of 56% vaccination coverage.

These findings further support our assumption that individuals in high social capital municipalities respond more promptly to vaccination as soon as vaccines are available. Starting from July, a decreasing pattern can be observed in the estimated effect of high social capital on vaccination coverage. No remarkable variation in the pattern is visible in correspondence with the introduction of COVID-19 certificate (August 6), or related subsequent tightening of restrictions on its validity (September 1, October 15). In the last week of October, a significant and positive differential effect of 0.82 percentage points remains between high social capital municipalities and the rest.

[16]A negligible drop detected in the week of March 15, in correspondence with the temporary suspension of the administration of the Astrazeneca vaccine. Note that this vaccine type represents a minority of the vaccine doses administered. According to AIFA (2021a), on March 26, Pfeizer, Astrazeneca and Moderna accounted for 77%, 18% and 5% respectively of the total doses administered. As of September 26, Pfeizer, Astrazeneca, Moderna and Johnson and Johnson represented 71.2%, 14.5%, 12.5% and 1.8% of the total doses administered, respectively (AIFA, 2021b).

Figure 2: 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 intervals at 95% level.

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.1 in the Appendix, we can observe that the patterns in the two subpopulations are very similar, with small differences in the magnitude of the effects.

Heterogeneous effects by age group We also investigate heterogeneous effects by age group. We consider four age groups: 12-19 years, 20-39 years, 40-59 years, and 60 years and over. The different access to vaccination according to the age group dictated by the vaccination plan emerges clearly from Figure B.2 in the Appendix. For instance, in the population aged 12-19 (panel a), no effect was revealed until the first week of June, when teenagers became eligible for COVID-19 vaccination and vaccination was accessible to all individuals (above 12). Starting from June we can recognise a pattern of positive significant effects for higher social capital municipalities with respect to the rest on vaccination coverage across all cohorts, with some differences in the magnitude of the effects. The peak effects are registered in the first week of July for the younger generations: 3.25 percentage points for individuals aged 12-19 and 2.94 percentage points for individuals aged 20-39 the week before (last week of June). Differently from younger cohorts, for people aged 40 and above, the estimated β coefficients never exceed 2 percentage points.

5 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 consider three sets of characteristics: risk of COVID-19 contagion, socio-demographics and political affiliation characteristics (see section 3 for a detailed description of the control variables). Given the computationally demanding exercise, we include each set of control variables separately. All control variables are interacted with week dummies. Reassuringly, the estimated results in panels (a), (b), (c) of Appendix Figure B.3 are very similar to the ones of our baseline model.

Comparison between North and South 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[17]. The identification of the municipalities lying in the top quartile of high social capital has 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 with some differences in the magnitude (Figures B.4 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, the region faced challenges in the initial phase of the vaccination campaign, experiencing a slower start compared to other regions[18]. 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.5 in the Appendix shows similar results to those obtained in the baseline model. The exclusion (inclusion) of Lombardy does not affect our findings.

Comparison by degree of access to basic services. We use the ISTAT definition of inner areas and divide municipalities into different groups according to the degree of access to basic services. Specifically, the Inner Areas National Strategy (SNAI) defines as "pole areas" municipalities that provide three types of services: health, education and transport. The remainder are defined, in order of decreasing relative geographical distance (travel time) from these poles,

[17] 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, Campania, Lazio.

[18] 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/

as: belt, intermediate, peripheral and ultra-peripheral areas. We consider three groups: i) poles and belt areas, ii) intermediate, and iii) peripheral and ultra-peripheral areas.[19] Estimates for the first two groups are most similar to those in our baseline analysis. As one may reasonably expect given the greater difficulty in access to services, effects estimated in more peripheral areas are smaller. Nevertheless, the positive and significant effects registered in the latter group from the month of June onwards are consistent with the main results.

Restricting to regions with no "open days" for COVID-19 vaccination. One may be concerned that our estimated effects may be biased due to confounding effects stemming from differential increased availability of vaccine doses through open day vaccination events within regions. Open days were organized as ad-hoc events for COVID-19 vaccinations, not requiring advance booking and targeting specific age or priority categories of the population (e.g. based on specific characteristics such as students or school staff during examinations).

Unfortunately, there is no systematic reporting of such events. We conducted a careful review of COVID-19 open day events reported in the Agenzia Nazional Stampa Associata (ANSA), the leading news agency in Italy.[20] We identified three regions which did not organize COVID-19 open days for population under 60 years of age over most of the period of analysis. These are the regions of Lombardy, Veneto and Friuli Venezia Giulia. We replicate the analysis restricting the sample to population under 60 years of age and to the period January to mid-August.[21] This is due to the fact that the COVID-19 commissioner recommended all regions to accelerate vaccinations starting from mid-August, including via open-day events, for students ahead of school reopening in September(Consiglio dei Ministri, 2021g).[22] Municipalities in the top quartile of social capital have been identified referring to the distribution across these regions. Figure B.7 shows that, overall, the estimated effects of social capital are robust to this sample restriction. Not only, in the restricted sample, estimated effects reach magnitudes that are even higher than those registered in the baseline analysis. This suggests that, if anything, the estimated effects in our baseline analysis may be underestimated.

Alternative measures of social capital. Results are robust to different measures of social capital. Using turnout in the 2011 referenda in continuous form, results mirror those in the baseline analysis. (Appendix Figure B.8). We also test the use of alternative measures of social capital to identify municipalities in the top quartile of the high social capital distribution. The use of average electoral turnout at the last two EU elections in 2014 and 2019 as a measure leads to consistent results (Appendix Figure B.9 in the Appendix). Although in the first period, the

[19]Travel time distance from poles is less than 20 minutes for belt areas, 20-40 minutes for intermediate areas, 40-75 minutes for peripheral areas and above 75 minutes for ultra-peripheral areas (Unitá di valutazione degli investimenti pubblici, 2014).

[20]The information was cross-checked with the relevant regional offices.

[21]Population over 60 years of age was considered a priority group.

[22]See https://www.ansa.it/canale_saluteebenessere/notizie/sanita/2021/08/11/dal-16-agosto-vaccini-senza-prenotazioni-a-12-18enni_23651877-9787-4b34-86d1-f34d350abd4b.html

estimated pattern shows some differences from that in figure 2, a persistent and positive effect of high social capital on vaccination coverage is observed starting from early June. The use of the share of households paying TV license fee in 2014 also does not alter our main findings (Figure B.10 in the Appendix).

Finally, referring to the study of Durante et al. (2023), where social capital is unpacked to its components, we use ADL survey data to test robustness to different dimensions of social capital. To do so, we restrict our analysis to the sub-sample of municipalities covered by the ADL survey and select the indices capturing the dimensions that correlate the most with the above social capital measures, namely social participation and general trust (see the online Appendix for details on the generation of the indices and respective summary statistics). Figures B.12b and B.12c in the Appendix plot the estimated effects of two separate analyses using social participation and general trust respectively to identify municipalities in the top quartile of the high social capital distribution. The estimated effects show a positive and persistent pattern throughout the period of observation, confirming our main results.

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. Importantly, we should keep in mind that 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. In fact, 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. As shown in Figure B.11 in the Appendix, the effect of high social capital on our measure of full vaccination coverage exhibits a similar pattern to that observed for vaccination coverage considering the first dose (Figure 2), with a slight time lag. The highest estimated effect is registered in the first week of August and equals to 1.54 percentage points. The observed time lag difference with respect to the main results 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 updated its recommendations multiple times regarding the timing between the first and the second doses for each type of vaccine.

6 Conclusions

In this paper, we investigate the relationship between the civic-duty dimension of social capital and vaccination compliance using high-frequency vaccination data from the universe of municipalities in Italy during the COVID-19 pandemic.

Our results document a significant positive effect of social capital on vaccination coverage.

Once vaccines are available, municipalities characterized by higher levels of social capital 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.[23] From the policy making point of view, social capital, and in particular, civic mindedness, may play a significant role in shaping effective vaccination campaigns. Policymakers shall consider investing 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. The reintroduction of transversal teaching of civic education at school approved by the Italian government in 2019 goes into this direction.[24] Additionally, local initiatives can contribute to the establishment of stronger social bonds and cooperation (Attanasio et al., 2015; Fearon et al., 2009).

[23] 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.

[24] Law no 92/2019; https://www.gazzettaufficiale.it/eli/id/2019/08/21/19G00105/sg

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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, 20-39, 40-59, 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		
(Log) COVID-19 total cases	(Log) weekly total 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
Hospitalization capacity	Average number of hospital beds for high care specialities per hospital in a given province per 10k inhabitants in 2019	ISTAT
Stringency index	Index combining all COVID-19 policy measures present in a given week in a municipality	Conteduca & Borin (2022)
Population density	Population per square kilometer in a municipality as of January 1 2021	ISTAT
Population share aged 60 and over	Share of population aged 60 and over as ratio to the total population in a given municipality (1st January 2021)	ISTAT High school diploma share
Share of population with at least upper secondary education as a ratio with respect to the population aged 25-64 in a given municipality in 2019	ISTAT	
Employment rate	Share of population in employment in a given municipality as a ratio with respect to the population aged 20-64 in 2019	ISTAT
Income pro capite	Average income pro capite in a given province in 2017	ISTAT
Right, left, Five Star movement, civic list, missing list	Indicators (0/1) of mayor's political party affiliation in a given municipality in 2020	Ministry of the Interior

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

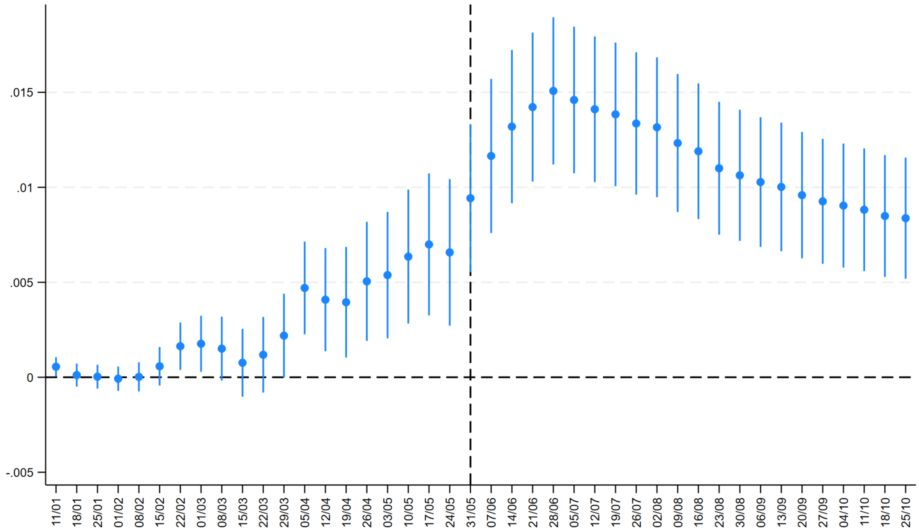
Table A.2: Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max	N. Obs.
Dependent variables					
Vaccination coverage rate	0.356	0.293	0	1	363492
Vaccination coverage rate: female population	0.363	0.292	0	1	363492
Vaccination coverage rate: population aged 12-19	0.241	0.310	0	1	363492
Vaccination coverage rate: population aged 20-39	0.313	0.312	0	1	363492
Vaccination coverage rate: population aged 40-59	0.378	0.332	0	1	363492
Vaccination coverage rate: population aged 60+	0.485	0.361	0	1	363492
Full vaccination coverage rate	0.256	0.257	0	1	363492
Social capital					
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
Control variables					
(Log) total COVID-19 cases	12.230	0.969	9	15	363492
Hospital bed capacity per 10k inhabitants	2.880	1.056	0	9	363492
Stringency index	59.297	11.813	37	85	363492
Population density	299.126	636.996	1	11886	363492
Population share aged 60 and over	0.329	0.059	0.136	0.671	363492
Population share with at least upper secondary education	0.602	0.083	0	1	363492
Employment rate	0.647	0.097	0	1	363492
Income pro capite	18268.364	3600.069	10881	27301	358570
Mayor's affiliation: right-wing party	0.063	0.243	0	1	353602
Mayor's affiliation: left-wing party	0.043	0.203	0	1	353602
Mayor's affiliation: Five Star Movement	0.005	0.070	0	1	353602
Mayor's affiliation: civic list	0.728	0.445	0	1	353602
Mayor's affiliation: left-wing party	0.043	0.203	0	1	353602
Mayor's affiliation: missing information	0.161	0.367	0	1	353602

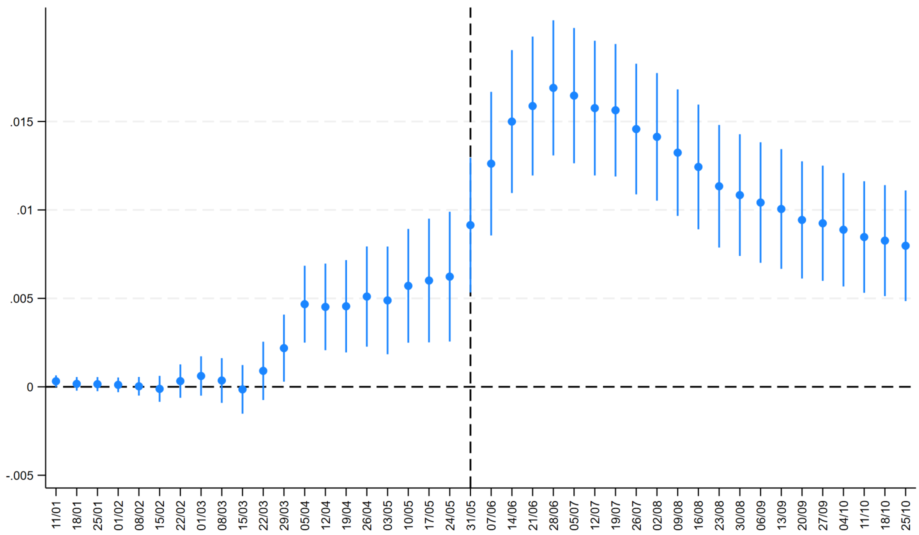
Note: The table reports mean, standard deviation, mininum, maximum value and number of observations for each variable in our sample.

Appendix B: Figures

Figure B.1: Effects of social capital on vaccination coverage by gender



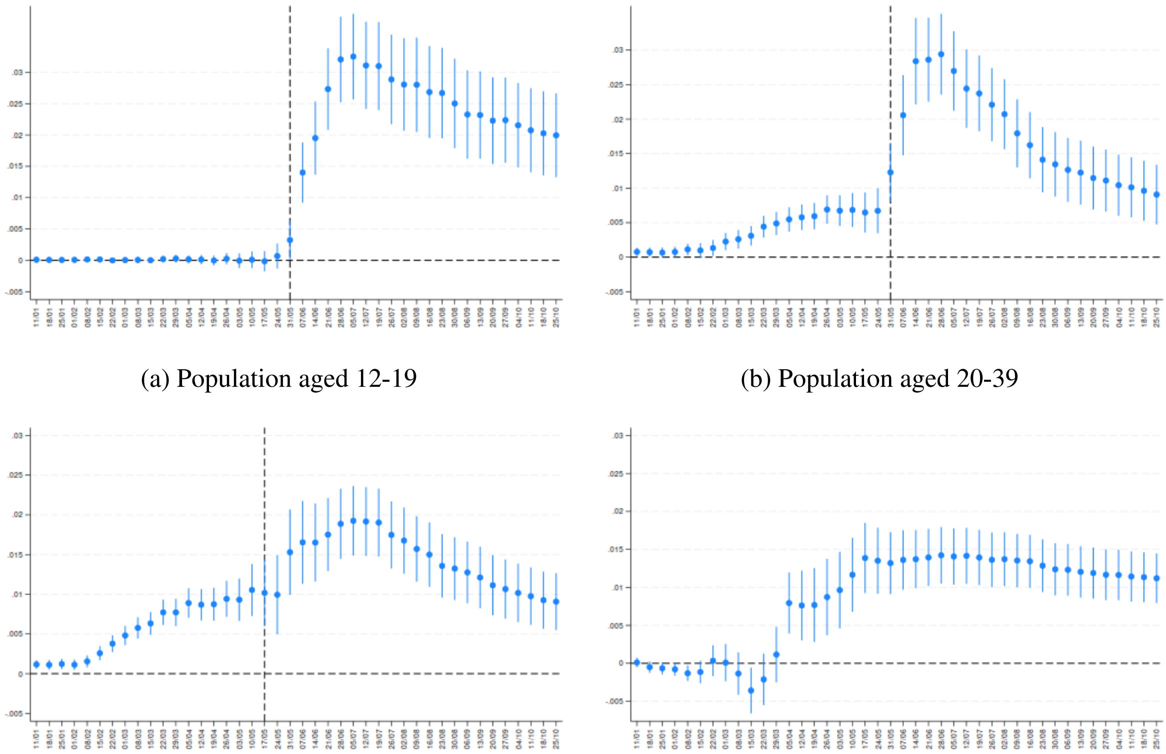
(a) Female population



(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 intervals at 95% level.

Figure B.2: Effect of high social capital on the vaccination cumulative rate by age group



(a) Population aged 12-19

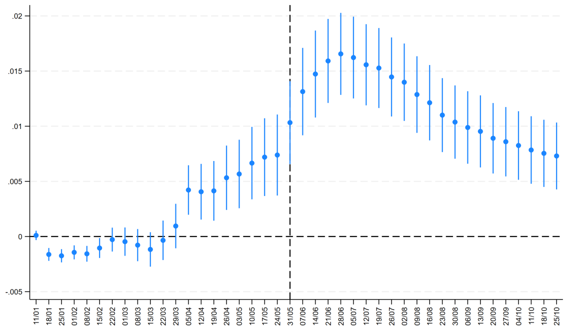
(b) Population aged 20-39

(c) Population aged 40-59

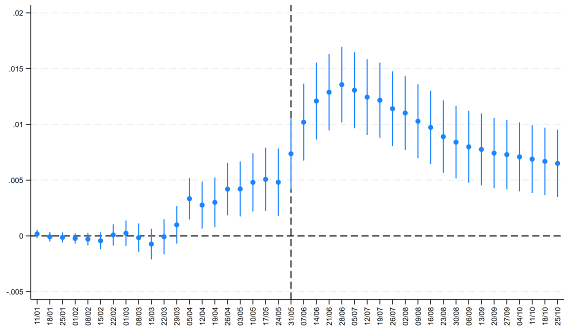
(d) Population aged 60+

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) 20-39, (c) 40-59 and (d) 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 intervals at 95% level.

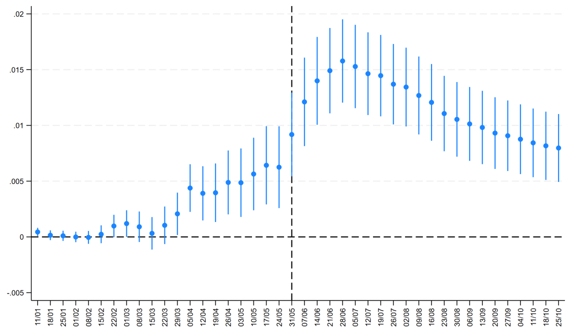
Figure B.3: Effect of high social capital on the vaccination coverage, controlling for the severity of the COVID-19 pandemic, socio-demographic and political factors



(a) Severity of the COVID-19 pandemic



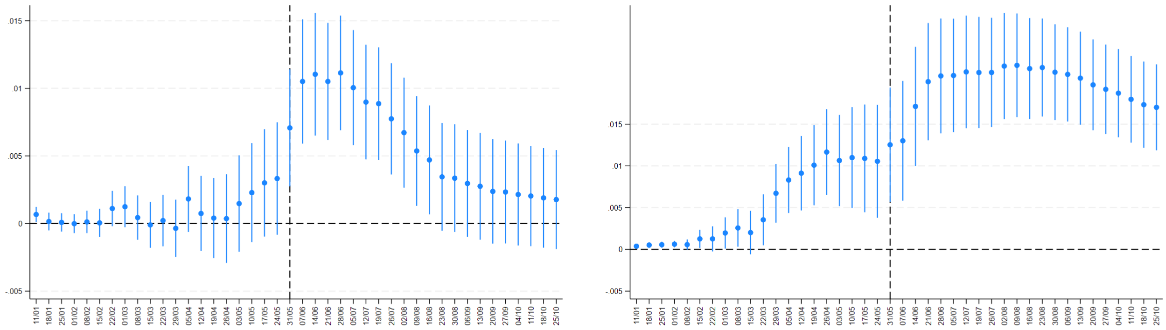
(b) Socio-demographic factors



(c) Mayor's political party affiliation

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, including controls for (a) severity of the COVID-19 pandemic, (b) socio-demographic factors and (c) mayor's political party affiliation. 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 the respective samples of (a) 7,902 municipalities (339,786 observations), (b) 7,795 municipalities (335,185 observations), and (c) 7,687 municipalities (330,541 observations) municipalities. Confidence intervals at 95% level.

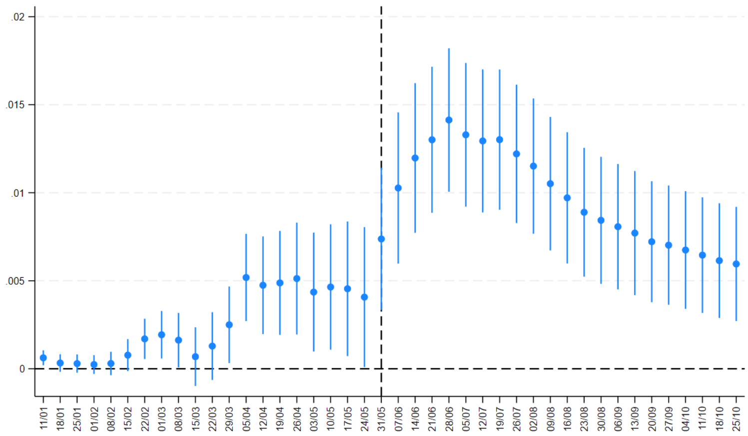
Figure B.4: Effect of high social capital on the vaccination coverage - Northern-Central vs Southern-Central Italian regions



(a) Northern-Central Italian regions (b) Southern-Central Italian regions

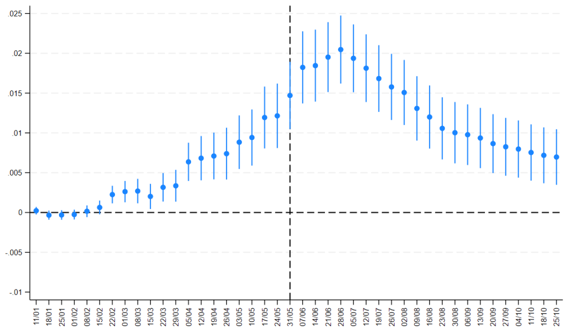
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week, for (a) Northern-Central and (b) Southern-Central Italian regions separately. Northern-Central 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 intervals at 95% level.

Figure B.5: Effect of high social capital on the vaccination coverage - excluding Lombardy region

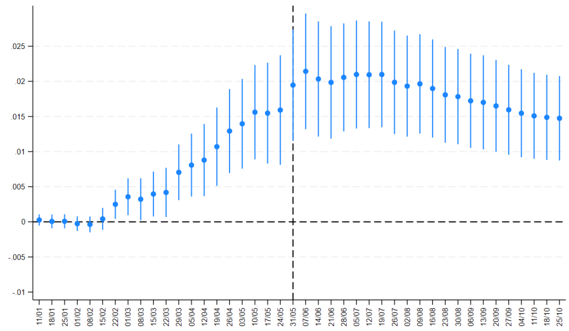


Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. The plotted estimates are the coefficients of the interaction terms between week fixed effects 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 intervals at 95% level.

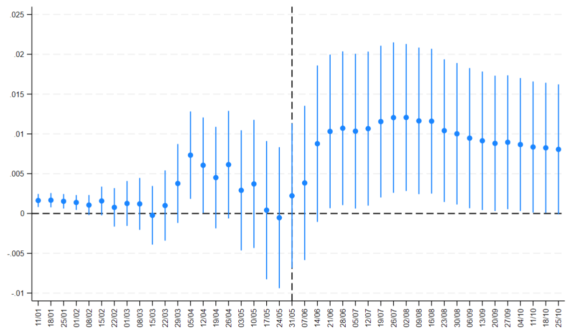
Figure B.6: Effect of social capital by degree of access to basic services



(a) Pole and belt areas



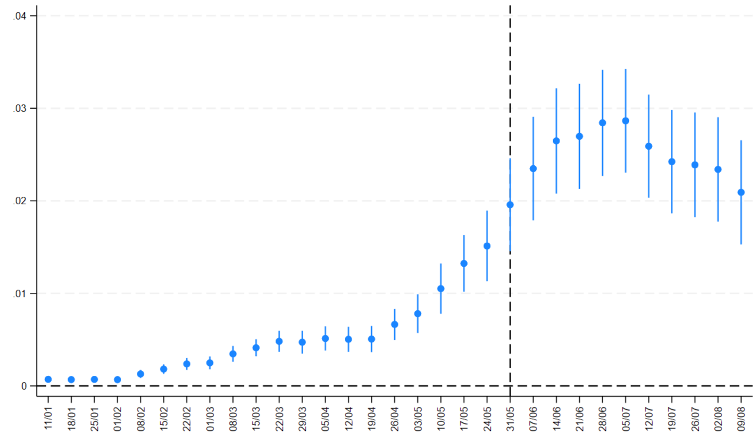
(b) Intermediate areas



(c) Peripheral and ultra-peripheral areas

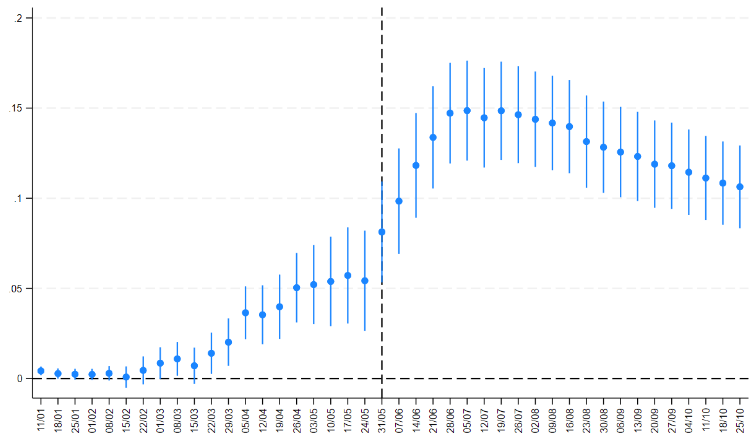
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week, for (a) pole and belt areas, (b) intermediate areas, and (c) peripheral and ultra-peripheral areas. 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 the respective subsamples of: (a) 4,068 municipalities (174,924 observations), (b) 1,928 municipalities (82,904 observations), and (c) 1,906 municipalities (81,958 observations). Confidence intervals at 95% level.

Figure B.7: Effect of high social capital on the vaccination coverage - excluding regions with COVID-19 “open days”



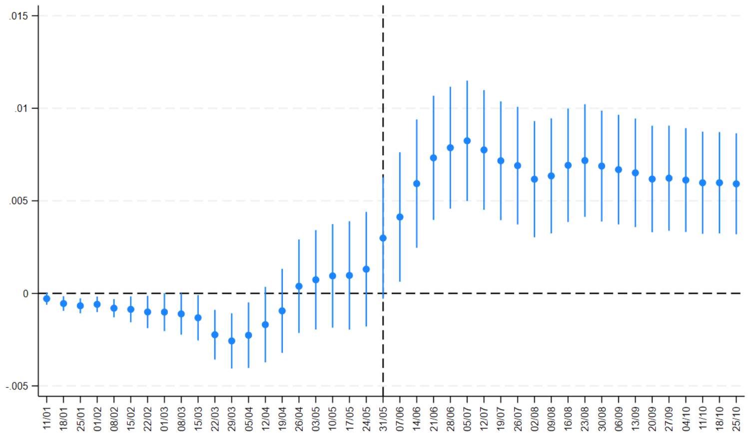
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. The plotted estimates are the coefficients of the interaction terms between week fixed effects 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 2,284 municipalities (73,088 observations). Confidence intervals at 95% level.

Figure B.8: Effect of social capital on the vaccination coverage using the continuous measure of social capital



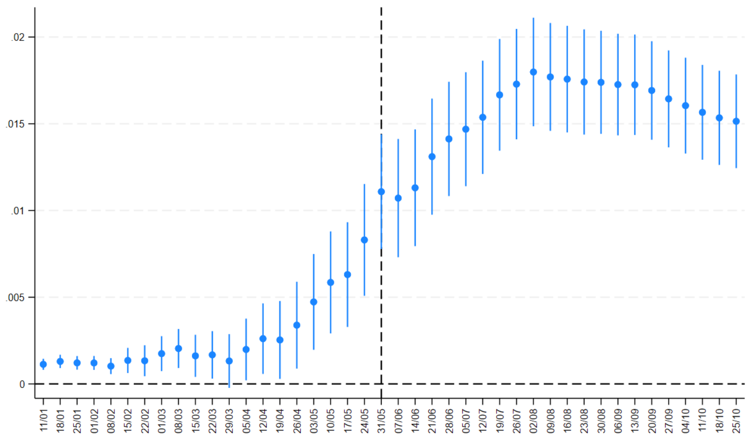
Note: The figure plots the effect of social capital on COVID-19 (first dose) vaccination coverage by calendar week. Social capital is measured as the average municipal turnout in 2011 referenda. The plotted estimates are the coefficients of the interaction terms between weekly dummies and the continuous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

Figure B.9: Effect of high social capital on the vaccination coverage using EU turnout as social capital measure



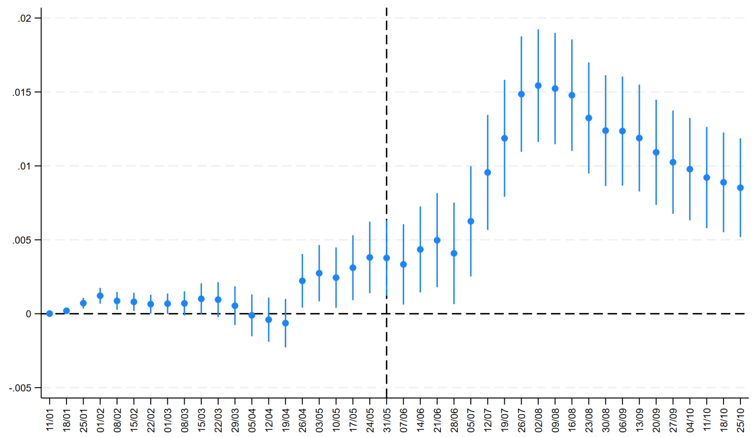
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. Social capital is measured by the average turnout in the European election in 2014 and 2019. 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 intervals at 95% level.

Figure B.10: Effect of high social capital on the vaccination coverage using the share of households paying TV license fee as social capital measure



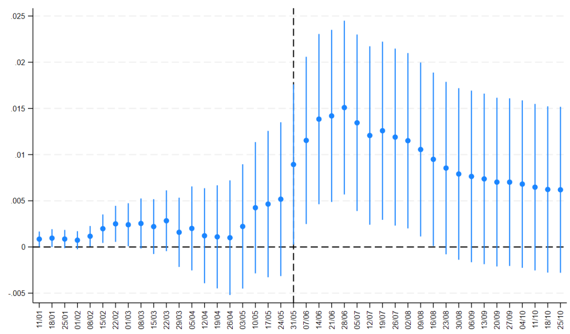
Note: The figure plots differences in COVID-19 (first dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. Social capital is measured by the share of households paying TV license fee in 2014. The 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 intervals at 95% level.

Figure B.11: Effects of social capital on full vaccination coverage

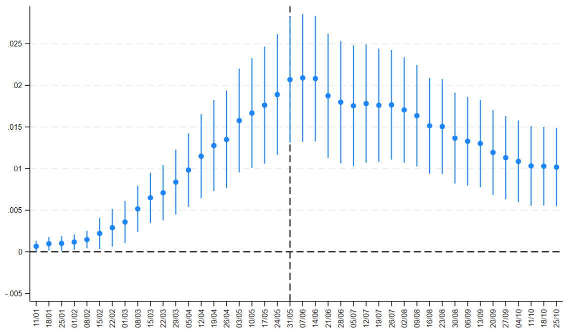


Note: The figure plots differences in COVID-19 full (second dose) vaccination coverage between high social capital (above 75th percentile) and low social capital (below 75th percentile) municipalities by calendar week. The plotted estimates are the coefficients of the interaction terms between week fixed 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 (339,786 observations). Confidence intervals at 95% level.

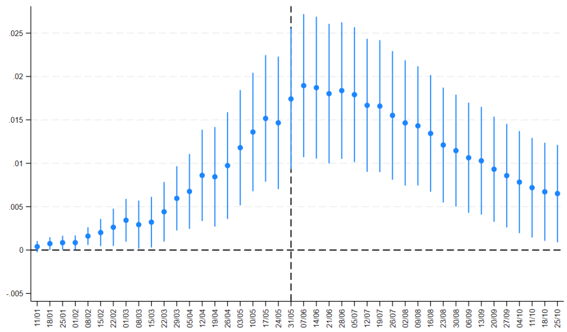
Figure B.12: Effect of high social capital on the vaccination coverage using social capital measures from the Aspects of Daily Life survey



(a) Voter turnout in 2011 referenda



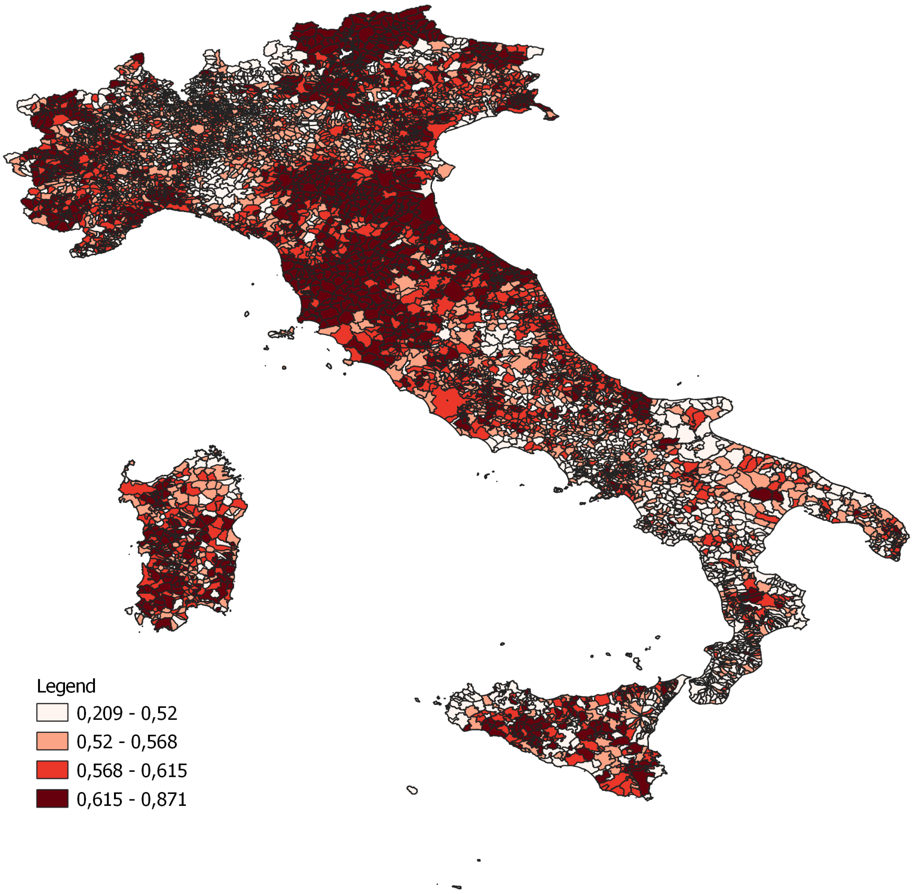
(b) Social participation index



(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 1,065 municipalities (45,795 observations). Confidence intervals at 95% level.

Figure B.13: 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.[25] 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 individual 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 ISTAT 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.

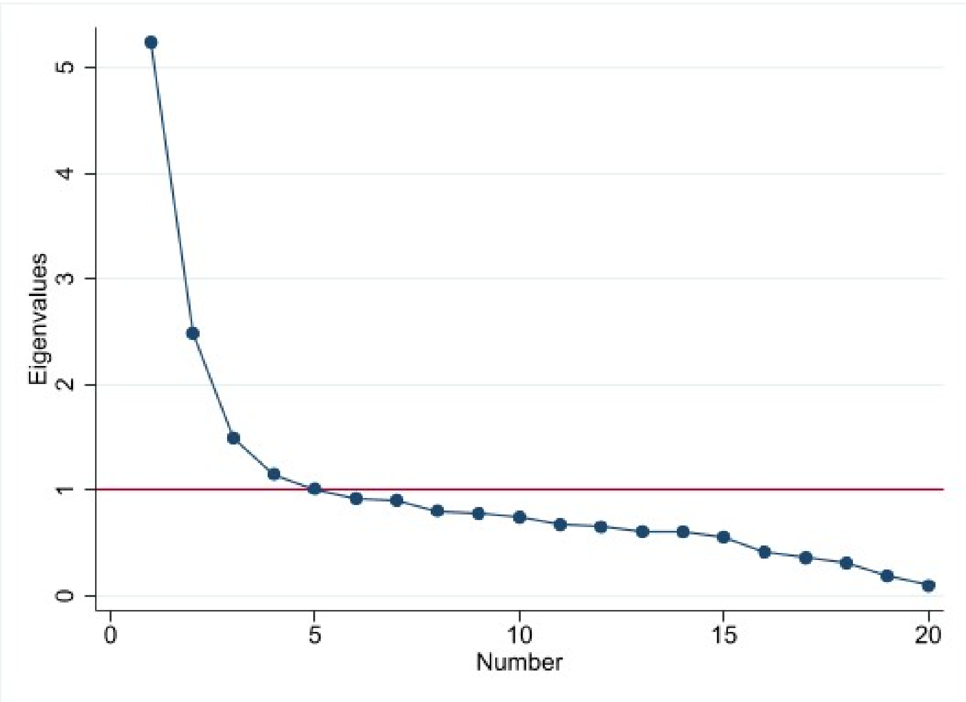
[25] Questions on institutional trust are only recorded from 2012 onwards. As in Durante et al. (2023), we exclude individuals with missing responses to any of the relevant questions. However, their inclusion does not alter the results.

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.