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IGIER – Università Bocconi, Via Guglielmo Röntgen 1, 20136 Milano –Italy
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Epidemics and Trust: The Case of the Spanish Flu[☆]

Arnstein Aassve[a], Guido Alfani[a,b], Francesco Gandolfi[a], Marco Le Moglie[a]

[a] *Bocconi University*
[b] *Innocenzo Gasparini Institute for Economic Research (IGIER)*

Abstract

Recent studies argue that major crises can have long lasting effects on individual behavior. While most studies focused on natural disasters, we explore the consequences of the global pandemic caused by a lethal influenza virus in 1918-19: the so-called "Spanish Flu". This was by far the worst pandemic of modern history, causing up to 100 million deaths worldwide. Using information about attitudes of respondents to the General Social Survey (GSS), we find evidence that experiencing the pandemic likely had permanent consequences in terms of individuals' social trust. Our findings suggest that lower social trust was passed on to the descendants of the survivors of the Spanish Flu who migrated to the US. As trust is a crucial factor for long-term economic development, our research offers a new angle from which to assess current health threats.

JEL Classification: I15, N3, Z1
Keywords: Epidemic, Generalized trust, Spanish flu, Pandemic, Mortality crisis

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Email addresses: arnstein.aassve@unibocconi.it (Arnstein Aassve), guido.alfani@unibocconi.it (Guido Alfani), francesco.gandolfi@unibocconi.it (Francesco Gandolfi), marco.lemoglie@unibocconi.it, corresponding author (Marco Le Moglie)

Introduction

A century ago, an influenza-A virus caused the greatest pandemic in human history, the "Spanish Flu". It infected about a third of the world population and caused an estimated 50-100 million victims (Johnson and Mueller, 2002; Taubenberger, 2006). This historical episode is an important reason why influenza viruses are still included among the main health threats today (Hill et al., 2017; Pariente, 2018; Medina et al., 2010). The long-term effects of the Spanish Flu went well beyond the immediate demographic losses that it caused. Much research has been conducted into its consequences for the health of survivors, even when experienced in-utero (Myrskylä et al., 2013; Bengtsson and Helgertz, 2015; Almond, 2006). Fewer studies exist on the way in which experiencing the Spanish Flu shaped individual behavior and human societies at large (Bengtsson and Helgertz, 2015; Almond, 2006; Karlsson et al., 2014; Lin and Liu, 2014; Cohn, 2018; Guimbeau et al., 2019). Yet a growing literature argues that the second-worst pandemic in human history, the Black Death, had long term economic, social and cultural consequences, shaping behavior well into the twentieth century (Richardson and McBride, 2009; Voitgländer and Voth, 2012; Jedwab et al., 2016; Alfani and Murphy, 2017). Here we show that similarly to the Black Death, also the Spanish Flu had long-lasting social consequences, leading to a decline in social trust. This would result from having experienced the social disruption and generalized mistrust characterizing the pandemic period.

Uncovering the broader societal impact of an historical pandemic, such as the Spanish flu, is obviously challenging. In the case of attitudes and social trust, which we study here, no direct survey measures exist. Instead we exploit information about the descendants of those who experienced the historical event (Algan and Cahuc, 2010). This method leverages on the fact that cultural traits and attitudes are inherited across generations, passing on from parents to children (Dohmen et al., 2012). We use the General Social Survey (GSS), which is a representative survey of the US population. Social trust is derived from those respondents who were direct descendants of migrants to the US, and by using this information, we are able to provide an estimate of social trust for each country of origin before and after the spread of the Spanish Flu. Importantly, the derived measure of trust from the GSS is exogenous to socio-economic differences between countries at that time. For each country of origin, we compare the estimated levels of social trust for the two periods, and we analyze how the possible difference

in trust depends on the pandemic mortality rate by adopting a difference-in-difference (DiD) approach.

The results of our analysis suggest a negative and significant effect of the Spanish Flu on trust. An increase in influenza mortality of 1 death per thousand resulted in a 1.4 percentage points decrease in trust. This result is robust to an extensive set of tests (including falsification tests), different samples and variable definitions, different functional specifications and different control strategies. We also provide evidence on the possible mechanism underlying the change in trust, namely the neutrality of the home country in WWI. A narrower resonance of the war within neutral countries, together with the specific lack of war censorship on media, might have led their respective citizens to internalize the extent and severity of the pandemic, and thus altered their social interactions accordingly.[1] Consistently with this hypothesis, we do find a stronger reduction in social trust for the descendants of people migrating from countries heavily hit by the epidemic and that remained neutral during the war.

Trust is an important determinant of long-run economic development (Tabellini, 2010), and recent literature has shown its reactivity to natural disasters such as earthquakes or floods (Skidmore and Toya, 2014; Carlin et al., 2014). By bringing attention to major epidemics, our study also provides useful insights into how more recent events, such as the HIV pandemic or the recent Ebola epidemic of 2013-16 as well as the one which started in 2018 and is currently ongoing, might have lasting consequences on the societies affected (Young, 2005; Hayden, 2014), possibly compromising their economic performances for years to come. However, we also argue that the effects of a specific pandemic or epidemic cannot be easily generalized, as they depend on its characteristics both in terms of infection rates and chances of survival, as well as on the cultural and social-economic context in which it took place. This conclusion is in line with the recent literature on the consequences of large-scale plagues in European history (Alfani and Percoco, 2019). Finally, the fact that the impact of the Spanish Flu on trust in neutral countries is different from belligerent ones, illustrates how the portrayal of a pandemic by the media plays an important role in affecting societies. All too often in human history,

[1] In fact, as described by Honigsbaum (2013) pg. 184, in belligerent countries, *"propaganda discourses encouraged the cultivation of stoicism at the expense of other emotional scripts"*, which might have gone a long way towards reducing the impact of the pandemic on individual behaviour and on public memory (Crosby, 1976).

specific groups have been blamed for the spread of infections (Cohn, 2018) and also during the Spanish Flu, in many countries, war propaganda blamed external enemies (and their internal spies) for the spread of the disease at home. In this regard, the lesson from history as well as from recent episodes, is that while open, accurate and reliable information should always be favoured, the media should refrain from creating undue alarm. This is obviously difficult to achieve, as readily shown by the current COVID-2019 crisis as well as by the earlier coronavirus-related scare, the SARS of 2013.

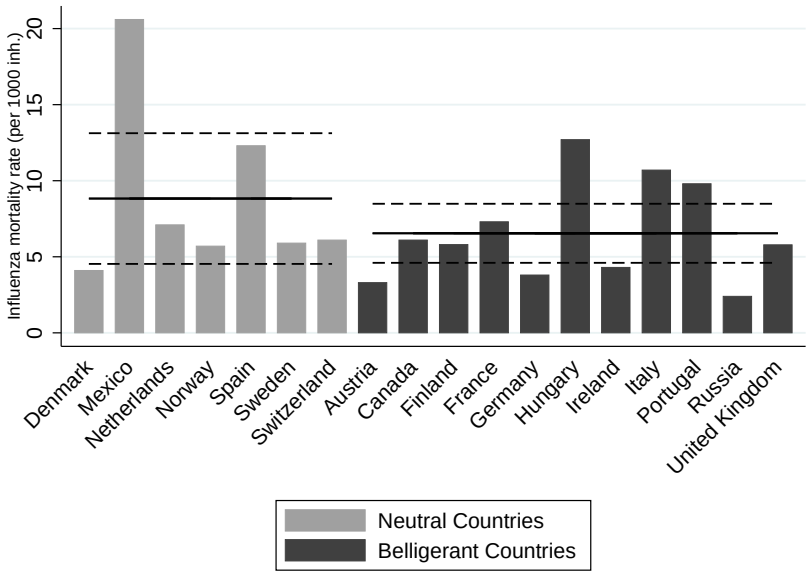
In the next section we provide an overview of the Spanish Flu and its main impact on society. Section 2 describes the data employed in the analysis while Section 3 the methodology applied to carry it out. In Section 4 we report our main findings as well as an extended set of robustness tests. Finally, Section 5 concludes.

1. The Influenza Pandemic and its Impact on Society

The first wave of the Spanish Flu pandemic started in spring 1918 and spread rapidly across the world. Earlier scholarship placed its origin in the United Stated, where the influenza was first identified in March 1918, however this is now doubted (Taubenberger, 2006; Crosby, 1976). The pandemic was caused by an influenza H1N1 virus, whose entire genome has been sequenced (Tumpey et al., 2005; Taubenberger et al., 2005). All influenza A pandemics since 1918 have been caused by descendants of the Spanish Flu virus (Taubenberger, 2006) and vaccines developed to protect against the 2009 H1N1 virus would also work against the original Spanish Influenza virus (Medina et al., 2010). While this offers some reassurance about the health threats associated to H1N1, it is also one of two factors explaining why the Spanish Flu continues to be the object of considerable interdisciplinary attention. The other is its exceptional severity, especially during the second wave (September-November 1918) and the third (early 1919). The third wave, which involved fewer countries, was probably exacerbated by the end of World War I, with soldiers returning home and the resuming of commerce (Taubenberger, 2006; Crosby, 1976). However, looking at the average mortality rates associated with the influenza pandemic showed in Figure 1, there is no considerable differences across neutral and belligerent countries.

The exceptionally high mortality is the combined result of the extremely high infectiousness of the disease and of a case-fatality rate of $>2.5\%$, which is high compared to the $<0.1\%$ characterizing other influenza pandemics (Taubenberger, 2006). Overall, this

Figure 1: Spanish Flu Mortality by Participation to WWI

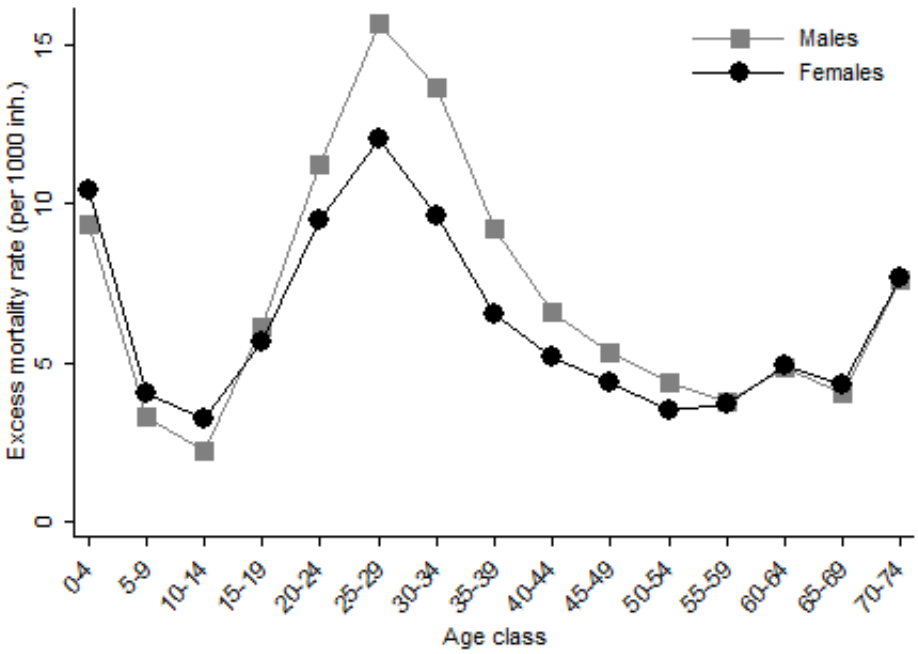


Note: The figure shows the influenza mortality rates for the sample countries employed in the analysis, divided by their participation in World War I. Horizontal lines represent the mean death rate for each group while the dashed horizontal lines show the 95% confidence intervals.

resulted in at least 50, and possibly as much as 100 million victims globally (Johnson and Mueller, 2002; Taubenberger, 2006). These grim statistics place the Spanish Flu at the top of the ranking of the worst pandemics in human history, at least looking at the number of deaths (Alfani and Murphy, 2017). Another striking characteristic of the Spanish Flu was that most of its victims were young adults. This is different from the standard influenza outbreaks that tend to affect the very young and older strata of the population, thereby leading to the well-known U-shaped relationship between age and flu mortality. The Spanish flu in contrast, killed disproportionately young adults aged 15-34. The resulting relationship between age and deaths is W-shaped (Mamelund, 2011), and very similar across genders, as shown in Figure 2.

Explaining differences in trust has attracted considerable interest. This is in part driven by the fact that social trust matters for a whole range of societal outcomes - including economic prosperity. Additionally, this interest comes from the observation that social trust appears rather stable over time, though with significant differences across countries. Consequently, it is important to identify the cultural roots of social trust. Some have focused on climate variation, arguing that in agricultural societies,

Figure 2: Age-Specific excess mortality rates



Note: The figure shows the median excess mortality rates by sex and age group, based on data for 13 countries, namely Australia, Denmark, England, Finland, France, Italy, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and USA. (Source: Murray et al. (2006))

unfavourable weather conditions may have encouraged cooperation, and therefore created differences in trust over time (Buggle and Durante, 2017). Others have emphasized historical developments (Guiso et al., 2016), such as the slave trade and colonial medicine in Africa (Lowes and Montero, 2018; Nunn and Wantchekon, 2011), the establishment of Leaper colonies in Colombia (Ramos-Toro, 2019), or mass-surveillance in East-Germany (Lichter et al., 2015), that might have generated long-standing distrust in those societies exposed to them. Another strand of literature has focused on the potential role of natural disasters in affecting social trust (Calo-Blanco et al., 2017; Carlin et al., 2014; Uslaner and yamamura, 2016; Toya and Skidmore, 2014), a literature related to our current study.

This literature does not make clear-cut predictions for how a natural disaster may alter social trust. On the one hand, a natural disaster could increase trust as citizens get together through rebuilding efforts. But in so far as a natural disaster brings about economic destitution and poverty, individuals may be forced to fend for themselves rather

than engaging in healthy cooperation, which may in turn lower social trust.

A similar issue applies for pandemics. It seems natural to hypothesize that a highly contagious disease would reduce social contacts from fear of contracting the disease. People would naturally avoid social interaction with those they do not know and perhaps avoid large gatherings, and over time, the social trust will decline. For the Spanish Flu, measures of public health, and the general encouragement from the authorities and the media to avoid inter-personal contacts, created a profound climate of suspicion and mistrust (Cohn, 2018). High mortality and the concentration of deaths among young adults increased the ability of the pandemic to disrupt the social tissue. Indeed, historical accounts of the Spanish Flu show that panic was so widespread that the red cross in rural Kentucky reported "people starving to death not from lack of food but because the [healthy] were panic stricken and would not go near the sick" (Barry, 2005). Different locations attempted to combat the pandemic with a variety of methods. Quarantines, closing schools, bars, churches and other gathering places and compulsory gauze masks were implemented, though most of these actions turned ineffective in containing the disease (Crosby, 1976; Johnson, 2012). In other words, the fear of contracting influenza dramatically altered social interactions (Phillps and Killingray, 2003). Some scientists worried that "*If the epidemic continues its mathematical rate of acceleration, civilization could easily disappear from the face of the earth within a matter of a few more weeks*" (Collier, 1974). However, comparatively speaking, the Spanish Flu was not as lethal as other epidemics, such as the Ebola. An important aspect of the Spanish Flu was instead its sheer magnitude. The world struggled to cope as vaccines were not developed and none of the suggested cures were effective (Taubenberger, 2006; Crosby, 1976). Across Europe and the United States, civilian hospitals were severely understaffed, in part because doctors and nurses were involved in the war efforts, but also because of the very large number of people contracting the disease. The case of the Spanish Flu is consequently a textbook case of utter failure of health care institutions both in containing the spread of an epidemic and in providing effective care, a feature that may very well affect individuals' social trust.

Other pandemics may have different impact. The case-fatality rate from contracting Ebola is way higher than the Spanish Flu, for instance. But its extent, in terms of infections rates and overall mortality, has been dramatically lower so far, and the areas where one may contract Ebola are typically very small. Individuals will know instantly about an outbreak as they observe fellow villagers dying from the disease. But given

the (relatively) small scale, it is not at all sure that an Ebola epidemic would have a big impact on social trust. In fact, a recent study found evidence that effective public intervention to contain Ebola outbreaks might have actually increased trust in government authorities (Flückiger et al., 2019). The same study, however, did not find a strong effect on social trust. In contrast to the Ebola outbreaks, the number of people who were infected by the Spanish Flu - but survived - was orders of magnitude greater and those survivors (and their relations) might have experienced the deepest changes in their attitudes. Indeed, the survivors were those who had been faced more directly with the collapse of traditional networks of social support as well as with the inability of public institutions to provide adequate care and relief.

2. Data: Inherited Trust and Spanish Flu Mortality

The data employed in this work are mostly obtained from General Social Study (GSS). The GSS is a yearly survey held in the United States since 1972, containing a standard core of demographic, behavioral, and attitudinal questions that are repeated in each wave of the survey. This gives access to a vast pool of respondents providing the information required for our analysis. We use the waves from 1978 to 2018.

The main variable of interest that can be obtained from the GSS is generalized trust. This variable comes from the question *"Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"*. First formulated by Almond and Verba (1963), the question is extensively used in the literature to measure generalized trust on the basis of surveys (Algan and Cahuc, 2014). We code generalized trust as a dummy variable that takes value 1 (high trust) for the people that answered *"Can Trust"* and 0 (low trust) for those who answered either *"Cannot Trust"* or *"Depends"*.[2]

Survey respondents were also asked about their country of ethnic origin and a series of questions regarding their migration history: whether they were born in the United States or not, whether their mother and father were born in the U.S. and the number of grandparents born outside the country. Using this information, we group respondents on the basis of their country of ethnic origin and categorize them in three waves of

[2]In a robustness test included in Section 4 we also consider the three categories separately.

immigration: second-generation Americans (i.e. people born in the US with at least one parent and all the grandparents born abroad), third-generation Americans (i.e. people with at least two immigrant grandparents and both parents born in the United States) and fourth-generation Americans (i.e. people with more than two grandparents born in the United States and both parents born in the United States). We exploit different waves of immigration to measure the inter-generational path of social capital transmission by people migrated before and after the spread of the Spanish flu (i.e. 1918), following the methodology introduced by Algan and Cahuc (2010) and Tabellini (2008).

We measure the severity of the Spanish flu using the data on flu mortality, expressed in deaths per thousand inhabitants, collected by Johnson and Mueller (2002). This study is the most comprehensive in terms of countries coverage, and it presents the most recent estimates for flu mortality, pooling together the results of multiple studies on single countries. Specifically, the countries for which the estimates of Spanish flu death rates are available that are included in our analysis are Austria, Canada, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Mexico, the Netherlands, Norway, Portugal, Russia, Spain, Sweden, Switzerland, and United Kingdom.[3]

3. Methodology

3.1. Estimation of Inherited Trust in the Home Countries

In order to obtain estimates for the level of trust in each country before and after the spread of the Spanish flu, we follow the method proposed by Algan and Cahuc (2010) and Tabellini (2008). Algan and Cahuc (2010) leverage on the evolution of trust of descendants of U.S. migrants to detect historical changes in the level of trust in the home country. The starting point is that a part of social attitudes, including trust, is shaped by the contemporary environment and society while another is due to beliefs and

[3]There are three other countries for which this information is available, that is Japan, India and the Philippines. Concerning Japan, it is excluded from the baseline due to its very limited representation within the final samples used to run our main analysis. However, among the sensitivity tests, we re-run the regression including this country and the results are almost unaffected. Regarding India and the Philippines, they are excluded because of missing values in the control variables. It is also worth mentioning that an estimation of the Spanish flu mortality is also available for Brazil from a specific administrative source and it has been employed in Guimbeau et al. (2019), but such estimation cannot be used in our study since it regards only a specific region within the country (i.e. the state of Sao Paulo), thus not comparable with those at the country level provided in Johnson and Mueller (2002).

norms inherited from earlier generations (Dohmen et al., 2012). By estimating the latter part using the GSS survey, they obtain a proxy for the level of generalized trust that was present in the countries of origin at the time of the ancestors' migration to the United States. Since the date of departure of the respondents' ancestors is not directly available from the survey, the authors infer it from the year of birth of the person interviewed and whether he is second-, third- or fourth-generation American. Assuming a 25-year gap between generations, Algan and Cahuc (2010) hypothesize that the respondent's ancestor moved to the United States before the date Y if I) the respondent is a second-generation American born before Y or II) the respondent is a third-generation American born before Y+25 or III)the respondent is a fourth-generation American born before Y+50. Algan and Cahuc (2010) also assume that the respondent's ancestor moved to the United States after the date Y if I) the respondent is a second-generation American born after Y or II) the respondent is a third-generation American born after Y+25 or III) the respondent is a fourth-generation American born after Y+50. Having created these two groups, for each of them Algan and Cahuc (2010) regress the individual levels of trust on a set of variables, including dummies for each country of origin. Thus, the levels of trust for a specific country of origin before and after date Y are captured by the coefficients of the fixed effect for that country in each of the two regressions.

This approach provides numerous advantages in the estimation of country-level trust. First and foremost, it allows us to calculate inherited trust starting from a measure of present trust that is exogenous to socio-economic differences between countries at the time of the pandemic. Furthermore, we can rely on a single survey and on questions that are consistent across the waves, granting the comparability of the variables both between countries and between periods.

As in Algan and Cahuc (2010) we run two separate regressions: one to estimate trust up to 1918 and the other to estimate trust after 1918. Furthermore, as in Algan and Cahuc (2010), we assume a 25-year gap between generations. Specifically, in the sample used to estimate inherited trust before 1918 we include I) all the second-generation respondents that were born in 1918 or earlier II) all the third-generation respondents that were born by $1918+25$ (i.e. 1943) and III) all the fourth-generation Americans that were born by $1918+50$ (i.e. 1968). As for trust after 1918, we sample I) all the second-generation respondents that were born after 1918, II) the third-generation respondents born after $1918+25$ (i.e. 1943) and III) all the fourth-generation Americans born after $1918+50$ (i.e. 1968).

Differently from Algan and Cahuc (2010), we are interested in the variation of inherited trust around a precise date, 1918, and this requires higher accuracy in the identification of the respondents whose ancestors migrated before or after such date. Taking for example second-generation Americans, since we infer the date of migration of their parents from their year of birth, including in the post-1918 sample also people born immediately after such date (i.e. 1919, 1920 etc..) might lead to consider as migrated after the spread of the epidemic also some individuals whose parents actually migrated before that date. Such risk of mis-classification of the period in which individuals' parents migrated is decreasing in the time distance L between their birth date and the date of the outbreak of the Spanish flu (1918). Thus, to address this possible issue, in a robustness test we allow for the existence of a lag between the time of migration and having a child in the country of arrival, and we test the robustness of our baseline results to the use of different lengths for such lag, always finding no significant change with respect to the main specification.

More specifically, we estimate inherited trust in both periods by Ordinary Least Squares (OLS) and using the following equation:

$$Trust_i = \beta_0 + \sum_{c=2}^{18} \beta_c Country_i + \mathbf{X}_i^{'}\boldsymbol{\gamma} + \varepsilon_i \tag{1}$$

where i identifies the individual and c the country of ethnic origin. We exclude from the estimation all those countries which are present within only the pre-1918 sample or only the post-1918 one, and those for which there are less then 25 observations in one of the two periods, in order to guarantee a minimum level of representation within each sample (see Section *Sensitivity Tests*). We are interested in estimating the coefficients β_c, i.e. the coefficients of the country-of-origins fixed effects. Each of these coefficients should capture the average level of trust transmitted to their descendants by people that moved from one of the sample countries of origins to the United States with respect to the reference country of origin, that is Austria. Given the dichotomous nature of the dependent variable each coefficient represents the variation in the predicted probability of trusting others (i.e. $Trust_i = 1$) for a given country of origin with respect to Austrian Americans. The vector $\mathbf{X}_i$ includes all the controls used in the regression, namely age, age squared, gender, education, income, religion, employment status, number of immigrant grandparents and whether he is second-, third- or fourth-generation American. Standard

errors are adjusted for heteroskedasticity and clustered at country-of-origins level to account for serial correlation.

Appendix A.1 provides a detailed list of all the variables employed in the estimation of inherited trust together with their description, while Table 1 shows the summary statistics for all of them. Table 2, instead, provides the estimated value of inherited trust (i.e. the predicted probability of trusting the others) for each country of origin, separately for the pre and post-1918 samples.

Table 1: Estimating Inherited Trust: Summary Statistics

	Mean	Std. Dev.	Min	Max
Pre-1918				
Trust	0.48	0.50	0	1
Income class	10.61	2.38	1	12
Age	51.40	16.92	18	89
Education	13.41	2.90	0	20
Male	0.46	0.50	0	1
Protestant	0.66	0.47	0	1
Catholic	0.21	0.41	0	1
Employed	0.60	0.490	0	1
Unemployed	0.02	0.15	0	1
Immigrant grandparents	0.55	1.140	0	4
Second-generation	0.03	0.16	0	1
Third-generation	0.12	0.32	0	1
Fourth-generation	0.86	0.35	0	1
Post-1918				
Trust	0.39	0.49	0	1
Income class	10.97	2.18	1	12
Age	37.42	13.99	18	89
Education	13.94	2.57	0	20
Male	0.48	0.50	0	1
Protestant	0.38	0.49	0	1
Catholic	0.35	0.48	0	1
Employed	0.73	0.45	0	1
Unemployed	0.04	0.19	0	1
Immigrant grandparents	1.83	1.64	0	4
Second-generation	0.18	0.38	0	1
Third-generation	0.40	0.49	0	1
Fourth-generation	0.42	0.49	0	1

Note: The table displays the summary statistics for the variables used in the estimation of inherited trust.

Table 2: Estimates of Inherited Trust

Country	Pre-1918	se	Post-1918	s.e.
Austria	0.5407***	(0.0132)	0.4057***	(0.0063)
Canada	0.4857***	(0.0055)	0.4933***	(0.0027)
Denmark	0.4774***	(0.0047)	0.5499***	(0.0098)
Finland	0.5090***	(0.0090)	0.4495***	(0.0088)
France	0.4828***	(0.0018)	0.3605***	(0.0028)
Germany	0.4808***	(0.0008)	0.4032***	(0.0021)
Hungary	0.4982***	(0.0093)	0.4154***	(0.0065)
Ireland	0.4685***	(0.0024)	0.4127***	(0.0042)
Italy	0.4281***	(0.0098)	0.3379***	(0.0065)
Mexico	0.4695***	(0.0085)	0.2832***	(0.0077)
Netherlands	0.4493***	(0.0028)	0.4316***	(0.0040)
Norway	0.5618***	(0.0059)	0.4223***	(0.0097)
Portugal	0.3841***	(0.0090)	0.3363***	(0.0042)
Russia	0.3855***	(0.0178)	0.4198***	(0.0122)
Spain	0.3854***	(0.0058)	0.3875***	(0.0023)
Sweden	0.4531***	(0.0055)	0.4439***	(0.0057)
Switzerland	0.4709***	(0.0034)	0.5154***	(0.0041)
United Kingdom	0.5041***	(0.0028)	0.4418***	(0.0053)
Observations	10,107		4,901	

Dependent variable: Trust. Each coefficient represents the predicted probability of trusting the others in one of the country of origin included in the estimation samples for the pre-1918 and post-1918 periods. The predicted probability are calculated using the estimates of Equation 1 for both periods.

3.2. Inherited Trust and Spanish Flu

In order to evaluate how inherited trust varied due to the spread of an epidemic, we compare its evolution before and after the outbreak of the Spanish flu. Thus, the estimates of inherited trust for each country of origin for the pre-1918 and post-1918 periods obtained as explained in Section *Estimation of Inherited Trust* are now used as the dependent variable.

To isolate the effect of the Spanish flu on inherited trust we adopt the following empirical approach:

$$\begin{aligned} Inherited\ Trust_{c,t} = \beta_0 + \beta_1 Post1918_t + \beta_2 Flu\ Mortality_c * Post1918_t + \\ + \mathbf{X}'_{c,t}\boldsymbol{\beta} + \delta_c + \varepsilon_{c,t} \end{aligned} \tag{2}$$

Where c identifies one of the 18 countries of origin and t the period of migration (i.e. pre- or post-1918). The dependent variable, $Inherited\ Trust$ is the predicted probability of trusting the others for each country as given in Table 2. The coefficient of interest here is β_2, that captures the effect of the treatment: mortality in the home country interacted with $Post1918$, a dummy that takes value 1 for the post-1918 observations and 0 for those before 1918. It broadly measures the variation in the level of inherited trust of people whose ancestors emigrated to the U.S. after the outbreak of the Spanish flu from countries highly affected by the pandemic with respect to those whose ancestors came from less affected countries.

The equation includes $\boldsymbol{X}_{c,t}$ which collects the country of origin-level controls. We focus on five main variables that could affect both the level of trust of people emigrating from a specific country and their propensity to migrate from that country. Among these factors, which we collected for the pre- and post-1918 periods, we take into consideration the GDP per capita, the population density, primary school enrollment, a general index for the quality of the home country institutions (Polity-IV score) and the rate of change in migration flows from the home country to the United States. Moreover, we also include the interaction between $Post1918$ and a dummy, $Neutral$, which is equal to 1 if the country of origins remained neutral during WWI, and 0 otherwise. Given the time overlap between the spread of the epidemic and the end of WWI, the inclusion of such interacting term is aimed at controlling for different kinds of heterogeneity in the post 1918 period for neutral and belligerent countries, respectively. In fact, the literature have found that experiencing a war may either lower or foster the level of trust among

individuals (Bauer et al., 2016), thus controlling for the participation of the countries to WWI becomes crucial in our setting in order to avoid a possible bias in our estimates due to this alternative source of long-lasting change in trust that is contemporaneous to the outbreak of the Spanish flu.

Lastly, δ_c captures country of origin-fixed effects. Standard errors are adjusted for heteroskedasticity.

Appendix A.2 provides a detailed list of all variables employed in the estimation of the effect of the pandemic on inherited trust together with their description, while Table 3 reports the summary statistics for all of them.

Table 3: Spanish Flu and Trust: Summary Statistics

	Mean	Std. Dev.	Min	Max
Inherited Trust	0.44	0.06	0.28	0.56
Flu Death Rate (Deaths per 1000 inh.)	7.4	4.4	2.4	20.6
Polity-IV	3.8	6.0	-6.6	10
Population Density (Inh. per km^2)	70	62	1	217
GDP per Capita	10,783	8,923	1,608	31,856
Primary school enrollment (%)	59	23	16	95
Change in migration flows to US	0.39	0.93	-0.95	3.26

Note: The table displays the summary statistics for the variables used in the estimation of the relationship between inherited trust and Spanish flu mortality.

4. The Impact of the Spanish Flu on Social Trust

The main results of our analysis are presented in Table 4. In column (1) we run Equation 2 without any control, in column (2) we add the time-varying controls, while in column (3) we also include the interaction between $Post1918$ and $Neutral$. Instead, column (4) investigates how the neutrality of the home country in WWI eventually channelled the impact of the epidemic on trust by including a triple interaction between $FluMortality$, $Post1918$ and the dummy $Neutral$.

As columns (1)-(3) show, we find a negative and significant effect of the Spanish Flu on trust, suggesting that large-scale epidemics can indeed have a negative impact on the latter. According to the most complete estimates (i.e. column (3)), an increase in

influenza mortality of 1 death per thousand resulted in a 1.4 percentage points decrease in trust, while a 1 standard deviation increase in mortality (i.e. an increase of 4.4 deaths per thousands) decreased our measure of trust by 6.6 percentage points, corresponding approximately to a 1 standard deviation in trust.

The results showed in column (4) provide suggestive evidence on the possible mechanism through which the main effect took place: the impact of the pandemic on trust was significantly more negative in countries that remained neutral during WWI. In fact, an increase in influenza mortality of 1 death per thousand in neutral countries resulted in a 2.1 percentage points decrease in trust. This evidence is strongly consistent with the idea that the narrower resonance of the war within these countries, and in particular the specific lack of war censorship on media, allowed citizens to fully perceive the extent and severity of the pandemic, and thus alter their social interactions in a stronger way.

Table 4: The Effect of Spanish Flu on Inherited Trust: Estimates

	(1)	(2)	(3)	(4)
Post1918	-0.0004	0.0314	0.1399	0.1575
	(0.0321)	(0.1016)	(0.1010)	(0.1009)
Flu Mortality*Post1918	-0.0069**	-0.0086**	-0.0141***	-0.0086***
	(0.0032)	(0.0035)	(0.0037)	(0.0028)
Flu Mortality*Post1918*Neutral				-0.0126***
				(0.0039)
Country FE	YES	YES	YES	YES
Controls	NO	YES	YES	YES
Neutral*Post 1918 FE	NO	NO	YES	YES
Observations	36	36	36	36
Number of Countries	18	18	18	18
R^2	0.4857	0.5676	0.6659	0.7245

Dependent variable: Inherited Trust. *FluMortality* is the country-level death rate for Spanish flu (i.e. deaths per thousand inh.). *Post*1918 is a dummy taking the value 1 for the observations after 1918 and 0 otherwise. Columns (2), (3), and (4) include time-varying controls. The controls are: GDP per capita (PPP), population density, primary school enrollment (%), Polity-IV index and the change in migration flows to the US. Columns (3) and (4) also includes the interaction between the dummy *Post*1918 and the dummy *Neutral*, which is equal to 1 if the country of origins remained neutral during WWI and 0 otherwise. Standard errors are robust to heteroschedasticity. *, **, *** indicate statistical significance at 10%, 5%, and 1% level, respectively.

In Table 5 we present the results of several tests to assess the robustness of the baseline results presented in column (3) of Table 4.

In Panel (a) we test different ways of constructing the sample for estimating inherited trust in the pre- and post-1918 periods, as well as the exclusion of Mexico from the analysis. Specifically, in row (1) we remove the minimum threshold of 25 respondents in each period, which essentially means adding also Japan to the sample of countries of origins taken into account. Instead, in row (2) we increase this threshold to 50 respondents. On the one hand, this implies an increase in the degree of representativeness of our estimates of inherited trust, but on the other hand it leads to a narrower sample of countries of origins.[4] In row (3) we exclude Mexico from our estimation since it represents an outlier both in terms of deaths due to the epidemic and and size of the migration flow towards the US.

Next, in Panel (b) we test an alternative functional forms for Equation 1. In row (4) we implement a one-step procedure, thus estimating an individual-level regression on GSS respondents that include individual controls, country fixed effects, time-varying country characteristics, and the dummy $Post1918$ to measure if the respondent's ancestors migrated before or after the epidemics. As in the baseline model, we interact $Post1918$ with Spanish flu mortality in the home country to assess the impact of the epidemics on generalized trust. In row (5), we take into consideration the dichotomous nature of the dependent variable in Equation 1 and we estimate this latter by using a non linear regression model in the place of OLS, that is a Logit regression model. Next, while in the baseline we code trust as 1 for "Most people can be trusted" and 0 for "Can't be too careful" or "Depends", in row (6) we estimate trust using an ordered logit model, thus separating the respondents that answered "Depends" from those that answered "Can't be too careful".

Following, in Panel (c) we show the results of a set of tests aimed at better differentiating the respondents whose ancestors migrated before the flu epidemic from those whose ancestors migrated after that. We do that by introducing a lag L for selecting the respondents to include in the post-1918 sample according to their birth date. In details, the post-1918 sample will include now I) all the second-generation respondents that were born after 1918+L, II) the third-generation respondents born after 1943+L and III) all

[4]Specifically, using the threshold of 50 respondents we are left only with Canada, United Kingdom, France, Germany, Ireland, Italy, Mexico, Netherlands, Norway, Russia, Spain and Sweden.

the fourth-generation Americans born after 1968+L. As pointed out in Section 3.1, this is a departure from Algan and Cahuc (2010), and it is due to the fact that differently from them, we are interested in the variation of inherited trust around a precise date, 1918, thus requiring higher accuracy in the identification of the respondents whose ancestors migrated before or after such date. Taking for example second-generation Americans, since we infer the date of migration of their parents from their year of birth, including in the post-1918 sample also people born immediately after such date (i.e. 1919, 1920 etc..) might lead to consider as migrated after the spread of the epidemic also some individuals whose parents actually migrated before that date. Indeed, it is fair to assume the existence of a lag between the time of migration and having a child in the country of arrival, for instance related to the adaptation to the new context. Such risk of mis-classification of the period in which individuals' parents migrated is decreasing in the time distance L between their birth date and the date of the outbreak of the Spanish flu (1918). Allowing for greater values of L would mean that we are allowing for a wider adaptation period, thus we are more likely to include only people whose parents did migrate after 1918 and then they had the child. On the contrary, very high values of L might lead us to consider in the post-1918 sample many individuals whose parents did not really experience the epidemic in their home country because they were too young at that time or still not born. In row (7) L is equal to 10 years, while it is equal to 20 in row (8).

In Panel (d) we present alternative discrete measures for the Spanish flu mortality in each county. Indeed, the method used to calculate the death rates employed in the main analysis varies from study to study, on the basis of the data available for each country. Such heterogeneity in how the death rates are calculated for each country could undermine the reliability of the comparison based on the continuous measure, mainly due to the difficulty of measuring marginal differences in such rates across countries. Moreover, in terms of size of the effect, the continuous measure captures the effect of the Spanish flu on trust only at the average level of the former, while it says nothing on the existence of possible non linearities in the relationship between the two variables. For this reasons, we repeat the analysis using two discrete measures of Spanish flu mortality related to its general distribution across all the countries included in our sample. In row (9) countries are assigned to the high flu mortality group if they belong to top 40% of the flu mortality distribution and 0 otherwise. In row (10) countries are assigned to the high flu mortality group if they belong to the top 10% of the flu mortality distribution and 0 otherwise. These measures, given their non-parametric nature, should make the

analysis of differences across countries both more reliable and more insightful than the use of a continuous measure of the impact of the Spanish flu.

In Panel (e), we test different control strategies for our baseline regression. In row (11) we do not include population density as a control in the regression, since population density after 1918 was potentially affected by the Spanish flu epidemic. In row (12) we allow the dummy $Post1918$ to vary differently with respect the country participation to world war II (WWII) by interacting it with a dummy taking value 1 if a country participated in WWII and 0 otherwise. Similarly, in rows (13)-(18) we include as controls a set of interactions between the dummy $Post1918$ and the pre-1918 value of the controls present in the baseline regression, before separately and then all together. The aim of this set of tests is to control for other possible major shocks experienced by some countries in the post-1918 period by allowing the post-1918 fixed effect to vary across different levels of each control variable.

In row (19) of Panel (f) we adjust standard errors for small-sample. Instead, in Panel (g) we run a series of falsification tests for the baseline specification by analyzing other social attitudes that, while correlated with generalized trust, should not have been significantly altered by the Spanish flu pandemic. Specifically, in row (20) the dependent variable is trust in government and in row (21), trust in the army. These measures of trusts are calculated with the same methodology employed to calculate generalized trust as explained in the Supplementary Material, but using different GSS survey questions.

All the tests presented through Panels (a)-(f) show that the coefficient of interest remains significantly negative, while the falsification tests presented in Panel (g) are both not statistically different from zero. These results ultimately confirm the robustness of the main findings: social trust appears to have decreased in countries that were hit the hardest by the pandemic.

Table 5: Robustness Tests

	(1). Coeff.	(2) Std. Err.	(3) R^2	(4) F.S. obs.	(5) S.S. obs.	(6) Countries
Panel (a): Different samples						
1) Excluding Mexico	-0.0094***	(0.0028)	0.570	14,909	34	17
2) No minimum num. of respondents	-0.0137***	(0.0030)	0.538	15,579	38	19
3) Minimum 50 respondents	-0.0163***	(0.0039)	0.776	14,933	24	12
Panel (b): Functional specification						
4) One step estimation	-0.0149***	(0.0029)	0.067	-	15,536	18
5) Logit	-0.0139***	(0.0036)	0.671	15,536	36	18
6) Ordered logit	0.0140***	(0.0032)	0.652	15,536	36	18
Panel (c): Lag L						
7) L = 10	-0.0144***	(0.0040)	0.735	13,273	36	18
8) L = 20	-0.0153**	(0.0059)	0.840	11,526	34	17
Panel (d): Discrete measures						
9) Top 40%	-0.0954*	(0.0484)	0.578	15,536	36	18
10) Top 10%	-0.2617***	(0.0619)	0.673	15,536	36	18
Panel (e): Different control strategies						
11) Excluding Population Density	-0.0144***	(0.0039)	0.660	15,536	36	18
12) WWII*Post1918	-0.0139***	(0.0039)	0.749	15,536	36	18
13) Education*Post1918	-0.0099**	(0.0036)	0.584	15,536	36	18
14) GDP*Post1918	-0.0078*	(0.0041)	0.560	15,536	36	18
15) Polity-IV*Post1918	-0.0082**	(0.0037)	0.558	15,536	36	18
16) Population density*Post1918	-0.0083**	(0.0036)	0.559	15,536	36	18
17) Migration*Post1918	-0.0084*	(0.0040)	0.558	15,536	36	18
18) All interactions	-0.0081*	(0.0043)	0.678	15,536	36	18
Panel (f): Std. Errors correction						
19) Small sample correction	-0.0141***	(0.0036)	0.666	15,536	36	18
Panel (g): Falsification tests						
20) Trust in federal govt.	-0.0030	(0.0023)	0.433	22,793	36	18
21) Trust in military	-0.0043	(0.0025)	0.407	22,820	36	18

Dependent variable: Inherited Trust. Coefficients showed in column (1) refers to the interaction term between $FluMortality$ and $Post1918$ showed in Equation 2, while column (2) reports the standard errors of such coefficients. Column (3) reports the R^2, whereas columns (4)-(6) the number of observations in the first step of the estimation procedure, those in the second one and the total number of countries included i each specifications, respectively. In row 1) we exclude Mexico from the sample countries. In row 2) we don't set a minimum number of GSS respondents for a country to be included in the sample, thus adding Japan. In row 3) we set a minimum of 50 GSS respondents. In row 4) we use a one step procedure for the estimation, while in row 5) and 6) we use as estimation model a logit and an order logit respectively. In row 7) and 8) we test different lags L to separate the pre-1918 and post-1918 GSS respondents groups. In panel d) we adopt discrete measures of flu mortality: in row 9) $FluMortality$ is coded as 1 if a country belongs to the top 40% of the flu mortality distribution while in row 10) if it belongs to the top 10%. In row 11) we exclude population density as a control, while in row 12) we add the interaction between participation to $WWII * Post1918$ as furter control. In rows 13)-17) we separately include the value of each control before 1918 interacted with $Post1918$, and jointly in row 18). In row 19) we adjust standard errors for small sample size. In row 20) we use as dependent variable Trust in the federal government. In row 21) we use as dependent variable Trust in the Army. If not diversely specified, the controls are GDP per capita (PPP), population density, primary school enrollment (%), Polity-IV, migration to US and the interaction between the dummy $Post1918$ and the dummy $Neutral$, which is equal to 1 if the country of origins remained neutral during WWI and 0 otherwise. Standard errors are heteroskedastic-robust. *, **, *** indicate statistical significance at 10%, 5%, and 1% level, respectively.

5. Conclusions

Our analyses suggest that experiencing the Spanish Flu and the associated condition of social disruption and generalized mistrust had permanent consequences on individual behaviour in terms of lower social trust. These mutated individual social traits were inherited by descendants, at least to some significant degree. Our results are in line with recent studies showing how large-scale crises affect individual behavior in a lasting way. This literature, however, has focused on natural disasters, and not on epidemics or pandemics. Moreover, disasters of different kinds also produce different consequences for trust (Skidmore and Toya, 2014; Albrecht, 2017). In other words, not all natural disasters would necessarily reduce social trust. Among those that do, however, earthquakes and floods feature prominently (Skidmore and Toya, 2014; Carlin et al., 2014). Our finding suggests that major pandemics should be added to this list of trust-reducing catastrophes. Although we are unable to undertake similar studies for pre-Spanish Flu pandemics, one can hypothesize that processes of this kind might also have been triggered by other major mortality crises of the past, which would include the medieval Black Death and the severe Cholera pandemics of the nineteenth century. Our findings are fully in line with recent research on the lasting consequences of some of these episodes, consequences that can be felt for several centuries (Richardson and McBride, 2009; Voitgländer and Voth, 2012; Jedwab et al., 2016; Alfani and Murphy, 2017; Jedwab et al., 2019; Koyama and Johnson, 2019). Although our evidence involves a much shorter time period and we do not claim that the effects of the Spanish Flu will be felt centuries from now, our key result has important implications for our understanding of socio-economic development of today's societies. Given the enduring differential in health levels across world regions, and considering the fact that the most recent major epidemics have mostly involved relatively poor countries, one may argue that any forecasting of their future performance should account for the lasting damage to social trust, which has elsewhere been shown to have pivotal impact on the quality of institutions (Knack, 2002) and economic success (Algan and Cahuc, 2010). This feature might be relevant for the African sub-Saharan countries which have been affected by Ebola in recent years, and maybe also for the parts of East Asia affected by the current epidemic of COVID-19. Indeed, during the 2013-16 Ebola epidemic episodes of social mistrust were reported, involving not only those infected but also the survivors who carried a heavy social stigma several months after they had recovered from the disease (Hayden, 2014;

Reardon, 2015; O'Grada, 2016). The trauma suffered caused lingering clinical mental health conditions to the survivors (Reardon, 2015), but the consequences of Ebola and of other severe epidemics and pandemics –both future and past– might be more subtle, last longer, and in the end be more harmful to society as a whole than what can be detected clinically.

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Appendix: Data sources

A.1. Estimation of Inherited Trust in the Home Country

The following list describes all the variables used in the estimation of inherited trust together with their source.

- Trust: Generalized social trust at individual level. It is obtained from the survey question *"Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"*. The variable takes value 1 for the answer *"Can Trust"* and 0 for the answer *"Cannot Trust"* or *"Depends"*. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.

- Trust in federal govt.: Trust in members of the executive branch of the federal government at individual level. It is obtained from the survey question *"As far as the people running the executive branch of the federal government are concerned, would you say you have a great deal of confidence, only some confidence, or hardly any confidence at all in them? "*. The variable takes value 1 for the answer *"A great deal"* and 0 for the answer *"Hardly any"* or *"Only some"*. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.

- Trust in military: Trust in the military at individual level. It is obtained from the survey question *"As far as the people running the military, would you say you have a great deal of confidence, only some confidence, or hardly any confidence at all in them? "*. The variable takes value 1 for the answer *"A great deal"* and 0 for the answer *"Hardly any"* or *"Only some"*. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.

- Country: Country of family origin of the respondent. The survey question is: *"From what countries or part of the world did your ancestors come?"*. The respondent can name up to three different countries, ordered by which one the respondent feels the closest to. We select as country of family origin the country to which the respondent feels the closest to. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.

- Age: Age of the individual. It is the age of the respondent to the GSS survey. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.

- Age^2: Squared age of the survey's respondent. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Protestant: Dummy variable that takes the value 1 if the individual's religious preference is Protestant and 0 otherwise. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Catholic: Dummy variable that takes the value 1 if the individual's religious preference is Catholic and 0 otherwise. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Employed: Dummy variable that takes the value 1 for the answer either *"Working full time"* or *"Working part time"* and 0 otherwise. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Unemployed: Dummy variable that takes the value 1 for the answer to be either *"Temporarily not working"* or *"Unemployed, laid off"* and 0 otherwise. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Immigrant grandparents: Number of respondents' grandparents who were not born in the U.S. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Male: Gender of the respondent. It is coded as 1 if the respondent is male and 0 if female. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Education: Highest year of schooling completed by the individual.The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Income class: The respondent's household total income group. The groups are coded from 1 (less than 1000$) to 12 (25000$ or more). The data is taken from the GSS (General Social Survey) waves 1978 to 2018.
- Second-generation: Dummy variable that takes the value 1 if the respondent is second-generation American and 0 otherwise. We consider as second-generation American who was born in the U.S. with at least one parent and all the grandparents born abroad. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.

- Third-generation: Dummy variable that takes the value 1 if the respondent is third-generation American and 0 otherwise. We consider as third-generation American a respondent who was born in the US with at least two immigrant grandparents and both parents born in the U.S. The data is taken from the GSS (General Social Survey) waves 1978 to 2018.

- Fourth-generation: Dummy variable that takes the value 1 if the respondent is fourth-generation American and 0 otherwise. We consider as fourth-generation American a respondent who was born in the US with more than two grandparents and both parents born in the United States. The data is taken from the GSS (General Social Survey) waves 1978 to 2018. It represents the reference category for the information about the time since the migration of the respondents' ancestors to U.S.

A.2. Inherited Trust and Spanish Flu

The following list describes all the variables used in the analysis of the effect of Spanish flu on inherited trust, together with their source.

- Flu Mortality: Death rate of the 1918-1919 Spanish influenza at country-of-origins level (deaths per thousand inh.). The data are collected from Johnson and Mueller (2002).

- GDP per capita: Gross domestic product per capita in fixed 2005-prices by Purchasing Power Parities at country of origin level. GDP for the pre-1918 period is calculated as the country average for the years 1900 to 1918. GDP for the post-1918 period is calculated as the country average for the years 1919 to 1930. The data are collected from GapMinder.

- Population Density (inhabitants per km^2): Population density at the country of origin level. It is calculated as the number of people that live in a country divided by the area of the country itself. Population density for the pre-1918 period is obtained as the country average of the measures for 1900 and 1910 provided by GapMinder, while for the post-1918 period it is obtained as the country average of the measures for 1920 and 1930 still provided by GapMinder. The data on countries' areas is collected from The World Factobook produced by the U.S. Central Intelligence Agency (CIA).

- Primary school enrollment (%): Primary school enrollment rates at country level. They are calculated as the number of children aged 5-14 enrolled in school divided by the total number of children in the age group 5-14. The data are collected from Benavot and Riddle (1988).

- Polity-IV: The Polity-IV score is a measure of the openness and freedom of a country's political regime. It is computed by subtracting the AUTOC score (that measures the presence of a set of political characteristics that sharply restrict or suppress competitive political participation) from the DEMOC score (that measures the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive). Polity-IV for the pre-1918 period is calculated as the country average for the years 1900 to 1918. Polity for the post-1918 period is calculated as the country average for the years 1919 to 1930. The data are collected from the Center for Systemic Peace.

- Migration to US: Measure of the relative change in the number of people who lived in the United States and were born in one of the sample countries. Migration to US for the pre-1918 period is calculated as the change in immigrants between 1900 and 1910 as a share of the number of immigrants in 1900. Migration to US for the pre-1918 period is calculated as the relative change in immigrants between 1920 and 1930 as a share of the number of immigrants in 1920. The data is obtained from the United States Census of Population and Housing waves 1900, 1910, 1920, and 1930.