CAGE

Epidemics and pandemics: from the Justinianic Plague to the Spanish Flu

CAGE working paper no. 682

September 2023

Guido Alfani

WARWICK
THE UNIVERSITY OF WARWICK

UKRI Economic and Social Research Council

Guido Alfani

Bocconi University, Milan (Italy)

Dondena Centre and IGIER

Stone Center on Socio-economic inequality (New York)

guido.alfani@unibocconi.it

Epidemics and pandemics: from the Justinianic Plague to the Spanish Flu

(the final version of this article is forthcoming in the *Handbook of Cliometrics*, 3rd edition, ed. by C. Diebolt and M. Haupert)

Abstract

This article provides an overview of current knowledge about the economic consequences of major epidemics and pandemics in the long run of history, from the Justinianic Plague of the 540s to the Spanish Flu of 1918-19. For the preindustrial period, the analysis concentrates on plagues (and particularly on the Black Death pandemic of the fourteenth century and on the last great European plagues of the seventeenth), which stand out in the comparison with other epidemics both because of their outsized economic and demographic effects, and for having concentrated the attention of economic historians and other social scientists. For the industrial period, cholera is taken as the main pandemic threat of the nineteenth century. The article concludes analyzing the Spanish Flu, which made the world aware of the danger posed by the influenza viruses – and which is arguably the best term of comparison with the recent Covid-19 pandemic, due to some epidemiological similarities. The article illustrates the short, medium and long-run consequences of the various epidemics and pandemics discussed, and also highlights the importance of the historical context in mediating the impact of any epidemic, against tendencies to generalize from some well-known, but possibly exceptional, cases such as the Black Death. This and other findings teach us some useful lessons for understanding better recent pandemics, like Covid-19, and might help to build preparedness against future threats of a similar kind.

Keywords: epidemics; pandemics; health threats; plague; cholera; influenza; Covid-19; Black Death; Spanish Flu; health inequality

Introduction

The appearance of pathogens able to cause epidemics, or even pandemics, has accompanied the development of human civilization.[1] For a serious epidemic to develop, a certain population density is needed, as by definition an epidemic requires the sustained transmission of an infection across a given population. From the Agricultural Revolution of the Neolithic (ca. 10,000-8,000 years BCE), when the first permanent human settlements appeared, we have evidence that epidemics became a recurring feature of human life. And from the very beginning, they must have had important consequences, which we have difficulty in observing directly for prehistorical societies – but it can be demonstrated that, in these small-scale societies, a serious epidemic might easily have led to the extinction, or at least to the dispersion, of recently-settled human groups (Livi Bacci 2017). When written documentation begins to appear, we immediately get accounts of terrible epidemics, from the "plague of Athens" of 431-426 BCE (whose pathogen remains the object of debate) to "Antonine's plague" of 160-180 CE (probably caused by smallpox) and the "Plague of Cyprian" of 249-270 (probably caused by some sort of hemorrhagic fever). The Bible too makes frequent reference in the Old Testament to terrible epidemics, or to cattle epizootics which could also have dire consequences for an entire population, left without sufficient animal workforce or essential sources of nutrition. Scholars have usually conceptualized these terrible episodes as external ("exogenous") shocks, on a scale able to shake even advanced civilizations and to alter dramatically the course of events. For example, the Plague of Cyprian might have contributed to accelerating the decline of the Roman Empire, at least in the West (Harper 2016; 2017; 2021).

And yet, one of the main actors, in the long-running drama of human brushes with deadly pathogens, had not even appeared on the scene. *Yersinia pestis*, the bacterium responsible for bubonic plague (in the following, the word "plague" will be used in this stricter meaning), caused its first known pandemic in the 540s: the "Justinianic Plague", whose spread and consequences will be briefly discussed at the beginning of the next section – before focusing on the fourteenth-century Black Death, which was probably the worst pandemic of preindustrial times. After this event, for centuries the plague remained a recurring feature of the Old World, shaping deeply its society, its economy and its culture, and in this sense, the Black Death initiated an "Age of Plague". This will also be the real starting point of our analysis: as from the fourteenth century, the surviving evidence allows us to analyze much more systematically the complex consequences that major epidemics and pandemics could have, in the short, medium and even in the long run. The main focus will be on the economic

[1] I am grateful to Monica Green for many helpful comments.

consequences, as is proper for this *Handbook of Cliometrics* – but without forgetting the additional social, demographic, political and cultural consequences, insofar as they also affected the economic sphere.

Bubonic plague was surely not the only pathogen able to have relevant economic consequences in a preindustrial setting. And yet, from the late Middle Ages to the turn of the eighteenth century it was the one which had the largest economic impact, and by far. For this reason, it has focused the attention of scholars and consequently will also feature prominently in this article. The situation changes entirely when we enter the industrial world, not only because by then the plague was in full retreat (at least in the West), but also because new pathogens appeared which spread globally thanks to the new transport systems which the Industrial Revolution itself had made available, beginning with cholera. While remaining clearly under-studied, cholera has nevertheless been the object of some recent historical-economic research and will be taken as a characterizing pandemic infection of the nineteenth century. It also had a major impact, not only directly, but also through the large-scale changes in institutions and in the urban environment that it triggered. By the end of the nineteenth century, cholera had become a relatively minor threat – precisely when a new character came on scene: influenza, which caused the terrible global pandemic known as "Spanish Flu" during 1918-19. Since then, the continuous emergence and rapid spread of new influenza viruses has become a common feature of human life. This also caused considerable worries, as many expected that some sort of influenza virus would one day cause the first serious global pandemic of the twenty-first century: only to be taken by surprise by Covid-19 (caused by a coronavirus). The article will conclude with some considerations about the historical meaning of this turn of events.

Before proceeding, it is necessary to clarify some key epidemiological concepts which will be used throughout the article. First of all, we need to distinguish properly between "epidemics" and "pandemics". Epidemics occur when cases of a given infectious disease become more widespread in a population at a particular time with respect to its long-term prevalence in that same population. Pandemics are epidemics that spread across multiple continents, or even worldwide (Last 2001). Crucially, pandemics do not differ from epidemics because of the number of victims that they cause, but because of their broader spread across the world. The medieval Black Death was a pandemic, but so was the Swine Flu of 2009-11 notwithstanding its very low case fatality rate and overall mortality rate. Some other recent episodes, such as the Ebola epidemic of 2013-16, did not develop into pandemics because, notwithstanding their ability to kill many in the areas affected, they failed to spread much further beyond the original areas of infection. Ebola is also a good example of a highly lethal infection (as measured by the case fatality rate, that is, the percentage of infected people who

die) that, so far, has caused fairly low overall mortality rates (the percentage of the overall population who die) even in the worst-affected countries. This, because mortality rates result not only from the lethality of the infection, but also from its infectiousness: its ability to spread across the population. So, the same mortality rates can result from different combinations of case fatality rates and of infection rates (the percentage of the overall population who become infected, without consideration of how many survive and how many die). As will be seen, some highly infectious pathogens, like for example the influenza virus which caused the Spanish Flu, were able to cause vast numbers of deaths even if their associated case fatality rates were relatively low. The mortality rates and the infection rates are some of the key determinants of the economic consequences of a pandemic or epidemic, although their impact is mediated by a much broader range of contextual factors – sometimes leading to results which would have been difficult to foretell based on previous experiences.

1. The Age of Plague

In year 541 of the Current Era, a terrible infection began to spread in northern Egypt. Whence it came remains unclear, but possibly it had reached Egypt through the Red Sea trade routes. We know more about its further diffusion, first to the Levant, then to the rest of the Mediterranean, Asia Minor and Europe. In 542 Constantinople, the capital of the Byzantine Empire, was struck, during the reign of Emperor Justinian I: hence the name, Justinianic Plague, commonly given to this, which is the first known epidemic caused by *Yersinia pestis*. Although *Yersinia pestis* is a relatively young bacterium, which probably evolved from its mostly harmless ancestor, *Yersinia pseudotuberculosis*, only about six to seven thousand years ago, it must have existed in proximity to at least some human groups for many centuries before the Justinianic Plague (after all, the early genetic evidence collected so far comes from human remains) – but it did not cause any outbreak of which we have evidence, and almost certainly nothing on a scale comparable to the pandemic of the 540s. This might be due to environmental factors, as the spread of *Yersinia Pestis* depends crucially upon the population of rodents which are its normal animal reservoir (Green 2020, pp. 1602-1605; 2022a; Harper 2021, pp. 204-8).[2] In fact, *Yersinia pestis* primarily affects rodents, such as gerbils or rats, involving human beings only when an epizootic is well underway, through the rodent's fleas desperate to find another source of nourishment. At that point, however, in a preindustrial setting transmission human-to-

[2] The "animal reservoir" of an infection agent is composed of any animal species where it normally lives and multiplies, and from which under appropriate circumstances it can be transmitted to a human population potentially originating an epidemic (Last 2001).

human (possibly involving human parasites) must have been relatively easy, otherwise we struggle to explain the rapid spread of the infection during major epidemics (Whittles and Didelot 2016; Alfani and Murphy 2017, pp. 321-322; Alfani and Bonetti 2019).

We now have solid paleo-biological evidence that the Justinianic Plague was caused by *Yersinia pestis*. We also have written accounts of the pandemic from first-hand witnesses who describe the typical swellings, the buboes, which appeared on various parts of the body of the diseased. But in other respects, our knowledge of the Justinianic Plague remains limited, including regarding the number of victims. These might have been up to 25–50 million across Europe and the broader Mediterranean area (Little 2007; Horgan 2014; Harper 2016), in a pandemic spread that reached even England in the northwest and possibly Ireland as well (Dooley 2007, pp. 215–16; Harper 2021, pp. 214-5). If these numbers are even remotely close to the mark, by death toll the Justinianic Plague might have been the third-worst pandemic in human history, after the Black Death and the Spanish Flu (Table 1). The associated mortality rates were extreme, up to 50% in the worst-affected areas such as Egypt. This would explain the major consequences that some have attributed to this pandemic. It might have doomed Justinian's project to "renew" the Roman Empire (*renovatio imperii*), and weakened the state military and fiscal capacity of Byzantium for generations (Sarris 2002; 2022; Little 2007). In Egypt, the economic consequences of the plague were very negative (Harper 2016). More generally, in much of Europe and the Mediterranean it might have caused a long-lasting contraction of trade, the demographic and economic decline of cities, and an overall wave of «economic simplification» (Harper 2021, p. 217). Some positive consequences are also possible, such as a sizeable increase in real wages in at least some areas (Alfani 2022, pp. 10-11). The supporting evidence is admittedly very limited, and indeed, some recent studies have argued that the demographic and economic impact of the Justinianic Plague is vastly over-stated (Mordechai and Eisenberg 2019), but these revisionist views have been strongly criticized for being even less in agreement with the available information (Sarris 2022). Only from the medieval Black Death do we have the opportunity to observe the consequences of a major plague in a relative wealth of detail.

Table 1. Major lethal epidemics of the preindustrial world

	Infection	Regions affected	Estimated death toll	
			Victims (millions)	Mortality rate (% of pop. killed)
Epidemics of Late Antiquity				
160-180 – Antonine 'plague'	Smallpox (supposed)	Roman Empire		10-30%
249-270 – 'Plague' of Cyprian	Hemorrhagic fever (supposed)	Roman empire		15-25%
Plagues (main and well-documented)				
540-541 (possibly up to ca. 550 in northern Europe) – Justinianic Plague[a]	*Yersinia pestis*	Europe, Mediterranean	Up to 25-50 overall	25-50%- overall (50% in Egypt and other densely-populated areas)
1346-1352 – Black Death	*Yersinia pestis*	Europe, Mediterranean, Middle East, central Asia, possibly parts of China and other areas	Up to 50 in Europe and the Mediterranean; unknown elsewhere	35-60% in Europe and the Mediterranean; unknown elsewhere
1356-1366 – *pestis secunda*	*Yersinia pestis*	Europe, Mediterranean, Middle East	Up to 5-10 in Europe and the Mediterranean; unknown elsewhere	15-20% in Europe and the Mediterranean; unknown elsewhere
1625-1632	*Yersinia pestis*	Most of central and western Europe (areas spared include most of Spain and central-southern Italy)	Up to 2 in northern Italy; up to 1.15 in France; up to 0.25 in Switzerland; up to 0.16 in the Dutch Republic; unknown elsewhere	30-35% in northern Italy, 20-25% in Switzerland; 20-25% in South Germany, Rhineland and Alsace (up to 40% if also victims of famines and of the Thirty Years' War are included); 8-11% in the Dutch Republic; unknown elsewhere
1647-1657	*Yersinia pestis*	Andalusia, Spanish Mediterranean and central-southern Italy	Up to 1.25 in the Kingdom of Naples; up to 0.5 in Spain; up to 0.33 in France; unknown elsewhere	30-43% in the Kingdom of Naples; at least 25% in Andalusia; 15-20% in Catalonia; unknown elsewhere
Other extreme epidemiological events of the early modern period				
1492-1650[b] – Columbian exchange (Old to New World)	Smallpox, typhus, measles, influenza, etc.	American continent		Up to 80-90% in the first century (cumulated effects of different epidemics, confounded with the direct impact of colonization)
1492-1550[c] – Columbian exchange (New to Old World)	Syphilis	Europe, Asia	Up to 2-5 in Europe[d]; unknown elsewhere	Up to 4-5% in Europe; unknown elsewhere

Sources: Alfani and Murphy 2017, with some updates and integrations based on the sources cited in the main text.

Notes: [a] figures for the Justinianic plague refer to the initial outbreak only, not to the outbreaks which occurred in the following two centuries (see note n. 2 for clarifications); [b] following colonization epidemics repeated regularly for centuries where population was

not entirely eradicated, yet the larger demographic toll took place roughly in the first 150 years; [c] after the mid-sixteenth century, syphilis mutated towards a less aggressive disease; [d] Given the scarcity of information, the victims of syphilis are a very uncertain upper boundary only; see Alfani and Murphy 2017 for a discussion of the possible impact that syphilis had in Europe.

1.1. The Black Death of 1346-52

After the terrible outbreak of the 540s, for two centuries plague remained endemic in Europe, the Mediterranean and the Middle East, resurfacing regularly to cause terrible, although much more localized, epidemics.[3] And then, around the middle of the eighth century it disappeared and was almost entirely forgotten in Europe, while medical knowledge about it was preserved by the Islamic tradition (Green 2020). This is why, when in 1346 it manifested itself again along the shores of the Black Sea, it took everybody by surprise.[4] In l347, traveling by ship, the plague spread to Byzantium, north Egypt, south Italy and southern France. In the following year it went much further, causing a wave of panic across Europe and the Mediterranean and the virtual collapse of institutions and society. The overall mortality rate was in the range of 35-60%, the largest so far for any pandemic in history. Across the Euro-Mediterranean area the death count might have been as high as 50 million, but many others must have died in the Middle East and in central Asia, and possibly in parts of China and sub-Saharan Africa, although for these latter territories the evidence remains scarce (see Green 2020, pp. 1603-5 for a survey). Equally debated remain the origins of the Black Death. A recent study based on new paleo-biological evidence suggests that it began in Kyrgyzstan in Central Asia in the late 1330s (Spyrou et al. 2022). Others, however, based on phylogenetic analysis, have argued that, genetically, the "Black Death" might have begun much earlier: in the early thirteenth century, when four new branches of *Yersinia pestis* developed, later spreading to Europe and the Mediterranean, central Eurasia and China. Of these, only Branch 1 spread to Europe, so that, globally, it might be more appropriate to talk about «four Black Deaths: four explosive proliferations of *Yersinia pestis* into new environments» (Green 2020, p. 1603). While in some world areas these new branches of

[3] Note that most scholars use the definition of "Justinianic plague" to indicate a *series* of plague outbreaks, from 541 until ca. 750 (Little 2007). This period is also sometimes referred to as that of the plague "First Pandemic". This refers to a traditional classification used in plague studies which sees the Black Death of 1346-52 as the first episode of a "Second Pandemic" of plague, also composed of a series of outbreaks spanning the entire early modern period. A "Third Pandemic" began in the Chinese province of Yunnan in the nineteenth century and continues to this day. However, this terminology, which is plague-specific, will not be used here because it is at odds with the current definition of "pandemic" (see the Introduction), which can be applied to *any* pathogen allowing for the kind of broad comparisons which are attempted here.

[4] According to a well-known account by chronicler Gabriele de' Mussi, plague first appeared at the Genoese colony of Caffa in the Crimean Peninsula, then besieged by a Mongol army which might have carried the infection from central Asia to the Black Sea – and purposefully infected the city by hurling with trebuchets corpses beyond the city walls. This account, however, is probably fictional, and according to recent studies plague might have reached the Mediterranean with shipments of grain coming from the city of Tana, also in the Black Sea area (Barker 2021).

plague might have caused serious epidemics well before the fourteenth century (like in Baghdad in 1258: Fancy and Green 2021), the chronology of the spread of plague to Europe would not change. This is why, in agreement with the previously-introduced definition of pandemic (which is primarily epidemiological, not genetic), this article will stick to the traditional definition of the outbreak which began its catastrophic spread in 1346 as "the" Black Death.

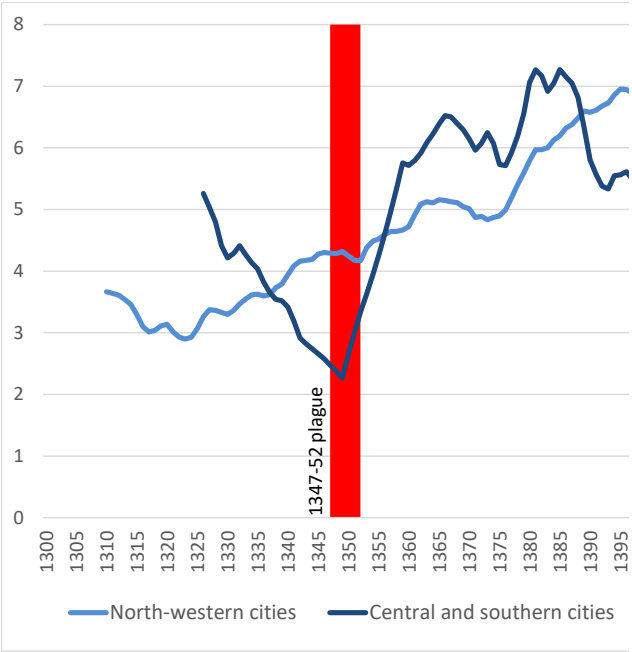
The debate about the origin of the Black Death can reasonably be expected to continue for years to come. Fascinating as it is, however it is of limited import for analyzing the long-run consequences of the pandemic in the areas for which the best documentation has survived: Europe and the Mediterranean. There is no doubt whatsoever that, in these areas, the short-term economic consequences of the Black Death were very negative: it brought to a stop many productive activities, trade and other commercial activity. Disruption of trade networks and the associated increase in transaction costs damaged more the most commercialized and specialized segments of the Medieval economy (Jedwab, Johnson and Koyama 2022, pp. 143-4), with a tendency to induce economic simplification –similarly to what might have happened after the Justinianic Plague, as seen above. The horrific human losses also imply the loss of knowledge, skills and competences on a vast scale. And yet, most narratives of the consequences of the pandemic tend to focus on the long run, and to suggest a dramatically different scenario of generally positive effects.

A first point to highlight is that the survivors enjoyed a sharp re-balancing of population and available resources. In much of Europe this helped to provide a solution of sorts to a situation which, by the start of the fourteenth century, had become precarious as shown by the relatively high frequency of terrible famines, such as the so-called "Great Hunger" of 1315-1317 (Alfani and Ó Gráda 2018). In a sense, the Black Death created a window of opportunity which was used to achieve a reorganization of agricultural production towards greater efficiency and productivity (Herlihy 1997; Dodds and Britnell 2008), although some aspects of this overall process of change had already begun before the pandemic (regarding for example the reorganization of the settlement pattern and the related abandonment of many villages. Dyer 1982). We also have substantial evidence that the Black Death caused sizeable increases in real wages (Pamuk, 2007; Fochesato, 2018), which can be taken as indicative of substantial improvements in standards of living (Figure 1, Panel A). While some earlier literature had argued that the Black Death triggered a sort of "golden age of labour", most medievalists today consider this an exaggeration. And yet, there is little doubt that, thanks to the pandemic, «improved living conditions for the lower ranks of wage earners was a memorable characteristic of the late medieval economy» (Dyer 2015, p. 195) and this, notwithstanding the direct attempts of governments across Europe to contain wage increases, through decrees "against the

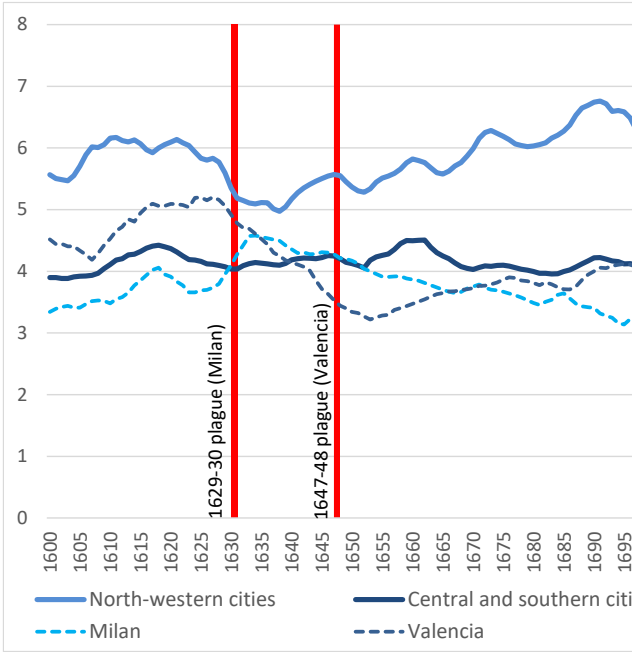
workers" (*contra laboratores*), or at least against their requests which urban elites deemed unreasonable, especially when they came from rural workers (Cohn 2007; Alfani and Murphy 2017, p. 335; Jedwab, Johnson and Koyama 2022, p. 143).

Figure 1. Real wages of unskilled workers in European cities, 1300-1400 and 1600-1700 compared (in grams of silver)

A. Real wages and the Black Death



B. Real wages and the plagues of the 17th C.



Sources: Alfani 2022, based on data from Fochesato (2018).

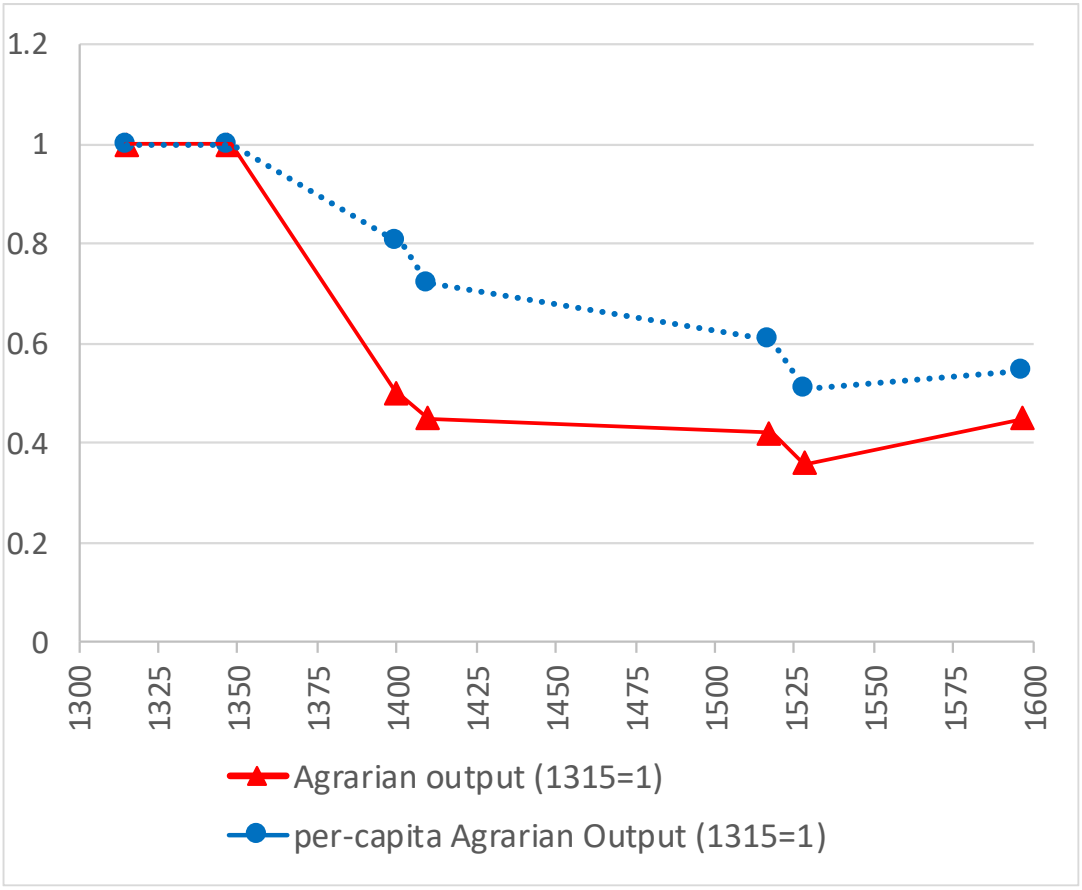
The fact that, after the first terrible outbreak of 1346-52, plague remained endemic in Europe and the Mediterranean leading to a long string of subsequent epidemics of various intensity helps to explain why some of its immediate effects could continue to operate for a long time. Arguably, plague led to the establishment in Europe of a new "high-mortality, high-income" equilibrium which allowed for quicker economic development through a variety of mechanisms (Clark, 2007; Voigtländer and Voth, 2013; Campbell, 2016). This might also have contributed to trigger the rise of western Europe over the most advanced Asian economies, in the process known as "Great Divergence". Paradoxically, these economies might have been disadvantaged in the long run because they were spared (Japan) or only lightly affected (China) by the Black Death and by the recurrent plagues that followed it, remaining stuck in a "low-mortality, low-income" equilibrium (Clark, 2007). Even more paradoxically, this relatively low prevalence of plague might be the consequence of some "positive"

feature of Asian societies, such as higher hygiene standards than the European, especially in cities, which led to lower disease mortality overall (Voigtländer and Voth, 2013, p. 780). And yet, until a few years ago the information that was available about the actual prevalence of plague in East Asia was extremely limited, and potentially misleading. According to recent studies, the actual demographic damage caused by plague in China during the late Middle Ages and beyond might have been significantly greater than has usually been assumed (Hymes 2015). But even had the demographic impact of the Black Death (or of plague more generally) been similar in Europe and China, the latter might have suffered from a context which prevented it from benefiting from the shock. The so-called "Mongol interlude", which overlapped with the Black Death period, might have compromised the institutional framework that had led to relatively high per-capita incomes in earlier epochs (Broadberry, 2013).

The hypotheses about the different economic consequences of plague in Europe and East Asia remind us that the effects of a pandemic or of an epidemic shock are mediated by the context (institutional, environmental…) in which it takes place, and consequently we should be wary of easy generalizations. The general ability of this kind of shock to produce asymmetric consequences should also be highlighted (Alfani 2020a). Even within Europe, the historical experience of some areas departs from the "general" story of long-term positive economic consequences of the Black Death traced above, not because of differences in mortality rates, but in the conditions in place at the onset of the crisis. In Spain, which at the beginning of the fourteenth century was a relatively under-populated area, the pandemic destroyed the equilibrium between scarce population and abundant resources upon which a prosperous kind of trade-oriented "frontier economy" had been built. As a consequence, it interrupted a phase of quick growth that had been ongoing for 70-80 years; the pre-plague levels in per-capita income were not recovered before the late 16th century, and then only temporarily (Álvarez Nogal and Prados de la Escosura, 2013; Álvarez Nogal, Prados de la Escosura and Santiago Cabalero 2020). The case of Ireland might have been similar, but doubts remain due to the paucity of surviving documentation for that period (Kelly, 2001). One way of looking at the cases of both Spain and Ireland is that there, due to their relative underpopulation, the general wave of economic simplication brought forward by the plague was more severe and long-lasting than elsewhere. In Eastern Europe, according to some the Black Death contributed to foster the so-called "second serfdom", as lords tried successfully to coerce the now-scarce workforce (Domar 1970). Although some have challenged this hypothesis based on historical evidence (Dyer, 1998: 111), in recent years it has been the object of many studies which renewed the debate and clarified how the Black Death impacted on the conditions of rural workers and on labour markets, possibly acting as a

powerful source of divergence beween Western and Eastern Europe (see for example Acemoglu and Robinson 2013, pp. 100–101, and Jedwab, Johnson and Koyama 2022, pp. 162-4 for an updated synthesis). Beyond Europe, we have strong evidence that the pandemic proved very damaging to Egypt, as rural depopulation hindered the maintenance of a sophisticated irrigation system, which finally collapsed, remaining for centuries in a precarious condition made worse by local crashes (Borsch, 2015). This led to a large and permanent drop in agrarian output, as seen in Figure 2.

Figure 2: The Black Death and the economic collapse of Egypt (total and per-capita agrarian output, 1300–1600).



Source: Alfani and Murphy (2017), based on data by Stuart Borsch (2005; 2015)

A final branch of the literature about the economic consequences of the Black Death concerns its distributive impact, and in particular its ability to produce a substantial reduction in both income and wealth inequality. Unfortunately, based on the surviving historical sources, it is impossible to observe directly the impact that the pandemic had on income inequality – but the information that we have available about real wages strongly suggests that the conditions of wage-earners improved

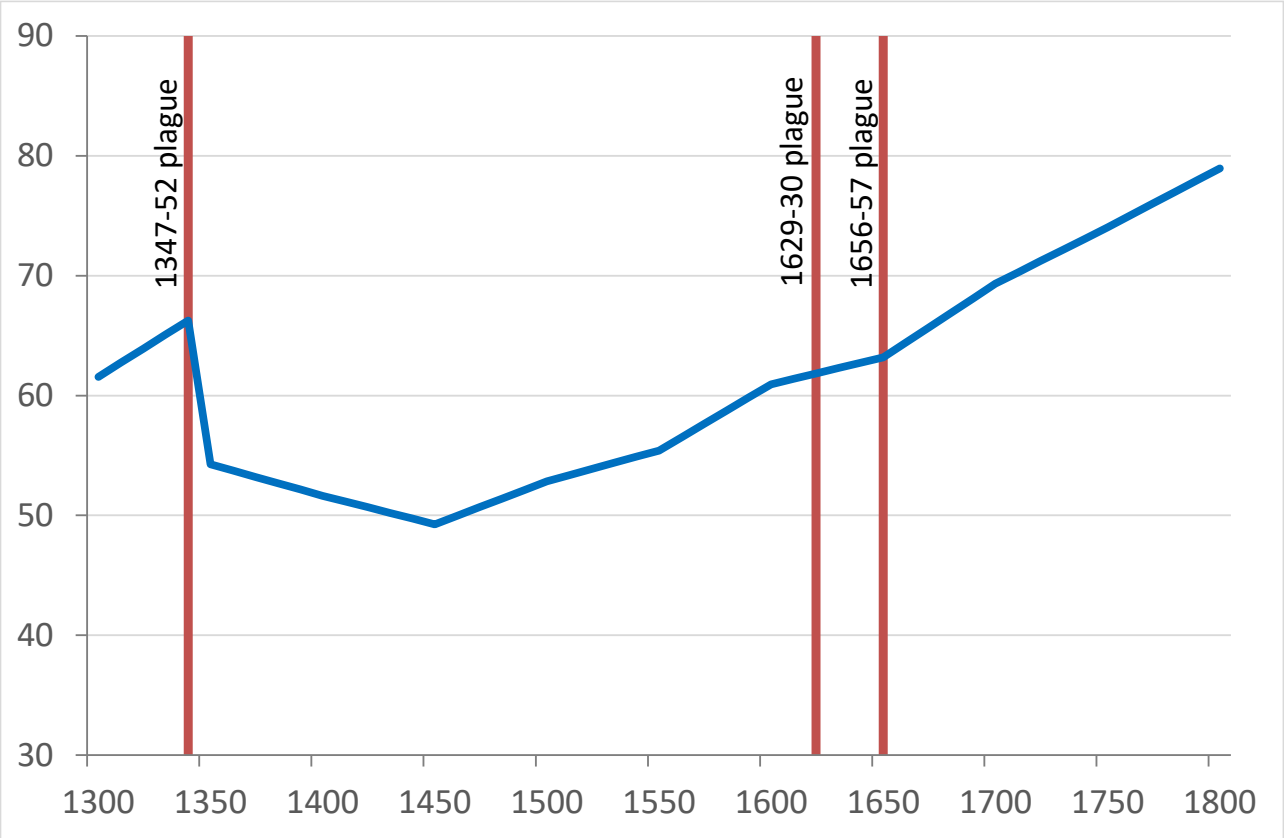
relative to landowners and to other well-off strata of society. We have much better information about wealth inequality, which can be observed "directly" by careful analysis of fiscal sources. These provide us with reliable data about the household-level distribution of taxable properties, among which real estate featured prominently (in preindustrial and mostly agrarian societies land was the main component of wealth). The evidence that has been collected so far, covering various parts of Italy, South France and Germany, univocally supports the view that the Black Death had a strong leveling impact on the wealth distribution (Alfani 2015; 2021; 2022; 2023; Alfani and Ammannati 2017; Alfani, Gierok and Schaff 2022). In Italy, where the best documentation survived, in the aftermath of the Black Death the richest 10% of the population lost their grip on between 15% and 20% of overall wealth, as seen in Figure 3. This decline in inequality was long-lasting, as wealth concentration did not reach the pre-Black Death level again before the second half of the seventeenth century.

There were two main causes of the reduction in wealth inequality. First, in the aftermath of the plague labour became scarce and the poorest strata enjoyed a boost to their bargaining power and were able to negotiate better conditions – increases in real wages reflect this situation, as seen above. Larger real incomes allowed the poorest strata to acquire property for the first time, or to expand their meagre holdings. The second inequality-reducing mechanism was the fragmentation of large patrimonies caused by extremely high mortality in the context of the partible inheritance system which in the late Middle Ages characterized many European areas. This resulted in many people inheriting more properties than they needed or wanted, and in an unusual abundance of property being offered on the market. Together with higher real wages due to the scarcity of labour, this situation helped a larger part of the population gain access to property, thus reducing wealth inequality (Alfani 2021; 2022).

Based on the example of the Black Death, the view that pandemics had the power to (brutally) level inequality has become quite widespread (Milanovic 2016; Scheidel 2017). However, there are good reasons to doubt that what was found for the Black Death can be generalized to other pandemics or epidemics, even catastrophic ones. Also in this case, the conditions in place at the onset of the crisis are of crucial importance to determine the impact of an epidemic – and indeed, Spain is again the main example of a European area which might have moved in the opposite direction compared to the rest of the continent, as there it has been argued that instead of reducing, income inequality increased after the Black Death (Álvarez Nogal and Prados de la Escosura, 2013), although admittedly this conclusion is based on relatively indirect information. Maybe more importantly, in early modern times, when certain parts of Europe, especially in the South, were affected by the worst plagues after

the Black Death, cases of significant inequality reduction appear to have been the exception, not the rule: as is discussed in the next section.

Figure 3 The share of wealth of the richest 10% in Italy, 1300-180



Source: elaboration based on Alfani (2021)

1.2. From the late Middle Ages to the early modern times

After the Black Death, epidemics of plague became a regular occurrence across Europe and the Mediterranean. Already in summer 1356, the outbreak known as *pestis secunda* (or "the second plague", as it was referred to by contemporaries) began to spread out of Central Germany and in the following years it covered Europe, northern Africa and the Middle East (alternative reconstructions place the point of origin of this outbreak in Russia, or argue for a polycentric genesis leading to overlapping waves of infection). Mortality rates, while much lower than those of the Black Death, were reportedly catastrophic: 15-20% of the overall population might have died (5-10 million victims

across Europe and the Mediterranean: Table 1), although admittedly these estimates are even more uncertain than those available for the Black Death.[5] This is because, despite a recent burst of research (Slavin 2021; Green 2022b), we know little about this epidemic, a situation which also characterizes subsequent medieval plagues (see Cohn 2008 for a useful synthesis concerning these events). Studies of their specific economic impact are almost entirely lacking. There is only a general awareness of the fact that these recurring plagues contributed to keeping the population at relatively low levels – which is crucial to understanding why the re-balancing effect of the Black Death could be so long-lasting. In other words, some of the long-term economic (and demographic, social, cultural…) effects that are traditionally attributed to the Black Death alone were in fact the compounded result of a series of plagues.

This situation began to change from the mid-fifteenth century, when a progressive decline in the severity, in the geographic extent and in the frequency of plagues allowed for a return to population growth across the European continent. The plagues of the late fifteenth and the sixteenth century are considerably better-known compared to the immediate post-Black Death outbreaks, especially regarding their demographic and social-cultural consequences (for example, Biraben 1975; Slack 1985; Cohn 2009). Their economic consequences have attracted much less attention, probably because these more local events also tended to have a more local, and more transient, impact on economies (see Alfani 2013a for a synthesis). Until recently, this relative neglect also characterized the seventeenth-century plagues, but things have begun to change in recent years: as these, which were the last great outbreaks of plague in Europe, have been attracting increasing attention both because of the vast consequences that they seem to have had in the south of the continent, and because, notwithstanding their severity which locally could reach a scale comparable to the Black Death, they had deeply different, and in the long run overall negative, economic effects.

The worst of these seventeenth-century plagues spread across central Germany from 1625-26 and thereafter moved south covering, by 1628-29, the area comprised between Bavaria and Switzerland to the east, and the Pyrenees to the west (Eckert 1996; Alfani 2013b). Until 1629, the medical authorities of the Italian states managed to keep it out of the Peninsula, probably thanks to the efficient application of a sophisticated mix of anti-epidemic interventions and policies. These included health controls at river and sea harbours, at mountain passes, and at political boundaries. Within each Italian

[5] In some specific areas, like Hainaut and the southern Netherlands, the *pestis secunda* might have killed a larger percentage of the population than the Black Death, possibly because the first outbreak in 1348 had been relatively mild (Roosen and Curtis 2019). The *pestis secunda* is also known to have affected in a very severe way the few regions of Europe which had been mostly spared by the Black Death, such as Lombardy in northern Italy.

state, infected communities or territories were isolated. Within each infected community, human contact was limited by quarantines and other temporary restrictions on the freedom of movement (Cipolla 1981; Alfani and Murphy 2017; Henderson 2019; Alfani, Bonetti and Fochesato 2023). All these public health measures and policies (which remain crucial components of today strategies to contain pandemics) had been developed in the centuries following the Black Death and indeed, institutional adaptation constitutes a characterizing feature of human reactions to changes in the biological environment like that caused by the return of plague to Europe. However, not always do the best anti-pandemic policies prove successful. In Italy, in October 1629, they finally failed, but not because they were inefficient: plague crossed the Alps with infected armies coming from France and Germany to fight in the War of the Mantuan Succession (1627-31), and it would have been impossible to impose a quarantine on an enemy army. After that, mortality rates reached a scale probably unseen from the time of the Black Death, maybe also as a side-effect of the earlier successes of the Italian health authorities:

«arguably the main achievement of the Italian health authorities was to make the Peninsula free of endemic plague from the mid-sixteenth century. There is clear historical evidence that all subsequent outbreaks were due to re-introduction of the infection from the outside, usually by war or trade. (…) This might have been a mixed blessing. When war brought the plague back to Italy in late 1629, the Peninsula had been plague-free for decades and some areas had not experienced any plague since the end of the Italian Wars (1494-1559). As a consequence, the vast majority of the population had never been in contact with the pathogen, which may help to explain why this European plague wave proved exceptionally harmful to the Italian population» (Alfani and Murphy, 2017, p. 329).

Whatever the reasons for the horrifically efficient spread of the plague in northern Italy (possibly matched in other parts of southern and central Europe such as Germany and south France, where this is also considered to have been the worst plague after the Black Death), the fact remains that this area was infected pervasively, save for Liguria and some parts of Piedmont to the west, and parts of Friuli to the east. All major cities were affected, as well as most rural communities, in contrast to plague outbreaks from the late fifteenth century through the sixteenth which seem to have affected mostly urban populations sparing rural dwellers. It has been estimated that excluding Liguria, a northern Italian city had just a 5% chance of being spared the plague in 1630, while a rural community had a 7% chance (Alfani 2013b, p. 420). This high territorial pervasiveness went hand in hand with exceptionally high overall mortality rates: an estimated 30-35% of the entire population of northern

Italy was killed, or about two million victims. An additional 1.5 million died in France, 250,000 in Switzerland, 160,000 in the Dutch Republic, and unknown in Germany and elsewhere (see Table 1).

Recent literature has argued that the plague of 1629-30 and that of 1656-57 which spread to precisely those Italian regions that had been spared by the first outbreak (as well as severely affecting other southern European areas, and particularly Spain, during the decade from 1647 to 1657: Alfani 2013b) might have acted as threshold events, contributing in a decisive way to the so-called "Little Divergence" between northern and southern Europe. This, because they struck at the worst possible moment, that is when southern economies, and in particular the advanced Italian economies, faced growing economic competition from north Europe, partly due to the opening of the Atlantic trade routes. In this context, which was also one of rampant mercantilism, damages to the labour force and the sharp contraction in domestic demand due to large population losses prevented a quick recovery, and might also have led the Italian economic elites to cut their investments in trade and in manufacture in favour of more conservative investments in land (Alfani 2013b; Alfani and Murphy 2017; Alfani and Percoco 2019). At the other extreme of the continent, even if plagues were recurrent during the seventeenth century (for example, London was affected by four distinct plague waves between 1600 and the last episode, the well-known "Great Plague" of 1665-66), they remained similar to the sixteenth century outbreaks in mostly affecting cities. As a result, their cumulative effect was only a fraction of that suffered by north Italy during little more than one year of epidemic, and human losses to the urban population could be replaced easily by means of substantial migration from country to city. Indeed, the total number of victims suffered by England during the many plagues that affected it in the seventeenth century represents only 8-10% of the population in 1600, which is dwarfed by the 30-35% mortality caused by the 1629-30 plague alone in north Italy, and the 30-43% of South Italy in 1656-57 (Alfani 2013b, p. 411). In the context of seventeenth-century Europe, these asymmetries in the demographic impact of plague appear to have been the source of an asymmetric economic impact across the continent (Alfani 2020a). Note that this is different from the case of the Black Death, when a fairly *homogeneous* demographic impact of the plague led to asymmetric economic consequences because of differences in the pre-plague situation (see Section 1.1).

We have some direct evidence of a negative and long-lasting economic impact of the seventeenth-century plagues on southern European economies in the damage done to the production of manufactured goods, especially in the textile sector (Alfani 2013b, pp. 425-6), and in the decline in urbanization rates (Alfani 2020a, pp. 204-5). Equally important is the lack of evidence concerning the same kind of positive effects that have been attributed to the Black Death. In North Italy, real wages did not increase after the 1630 plague killed one-third of the workforce – indeed, based on a

recent study (Alfani and Percoco 2019, pp. 1195–1196), the only northern Italian city where we have some evidence of increasing real wages was Genoa, which however was also the only major city of the area spared by plague in that year. As can be seen in Figure 1 (Panel B), in Milan, where an estimated 46% of the population died in 1630, the real wages of unskilled workers do not show a tendency towards an increase, and the same is true for Valencia in Spain after the plague of 1647-48 which killed over 30% of the local population. This episode belongs to the same outbreak which spread to Italy during 1656-57; for that epidemic, a recent study of real wages in Rome did not detect any increase. On the contrary, real wages of both skilled and unskilled workers declined quite significantly after the plague (Rota and Weisdorf, 2020). More generally, as shown by Figure 1 (compare Panels A and B), in the seventeenth century a greater intensity of plague in the South compared to the North of the continent did not result in a relative boost to real wages (and living standards), in stark contrast to what was the case for (most of) Europe after the Black Death.

Another possible positive consequence of severe pandemics which was absent (or was at least very limited and short-lived) after the seventeenth-century plagues in Italy is inequality reduction. A first point is that the trends in real wages discussed above strongly suggest that these epidemics did not lead to leveling in the income distribution (also see Alfani 2022). As with the Black Death, we can observe the distribution of wealth much more directly than that of income by means of fiscal records of taxable property. Recent studies have demonstrated that, across many European areas which were badly affected by the seventeenth-century plagues, including different Italian states, southern France and north-eastern Spain, these epidemics f ailed to cause any substantial and long-lasting decline in wealth inequality (Alfani 2010; 2015; 2021; 2022; 2023 Alfani and Di Tullio 2019); Figure 3 shows the general picture for Italy. So far, the only European area where the occurrence of severe plagues in the seventeenth century seems to have been associated with wealth inequality decline is Germany. There, however, the demographic and economic effects of the 1627–1629 plague could not be easily disentangled from those of the Thirty Years' War (1618-48). This was the most devastating conflict of preindustrial Europe, and it seems certain that it was the combined effect of a terrible plague and a terrible war which triggered a phase of inequality reduction which continued throughout the century, making the German area stand out from all others for which we currently have information (Alfani, Gierok and Schaff 2022).

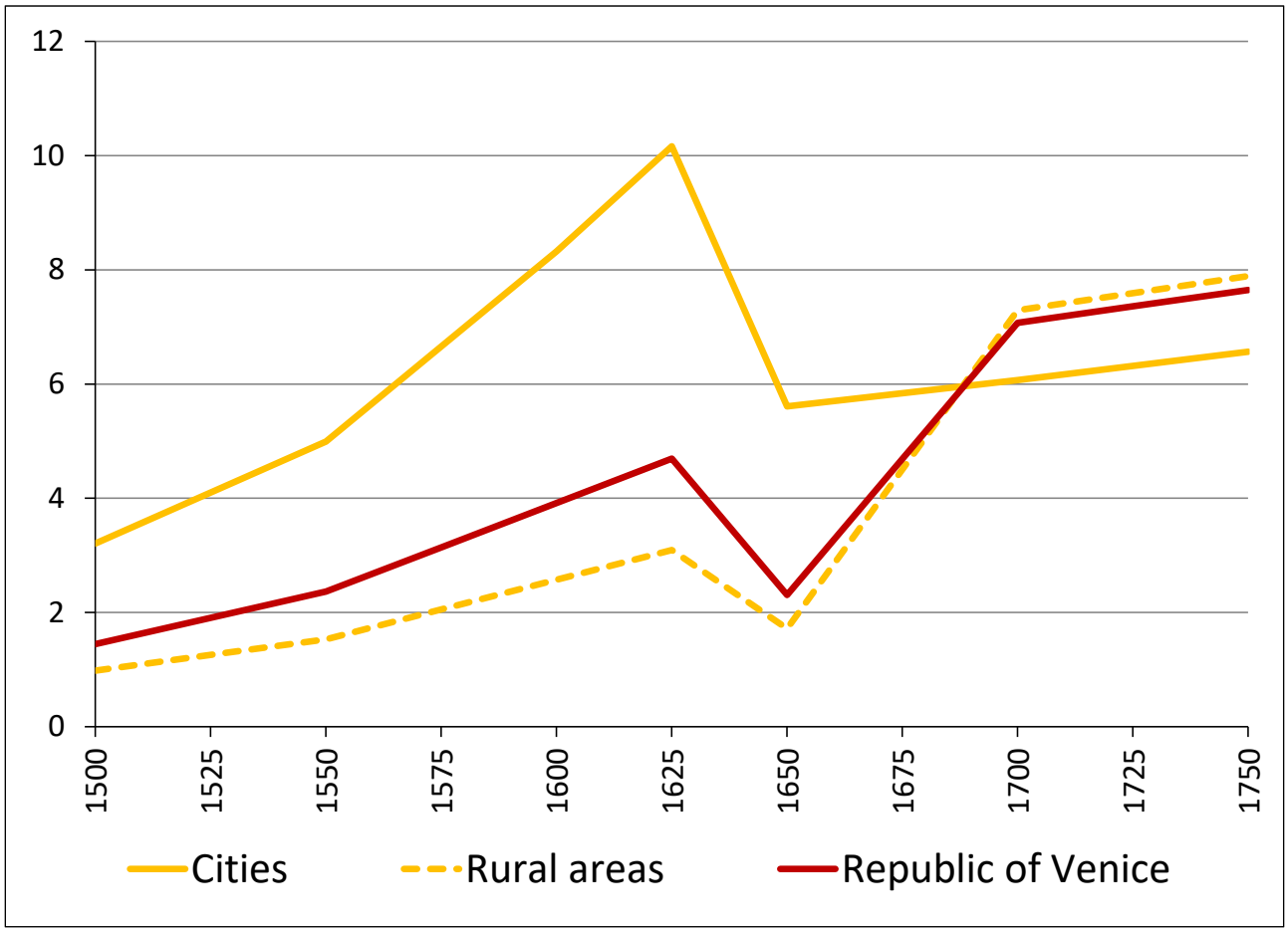
Even accounting for the exceptional case of Germany, the seventeenth century plagues clearly had much less capacity than the Black Death to produce a leveling of the wealth distribution. In part, this is due to the lack of a positive impact on real wages, which prevented the middling and poor strata of the population from improving their ability to acquire property. In part, however, this is the

consequence of a very different institutional framework. In particular, during the centuries following the Black Death, when it had become clear that plague was to remain a recurrent scourge, the richest families began to protect their patrimonies from unwanted fragmentation by using institutions, like the *fideicommissum* (entail), which allowed testators to derogate from the general rule of partible inheritance: another example of how Europeans adapted to a mutated biological environment. This interrupted one of the key mechanisms through which plague might have reduced wealth inequality (see Section 1.1). In other words, this kind of institutional adaptation after the Black Death, while it made patrimonies (and as a consequence, the established social order) more resilient to large-scale mortality crises, also entrenched wealth inequality (Alfani 2010; 2022; Alfani and Murphy 2017).

Recent studies have shown that the seventeenth-century plagues had a somewhat larger impact in terms of poverty reduction, but this was probably due more to their selectivity by social-economic status. While the Black Death is usually considered to have acted as a "universal killer", affecting all the components of society in a similar way, from the fifteenth century plague tended to focus increasingly on the poor, as noted by the doctors of the time and as confirmed by some recent studies (Cohn and Alfani 2007, Galanaud, Galanaud, and Giraudoux 2015; Whittles and Didelot 2016; Cummins, Kelly, and Ó Gráda 2016). Micro-demographic research identified a strong positive correlation between the size of the group of co-residents and the individual risk of dying of plague (Alfani and Bonetti 2019) – and the poor tended to live in overcrowded houses and in the most densely populated and unhealthy quarters of cities.[6] Due to at least some selectivity by social-economic status of early modern plagues, and also taking into account their inability to reduce inequality more generally, it seems probable that the observed reduction in poverty that they did cause (see Figure 4 for the example of the Republic of Venice after the 1630 plague) was due more to direct extermination *of* the poor, than to redistribution of properties *toward* the (surviving) poor. Arguably, the opposite had been true for the Black Death (Alfani 2020b; 2022): which might serve as one final warning against a-critical generalizations based on the historical experience of one specific pandemic.

[6] This is why, in some specific settings like that of Carmagnola in 1630, the poor might have benefited from nternment in the *lazzaretto* (plague isolation hospital) where they were guaranteed food and shelter (Alfani, Bonetti and Fochesato 2023). But in other settings, like that of Florence, Venice and of other large cities, mortality rates at the overcrowded *lazzaretti* were horrific (Stevens Crawshaw 2012; Henderson 2019).

Figure 4. *Absolute poverty in Italy: the prevalence of the propertyless in the Republic of Venice, 1500-1750*



Sources: Alfani, Ammannati and Ryckbosch 2022.

2. Pandemics for an industrial world: from Cholera to the Spanish Flu

After the terrible epidemics that devastated central and southern Europe during the seventeenth century, plague began to retreat from the European continent. The last major epidemic dates from 1675 to 1684, when plague appears to have spread initially across the territories of the Ottoman Empire, in the Balkans as well as in Asia Minor and north Africa. In Europe, it also involved Austria, Bohemia, Hungary, Poland and a few other areas; in Vienna alone, where it came to be remembered as "the Great Plague", it killed about 76,000 people in 1679. However, in comparison with previous decades, the final quarter of the seventeenth century stands out as having been relatively plague-free (Alfani 2013b). Thereafter the situation would improve further, as even the worst European plague of the eighteenth century (the "plague of Marseille" of 1720-22) was a relatively minor episode

compared to previous outbreaks, and the same is true for the worst episode of the nineteenth century, the "plague of Mallorca" of 1820-22. These two epidemics, as well as some other minor ones, were all caused by re-infection of territorially-limited coastal regions of Europe from the broader Mediterranean area, as the continent had basically become plague-free from the late seventeenth century (although plague might have lingered longer in the European domains of the Ottoman Empire: Panzac 1985).

The reasons why plague disappeared from Europe remain a mystery, in spite of the recent acquisitions from paleobiology. Scholars have highlighted various factors which might have played a role, acting alone or together. These include environmental factors (a process of mutual adaptation between humans and pathogens, or variations in the population of vectors of the disease, maybe associated with climate change) as well as institutional factors (improvements in public health, in hygiene, etc.) (Livi Bacci 2000; Alfani and Murphy 2017). The exceptional severity of the last great plagues of the seventeenth century, possibly reflecting pathogen mutation (a hypothesis which is still to be confirmed by paleo-biological research), could also have led the plague to burn itself off the continent (Alfani 2013b). Exploring these factors in greater detail is beyond the scope of this article. What needs highlighting, instead, is that *whatever the reasons* for the disappearance of plague from Europe, the progressive weakening and spacing in time of large-scale lethal epidemics and pandemics from the seventeenth to the early nineteenth century led by itself to substantial improvements in life expectancy at birth, and this in a way which can be presumed to have been largely *independent* of any substantial improvement in economic development (Livi Bacci 2017, p. 45; Alfani 2022, pp. 33-4). The history of Europe's, and indeed the world's, sudden brushes with pandemic-induced mass-mortality, however, was far from ended. During the nineteenth century, with the Industrial Revolution well underway, pandemic scares were mostly associated with the appearance of a new infection: cholera. It is only from the end of that century, and then more clearly from the beginning of the twentieth, that influenza would replace cholera as the most feared pandemic threat.

2.1 Cholera

Cholera was the first new pandemic threat of the industrial world. The bacterium responsible for it, the *vibrio cholerae*, appears to have been endemic in India, in the delta of the Ganges and Brahmaputra rivers, and for a long period its spread remained limited to this area. Only from 1817 did it manage to diffuse across the world, triggering a major pandemic. The reasons for this are many-fold (and imperfectly known). In a first phase, British colonial policies might have played an

important role, together with weather instability (during 1816-17, India was affected by severe floods and famines). The breaking of an established environmental, and institutional, equilibrium might have led also to the breaking of an epidemiological equilibrium. Desperate people fleeing famine-affected areas carried the disease with them, all the more easily considering that those same refugees, undernourished, dirty and in poor health, were particularly prone to cholera infection. Thereafter, the spread of cholera was greatly favoured by the transport revolution: railroads and steamships were servicing not only human beings, but also pathogens (Harrison 2012; Snowden 2019). Also in this sense, the history of cholera is closely connected to that of western industrialization.

Considering that India was its place of origin, it comes as no surprise that cholera mortality there was higher than in any other part of the world. Overall, during the period 1817-60 cholera might have caused 10 to 15 million victims in India, and another 23 million (or more) died during 1865-1947 (Arnold 1986), although the estimates remain somewhat uncertain (Harrison 2020). Cholera arrived for the first time in western Europe in 1831, during its second pandemic (from 1817 to 1923, six cholera pandemics took place: 1817-24, 1829-37, 1840-60, 1863-75, 1881-96 and 1899-1923. All these pandemics originated from India) (Bourdelais 1987; Kohn 2007). The level of mortality, while much lower than in India, was still horrific for the standards of post-plague Europe. In Italy, which was severely affected, cholera caused 500,000-700,000 deaths during the nineteenth century; the worst outbreak alone (in 1865-67) caused over 160,000 (Alfani and Melegaro 2010, pp. 59-60). In France, also badly affected, cholera caused about 300,000 victims during the nineteenth century; the demographic losses were especially large in 1832 (102,000 deaths) and in 1853-54 (143,000), and were concentrated in specific areas, particularly those closer to Paris – in 1854 for example, mortality rates were above 2% in several *départements* of north-eastern France, but just half to a quarter of that in most central and southern areas of the country (Bourdelais, Demonet and Raulot 1978). Also in England, where cholera proved less damaging than to continental Europe causing about 110,000 deaths altogether in the four main outbreaks of 1831, 1848-49, 1853-54 and 1866, the great metropolis of London was affected in a particularly severe way, with an overall death toll slightly exceeding 36,000: more than one-third of all cholera fatalities in the country (Ashworth Underwood 1947).

The relative ease with which cholera spread in large cities did not escape the contemporaries, leading, first, to a barrage of interventions in matters of public health and urban hygiene which were the exact replicas of those developed during the Age of Plague (cleaning of streets, removal of waste, emptying of latrines, purging of wells, etc: all measures that might actually have been of some help) and, secondly, to a more precise identification of the conditions which favoured the spread of the infection. It is in London that, in 1854, doctor John Snow demonstrated empirically that cholera spread more

easily among those using drinking water collected from specific wells (Ashworth Underwood 1947; Snowden 2019). Improving the quality of drinking water, especially in cities, then became the focus of public health interventions against cholera – and with good reason, as across Europe water quality remained a serious issue, also due to the relative inefficiency (or the complete absence) of sewage systems. This problem, which nineteenth-century Europe had inherited from its preindustrial past, and more generally the problem of unhealthy urban environments, had in fact, at least in some settings such as London itself, been made worse by the Industrial Revolution:

«[Epidemic diseases] exploit features of a society that are social, economic, political, and environmental. In the case of cholera –a disease transmitted by the oral-fecal route– the Industrial Revolution and its pathologies created favoring conditions. Cholera thrived on such features of early industrial development as chaotic and unplanned urbanization, rapid demographic growth, crowded slums with inadequate and insecure water supplies, substandard housing, an inadequate diet, ubiquitous filth, and the absence of sewers» (Snowden 2019, p. 234).

The awareness that cholera tended to affect worst the poor quarters where the workers of the Industrial Revolution clustered, that is, the fact that the infection tended to manifest a social connotation, was increased by the new scientific acquisitions: indeed, John Snow himself argued that, beyond the contamination of water supplies, poverty and overcrowding played a major role in spreading the infection (Durey 1979, pp. 66-7). But the relationship between poverty, quality of the urban environment, and cholera might be more complicated, as a recent study has suggested that, even when it affected city areas which were not initially poor, such as the Soho quarter of London in 1854, cholera could *make* them poor by causing a persistent shock to the value of estate and the typology of tenants (Ambrus, Field and Gonzalez 2020). This has important implications, which to some degree can be generalized to all poverty-related infections: «if relatively poor urban environments favour their spread, and if each outbreak makes those environments poorer and more overcrowded, then there is no way for the residents to escape a kind of 'epidemiological poverty trap'. The stimulus needed to change this trajectory must come from the outside» (Alfani 2022, p. 27). In the nineteenth century, this "external" stimulus came from the growing efforts to improve public hygiene, especially in cities; John Snow's discovery in 1854 only boosted the fortunes of the "sanitationist" movement, which from the 1830s had been championing public intervention to ameliorate the urban environment,

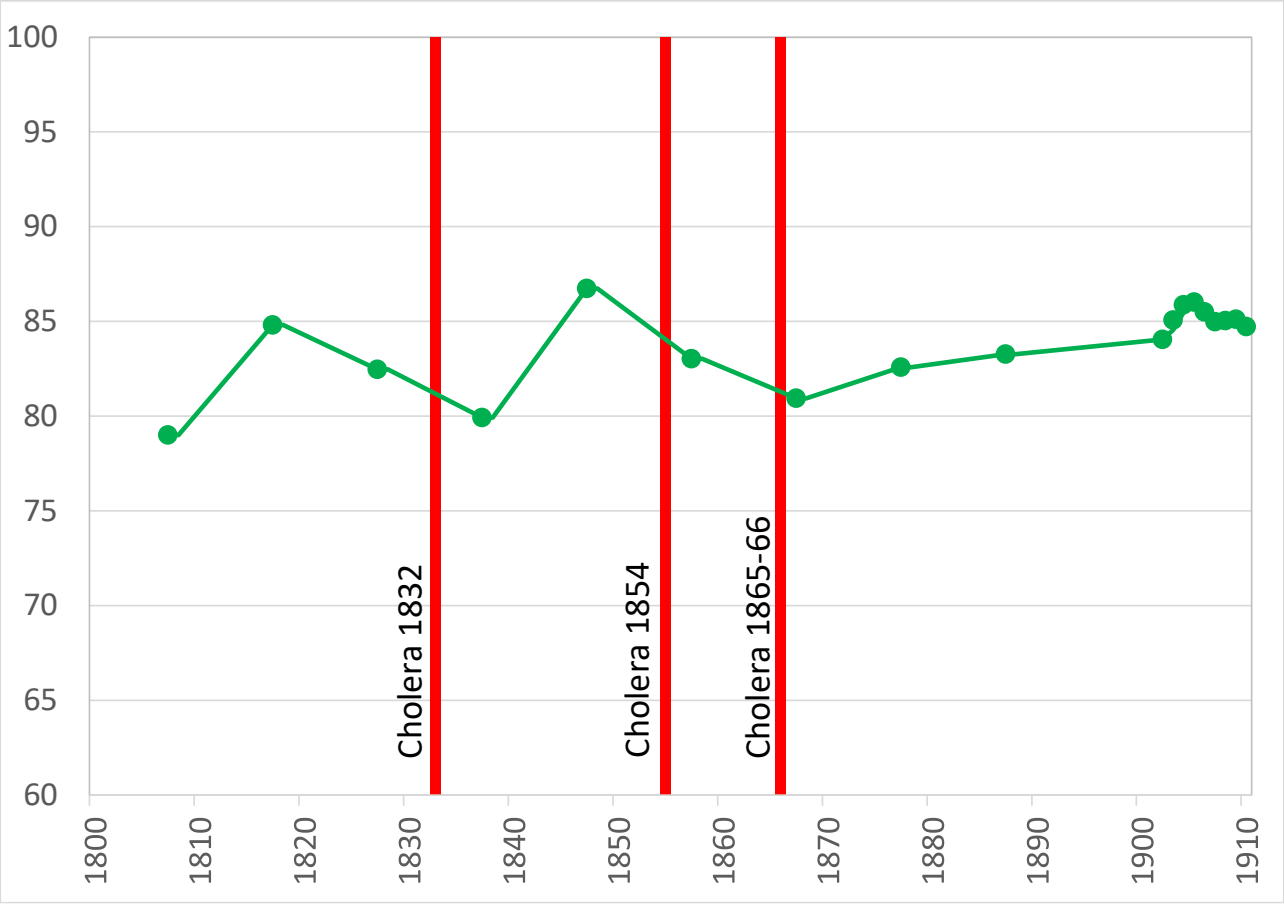
both for improving the conditions of the poor and for making cities healthier for all (Durey 1979; Baldwin 1999; Alfani and Melegaro 2010):

"Sanitationism was a remarkably consistent and unified vision that combined social reform and public hygiene in a seamless whole. All epidemic diseases were to be prevented, or at least ameliorated, in one fell swoop while at the same time social problems were addressed […]. Housing reform and disease prevention, for example, went hand in hand, part and parcel of the same grand vision of a society that through its concern with public health also improved the lives of its poorest. Hygienic reforms providing all with potable water and efficient waste removal and social change to ensure the poorest what had formerly been a middle-class standard of dwelling and diet: such was the sanitationists' modest prescription for preventing epidemic disease. Best of all, sanitationism was a self-sustaining program of reform that not only improved matters for all, but paid for itself […]. Over the long haul, the cost of bad hygienic conditions was expected to outstrip that of ameliorating them." (Baldwin 1999, pp. 128-129).

Social reformers, such as Edwin Chadwick in Britain, played a key role in building the political consensus to act in the sphere of public health. No doubt part of the elite was self-interested (nobody would want cholera spreading in their city), and to some degree the poor continued to be stigmatized as potential infection-spreaders and frowned upon for their supposed scarce propensity for hygiene (Durey 1979; Chen 2020), but in the medium to long run it was the poor who benefited the most from the improvements in sanitation and in the quality of the urban environment. As seen above, the Industrial Revolution had led to a worsening of the housing and the general environmental situation experienced by great masses of workers, especially in large cities – to the point that, in Britain, the height of workers, who at the end of the eighteenth century were on average the tallest in Europe, tended to reduce during the nineteenth century: a process which can be reasonably expected to reflect changes in the health and nutritional conditions experienced in early life (Nicholas and Steckel 1991; Allen 2017, pp. 77-8). As a consequence, the difference in height between the British workers and the middle class increased, suggesting growing health inequalities which closely mirror reported inequalities in access to facilities for waste disposal and to clean water (Szreter 1988; Deaton 2003, pp. 132-133). In this perspective, as cholera acted as a powerful stimulus toward improving the urban environment, it also favoured future reductions in inequalities in health and in life expectancy, which themselves presumably tended to reduce income and wealth inequality (Alfani 2022).

Unfortunately, there is another mechanism through which cholera might have led to a reduction in economic inequality. As it is the prototypical infection which tends to affect the poor more than any other strata (and this, in the past as well as today: Anbarci, Escalares and Register 2012; Ali et al. 2015), cholera might have had an immediate moderating impact on poverty and inequality not by means of redistribution of resources, but simply through extermination of the poor (see above, Section 1.2 as well as Alfani 2022). Given the current scarcity of micro-level data, our best chance for observing this possible impact is by looking at countries which were affected by cholera in a relatively serious way, and for which we have available detailed inequality measurements covering the nineteenth century. Currently, the only country which satisfies this double condition is France – where the two main cholera outbreaks, in 1832 and 1854, are indeed associated with phases of inequality decline, as seen in Figure 5. While this correlation must be interpreted conservatively, given the current lack of more granular data, in this specific historical setting a (brutal) inequality-reducing impact of cholera seems probable (Rosenthal 2020; Alfani 2022, pp. 25-6).

Figure 5. Cholera pandemics and the share of wealth of the richest 10% in France, 1800-1910



Source: Alfani 2022, based on data from the World Inequality Database.

To sum up: cholera might have reduced poverty and inequality in the short run simply by killing proportionally more among the poor. In the medium to long run, cholera might have contributed to reduce poverty in a more virtuous way, by making the sanitary (and social) problem of urban poverty more apparent and by favouring the building up of a political consensus to invest in large-scale urban renovation, leading to a reduction in health inequality and consequently (probably with some delay) in economic inequality as well. There is much, in this reconstruction, which requires further study and we currently lack the data to measure properly the size and the overall relevance of these effects, but the general point appears to be rather strongly supported by the overall historical literature. Unfortunately, we know much less about other possible economic effects of the cholera pandemics – or at least, we know about some general consequences, but we lack proper measurement of their extent. This is particularly the case for the impact of cholera on global commerce. As seen above, at the time of its first spread in the West, in the 1830s, central and local governments tended to react by applying exactly the same measures which had been introduced, centuries before, to fight the plague. This included sanitary cordons and quarantines, which obviously interrupted trade, sometimes led to the physical destruction of goods suspected of being contaminated, and in general imposed substantial costs upon parts of the economic elite. As a consequence, that same elite tried to exert political pressure over governments in the attempt to avoid "useless" restrictions to trade – and the reason why they could argue they were useless, is that the nature of the infection was still unknown and many thought that it did not spread because of "contagion" (hence, person to person) but through noxious miasmas, which could be better fought by cleaning up cities and similar interventions. This was for example the case in the German port city of Hamburg, where initially severe restrictions on incoming vessels were established, but «a backlash was soon orchestrated by merchants and others who opposed quarantine on economic grounds. […] In 1832 […] Hamburg dismantled the quarantine it had established the year before and took little action against cholera when it reappeared in 1848» (Harrison 2012, p. 67), in stark opposition with another German region, Prussia, where commercial and industrial interests were less able to influence public health measures and the authorities continued to impose strict quarantines anytime cholera was perceived as a threat.

The situation only grew worse as the century progressed, not only because it was soon understood that cholera had become a recurrent scourge, but also because the global movement of goods and people increased substantially: a Transportation Revolution fuelled by steam, which powered iron ships as well as trains moving along an ever-expanding network of railways. As had happened during the Age of Plague, human beings adapted to a change in their biological environment also by changing

their institutions – health institutions and policies, as seen above, but rules for international commerce as well. The debate remained intense between those who argued that the cure was worse (more costly to the economy) than the illness, and those, like Britain, who insisted on the necessity of imposing controls such as quarantines over international trade in order to avoid even greater economic damage in case cholera took root in their own territories. For Britain, of particular concern was the situation in India, then part of its colonial empire, as it was under the constant suspicion of being the potential point of origin of new cholera outbreaks. This led the British Indian authorities to favour strict sanitary controls over the movement of people or goods, for the purpose of avoiding reputational damage and becoming the focus of restrictions to trade imposed by their commercial partners. Across the British Empire, quarantine stations were set up in all key ports, and Britain's rivals did the same: in a sort of collective effort which, especially from the 1870s, also established additional means for retaliation and for waging more-or-less declared commercial wars. This development further complicates the already daunting task of evaluating the overall damage caused by cholera to international trade – also because cholera was far from being the only dreaded infection potentially spread by trade: plague itself had resurfaced, first in some parts of China whence, in 1896, it moved to India through the great port city of Bombay. Fear that plague could then spread globally using the effective communication routes of the British Empire immediately led to the imposition of quarantines against all vessels sailing from India (Harrison 2012).

2.2 The Spanish Flu

By the end of the nineteenth century, cholera appeared to have been tamed, at least in western countries: the sixth pandemic, from 1899 to 1923, spared entirely the Americas, just brushed Europe, and remained mostly limited to South Asia and the Middle East. But a new threat was looming: influenza, whose pathogen was impossible to observe with the instruments of the time and remained the object of much discussion and speculation (the influenza virus was first isolated in 1934). Already in 1889-90, a global influenza pandemic, the "Russian flu", had killed about 1 million people around the world (about 250,000 in Europe alone). Earlier episodes include the so-called *grippe* of 1781-82, four other serious epidemics or pandemics during the nineteenth century (1800-02, 1830-33, 1847-48, 1857-58), and other minor events (Patterson 1986; Alfani and Melegaro 2010). While some doubt remains about the actual pathogen causing all these epidemics (according to a recent hypothesis, the 1889-90 pandemic might have been caused by a coronavirus, not by an influenza virus: Brüssow and Brüssow 2021), an incertitude also coming from the relative similarity in the symptoms caused by respiratory infections of various kinds, maybe the most important point to highlight is that, before the

Spanish Flu, influenza was considered to be relatively benign, given its low case-fatality rate (in this case, the high number of victims is the result of high infectiousness) and its tendency to kill mostly the old and the frail.

A characterizing feature of the influenza viruses, however, is their ability to mutate easily, and sometimes dramatically over very short periods of time.[7] This was also the case for the Spanish Flu, which began its spread during spring 1918. Some uncertainty remains about its place of origin – either the Kwangtung or another region of south China, or the United States where the infection was first properly described (Shortridge 1997; Taubenberger and Morens 2006). Whatever its place of origin, there is no doubt that the global diffusion of the Spanish Flu, like cholera in the preceding century, was facilitated by the modern means of transportation. An aggravating factor was the concomitant World War I, which led to the concentration of many people in overcrowded spaces and required mass-movements of troops, including across the oceans: and, as already seen for medieval and early modern plagues, armies tend to act as infection-spreaders. War conditions also explain why this influenza is called "Spanish": as Spain was neutral, its media were freer to report on its spread and consequences than belligerent countries, where censors tried to suppress news that could negatively affect morale. This led many to wrongly assume that the pandemic had begun in Spain (while the Spanish themselves thought that it came from France). As a matter of fact, by May or June 1918 the pandemic had already spread globally – although with limited consequences, as the first wave appears to have been relatively benign. It is from the second wave, in autumn 1918, that the number of deaths started to become staggering: the virus had mutated *during* the pandemic, becoming more lethal (Taubenberger and Morens 2006, pp. 16-7). By November 1918, however, the situation seemed to be improving quickly – only to worsen again from December, when the third and final wave of the Spanish Flu began, which continued through the first part of the following year. War played a final aggravating role, as the spread of the infection might have been revived by the celebrations and the get-togethers which followed the armistice stipulated on November 11.

Whatever the factors shaping the global spread of the Spanish Flu, the death toll was horrific: an estimated 50 to 100 million across the world. For sheer numbers of victims, this is considered to have

[7] Influenza viruses mutate because of either antigenic drift, or antigenic shift. The first refers to small-scale, incremental mutations of the genome which can occur when the virus replicates. Instead, the antigenic shift, or re-assortment, is a much more radical mutation which involves the complete replacement of an antigen (something made possible by the segmented nature of the influenza viruses) with an antigen coming from a different influenza virus. When the re-assortment involves a human influenza virus and an animal influenza virus, it is possible that a new virus appears which is capable of infecting easily human beings, but against which humans have no acquired immune defence coming from earlier exposure to different influenza viruses. This has been the case with the (not very lethal) "Swine flu" of 2009-10, and this is why there are many worries about the possible emergence of new "avian" influenza virus.

been the worst pandemic in human history – but given that the world population had grown considerably in the earlier centuries (and especially from the beginning of the Demographic Transition in the early nineteenth century), in terms of mortality rates the Spanish Flu was much less severe than the Black Death and other major plagues. In the West, mortality rates showed significant variation but remained relatively low, ranging from a low level of about 0.3-0.4% (for example, 0.37% in Germany) to a high level of about 1.1-1.3% (in Italy); the U.S. was an intermediate case, at 0.65%. In other world areas, mortality rates were higher: up to 2% in China, 5-6% in British India (which implies about 20 million victims in that region alone), and 6% in South Africa. For other world areas estimates are much more uncertain, however, an overall death toll of 50-100 million victims for the Spanish Flu equals to a global death rate in-between 2.5 and 5%.[8] While mortality rates were relatively low compared to previous pandemics and especially those caused by plague, the percentage of the population which became infected was extremely high (a – maybe conservative – estimate is that the Spanish Flu infected at least one-third of the world population), and this has important implications for the economic effects of the pandemic. Before discussing them, it should also be noted that for the public health systems of the time, experiencing very large numbers of infected people requiring assistance became an impossible logistical problem. Hospitals, often under-staffed to begin with because of the war effort, could not host everybody and emergency structures had to be found in order to provide at least some basic care: which, in the absence of effective drugs, consisted in what American nurses ironically labelled "TLC cure" (Tender Loving Care); nurses themselves, as well as the rest of the medical personnel, were among the main victims of the Spanish Flu (Crosby 2003). The collapse of the public health system which occurred during the 1918-19 influenza pandemic led to increases in case-fatality rates, especially in cities. This is precisely what governments and health authorities across the world tried to avoid during the Covid-19 pandemic, "hammering the curve" of the infections by means of lockdowns and other strong anti-pandemic measures.

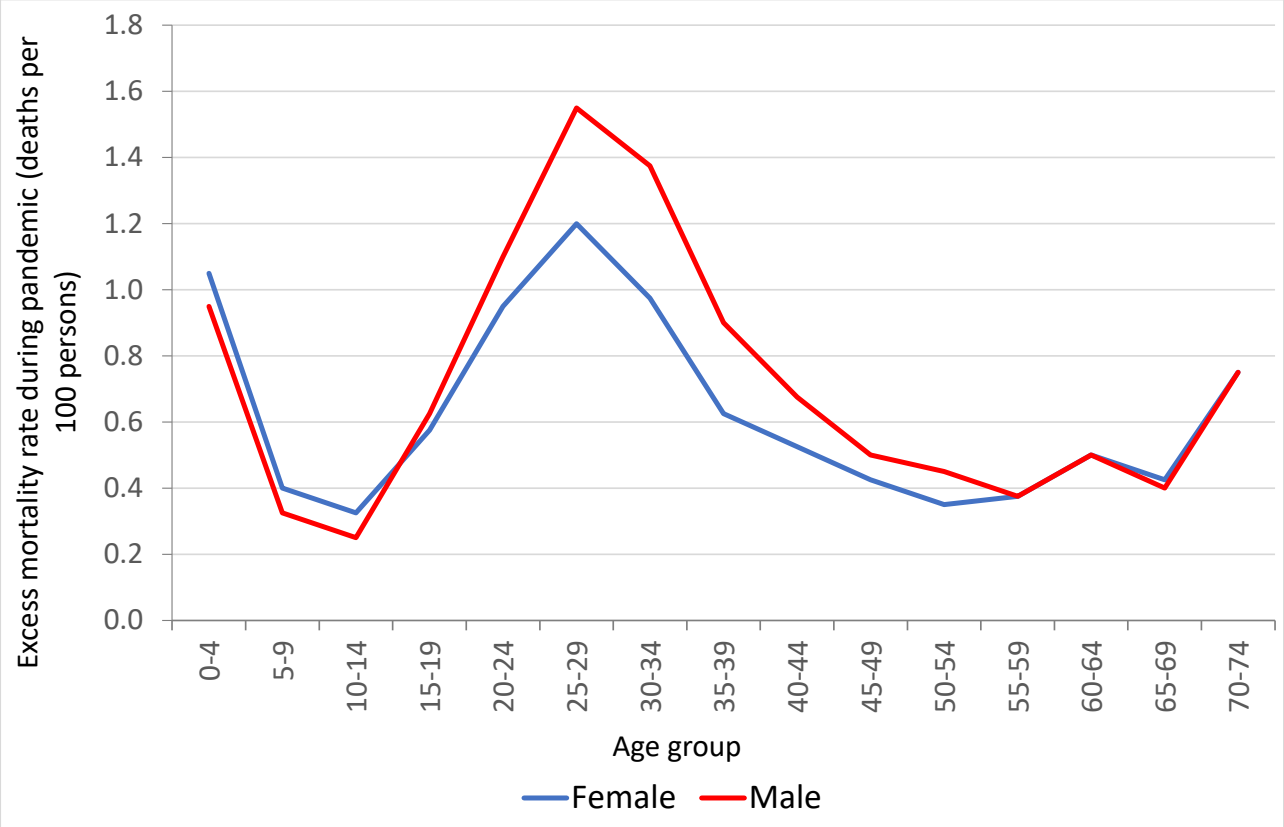
Notwithstanding its scale and its historical significance, until recently the Spanish Flu had been relatively neglected by scholars, mirroring a general tendency towards forgetfulness in the general population – which is why a well-known account labelled it "America's forgotten pandemic" (Crosby

[8] The estimates of global mortality rates are from Johnson and Mueller 2002, which are also the source for many of the reported estimates – exception made for India (Tumbe 2020, p. 139), Italy (Fornasin, Breschi and Manfredini 2018) and South Africa (Fourie and Jayes 2021). While most country-specific recent studies have tended to propose higher estimates compared to earlier and more hypothetical studies, some attempts to provide overall revisions of the estimates across countries have gone in the opposite direction (see in particular Barro, Ursúa and Weng 2020, who argue for 39 million victims overall, or about 2% of the world population). Also see Beach, Clay and Saavedra (2022, p. 51) for a comparison between different sets of estimates.

2003).[9] This is also true for economic historians, who had rarely worked on the consequences of the Spanish Flu before 2020, when Covid-19 made it a hot and urgent topic and triggered a wave of new research which is still ongoing. Indeed, one reason why knowing about the economic effects of the Spanish Flu was considered so important during the recent crisis, is that epidemiologically it is much closer to Covid-19 than any other major pandemic so far, and this, because it tended to infect and to debilitate – but not usually kill – a very large part of the population. This is particularly relevant for the distributive impact of the pandemic, as the kind of shock to the labour market caused by an event which kills relatively few but temporarily invalidates many is entirely different from that previously described for the Black Death. The Spanish Flu did not make labour scarce, which is of course a blessing because it means that it did not exterminate large masses of workers – but by not curtailing the offer of labour, it allowed for drops in the demand of labour (which could also result from public anti-pandemic policies: a mechanism which played a minor role at the time of the Spanish Flu, but a much larger one during Covid-19) to lead to loss of jobs (or at least, of part of the income), compounding that caused by widespread illness and inability to work. And as is invariably the case in similar instances, the first to suffer were those who had the least secure and worst-paid jobs to begin with. In the case of the Spanish Flu, this process was aggravated further by its vicious ability to affect in a particularly severe way the young adults (both males and females), which resulted in the characteristic W-shape in age-specific mortality rates shown in Figure 6.

[9] The causes of this generalized "forgetfulness" remain unclear, but possibly a key role was played by the context in which the pandemic developed. In 1918, World War I still focused the attention of many countries, especially in the West. The conflict was causing a staggering number of deaths, including among the civilian population. The Spanish Flu, then, "only" made worse the death toll in a context which already was very far from normal. When both the war and the pandemic finally ended, the survivors might have coped with the catastrophe that they had experienced by looking at the future – and doing their best to forget about the past.

Fig. 6. Median excess mortality by age and sex in 13 countries during the Spanish Flu



Notes: the sample includes countries for which information about age-specific excess mortality during the Spanish Flu was available (see Murray 2006 for details).

Sources: Murray 2006; Beach et al. 2022.

By causing loss of job and general income damage especially to young adults belonging to the low and medium-low strata of society, the Spanish Flu can be expected to have caused not a reduction, but an increase in income inequality. While studies of the distributive impact of the Spanish Flu remain rare, some evidence supporting this implication has now been provided for Italy, where the economic crisis triggered by the pandemic appears to have affected more than proportionally the incomes of the most economically fragile part of the population (Galletta and Giommoni 2022). Another study focused on Spain, which has the relevant feature of having remained neutral during World War I, hence its economy was less perturbed by the war effort and the direct effects of the pandemic are easier to observe. In Spain, the shock to the demand of labour, in part due to the drop in overall consumption during the pandemic, prevailed over the mortality-induced shock to the offer of labour, leading to lower real wages and higher income inequality (Basco, Domenech and Roses 2021; 2022, pp. 54-61). In another neutral country, Sweden, the Spanish Flu contributed to the spread

of poverty, as for each death caused by the pandemic four new poor people had to have recourse to public help in order to survive, applying for residence in poorhouses managed by the municipality. As the Spanish Flu produced 35,000 victims in Sweden (0.6% the overall population), the impact on the local prevalence of poverty was massive (Karlsson et al. 2014). Only in India and in some other world areas where the mortality rates caused by the Spanish Flu were relatively high on average, and where at the same time mortality appears to have been much higher among the poorer strata than among the socio-economic elite, is there reason to think that the pandemic might have lowered inequality (Beach et al. 2022, p. 77): by killing the poor, precisely as cholera did a few decades earlier. Additionally, as has been recently argued for India, it might have boosted female labour participation (another inequality-reducing mechanism), although probably only in the short term (Fenske, Gupta and Song 2022).

As with earlier pandemics, a substantial part of the literature on the economic effects of the Spanish Flu has tried to measure the way in which it impacted GDP in the short, medium and long run. Again for Sweden, it has been argued that the areas experiencing the highest influenza mortality grew at a relatively lower pace after the pandemic, until ca. 1930, as suggested by lower capital earnings (Karlsson et al. 2014). For countries involved in World War I, the end of the war itself in November 1918 complicates the analysis. Some country-specific studies have suggested that in the short run the Spanish Flu led to a sharp drop in GDP, proportionally worse in the most-affected regions. This would have been the case for Italy (Carillo and Jappelli 2022) and Denmark (Dahl, Hansen and Jensen 2022), while for the U.S. some studies reported immediate economic damage evidenced by higher rates of business failures in the states suffering from the highest influenza mortality rates (Brainerd and Siegler 2003). In a comparative study of 43 countries, Barro, Ursúa and Weng (2020) estimate that on average, a pandemic-related mortality rate of 2% was associated with a drop of 6% in GDP and of 8% in private consumption. Part of this economic damage, of course, was compensated for in subsequent years by higher-than-average growth – but, in general, it remains an open question whether this was sufficient to generate a V-shape recovery pattern (that is, one in which quicker post-pandemic growth compensated entirely the short-term damage caused by the Spanish Flu), or whether the pattern was closer to an L-shape and consequently, the pandemic-induced economic damage was longer-lasting (see Beach et al. 2022 for an overview of the literature on this topic).

The pattern of recovery after the Spanish Flu became a hot topic during the Covid-19 pandemic, as while the new crisis unfolded there was an urgent need to forecast the possible scenarios, also in order to design policies aimed at making the worst ones less likely. In that context, the relative scarcity of studies of the Spanish Flu became an important constraint on our ability to understand the

implications of the new crisis (see the Conclusions). But there is more: the possible negative consequences of a pandemic go well beyond those on GDP or inequality, and can involve aspects even more difficult to measure, such as individual attitudes. A recent study focused on social trust, finding evidence that having experienced the Spanish Flu –and the related collapse of institutions and of traditional networks of social support– led to long-lasting damage to interpersonal trust, which was more intense for the residents of countries that had suffered the highest influenza mortality. This loss in social trust potentially constrained economic growth for many decades following the pandemic (Aassve et al. 2022). Other long-term damage caused by the Spanish Flu include the health of the survivors (debilitating physical weakness, breathing difficulties, and other afflictions were reported) as well as permanent consequences for those who experienced the pandemic in-utero, that is before birth. A well-known study by Almond (2006) argued for permanent in-utero scarring caused by the Spanish Flu, as evidenced by poorer school performance, relatively low income, and higher prevalence of disability limiting or preventing work. While Almond provided a purely biological interpretation of these findings, the literature generated by his seminal work also considered social dynamics, which might have strengthened the effect of in-utero exposure (for example, parental selection leading to reallocation of resources toward healthier siblings) and, in general, deepened and nuanced this venue of research (see Beach et al. 2022, pp. 69-74 for a synthesis).

Conclusions: What lessons for the present – and what to expect from the future?

The Spanish Flu of 1918-19 taught everybody a hard lesson: in the modern world, characterized by unprecedented ease of long-distance travel between very densely populated areas, a lethal infection was able to spread very effectively, very quickly, and was very difficult to contain unless immediate action was taken. In this context, a high level of international cooperation against global health threats was deemed a necessity; the establishment of the World Health Organization, in 1948, was an attempt to provide an answer to this pressing need. In subsequent decades, two relatively severe influenza pandemics (the Asian Flu of 1957-58 and the Hong Kong Flu of 1968-69), and more recently, repeated scares caused by the appearance of strains of "avian" influenza, or by the global diffusion of the "Swine Flu" of 2009-10, explain why, before Covid-19, the emergence of a new, lethal influenza virus was considered to be the main, looming global threat of a pandemic nature (Kilbourne 2006; Alfani and Melegaro 2010; Taubenberger and Morens 2010). As it happened, a coronavirus stole the scene – a somewhat unexpected turn of events, as preceding crises caused by a lethal SARS-

associated coronavirus (SARS stands for "Severe and Acute Respiratory Syndrome") were contained with relative ease, beginning with the first outbreak in 2003. But epidemiologically, the spread of Covid-19 followed a pattern which corresponds rather closely to the worst-case scenario imagined for the global diffusion of a lethal influenza virus that escaped all attempts at early containment. In this respect, the apparent failure of the World Health Organization to speedily contain the nascent pandemic, and the many critiques that were then addressed at this institution (including that of being prone to pressures from powerful and assertive countries, and particularly China where the crisis had begun) should not trick us into believing that we can do without it. On the contrary: the long-run history of human attempts at pandemic management strongly suggests that over the next few decades, the World Health Organization and all other international institutions active in the field of public health will be strengthened, precisely because of what we have learned from Covid-19.

The need to improve our ability to monitor and, hopefully, contain pandemic threats at the global level comes from an awareness, which has always been present among specialists but today is to be found also among large strata of the civil society, that Covid-19 will not be the last new, severe pathogen to appear during the twenty-first century. After all, we only need to look at the last fifty years or so to see the emergence of new pathogens able to take the world by surprise. Two well-known examples include HIV and Ebola, but there are others (see Bloom, Kuhn, and Prettner 2022 for insights about the economic impact of these new infections). Unfortunately, the processes which lead to the appearance of new pathogens remain largely outside our control – which is why, in a condition of uncertainty about what characteristics the next threat will show, we would do well to intensify research on past pandemics in order to build a base of knowledge that we can tap in case of need. As seen in the previous section, during Covid-19 knowing more about the economic consequences of the Spanish Flu would have helped us considerably in our effort to devise policies for moderating its negative impact on the economy. More generally, the history of recent crises, of a pandemic character or otherwise, strongly suggests that when faced with the unexpected, human beings (including of course scholars and decision-makers) turn to the past to look for clues about the best course of action. This is one reason to hope that the current renewal of interest in the history (and particularly, in the economic history) of past pandemics will continue in the upcoming years.

References

Aassve A, Alfani G, Gandolfi F, Le Moglie M (2021) Epidemics and Trust: The Case of the Spanish Flu, *Health Econ* 30 (4): 840-857

Acemoglu D, Robinson J (2013) Why Nations Fail? The Origins of Power, Prosperity and Poverty, reprint edn. Currency, London

Alfani G (2010) The Effects of Plague on the Distribution of Property: Ivrea, Northern Italy 1630. Popul Stud 64 (1): 61–75

Alfani G (2013a) Calamities and the Economy in Renaissance Italy. The Grand Tour of the Horsemen of the Apocalypse. Palgrave, London

Alfani G (2013b) Plague in Seventeenth Century Europe and the Decline of Italy: an Epidemiological Hypothesis. Eur Rev Econ Hist 17:408-430

Alfani G (2015) Economic inequality in northwestern Italy: A long-term view (fourteenth to eighteenth centuries). J Econ Hist 75(4):1058-1096

Alfani G (2020a) Pandemics and asymmetric shocks: evidence from the history of plague in Europe and the Mediterranean. Journal for the History of Environment and Society 5:197–209

Alfani G (2020b) The economic history of poverty, 1450-1800. In: Hitchcock D, McClure J (eds) The Routledge History of Poverty in Europe, c.1450-1800. Routledge, London, pp 21-38

Alfani G (2021) Economic inequality in preindustrial times: Europe and beyond. J Econ Lit 59(1):3-44

Alfani G (2022) Epidemics, inequality and poverty in preindustrial and early industrial times. J Econ Lit 82(1), 2022: 87-125

Alfani G (2023) As Gods among Men. A social and economic history of the rich in the West. Princeton University Press, Princeton (in press)

Alfani G, Ammannati F (2017) Long-term trends in economic inequality: the case of the Florentine State, ca. 1300-1800. Econ Hist Rev 70(4):1072-1102

Alfani G, Ammannati F, Ryckbosch W (2022) Poverty in early modern Europe: New approaches to old problems. EHES working paper no. 222. European Historical Economics Society

Alfani G, Bonetti M (2019) A survival analysis of the last great European plagues: The case of Nonantola (Northern Italy) in 1630. Popul Stud 73(1):101-118

Alfani G, Bonetti M, Fochesato M (2023) Pandemics and socio-economic status. Evidence from the plague of 1630 in northern Italy. Popul Stud, forthcoming

Alfani G, Di Tullio M (2019) The Lion's Share. Inequality and the Rise of the Fiscal State in Preindustrial Europe. Cambridge University Press, Cambridge

Alfani G, Melegaro A (2010) Pandemie d'Italia. Dalla peste nera all'influenza suina: l'impatto sulla società. Egea, Milan

Alfani G, Murphy T (2017) Plague and Lethal Epidemics in the Pre-Industrial World. J Econ Hist 77(1):314-343

Alfani G, Percoco M (2019) Plague and Long-Term Development: the Lasting Effects of the 1629-30 Epidemic on the Italian Cities. Econ Hist Rev 72(4):1175–1201

Alfani G, Schaff F, Gierok V (2022) Economic inequality in preindustrial Germany, ca. 1300-1850. J Econ Hist 82(1):87-125

Alfani G, Ó Gráda C (2018) The timing and causes of famines in Europe. Nat Sustain 1:283-288

Ali M, Nelson AR, Lopez AL, Sack DA (2015) Updated global burden of cholera in endemic countries. PLoS Negl Trop Dis 9(6):e0003832

Almond D. (2006) Is the 1918 influenza pandemic over? Long-term effects of in utero influenza exposure in the post-1940 U.S. Population. J Polit Econ 114(4): 672–712

Álvarez Nogal C, Prados de la Escosura L (2013) The Rise and Fall of Spain (1270–1850). Econ Hist Rev, 66(1):1–37

Álvarez-Nogal C, Prados de la Escosura L, Santiago-Caballero C (2020) Economic Effects of the Black Death: Spain in European Perspective. Investigaciones de Historia Económica - Economic History Research 16:35-48

Ambrus A, Field E, Gonzalez R (2020) Loss in the Time of Cholera: Long-Run Impact of a Disease Epidemic on the Urban Landscape. Am Econ Rev 110(2):475–525

Anbarci N, Escaleras M, Register CA (2012) From cholera outbreaks to pandemics: the role of poverty and inequality. The American Economist 57(1):21-31

Arnold D (1986) Cholera and Colonialism in British India. Past Present 113(1):118–151

Ashworth Underwood E (1947) The History of Cholera in Great Britain. Proceedings of the Royal Society of Medicine 41:165-173

Baldwin P (1999) Contagion and the State in Europe, 1830-1890. Cambridge University Press, Cambridge

Barker H (2021) Laying the Corpses to Rest: Grain, Embargoes, and Yersinia pestis in the Black Sea, 1346–48. Speculum 96(1): 97-126

Barro R, Ursúa JF, Weng J (2020) The Coronavirus and the Great Influenza Pandemic: Lessons from the "Spanish Flu" for the Coronavirus's Potential Effects on Mortality and Economic Activity, NBER working paper no. 26866. National Bureau of Economic Research, Cambridge MA

Basco S. Domenech J, Roses JR (2021) The Redistributive Effects of Pandemics: Evidence of the Spanish Flu. World Development 141

Basco S. Domenech J, Roses JR (2022). Pandemics, Economics and Inequality: Lessons from the Spanish Flu. Palgrave, Cham

Beach B, Clay K, Saavedra M (2022) The 1918 Influenza Pandemic and Its Lessons for COVID-19. J Econ Lit 60(1):41–84

Biraben JN (1975) Les hommes et la peste en France et dans les pays Européens et Méditerranées. Mouton, Paris

Bloom DE, Kuhn M, Prettner K (2022) Modern Infectious Diseases: Macroeconomic Impacts and Policy Responses. J Econ Lit 60(1):85–131

Borsch, SJ (2005) The Black Death in Egypt and England: A Comparative Study. University of Texas Press, Austin

Borsch SJ (2015) Plague, Depopulation and Irrigation Decay in Medieval Egypt. In: Green MH (ed) Pandemic Disease in the Medieval world. Rethinking the Black Death. Arc Medieval Press, Kalamazoo and Bradford, pp 125–56

Bourdelais P (1987) Une peur bleue: histoire du choléra en France. 1832-1854. Payot, Paris

Bourdelais P, Demonet M, Raulot JY (1978) La marche du choléra en France: 1832-1854. Annales. Economies, sociétés, civilisations 33(1):125-142

Brainerd E, Siegler MV (2003) The Economic Effects of the 1918 Influenza Epidemic. CEPR Discussion Paper no. 3791

Broadberry S (2013) Accounting for the Great Divergence. LSE Economic History Working Papers no. 184. London School of Economics and Political Science, London

Brüssow H, Brüssow L (2021) Clinical evidence that the pandemic from 1889 to 1891 commonly called the Russian flu might have been an earlier coronavirus pandemic. Microb Biotechnol 14(5):1860–1870

Campbell BMS (2016) The Great Transition: Climate, Disease and Society in the Late-Medieval World. Cambridge University Press, Cambridge

Carillo M, Jappelli T (2022) Pandemics and regional economic growth: evidence from the Great Influenza in Italy. Eur Rev Econ Hist 26(1):78-106

Chen C (2020) Victorian contagion. Risk and social control in the Victorian literary imagination. Routledge, Abingdon

Cipolla CM (1981) Fighting the Plague in Seventeenth-Century Italy. University of Winsconsin Press, Madison

Clark G (2007) A Farewell to the Alms: A Brief Economic History of the World. Princeton University Press, Princeton

Cohn SK (2007) After the Black Death: Labour Legislation and Attitudes towards Labour in Late-Medieval Western Europe. Econ Hist Rev 3:486–512.

Cohn SK (2008) Epidemiology of the Black Death and Successive Waves of Plague. In: Nutton V (ed) Pestilential Complexities: Understanding Medieval Plague, Supplement Medical History 27. The Wellcome Centre Trust for the History of Medicine, London, pp 74–100

Cohn SK (2009) Cultures of Plague. Medical thought at the end of the Renaissance. Oxford University Press, Oxford

Cohn SK, Alfani G (2007) Households and Plague in Early Modern Italy. J Interdiscip Hist 38:177-205

Crosby AW (2003) America's Forgotten Pandemic. The Influenza of 1918, 2nd edn. Cambridge University Press, Cambridge

Cummins N, Kelly M, O' Grada C (2016) Living Standards and Plague in London, 1560-1665. Econ Hist Rev 69(1):3-34

Dahl CM, Casper WH, Jensen PS (2022) The 1918 epidemic and a V-shaped recession: evidence from historical tax records. Scand J Econ 124(1):139–163

Deaton A (2003) Health, Inequality and Economic Development. J Econ Lit 41:113-158

Dodds B, Britnel R (eds) (2008) Agriculture and Rural Society after the Black Death. University of Hertfordshire Press, Hatfield

Domar ED (1970) The Causes of Slavery or Serfdom: A Hypothesis. J Econ Hist 30(1): 18-32

Dooley A (2007) The plague and its consequences in Ireland. In: Little LK (ed) Plague and the End of Antiquity: The Pandemic of 541-750. Cambridge University Press, Cambridge, pp 215-228

Durey M (1979) The Return of the Plague. British Society and the Cholera 1831-2. Macmillan, London

Dyer C (1982) Deserted Medieval Villages in the West Midlands. The Economic History Review, New Series, 35(1):19-34

Dyer C (1998) Rural Europe. In: Allmand C (ed) The New Cambridge Medieval History –Volume VII, c. 1415–1500. Cambridge University Press, Cambridge, pp 106–120

Dyer C (2015) A Golden Age Rediscovered: Labourers' Wages in the Fifteenth Century. In: Allen M, Coffman D (eds) Money, Prices and Wages. Palgrave Macmillan, London, pp 180-195

Eckert EA (1996) The Structure of Plagues and Pestilences in Early Modern Europe. Central Europe, 1560-1640. Karger, Basel

Fancy N, Green M (2021) Plague and the Fall of Baghdad (1258). Med Hist 65(2):157–177

Fenske J, Gupta B, Song Y (2022) Demographic Shocks and Women's Labour Market Participation: Evidence from the 1918 Influenza Pandemic in India. J Econ Hist 82(3): 875-912

Fochesato M (2018) Origins or Europe's North-South Divide: Population changes, real wages and the 'Little Divergence' in Early Modern Europe. Explor Econ Hist 70:91-131

Fornasin A, Breschi M, Manfredini M (2018) Spanish flu in Italy: new data, new questions. Le Infezioni in Medicina 1:97-106

Fourie J, Jayes J (2021) Health inequality and the 1918 influenza in South Africa. World Dev 141:e105407

Galanaud P, Galanaud A, Giraudoux P (2015) Historical Epidemics Cartography Generated by Spatial Analysis: Mapping the Heterogeneity of Three Medieval 'Plagues' in Dijon. PLoS ONE 10(12):e0143866

Galletta S, Giommoni T (2022) The Effect of the 1918 Influenza Pandemic on Income Inequality: Evidence from Italy. Rev Econ Stat 104(1):187–203

Green MH (2020) The Four Black Deaths. Am Hist Rev 125(5):1601–1631

Green MH (2022a) Plague (Yersinia pestis). In: Phillips CJ (ed) Encyclopedia of the History of Science. Carnegie Mellon University Libraries Publishing Service, Pittsburgh (in press)

Green MH (2022b) Out of the East (or North or South): A Response to Philip Slavin. Past Present 256(1):283–323

Harper K (2016) People, Plagues, and Prices in the Roman World: The Evidence from Egypt. J Econ Hist 76(3):803-39

Harper K (2017) The Fate of Rome: Climate, Disease, and the End of an Empire. Princeton University Press, Princeton

Harper K (2021) Plagues Upon the Earth. Disease and the course of human history. Princeton University Press, Princeton

Harrison M (2012) Contagion. How Commerce Has Spread Disease. Yale University Press, New Haven

Harrison M (2020) A Dreadful Scourge: Cholera in early nineteenth-century India. Mod Asian Stud 54(2):502-553

Herlihy D (1997) The Black Death and the Transformation of the West. Harvard University Press, Cambridge MA

Henderson J (2019) Florence under Siege. Surviving Plague in an Early Modern City. Yale University Press, New Haven

Horgan J (2014) Justinian's Plague (541-542 CE). In: World History Encyclopedia. World History Publishing. Available via https://www.worldhistory.org/article/782/justinians-plague-541-542-ce/. Accessed 9 Nov 2022

Hymes R (2015) The East Asian beginnings of the Yersinia Pestis politomy. In: Green MH (ed) Pandemic disease in the Medieval world. Rethinking the Black Death. Arc Medieval Press, Kalamazoo and Bradford, pp 285-308

Jedwab R, Johnson ND, Koyama M (2022) The Economic Impact of the Black Death. J Econ Lit 60(1):132–178

Karlsson M, Nillson T, Pichler S (2014) The impact of the 1918 Spanish flu epidemic on economic performance in Sweden. An investigation into the consequences of an extraordinary mortality shock. J Health Econ 36:1-19

Kelly M (2001) A History of the Black Death in Ireland. Tempus, London

Kilbourne ED (2006) Influenza pandemics of the 20th century. Emerg Infec Dis 12(1):9-14

Kohn GC (2007) Encyclopedia of Plague and Pestilence, 3rd edn. Facts on File, New York.

Johnson NPAS, Mueller J (2002) Updating the accounts: Global mortality of the 1918-1920 'Spanish' influenza pandemic. Bull Hist Med 76:105-115

Last JM (2001) A Dictionary of Epidemiology, 4th edn. Oxford University Press, Oxford

Little LK (ed) (2007) Plague and the End of Antiquity: The Pandemic of 541-750. Cambridge University Press, Cambridge

Livi-Bacci M (2000) The Population of Europe. Blackwell, Oxford

Livi Bacci M (2017) A Concise History of World Population, 6th edn. Wiley Blackwell, Chichester

Milanovic B (2016) Global Inequality: a new approach for the age of globalization. Harvard University Press, Cambridge MA

Mordechai L, Eisenberg M (2019) Rejecting catastrophe: the case of the Justinianic plague. Past Present 244(1):3-50

Murray CJL, Lopez AD, Chin B, Feehan D, Hill KH (2006) Estimation of potential global pandemic influenza mortality on the basis of vital registry data from the 1918-20 pandemic: a quantitative analysis. Lancet 368:2211-2218

Nicholas S, Steckel RH (1991) Heights and Living Standards of English Workers During the Early Years of Industrialization, 1770-1815. J Econ Hist 51(4):937-957

Pamuk S (2007) The Black Death and the origins of the 'Great Divergence' across Europe, 1300–1600. Eur Rev Econ Hist 11:289–317

Panzac D (1985) La peste dans l'Empire Ottoman 1700-1850. Turcica, Louvain

Patterson DK (1986) Pandemic influenza 1700-1900. A study in historical epidemiology. Rowman & Littlefield, New Jersey

Roosen J, Curtis D (2019) The 'light touch' of the Black Death in the Southern Netherlands: an urban trick?. Econ Hist Rev 72(1):32–56

Rosenthal JL (2020) Pandemics and the Economy: Lesson from History. Presentation delivered at the 83rd Annual Seminar Day (Online), Caltech, Pasadena, 22 May 2020. https://www.youtube.com/watch?v=ziImAdHziDo

Rota M, Weisdorf J (2020) Italy and the Little Divergence in Wages and Prices: New Data, New Results. J Econ Hist 80(4):931–960

Sarris P (2002) The Justinianic Plague: Origins and Effects. Contin Chang 17:255-76

Sarris P (2022) New approaches to the 'Plague of Justinian'. Past Present 254(1):315–346

Scheidel W (2017) The Great Leveler: Violence and the History of Inequality from the Stone Age to the Twenty-First Century. Princeton University Press, Princeton

Shortridge FK (1997) Is China an influenza epicenter?. Chin Med J 110(8):637-641

Slack P (1985) The impact of plague in Tudor and Stuart England. Routledge & Kegan Paul, London

Slavin P (2021) Out of the West: Formation of a Permanent Plague Reservoir in South-Central Germany (1349–1356) and its Implications. Past Present 252(1):3–51

Snowden FM (2019) Epidemics and Society: From the Black Death to the Present. Yale University Press, New Haven

Stevens Crawshaw JL (2012) Plague hospitals: public health for the city in early modern Venice. Ashgate, Farnham

Szreter S (1988) The Importance of Social Intervention in Britain's Mortality Decline c.1850–1914. Soc Hist Med 1(1):1-38

Spyrou MA, Musralina L, Gnecchi Ruscone GA et al (2022) The source of the Black Death in fourteenth-century central Eurasia. Nature 606:718–724

Taubenberger JK, Morens DM (2006) 1918 influenza: the mother of all pandemics. Emerg Infec Dis 12(1):15-22

Taubenberger JK, Morens DM (2010) Influenza: The Once and Future Pandemic. Public Health Rep 125(Suppl 3):16–26

Tumbe C (2020) The Age of Pandemics. How they shaped India and the World. Harper Collins, Noida

Voitgländer N, Voth HJ (2013) The Three Horsemen of Riches: Plague, War, and Urbanization in Early Modern Europe. Rev Econ Stud 80(2):774–811

Whittles LK, Didelot X (2016) Epidemiological analysis of the Eyam plague outbreak of 1665–1666. Proc. Royal Soc. B: Biological Sciences 283:e2016061