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Close encounters on the verge of a pandemic: the role of social contacts on the spread and mortality of COVID-19

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Abstract

Close proximity interactions facilitate the spread of COVID-19, which is predominantly transmitted via droplets. In this paper we study to what extend the transmission and mortality of the virus are related to social habits regarding physical interactions. Using regional data for a maximum of 8 European countries we find that a standard deviation increase in the percentage of people having daily face-to-face contacts raises COVID-19 cases by 10% but does not affect the number of fatalities. Analyzing the effects by type of contact, we observe that only the interactions with friends are relevant for the transmission and mortality of the virus. Additionally, our results show that this impact is reinforced by the presence of inter-generational families in the region. Finally, we find evidence of a negative relationship between civic habits and the growth rate of contagion between April and June 2020.

JEL Codes: I1, I12, I18.

Keywords: COVID-19; Social contacts; Virus contagion.

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1 Introduction

As is well known from epidemiological studies, close proximity interactions facilitate the spread of diseases that are predominantly transmitted via droplets, as is the case of COVID-19 (see for example Murgante et al., 2020). Social interactions involving physical contacts can then increase the probability of infection, a fact which resolved many governments to enact social distancing measures, though at high economic costs.[1]

In this paper we use measures of social contacts obtained from social surveys to assess whether they provide statistically significant information regarding the pattern of contagion, in addition to standard epidemiological and socio-economic controls. Given the highly uneven spread of the contagion observed within the European countries, we conduct the analysis at the European NUTS 2 level, which we regard as the minimum suitable level of disaggregation. For each unit of observation, the number of COVID-19 cases and fatalities are then merged with region average epidemiological and socio-economic variables.

In addition, we contribute to two areas of the socio-economic literature that have recently been considered in relation to the virus diffusion. First of all, we broaden the notion of social contacts to encompass the collective values that a society develops through social relations and networks and the ensuing citizens' behaviour. Recent empirical evidence has shown that the ethics associated with unspoken norms of reciprocal respect and trust, which emerge where social contacts are dense (Putnam, 2000), can enhance the efficacy of the restrictions imposed by Governments to curb the epidemic (Durante et al., 2020; Borgonovi and Andrieu, 2020; Bartscher et al., 2020). In order to disentangle this behavioural effect from the direct link between the number of infections and the count of physical contacts, we use the percentage of blood donors in the region as a proxy of civic sense and assess its relevance on the growth of COVID-19 outbreaks between April and June 2020, when restrictive measures had been implemented.

Furthermore, we recognize that an important component of social contacts occurs within the family. Multi-generational households, in particular, can physically connect old and young adult people and may favour the transmission of the infection to the elderly, even if they are relatively less active socially (Cornwell, 2011; Bayer and Kuhn, 2020); indeed, the elderly has been the worst affected age group, in terms of fatalities, especially in those Mediterranean countries where the share of multi-generational households is

[1] A direct relation between contagion and contact rate is established by the basic reproduction number, i.e. the secondary cases produced by a single infection in a homogeneous susceptible population: $R_0 = \beta \cdot \bar{c} \cdot d$, where R_0 is the basic reproduction number, $\beta = \frac{infection}{contact}$ is the probability of infection given contact between an infected individual and a susceptible one, $\bar{c} = \frac{contact}{time}$ is the contact per unit of time or contact rate between an infected individual and a susceptible one, and $d = \frac{time}{infection}$ is the duration of the infectiousness (Heffernan et al., 2005; Jones, 2007).

largest. The paper sheds light also on this issue by distinguishing between contacts within and outside the family and controlling for multi-generational households.
Our preferred measure of social contacts are face-to-face daily contacts obtained from the European Quality of Life Survey; this measure explicitly excludes contacts through social networks and telephone. We check the robustness of the results to alternative definitions of social contacts based, more broadly, on the frequency of various types of social activities; we also check the robustness of our findings to different groups of countries as the number of regions differs considerable across them.

We consider three pandemic-related outcomes: cases to population, fatalities to population and CFR (cases-fatality rate), in two different points in time: April and June 2020; differences in significance and magnitudes of the estimated relationships will shed light on how social contacts have played a part in the early phase of the pandemic. In order to identify the effect of social contacts on COVID-19 contagion and mortality we account for the possibility that our variable of interest could be correlated with other regional socio-economic characteristics (see Brown and Ravallion, 2020). For example, it is likely that skin-to-skin contacts are positively related to population density and employment rate but negatively to the share of elderly people. By including these controls in our analysis we separate physical contacts associated with the urban, economic or demographic structure of the region from social interactions inherent to its customs and habits. It is important to notice that when we comment on the effect of social contacts in this paper, we refer to this latter component.

The main findings can be summarized as follows:
- Face-to-face daily social contacts help explaining the spread of the contagion across European regions, in addition to standard epidemiological and socio-economic variables, but are not relevant to the lethality of the disease.
- Specifically, we estimate that a standard deviation increase in the percentage of people having daily social contacts rises COVID-19 cases by 9% to 10%, ceteris paribus; this is a comparably larger effect than that due to a rise in the population density but lower than the rise associated with a standard deviation increase of the employment rate, which is threefold as large.
- Relevant daily contacts are those with friends rather than with relatives; however, multi-generational families appear to favour contagion with a semi-elasticity close to that found for face-to-face contacts with friends. Additionally, the presence of multi-generational families reinforces the impact of daily face-to-face contacts with friends on both COVID-19 contagion and mortality.
- A diffused ethical behaviour is associated with a lower growth of the contagion between April and June 2020. As in this period most Governments had enacted mobility restriction

measures, this result accords with social capital enabling a greater efficacy of these policies.
- We find relevant non linear effects both in the role of family links as well as in the role of civic behaviour.

The paper is organized as follows. The next section introduces the measures of social contacts and their geographical characterization. Section 3 describes the empirical specification and discusses the inclusion of control variables; regression results are presented in Section 4. Section 5 draws the main conclusions, together with the limits of the analysis and its usefulness to the understanding of the present pandemic and to decisions concerning the adoption of contrasting measures.

2 Social contacts and contagion

2.1 The measures of social contacts

There are various ways to map proximity in human communities. Epidemiologists have generally used diary-based surveys as well as, more recently, wireless sensors. Both techniques allow to distinguish between various types of contacts and their role in disease transmission.

Using a diary-based survey Read et al. (2008) distinguished between casual and close encounters, where the former normally occurred in the workplace and were conversational contacts, whereas the latter involved skin-to-skin contacts and usually took place at home. Authors found that casual encounters, though larger in number, are irregular and of a relatively shorter duration, while close contact meetings last longer and are more stable. Using a similar approach but on a much larger scale Mossong et al. (2008)[2] found that encounters occurring on a daily basis or those lasting at least one hour were likely to involve physical contacts, like a handshake. On average, 13.4 daily contacts per person were recorded although country variation ranged from an average of 7.9 in Germany to an average of 19.8 in Italy. In all countries, contact patterns showed a clear assortative feature and were, on average, highest between 5 and 19 year old children and lowest for people older than 60. Epidemiological models where self-reported social contacts augment infectious disease data, have generally been shown to better capture the observed patterns of infection, especially when pathogens are transmitted through small droplets, as in this case transmission parameters can differ, for example, by age-groups (Wallinga et al., 2006).

An alternative to self-reported number of contacts, are contact network data collected using wireless sensors. Salathé et al. (2010) employed such a device and gathered information on contacts up to a maximum distance of 3 meters for 788 individuals. Though

[2]Read et al. (2008) involved a group of 48 adults for 14 non consecutive days; Mossong et al. (2008) involved 7,290 participants of eight European countries.

the number of recorded contacts is large, the wireless sensor device misses the additional information easily obtainable through a diary-based recording. To compare the social contact collection procedures, Mastrandrea et al. (2015) gathered network patterns for the same sample of high school students using both wearable sensors and contact diaries and compared both datasets with self-reported friendship surveys and online social links. They found that short-duration encounters are underreported in diaries and that the contact matrix based on friendship surveys, though less dense than the one based on the actual contacts measured by sensors, compared well with the contact network matrix of sufficiently long duration. On the contrary, the probability of a contact being observed between two individuals linked in Facebook was smaller than if the two individuals were linked through the friendship survey. On the whole, Facebook links seemed to represent more casual contacts.

Although this characteristic may reduce the interest in such kind of contact data in the specific case of pathogen transmission in respiratory-spread epidemic, Facebook links have the undoubted advantage of an extremely large coverage, as well as carrying more general socio-economic information and affecting economic choices (Bailey et al., 2018). Recently, an anonymized snapshot of Facebook active users and all their friendship network have being used to compare the outbreaks of the contagion in two early COVID-19 hotspots: Lodi Province (Lombardy) in Italy and Westchester County (NY) in US (Kuchler et al., 2020). For both areas the authors compute the *Social Connectedness Index* (SCI)[3] to measure the relative probability that individuals across two locations are connected through a friendship link in Facebook. Controlling for population density, income and distance to the hotspot, the authors find that a doubling of the index is associated with an increase in the number of recorded cases of 8/1,000 in Westchester and of 166/1,000 in Lodi province.

Measures of social interactions can also be drawn from existing social surveys. Since the latter are designed for more general purposes, social contact data are not as precise as those collected via sensor devices or specific diaries; still, survey data have the advantages of being based on a representative sample of people and of providing additional information that allows to control for socio-economic heterogeneity. Bayer and Kuhn (2020) use the World Value Survey to proxy for inter-generational contacts taking place within the household. Similarly, Mogi and Spijker (2020) use the European Social Survey to measure social ties by the frequency of social meetings and to detect multi-generational households.

Although suggesting interesting ideas, both papers use data at the country level,

[3]The SCI is defined as the ratio between the number of Facebook friendship links between Facebook users living in the location of interest i and Facebook users living in any other location j of the country, and the product of the number of Facebook users in the two locations.

which, as we argued, are far from capturing the granular spatial differences in COVID-19 outbreaks. In Bayer and Kuhn (2020) the number of observations ranges from 17 to 24 and controls are absent, except for the East-Asia dummy; this opens to omitted variable bias critics.[4] Mogi and Spijker (2020) consider a similar number of countries but measure infection in four dates, which increases the number of observations; moreover, they use factor analysis to save degrees of freedom and add sufficient controls;[5] however, no country fixed effects are included, thus allowing for possible confounding factors.

Regional level data, in addition to allowing for within-country variability, allow sufficient degrees of freedom to add adequate controls, thus avoiding the bias that undermines these existing studies.

2.2 Data visualization

Figure 1 compares two measures of social contacts taken from the European Quality of Life Survey (EQLS)[6] and explained in detail in Section 3.2: the percentage of people having daily or almost daily face-to-face contacts with family or friends and the percentage of people involved in social activities every day or almost every day. Face-to-face daily contacts are highest in a few regions of Italy, Portugal and in most Northern regions of Spain. The involvement in social activities cuts across traditional country groupings, with the diffusion being highest in Northern Spain as well as in a few German and French regions. Table A5 in the Appendix shows the existence of a positive and significant unconditional correlation between our social interaction variables.

Figure 2 illustrates the recorded COVID-19 cases and fatalities up to mid-April: the well-known worst hit regions of Italy and Spain stand out. The cross correlation of cases and fatalities is positive and strongly significant while among the social contact measures, the percentage of people taking part in social activities shows the highest and most significant unconditional correlation with both cases and fatalities (Table A5).

Concerns with the recorded numbers of COVID-19 related death have been raised in

[4] See also Belloc et al. (2020).

[5] They summarize the social and economic variables of interest in three factors and find that the only one positively associated with the log of the cumulative number of cases as well as with its 10-day rate of growth is the factor defined by the percentage of people having frequent social meetings, which enter positively, the percentage of people living in multi-generational households, which enters negatively and GDP per capita, which enters positively. The same factor, however, is not correlated with the cumulative number of cases per population, except for the final date of March. The other two factors capture education, demography, population density and frequency of attendance to religious services.

[6] EQLS is an Eurofound survey carried out every four years with the objective to examine European citizens' lives and how they feel about their lives. The fourth and most recent wave has been carried out in 2016 addressed to the adult population (18+) resident in the 27 EU countries, UK, and five candidate countries. Face-to-face interviews have been carried out in people's homes using CAPI. The sample size is set at a minimum of 1,000 achieved interviews per country, with the sample stratified by region and the degree of urbanisation.

Figure 1: Social contact measures

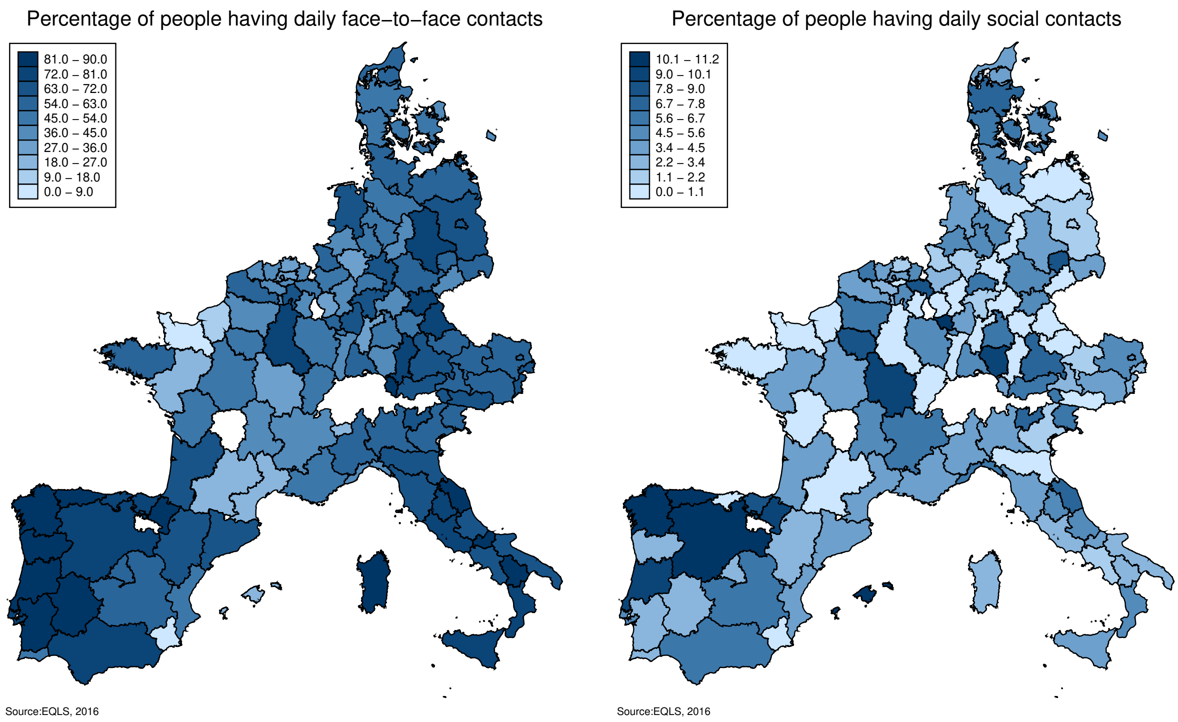
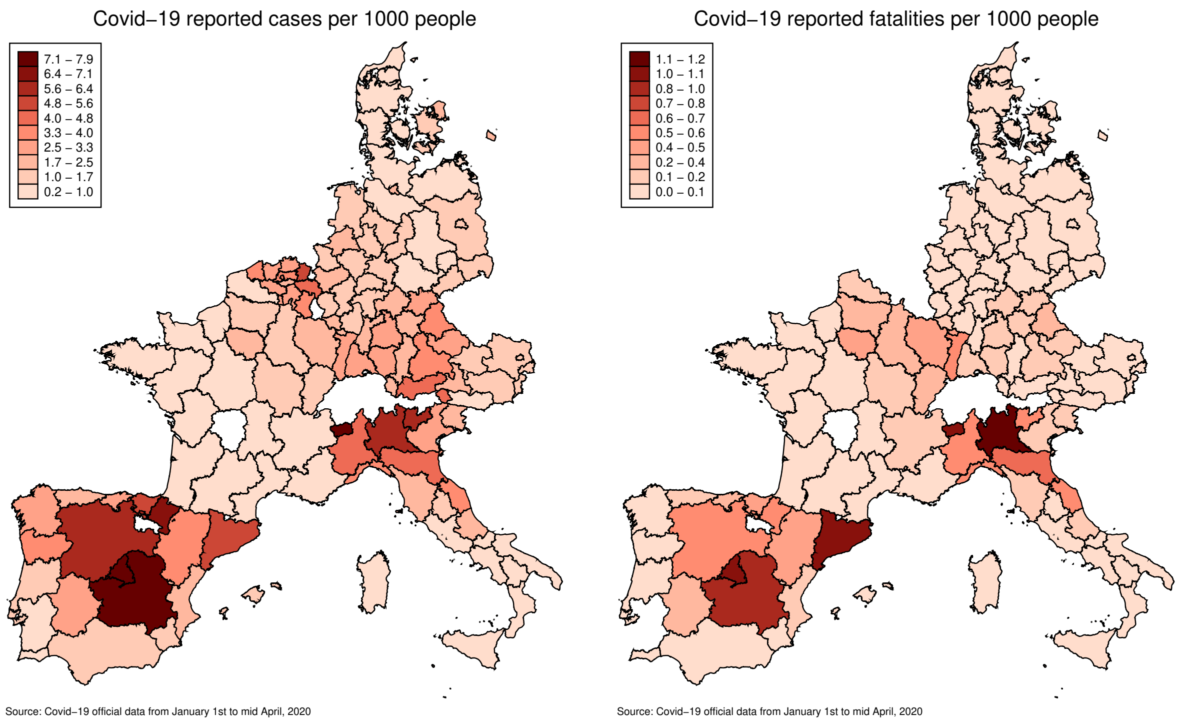
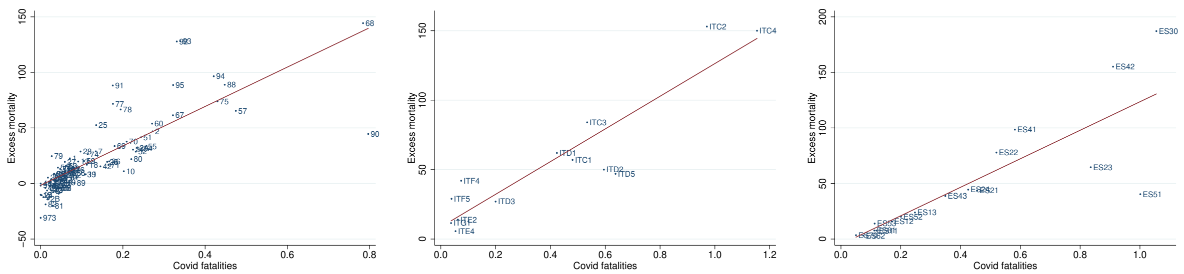


Figure 2: COVID-19 reported cases and fatalities



relation to the likely under-reporting and to differences in recording across countries.[7] While the use of fatality data could then be controversial in cross-country analysis, excess mortality would avoid these mis-measurements (Aron and Muellbauer, 2020) and could be a more reliable measure. Unfortunately, this information is not available at the regional level for a number of countries sufficient to carry out a sound estimation. Notwithstanding, using available data for French departments, and Italian and Spanish regions, Figure 3 shows a clear positive correlation between excess mortality and COVID-19 mortality in all countries. Given that our analysis exploits within-country variations, as we explain in detail below, this finding lessens our concern about the use of data on COVID-19 fatalities.

Figure 3: Excess mortality vs COVID-19 fatalities



(a) France (b) Italy (c) Spain

Notes: French data is disaggregated by Departments. Italian data refers to major cities, when we have more than one city per region we take the average value.

3 Data and empirical strategy

3.1 Empirical strategy

The relation between social contacts and the virus is assessed by exploiting NUTS 2 regional cross-section data. More formally, we estimate:

$$\ln(Y_i) = \beta_0 + \beta_1 X_i + \beta_2 \boldsymbol{Z}_i + \mu_j + \epsilon_i, \tag{1}$$

where subscript i indicates the region, Y refers to COVID-19 cases or fatalities per 1,000 population, or to the CFR, X represents one of our social contact variables and $\boldsymbol{Z}$ is a row vector of control variables. μ_j are country fixed effects, ϵ is a zero mean white-noise residual and β_1 is our parameter of interest, which represents the semi-elasticity between social contacts and COVID-19 variables.

[7]For example, France did not include nursing home deaths, Germany did not count as COVID-19 deaths those of patients with previous major illnesses, Italy recorded as COVID-19 deaths only those of patients that had been tested positive to COVID-19.

Given the nature of the emergency, countries have neither had the time to homogenize criteria nor the same resources to carry out tests among the population. As a result, cross-country comparisons are barely useful. We overcome this problem by exploiting only within-country regional variation through the inclusion of country fixed effects. An alternative would have been to use the number of cases (fatalities) per number of tests carried out. Unfortunately, this information is mostly available only at the country level, a level of aggregation that makes it difficult to identify the relevance of social contacts in the transmission of the virus.[8]

The magnitude of the COVID-19 crisis has provoked an avalanche of studies on the determinants of the virus; in our analysis we draw from them and include a rich set of controls that can be classified into three groups: baseline controls, demographic and economic controls, and regional idiosyncrasies. As baseline controls we include four variables that have been widely acknowledged and are commonly used as the main determinants of the virus: GDP per-capita, which accounts for economic activity and regional specificities in a general way; number of cold days or average temperature, as corona-type viruses are normally seasonal and worsen with cold weather; population density, as the higher it is, the higher the probability of skin-to-skin contacts and of infection being spread by droplets as it may happen in busy public transports, markets and supermarkets, cafes and restaurants, and the number of days since the first cases were detected to account for the stage of the epidemic curve. In order to account for the capacity of the health system, when we study the mortality of COVID-19 we further include the number of beds available in hospitals per 100,000 inhabitants.

The second block of controls include variables related to the structure of the economy and demographics. In addition to the GDP per capita, the economic environment is captured by income poverty, which may reduce the capability to adjust to the required social behavioural changes as well as by measures related to the labour market and production sectors. Specifically, we consider the employment rate, the education of the workforce and the share of employment in the service sector; all have a bearing on the way of living and this may in turn facilitate or hamper the transmission of the virus. For example, the work of small craft businesses is likely to involve travelling across local areas and regions, having contacts with different and numerous households and businesses to whom they provide their services; on the contrary, jobs in the advanced tertiary sector can in most cases be performed remotely, with minimum physical contacts. Regarding the demographic variables, we include in the analysis the share of people aged 65 or more and the ratio of women per men as the virus appears to affect more men than women and hit older people more often.

[8] A robustness test with COVID-19 data from a different point in time is provided in the Appendix.

Finally, we include a set of more heterogeneous factors that could still be relevant in the spread and mortality of COVID-19. Environmental factors such as pollution (Murgante et al., 2020) or humidity (Mäkinen et al., 2009) have been usually found to be important determinants of respiratory virus similar to COVID-19. However, given the complex relationship between these factors and COVID-19 (e.g. different particles in the air could have different effects; pollution, humidity and temperature interact with each other...) we opt for including an indicator that correlates with these factors in a general way: the crude death rate for diseases of the respiratory system for people aged 65 and more. Another potential factor in the transmission of COVID-19 is the inter-connectivity of the region with the rest of the world as regions with larger connectivity are more likely to be exposed to the virus. We proxy the connectivity of a region by the number of air passengers carried per population. Finally, we include two dummy variables: one takes value 1 if the region has a physical border with the national epicentre of the pandemic and the other one if the region is an island.[9]

3.2 Data

Since the transmission of COVID-19 can happen only if encounters are sufficiently proximate in space, a correct measure of social contacts must exclude contacts that take place remotely, either by telephone, email or through the internet. Though there are various surveys that collect information on social contacts, only EQLS distinguishes contacts according to whether they involve physical proximity or not; specifically we define the following variables:[10]

- FACE-TO-FACE CONTACTS Percentage of people in the region that answered **Daily or almost daily** to at least one of the following questions: *a.How often do you have face-to-face contact with family members or relatives living outside the household? b.How often do you have face-to-face contact with friends or neighbours living outside the household?*

[9] As we have commented before, the number of skin-to-skin contacts in a region is likely to be correlated with other socio-economic characteristics. By including a rich set of controls in the analysis we try to separate the “cultural” component of social contacts from physical contacts that occur due to the urban, economic or demographic structure of the region. In other words, our paper estimates the relevance of people social habits in the transmission and fatality of the virus after controlling for other regional idiosyncrasies.

[10] EQLS has several advantages over other surveys: SHARE -Survey of Health, Ageing and Retirement in Europe- provides detailed measures of social contacts but it addresses people above 50 only and it does not differentiate between physical and digital interactions. Similarly, ESS -European Social Survey- does not distinguish among contacts and also limits the geographical disaggregation for Germany to NUTS 1 level. As Germany counts for 1/3 of the regions, we rather keep it in the sample and carry out robustness checks to assess the validity of our results to the exclusion of Germany (see Appendix).

- SOCIAL ACTIVITIES Percentage of people in the region that answered **Daily or almost daily** to at least one of the following questions: *a.How often do you attend religious services, apart from weddings, funerals or christenings? b.How often do you participate in social activities of a club, society, or an association?*

Regional data on COVID-19 cases and fatalities are obtained from official national sources.[11] In the manuscript we use the cumulative number of cases and fatalities until mid-April.[12] In the Appendix we replicate our estimates using the COVID-19 data recorded up to the beginning of June. The reason to use April data in the main analysis is that at that time the distribution of COVID-19 cases and fatalities is less likely to be influenced by social distancing restrictions, and therefore it should be more related to the pre-COVID-19 regional idiosyncrasies.

In our analysis control variables are mostly provided by Eurostat. The only exception is the poverty rate which is obtained from EQLS and it is defined as the percentage of households who answer that they are able to make ends meet with difficulty or great difficulty. Tables A1 and A2 in the Appendix show, respectively, a detailed list and the descriptive statistics of the variables used.[13]

4 Regression results

In this section we present our main results. Section 4.1 displays our baseline results on the importance of social contacts on the transmission (Section 4.1.1) and mortality (Section 4.1.2) of the virus; Section 4.2 checks the robustness of our results to changes in the sample and the period under analysis. Heterogeneities in the nature of face-to-face contacts and the role of inter-generational families are analyzed in Section 4.3. Finally, Section 4.4 studies the role of civic capital on the spread of COVID-19.

4.1 Baseline results

4.1.1 Cases

Table 1 studies the importance of social contacts on the transmission of the virus. Results are separated in two blocks depending on the variable used to proxy social contacts. Columns [1]-[3] consider face-to-face contacts and columns [4]-[6] use the percentage of people participating in social activities. Within each block, we present three different

[11] See the note in Table A1 in the Appendix.
[12] Table A3 in the Appendix shows the specific date for each country.
[13] Although Eurostat also provides some regional poverty measures, the coverage is much limited, reducing our sample almost 60%.

regressions: the first specification includes only the baseline set of controls, the second adds economic and demographic controls and the final one includes the full set of controls described above.

The first remarkable result is that we find a positive and significant impact of our variables of interest on the number of cases regardless of the social contact proxy used, although the precision of our estimates improves with the inclusion of economic and demographic controls. If we focus on our preferred specification, which includes the full set of controls, we observe that a 1 percentage point increase in our social contact variable raises the number of cases by 0.5% when we consider face-to-face contacts and by 3.4% in the case of social activities. This interval in the estimates is greatly reduced if we account for the distribution of our variables of interest: if we assume an increase of 1 standard deviation, we obtain that the number of cases increases by 9.4% when face-to-face contacts are considered ($0.5\% * 18.77$) and by 10% in the case of social activities ($3.4\% * 2.97$).

Regarding the control variables, we find a positive robust relationship of the number of cases with cold temperatures, employment rate and number of days since the first COVID-19 cases; in contrast, we uncover a negative association with the share of people above 65 years. While the positive impacts of colder temperatures and the number of days since the first cases have been widely acknowledged by the epidemiology literature, we believe that the employment rate and the share of people above 65 years capture the importance of the workplace in the transmission of the virus. Indeed, using data for US counties, Brown and Ravallion (2020) also find a negative impact of the share of elderly people on the transmission of COVID-19. They argue that "with higher retirement rates, the elderly will tend to face less economic pressure to be active outside home. Time-use surveys for the US indicate that elderly people have substantially lower contact rates in normal times (Cornwell, 2011)." (Brown and Ravallion, 2020, p. 6). In addition we find some evidence supporting a negative relationship between the share of people working in the service sector and the spread of the virus, indicating that it is not only the economic activity what matters, but the kind of activity as well. When we use face-to-face contacts, we further observe a positive impact of population density on the number of cases.

One way to put the importance of social habits into perspective is to compare the actual number of cases in one region with the number that would have resulted had the number of social contacts been higher, everything else held constant. For example, if a region with a relatively low percentage of face-to-face contacts like Liguria (38.66%) were to have the same percentage of face-to-face contacts as Andalucía (80.83%), the number of cases would be 21% higher (0.5*[80.83-38.66]); in other words, such an increase would have produced, in mid-April, 1,268 additional cases for a total of 7,307 instead of 6,039. By comparison, notice that 1 standard deviation increase of the employment rate would increase the number of cases between 34.8% and 40%, around 4 times the impact of our social contact variables. Likewise, using again estimates from column [3], a doubling of the population density would be associated with a 13.4% increase in the number of cases, slightly more than the impact of 1 standard deviation increase in social contacts.

4.1.2 Fatalities

Regarding the role of social contacts on COVID-19 fatalities we consider two different mortality indicators: the number of fatalities per 1,000 people (Table 2) and the case-fatality rate (Table 3).

A notable result is the lack of a significant relation between social contacts and COVID-19 fatalities regardless of the social contact or dependent variable used. Given the positive relation between social contacts and the number of COVID-19 cases uncovered in the previous section this result may be surprising. However, we think that it highlights the relevance of environmental and other structural factors in the mortality rate of respiratory diseases like COVID-19.[14] In particular, we find a positive relationship between the number of fatalities and: i) colder regions, ii) larger economic activity (GDP_{pc}), iii) more days since the first COVID-19 cases and iv) a higher population density; on the contrary, the number of fatalities is negatively associated with the share of people employed in the service sector. Again, these results are robust independently of the dependent variable consider in the analysis.

All in all, our results indicate that social interactions increase the spread of the virus, but they do not play a key role on its mortality. Given that recent evidence has pointed out that the mortality rate is positively related to the viral load (Pujadas et al., 2020), this could indicate that physical contacts in specific activities (e.g. economic activity, non service sector) could favour the spread of the virus more intensively than other types of social contacts.

4.2 Robustness checks

Before moving to an in-depth analysis on the relevance of family links and civic attitudes, we check the robustness of the results so far. There are two issues, in particular, that could affect our empirical analysis: i) our sample includes 38 German regions that represent 31% and 34% of the sample when we study, respectively, the number of COVID-19 cases and fatalities and ii) COVID-19 data is very preliminary and could be subject to measurement problems.

[14] Another possible explanation is that, given the average lag of 3 weeks between the infection and the death of a COVID-19 patient, our data on deaths account for a very early period of the pandemic. Later we discard this possibility when we use data from June.

Table 1: COVID-19 cases

	Face-to-face contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	0.003	0.006	0.005	0.024	0.034	0.034
	(0.003)	(0.003)*	(0.003)*	(0.015)	(0.016)**	(0.017)**
$\ln(GDP_{pc})$	1.007	0.271	0.185	0.989	0.289	0.176
	(0.277)***	(0.308)	(0.303)	(0.274)***	(0.321)	(0.308)
$\ln(Density)$	0.009	0.118	0.134	–0.001	0.073	0.092
	(0.061)	(0.064)*	(0.067)**	(0.062)	(0.067)	(0.068)
$\ln(Heating)$	1.196	1.118	1.223	1.177	1.060	1.087
	(0.375)***	(0.336)***	(0.376)***	(0.379)***	(0.350)***	(0.388)***
$\ln(Days)$	1.357	0.968	0.990	1.269	0.800	0.796
	(0.382)***	(0.386)**	(0.376)***	(0.395)***	(0.406)*	(0.397)**
Pop_{65}		–0.084	–0.075		–0.093	–0.085
		(0.027)***	(0.027)***		(0.027)***	(0.026)***
$\frac{Women}{Men}$		0.027	0.032		0.041	0.044
		(0.034)	(0.034)		(0.033)	(0.033)
$Serv\_share$		–0.011	–0.014		–0.016	–0.018
		(0.010)	(0.011)		(0.009)*	(0.010)*
$\frac{N}{L}$		0.053	0.048		0.047	0.045
		(0.013)***	(0.014)***		(0.015)***	(0.014)***
$Education$		–0.035	–0.018		–0.026	–0.007
		(0.019)*	(0.022)		(0.021)	(0.023)
$Poverty$		0.000	–0.001		0.001	0.000
		(0.005)	(0.005)		(0.005)	(0.005)
$\ln(Respiratory)$			0.259			0.375
			(0.352)			(0.351)
Air			0.000			–0.002
			(0.011)			(0.012)
$Borders$			0.177			0.198
			(0.111)			(0.111)*
$Islands$			0.466			0.350
			(0.286)			(0.310)
Constant	–25.361	–19.920	–21.821	–24.554	–19.089	–20.793
	(2.529)***	(4.184)***	(4.114)***	(2.549)***	(4.386)***	(4.162)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	8	8	8	8	8	8
Observations	124	124	124	124	124	124
Rsq	0.680	0.731	0.734	0.684	0.734	0.739
RMSE	0.454	0.416	0.414	0.451	0.414	0.410

Notes: Dependent variable $\ln(Cases)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3])) or daily social activities (Columns[4]-[6]).

Table 2: COVID-19 fatalities

	Face-to-face contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	0.002	0.006	0.005	0.001	0.015	0.015
	(0.004)	(0.005)	(0.005)	(0.025)	(0.025)	(0.026)
$\ln(GDP_{pc})$	1.625	1.527	1.341	1.608	1.550	1.342
	(0.384)***	(0.573)***	(0.578)**	(0.383)***	(0.591)**	(0.582)**
$\ln(Density)$	–0.025	0.228	0.251	–0.032	0.184	0.213
	(0.079)	(0.116)*	(0.127)*	(0.080)	(0.119)	(0.126)*
$\ln(Heating)$	1.339	1.322	1.379	1.337	1.261	1.284
	(0.401)***	(0.392)***	(0.434)***	(0.403)***	(0.406)***	(0.440)***
$\ln(Days)$	1.453	1.239	1.256	1.474	1.177	1.174
	(0.499)***	(0.531)**	(0.523)**	(0.524)***	(0.562)**	(0.567)**
$\ln(Beds)$	–0.134	0.349	0.269	–0.119	0.393	0.317
	(0.631)	(0.657)	(0.638)	(0.630)	(0.647)	(0.632)
Pop_{65}		–0.032	–0.018		–0.038	–0.024
		(0.048)	(0.050)		(0.049)	(0.051)
$\frac{Women}{Men}$		–0.037	–0.032		–0.020	–0.018
		(0.054)	(0.055)		(0.056)	(0.057)
$Serv\_share$		–0.021	–0.025		–0.026	–0.030
		(0.014)	(0.015)*		(0.014)*	(0.015)**
$\frac{N}{L}$		0.027	0.025		0.021	0.020
		(0.021)	(0.021)		(0.021)	(0.021)
$Education$		–0.074	–0.042		–0.063	–0.031
		(0.032)**	(0.036)		(0.033)*	(0.036)
$Poverty$		0.002	0.001		0.003	0.002
		(0.007)	(0.007)		(0.007)	(0.007)
$\ln(Respiratory)$			0.580			0.621
			(0.472)			(0.484)
Air			–0.002			–0.002
			(0.019)			(0.020)
$Borders$			0.255			0.283
			(0.174)			(0.175)
$Islands$			0.572			0.505
			(0.362)			(0.377)
Constant	–36.047	–33.596	–35.759	–35.847	–33.825	–35.644
	(4.261)***	(6.567)***	(6.709)***	(4.353)***	(6.723)***	(6.718)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	7	7
Observations	112	112	112	112	112	112
Rsq	0.633	0.666	0.670	0.631	0.661	0.666
RMSE	0.636	0.606	0.603	0.637	0.611	0.607

Notes: Dependent variable $\ln(Fatalities)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3]) or daily social activities (Columns[4]-[6]).

Table 3: COVID-19 case-fatality rate (CFR)

	Face-to-face contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	–0.001	–0.000	–0.000	–0.020	–0.016	–0.016
	(0.002)	(0.002)	(0.002)	(0.012)	(0.011)	(0.012)
$\ln(GDP_{pc})$	0.199	0.744	0.640	0.219	0.763	0.672
	(0.171)	(0.337)**	(0.335)*	(0.170)	(0.329)**	(0.332)**
$\ln(Density)$	0.002	0.118	0.127	0.004	0.116	0.126
	(0.046)	(0.060)*	(0.065)*	(0.046)	(0.057)**	(0.063)**
$\ln(Heating)$	0.264	0.281	0.290	0.273	0.277	0.322
	(0.085)***	(0.101)***	(0.135)**	(0.084)***	(0.098)***	(0.129)**
$\ln(Days)$	0.409	0.404	0.386	0.484	0.491	0.489
	(0.241)*	(0.246)	(0.259)	(0.244)*	(0.250)*	(0.268)*
$\ln(Beds)$	0.155	0.361	0.366	0.166	0.335	0.324
	(0.283)	(0.304)	(0.315)	(0.292)	(0.303)	(0.315)
Pop_{65}		0.024	0.031		0.029	0.036
		(0.025)	(0.026)		(0.024)	(0.026)
$\frac{Women}{Men}$		–0.037	–0.035		–0.037	–0.034
		(0.029)	(0.030)		(0.029)	(0.030)
$Serv\_share$		–0.009	–0.014		–0.009	–0.014
		(0.007)	(0.007)*		(0.007)	(0.007)*
$\frac{N}{L}$		–0.012	–0.014		–0.012	–0.015
		(0.012)	(0.012)		(0.011)	(0.011)
$Education$		–0.042	–0.030		–0.039	–0.029
		(0.018)**	(0.020)		(0.016)**	(0.019)
$Poverty$		0.003	0.003		0.003	0.003
		(0.003)	(0.003)		(0.003)	(0.003)
$\ln(Respiratory)$			0.313			0.234
			(0.227)			(0.239)
Air			0.008			0.008
			(0.008)			(0.008)
$Borders$			0.074			0.077
			(0.087)			(0.089)
$Islands$			0.065			0.117
			(0.166)			(0.155)
Constant	–10.438	–12.749	–13.552	–11.085	–13.160	–13.921
	(2.210)***	(3.461)***	(3.824)***	(2.233)***	(3.459)***	(3.754)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	7	7
Observations	112	112	112	112	112	112
Rsq	0.750	0.771	0.767	0.757	0.776	0.772
RMSE	0.331	0.317	0.320	0.327	0.314	0.317

Notes: Dependent variable $\ln\left(\frac{Fatalities}{Cases}\right)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3]) or daily social activities (Columns[4]-[6]).

Regarding the importance of Germany in our sample, we replicate our previous analysis after excluding German regions from the sample. Tables A6-A8 show a very similar picture to the one obtained in our baseline analysis, indicating that our results are not driven by Germany. As expected, our estimations present lower precision due to the decrease in the sample size.

During the main analysis we have used COVID-19 data to mid-April for two reasons: i) a considerable number of regions already presented cases and ii) the effects of social distance policies were not yet so important to undermine the role of pre-COVID-19 social interactions. Tables A11-A13 in the Appendix show the robustness of our results to the use of COVID-19 from a different point in time, in this case beginning of June.[15] Regarding social interactions, it is worthy to note that, despite the similarity of the coefficients, the impact on the number of cases is not precisely estimated. This result is in line with our argument that social distance policies could have affected regions in different ways, undermining the role played by social interactions. Interestingly, in contrast with April data, the results show that the CFR is higher in regions with a larger number of air passengers carried per inhabitants.[16]

On the whole, we gauge that the use of April data is not driving the main results.

4.3 The role of family links and inter-generational households

Daily face-to-face contacts outside the household occur both with friends and with relatives. In this section we ask whether the two types of contacts have a different association with the spread of the virus. Figure A1 in the Appendix compares the geographical distribution and variability of both types of contacts and shows that the percentage of family contacts is normally lower than that of contacts with friends though their variability is similar. Table 4 displays the results in three different blocks depending on the dependent variable being cases, fatalities or CFR. Within each block, we present two specifications that include the full set of controls but differ in the type of social contact considered. The first specification is included for comparison reasons and considers, as before, the impact of face-to-face contacts on the different COVID-19 variables. The second specification splits face-to-face contacts by type (i.e. family vs friends).

Regarding the number of COVID-19 cases, we find that only face-to-face contacts with friends are positively related to the spread of the virus. One possible explanation of this result is the place where these interactions usually take place; while friends are

[15] Figure A2 in the Appendix displays the regional distribution of cases and fatalities.

[16] When we study the impact on fatalities there is a small difference in the number of observations using COVID-19 data from April (112) and June (113). The reason is that Alentejo (Portugal) had 0 fatalities in April and 1 in June.

more likely to meet in public spaces (with higher potential interactions with other people), family meetings often take place at home, where the risk of contagion, given the type and duration of the contact, is expected to be lower, as the number of people encountered is smaller.

The second block, which analyzes the impact of our variables of interest on the number of COVID-19 fatalities per 1,000 inhabitants, also shows a positive and significant impact of face-to-face contacts with friends, in contrast with previous results. In particular, a 1 percentage point increase in the share of contacts with friends increases the mortality rate by 1%.[17] The similar magnitudes of the coefficients of contacts with friends in the cases and fatalities regressions explain the reduction of the magnitude of the estimated coefficient in the CFR regression.

When considering family contacts, a potentially key qualification is the type of households in which these may occur. At this regard, inter-generational families may contribute to the transmission and mortality of the virus as young adults are prone to COVID-19 contagion but less susceptible to serious illness or death than people aged 65 or more.[18] Table 5 shows the results obtained when including a measure of inter-generational families as an additional regressor.[19]

Interestingly, we find a positive correlation with the number of fatalities, but not with the number of cases. The magnitude of the coefficient implies a 1% increase in the mortality rate for a 1 p.p. increase in the percentage of inter-generational families; the role of contacts with friends remains significant and the coefficient is of comparable magnitude. While fatalities are responsive to the percentage of inter-generational families and both cases and fatalities are responsive to the percentage of face-to-face contacts with friends, COVID-19 lethality turns out to be uncorrelated with both. Control variables are in line with results from previous sections.[20]

However, the impact of face-to-face contacts on COVID-19 pandemic may not be independent of the percentage of inter-generational households. On the contrary, since the size of inter-generational households is, on average, larger than the size of one-generation households (e.g. a couple with kids vs only a couple), it is reasonable to think that

[17] Results are robust to using cumulative cases and fatalities up to June and to the exclusion of German regions. See Tables A9 and A14 in the Appendix.

[18] See for example https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-age.html. Accessed September 8^{th}, 2020.

[19] Inter-generational families are defined as those in which more than one generation cohabit; for convenience, in the text, inter-generational and multi-generational families or households are used interchangeably.

[20] Results are robust to using cumulative cases and fatalities up to June (see Table A15); however, when we exclude German regions we do not observe any significant impact of inter-generational households (see Table A10).

Table 4: COVID-19: family vs friends

	Cases		Fatalities		Fatalities/Cases	
	[1]	[2]	[3]	[4]	[5]	[6]
$Contacts$	0.005		0.005		–0.000	
	(0.003)*		(0.005)		(0.002)	
$Friends$		0.007		0.010		0.004
		(0.003)**		(0.005)*		(0.003)
$Family$		–0.002		–0.005		–0.005
		(0.004)		(0.006)		(0.004)
$\ln(GDP_{pc})$	0.185	0.101	1.341	1.187	0.640	0.566
	(0.303)	(0.316)	(0.578)**	(0.597)*	(0.335)*	(0.332)*
$\ln(Density)$	0.134	0.138	0.251	0.266	0.127	0.134
	(0.067)**	(0.065)**	(0.127)*	(0.123)**	(0.065)*	(0.063)**
$\ln(Heating)$	1.223	1.266	1.379	1.448	0.290	0.324
	(0.376)***	(0.370)***	(0.434)***	(0.429)***	(0.135)**	(0.138)**
$\ln(Days)$	0.990	1.010	1.256	1.306	0.386	0.415
	(0.376)***	(0.378)***	(0.523)**	(0.523)**	(0.259)	(0.260)
$\ln(Beds)$			0.269	0.323	0.366	0.389
			(0.638)	(0.653)	(0.315)	(0.318)
Pop_{65}	–0.075	–0.075	–0.018	–0.018	0.031	0.031
	(0.027)***	(0.027)***	(0.050)	(0.050)	(0.026)	(0.026)
$\frac{Women}{Men}$	0.032	0.037	–0.032	–0.026	–0.035	–0.033
	(0.034)	(0.033)	(0.055)	(0.054)	(0.030)	(0.030)
$Serv\_share$	–0.014	–0.017	–0.025	–0.031	–0.014	–0.018
	(0.011)	(0.011)	(0.015)*	(0.016)*	(0.007)*	(0.008)**
$\frac{N}{L}$	0.048	0.048	0.025	0.024	–0.014	–0.015
	(0.014)***	(0.014)***	(0.021)	(0.021)	(0.012)	(0.012)
$Education$	–0.018	–0.014	–0.042	–0.038	–0.030	–0.027
	(0.022)	(0.023)	(0.036)	(0.037)	(0.020)	(0.020)
$Poverty$	–0.001	–0.001	0.001	0.001	0.003	0.003
	(0.005)	(0.005)	(0.007)	(0.007)	(0.003)	(0.003)
$\ln(Respiratory)$	0.259	0.318	0.580	0.688	0.313	0.392
	(0.352)	(0.363)	(0.472)	(0.492)	(0.227)	(0.237)
Air	0.000	0.002	–0.002	0.003	0.008	0.011
	(0.011)	(0.011)	(0.019)	(0.020)	(0.008)	(0.008)
$Borders$	0.177	0.175	0.255	0.249	0.074	0.060
	(0.111)	(0.111)	(0.174)	(0.177)	(0.087)	(0.087)
$Islands$	0.466	0.508	0.572	0.620	0.065	0.095
	(0.286)	(0.286)*	(0.362)	(0.370)*	(0.166)	(0.177)
Constant	–21.821	–21.956	–35.759	–36.030	–13.552	–13.631
	(4.114)***	(4.116)***	(6.709)***	(6.588)***	(3.824)***	(3.761)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	8	8	7	7	7	7
Observations	124	124	112	112	112	112
Rsq	0.734	0.736	0.670	0.673	0.767	0.772
RMSE	0.414	0.412	0.603	0.600	0.320	0.317

Notes: Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: COVID-19: inter-generational families

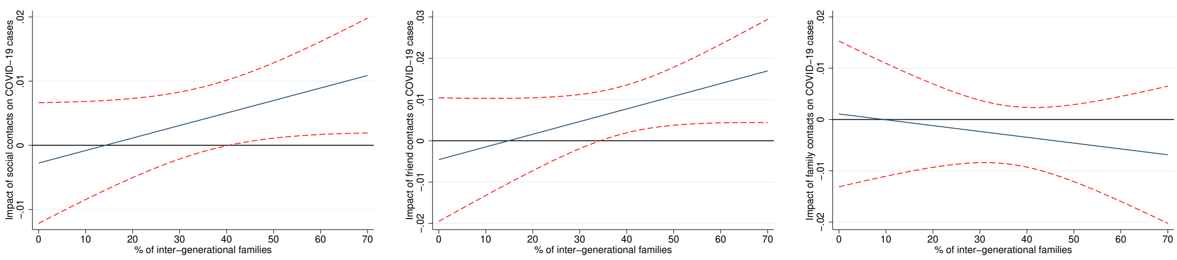
	Cases			Fatalities			Fatalities/Cases		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
$Inter-generational$	0.005	0.004	0.005	0.009	0.008	0.010	0.002	0.002	0.003
	(0.004)	(0.004)	(0.004)	(0.005)*	(0.005)	(0.005)*	(0.003)	(0.003)	(0.003)
$Contacts$		0.005			0.004			–0.001	
		(0.003)			(0.005)			(0.002)	
$Friends$			0.008			0.010			0.004
			(0.003)**			(0.005)*			(0.003)
$Family$			–0.003			–0.007			–0.006
			(0.003)			(0.006)			(0.004)
$\ln(GDP_{pc})$	0.271	0.220	0.139	1.485	1.445	1.295	0.665	0.671	0.600
	(0.311)	(0.313)	(0.324)	(0.574)**	(0.578)**	(0.590)**	(0.336)*	(0.337)**	(0.332)*
$\ln(Density)$	0.096	0.131	0.135	0.227	0.259	0.281	0.134	0.129	0.138
	(0.067)	(0.066)*	(0.064)**	(0.126)*	(0.127)**	(0.124)**	(0.061)**	(0.065)**	(0.062)**
$\ln(Heating)$	1.191	1.244	1.296	1.359	1.409	1.499	0.307	0.300	0.340
	(0.423)***	(0.401)***	(0.397)***	(0.476)***	(0.467)***	(0.461)***	(0.130)**	(0.138)**	(0.141)**
$\ln(Days)$	1.019	0.998	1.022	1.287	1.270	1.329	0.388	0.390	0.423
	(0.371)***	(0.378)***	(0.377)***	(0.517)**	(0.528)**	(0.524)**	(0.260)	(0.260)	(0.261)
$\ln(Beds)$				0.361	0.345	0.419	0.386	0.388	0.419
				(0.620)	(0.618)	(0.623)	(0.310)	(0.314)	(0.313)
Pop_{65}	–0.063	–0.066	–0.063	0.004	0.002	0.007	0.036	0.036	0.039
	(0.028)**	(0.028)**	(0.028)**	(0.051)	(0.052)	(0.052)	(0.028)	(0.028)	(0.028)
$\frac{Women}{Men}$	0.037	0.027	0.030	–0.041	–0.051	–0.050	–0.042	–0.040	–0.040
	(0.035)	(0.034)	(0.033)	(0.056)	(0.054)	(0.053)	(0.031)	(0.030)	(0.030)
$Serv\_share$	–0.015	–0.012	–0.014	–0.023	–0.020	–0.025	–0.012	–0.013	–0.016
	(0.010)	(0.010)	(0.011)	(0.014)*	(0.014)	(0.015)	(0.007)*	(0.007)*	(0.008)**
$\frac{N}{L}$	0.043	0.048	0.048	0.020	0.025	0.024	–0.013	–0.014	–0.015
	(0.014)***	(0.014)***	(0.014)***	(0.020)	(0.021)	(0.021)	(0.012)	(0.012)	(0.012)
$Education$	–0.005	–0.015	–0.011	–0.028	–0.039	–0.034	–0.030	–0.029	–0.026
	(0.023)	(0.022)	(0.022)	(0.034)	(0.035)	(0.036)	(0.018)*	(0.019)	(0.019)
$Poverty$	0.001	–0.001	–0.000	0.002	0.001	0.002	0.002	0.003	0.003
	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.003)	(0.003)	(0.003)
$\ln(Respiratory)$	0.249	0.280	0.358	0.581	0.607	0.747	0.325	0.321	0.410
	(0.342)	(0.342)	(0.354)	(0.458)	(0.455)	(0.475)	(0.224)	(0.224)	(0.234)*
Air	–0.002	–0.001	0.001	–0.006	–0.005	–0.000	0.007	0.007	0.010
	(0.011)	(0.011)	(0.011)	(0.019)	(0.019)	(0.019)	(0.008)	(0.008)	(0.007)
$Borders$	0.194	0.172	0.165	0.265	0.241	0.223	0.066	0.069	0.052
	(0.118)	(0.113)	(0.112)	(0.182)	(0.178)	(0.179)	(0.089)	(0.089)	(0.089)
$Islands$	0.481	0.484	0.535	0.594	0.605	0.670	0.076	0.075	0.110
	(0.295)	(0.281)*	(0.279)*	(0.351)*	(0.347)*	(0.347)*	(0.154)	(0.157)	(0.164)
Constant	–22.741	–22.461	–22.743	–37.293	–36.947	–37.457	–13.852	–13.905	–14.077
	(4.270)***	(4.267)***	(4.259)***	(6.803)***	(6.907)***	(6.777)***	(3.943)***	(3.945)***	(3.893)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	8	8	8	7	7	7	7	7	7
Observations	124	124	124	112	112	112	112	112	112
Rsq	0.730	0.735	0.738	0.673	0.673	0.680	0.769	0.766	0.772
RMSE	0.417	0.413	0.410	0.600	0.601	0.594	0.319	0.321	0.317

Notes: Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

inter-generational families would amplify the effect of face-to-face contacts outside the household on the number of cases and fatalities. Beyond this mechanism, fatalities are also affected by the different COVID-19 mortality rate by age. That is, a larger share of inter-generational households could increase the mortality rate due to face-to-face contacts by facilitating the contagion from more resistant younger generations, usually characterized by having a larger number of face-to-face contacts, to more vulnerable older generations.

We test this conditional hypothesis by interacting our social contacts variables with the percentage of inter-generational households. Figures 4 and 5 show, for a relevant range of inter-generational household values, the marginal effects of social contacts on COVID-19 cases and fatalities, respectively.[21] Figures 4.a and 5.a are obtained by including an interaction term between face-to-face contacts and inter-generational households (i.e. we add an interaction term in columns [2] and [5] of Table 5). The rest of the figures come from differentiating face-to-face contacts between friends and relatives, so that the results are obtained by adding two interaction terms in columns [3] and [6] of Table 5. We find that the impact of face-to-face contacts increases with the share of inter-generational households, contacts with friends being, as before, the main driver. In particular, we observe that face-to-face contacts are not significant for low values of inter-generational families, but have a positive impact on the number of COVID-19 cases in regions where inter-generational families represent at least 35%-40% of the total households. The increase in the number of cases associated to a 1 percentage point increase in the number of contacts with friends goes from 0.6% when the share of inter-generational families is 35% to 1.7% when that share reaches 70%. This result supports our hypothesis about the complementarity of these two factors on the spread of the virus.

Figure 4: Social contacts and inter-generational families: COVID-19 cases



(a) Contacts (b) Friends (c) Family

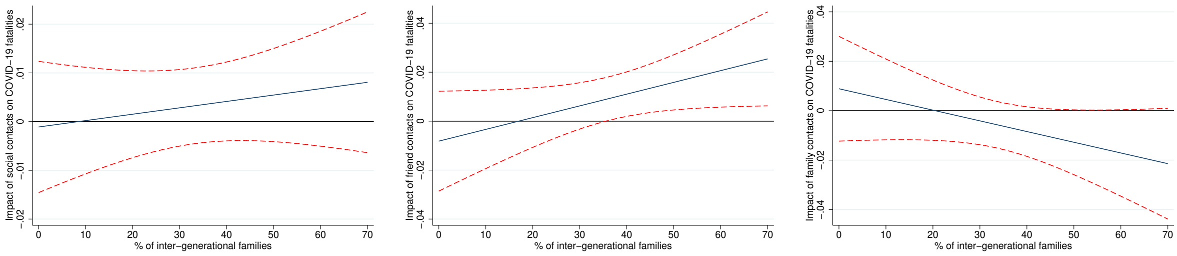
Notes: Marginal effects computed, respectively, from $\ln(Cases_i) = \beta_0 + \beta_1 Contacts_i + \beta_2 Inter-generational_i + \beta_3 Contacts_i \times Inter-generational_i + \beta_4 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figure 4.a) and from $\ln(Cases_i) = \beta_0 + \beta_1 Family_i + \beta_2 Friends_i + \beta_3 Inter-generational_i + \beta_4 Family_i \times Inter-generational_i + \beta_5 Friends_i \times Inter-generational_i + \beta_6 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figures 4.b and 4.c). 90% Confidence intervals.

Figure 5 presents the marginal effects where the dependent variable is the number

[21]The full set of results is available upon request.

of COVID-19 fatalities per 1,000 inhabitants. Although we do not find an impact of face-to-face contacts for any value of inter-generational households, when we consider contacts with friends and family together, Figure 5.b displays a positive impact for the contacts with friends that increases with the share of inter-generational households and it is significant after a share of 35%.[22] Similarly to what found for the number of cases, 1 percentage point increase in the number of contacts with friends raises the number of fatalities by 0.9% when the share of inter-generational families is 35% and by 2.5% if this share arrives at 70%.

Figure 5: Social contacts and inter-generational families: COVID-19 fatalities



(a) Contacts (b) Friends (c) Family

Notes: Marginal effects computed, respectively, from $\ln(Fatalities_i) = \beta_0 + \beta_1 Contacts_i + \beta_2 Inter-generational_i + \beta_3 Contacts_i \times Inter-generational_i + \beta_4 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figure 5.a) and from $\ln(Fatalities_i) = \beta_0 + \beta_1 Family_i + \beta_2 Friends_i + \beta_3 Inter-generational_i + \beta_4 Family_i \times Inter-generational_i + \beta_5 Friends_i \times Inter-generational_i + \beta_6 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figures 5.b and 5.c). 90% Confidence intervals.

4.4 Civic capital and the spread of the COVID-19

In view of the COVID-19 pandemic, most Governments have implemented lockdown policies to try and contain the spread of the disease. Although the most relevant measures have been applied at the national level, Bartscher et al. (2020) have shown that the social capital (i.e. the civic habits) of a specific area plays an important role. Indeed it is well documented that a society which has developed dense social networks is also likely to be characterized by generalized reciprocity, a norm at the base of the so-called thin trust, that is trust towards the 'generalized other' (Putnam, 2000). Then, in the face of a pandemic, rules aimed at curbing infection (lockdown, masks, social distancing) are expected to be more effective where social texture is dense as people internalize the negative externality of dodging restrictions (Giuliano and Rasul, 2020 and references therein). In this section we complement Bartscher et al. (2020) analysis by studying how social capital has affected the spread of the virus in our sample.[23] Table A16 in the Appendix shows

[22]Results are robust to using cumulative cases and fatalities up to June and to the exclusion of Germany regions. See Figures A3 and A6 in the Appendix.

[23]Given that the variable used as a proxy of social capital (blood donation, obtained from the Eurobarometer) is only available at NUTS 1 level for Germany, we exclude the country from our sample.

the results of a regression where the dependent variable is the log-difference of COVID-19 cases (columns [1]-[4]) or fatalities (columns [5]-[8]) between April and June and where face-to-face contacts is used to proxy social interactions.[24] The first column of each block shows the results when we include our usual set of controls in the regression. We find that the growth rate of cases are positively related with the density of the population, the percentage of people above 65 years of age and cold temperatures. In contrast, the growth rate of fatalities is only positively correlated with the density of the population. Surprisingly, there is a negative relation between the (log of) the crude death rate for diseases of the respiratory system for people aged 65 and more and the fatalities growth rate. One potential explanation is that those regions suffered more at the beginning of the pandemic; however, we do not find any empirical evidence supporting this hypothesis in our baseline regressions. Definitely, this result deserves further attention but unfortunately it is beyond the scope of this paper.

In the rest of the table we include the percentage of people that have donated blood, as a proxy of civic habits (or social capital).[25] When considering a simple linear relation (columns [2] and [6]), we find an unexpected positive impact on the growth rate of fatalities, while there is no-relevant influence on the growth rate of COVID-19 cases. In columns [3] and [7] we allow for a more flexible functional form by including a quadratic and a cubic term. To help with the interpretation of the interaction terms, Figure 6 presents graphically the results.

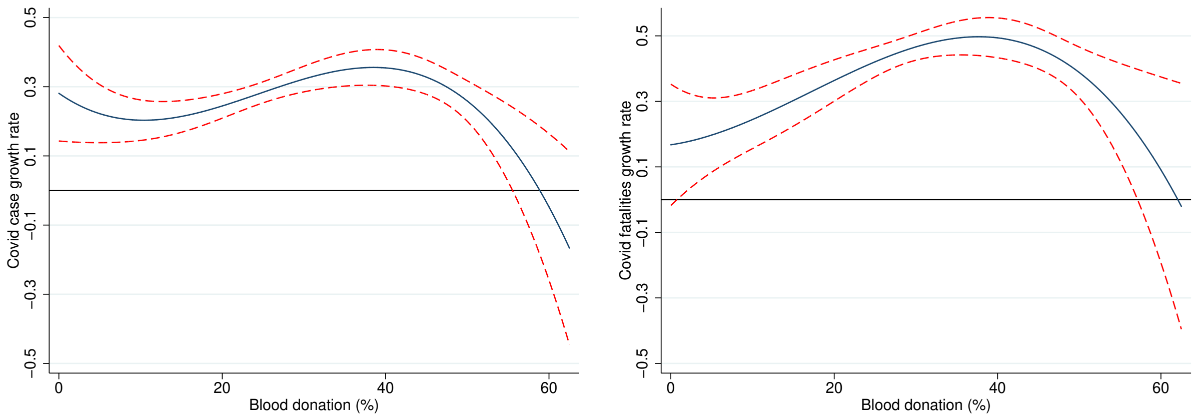
More specifically, Figures 6.a and 6b plot, respectively, the growth rate of cases and fatalities for percentages of blood donors ranging between 0 and 60%. The value of the growth rate is computed evaluating the rest of controls at their mean value. For percentages of blood donors up to around 40% of the population, cases and especially fatalities growth rates are positively associated with the percentage of blood donations; however, both growth rates start decreasing as the percentage of donors rises above 40%. We think that these non-linearities result from the two forces that link social capital measures and COVID-19 outcomes: on the one hand the density of social networks and close encounters that are necessary to create social capital, but which can positively affect the spread of the virus and possibly its fatal consequences; on the other hand, the mutual care for the 'other' that emerges as social capital grows and that can effectively contrast the initial effect by increasing the effectiveness of virus containment policy measures.

[24] COVID-19 data has been subject to adjustments and some regions have corrected their numbers. Although we try to mitigate this problem by excluding regions with a lower number of cases or fatalities in June than in April from the analysis, results must be interpreted with caution.

[25] The percentage of blood donors in the population is frequently used as proxy of civic capital. The variable used in our regressions is obtained from question QE1(1) of Eurobarometer (October 2014). Specifically it is the percentage of people that stated to have donated blood in the past and be prepared to donate it in the future.

While the first one dominates at relatively low levels of social capital, the second one becomes effective at higher levels as based on reciprocity. Figure A7 in the Appendix completes the picture by showing the marginal effect of blood donation on the growth rate of cases and fatalities, independently of the values given to the rest of covariates. As we have already commented, there is a small positive impact for relatively low percentages of blood donors, but regions with percentages larger than 40% show a clear negative impact on the growth rate of both cases and fatalities.[26]

Figure 6: Blood donation and COVID-19 spread



(a) Cases (b) Fatalities

Notes: Cases and Fatalities growth rates are computed, respectively, from columns [3] and [7] in Table A16. Control variables are evaluated at their mean values. 90% confidence intervals.

Finally, columns [4] and [8] check the robustness of a non-linearity relationship between blood donations and the growth rate of our COVID-19 variables by interacting blood donations with a regional dummy that takes value 1 if the region is above the 75^{th} percentile of blood donations in our sample. We find that regions below the 75^{th} show a positive impact of blood donations on cases and fatalities growth rate (0.006 and 0.014,

[26]It is worth noticing the differences of significance between Table A16 and Figure A7. While we find a significant impact of the marginal effects in Figure A7, coefficients in Table A16 are not significant for the growth rate of fatalities (column [7]). For a benchmark model like $Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 XZ + \epsilon$, Brambor et al. (2006) explain this result as follows: "even more important to remember is that the analyst is not directly interested in the significance or insignificance of the model parameters per se anyway. Instead, the analyst who employs a multiplicative interaction model is typically interested in the marginal effect of X on Y. In the case of [our model], this is $\frac{\partial Y}{\partial X} = \beta_1 + \beta_3 Z$. As a result, the analyst really wants to know the standard error of this quantity and not the standard error of β_0 , β_1 , β_2 , or β_3 . The standard error of interest is:

$$\hat{\sigma}_{\frac{\partial Y}{\partial X}} = \sqrt{Var(\hat{\beta}_1) + Z^2 Var(\hat{\beta}_3) + 2ZCov(\hat{\beta}_1 \hat{\beta}_3)}$$

If the covariance term is negative, as is often the case, then it is entirely possible for $\beta_1 + \beta_3 Z$ to be significant for substantively relevant values of Z even if all of the model parameters are insignificant." (Brambor et al., 2006, p. 70) respectively), but that impact on the growth rate of cases in the regions above the 75^{th} percentile is reversed (the interaction term is -0.010) and almost fully compensated in the growth rate of fatalities (with an interaction term equal to -0.012). Analogous non-linearities of the percentage of blood donors have been found by Bartscher et al. (2020) on mobility restriction measures enacted in Italy.

5 Conclusions

The urge to understand the factors behind the dynamics of the COVID-19 pandemic has fostered epidemiological, medical and sociological research. Since the virus is transmitted via droplets, physical interactions are one of the main forms of contagion. In this paper we study to what extend the transmission, mortality and containment of the virus are related to socio-cultural habits regarding physical interactions.

Our data set is created by merging measures of social contacts from social surveys with standard epidemiological and socio-economic indicators at the regional level for various European countries. The use of regional data has two advantages over cross-country studies: i) it let us exploit within-country variations, overcoming problems related to the comparability of COVID-19 data across countries and ii) it increases the degrees of freedom, allowing us to include a rich set of control variables.

Our analysis shows that a standard deviation increase in the percentage of people having daily face-to-face contacts raises COVID-19 cases by 10 % but has no effects on fatalities. In line with previous studies, we also uncover the importance of other factors, such as temperature, population density, economic activity and economic and demographic structure, both on COVID-19 cases and fatalities.

When we split face-to-face contacts between contacts with family members and contacts with friends, we find that only the latter are relevant for the transmission and mortality of the virus. However, the household structure is not irrelevant: according to our results the effect of face-to-face contacts on the spread and mortality of COVID-19 is reinforced by the presence of inter-generational families. For example, if the percentage of inter-generational households would double from 35% to 70%, a 1 percentage point rise in face-to-face contacts with friends would increase the number of new cases by 1.7% instead of 0.6%, while the number of fatalities would grow by 2.5% instead of 0.9%.

Finally, we find indirect empirical evidence that corroborates the existence of a positive relationship between social capital and the respect for the rules. More specifically, using the growth rates of COVID-19 cases and fatalities between April and June, when most Governments implemented lockdown policies at the national level, we observe that civic habits (captured by the percentage of blood donors in the region) is associated with a lower growth rate of both cases and fatalities. This effect is particularly strong in regions with a relatively high level of civic habits.

On the whole, our analysis supports the relevance of social interactions on the impact of the COVID-19 pandemic and helps uncovering the intricate relationships linking household structure and social capital to the spread and mortality of the virus. In the design of effective policies aimed at containing the virus, these specificities should be taken into account by governments at the different administrative levels.

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APPENDIX: Supplementary tables and figures

Figure A1: Face-to-face contacts: friends vs family

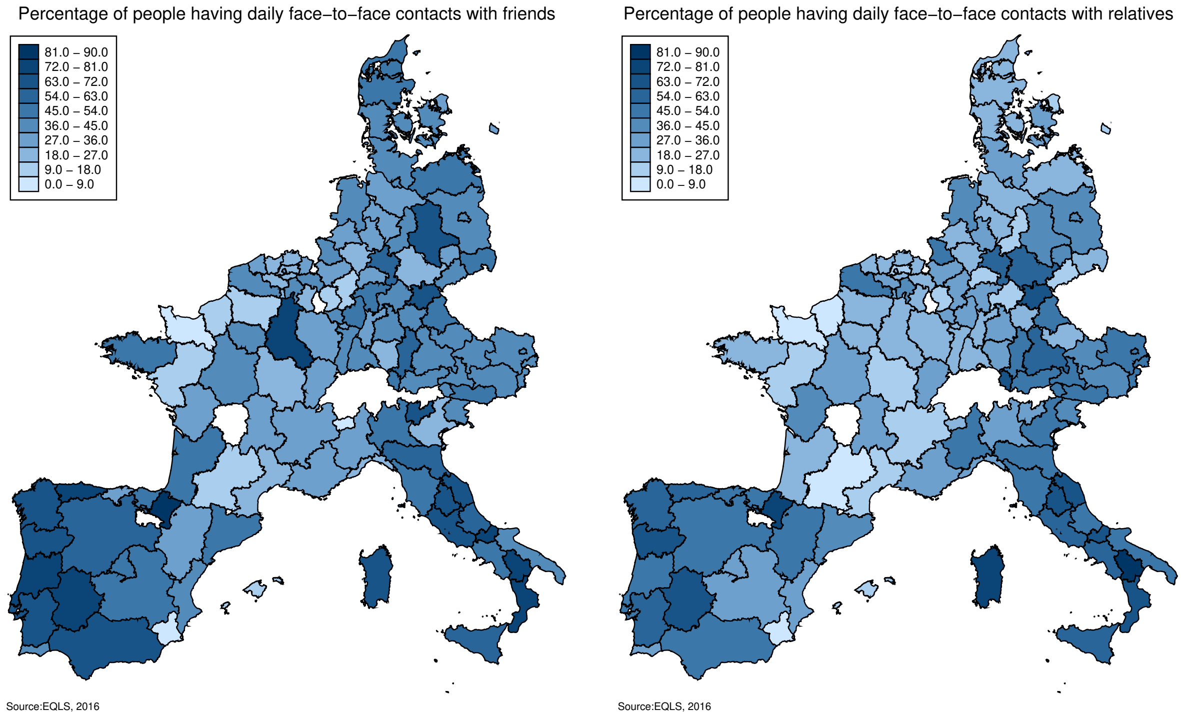


Figure A2: COVID-19 reported cases and fatalities (June)

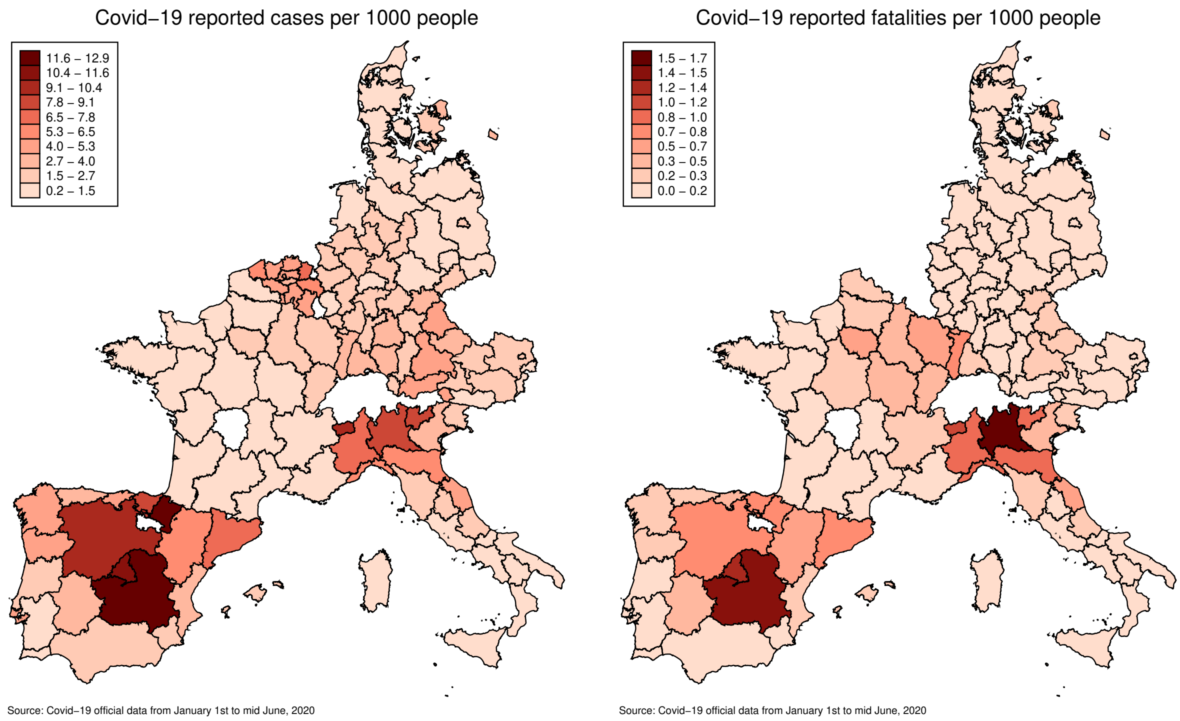
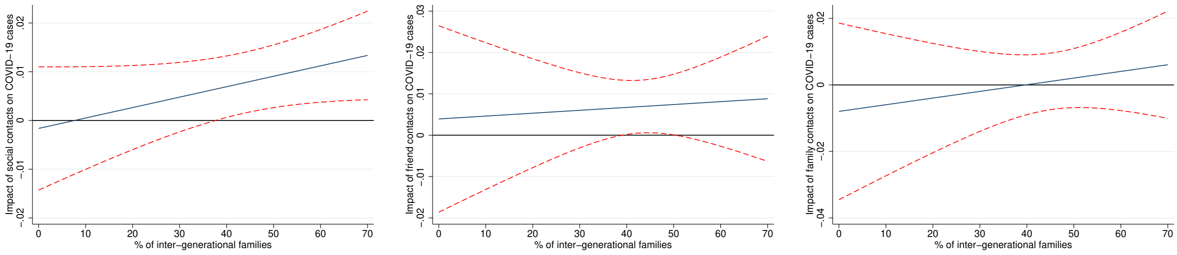


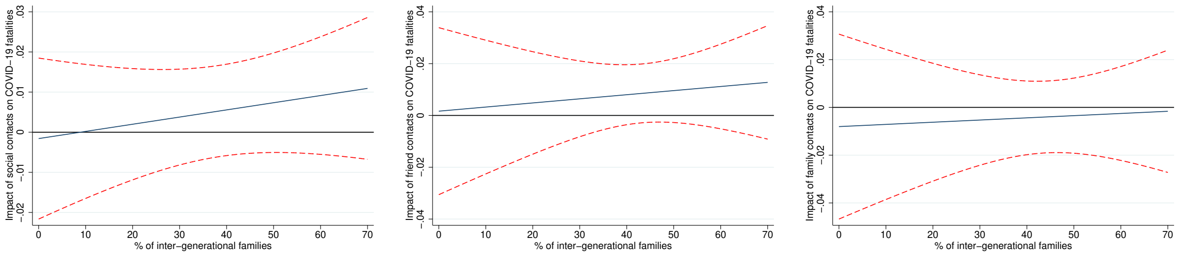
Figure A3: Social contacts and inter-generational families: COVID-19 cases, no Germany



(a) Contacts (b) Friends (c) Family

Notes: Marginal effects computed, respectively, from $\ln(Cases_i) = \beta_0 + \beta_1 Contacts_i + \beta_2 Inter-generational_i + \beta_3 Contacts_i \times Inter-generational_i + \beta_4 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figure A3.a) and from $\ln(Cases_i) = \beta_0 + \beta_1 Family_i + \beta_2 Friends_i + \beta_3 Inter-generational_i + \beta_4 Family_i \times Inter-generational_i + \beta_5 Friends_i \times Inter-generational_i + \beta_6 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figures A3.b and A3.c). 90% Confidence intervals.

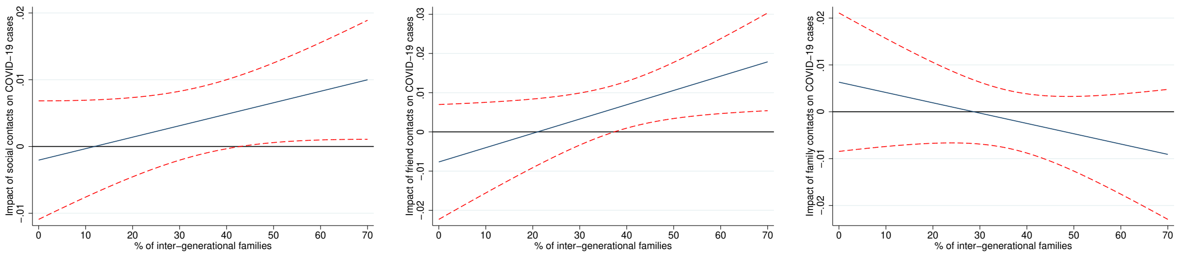
Figure A4: Social contacts and inter-generational families: COVID-19 fatalities, no Germany



(a) Contacts (b) Friends (c) Family

Notes: Marginal effects computed, respectively, from $\ln(Fatalities_i) = \beta_0 + \beta_1 Contacts_i + \beta_2 Inter-generational_i + \beta_3 Contacts_i \times Inter-generational_i + \beta_4 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figure A4.a) and from $\ln(Fatalities_i) = \beta_0 + \beta_1 Family_i + \beta_2 Friends_i + \beta_3 Inter-generational_i + \beta_4 Family_i \times Inter-generational_i + \beta_5 Friends_i \times Inter-generational_i + \beta_6 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figures A4.b and A4.c). 90% Confidence intervals.

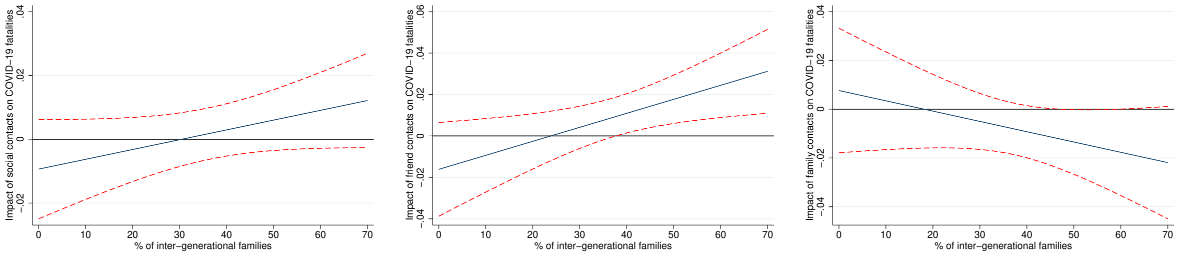
Figure A5: Social contacts and inter-generational families: COVID-19 cases, June



(a) Contacts (b) Friends (c) Family

Notes: Marginal effects computed, respectively, from $\ln(Cases_i) = \beta_0 + \beta_1 Contacts_i + \beta_2 Inter-generational_i + \beta_3 Contacts_i \times Inter-generational_i + \beta_4 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figure A5.a) and from $\ln(Cases_i) = \beta_0 + \beta_1 Family_i + \beta_2 Friends_i + \beta_3 Inter-generational_i + \beta_4 Family_i \times Inter-generational_i + \beta_5 Friends_i \times Inter-generational_i + \beta_6 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figures A5.b and A5.c). 90% Confidence intervals.

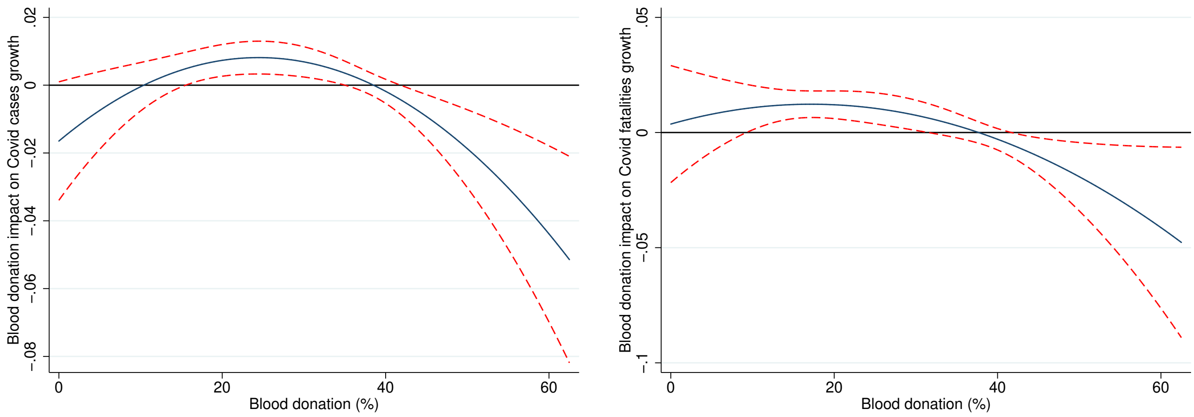
Figure A6: Social contacts and inter-generational families: COVID-19 fatalities, June



(a) Contacts (b) Friends (c) Family

Notes: Marginal effects computed, respectively, from $\ln(Fatalities_i) = \beta_0 + \beta_1 Contacts_i + \beta_2 Inter-generational_i + \beta_3 Contacts_i \times Inter-generational_i + \beta_4 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figure A6.a) and from $\ln(Fatalities_i) = \beta_0 + \beta_1 Family_i + \beta_2 Friends_i + \beta_3 Inter-generational_i + \beta_4 Family_i \times Inter-generational_i + \beta_5 Friends_i \times Inter-generational_i + \beta_6 \boldsymbol{Z}_i + \mu_j + \epsilon_i$ (Figures A6.b and A6.c). 90% Confidence intervals.

Figure A7: Marginal effects: Blood donation and COVID-19 spread



(a) Cases (b) Fatalities

Notes: Cases and Fatalities marginal effects are computed, respectively, from columns [3] and [7] in Table A16. 90% confidence intervals.

Table A1: Data description

Variable	Description	Source
$\ln(Cases)$	(log of) COVID-19 cases per 1,000 people	(1)
$\ln(Fatalities)$	(log of) COVID-19 fatalities per 1,000 people	(1)
$Contacts$	% of people who has direct face-to-face contact every day or almost every day with, friends, neighbours, family members or relatives	(2)
$Friends$	% of people who has direct face-to-face contact every day or almost every day with friends or neighbours	(2)
$Family$	% of people who has direct face-to-face contact every day or almost every day with family members or relatives	(2)
$Social$	% of people who attend religious services or participate in social activities of a club, society, or an association every day or almost every day	(2)
$Inter-generational$	% of households in which several generations coexist	(2)
$Poverty$	% of households able to make ends meet with difficulty or great difficulty	(2)
$Blood$	% of people that have donated blood in the past and are willing to do it again in the future	(3)
$\ln(GDP_{pc})$	(log of) 2018 GDP per capita	(4)
$\ln(Density)$	(log of) persons per km^2	(4)
$\ln(Heating)$	(log of) heating degree days	(4)
Pop_{65}	Proportion of population aged 65 years and more (%)	(4)
$\frac{Women}{Men}$	Women per 100 men	(4)
$Serv\_share$	Service sector employment as % of total employment	(4)
$\frac{N}{L}$	Employment rate (%)	(4)
$Education$	Active population with tertiary education as % of total population	(4)
$\ln(Respiratory)$	(log of) crude death rate for diseases of the respiratory system for people aged 65 years and more	(4)
Air	Air passengers carried per population	(4)
$\ln(Beds)$	(log of) Available beds in hospitals per 100,000 inhabitants	(4)
$\ln(Days)$	(log of) days since first COVID-19 cases	
$Borders$	Dummy variable identifying regions that share a physical borders with the COVID-19 epicentre region in each country	
$Islands$	Dummy variable identifying islands	

Notes: (1) Official data from several sources: Bundesministerium für Soziales, Gesundheit, Pflege und Konsumentenschutz (Austria), Sciensano (Belgium), Sundhedsstyrelsen (Denmark), Santé Publique (France), Robert Koch Institute (Germany), Dipartimento della Protezione Civile (Italy), Direção-Geral da Saúde (Portugal), Ministerio de Sanidad and Generalitat de Catalunya (Spain); (2) European Quality of Life Surveys; (3) Eurobarometer; (4) Eurostat. From Eurostat we use data from the last year available.

Table A2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
COVID-19					
$\ln(Cases)$	124	0.453	0.803	-1.52	2.06
$\ln(Cases_{June})$	124	0.710	0.865	-1.45	2.55
$\ln(Fatalities)$	112	-2.31	1.05	-4.44	0.143
$\ln(Fatalities_{June})$	113	-2.03	1.15	-6.56	0.481
$\ln\left(\frac{Fatalities}{Cases}\right)$	113	-2.70	0.663	-4.19	-1.34
$\ln\left(\frac{Fatalities_{June}}{Cases_{June}}\right)$	113	-2.65	0.753	-5.59	-1.20
$\Delta\ln(Cases)$	83	0.292	0.176	0.013	1.08
$\Delta\ln(Fatalities)$	72	0.421	0.180	0.013	1.16
Social interactions and civic habits					
$Contacts$	124	55.67	18.77	0	90
$Friends$	124	41.96	18.06	0	90
$Family$	124	36.05	17.97	0	87.50
$Social$	124	3.86	2.97	0	11.11
$Inter-generational$	124	39.33	13.64	0	70
$Blood$	83	28.18	10.34	0	51.43
Controls					
$\ln(GDP_{pc})$	124	10.38	0.307	9.74	11.15
$\ln(Density)$	124	5.17	1.02	3.13	8.92
$\ln(Heating)$	124	7.69	0.396	5.20	8.34
$\ln(Days)$	124	3.86	0.255	3.22	4.42
Pop_{65}	124	21.37	2.78	13.10	28.90
$\frac{Women}{Men}$	124	104.07	2.73	98	113.80
$Serv\_share$	124	72.30	6.59	59.90	88
$\frac{N}{L}$	124	68.31	8.37	40.70	80.30
$Education$	124	15.27	4.34	6.27	27.21
$Poverty$	124	13.71	10.83	0	57.50
$\ln(Respiratory)$	124	5.90	0.280	5.32	6.63
Air	124	2.73	5.14	0	33.41
$\ln(Beds)$	112	6.24	0.461	5.39	7.16
$Borders$	124	0.177	0.384	0	1
$Islands$	124	0.032	0.177	0	1

Table A3: COVID-19 data, reference period

Country	1^{st} period	2^{nd} period	Country	1^{st} period	2^{nd} period
Austria	April 20^{th}	June 8^{th}	Germany	April 20^{th}	May 20^{th}
Belgium	April 20^{th}	June 7^{th}	Italy	April 16^{th}	June 7^{th}
Denmark	April 17^{th}	June 8^{th}	Portugal	April 20^{th}	June 8^{th}
France	April 20^{th}	June 7^{th}	Spain	April 16^{th}	May 20^{th}

Notes: At the time June data was collected (June 8^{th}, 2020), Spain and Germany had not updated their regional COVID-19 series beyond May 20^{th}, 2020.

Table A4: Sample selection

Region	NUTS code	Country	Region	NUTS code	Country
Burgenland	AT11	Austria	Kassel	DE73	Germany
Niederösterreich	AT12	Austria	Mecklenburg-Vorpommern	DE80	Germany
Wien	AT13	Austria	Braunschweig	DE91	Germany
Kärnten	AT21	Austria	Hannover	DE92	Germany
Steiermark	AT22	Austria	Lüneburg	DE93	Germany
Oberösterreich	AT31	Austria	Weser-Ems	DE94	Germany
Salzburg	AT32	Austria	Düsseldorf	DEA1	Germany
Tirol	AT33	Austria	Köln	DEA2	Germany
Vorarlberg	AT34	Austria	Münster	DEA3	Germany
Région de Bruxelles-Capitale	BE10*	Belgium	Detmold	DEA4	Germany
Prov. Antwerpen	BE21*	Belgium	Arnsberg	DEA5	Germany
Prov. Limburg	BE22*	Belgium	Koblenz	DEB1	Germany
Prov. Oost-Vlaanderen	BE23*	Belgium	Trier	DEB2	Germany
Prov. Vlaams-Brabant	BE24*	Belgium	Rheinhessen-Pfalz	DEB3	Germany
Prov. West-Vlaanderen	BE25*	Belgium	Saarland	DEC0	Germany
Prov. Brabant wallon	BE31*	Belgium	Dresden	DED2	Germany
Prov. Hainaut	BE32*	Belgium	Chemnitz	DED4	Germany
Prov. Ličge	BE33*	Belgium	Leipzig	DED5	Germany
Prov. Luxembourg	BE34*	Belgium	Sachsen-Anhalt	DEE0	Germany
Prov. Namur	BE35*	Belgium	Schleswig-Holstein	DEF0	Germany
Hovedstaden	DK01	Denmark	Thüringen	DEG0	Germany
Sjćlland	DK02	Denmark	Piemonte	ITC1	Italy
Syddanmark	DK03	Denmark	Valle d'Aosta	ITC2	Italy
Midtjylland	DK04	Denmark	Liguria	ITC3	Italy
Nordjylland	DK05	Denmark	Lombardia	ITC4	Italy
Île de France	FR10	France	Provincia Autonoma di Trento	ITD2	Italy
Champagne-Ardenne	FR21	France	Veneto	ITD3	Italy
Picardie	FR22	France	Friuli-Venezia Giulia	ITD4	Italy
Haute-Normandie	FR23	France	Emilia-Romagna	ITD5	Italy
Centre - Val de Loire	FR24	France	Toscana	ITE1	Italy
Basse-Normandie	FR25	France	Umbria	ITE2	Italy
Bourgogne	FR26	France	Marche	ITE3	Italy
Nord-Pas-de-Calais	FR30	France	Lazio	ITE4	Italy
Lorraine	FR41	France	Abruzzo	ITF1	Italy
Alsace	FR42	France	Molise	ITF2	Italy
Franche-Comté	FR43	France	Campania	ITF3	Italy
Pays-de-la-Loire	FR51	France	Puglia	ITF4	Italy
Bretagne	FR52	France	Basilicata	ITF5	Italy
Poitou-Charentes	FR53	France	Calabria	ITF6	Italy
Aquitaine	FR61	France	Sicilia	ITG1	Italy
Midi-Pyrénées	FR62	France	Sardegna	ITG2	Italy
Rhône-Alpes	FR71	France	Norte	PT11	Portugal
Auvergne	FR72	France	Algarve	PT15	Portugal
Languedoc-Roussillon	FR81	France	Centro	PT16	Portugal
Provence-Alpes-Côte d'Azur	FR82	France	Área Metropolitana de Lisboa	PT17	Portugal
Stuttgart	DE11	Germany	Alentejo	PT18*	Portugal
Karlsruhe	DE12	Germany	Galicia	ES11	Spain
Freiburg	DE13	Germany	Principado de Asturias	ES12	Spain
Tübingen	DE14	Germany	Cantabria	ES13	Spain
Oberbayern	DE21	Germany	País Vasco	ES21	Spain
Niederbayern	DE22	Germany	Comunidad Foral de Navarra	ES22	Spain
Oberpfalz	DE23	Germany	Aragón	ES24	Spain
Oberfranken	DE24	Germany	Comunidad de Madrid	ES30	Spain
Mittelfranken	DE25	Germany	Castilla y León	ES41	Spain
Unterfranken	DE26	Germany	Castilla-la Mancha	ES42	Spain
Schwaben	DE27	Germany	Extremadura	ES43	Spain
Berlin	DE30	Germany	Cataluña	ES51	Spain
Brandenburg	DE40	Germany	Comunidad Valenciana	ES52	Spain
Bremen	DE50	Germany	Illes Balears	ES53	Spain
Hamburg	DE60	Germany	Andalucía	ES61	Spain
Darmstadt	DE71	Germany	Región de Murcia	ES62	Spain
Gießen	DE72	Germany	Canarias	ES70	Spain

Notes: * Regions without data on COVID-19 fatalities. Alentejo enters the analysis in June as the number of deaths goes from 0 to 1.

Table A5: Unconditional correlations

Variables	$\ln(Cases)$	$\ln(Fatalities)$	$Contacts$	$Friends$	$Family$	$Inter-generational$	$Social$	$Blood$
$\ln(Cases)$	1							
$\ln(Fatalities)$	0.775***	1						
$Contacts$	0.121	0.048	1					
$Friends$	0.063	0.079	0.907***	1				
$Family$	0.098	0.049	0.870***	0.735***	1			
$Inter-generational$	0.174*	0.257***	0.317***	0.268***	0.367***	1		
$Social$	0.246***	0.184*	0.242***	0.250***	0.178**	0.204**	1	
$Blood$	-0.251***	-0.223**	-0.099	-0.123	-0.124	-0.143	-0.144	1

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A6: COVID-19 cases, no Germany

	Daily contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	0.001	0.008	0.007	0.025	0.038	0.035
	(0.003)	(0.004)**	(0.004)*	(0.018)	(0.021)*	(0.021)
$\ln(GDP_{pc})$	0.793	–0.238	–0.356	0.768	–0.196	–0.353
	(0.345)**	(0.348)	(0.355)	(0.331)**	(0.394)	(0.391)
$\ln(Density)$	–0.009	0.112	0.148	–0.010	0.046	0.087
	(0.070)	(0.079)	(0.084)*	(0.072)	(0.092)	(0.091)
$\ln(Heating)$	1.253	1.399	1.486	1.240	1.298	1.322
	(0.405)***	(0.379)***	(0.398)***	(0.407)***	(0.405)***	(0.421)***
$\ln(Days)$	2.672	2.203	2.326	2.566	2.105	2.226
	(0.613)***	(0.568)***	(0.569)***	(0.648)***	(0.672)***	(0.640)***
Pop_{65}		–0.062	–0.055		–0.074	–0.071
		(0.032)*	(0.033)		(0.033)**	(0.034)**
$\frac{Women}{Men}$		0.000	0.004		0.021	0.024
		(0.041)	(0.040)		(0.041)	(0.041)
$Serv\_share$		0.018	0.012		0.008	0.005
		(0.012)	(0.013)		(0.011)	(0.012)
$\frac{N}{L}$		0.060	0.058		0.051	0.054
		(0.014)***	(0.016)***		(0.016)***	(0.016)***
$Education$		–0.047	–0.025		–0.030	–0.010
		(0.025)*	(0.028)		(0.027)	(0.030)
$Poverty$		–0.004	–0.006		–0.003	–0.005
		(0.005)	(0.005)		(0.006)	(0.006)
$\ln(Respiratory)$			0.734			0.770
			(0.595)			(0.569)
Air			–0.002			–0.007
			(0.011)			(0.013)
$Borders$			0.126			0.112
			(0.122)			(0.126)
$Islands$			0.553			0.468
			(0.293)*			(0.307)
Constant	–28.461	–21.607	–25.995	–27.699	–20.974	–25.112
	(3.231)***	(5.390)***	(5.366)***	(3.238)***	(6.085)***	(5.769)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	7	7
Observations	86	86	86	86	86	86
Rsq	0.744	0.782	0.786	0.750	0.779	0.782
RMSE	0.457	0.421	0.417	0.451	0.424	0.421

Notes: Dependent variable $\ln(Cases)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3])) or daily social activities (Columns[4]-[6]).

Table A7: COVID-19 fatalities, no Germany

	Daily contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	–0.001	0.006	0.006	0.007	0.024	0.019
	(0.005)	(0.006)	(0.007)	(0.028)	(0.032)	(0.033)
$\ln(GDP_{pc})$	1.034	0.121	0.089	1.049	0.183	0.120
	(0.441)**	(0.878)	(0.905)	(0.434)**	(0.909)	(0.933)
$\ln(Density)$	0.021	0.251	0.302	0.024	0.194	0.253
	(0.079)	(0.138)*	(0.150)**	(0.080)	(0.145)	(0.148)*
$\ln(Heating)$	1.486	1.810	1.850	1.482	1.727	1.741
	(0.450)***	(0.454)***	(0.484)***	(0.447)***	(0.477)***	(0.493)***
$\ln(Days)$	3.166	2.766	2.935	3.103	2.766	2.922
	(0.768)***	(0.922)***	(0.900)***	(0.810)***	(1.000)***	(0.945)***
$\ln(Beds)$	0.281	0.764	0.485	0.273	0.780	0.505
	(0.665)	(0.705)	(0.704)	(0.669)	(0.720)	(0.741)
Pop_{65}		–0.029	–0.014		–0.038	–0.025
		(0.065)	(0.071)		(0.063)	(0.074)
$\frac{Women}{Men}$		–0.082	–0.079		–0.060	–0.061
		(0.067)	(0.067)		(0.071)	(0.073)
$Serv\_share$		0.021	0.014		0.013	0.009
		(0.019)	(0.019)		(0.017)	(0.018)
$\frac{N}{L}$		0.046	0.043		0.037	0.038
		(0.028)	(0.030)		(0.028)	(0.031)
$Education$		–0.066	–0.034		–0.052	–0.023
		(0.051)	(0.060)		(0.053)	(0.063)
$Poverty$		–0.005	–0.007		–0.004	–0.006
		(0.008)	(0.008)		(0.008)	(0.008)
$\ln(Respiratory)$			1.146			1.174
			(0.753)			(0.729)
Air			–0.009			–0.013
			(0.023)			(0.024)
$Borders$			0.159			0.152
			(0.205)			(0.222)
$Islands$			0.696			0.661
			(0.387)*			(0.390)*
Constant	–40.300	–31.142	–36.885	–40.264	–31.693	–37.148
	(5.831)***	(11.298)***	(11.444)***	(5.959)***	(11.888)**	(11.739)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	6	6	6	6	6	6
Observations	74	74	74	74	74	74
Rsq	0.685	0.699	0.700	0.685	0.694	0.696
RMSE	0.633	0.619	0.618	0.634	0.624	0.623

Notes: Dependent variable $\ln(Fatalities)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3]) or daily social activities (Columns[4]-[6]).

Table A8: COVID-19 case-fatality rate (CFR), no Germany

	Daily contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	–0.003	–0.002	–0.002	–0.013	–0.011	–0.012
	(0.002)	(0.003)	(0.003)	(0.014)	(0.014)	(0.016)
$\ln(GDP_{pc})$	–0.209	–0.037	–0.040	–0.131	–0.038	–0.027
	(0.186)	(0.488)	(0.522)	(0.198)	(0.497)	(0.532)
$\ln(Density)$	0.045	0.145	0.160	0.047	0.159	0.177
	(0.044)	(0.069)**	(0.070)**	(0.046)	(0.063)**	(0.064)***
$\ln(Heating)$	0.377	0.487	0.488	0.372	0.508	0.533
	(0.098)***	(0.124)***	(0.164)***	(0.099)***	(0.118)***	(0.146)***
$\ln(Days)$	0.985	0.911	0.957	0.961	0.942	1.004
	(0.368)***	(0.461)*	(0.495)*	(0.366)**	(0.451)**	(0.485)**
$\ln(Beds)$	0.265	0.417	0.354	0.252	0.399	0.321
	(0.294)	(0.348)	(0.400)	(0.303)	(0.340)	(0.392)
Pop_{65}		0.020	0.024		0.025	0.032
		(0.032)	(0.036)		(0.031)	(0.036)
$\frac{Women}{Men}$		–0.056	–0.055		–0.063	–0.063
		(0.035)	(0.036)		(0.037)*	(0.039)
$Serv\_share$		0.005	0.003		0.007	0.004
		(0.009)	(0.009)		(0.009)	(0.010)
$\frac{N}{L}$		–0.002	–0.003		–0.001	–0.003
		(0.015)	(0.016)		(0.013)	(0.016)
$Education$		–0.023	–0.015		–0.025	–0.017
		(0.031)	(0.036)		(0.027)	(0.033)
$Poverty$		0.000	–0.001		–0.000	–0.001
		(0.003)	(0.003)		(0.003)	(0.003)
$\ln(Respiratory)$			0.382			0.363
			(0.334)			(0.348)
Air			–0.001			0.001
			(0.009)			(0.008)
$Borders$			0.023			0.036
			(0.119)			(0.130)
$Islands$			0.153			0.182
			(0.160)			(0.148)
Constant	–10.004	–8.449	–10.450	–10.806	–8.383	–10.431
	(2.625)***	(5.566)	(6.093)*	(2.691)***	(5.578)	(6.081)*
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	6	6	6	6	6	6
Observations	74	74	74	74	74	74
Rsq	0.788	0.781	0.769	0.783	0.782	0.770
RMSE	0.319	0.325	0.334	0.323	0.324	0.333

Notes: Dependent variable $\ln\left(\frac{Fatalities}{Cases}\right)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3]) or daily social activities (Columns[4]-[6]).

Table A9: COVID-19: family vs friends, no Germany

	Cases		Fatalities		Fatalities/Cases	
	[1]	[2]	[3]	[4]	[5]	[6]
$Contacts$	0.007		0.006		–0.002	
	(0.004)*		(0.007)		(0.003)	
$Friends$		0.007		0.009		0.003
		(0.004)*		(0.006)		(0.003)
$Family$		0.001		–0.004		–0.007
		(0.005)		(0.008)		(0.005)
$\ln(GDP_{pc})$	–0.356	–0.426	0.089	–0.004	–0.040	–0.072
	(0.355)	(0.372)	(0.905)	(0.948)	(0.522)	(0.530)
$\ln(Density)$	0.148	0.161	0.302	0.324	0.160	0.161
	(0.084)*	(0.084)*	(0.150)**	(0.155)**	(0.070)**	(0.073)**
$\ln(Heating)$	1.486	1.537	1.850	1.920	0.488	0.513
	(0.398)***	(0.402)***	(0.484)***	(0.496)***	(0.164)***	(0.175)***
$\ln(Days)$	2.326	2.286	2.935	2.874	0.957	0.898
	(0.569)***	(0.590)***	(0.900)***	(0.939)***	(0.495)*	(0.502)*
$\ln(Beds)$			0.485	0.553	0.354	0.397
			(0.704)	(0.708)	(0.400)	(0.394)
Pop_{65}	–0.055	–0.054	–0.014	–0.011	0.024	0.024
	(0.033)	(0.034)	(0.071)	(0.074)	(0.036)	(0.037)
$\frac{Women}{Men}$	0.004	0.008	–0.079	–0.074	–0.055	–0.050
	(0.040)	(0.040)	(0.067)	(0.065)	(0.036)	(0.034)
$Serv\_share$	0.012	0.012	0.014	0.011	0.003	–0.001
	(0.013)	(0.014)	(0.019)	(0.021)	(0.009)	(0.010)
$\frac{N}{L}$	0.058	0.059	0.043	0.042	–0.003	–0.007
	(0.016)***	(0.017)***	(0.030)	(0.034)	(0.016)	(0.017)
$Education$	–0.025	–0.026	–0.034	–0.036	–0.015	–0.015
	(0.028)	(0.029)	(0.060)	(0.059)	(0.036)	(0.035)
$Poverty$	–0.006	–0.006	–0.007	–0.006	–0.001	0.000
	(0.005)	(0.005)	(0.008)	(0.008)	(0.003)	(0.004)
$\ln(Respiratory)$	0.734	0.730	1.146	1.114	0.382	0.340
	(0.595)	(0.592)	(0.753)	(0.766)	(0.334)	(0.342)
Air	–0.002	–0.001	–0.009	–0.006	–0.001	0.001
	(0.011)	(0.012)	(0.023)	(0.023)	(0.009)	(0.009)
$Borders$	0.126	0.126	0.159	0.152	0.023	0.006
	(0.122)	(0.119)	(0.205)	(0.204)	(0.119)	(0.115)
$Islands$	0.553	0.585	0.696	0.725	0.153	0.167
	(0.293)*	(0.294)*	(0.387)*	(0.392)*	(0.160)	(0.174)
Constant	–25.995	–25.952	–36.885	–36.619	–10.450	–9.999
	(5.366)***	(5.563)***	(11.444)***	(11.528)***	(6.093)*	(6.070)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	6	6	6	6
Observations	86	86	74	74	74	74
Rsq	0.786	0.785	0.700	0.699	0.769	0.773
RMSE	0.417	0.418	0.618	0.620	0.334	0.331

Notes: Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A10: COVID-19: inter-generational families, no Germany

	Cases			Fatalities			Fatalities/Cases		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
$Inter-generational$	0.001	–0.002	–0.000	–0.002	–0.004	–0.002	–0.004	–0.003	–0.002
	(0.004)	(0.005)	(0.005)	(0.006)	(0.008)	(0.008)	(0.003)	(0.003)	(0.004)
$Contacts$		0.007			0.006			–0.001	
		(0.004)*			(0.007)			(0.003)	
$Friends$			0.007			0.008			0.003
			(0.004)*			(0.006)			(0.004)
$Family$			0.001			–0.003			–0.006
			(0.005)			(0.009)			(0.006)
$\ln(GDP_{pc})$	–0.279	–0.383	–0.431	0.146	–0.024	–0.045	–0.156	–0.125	–0.118
	(0.391)	(0.366)	(0.378)	(0.969)	(0.971)	(1.007)	(0.560)	(0.552)	(0.562)
$\ln(Density)$	0.099	0.153	0.162	0.257	0.309	0.326	0.175	0.165	0.163
	(0.087)	(0.084)*	(0.083)*	(0.147)*	(0.152)**	(0.157)**	(0.064)***	(0.071)**	(0.074)**
$\ln(Heating)$	1.401	1.491	1.538	1.778	1.866	1.924	0.516	0.499	0.517
	(0.429)***	(0.391)***	(0.402)***	(0.490)***	(0.470)***	(0.495)***	(0.141)***	(0.160)***	(0.174)***
$\ln(Days)$	2.440	2.331	2.288	3.064	2.941	2.883	0.938	0.961	0.907
	(0.582)***	(0.578)***	(0.597)***	(0.877)***	(0.909)***	(0.943)***	(0.497)*	(0.494)*	(0.497)*
$\ln(Beds)$				0.423	0.490	0.551	0.371	0.359	0.395
				(0.746)	(0.706)	(0.715)	(0.405)	(0.401)	(0.400)
Pop_{65}	–0.051	–0.057	–0.054	–0.013	–0.022	–0.014	0.017	0.019	0.021
	(0.035)	(0.035)	(0.035)	(0.073)	(0.075)	(0.077)	(0.038)	(0.037)	(0.039)
$\frac{Women}{Men}$	0.017	0.003	0.008	–0.065	–0.076	–0.073	–0.055	–0.053	–0.049
	(0.043)	(0.040)	(0.040)	(0.068)	(0.066)	(0.065)	(0.036)	(0.035)	(0.033)
$Serv\_share$	0.006	0.012	0.012	0.008	0.014	0.011	0.003	0.002	–0.001
	(0.012)	(0.013)	(0.014)	(0.017)	(0.019)	(0.021)	(0.009)	(0.009)	(0.010)
$\frac{N}{L}$	0.049	0.057	0.059	0.034	0.043	0.042	–0.002	–0.003	–0.006
	(0.016)***	(0.016)***	(0.017)***	(0.029)	(0.031)	(0.034)	(0.016)	(0.016)	(0.017)
$Education$	–0.007	–0.026	–0.026	–0.016	–0.035	–0.036	–0.019	–0.016	–0.015
	(0.031)	(0.028)	(0.029)	(0.062)	(0.060)	(0.060)	(0.032)	(0.036)	(0.036)
$Poverty$	–0.004	–0.006	–0.006	–0.006	–0.008	–0.007	–0.001	–0.001	–0.000
	(0.006)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)	(0.003)	(0.003)	(0.004)
$\ln(Respiratory)$	0.732	0.724	0.728	1.137	1.132	1.111	0.370	0.371	0.337
	(0.596)	(0.591)	(0.592)	(0.743)	(0.756)	(0.771)	(0.341)	(0.342)	(0.349)
Air	–0.005	–0.001	–0.001	–0.010	–0.007	–0.005	0.001	0.000	0.002
	(0.012)	(0.012)	(0.012)	(0.023)	(0.023)	(0.024)	(0.008)	(0.009)	(0.009)
$Borders$	0.143	0.128	0.126	0.190	0.167	0.157	0.025	0.029	0.012
	(0.133)	(0.124)	(0.122)	(0.216)	(0.209)	(0.212)	(0.121)	(0.122)	(0.121)
$Islands$	0.577	0.547	0.584	0.709	0.675	0.716	0.131	0.137	0.157
	(0.312)*	(0.299)*	(0.298)*	(0.413)*	(0.407)	(0.406)*	(0.178)	(0.178)	(0.188)
Constant	–26.583	–25.535	–25.883	–36.926	–35.800	–36.237	–9.430	–9.636	–9.563
	(5.619)***	(5.502)***	(5.603)***	(12.072)***	(11.959)***	(12.042)***	(6.468)	(6.424)	(6.482)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	6	6	6	6	6	6
Observations	86	86	86	74	74	74	74	74	74
Rsq	0.771	0.783	0.782	0.694	0.696	0.693	0.771	0.767	0.769
RMSE	0.432	0.420	0.421	0.625	0.623	0.625	0.332	0.335	0.333

Notes: Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A11: COVID-19 cases, June

	Daily contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	0.002	0.005	0.005	0.020	0.028	0.028
	(0.002)	(0.003)*	(0.003)	(0.015)	(0.017)	(0.017)
$\ln(GDP_{pc})$	0.945	0.344	0.264	0.928	0.364	0.261
	(0.266)***	(0.316)	(0.322)	(0.263)***	(0.326)	(0.329)
$\ln(Density)$	0.064	0.182	0.195	0.055	0.140	0.157
	(0.059)	(0.065)***	(0.067)***	(0.059)	(0.067)**	(0.067)**
$\ln(Heating)$	1.295	1.239	1.289	1.280	1.184	1.171
	(0.342)***	(0.321)***	(0.352)***	(0.347)***	(0.334)***	(0.361)***
$\ln(Days)$	1.402	1.135	1.148	1.332	1.002	0.991
	(0.389)***	(0.412)***	(0.402)***	(0.405)***	(0.437)**	(0.428)**
Pop_{65}		–0.057	–0.051		–0.064	–0.059
		(0.028)**	(0.026)*		(0.027)**	(0.026)**
$\frac{Women}{Men}$		0.008	0.012		0.020	0.023
		(0.036)	(0.036)		(0.035)	(0.034)
$Serv\_share$		–0.008	–0.010		–0.013	–0.014
		(0.010)	(0.012)		(0.010)	(0.011)
$\frac{N}{L}$		0.044	0.041		0.039	0.038
		(0.014)***	(0.014)***		(0.015)**	(0.014)***
$Education$		–0.032	–0.016		–0.023	–0.006
		(0.020)	(0.024)		(0.022)	(0.025)
$Poverty$		–0.000	–0.001		0.000	0.000
		(0.005)	(0.005)		(0.005)	(0.005)
$\ln(Respiratory)$			0.227			0.317
			(0.379)			(0.394)
Air			–0.004			–0.005
			(0.012)			(0.013)
$Borders$			0.187			0.206
			(0.122)			(0.122)*
$Islands$			0.382			0.286
			(0.270)			(0.290)
Constant	–25.823	–20.539	–22.021	–25.127	–19.909	–21.189
	(2.529)***	(4.347)***	(4.382)***	(2.536)***	(4.507)***	(4.407)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	8	8	8	8	8	8
Observations	124	124	124	124	124	124
Rsq	0.716	0.742	0.743	0.718	0.742	0.744
RMSE	0.461	0.439	0.438	0.460	0.439	0.438

Notes: Dependent variable $\ln(Cases)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3])) or daily social activities (Columns[4]-[6]).

Table A12: COVID-19 fatalities, June

	Daily contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	0.002	0.005	0.004	0.008	0.023	0.018
	(0.004)	(0.005)	(0.005)	(0.025)	(0.025)	(0.026)
$\ln(GDP_{pc})$	1.227	0.949	0.818	1.211	0.967	0.810
	(0.443)***	(0.669)	(0.647)	(0.440)***	(0.686)	(0.659)
$\ln(Density)$	0.129	0.364	0.375	0.124	0.325	0.347
	(0.101)	(0.119)***	(0.126)***	(0.103)	(0.123)***	(0.126)***
$\ln(Heating)$	1.417	1.312	1.396	1.411	1.262	1.313
	(0.382)***	(0.367)***	(0.432)***	(0.384)***	(0.376)***	(0.433)***
$\ln(Days)$	1.843	1.491	1.531	1.823	1.377	1.422
	(0.631)***	(0.607)**	(0.590)**	(0.651)***	(0.642)**	(0.646)**
$\ln(Beds)$	0.673	1.021	0.871	0.674	1.060	0.917
	(0.827)	(0.831)	(0.799)	(0.821)	(0.812)	(0.782)
Pop_{65}		–0.053	–0.036		–0.061	–0.042
		(0.054)	(0.052)		(0.054)	(0.053)
$\frac{Women}{Men}$		–0.003	0.005		0.010	0.014
		(0.059)	(0.060)		(0.060)	(0.061)
$Serv\_share$		–0.024	–0.029		–0.029	–0.033
		(0.015)	(0.017)*		(0.015)**	(0.017)*
$\frac{N}{L}$		0.041	0.033		0.036	0.030
		(0.022)*	(0.021)		(0.022)	(0.021)
$Education$		–0.076	–0.050		–0.068	–0.043
		(0.031)**	(0.033)		(0.032)**	(0.034)
$Poverty$		0.004	0.004		0.005	0.005
		(0.008)	(0.008)		(0.008)	(0.008)
$\ln(Respiratory)$			0.152			0.222
			(0.524)			(0.540)
Air			0.008			0.008
			(0.021)			(0.022)
$Borders$			0.356			0.373
			(0.200)*			(0.196)*
$Islands$			0.390			0.321
			(0.433)			(0.458)
Constant	–39.604	–36.824	–36.933	–39.220	–36.666	–36.648
	(5.231)***	(7.578)***	(7.623)***	(5.334)***	(7.780)***	(7.752)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	7	7
Observations	113	113	113	113	113	113
Rsq	0.640	0.673	0.675	0.640	0.672	0.675
RMSE	0.689	0.657	0.655	0.689	0.658	0.655

Notes: Dependent variable $\ln(Fatalities)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3]) or daily social activities (Columns[4]-[6]).

Table A13: COVID-19 case-fatality rate (CFR), June

	Daily contacts			Social activities		
	[1]	[2]	[3]	[4]	[5]	[6]
X	–0.001	–0.000	–0.001	–0.008	–0.004	–0.008
	(0.002)	(0.002)	(0.002)	(0.013)	(0.012)	(0.012)
$\ln(GDP_{pc})$	0.003	0.201	0.144	0.015	0.201	0.154
	(0.231)	(0.431)	(0.405)	(0.231)	(0.435)	(0.413)
$\ln(Density)$	0.052	0.137	0.138	0.055	0.140	0.143
	(0.060)	(0.066)**	(0.069)**	(0.060)	(0.067)**	(0.071)**
$\ln(Heating)$	0.212	0.134	0.225	0.216	0.137	0.249
	(0.105)**	(0.110)	(0.147)	(0.104)**	(0.110)	(0.142)*
$\ln(Days)$	0.562	0.413	0.423	0.589	0.432	0.472
	(0.348)	(0.291)	(0.286)	(0.348)*	(0.299)	(0.303)
$\ln(Beds)$	0.470	0.574	0.506	0.473	0.568	0.486
	(0.406)	(0.431)	(0.406)	(0.411)	(0.433)	(0.409)
Pop_{65}		–0.014	–0.003		–0.013	–0.000
		(0.030)	(0.029)		(0.031)	(0.029)
$\frac{Women}{Men}$		0.018	0.024		0.017	0.022
		(0.033)	(0.034)		(0.033)	(0.034)
$Serv\_share$		–0.013	–0.019		–0.013	–0.019
		(0.008)	(0.009)**		(0.008)	(0.008)**
$\frac{N}{L}$		0.009	0.001		0.009	0.001
		(0.014)	(0.013)		(0.013)	(0.013)
$Education$		–0.044	–0.036		–0.044	–0.037
		(0.017)**	(0.018)**		(0.016)***	(0.017)**
$Poverty$		0.005	0.005		0.005	0.005
		(0.004)	(0.004)		(0.004)	(0.004)
$\ln(Respiratory)$			0.010			–0.025
			(0.264)			(0.272)
Air			0.018			0.018
			(0.010)*			(0.010)*
$Borders$			0.127			0.125
			(0.094)			(0.094)
$Islands$			0.031			0.058
			(0.256)			(0.250)
Constant	–10.591	–13.274	–13.000	–10.923	–13.340	–13.155
	(2.687)***	(3.824)***	(3.983)***	(2.750)***	(3.862)***	(4.041)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	7	7
Observations	113	113	113	113	113	113
Rsq	0.779	0.791	0.793	0.780	0.792	0.793
RMSE	0.354	0.344	0.343	0.353	0.344	0.342

Notes: Dependent variable $\ln\left(\frac{Fatalities}{Cases}\right)$. Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%. X is our social network proxy and represents daily face-to-face contacts with friends or relatives (Columns [1]-[3]) or daily social activities (Columns[4]-[6]).

Table A14: COVID-19: family vs friends, June

	Cases		Fatalities		Fatalities/Cases	
	[1]	[2]	[3]	[4]	[5]	[6]
Contacts	0.005		0.004		–0.001	
	(0.003)		(0.005)		(0.002)	
Friends		0.006		0.010		0.004
		(0.003)*		(0.006)*		(0.003)
Family		–0.001		–0.006		–0.006
		(0.004)		(0.006)		(0.004)
$\ln(GDP_{pc})$	0.227	0.156	0.751	0.610	0.126	0.058
	(0.337)	(0.354)	(0.673)	(0.691)	(0.412)	(0.412)
$\ln(Density)$	0.205	0.210	0.386	0.404	0.141	0.147
	(0.069)***	(0.068)***	(0.129)***	(0.127)***	(0.070)**	(0.070)**
$\ln(Heating)$	1.276	1.315	1.373	1.448	0.215	0.250
	(0.354)***	(0.352)***	(0.432)***	(0.431)***	(0.147)	(0.155)
$\ln(Days)$	1.428	1.454	1.794	1.874	0.447	0.505
	(0.593)**	(0.596)**	(0.835)**	(0.842)**	(0.410)	(0.425)
$\ln(Beds)$			0.984	1.005	0.541	0.549
			(0.822)	(0.830)	(0.419)	(0.421)
Pop_{65}	–0.059	–0.059	–0.050	–0.048	–0.008	–0.006
	(0.027)**	(0.027)**	(0.053)	(0.053)	(0.029)	(0.029)
$\frac{Women}{Men}$	0.017	0.021	0.013	0.015	0.027	0.027
	(0.037)	(0.036)	(0.062)	(0.060)	(0.035)	(0.034)
$Serv\_share$	–0.011	–0.013	–0.031	–0.036	–0.020	–0.023
	(0.012)	(0.012)	(0.017)*	(0.018)*	(0.009)**	(0.010)**
$\frac{N}{L}$	0.043	0.044	0.036	0.035	0.002	0.000
	(0.014)***	(0.015)***	(0.021)	(0.022)	(0.013)	(0.013)
Education	–0.015	–0.013	–0.048	–0.044	–0.036	–0.032
	(0.024)	(0.026)	(0.033)	(0.034)	(0.018)*	(0.018)*
Poverty	–0.000	–0.000	0.005	0.005	0.005	0.005
	(0.005)	(0.005)	(0.008)	(0.008)	(0.004)	(0.004)
$\ln(Respiratory)$	0.236	0.279	0.185	0.322	0.020	0.114
	(0.384)	(0.402)	(0.530)	(0.545)	(0.265)	(0.270)
Air	–0.003	–0.002	0.009	0.014	0.018	0.021
	(0.012)	(0.013)	(0.022)	(0.022)	(0.010)*	(0.011)*
Borders	0.197	0.197	0.368	0.352	0.130	0.113
	(0.125)	(0.124)	(0.203)*	(0.200)*	(0.095)	(0.090)
Islands	0.357	0.392	0.342	0.403	0.015	0.051
	(0.273)	(0.277)	(0.440)	(0.443)	(0.258)	(0.271)
Constant	–24.195	–24.395	–39.886	–40.182	–13.650	–13.806
	(4.975)***	(4.979)***	(8.464)***	(8.331)***	(4.387)***	(4.299)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Countries	8	8	7	7	7	7
Observations	124	124	113	113	113	113
Rsq	0.734	0.734	0.663	0.667	0.790	0.794
RMSE	0.447	0.447	0.667	0.662	0.345	0.342

Notes: Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A15: COVID-19: inter-generational families, June

	Cases			Fatalities			Fatalities/Cases		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
$Inter-generational$	0.004	0.003	0.004	0.011	0.010	0.012	0.004	0.004	0.005
	(0.004)	(0.004)	(0.004)	(0.005)**	(0.006)*	(0.006)**	(0.003)	(0.003)	(0.003)
$Contacts$		0.005			0.003			–0.001	
		(0.003)			(0.005)			(0.002)	
$Friends$			0.007			0.010			0.004
			(0.003)*			(0.006)*			(0.003)
$Family$			–0.002			–0.008			–0.006
			(0.004)			(0.006)			(0.004)
$\ln(GDP_{pc})$	0.302	0.254	0.185	0.915	0.884	0.745	0.166	0.180	0.113
	(0.342)	(0.347)	(0.363)	(0.669)	(0.679)	(0.688)	(0.412)	(0.413)	(0.410)
$\ln(Density)$	0.170	0.203	0.208	0.373	0.395	0.419	0.154	0.144	0.153
	(0.068)**	(0.069)***	(0.068)***	(0.128)***	(0.129)***	(0.128)***	(0.070)**	(0.070)**	(0.071)**
$\ln(Heating)$	1.241	1.292	1.340	1.376	1.412	1.508	0.247	0.231	0.274
	(0.391)***	(0.373)***	(0.372)***	(0.467)***	(0.466)***	(0.462)***	(0.147)*	(0.153)	(0.160)*
$\ln(Days)$	1.473	1.449	1.488	1.866	1.856	1.963	0.468	0.472	0.541
	(0.589)**	(0.604)**	(0.604)**	(0.833)**	(0.846)**	(0.848)**	(0.407)	(0.409)	(0.424)
$\ln(Beds)$				1.072	1.067	1.102	0.572	0.575	0.589
				(0.799)	(0.801)	(0.801)	(0.416)	(0.419)	(0.418)
Pop_{65}	–0.049	–0.051	–0.049	–0.023	–0.025	–0.017	0.002	0.003	0.007
	(0.029)*	(0.029)*	(0.029)*	(0.055)	(0.055)	(0.055)	(0.030)	(0.030)	(0.031)
$\frac{Women}{Men}$	0.023	0.013	0.015	–0.005	–0.012	–0.015	0.014	0.017	0.015
	(0.037)	(0.037)	(0.036)	(0.060)	(0.059)	(0.058)	(0.034)	(0.035)	(0.034)
$Serv\_share$	–0.012	–0.009	–0.011	–0.027	–0.024	–0.029	–0.016	–0.017	–0.021
	(0.011)	(0.012)	(0.012)	(0.016)	(0.016)	(0.017)*	(0.009)*	(0.009)**	(0.010)**
$\frac{N}{L}$	0.038	0.043	0.044	0.032	0.035	0.035	0.003	0.001	–0.000
	(0.014)***	(0.014)***	(0.015)***	(0.021)	(0.021)	(0.022)	(0.012)	(0.013)	(0.013)
$Education$	–0.003	–0.013	–0.010	–0.036	–0.043	–0.039	–0.037	–0.034	–0.030
	(0.025)	(0.024)	(0.025)	(0.033)	(0.032)	(0.032)	(0.018)**	(0.018)*	(0.018)*
$Poverty$	0.001	–0.000	–0.000	0.006	0.005	0.006	0.005	0.005	0.005
	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)
$\ln(Respiratory)$	0.221	0.251	0.310	0.207	0.222	0.395	0.042	0.035	0.143
	(0.379)	(0.378)	(0.396)	(0.509)	(0.511)	(0.522)	(0.260)	(0.262)	(0.264)
Air	–0.005	–0.003	–0.002	0.005	0.005	0.010	0.017	0.017	0.020
	(0.013)	(0.012)	(0.013)	(0.021)	(0.021)	(0.022)	(0.010)*	(0.010)*	(0.010)*
$Borders$	0.214	0.194	0.189	0.365	0.349	0.320	0.115	0.122	0.100
	(0.130)	(0.127)	(0.126)	(0.209)*	(0.208)*	(0.204)	(0.096)	(0.097)	(0.091)
$Islands$	0.368	0.372	0.415	0.380	0.387	0.467	0.035	0.033	0.077
	(0.282)	(0.270)	(0.272)	(0.404)	(0.401)	(0.396)	(0.230)	(0.237)	(0.247)
Constant	–25.053	–24.750	–25.111	–41.713	–41.493	–42.060	–14.207	–14.303	–14.571
	(5.098)***	(5.201)***	(5.186)***	(8.654)***	(8.786)***	(8.628)***	(4.522)***	(4.556)***	(4.466)***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	8	8	8	7	7	7	6	6	6
Observations	124	124	124	113	113	113	113	113	113
Rsq	0.729	0.733	0.734	0.671	0.668	0.675	0.793	0.791	0.796
RMSE	0.450	0.447	0.447	0.659	0.662	0.655	0.343	0.344	0.340

Notes: Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A16: COVID-19: blood donations

	$\Delta\ln(Cases)$				$\Delta\ln(Fatalities)$			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
$Blood$		0.002	–0.016	0.006		0.004	0.004	0.014
		(0.001)	(0.010)	(0.003)*		(0.002)**	(0.015)	(0.004)***
$Blood^2$			0.001				0.001	
			(0.000)**				(0.001)	
$Blood^3$			–0.000				–0.000	
			(0.000)**				(0.000)	
$Blood \times Blood_{75}$				–0.010				–0.012
				(0.005)*				(0.006)*
$Blood_{75}$				0.316				0.268
				(0.210)				(0.265)
$Contacts$	–0.000	–0.000	–0.000	0.000	0.000	–0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\ln(GDP_{pc})$	–0.065	–0.086	–0.061	–0.063	–0.130	–0.269	–0.168	–0.331
	(0.142)	(0.143)	(0.141)	(0.148)	(0.262)	(0.291)	(0.291)	(0.270)
$\ln(Density)$	0.067	0.070	0.078	0.074	0.098	0.095	0.101	0.118
	(0.025)***	(0.025)***	(0.024)***	(0.026)***	(0.038)**	(0.037)**	(0.037)***	(0.034)***
$\ln(Heating)$	0.111	0.113	0.121	0.132	–0.037	–0.030	–0.004	0.032
	(0.049)**	(0.051)**	(0.055)**	(0.056)**	(0.092)	(0.091)	(0.085)	(0.085)
$\ln(Days)$	0.112	0.084	0.037	0.018	–0.076	–0.131	–0.174	–0.249
	(0.164)	(0.168)	(0.165)	(0.170)	(0.282)	(0.294)	(0.298)	(0.252)
$\ln(Beds)$					0.222	0.278	0.191	0.228
					(0.208)	(0.211)	(0.209)	(0.188)
Pop_{65}	0.019	0.018	0.018	0.018	0.020	0.010	0.010	0.011
	(0.009)**	(0.009)*	(0.009)*	(0.009)*	(0.014)	(0.015)	(0.015)	(0.014)
$\frac{Women}{Men}$	–0.022	–0.021	–0.020	–0.023	–0.008	–0.001	–0.003	–0.008
	(0.013)	(0.013)	(0.012)	(0.013)*	(0.018)	(0.017)	(0.017)	(0.017)
$Serv\_share$	0.007	0.007	0.006	0.007	0.006	0.006	0.006	0.008
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)
$\frac{N}{L}$	–0.004	–0.002	–0.003	–0.002	0.004	0.008	0.008	0.012
	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.009)	(0.009)	(0.009)
$Education$	0.005	0.004	0.002	0.003	–0.005	–0.005	–0.010	–0.006
	(0.011)	(0.011)	(0.011)	(0.011)	(0.016)	(0.017)	(0.017)	(0.015)
$Poverty$	–0.000	–0.000	–0.000	–0.001	0.001	0.001	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
$\ln(Respiratory)$	–0.250	–0.250	–0.296	–0.297	–0.519	–0.551	–0.635	–0.683
	(0.209)	(0.209)	(0.211)	(0.212)	(0.231)**	(0.231)**	(0.224)***	(0.217)***
Air	–0.006	–0.006	–0.005	–0.005	–0.002	–0.003	–0.003	–0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)
$Borders$	0.010	0.017	0.026	0.022	0.025	0.038	0.044	0.043
	(0.036)	(0.037)	(0.036)	(0.036)	(0.061)	(0.060)	(0.057)	(0.055)
$Islands$	–0.078	–0.092	–0.120	–0.093	–0.135	–0.171	–0.174	–0.185
	(0.089)	(0.093)	(0.096)	(0.094)	(0.103)	(0.109)	(0.107)	(0.107)*
Constant	2.131	2.170	2.346	2.433	3.123	3.464	3.504	4.995
	(2.102)	(2.025)	(1.998)	(2.063)	(3.052)	(3.275)	(3.517)	(3.439)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	6	6	6	6
Observations	83	83	83	83	72	72	72	72
Rsq	0.477	0.479	0.504	0.491	0.255	0.286	0.334	0.380
RMSE	0.128	0.127	0.124	0.126	0.155	0.152	0.147	0.141

Notes: Robust standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.